Fig. 10

Fig. 11

INVENTORS

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Fig. 18

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MATERIAL HANDLING AND STORAGE SYSTEM

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Fig. 76

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Fig. 23

Fig. 94

Fig. 95

CHECK PLUG

CC1
CC2
CC3
CC4
CC5
CC6
CC7
CC8

CSA

353

354

CSA

CSA

CC5

CC6

CC7

CC8

R352

R323

TALL CAR ERROR IND

-24V

-24V

-24V

CARD CODE

-24V

1001

PKK

PK
MATERIAL HANDLING AND STORAGE SYSTEM


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ABSTRACT OF THE DISCLOSURE

An automatic material handling and storage system in which each of a plurality of storage spaces is identified by an individual electrical signal or signals which may, if desired, be binary coded and converted to decimalized form for transport control purposes. One or more transports, each bearing a load conveyor arranged to move a load between the transport and storage space are provided. A combination of stall-identifying and operation-defining signals control the transport means and may be stored for delivery to the transport controlling means until accepted thereby; after which the stored signals are extinguished.

The centralized transport control system includes information storage facilities incorporating a "memory" cell individual to each storage space and may, if desired, include storage space-identifying and time-utilization means in conjunction with storage-fee calculating means.

Each combination of space-identifying and operation-defining signals act to sample the operational state of the associated memory and the transport means is prevented from responding to control signals if the operational state of the memory and the intended operation of the transport are not in agreement. Various other system operations are included.

This invention relates to materials handling and storage systems, and, more particularly is concerned with automated means for receiving a unitized article, storing and retrieving such article and, if desired, preparing a permanent type record of the storage operation.

The invention is capable of useful employment in a wide variety of warehousing applications. Possibly one of the most readily apparent needs for it is for the automatic parking of automobiles near the center of established cities in an effort to reverse the trend toward shopping centers located in suburban areas.

Because land values in such locations are usually relatively expensive, the storage facility will take the form of a multilevel structure. Also, because labor costs generally constitute a major portion of the operating charges of a parking or garage facility it is desirable that the need for attendants be held to an absolute minimum.

Accordingly, it is an object of this invention to make possible a complete warehousing system which requires only the presence of a single attendant for supervisory purposes.

It is a further object of the invention to provide in such a system automated means not only for receiving and storing a unitized object but also for passing any designated one of such objects from the input to output positions without performing the storage operation.

It is still another object of the invention to provide in such an automated warehouse a permanent record of the date and time of input, the date and time of discharge, any fee or charge made for the storage interval and other pertinent information incident to the storage operation.

An additional object of the invention is to make possible the withdrawal of a stored object for inspection without necessitating its discharge from the storage system and without disturbing or changing any of the facts recorded at the time it was taken into the warehouse or garage.

The manner in which the invention accomplishes the above-described and other of its objectives and the advantages that are to be derived from its utilization may best be understood from a consideration of the following explanation of a preferred form of it as utilized in an automated parking garage. It will be understood that in such a garage the automobile constitutes one of the many forms of unitized objects the inventive arrangement is particularly adapted to handling.

In the description which follows reference will be made to the drawing of the garage and its equipment in which there is shown in:

FIGURE 1, a street level floor plan;
FIGURE 1a, a sectional view taken at 1a—1a of FIGURE 1;
FIGURE 2, a sectional view taken from the left portion of FIGURE 1;
FIGURE 3, a plan view of any upper level garage floor;
FIGURE 4, a section along the line 4—4 of FIGURE 1;
FIGURE 5, a side elevational section along the line 5—5 of FIGURE 1;
FIGURE 6, a cross sectional elevation through a loading platform and tower;
FIGURE 7, a schematic plan view of a portion of the finger lift arrangement of FIGURE 6;
FIGURE 8, a sectional view along the line 8—8 of FIGURE 7;
FIGURE 9, a diagrammatic plan view of a protection circuit;
FIGURES 10 through 26 are simplified wiring diagrams, in schematic form, relating to the various control circuits. For purpose of brevity, circuits for only one tower and elevator have been shown. In more detail:
FIGURES 10—11—12 relate to the door, barrier and gap lifter controls at the loading and unloading stations;
FIGURE 13 relates to the signalling signs;
FIGURES 14—15—16—17—18 relate to garage main operation control circuits for such functions as semi and full automatic stall designation and order registering, cancellation of designation and order, front and rear conveyor lift finger control, brake operation, check for proper response to stall designation order and various other operational functions described later herein;
FIGURE 19 relates to motor control;
FIGURES 20—21—22 relate to tower control circuits for motion and direction dictation, motor control and stall alignment and the selector;
FIGURES 23—24—25 relate to elevator control circuits for motion, speed and direction dictation, zone transfer operation and other operational functions described later herein;
FIGURE 26 relates to position indicators for tower and elevators and visual indication of stall designation;
FIGURES 27a through 31a are spindle sheets intended for use by side alignment with FIGURES 10 through 26 as an aid to locating the coils and contacts of the electromagnetic switches—the appropriate drawing figure appearing as a numerical subscript to the coil or contact designation;
FIGURE 32a is a similar spindle sheet for the mechanical switches actuated by physical movement of the various system components—the appropriate drawing figure for the switch being designated at the top of the spindle line;
FIGURE 33a is a spindle sheet individual to the contacts of the light ray receivers, which themselves are shown in FIGURES 1 through 9, with the appropriate
drawn figure being designated by a numerical subscript;

FIGURES 34 through 115 relate to the computer branch of the system and more particularly are concerned with the designation of the storage space to be utilized, the direction of the mechanism to and from that space and the calculation of the permanent record and charges concerning the transaction. In general, their disclosure is in functional schematic form;

FIGURE 34 relates to the initiation of the parking operation;

FIGURE 35 relates to control of the unparking operation;

FIGURE 36 relates to the lost key operations;

FIGURE 37 relates to the operation when the storage period exceeds twenty-four hours;

FIGURE 38 relates to the retrieve operations;

FIGURE 39 relates to the unpark convert operations;

FIGURE 40 relates to the by-pass operations of the east and west towers;

FIGURE 41 relates to control of the cash transaction function;

FIGURE 42 relates to the key and card reading operation and the storage of the read information;

FIGURE 43 relates to the key removal operation and error indication obtained if removal is premature;

FIGURE 44 relates to the card removal operation and the card reader signal generating circuit;

FIGURE 45 relates to the cycle counter operation and shows a binary counter for the generation of the counting pulses;

FIGURE 46 relates to a gate circuit which responds to the binary counter of FIGURE 45, thereby producing the cycle counting pulses;

FIGURE 47 relates to the decoding of the key reader storage signals and the production of signals for the storage in the memory device;

FIGURE 48 relates to the generation of the "hour" parking time data signal;

FIGURE 49 relates to the production of the "days" parking time data control signal;

FIGURE 50 relates to producing the park interlock signal to the memory;

FIGURE 51 relates to one of the memory data circuits which controls the writing of data into the memory unit and the storing of data read out of the memory. This one of these circuits controls the storing of the bit relating to the occupancy of a stall during cycle one as well as time bits in cycle two and cycle three;

FIGURE 52 relates to one of the memory data circuits which controls the writing of time bits into the memory and their storage on read out. Specifically, it controls the second least significant bit;

FIGURE 53 is a tabulation showing gate numbers, the digital clock outputs and the inhibit winding drive outputs for time bits three through ten for cycles two and three;

FIGURE 54 relates to a single east column driver and a single west column driver which effects the selection of tier 1;

FIGURE 55 is a tabulation related to FIGURE 54 showing the designation of corresponding elements and the inputs and outputs for east and west tiers 2 through 9;

FIGURE 56 relates to the carry circuit which controls the production of a signal element defining a value of one when it is required to be inserted in the shift register circuit;

FIGURE 57 relates to the clock timing circuit which drives the digital clock;

FIGURE 58 relates the difference register circuit in which the results of the subtraction are stored. The circuits for the first and last bits are indicated and the corresponding arrangements for the intermediate bits are represented in a tabulation;

FIGURE 59 relates to the subtraction process and the generation of a "carry" signal;

FIGURE 60 relates to the memory timer circuit;

FIGURE 61 shows the details of a typical flip-flop circuit and the symbol used to represent it;

FIGURE 62 relates to the digital clock hours circuit;

FIGURE 63 relates to the digital clock days circuit;

FIGURE 64 relates to the digital calendar days and months circuit;

FIGURE 65 relates to the generation of counting pulses which regulate the serialized subtraction process;

FIGURE 66 relates to the combination of the subtractor counting signals produced by the subtraction counting signal generator of FIGURE 65 into 16 counting pulses to control the subtraction process. Two of the gate circuits are indicated and 13 and 15 are represented by a tabulation;

FIGURE 67 relates to the memory output serializer circuit;

FIGURE 68 relates to the digital clock serializer circuit and the digital calendar serializer circuit;

FIGURE 69 shows a tandem group of flip-flops for processing the signal elements produced by the subtraction process;

FIGURE 70 relates to the production of the correction signal for the adder when required as a result of the subtraction process;

FIGURE 71 relates to the difference register elapsed time relay circuit;

FIGURE 72 indicates the association of the elapsed hours grouping relays;

FIGURE 73 shows the front view of a plug board;

FIGURE 74 indicates the patch board scan stepping switches;

FIGURE 75 relates to the index counter circuit;

FIGURE 76 relates to the index relay circuit;

FIGURE 77 relates to the card reader index circuits;

FIGURE 78, 79 and 80 relate to the grouping of service charge signals having a value of 25, 50, or 75 cents, respectively;

FIGURE 81 relates to the production of the signals which clear the index counter and end the print operation;

FIGURE 82 relates to the lister advance circuit;

FIGURE 83 relates to the control of the add print motor bar and the non-add print motor bar of the lister;

FIGURE 84 relates to the index decoding circuit and the lister solenoids which it controls;

FIGURE 85 shows the arrangement of the output relays for the east tower;

FIGURE 86 and 87 jointly relate to the buffer relay circuit which interconnects the computer to the stall selection and function equipment that controls the various movements of the stored article;

FIGURE 88 shows the arrangement of the output relays for the west tower;

FIGURE 89 relates to the output relay check circuit;

FIGURE 90 relates to the manual operation of the cash transaction display;

FIGURE 91 relates to the parity checking circuit;

FIGURE 92 relates to the stall empty and a stall full error indications;

FIGURE 93 relates to the error indication produced by an improperly positioned vehicle;

FIGURE 94 relates to the misdirection of a tall car;

FIGURE 95 relates to the charge card identification check;

FIGURES 96, 97, 98 and 99 show the arrangement of fee display relays for the most, the second most, the third most, and the least significant digits, respectively;

FIGURE 100 shows the details of a typical delay flip-flop circuit and symbol used to represent it;

FIGURE 101 indicates the arrangement for illuminating the lamps in the cash key-board display circuit and the control of potential to the fee display selecting relays;
FIGURE 102 relates to the generation of testing impulses for checking the various circuit branches; FIGURE 102a relates to the rate schedule control test circuit; FIGURE 103 shows the circuit details of a typical core write amplifier circuit and the symbol used to represent it; FIGURE 104 shows the details of a typical gate driven inverting amplifier and the symbol used to represent it; FIGURE 105 shows the circuit details of a typical inhibit driver and the symbol used to represent it; FIGURE 106 shows the details of a typical blocking oscillator and the symbol employed to represent it. Actually, the unit is a monostable multivibrator used for logical differentiation and pulse forming; FIGURE 107 shows the details of a typical non-inverting amplifier and the symbol used to represent it; FIGURE 108 shows the arrangement of a typical two input "and" gate and a diode buffer used as a mixer gate, and the symbol used to represent it; FIGURE 109 shows the arrangement of a two input "and" gate and the symbol used to represent it; FIGURE 110 shows the arrangement of a typical "or" gate or buffer as it is sometimes called and the symbol used to represent it; FIGURE 111 shows the details of a typical sensing amplifier and the symbol used to represent it; FIGURE 112 shows the details of a typical bilateral switch and the symbol used to represent it; FIGURE 113 shows a relay winding and shows the symbol used to represent it; and FIGURES 114 and 115 together form a functional diagram used in explaining the operation of the circuitry which directs the functional circuits and in explaining the manner in which a charge is calculated. Although the invention may be applied to the storing and retrieving of any article and may have wide applicability in the automation of housing, in which it has been employed, and in safety deposit operation and in computing the charges for such services, in the present embodiment it is applied to an automatic multi-unit public garage.

While the garage might be of any capacity, the present embodiment it is limited to accommodating 270 cars. The garage comprises two towers, an east tower and a west tower. Each tower is divided into two sections, a front section and a rear section, making a total of four sections. Each of these sections is divided into nine vertical tiers, making a total of 36 tiers. There are a total of eight floors. An individual garage unit or stall occupies the space of one tier on one floor. The two central sections of each tower have no facilities for parking cars. These sections are reserved to provide passageways through the garage for the cars and space for an office. The two remaining sets of nine stalls each remaining on the bottom floor and the four sets of nine stalls each on the top floor of the garage are reserved for tall cars.

In addition to the parking and to the unparking functions mentioned in the foregoing, the garage is arranged also so that it can perform a number of other functions. The more important of these will now be described briefly. In this garage a car which has been parked can be retrieved temporarily from a stall in which it has been placed. This function is advantageous to a patron when he has left some article in his car which he requires, but when he does not want to unpark his car permanently. Under such condition, a car which has been parked is retrieved and brought to an unpark position. After the article has been retrieved, the car is returned to its original stall. In the process of such an operation which has just been described, it is possible, if desired, to unpark a car. By this is meant that instead of restoring the car to its original stall, it may be permanently unparked, and a record of the charge for the parking service may be computed.

There is another major operation which this garage is capable of performing. When a patron parks a car, he is handed a control, called a key, which controls the parking in and the unparking of his car from a selected stall. The other major operation mentioned is performed when a patron has lost a key. In this circumstance, a study of a record is made to determine what cars, if any, were parked at about the same time when the patron who has lost his key, parked his car. One or more cars that were parked at this particular time may be brought from its garage stall to the unpark position in succession until the patron identifies his car. In the process of doing this, any car which is brought to the unpark position which is not the car of the party who has lost his key, can be returned automatically to the stall from which it has been temporarily removed.

There is yet another operation which is called the by-pass operation. In carrying out the by-pass operation, the car is not stored. A car which has been brought to the garage, presumably for storage, is passed directly out without storage. In other words, storage is by-passed. Such an operation might be carried out for instance when the garage is full, or for some other reason.

In operating the garage, an incoming car is required to be brought to a stop at an exact position in the passageway mentioned in the foregoing. If the car is not brought to a stop in the exact assigned stop position, further operations cannot proceed until it is properly adjusted. While in position in the receiving passageway, the car is tested to see whether or not it exceeds the normal height and requires insertion in a garage stall on the first floor or on the eighth floor reserved for tall cars, as mentioned previously.

The selection of an assigned stall, the directing of a car to the stall, and the computing of the charges for the garaging service are all under control of the key, mentioned heretofore, and a button called the park button which controls the parking functioning.

There is another device known as a card, corresponding to a key which is issued to charge customers. We will not at present concern ourselves with a card.

The key is inserted in a slot known as a key reader, and the button, individual to the parking function, is actuated simultaneously. The key controls the operation of a group of photo-electric circuits. There is a key individual to each stall in the garage. The key has an individual permutation of serrations and non-serrations along each of its two edges. When the key is inserted in the key reader slot, light passes through spaces which are notched, and is prevented from passing through spaces which are un-notched. The notches are arranged to produce three permutations of signals in binary notation. The light activates photo-electric cells in accordance with the permutations assigned to each key individually.

The stall individual to the selected key is identified by three digits which are encoded in the key in binary form. The first digit defined may be either one, two, three or four. One defines the East tower rear, two the East tower front, three the West tower front, and four the West tower rear. These four positions are definable by means of four possible permutations of notches or serrations in two space elements of the key. Four space elements of the key are used to define any one of the nine tiers from one to nine. Four more space elements of the key are used to define any one of the eight floors. The particular key which has been selected thus defines an individual stall and effects a selection of that stall. It also effects the selection of a memory device individual to the selected stall. A record with a record of the time at which the car is parked, in hours and tenths of hours and of the day of the year is stored in the memory for use in computing the charge for the service. At the time of parking a car, the patron is handed the key mentioned in the foregoing which identifies the individual stall in which his car is parked. He is also furnished with a record of the time at which his car is parked. This record, which is given to the patron, is for his own personal use. It is not used in computing
the charges. This is done automatically with the aid of the memory and of a clock and coacting circuitry. The clock is used to control the timing operations. The clock drives the mechanism once every tenth of a second. The mechanism counts the number of charges and then applies the proper rate of charge for the elapsed time. This is a record of the time that the car was parked in the individual memory circuit associated with the stall in which the car was parked. This is now read out of the memory, that is to say, the memory is sensed and the condition of each of the twenty magnetic cores assigned to record the parking time in days and in hours is transferred from the memory to a corresponding number of multi-vibrators each of which is set in one of its two possible conditions to provide the required parking information. The time when the car was garaged is read into a subtracting circuit. The present time is read from the two clocks, that is, the clock which records the present days and the clock which records the present hours. It is to be understood that these two clocks are two sets of switches as heretofore explained. The subtracting circuit performs a subtracting operation, subtracting the time that the car was garaged from the present time.

In the present circuitry provision is made for different rates of charges at different times, particularly hours of the day, particular days and so forth will have different rates of charges for differing periods of garaging. This requires translation of the parking time into charges incident to the present time. This translation is effected by means of a set of devices known as a patchboard and associated switches which translate the parked interval into a specific charge, taking into consideration the particular hour or day. The present circuitry includes provision for providing the patron with a record of the charges. This is performed by the lister. In addition, there is provision for a visual display of the charges.

It was stated in the foregoing that there was provision in the circuitry whereby a car which had been parked might be removed from the parking stall to an unparked position for various purposes. As mentioned, one of these was to permit a patron to retrieve an article which had been left inadvertently in the car. The other was the situation wherein a patron had lost his key and had no means of identifying the stall in which it was parked. It will be remembered also that in the foregoing it was described that when a car was parked, a record of the parking time was written into the memory device associated with the individual stall. The patron might return to retrieve an article left in the car at any time during the parking operation. It is of course desirable under these circumstances not to have an individual charge for the different periods, that is, the period from the start of parking to the start of the retrieval operation and, assuming the car was returned to its stall, another charge for the period thereafter until the car is withdrawn permanently from the stall by the unpark operation. It was explained also that under certain circumstances the patron might wish to convert such an operation as a retrieval operation or a lost-key operation into a permanent unpark operation. This involves complication of the circuitry. In each one of these operations involving the temporary removal of a car from a stall, the memory device associated with the stall is interrogated. The contents of the memory are transferred to the set of multi-vibrators mentioned heretofore as in an unpark operation. If after the temporary removal of the car from the stall, the car is returned to its stall, the information stored on this group of elements is again written into the memory. Of course it is to be understood that this record is a record of the time when the car was originally installed in its individual stall. During any temporary removal of a stall, the record stored in the set of magnetic memory rings individual to the stall, is read out of the memory to the set of multi-vibrators as in an unpark operation. If the car is returned to the stall, the information is transferred back to the individual set of stall memory rings.
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The foregoing is simply a broad general description of the more important functions. There are necessarily many minor functions incident to the foregoing, many refinements and many checks necessary to prevent malfunctioning. The arrangements for these are indicated in the drawings and their operation will be explained in the detailed disclosure.

Because the illustrated embodiment of the invention in an automated parking garage is a fairly complex mechanism which requires a rather lengthy description for an understanding of its operation, it is proposed to divide the description into several portions.

The first will deal with the physical configuration of the garage (that is, its floor plan and operating signals) the barrier devices at the loading and unloading stations, the tower and elevator conveyors and other related units.

The second will describe the mode of operation in performing the parking and unloading functions. In this section it will be assumed that certain command signals have been received from a command station—which signals may originate in a so-called computer device or may result from the operation of a less sophisticated mechanism adapted for manual manipulation.

A third section will deal with a description of the computer mechanism itself and the manner in which it operates to originate the command signals and to perform automatically its other functions for which it is designed.

A further section will deal with what might be deemed an alternate mode of operation such as might be resorted to during a period when the computer was disabled or otherwise unavailable.

Referring now to FIGURE 1, there is illustrated a garage building 70 having front and rear walls 71, 72 along respective city streets, and east and west side walls 73, 74 alongside each of which are arranged nine storage stalls or spaces 75.

In the description which follows garage 70 will occasionally be referred to as having an east wing 73a and a substantially duplicate west wing 74a—in each of which there is a runway 76 or 77 accommodating tower structures 89 or 90, as the case may be. Both runways include rails (not shown) upon which the running gear of the tower rolls as it traverses the runway. Each runway takes the form of an open space extending horizontally between front and rear walls 71, 72 and vertically from the ground level on which the rails rest to a height above the topmost stall level adequate to accommodate the tower structure. Each tower accommodates a vertically moving elevator conveyor.

The central area of the street level floor (FIGURE 1) includes an incoming roadway 78, east and west parking or loading stations 79, 80, center 81 and side 82, 83 walkways, an enclosure 84 serving to house parking control console 88 and also function as a passenger waiting room, unparking stations 85, 86 and exit roadway 87. There are no parking stalls in this central area at the street level, but, as will be noted by reference to FIGURE 3, the central area in the upper floor levels does accommodate two inner rows of spaces, one row on the inner side of each tower runway and in position to be served by the respective tower. For convenience of later description the parking spaces or stalls along the east and west walls will be designated as east rear and west rear stalls, respectively; and the stalls in the central area (second to eighth floors) will be referred to as east front and west front stalls depending whether they are in the east wing 73a or west wing 74a, respectively.

Center walkway 81 serves to guide the entering automobiles to either the east or west loading or parking station 79, 80 in proper orientation for further handling.

In order to make maximum use of space, and recognizing that the height of vehicles is not uniform, the intermediate level stalls have lower ceiling heights than those on the street and top levels. To detect the tall autos a light source 98 supplies a beam of light 99 at a selected level across the entranceway to a light receiving unit 97. An entering vehicle of undesired height operates to interrupt beam 99, thereby actuating unit 97 and causing the illumination of sign 100, which reads "STOP—CAR TOO HIGH," over the center of the incoming runway. Additional alarms, not shown, may be actuated to insure that the attendant in charge does not permit the oversize vehicle to further enter the premises. Permanently illuminated signs 101, denote the positions where properly sized vehicles are to stop. Each sign has a red colored portion reading "STOP HERE" and a white colored portion reading "TO LET OUT PASSENGERS AND THEN PROCEED SLOWLY." Red and green "STOP" and "GO" traffic lights 102 provide further signals to the car operator beyond the position of signs 101. Traffic light 102 will display its "GO" signal if the narrow driveway 95, 96 leading to a parking or loading station is clear and the parking station 79, 80 is prepared to accept the incoming car. Each traffic light 102 is controlled by a corresponding micro switch actuator 103 which is embedded transversely of its driveway surface at a point slightly beyond light 102 and just in front of the actual entrance to the parking or loading station. As the weight of the vehicle depresses the actuator, light 102 assumes its "STOP" characteristic and retains this until the oncoming vehicle has been removed from the parking station by the elevator conveyor and the loading station is again prepared to receive another vehicle.

In order to distinguish acceptable vehicles which are too tall for the intermediate landing stalls a second detection function is performed by light source 105 projecting a light beam 106 at a selected height to light receiving unit 104. This unit is actuated momentarily by the actuation of driveway actuator 103. If beam 106 is interrupted an appropriate signal (not shown in FIGURE 1) is actuated to alert the attendant to select an appropriately sized stall for the car.

The operation of driveway actuator 103 also serves to illuminate sign 107 reading, "DRIVE SLOWLY TO TOUCH WHEEL BLOCK." This wheel block 108 is shown in FIGURE 1a along with its companion ramp block 109. These extend parallelly to form a trough across the front end of the loading station in the center of which is located a loading station switch 110. When actuated by car weight this switch operates to extinguish light source 105 and extinguish that portion of sign 107 which referred to the wheel block, while at the same time causing the illumination of an additional portion reading, "APPLY PARKING BRAKE—STOP ENGINE—LIGHTS OFF—CLOSE ALL DOORS SECURELY." In addition, switch 110 serves to operate a signal at control console 88 to inform the garage attendant that the vehicle is properly positioned for the parking operation. The failure to actuate switch 110 prevents further operation of the parking apparatus. In addition, the control attendant can observe the position of the vehicle through transparent walls 111 and the barriers 115, 117 which also are transparent. Barriers 117 and 118 are movable and must be actuated to their raised positions before the parking operation can proceed. The movements of these are controlled by a continuous pressure switch.

Intermediate the loading stations and the nearby holistway doors 113 are sections 119 which together with the top surfaces of movable barriers 117, 118 contain pressure responsive switches serving to detect the presence of a person or object and to arrest further movement of the mechanism.

Each loading station 79, 80 is made up of a plurality of parallel finger lift beams. As indicated in FIGURE 1a, alternate fingers 121 are movable and the intervening ones 120 are immovable. The stationary ones, and the movable ones, when lowered, present a substantially horizontal surface level with the surface of the approach driveway. As seen in FIGURE 1a, two of the foremost movable fingers de-
part from the flat upper surface configuration and form the wheel block 108 and the ramp block 109. The intervening stationary beam includes loading station switch 110.

As seen from FIGURE 4, each loading station end barrier 118 recesses into the approach driveway such that its upper rail or surface is level with or slightly below the drive surface. It is actuated between its raised and retracted positions by its electric motor 156. A more detailed explanation of the structural arrangement will be given shortly in connection with the explanation of FIGURE 6.

The arrangements at the unparking stations 85, 86 are substantially like those of the park or loading stations, the principal departure being that the whole trough and its actuator switch are at the exit end of the platform.

Referring now to FIGURES 2 and 5, it may be seen that each movable tower 89, 90 has a tower base 91 which in turn rests on wheels to which power is supplied by motor 227. Wheels 93 ride or roll on rails 94 such that the tower in traversing its runaway passes by each tier of stalls. Each tower is an openwork frame of braced columns 157a to support hoisting sheave 209 in the overhead space 159, which serves as a machine room. Hoisting ropes 208 pass around sheaves 207, 209 and act to support the elevator conveyor 92 and its counterweight 158 for vertical movement between levels of parking stalls 75. This elevator conveyor has a base unit 165 which supports rigid member 166 which in turn supports the fingers, lift beams on which the vehicle is conveyed. Similarly rigid frame member 182 supports a second set of such fingers at a lower level. These are so displaced relative to the upper fingers that each finger interweaves with conjugate ones in the upper set, and the lower set can be raised to a level above the upper set in a manner to be explained.

As seen in FIGURE 5, guide rails 160 are carried by the tower and these plus the tower framework constitute a travelling hoistway for elevator 92. Crosshead 161, uprights 162 and base framework 165 constitute the equivalent of the customary car sling and serve to form the rigid car framework. The car or conveyor is guided by guide rails 160 and the conjugate roller guides 163. Support members 166 are fixed rigidly to base member 165 and act to support the upper level fingers 142 (FIGURE 6). These all times maintain a fixed vertical relation to member 165.

A second, and normally lower, set of finger lift beams 143 constitute a second conveyor which is capable of vertical movement. This conveyor includes channelled uprights 179 which are equipped with guides 181 (FIGURE 7) that engage the laterally extending guide rails 180 that are affixed to car uprights 140. These affixed to car uprights 140. Uprights 179 support channel members 182 which in turn support finger lift beams 143. Each upright 179 is supported by a rope 196, 197 which terminates at hitches 199a, 199b. The ropes pass over sheaves 198a, 198b around drum 195 which is rotated by motor 194. Thus as the drum 195 is rotated and the fingers 143 are lifted between the fingers 142 of the fixed position conveyor to assume a higher level position. Thus a vehicle may be transferred from one conveyor to the other regardless whether the tower is moving at the time of transfer. This is an important characteristic for, as will be explained in connection with FIGURE 6, each conveyor is capable of being extended from the elevator either to the right or left side but not to both sides. Thus, assuming a vehicle were loaded from the loading or park position 79 by the east tower, it would be picked up by conveyor fingers 142 moving out from the elevator and conveyed to position 230 inside of the car. The load is to be deposited in an east rear space or stall 75, it would be transferred to conveyor fingers 143 by winding ropes 196, 197 on drum 195 to raise the lower conveyor to a level higher than that of the upper conveyor fingers 142 and thus deposit the vehicle on fingers 143 for extension to the right side of elevator conveyor 92 when the tower and conveyor arrive at the designated space.

Elevator conveyor 92 is suspended on ropes 208 which pass from its dead end base at the base of the tower machine room 159 around sheaves 205, 206 mounted on the car crosshead 161 thence over hoisting sheave 209 which is rotated by hoisting machine 204, to pass under counterweight sheave 207 and back to its dead end hitch 211.

The vertical position of elevator conveyor 92 is at all times represented by a selector (not shown) located in machine room 159 which is driven by selector sprocket or sheave 233. This sheave is rotated by tape drive 234 which passes from its dead end 235 on crosshead 161, up over the sheave and then down to a dead end hitch 236 on the counterweight frame.

The horizontal position of the tower is at all times represented by a second selector mechanism (not shown) which is also located in machine room 159 and which is actuated by movement of its sprocket or sheave 237. Toothed tape 237 is dead ended on wall 71 at hitch 241. It extends around sheaves 239, 240 which are mounted on the tower structure, then over tower selector sprocket or sprocket 237 to the opposite garage wall 72 where it terminates in a connection 242 to a broken tape detector switch 243.

Switch 243 is spring biased so as to actuate an electrically operated warning alarm should tape 238 part. Tape 238 may, if desired, be supported by a longitudinal trough 244 attached to the building structure along the runway.

Power and control signals for operating the various mechanisms are carried over travelling cable 245 which terminates in, at the wall 71, an outlet box 246 and in an outlet box 247 on penthouse 159 of the tower. Boxes 246 and 247 are on opposite sides of the runway in order that cable 245 will hang in a diagonal plane when not extended. Travelling cable 245 is clamped at its mid point 248 by a trolley hitch 251, such that it hangs in loops 249, 250 when not extended. Trolley 251 is supported by rollers 252 engaging a surface of longitudinal I beam rail 253 and is roped through a ½ to 1 sheave arrangement with the movable tower such that trolley 252 moves one foot for each two feet of tower travel.

Limit switches are provided for both conveyors finger lift and for the elevator conveyor itself. Switches 202 and 203 are actuated by cams 209a and 201a as the normally lower fingers 143 are moved to their upper and lower positions, respectively. A final limit switch cam 223 and a relatively long inclined stop switch cam 224 are supported by the building structure near each end of each tower runway 76, 77 for providing regulation to the tower as it nears the end of its runway. Each tower carries final limit switches 225 and 226 located at its opposite ends, also a multi-stop switch 228 which is actuated by the relatively long inclined stop switch cam 224. This arrangement provides sequential retardation to halt the tower elevator mechanism at its normal stop limit and apply the brake device to drive means 227. If perchance a tower travels beyond its normal stop position and fails to be stopped by action of the final limit stop switch mechanical buffers 229 are provided at each end of the runway to effect the final stopping operation. Each block 229 has a ratchet type of ratchet 230 and friction brake device with the corresponding rail 94. Each block has a curved face accommodating individual ones of the tower wheels 93 such that the wheels 93 run up onto the blocks 229 and the slide friction thereafter operates to stop further tower travel. This action is assisted by the heavy buffer mechanism 230. If now the elevator conveyance is inclined, vertical movement is subject to the action of limit switches 231 which are supported on the guide rail structure 160 at the top and bottom levels. Switches 231 are actuated by a vertical cam operator 232 supported on and movable with the elevator conveyor structure.
The construction and actuation of the loading or parking station as well as those of the finger lift conveyors on elevator 92 (FIGURE 5) can best be understood from a study of FIGURES 6 and 7. It is to be noted that the structural arrangements of the upper and lower conveyers which are indicated by reference numerals 166, 182 in FIGURE 5 is the subject matter of U.S. Patent 2,915,204, issued December 12, 1960. Almost all of the structural arrangements of these conveyers forms no part of this present invention. A brief description of their structure and the manner in which they are actuated to cooperate with the loading or unloading station mechanism will be given herein to promote understanding of the arrangement. For more detailed information concerning the structure of these conveyers and their actualization, reference should be made to Patent 2,915,204.

Referring first to the loading or unloading station, one end of which is shown in the left part of FIGURE 6, it will be seen that each lift finger beam 121 is supported near its ends by a pair of struts 122, 123. These struts rest on I beams 124, 125 which extend longitudinally of the station and transverse of the lift fingers. Cross beam 126 acts as a stiffener to complete the box-like structure. This box-like structure, including as it does each movable lift finger 121, is supported on its lower ends at its two ends. Each lever 127, 128 is keyed to its shaft 129, 130 to turn therewith. Bearing members 155, supported by cross beam 151 provide support for shafts 129, 130. The two pairs of levers 127, 128 are connected by tie rod 135, such that they move in unison. A portion of the weight of the entire movable part of the station is counterbalanced by a horizontal beam 152 connected to each rotating lever 128. Each lever 127, 128 is connected through an arm 131, 132 to a bracket on the end of longitudinally extending I beam 124, 125. One arm 136 of lever 127 is pivotally connected through link 138, and its pivotal connection to gear unit 137 which when actuated by its motor rotates the crank arm 139 to approximately 180 degrees and prevent overtravel of the loading station fingers.

From FIGURE 6 it will be seen that when so actuated the lift fingers raise any vehicle which has passed through the fingers 143 of the vertically movable transfer member are cantilevered from beam 146. Fingers 143 of the vertically movable transfer member are cantilevered at their left end to box channel 147. The vertically fixed transfer member is nested inside of the vertically movable one as is indicated in FIGURE 7. Referring again to FIGURE 5 it will be recalled that vertically movable members 179 support a pair of box beams 182, 183 at the uppermost part of FIGURE 7. These beams though movable vertically are fixed in the horizontal plane. Lift fingers 143 and their supporting beam 147 form a comb-like structure which is supported on beams 182 by an intermediate carriage which utilizes a pair of I beams 184 as its end members. These I beams are placed at their left extremity by angle 183—such that the two I beams and angle 183 form a block type U section enclosing the comb-like transfer fingers 143. The outermost teeth or fingers 143 of the inner comb-like transfer have journalled thereon rollers 186 which extend in toward the web of I beam 184 and roll on the lower flange of that beam. In similar fashion, 184 is supported by rollers 185, which roll on the lower surface of its upper flange and are journalled on box beam 182. One end of these nested structures is shown in FIGURE 8 where the manner in which the journalled rollers 185, 186 operate is made evident. It will be noted that the outermost member is to be extended to the right (or left) of the elevator framework. This is accomplished by roping 190 which is dead ended on fingers 143 and box beams 182, while passing around sheaves 187, 188. Thus, as the intermediate or slow speed carriage comprising I beams 184 and channel 183 are pushed to the right (FIGURE 7) in a manner which will later be explained, the inner comb-like transfer including fingers 143 are moved to the right as is indicated by the broken line portion of FIGURE 7. In so doing the lift fingers 143 move at twice the speed of I beams 184.

The vertically fixed transfer member which includes fingers 143 is supported on box beam 146 fits within the outline of the vertically movable member which has been described immediately above. It is composed and is supported in a manner in all respects similar to that which has been explained. In this case the fixed box beams 166 are firmly affixed to the elevator platform 165 as is indicated in FIGURE 5. Its intermediate or slow speed supporting frame includes I beams 167 which are joined by angle beam 168. This frame is supported by rollers 16 which are journalled on beams 166 and in turn supports the transfer frame by offering support to rollers 170 which are journalled on the outermost fingers 142. As in the prior instance, roping 174 which passes around sheaves 172, 173 and is dead ended on the stationary beams 166 and on fingers 142 provides motion to fingers 142 at twice the rate of that for I beams 167.

Both the inner and outer intermediate (I beam) frameworks are prevented from tipping as their load is shifted outwardly by the cooperative action of a roller 171 (FIGURE 8) and roller 185 (or 169 as the case may be).

The manner in which the two transfer members are moved between their extended and retracted positions will now be explained with reference again to FIGURE 6. Each intermediate framework angle beam 168, 183 has fashioned in or on its lower surface a longitudinally extending channel 178, 193. Each channel is proportioned to accept an upright roller 177, 192 which is mounted on its rotating arm or crank 176, 191. Power is supplied each arm from an associated motor driven gear unit 144, 145. The operation is such that as the arm is rotated the roller is reciprocated in the channel and in so doing forces the framework outwardly or inwardly depending on the position of the rotational cycle that is being covered. Movement of the slow speed framework acts through the previously described roping and sheave arrangement to move the slow speed framework on which it is supported.

The motor-actuated gear unit 145, its arm 191 and...
Roller 192 are mounted on a shelf 148 which is attached to fitting 179 and moves in unison with it. As a result, when the movable transfer unit is elevated to its upper position (as indicated by the broken line illustration in FIGURE 6) the top of the gear unit approaches the underside of forks 142. Its rotating drive shaft extends upwardly between adjacent fingers 142 and the rotating arm 191 is rotated at a point in space above the upper surface of fingers 142.

Thus, the movable fingers 142 may be projected outwardsly from the left to pick up or deposit a vehicle on the fingers of a loading or unloading station as is indicated by the broken line outlines 142a and 142b, and on the fingers of a stall space as is indicated in broken line outlines 142c and 142d. The movable transfer unit having fingers 143 operates similarly to deposit vehicles or to remove vehicles from the rear parking stalls 75 on the right side of the hoistway, as is indicated by the broken line illustrations of fingers 143b, 143c, etc.

In the case of both right and left extending transfer mechanisms the motive power for moving the fingers from a lower (142a) to an upper (142b) position or an upper (142c) to a lower (142d) position is supplied by the elevator hoisting machine in raising or lowering the elevator conveyor 92. This is explained in detail in the operational description that follows.

Each elevator conveyor 92 carries five light sensitive photodiode sensing systems as illustrated in FIGURE 9. These light sensitive photocells 214 are longitudinally spaced of the elevator 92 at heights appropriate for detecting intervening objects. Light source 212 and its receiving unit 213 is mounted along the center line of the conveyor and detect a vehicle on either transfer unit. Sources 215a, 215 and their receivers 216a, 216b are mounted near the front and back edges of elevator 92 in correct positions to detect any object such as an opened door that overhangs the edge of the platform. Light sources 217, 220 are mounted at an angle to the elevator frame and direct light beams into each stall space as the car is opposite it. Reflectors 218, 221 are mounted in each such stall space such that if the space is unoccupied the reflected beam of light energizes or activates the corresponding light receiving unit 219, 222. The presence or absence of a signal thus derived is utilized in the control system in a manner that will be later described.

Before proceeding to any description of operation of the invention it is thought advisable to list the electromagnetic switches that are illustrated in FIGURES 10 through 26. This will be done by grouping them according to their primary function. In so doing, only the switches for one tower and elevator conveyors (the east) will be referred to, it being understood that a similar group will be utilized for the other tower and conveyor.

**LOADING AND UNLOADING STATION CONTROLS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR</td>
<td>Flicker relay</td>
</tr>
<tr>
<td>IHCL</td>
<td>High car light ray unit</td>
</tr>
<tr>
<td>LBDL</td>
<td>Loading barrier down limit switch</td>
</tr>
<tr>
<td>LBDS</td>
<td>Loading barrier down button switch</td>
</tr>
<tr>
<td>LBUL</td>
<td>Loading barrier up limit switch</td>
</tr>
<tr>
<td>LEBC</td>
<td>Loading end barrier down switch</td>
</tr>
<tr>
<td>LEBD</td>
<td>Loading end barrier up-down switch</td>
</tr>
<tr>
<td>LEBU</td>
<td>Loading end barrier up switch</td>
</tr>
<tr>
<td>LFM</td>
<td>Loading floor mat switch</td>
</tr>
<tr>
<td>LGC</td>
<td>Loading gate down switch</td>
</tr>
<tr>
<td>LGD</td>
<td>Loading gate up switch</td>
</tr>
<tr>
<td>LGDP</td>
<td>Loading gate down position switch</td>
</tr>
<tr>
<td>LGLUP</td>
<td>Auxiliary loading gate up position switch</td>
</tr>
<tr>
<td>LGO</td>
<td>Loading gate up switch</td>
</tr>
<tr>
<td>LGS</td>
<td>Loading gate up switch</td>
</tr>
<tr>
<td>LGR</td>
<td>Loading gate up switch</td>
</tr>
<tr>
<td>LGD</td>
<td>Loading gate down switch</td>
</tr>
<tr>
<td>LSC</td>
<td>Loading side barrier up switch</td>
</tr>
<tr>
<td>LSB</td>
<td>Loading side barrier down switch</td>
</tr>
</tbody>
</table>

**GARAGE MAIN OPERATION CONTROLS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALP</td>
<td>Above loading platform switch</td>
</tr>
<tr>
<td>AUP</td>
<td>Above unloading platform switch</td>
</tr>
<tr>
<td>BPS</td>
<td>By pass switch</td>
</tr>
<tr>
<td>BPX</td>
<td>High car bypass switch</td>
</tr>
<tr>
<td>CC</td>
<td>Call cancelation switch</td>
</tr>
<tr>
<td>CCR</td>
<td>Car call registered switch</td>
</tr>
<tr>
<td>CDO</td>
<td>Car door open switch</td>
</tr>
<tr>
<td>CHC</td>
<td>Common horizontal conveyor switch</td>
</tr>
<tr>
<td>CSH</td>
<td>Common sensor switch</td>
</tr>
<tr>
<td>CVC</td>
<td>Common vertical conveyor switch</td>
</tr>
<tr>
<td>CVD</td>
<td>Conveyor down switch</td>
</tr>
<tr>
<td>CVU</td>
<td>Conveyor up switch</td>
</tr>
<tr>
<td>DRS</td>
<td>Direction reverse switch</td>
</tr>
<tr>
<td>EEC</td>
<td>Floor cutout switch</td>
</tr>
<tr>
<td>ESE</td>
<td>Floor switches</td>
</tr>
<tr>
<td>ELS</td>
<td>Elevator light ray switch</td>
</tr>
<tr>
<td>FCE</td>
<td>Front car switch</td>
</tr>
<tr>
<td>FC</td>
<td>Front car switch</td>
</tr>
<tr>
<td>FCEP</td>
<td>Auxiliary front car switch</td>
</tr>
<tr>
<td>FCR</td>
<td>Front car retract switch</td>
</tr>
<tr>
<td>FICRP</td>
<td>First front car retract position switch</td>
</tr>
<tr>
<td>FLR</td>
<td>Front light ray switch</td>
</tr>
<tr>
<td>FOS</td>
<td>Front operation switch</td>
</tr>
<tr>
<td>HC</td>
<td>High car switch</td>
</tr>
<tr>
<td>HLR</td>
<td>High car light ray power switch</td>
</tr>
<tr>
<td>HLS</td>
<td>Home loading switch</td>
</tr>
<tr>
<td>LGA</td>
<td>Transfer switch</td>
</tr>
<tr>
<td>LK</td>
<td>Lost key switch</td>
</tr>
<tr>
<td>LKS</td>
<td>Car call registered auxiliary switch</td>
</tr>
<tr>
<td>LKY</td>
<td>Lost key switch</td>
</tr>
<tr>
<td>LPS</td>
<td>Loading platform load switch</td>
</tr>
<tr>
<td>LPSX</td>
<td>Loading platform load sequence switch</td>
</tr>
<tr>
<td>MPA</td>
<td>Loading station switch</td>
</tr>
<tr>
<td>MUN</td>
<td>Unloading station switch</td>
</tr>
<tr>
<td>PA</td>
<td>Parking switch</td>
</tr>
<tr>
<td>PAM</td>
<td>Manual parking registration switch</td>
</tr>
<tr>
<td>RC</td>
<td>Rear call switch</td>
</tr>
<tr>
<td>RCB</td>
<td>Rear conveyor extend switch</td>
</tr>
<tr>
<td>IRCRP</td>
<td>Auxiliary rear conveyor retract position switch</td>
</tr>
<tr>
<td>RCUS</td>
<td>Rear conveyor retract switch</td>
</tr>
</tbody>
</table>

**RCV**

RCUS Rear conveyor up limit switch
GARAGE MAIN OPERATION CONTROLS—Cont’d

RHLR Reversible high car light ray power switch
RLPS Reversible loading platform switch
RLR Rear light ray switch
RRL Rear operating switch
RPAC Retrieve parking switch
RPLK Repark lost key switch
RPSX Reversible loading platform switch
SOS Stall occupied switch
SSR Stall signal switch
IT-9T Tier switches
TCC Tower call cutout switch
UNM Manual unparking registration switch
UNP Unparking switch
UNPC Unloading platform call switch
UPLT Unloading platform load time switch
URS Unpark release switch
URSX Unpark release auxiliary switch
WS Wrong stall switch

TOWER CONTROLS

TC Potential switch
TIE First speed switch
TF Forward direction switch
TFE Full speed switch
TFF Auxiliary forward direction switch
TFXE Full speed auxiliary switch
TGL Timed aligned speed switch
TH Field and brake switch
THX Auxiliary field and brake switch
THY Second auxiliary field and brake switch
THZ Third auxiliary field and brake switch
TIL Alignment switch
TPM Pawl magnet
TPMY Pawl magnet switch
TR Reverse direction and alignment switch
TRX First auxiliary reverse direction switch
TTL Slow speed leveling switch
TLLX First speed auxiliary switch
TXF Forward direction auxiliary switch
TXFR Forward and reverse direction switch
TXR Reverse direction switch

ELEVATOR CONTROLS

C Potential switch
D Down reversing and leveling switch
DX Auxiliary down reversing and leveling switch
1ES First speed switch
1EE Full speed switch
1GL Timed leveling speed switch
H Field and brake switch
HSL Fast speed leveling switch
HX Auxiliary field and brake switch
LD Lower leveling zone down switch
LLS Levelling switch
LO Zone transfer holding switch
LU Lower leveling zone up switch
LV Lower leveling zone switch
LVS Lower leveling zone switch
LZS Low zone change switch
SUD Suicide delay switch
U Up reversing and leveling switch
UX Auxiliary up reversing switch
UZS Upper zone switch
XD Down direction switch
XLS Zone transfer switch
XU Up direction switch

In wiring diagrams of FIGURES 10 through 26, the foregoing identifying letters are applied to the coils of the electromagnetic switches, and, with reference numerals appended thereto, are applied to the contacts of the switches to differentiate between different sets of contacts on the same switch. Certain of the foregoing switches are of the latching type, having two coils, one an operating or set coil and the other a reset coil, the coils being so designed in the circuits in which they appear. Contacts of the switches are shown for the unoperated or reset condition of their respective switches.

Manually operated switches of the knife switch type bear letter and/or numeral designations with a K prefix as, for example, manual call test switch KCT shown in FIGURE 26.

The various aforementioned mechanical switches which may be located in the wiring diagrams of FIGURES 10 through 26 by means of the spindles of FIGURE 32a are shown in such wiring diagrams for the conditions of the (1) absence of automobiles entering or leaving the garage, (2) the side and end barriers, gap lifters and hoistway doors of the loading and unloading stations being in their fully lowered and closed positions, (3) the tower and elevator being parked at the loading station with the elevator in the lower leveling zone, and (4) the front and rear elevator lift fingers being in their respective fully lowered positions. The operation of these mechanical switches will be described hereinafter.

The light ray receiver contacts shown in the wiring diagrams of FIGURES 10 through 26, which contacts may be located thereon by means of the spindle of FIGURE 33a, are shown for the de-energized condition of their corresponding receivers.

Mechanism actuated in accordance with vertical movement of the elevator car is utilized in the control circuits of the garage. Such mechanism may be in the form of a conventional selector machine, as described and disclosed in the Larson Patent #2,611,431, but somewhat modified in that, instead of one helical contacting segment (segment 75 of FIGURE 4 of Larson) being provided for each landing served by the elevator and mounted on a shaft to be rotated thereby at a speed proportional to that of the elevator, two such helical contacting segments or cams are provided for each landing served. These pairs of cams are spaced apart on the shaft in accordance with the distances between the landings for which they are provided. The cams of each pair are spaced apart relative to each other and are positioned with respect to the landing for which they are provided so as to establish a lower leveling zone and an upper leveling zone at such corresponding landing, as will be described hereinafter. A pair of these cams is schematically illustrated for one landing in FIGURE 24 wherein the cam for the upper leveling zone is designated UZC and that for the lower leveling zone LZC. In accordance with the Larson patent, a plurality of contacting devices are arranged on a follower in the form of a crosshead movable in accordance with movement of the elevator along a path parallel to the axis of rotation of the shaft. These contacting devices are schematically shown in FIGURE 24 wherein those associated with cam LZC are designated 1LV-8 and the ones associated with cam UZC are designated 2LV-8. These contacting devices are principally in the form of contact fingers and are biased into position to slideably engage the face of each contacting cam when the elevator is within a certain zone of the landings for which their associated cams are provided. An electromagnet is carried by the crosshead for each set of contacting devices for retraction of its associated contacting devices into position to clear the cams when stops are not being made at the landings for which the cams are provided, which electromagnets are designated in their respective energizing circuits in FIGURE 24 as 1LV for contacts 1LV-8-8 and 2LV for contacts 2LV-8-8. In addition, various mechanical switches and stationary electrical contacts are provided for each landing and are mounted on the selector along the path of travel of the follower or selector crosshead. These mechanical switches and stationary contacts are spaced in accordance with the distances between the landings for which they are provided in position for coacting with corresponding contacting cams and electrical conducting brushes carried by the crosshead as it follows movement of the elevator. Toggle
switches ESW1-7, schematically shown in FIGURE 26, are such mechanical switches and are actuated by cam EPIC. Others are: hook switches EFW1-8 (FIGURE 23) arranged for coaction with cam EFDC, the upper portion of which cam is insulated and the lower portion of which is electrically conducting material; switches ILS to 6LS, OT1, OT2 (FIGURE 24), their respective actuating cams not being shown. Such stationary contacts and corresponding brushes are: in FIGURE 16, stationary contact 2FC for the 2nd landing and EMFC for the 1st landing and their corresponding conducting brushes TCF1 and EMFB; in FIGURE 12, stationary contacts ELZIC and EUZIC for the 1st landing and their corresponding conducting brushes ELZB, EUZB, which brushes are slightly elongated in the downward direction in order to engage their respective stationary contacts, upon downward movement of the selector crosshead in accordance with movement of the elevator, slightly in advance of the arrival of the crosshead and, in turn, the elevator at the 1st landing; and selector stationary contacts EFC1-8 in FIGURE 18 and their corresponding brush EFB.

Mechanism actuated in accordance with horizontal movement of the tower is utilized in the circuits of the garage controls. Such mechanism may be in the form of a conventional selector machine as described in connection with FIGURE 2 of the Glaser and Horning Patent 2,589,242. Such selector is equipped with a synchronous motor or panel which carries certain brushes and cams utilized in the control circuits for coaction with corresponding stationary contacts and mechanical switches mounted along its path of travel in accordance with the distances between the tiers for which such contacts and switches are provided. The selector is also equipped with an advance switch or panel which also carries brushes and cams, is carried by the synchronous panel and is caused to advance from a neutral position with respect to the synchronous panel prior to starting of the tower. The brushes and cams carried by the advance panel are position for coaction with corresponding stationary contacts and mechanical switches mounted on the selector along the path of travel of the advance panel. The advance of the advance panel is effected by means of a torque motor which will hereinafter be termed a brush advance motor, the power circuits of which are schematically represented in FIGURE 21 wherein its armature is designated BMF and its separately excited field windings are designated BMF. The advance motor advances the advance panel a certain distance ahead of the synchronous panel unless a stop is initiated prior to its being advanced fully. When a stop is initiated, the advance panel is returned to neutral position by means of pawls (not shown) which are spring biased to extended position for engaging stopping lugs (not shown) on the advance panel. The pawls stop movement of the advance panel while the synchronous panel continues to move relative thereto, bringing the advance panel to its neutral position, One panel is provided for each direction of travel, while a stopping lug is provided for each tier and is arranged on a tier bar, these bars being arranged along the path of travel of the advance panel and spaced in accordance with the distance between the tiers for which lugs are provided. An electromagnetic relay for controlling the extension and retraction of the pawls is carried by the advance panel and is termed a pawl magnet designated TPM. The pawl magnet has two coils, one an operating or set coil and the other a reset coil, both being designated TPM in the circuits of FIGURE 22.

The plurality of brushes and cams, carried by the synchronous and advance panels, cooperate with corresponding stationary contacts and mechanical switches provided for the various tiers and arranged on the tier bars. Such brushes and cams and their corresponding stationary contacts and mechanical switches are shown schematically in the wiring diagrams as, for example, in FIGURE 12, brushes TLZB, TUBZ and their corresponding stationary contacts TLZSC for the 5th tier and TLZ6C for the 6th tier; tower hook switches TFH1-9 in FIGURE 20 and their actuating elongated cam TD FC, the upper portion of which cam is insulated while its lower portion is electrically conducting material, for purposes to be described hereinafter; in FIGURE 22, mechanical switches SLS1, SLS4-6, SS1, SS2, SS7 and SS8, their respective actuating cams not being shown; in FIGURE 26 toggle switches TWS1-8 and their actuating cam designated TPIC; in FIGURE 18, selector stationary contacts TCF1 and EMFB; in FIGURE 12, TAL circuit shown.}

In the wiring diagrams of FIGURES 10 through 26, rectifiers are generally designated V, capacitors are generally designated C and resistors are generally designated R.

Direct power from any suitable source (not shown) is supplied to the control circuits of FIGURES 10 through 26 over supply lines B1+, BT+, B+ and BO; BO acting as a common ground for the direct power supplies. Line BT− is of FIGURE 21 is a continuation of the supply line indicated as BT− in FIGURE 22. Alternating polyphase power is supplied to the motor circuits of FIGURES 11 and 19 over supply lines L1, L2 and L3.

Referring to FIGURE 10, LGM and UGM generally designate direct current motors for opening and closing the hoistway doors of the loading and unloading stations, respectively, LGM and UGM a designation for the respective motors, while LGMF and UGMF designate their respective separately excited field windings. LB U2B and UB2B designate contacts of manual push buttons located at the computer console for initiating the raising of the side and end barriers of the loading and unloading stations, respectively, such buttons being spring biased to normally open condition. BU designates a warning buzzer provided in the area of the loading and unloading stations for warning the attendant and customers to clear the loading and unloading areas.

In FIGURE 11, simplified circuits of alternating current polyphase motors for raising and lowering the side and end barriers and gap lifters of the loading and unloading stations are illustrated, LSBM generally designating the motor provided for the loading station side barrier, LEBM the motor provided for the loading station end barrier; while USBM and UEBM designate the gap lifter; while USBM, UEBM and UGM generally designate the motors provided for similar mechanism of the unloading station.

In FIGURE 12, LB2B1, LDBB designate contacts of push buttons located at the computer console for initiating the raising and lowering, respectively, of the side and end barriers of the loading station while UB2B1, UBBB designate contacts of similar push buttons for the side and end barriers of the unloading station; such push buttons being spring biased to normally open condition.

In FIGURE 13 are illustrated schematically the energizing circuits for various illuminating signs and bell S23,
the locations of which signs and bell have been previously
described, and the functions of which will be described hereinafter.

In FIGURE 14, RSA, RSB and RSC generally designate manual rotary switches located at the computer console for manipulation by the garage attendant for semi-automatic operation of the garage controls, as will be described hereinafter. Such switches are schematically represented by broken line outlines; switch RSA having three brushes RSA1-3 arranged to be moved independently of each other into engagement with their respective associated contacts RSA1A, RSA2A, RSA1B, RSA2B and RSA1C, RSA2C. Switch RSB has a brush designated RSB1 arranged to be moved into engagement with its associated stationary contacts RSB1-9, and switch RSC has two brushes RSC1B, RSC2B, mechanically coupled to each other (which coupling is not shown) and arranged for simultaneous movement into engagement with their corresponding stationary contacts RSC1A to RSC6A for brush RSC1B and RSC1C to RSC6C for brush RSC2B. Stationary contacts RSC1A and RSC6A of rotary switch RSC are electrically interconnected, for purposes to be explained herein. Also associated with semi-automatic garage operation are several push buttons spring biased to normally open condition and designated BPK, BP5, CB, UNB and PAB. Computer order contact pairs, the electromagnetic actuating coils of which with their respective energizing circuits are shown in the circuits of the computer, have been illustrated in FIGURES 14 and 15 within broken line block outlines generally designated COMP, the designation of each contact pair being the same as shown in FIGURE 8B.

A manual rotary switch, also associated with semi-automatic garage operation, is shown schematically in FIGURE 15 in broken line outline generally designated RSD; RSDB designating its brush which is arranged for movement horizontally through its associated contacts RSD1-4. TOG designates a single pole, double throw manual switch which is spring biased to its normally open mid position.

In FIGURE 17, indicating lamps designated HCLP, WSLP and SOSLP are illustrated schematically within a broken line block outline generally designated HCLP which signifies that the lamps are located at the computer console.

In FIGURE 18, FCB, RCB and VCB designate brake release coils for the alternating current polyphase motors generally designated in FIGURE 19 as FCM for horizontal movement of the front conveyor lift fingers, RCM for horizontal movement of the rear conveyor lift fingers and VCM for vertical movement of the rear conveyor lift fingers, respectively.

With reference to FIGURE 22, the tower motive mechanism includes a direct current motor having an armature TMA supplied with current at a variable voltage from a generator armature TGA which is rotated by a driving motor (not shown). The motor has a separately excited field windings designated TMF. The generator has series field windings designated TGSF and a separately excited field winding TGFL. TGFL designates a separately excited alignment field provided for the generator to effect tier alignment operation of the tower, as will be described hereinafter. TB designates the release coil of the electromagnetic brake of the tower motor. The TOWER SAFE-TIES which include various overload protective devices, limit switches and switches and the like, for the sake of brevity, are indicated simply by legend in block outline, it being understood that such safeties, when actuated, interrupt the circuit for coil TC of the tower potential switch, thereby removing power from the tower controls and motor.

Likewise, in FIGURE 24, the safeties for the elevator are similarly simply indicated by legend in block outline, and are effective when actuated to interrupt the energizing circuit for coil C of the elevator potential switch, which, upon releasing, removes power from the elevator controls and elevator motor.

The elevator hoisting mechanism includes a direct current hoisting motor having an armature designated MA in FIGURE 25 and supplied with current at a variable voltage from a generator armature GA which is rotated by a driving motor (not shown). The hoisting motor has a separately excited field winding designated GSF (FIGURE 25) and a series field winding designated GSF. The generator also has a levelling field winding GLF which is utilized for leveling operation of the elevator at a landing and to initiallyexcite the generator for a particular direction of rotation as will be described hereinafter.

The release coil of the electromagnetic brake of the elevator hoisting motor is designated B.

In FIGURE 26, elevator position indicating lamps EP1-8, and tower position indicating lamps TP1-9, are illustrated, the suffix numerals indicating the landings or tiers for which such indicating lamps are provided. FCLP and RCLP designate lamps for indicating when a rear or front operation has been registered by the garage controls, as will be hereinafter described. These indicating lamps are located at the computer console.

In explaining the operation of one tower mechanism (east) and its associated elevator conveyor it will be assumed that power has been supplied to the garage control circuits of FIGURES 10 through 26, and the respective motor-generator sets of the tower and elevator are in operation. Under such conditions, potential switches TC (FIGURE 22) and C (FIGURE 24) of the tower and elevator, respectively, are in operated condition, connecting certain of the control circuits to their associated power sources (not shown) in preparation for operation of the tower and elevator. Also assume that the east tower and its elevator conveyor are at the landing station to be position to pick up a car, i.e., the east tower is positioned at tier 5 with its elevator conveyor at 1st landing 1E in the elevator lower leveling zone, the positions of the tower and its elevator conveyor shown in the drawings. Under such conditions, loading station switch MPA (FIGURE 16) is in operated condition, indicating that both the tower and elevator are at the loading platform; a circuit for coil MPA of the switch being completed from supply line B1+ through contacts T1E5 of the tower first speed switch, contacts FES of the elevator full speed switch, elevator selector stationary contact EMFC for the 1st landing presently in engagement with elevator selector brush EMFB which is cross-connected to tower selector brush TPTB presently in engagement with tower selector stationary contact TPTCS for the 5th tier, contacts DRS20 of the direction reversing switch, parallel connected contacts IFRCP8 and UZS4 of the front conveyor retract position switch and upper zone switch, respectively, contacts UNP8 of the unparking switch and coil MPA to line BO.

The present positions of the elevator and tower at the loading station are visually indicated to the attendant by means of the elevator and tower position indicating panel, located on the computer console. In FIGURE 22, there is shown a position indicating lamp EPI-1 (FIGURE 26) provided for first landing 1E and tower position indicating lamp TPI-5 provided for 5th tier 5T, are presently in illuminated condition; a energizing circuit for lamp EPI-1 being completed from supply line B+ to line BO through "snap action" toggle switch TSW1, mounted on the elevator selector, and one for lamp TPI-5 being completed from supply line B+ to line BO through toggle switches TSW8 through TSW5 and the upper pair of presently engaged contacts of toggle switch TSW4, which toggle switches are mounted on the tower selector.

It may be noted that the positions of the elevator and tower are indicated continuously at the position indicator.
panel as the elevator and tower, as will hereinafter be described, are caused to travel in response to service demand. To accomplish this, cam EPIC carried by the synchronous panel of the elevator selector moves in accordance with the elevator, actuating toggle switches ESW1 to ESW7 in sequence in the direction of elevator movement, thereby transferring illumination from one elevator position indicating lamp (EPI-1 to EPI-8) to the next succeeding one in the direction of elevator travel, as the elevator moves from one landing to the next adjacent landing; while cam TPIC carried by the synchronous panel of the tower selector moves in accordance with the tower, actuating toggle switches TWS1 through TWS8 in sequence in the direction of travel of the tower, thereby transferring illumination to successive tower position indicating lamps (TP-1 to TP-9) in the direction of tower movement, as the tower moves from one tier to the next adjacent tier.

Low zone switch LZS (FIGURE 17) is also in operated condition, indicating that the elevator is in its lower leveling zone; a circuit for its coil LZS being completed from supply line B1+ to supply line BO through mechanically actuated low zone switches L21 to L24 which are presently being maintained in closed condition by lower leveling cam LZ, provided that the elevator selector for the 1st landing IE, as has been previously explained.

In addition, assume that light ray unit ELCR for detecting the presence of an automobile on the elevator is in operation and its light beam is unbroken. In such case elevator light ray switch ELS (FIGURE 16) is in operated condition, indicating that the elevator conveyor is presently empty; the circuit for its coil ELS being completed from supply line B1+ to supply line BO through light ray receiver contacts ELCR (presently engaged). Front conveyor retract position switch IFCRP (FIGURE 4) and auxiliary rear conveyor retract position switch IRCRP are maintained in operated condition by means of cam actuated switches FCRP1 and RCRP1, previously described, thereby indicating that the front and rear conveyor lift fingers, respectively, are in their fully retracted position. Low zone holding switch LO (FIGURE 5) is in operated condition, preparing the lower leveling zone control circuits of the elevator for operation; a circuit for its set coil being completed from supply line B1+ to line BO through potential switch contacts C1, TC1; front conveyor retract position switch IFCRP1 and auxiliary rear conveyor retract position switch IRCRP (all presently engaged), contacts CCR12 of the car call registered switch and contacts ELS4 (presently engaged) of the elevator light ray switch. Lower leveling zone down switch LD (FIGURE 24) is also in operated condition; a circuit for its coil being maintained from supply line B1+ to line BO through potential switch contacts C3, contacts LO2 (presently engaged) of the low zone hall switch and LU4 of the low leveling zone up switch.

First auxiliary speed switch TIXE (FIGURE 22) and auxiliary full speed switch TFXE in the tower speed control circuits are also in operated condition; circuits for their respective coils and associated resistor-capacitor firing circuits being maintained from supply line BT+ to line BO through potential switch contacts TC4 (presently engaged) and for coil TIXE through contacts TH6 of the tower brake release coil, and for coil TFXE through contacts Thy speed switch. Wrong stall switch WS (FIGURE 4) is in operated condition, and its associated timing capacitor CW of the resistor-capacitor timing circuit connected across its coil is in fully charged condition; a circuit therefor being maintained through contacts CCR8 of the car call registered switch. Switch WS is utilized, as will be described hereinafter, to notify the attendant, should an emergency arise, that an emergency override has been actuated by the elevator and tower to a stall other than the one designated by the computer.

Also assume that at both the loading and unloading stations the respective hoistway doors are fully closed and the respective side barriers, end barriers and gap lifters are in their respective fully lowered positions. Under such conditions, in the loading station control circuits, loading barrier down limit switch LDLB (FIGURE 10) is in operated condition, indicating that the loading barrier is fully lowered; a circuit through its coil being completed through barrier actuated mechanical down limit switches LEBDL2 and LSBDL2 for the end and side barriers, respectively. Auxiliary loading gate down position switch ILGD is also in operated condition, indicating that the loading barrier gate is fully closed; a circuit through its coil ILGD being completed through door actuated, loading gate down position mechanical switch LGDP. Corresponding switches for the unloading station control circuits are similarly maintained in operated condition; i.e., unloading barrier down limit switch UBDL and auxiliary unloading gate down position switch IUGDP (FIGURE 10).

Assume further that there are no outstanding calls in the system and the garage has available space in which to park incoming automobiles. Under such conditions, the "ENTER THIS LANE" sign (FIGURE 13) is illuminated at the east tower entranceway (sign 500 in FIGURE 1), and the "GO GREEN" and "DRIVE SLOWLY" signs (signs 102 and 107, respectively, FIGURE 1) are illuminated, they being energized through presently engaged contacts LBDL3.

It may be noted that should parking space be unavailable in the east tower, the attendant may move manual switches KS1a, KS1b to their respective "full" positions, energizing the "DO NOT" portion of sign 500 (FIGURE 1) at the east tower entranceway, thereby illuminating it to notify incoming traffic not to enter the east tower incoming lane, and de-energizing the "GO GREEN" and "DRIVE SLOWLY" signs, thereby extinguishing them.

In addition, assume that contacts VHC1C of the very high car light ray receiver (shown as 97 in FIGURE 1) at the garage entranceway are presently engaged, indicating that the very high car detecting light beam directed across the entranceway is presently unbroken. Contacts VHC1C complete a circuit for coil VHC of the very high car switch through contacts FRX3 of the auxiliary flicker switch. Switch VHC is therefore also in operated condition and maintains its self-holding contacts VHC2 engaged. Switch VHC through its presently engaged contacts VHC3 also maintains an energizing circuit for coil FRX of the auxiliary flicker switch and a charging circuit for timing condenser CFRX in the R–C timing circuit connected across coil FRX. Switch FRX is thus also maintained in operated condition.

Next assume that an automobile which is too tall to be parked in the garage stalls at the garage, interrupting very high car light beam 99 (FIGURE 1). Interruption of such beam causes contacts VHC1C (FIGURE 13) of the very high car light ray receiver to separate, interrupting the circuit for coil VHC of the very high car switch which releases, separating its self-holding contacts VHC2. Switch VHC also engages its contacts VHC1, completing a circuit through presently energized capacitor CFRX, for the "CAR TOO HIGH" sign which illuminates and preparing a circuit for the "STOP" sign at the entranceway (both signs shown as 100 in FIGURE 1). Switch VHC also separates its contacts VHC3 disconnecting coil FRX from its timing condenser CFRX from across supply lines B1+, BO. However, switch FRX is maintained engaged for a certain time by the discharge of its timing condenser CFRX through its coil, thereby maintaining its contacts FRX2 engaged for that certain time to maintain the "CAR TOO HIGH" sign illuminated. Switch VHC also separates its contacts VHC4, completing a circuit for coil FR of the flicker switch and capacitor CFR, improperly carrying current in coil, which capacitor starts charging through timing resistor RFR. When capacitor CFR has charged sufficiently, switch FR operates, engaging its contacts FR3, shunting
its coil, resistor RFR and capacitor CFR, thereby causing the latter to begin discharging relatively rapidly. Switch FR also engages its contacts FR1, completing a circuit for the “STOP” sign which illuminates, and engages its contacts FR2, completing a circuit for a bell S23 which rings notifying the driver of the incoming automobile that he must not proceed into the garage. Attempting to enter the automobile is unparkable. When capacitor CFR has discharged sufficiently, switch FR releases, deserapating its contacts FR1 and FR2 in the energizing circuit for the “STOP” sign and bell S23, respectively, and reassembles its shunting contacts FR3, removing the short circuit across its coil, registering capacitor and, thereby, clearing the motor capacitor CFR to begin recharging through timing resistor RFR. When capacitor CFR has recharged sufficiently, the entire operation is repeated, resulting in the “STOP” sign being flickered and bell S23 being intermittently rung while the “CAR TOO HIGH” sign remains continuously illuminated. When switch FRX times out and provides that contacts VHC11 of the very high car receiver re-engage, the signs are extinguished and the bell ceases to ring, indicating that the garage entrance-way has been cleared of the unparkable very high car.

Next assume that a parkable automobile is driven into the entrance-way, and, as it approaches the loading station platform, actuates mechanical switches PS, IPS (FIGURE 16) to close condition (shown as 103 in FIGURE 1), completing a circuit through presently engaged contacts LBDL4 and contacts DRS11, LPSX1 for set coil HLRL of the high car light ray power switch. Switch HLRL, upon operation, separates its contacts HLRL4 (FIGURE 12), disabling the barrier, hoistway door and gap lifter control circuits from operation for upward movement thereof until the height of the incoming automobile may be checked. Switch HLRL also engages its contacts HLRL1 (FIGURE 10), preparing an energizing circuit for and engages its contacts HLRL5 (FIGURE 9), preparing an energizing circuit for set coil HC of the high car switch, for purposes to be explained hereinafter. Switch HLRL also engages its contacts HLRL5 (FIGURE 10), completing a circuit for set coil PSS of the parking station switch.

Assume further that the incoming automobile is detected to be what is termed a “high car,” i.e., a car which, although parkable in the garage, is of such height that it may only be parked in the parking stalls provided at the 1st and 8th landings, which stalls, as has been previously explained, unlike the stalls at the intermediate landings, are especially constructed of a height to accept such “high cars.” Such a “high car” is detected by the interruption of light beam 106 (FIGURE 1) directed across the entranceway of the roadway station platform. Interruption of light beam 106 causes contacts IHCL (FIGURE 16) of the high car light ray receiver to engage, completing a circuit for set coil HC of the high car switch through contacts RHCL of the high car light ray receiver (provided at the unloading station for reverse operation of the east tower, as will be explained hereinafter), contacts HLRL3 (presently engaged), RLPS2 and LPS2.

Switch HC, upon operation, engages its contacts HCl (FIGURE 18), preparing an energizing circuit for its reset coil HC. This switch also engages its contacts HC3 (FIGURE 17), completing an energizing circuit for high car lamp HCLP which illuminates, notifying the attendant at the console that the incoming automobile has been detected to be a “high car.” Switch HC also conditions the computer, as has been previously explained, to accept coded keys only for stalls which may receive such a “high car,” i.e., stalls located at the 1st or 8th landings, and reject coded keys for all other stalls. The attendant must select a coded key for a 1st or 8th landing stall in order to park the “high car.”

Switch PSS, upon operation, separates its contacts PSS4 (FIGURE 13), de-energizing the “GO GREEN” sign which extinguishes, and engages its contacts PSS5, completing an energizing circuit for the red “STOP” sign (shown as 102 in FIGURE 1), thereby notifying subsequent incoming cars to stop at the entranceway to the loading station platform which is presently occupied.

Switch PSS also engages its contacts PSS1 (FIGURE 10), preparing a circuit for its reset coil PSS, and engages its contacts PSS5, thereby setting up a circuit to energize the “high car.” Switch PSS in addition also engages its contacts PSS3, disabling the energizing circuit for reset coil SO of the sequence operation switch. Switch PSS in addition also engages its contacts PSS3, disabling the energizing circuit for reset coil SO of the sequence operation switch until the parking station switch returns to released condition, as will be hereinafter described.

As the incoming automobile progresses onto the loading station platform into loading position, its front wheels actuate loading position mechanical switch LPC (FIGURE 16) to closed condition (shown as 110 in FIGURES 1 and 1a), completing a circuit through contacts DRS8 for coil LPS of the loading platform load switch. Switch LPS, upon operation, permits the computer to read the coded key selected and inserted in the computer read out slot by the attendant. The code of the selected key, as has been previously explained, designates the stall in which the car is to be parked. The attendant may now also depress the “PARK” button at the console of the computer. In order from the computer to the garage control circuits and cause the tower and elevator to move to the loading station, if parked elsewhere, as will be described hereinafter.

Switch LPS also separates its contacts LPS7 (FIGURE 13), de-energizing the “DRIVE SLOWLY” sign which extinguishes, and engages its contacts LPS8 completing a circuit through presently engaged contacts LBDL3 for the “APPLY PARKING BRAKE” sign (shown as 107 in FIGURE 1). This switch also engages its contacts LPS1 (FIGURE 18), completing an energizing circuit for reset coil HLRL of the high car light ray power switch through contacts HLRL1 (presently engaged) and sets coil LPSX of the loading platform sequence switch.

Switch LPS in addition separate its contacts LPS2 (FIGURE 16), interrupting the energizing circuit of set coil HC of the high car switch, thereby preparing switch HC for release, as will hereinafter be described. Switch LPS also separate its contacts LPS5 (FIGURE 10), disabling the energizing circuit for reset coil PSS of the parking station switch, and engages its contacts LPS6, preparing an energizing circuit for set coil SO of the sequence operation switch. Switch LPS further engages its contacts LPS3 (FIGURE 12), preparing a circuit for the loading station side and end barriers for operation. High car light ray power switch HLRL, upon releasing, re-engages its contacts HLRL4 (FIGURE 12), preparing the loading station barrier, hoistway door and gap lifter up control circuits for operation, and reassembles its contacts HLRS (FIGURE 12), interrupting the energizing circuit for set coil PSS of the parking station switch, thereby preparing the switch for release.

Loading platform sequence switch LPSX, upon operation, engages its contacts LPSX2 (FIGURE 15), preparing an energizing circuit for its reset coil LPSX, and separates its contacts LPSX1 (FIGURE 16), disabling the energizing circuit for set coil HLRL of the high car light ray power switch, thereby preventing actuation of mechanical platform switch PS by the next incoming automobile from effecting the operation of switch HLRL while the automobile presently on the loading platform area while the loading operation is being loaded. Switch LPSX also engages its contacts LPSX7 (FIGURE 12), preparing the loading station hoistway door and gap lifter control circuits for operation.

After the motorist leaves his automobile and clears out of the loading station area, the attendant may raise the loading station side and end barriers to prevent anyone from entering the loading station platform area while the loading operation is taking place. To raise the barriers, the attendant holds the load barrier up manual button LBUB at the console continuously depressed, thereby maintaining its contacts LBUB1 (FIGURE 12) in closed
condition. Contacts LBUB1 complete a circuit for coil LSBU of the loading side barrier up switch and coil LEBM of the loading end barrier up switch from supply line B1+ to line B0 through contacts C6 (FIGURE 12), TCS, IFCRP3 (all presently engaged), HLR4, LFM1 and in turn to coil LHPS (presently engaged) LFM2. Switch LSBU through loading side barrier up limit mechanical switch LSBUL1 and contacts LSBD2, and for coil LEBM through loading end barrier up limit mechanical switch LBUL1, and contacts LEBD2.

Loading side barrier up switch LSBU, upon operation, engages its contacts LSBU4, LSBU5 (FIGURE 11), energizing loading side barrier motor LSBM for operation in a direction to raise the side barriers, and engages its contacts LSBU1 (FIGURE 10), completing a circuit for coil LSB of the loading side barrier up-down switch which operates, engaging its contacts LSBC1 (FIGURE 10), completing a circuit for brake release coil LSB of the side barrier motor LSBM, thereby releasing the brake and permitting the side barriers to move upward. Switch LSBU also separates its interlock contacts LSBU3 (FIGURE 12) in the loading side barrier down control circuits.

Loading end barrier up switch LEBU, upon operation, engages its contacts LEBU3, LEBU4 (FIGURE 11), completing an energizing circuit for loading end barrier motor LEBM for rotation in a direction to raise the end barriers, and engages its contacts LEBU1 (FIGURE 10), completing a circuit for coil LEB of the loading end barrier up-down switch which operates, engaging its contacts LEBC1 (FIGURE 10), completing a circuit for loading end barrier brake release coil LEB which releases the brake of the loading end barrier motor LEBM, thereby permitting the end barriers to move upward. Switch LEBU also operates its interlock contacts LEBU3 (FIGURE 12) in the loading end barrier down control circuits.

As the loading side and end barriers move upward from their fully lowered position, their respective down limit switches LSBDL1, LEBDL1 (FIGURE 12) are actuated by such movement to closed condition, preparing the loading side and end barrier down control circuits for operation at the completion of the loading operation. Such upward movement of the side and end barriers also actuates mechanical side and end barrier down limit switches LSBDL2, LEBDL2 (FIGURE 10) to open condition, interrupting the circuit for coil LEBL of the limit switch down limit which releases, indicating that the loading barriers are being raised.

Switch LBDL separates its contacts LBDL3 (FIGURE 8G), interrupting the circuit for the "APPLY PARKING BRAKE" sign which extinguishes, and reopens its contact LBDL3 (FIGURE 10), preventing parking switch PS from being released until the loading station barriers again arrive at their fully lowered position, as will be hereinafter described.

Contacts LBUB2 (FIGURE 12) of the loading barrier up button, as has been previously stated, are also maintained in closed position while the loading barriers are being raised. While such barriers are being raised, assume that the top edge of the end or side barriers comes into contact with an obstructing object. Such contact causes mechanical pressure responsive switches LEB, LLSB (provided along the top edge of the end and side barriers, respectively, as has been previously described) to the actuated to closed condition, completing a circuit through contacts LSBD1, LEBD7 and LBUL2 for coil LFM of the loading floor mat switch. Switch LFM operates and engages its contacts LFM2, completing a circuit for alarm buzzer BU to warn the attendant that the barriers have come into contact with an obstacle. Switch LFM also energizes its contacts LFM1 (FIGURE 12), interrupting the power supply to the loading barrier up control, the loading hoistway door up control and the loading gap lifter up control, thereby de-energizing such up control circuits and stopping upward movement of the loading station barriers. Buzzer BU continues sounding an alarm until either the attendant releases the loading station barrier up button LBUB at the console, causing button contacts LBUB1 and LBUB2 to reopen, or the obstruction is removed, in which case contacts LBUB1 and LBUB2 close again.

It may be noted that a person standing on loading station platform mat 119 (FIGURE 1) causes loading floor mat pressure responsive mechanical switch 1LFM (FIGURE 12) to close, similarly ringing buzzer BU (FIGURE 10) and causing switch LFM to operate to stop upward movement of the barriers, while disabling the hoistway door and gap lifter up controls. It may be seen that pressure responsive mechanical safety switches LEB, LLSB and LFM, upon actuation, prevent operation of the loading station equipment until the area is cleared, and while the barriers are being raised, stop barrier upward movement and sound an alarm to warn the attendant and anyone in the loading station platform area to clear that area.

Next assume that the obstruction is removed and the end and side barriers resume moving upward. As they arrive at their fully raised position, mechanical limit switches LEBUL1, LSBUL1 (FIGURE 12) are actuated to open condition by movement of the end and side barriers, respectively, interrupting the respective circuits of coil LEBU of the loading end barrier up-down switch and coil LSBU of the loading side barrier up switch. Loading end barrier up switch LEBU, upon releasing, separates its contacts LEBU3, LEBU4 (FIGURE 11), de-energizing loading end barrier motor LEBM, and separates its contacts LEBU1 (FIGURE 10), interrupting the circuit for coil LEB of the loading end barrier up-down switch which re-engages its contacts LEBC1 (FIGURE 10), causing application of brake LEB to motor LEBM, thereby stopping the loading end barriers in their fully raised position. Switch LEBU also re-engages its interlock contacts LEBU3 (FIGURE 12), preparing the loading end barrier down control circuits for operation.

Loading side barrier up switch LSBU, upon releasing, similarly separates its contacts LSBU4 and LSBU5 (FIGURE 11), de-energizing loading side barrier motor LSBM, and separates its contacts LSBU1 (FIGURE 10), interrupting the circuit for coil LSB of the loading side barrier up-down switch which re-energizes its contacts LSBC1 (FIGURE 10), causing application of brake LSB to motor LSBM, thereby stopping the side barriers in their fully raised position. Switch LSBU also re-energizes its interlock contacts LSBU3 (FIGURE 12), preparing the loading side barrier down control circuits for operation.

Arrival of the loading station end and side barriers to their fully raised position also actuates mechanical limit switches LSBUL2, LSBUL2 (FIGURE 10) for the end and side barriers, respectively, to closed condition, completing a circuit for coil LGB of the loading main limit switch. Switch LGB engages its contacts LBUL1 (FIGURE 12), completing circuits for coil LGU of the loading gate lifter up switch and coil LGO of the loading gate up switch; the circuits for such coils, extending from supply lines B1+ to B0 through contacts C6, TCS, IFCRP3 (all presently engaged), HLR4, LFM1, DR539, LBD3, LPSX7 (presently engaged) and for coil LGU through closed control pair LGLUP6 of the loading gate lifter up position mechanical switch, and contacts LGD2, and for coil LGO through the control circuit extending through contacts ALPL1, TXFTR2, lower selector brush TLZB presently in engagement with selector stationary contact TLZ5c for the 5th tier, elevator selector brush ELZB presently in engagement with its associated stationary selector contact ELZ5e for the 1st landing and loading gate open limit mechanical switch.

Switch LBUL also separates its contacts LBUL2, preventing subsequent actuation of the pressure responsive mechanical switches LEB, LLSB (provided along the top edges of the loading end and side barriers, respectively) from ringing buzzer BU or affecting the raising
of the loading hoistway door and gap lifters. Switch LBUL, in addition, engages its contacts LBUL3 (FIGURE 10), completing a circuit for set coil SO of the sequence operation switch; the circuit extending through contacts LPS6 and CSS (both presently engaged). Switch LBUL, in addition, engages its contacts LBUL4 (FIGURE 18), without effect at this time.

Loading gap lifter up switch LGU (FIGURE 12), upon operation, engages its contacts LGU5, LGU6 (FIGURE 11), energizing loading gap lifter motor LGLM for rotation in a direction to raise the loading gap lifter and return it to upper tower position. Switch LGU also engages its contacts LGU1 (FIGURE 12), completing a circuit for coil LGUD of the loading gap lifter up-down switch which operates and engages its contacts LGUD1 (FIGURE 10), completing an energizing circuit for brake release coil LGB, thereby releasing the brake from motor LGBM and permitting the loading gap lifter to move to its fully raised and extended position to place the automobile in position to be transferred to the elevator. Switch LGU also separates its interlocking contacts LGU2 (FIGURE 12), disabling the loading gap lifter down controls from operation while the gap lifter is being raised.

Loading gate up switch LGO (FIGURE 12), upon operation, engages its contacts LGO2, LGO3 (FIGURE 10), energizing loading hoistway door motor armature LGMA in a direction to move the door toward its fully open position, and engages its contacts LGO1 (FIGURE 10), completing a circuit for coil LGB which releases the brake from door motor LGM, thereby permitting the door to move toward its fully open position.

Sequence operation switch SO (FIGURE 10), upon operation, engages its contacts SO1, SO2, switch effect. As the moving gap lifter in moving upward lifts the automobile from the loading platform station, the front wheels of the automobile move out of contact with mechanical loading platform switch LPC (FIGURE 16), which switch returns to its normally open position, interrupting a circuit for coil LPS of the loading platform load switch.

Switch LPS, upon releasing, separates its contacts LPS1 (FIGURE 18), interrupting the circuit for set coil LPSX of the loading platform sequence switch, thereby preparing it for release by means of its reset coil. Switch LPS also engages its contact LPS2 (FIGURE 16), preparing an energizing circuit for coil IF for the high car switch for operation by subsequent incoming automobiles. Switch LPS further separates its contact LPS3 (FIGURE 12), disabling the loading station side and end barrier up controls from operation until a subsequent car is again in loading position at the loading platform station. This switch re-engages its contacts LPS5 (FIGURE 10) and re-engages its contacts LPS6, without effect, and re-engage its contacts LPS7 (FIGURE 13) and re-engages its contacts LPS8, preparing the "GO GREEN," "DRIVE SLOWLY" and "APPLY PARKING BRAKE" signs for operation by the next incoming car.

Movement of the loading station gap lifter upward from its fully lowered position also actuates mechanical switch LGDP1 (FIGURE 12) to closed condition, preparing the gap lifter down controls for operation, and actuates mechanical switch LGDLP to open condition, preventing operation of the loading station side and end barrier until the gap lifter is again returned to its fully lowered position.

Opening movement of the loading station hoistway door from its fully closed position actuates mechanical switch LGDP (FIGURE 10) to open condition, interrupting the circuit for coil LGLD of the auxiliary gate down loading position switch. Switch LGDLP, upon releasing, engages its contacts LGDP1 (FIGURE 12), preparing an energizing circuit for coil LGC of the loading gate down switch, and separates its contacts LGDP3, disabling the loading station side and end barrier down controls from operation until the hoistway door is returned to its fully closed position. Switch LGLD, in addition, separates its contacts LGLDP4 (FIGURE 24), preventing operation of the elevator start and direction main controls until the hoistway door is returned to its fully closed position.

As the loading station gap lifter arrives at its fully raised and extended position, its movement actuates mechanical switch LGLUP (FIGURE 12) from its lower to its upper position, opening switch contacts LGLUPb, thereby interrupting the circuit for coil LGLU of the loading gap lifter up switch, and closing switch contacts LGLUPa, thereby completing a circuit for coil LGLUP of the auxiliary loading gap lifter up position switch.

Switch LGO, upon releasing, separates its contacts LGU5, LGU6 (FIGURE 11), de-energizing loading gap lifter motor LGLM, and separates its contacts LGU1 (FIGURE 12), interrupting the circuit for coil LGUD of the loading gap lifter up-down switch which releases, separating its contacts LGUD1 (FIGURE 10), interrupting the circuit for brake release coil LGB, causing application of the brake to motor LGBM to stop and hold the loading gap lifter in its fully raised and extended position. Switch LGU also re-engage its interlocking contacts LGU2 (FIGURE 12), preparing the loading gap lifter down controls for operation.

Switch LGLUP, upon operation, engages its contacts LGLUP1 (FIGURE 18), preparing an energizing circuit for coil SSR of the call signal switch, for purposes to be explained hereinafter.

As the loading station hoistway door arrives approximately ¼ inch from its fully open position, its movement actuates mechanical switch LGOL (FIGURE 12) to open condition, interrupting the circuit for coil LGO of the loading gate up switch. Switch LGO, upon releasing, separates its contacts LGO2, LGO3 (FIGURE 10), in the circuit of hoistway door motor armature LGMA, thereby de-energizing door motor LGM, and also separates its contacts LGO1 (FIGURE 10), interrupting the circuit for brake release coil LGB, causing application of the brake to door motor LGM, thereby stopping the hoistway door in its fully open position.

As the door arrives at its fully open position, it actuates mechanical switch LGUP (FIGURE 17) to closed condition, preparing controls for extending the front conveyor lift fingers of the elevator into a position beneath the automobile previously passed by the loading gap lifter in preparation for transferring it from the gap lifter to the elevator conveyor, as will be hereinafter described.

In describing parking operation of the garage, it will be assumed, for purposes of explanation, that the automobile presently on the loading gap lifter in "pick up" position has not been detected as being a "high car," as had been previously assumed, but instead is of such size that it may be parked in any one of the available garage stalls; it being understood that parking of a "high car" is similar in all respects to the parking operation to be described, with the exception that such a "high car" may be parked only in the override stalls at the 1st and 2nd landings.

Also assume that, as has been previously described, the computer has designated that a parking operation be performed stall 4T, 6E of the front tiers being selected as the stall in which the automobile is to be parked. Under such conditions, computer order contacts TS4, F56 and FRONT1 (FIGURE 14) are engaged, indicating the selected stall and completing the respective circuits of the set coils for fourth tier switch 4T, 6th floor switch 6F and front call switch FC; the circuits for their respective set coils extending from supply line B4+ to line BO through contacts BP1, CR1 and manual master disconnect switch KMDSP.

These stall designation switches operate, conditioning the tower and elevator for travel to selected stall 4T, 6E, front, as will be explained hereinafter. In addition, computer order contacts PK are engaged, indicating that a
parking operation is to be performed and completing a circuit for set coil PAC of the loading platform call switch from supply line B1+ to line BO through contacts BP1, CCR1, manual master disconnect switch KMDS1 and contacts PA3 (presently engaged).

Switch PAC, upon operation, engages its contacts PAC6 (FIGURE 16), completing a circuit for set coil PA of the parking switch. Switch PAC, in addition, engages its contacts PAC8 (FIGURE 15), preparing a circuit for its reset coil PAC, and separates its contacts PAC5, preventing completion of a circuit for reset coil PA of the parking switch. Switch PAC further engages its contacts PAC3, completing a circuit for coil FOS of the front operation switch, and separates its contacts PAC4 in the circuit of coil ROS of the rear operation switch, preventing operation of switch ROS until the automobile is transferred to the elevator conveyor.

Switch PAC also engages its contacts PAC2 (FIGURE 16), completing a circuit for coil HLS of the home landing switch through contacts ELS1 (presently engaged). Switch PAC, in addition, engages its contacts PAC7 (FIGURE 18), completing a circuit for coil SSR of the stall signal switch to initiate, as will hereinafter be described, extension of the front conveyor lift fingers to pick up the automobile from the loading gap lifter; the circuit extending from supply line B1+ through potential switch contacts C1, TC1, elevator selector brush EFB presently engaged in engagement with its associated stationary selector contact EFC1 for the 1st landing, contacts PAC7, contacts DR516 of the direction reversing switch, LBU14 (presently engaged) of the loading barrier up limit switch, 1LGLUP1 (presently engaged) of the auxiliary loading gap lifter up protective switch, tower selector stationary contact TTC5 for the 5th tier (loading station) presently engaged by its associated selector switch TB and coil SSR to supply line BO.

Parking switch PA, upon operation, directs the garage controls to perform a parking operation, as will be described hereinafter. It also engages its contacts PA4 (FIGURE 15), preparing a circuit for its reset coil PA and contact PA5, preparing circuits for reset coils 4T, 6E of the tier and landing stall designation switches, respectively. Switch PA further engages its contacts PA6 (FIGURE 16), preparing a circuit for coil CCR of the car call registered switch, and PA5, preparing a circuit for coil SOS of the stall occupied switch in preparation for checking with call 4T, 6E, front, in which the automobile is to be parked, is already occupied, as will be described hereinafter.

Home landing switch HLS, upon operation, separates its contacts HLS1 (FIGURE 20) and HLS3 (FIGURE 23) in the respective direction control and start initiating circuits of the tower and elevator, without effect at this time.

Front operations switch FOS (FIGURE 12), upon operation, engages its contacts FOS4 (FIGURE 17), preparing the extend controls of the front conveyor lift fingers for operations.

Switch SSR, upon operation, engages its contacts SSR5 (FIGURE 17), completing energizing circuits for coils FCE of the front conveyor extend switch and CHC of the common horizontal conveyor switch; the circuits extending from supply line B1+ through potential switch contacts TC2, C2 (both presently engaged), tower alignment mechanical switches T21-4, contacts TH8 of the tower field and brake switch HLS2 of the elevator fast speed leveling switch, H10 of the elevator brake switch, presently engaged contacts ELS3 of the elevator light ray switch, L233 of the low zone switch, SSR5, FOS4 of the front operation switch and MPA10 (all presently engaged) switch, mechanical switches LGUP (presently closed for the fully open condition of the loading hoistway door), FCE, 1RDCL1 and E2HC, contacts L251 (presently engaged) of the low zone switch, FC14 of the front conveyor retract switch, coil FCE, conveyor slack cable mechanical switches IFSCS, 2FSCS and coil CHC to supply line BO.

Switch SSR also separates its interlock contact SSR7 (FIGURE 17) in the retract control circuits for the front and rear conveyor lift fingers (FIGURE 24), SSR2 (FIGURE 22) in the respective main control circuits of the elevator and tower, preventing their respective motive mechanisms from moving them from the loading station while the automobile is being transferred from the loading gap lifter to the elevator.

Front conveyor lift fingers FCE, upon operation, engages its contacts FCE6, FCE7 (FIGURE 19) and FCE1 (FIGURE 18), preparing front conveyor motor FC to rotation in a direction to extend the front conveyor lift fingers, while switch CHC, upon operation, engages its contacts CHC7, CHC8 (FIGURE 19) and CHC1 (FIGURE 18) connecting the polyphase windings of the front conveyor motor to supply lines L2, L3 and energizing brake release coil FCB, releasing the brake from motor FC to thereby energizing the motor and causing it to move the front conveyor lift fingers toward their fully extended position beneath the automobile presently standing on the loading gap lifter. Switch FC extends its interlock contacts FCE5 (FIGURE 17) in the retract control circuits for the front conveyor lift fingers.

It may be noted that switch FCE, in addition, engages its contacts FCE2 (FIGURE 17) in the energizing circuit for reset coil HC of the high car switch without effect. However, had the automobile presently being parked been detected as being a "high car," in which case switch HC would be in operated condition, the engagement of contacts FCE2 would complete a circuit for reset coil HC through contacts C1, TC1, MPA1 and HC (all presently engaged), causing switch HC to release. Thus, switch HC, if operated is caused to release, removing the indication, previously explained, that the automobile to be parked is a "high car," after the attendant has selected a coded key for a "high car" stall and the selected "high car" stall has been designated by the computer to the tower and elevator controls through the operation of the aforesaid stall designation switches in FIGURE 14 by the appropriate computer order contacts.

As the front conveyor lift fingers move from their fully retracted position, front conveyor retract position mechanical switch FCRP1 (FIGURE 17) releases the front conveyor lift fingers, movement, moving under the influence of its biasing spring to its open position, thereby interrupting the circuit for coil 1FCRP of the first front conveyor retract position switch. Switch FCRP, upon releasing, separates its contacts FCRP3, FCRP12 (FIGURE 12) in the front conveyor door, gap lifter and barrier control circuits of the loading station, preventing operation of the loading platform mechanism while the front conveyor lift fingers are in other than their fully retracted position. Switch FCRP also re-engages its contacts FCRP8 (FIGURE 16), without effect at this time, and separates its interlock contacts FCRP6 (FIGURE 17) in the rear conveyor vertical movement control circuits. Switch FCRP further separates its contacts FCRP10 (FIGURE 18), preparing the elevator zone transfer control circuits for operation, as will be described hereinafter, and separates its contacts FCRP2 (FIGURE 22), 1switch FCRP2 (FIGURE 24) in the main control circuits of the tower and elevator, respectively, preventing their movement from the loading station while the front conveyor lift fingers are not fully retracted.

Movement of the front conveyor lift fingers toward their extended position also release front conveyor retract mechanical switch FCRP1 (FIGURE 24), under the influence of its biasing spring, moves to its closed position, preparing the retract controls of the front conveyor lift fingers for operation.

As the front conveyor lift fingers approach their fully extended position, front conveyor extend limit mechanical
Next will be described how the automobile is transferred from the loading gap lifter to the presently extended front conveyor lift fingers of the elevator by causing the elevator to move upward from its lower leveling zone to its upper leveling zone at the 1st landing to lift the car off of the gap lifter. As the front conveyor lift fingers arrive at their fully extended position, mechanical switch IFCEP (FIGURE 17) completes a circuit by means of a cam carried by the conveyor fingers, completing a circuit for coil IFCEP of the auxiliary front conveyor extend position switch from supply line B1+ to line BO through potential switch contacts C2, C2 (presently engaged). Switch IPCEP, upon operation, engages its contacts IFCEP2 (FIGURE 18), completing a circuit to reset coil LO of the zone transfer holding switch; the circuit extending from supply line B1+ to line BO through contacts C1, C1, IFCEP2 (all presently engaged), contacts XLO2 of the zone transfer switch and LO3 (presently engaged). Switch LO, upon releasing, engages its contacts IFCEP2 (FIGURE 18), preparing a circuit for set coil XLO of the zone transfer switch. Switch LO also separates its contacts LO2 (FIGURE 12), interrupting the circuit for coil LD of the lower leveling zone down switch, and engages its contacts LO1, preparing a circuit for coil LU of the lower leveling zone up switch. Switch LD, upon releasing, engages its contacts LD4, completing a circuit for coil LU of the lower leveling zone up switch. Switch LD also separates its contacts LD1, LD2, LD3, in the lower zone leveling circuits of the elevator, preventing low zone leveling cam LZC from effecting a leveling operation of the elevator.

Switch LU, upon operation, separates its interlock contacts LU4 in the lower leveling control circuits and engages its contacts LU1, LU2, in the upper leveling zone elevator circuits, completing circuits for coil LL of the leveling switch, coil U of the up reversing and leveling switch and coil H of the elevator field circuit; the circuits extending from supply line B+ through contacts C3 (presently engaged), coil LL, contacts FEI of the full speed switch, leveling contacts 2LV, 2LV, both presently engaged by high zone leveling cam UZC over travel limit mechanical switch OLI, contacts LLI, contacts D1 of the down reversing and leveling switch, coil U, contacts C5 and coil H to supply line BO.

Switch LI, upon operation, separates its contacts LLI, without effect. Switch H, upon operation, engages its contacts H7, completing a circuit for coil SU of the suicide delay switch and its parallel timing switch SU1, coil D7, which charges fully. Switch SU, upon operation, separates its contacts SU3 (FIGURE 35), while switch H separates its contacts H8 disconnecting generator self-exciting field windings GSEF from generator armature GA in preparation for leveling operation of the elevator hoisting motor. Switch U, upon operation, separates its interlock contacts U1 (FIGURE 24) in the elevator down control circuits and engages its contacts U3, completing a circuit for brake release coil B, thereby releasing the brake on the elevator hoisting motor. Switch U also engages its contacts U4, U5, completing an energizing circuit for separately excited generator leveling field GLF, causing the elevator to move in the up direction at slow leveling speed.

The elevator travels to its upper leveling zone, its front conveyor lift fingers passing through corresponding gaps provided in the gap lifter; the elevator unloads from the loading gap lifter. When the elevator moves into proper alignment with a predetermined "dead zone" in its upper leveling zone, high zone cam UZC (FIGURE 24) moves off of leveling contact 2LV6 and into engagement with leveling contacts 2LV2 and 2LV1, interrupting the circuit for coils LI, U and H and, in turn, SU, thereby de-energizing the elevator hoisting motor leveling circuits and applying the brake, stopping the elevator in such "dead zone."

As the elevator moves into the aforementioned "dead zone."
zone,” upper zone cam UZC (FIGURE 24) actuates upper zone mechanical switches UZ1 to UZ4 (FIGURE 17) mounted on the selector synchronous panel to closed condition, completing a circuit for coil UZS of the upper zone switch. Simultaneously, low zone cam LZC (FIGURE 24) moves out of its “dead zone” into engagement with leveling selector contact ILVS and out of engagement with leveling contact ILV2, actuating low zone mechanical switches LZ1 to LZ4 to open condition, interrupting the circuit for coil LZS of the low zone switch. Switch LZS also releases, separates its contacts LZS1, LZS3 (FIGURE 17) in the front conveyor extend control circuits, without effect.

Upper zone switch UZS, upon operation, engages its contacts UZS3 (FIGURE 15), completing circuits for reset coils PAC, LPSX of the loading platform call and landing platform sequence switches, respectively; the circuits extending from supply line B1– through contacts TC3, C4 of the potential switches, 1FCEP of the auxiliary front conveyor extend position switch, SSR6 of the stall signal switch, UZ35, MPASH of the landing station switch, PAC8 (all of these contacts being presently engaged), and reset coil PACP to supply line BO and through contact LPSX2 (presently engaged) and coil LPSX to supply line BO. Switch UZS also separates its contacts UZS4 (FIGURE 16), without effect at this time.

Loading platform sequence switch LPSX, upon releasing, separates its contacts LPSX6 (FIGURE 12), LPSX7 (FIGURE 13), and engages its contacts LPSX5 (FIGURE 12), preparing the loading station controls for returning the landing gap lifter and barriers to their fully lowered position and the loading hoistway door to its fully closed condition when the front conveyor lift fingers are returned to their fully retracted position, as will be described hereinafter.

Switch PAC, upon releasing, separates its contacts PAC7 (FIGURE 18), interrupting the circuit for coil SSR of the stall signal switch. Switch PAC also separates its contacts PAC6 (FIGURE 16) and engages its contacts PAC5 (FIGURE 15), without effect at this time. Switch PAC further separates its contacts PAC2 (FIGURE 16), interrupting the circuit for coil HLS of the home landing switch, and separates its contacts PAC3 (FIGURE 15) in the circuit for coil FOS of the front operation switch but without effect, since an energizing circuit for coil FOS is maintained through contacts F1 of the front call switch, which switch is presently in operated condition, as has been previously stated.

Home landing switch HLS, upon releasing, separates its contacts HLS7 in the circuit of coil FOS, also without effect. Switch HLS, in addition, engages its contacts HLS1 (FIGURE 20) and HLS3 (FIGURE 23), establishing directions of travel for the tower and elevator, respectively, in accordance with the location of the selected stall in which the automobile is to be parked, as will hereinafter be described.

Switch SSR, upon releasing, engages its contacts SSR7 (FIGURE 17), completing energizing circuits for coil FCR of the front conveyor retract switch and coil CHC of the common horizontal conveyor switch; the circuits extending from supply line B1– through contact TC2, C2 (both presently engaged), tower alignment switches T7–4, contacts T8H, HLS2, H10 and SSR7, front conveyor retract limit mechanical switch FCRL (presently closed), contacts FCE5, coil FCR, front conveyor slack cable mechanical switches 1FSC5, 2FSC5 and coil CHC to supply line BO. Switch SSR also separates its contacts SSR6, preventing operation of the extend controls for the front and rear conveyor lift fingers, and engages its contacts SSR1 (FIGURE 24), SSR2 (FIGURE 22), preparing the elevator and tower main controls for operation to move the automobile to the selected stall.

Switch FCR, upon operation, engages its contacts FCR6, FCR7 (FIGURE 19) and FCR1 (FIGURE 18) in the circuit of front conveyor brake release coil FCB, preparing motor FCM of the front conveyor lift fingers for rotation in a direction to move the front conveyor lift fingers to their fully retracted position. Switch CHC, upon operation, engages its contacts CHC7, CHC8 (FIGURE 19) and CHCS (FIGURE 18), energizing front conveyor motor FCM and causing the front conveyor lift fingers to move toward their fully retracted position. Switch FCR also separates its interlock contacts FCR4 (FIGURE 17) in the extend control circuits for the front conveyor lift fingers.

Movement of the front conveyor lift fingers from their fully extended position causes the release of front conveyor extend limit mechanical switch FCEL and, under the influence of its biasing spring its return to closed position, preparing the front conveyor extend controls for the next front extend operation. Front conveyor extend position mechanical switch FCEP is similarly released, moving to its normally open position, thereby interrupting the circuit for coil 1FCEP of the auxiliary front conveyor extend position switch. Switch 1FCEP, upon releasing, separates its contacts 1FCEP2 (FIGURE 18) in the elevator zone transfer circuits, without effect at this time.

As the front conveyor lift fingers approach their fully retracted position, they actuate front conveyor retract limit mechanical switch FCRL (FIGURE 17) to open condition, interrupting the energizing circuits for coils FCR and CHC of the front conveyor retract and common horizontal conveyor switches, respectively. These switches release, de-energizing front conveyor motor FCM (FIGURE 19) and causing application of front conveyor brake FCB, thereby stopping the front conveyor lift fingers as they arrive at their fully retracted position within the confines of the elevator.

The front conveyor lift fingers, in retracting, carry the automobile, presently being loaded for parking, into the elevator, causing the automobile to break the “empty elevator” detecting light beam (shown as 214 in FIGURE 9). Interruption of such detecting beam causes contacts ELCR (FIGURE 16) of the empty elevator light ray receiver (213 FIGURE 9) to separate, interrupting the circuit for coil ELS of the elevator light ray switch which releases.

Switch ELS separates its contacts ELS4 (FIGURE 18), without effect, and ELS1 (FIGURE 16), preventing operation of home landing switch HLS until the elevator is again empty.

As the front conveyor lift fingers arrive at their fully retracted position, front conveyor retract position mechanical switch FCRP1 (FIGURE 17) is actuated by them to closed condition, completing a circuit for coil 1FCRP of the first front conveyor retract position switch. Switch 1FCRP, upon operation, engages its contacts 1FCRP7 (FIGURE 18), completing a circuit for set coil XLO of the zone transfer switch through contacts C1, TC1, 1RCRP7 (all presently engaged) and I04. Switch XLO, upon operation, engages its contacts XLO3, preparing a circuit for set coil LO of the zone transfer holding switch in preparation for parking the automobile in designated stall 4T, 6E, front, as will be described hereinafter.

Switch 1FCRP also separates its contacts 1FCRP8 (FIGURE 16), interrupting the circuit for coil MPA of the landing station switch, and engages its contact 1FCRP11, preparing a circuit for coil SOS of the stall occupied switch.

Switch MPA, upon releasing, re-engages its contacts MPA3, 5 and 6 (FIGURE 18) in the circuit of coil SSR of the stall signal switch, preparing such switch for operation upon arrival of the tower and elevator at the designated stall, as will be described hereinafter. Switch MPA also re-engages its contacts MPA4 (FIGURE 16), preparing a circuit for coil SOS of the stall occupied switch, for purposes to be explained hereinafter, and MPA7 (FIGURE 15), preparing the stall designation cancellation circuits for operation.
Switch 1FCRP also engages its contacts 1FCRP1 (FIGURE 24) and 1FCRP2 (FIGURE 22), in the respective main control circuits of the elevator and tower, thereby, as will be hereinafter described, initiating start- ing of the elevator and tower toward the designated stall in which the car is to be parked.

Switch 1FCRP, in addition, causes operation of the loading gap station mechanism controls as will now be described, to place such mechanism in condition to receive the next incoming automobile to be loaded. This switch engages its contact 1FCRP3 (FIGURE 3G), completing energizing circuits for coils LGC and XLGD of the loading gate down and auxiliary loading gap lifter down switches, respectively, the circuits extending from supply line B1-4 to line BO through circuit for set C6, C15, 1FCRP3 (all presently engaged), LSPX5, DRS25 and 1LGDP1 for coil LGC, and for coil XLGD through loading gap lifter down position mechanical switch 1LGDP4 (presently closed), contacts DR53, manual switch KLPS3, and contacts DR33.

Loading gap down switch LGC, upon operation, engages its contacts LGC3, LGC4 (FIGURE 1G), energizing loading hoistway door motor armature LGMA for rotation in a direction to close the door, and contacts LGC2 (FIGURE 2G), energizing motor brake release coil LGB, releasing the brake and causing the door to be moved toward its fully closed position by its motor.

Movement of the door from its fully open position, causes mechanical door switches LGUP (FIGURE 17) and LGOL (FIGURE 12) to reclose, preparing the front conveyer and loading hoistway door open controls for subsequent operation.

Auxiliary loading gap lifter down switch XLGD (FIGURE 12), upon operation, engages its contacts XLGD2, completing the previously prepared circuit for coil LGD of the loading gap lifter down switch, and its contacts XLG1, completing a circuit for coil LGD of the loading gap lifter sequencer switch.

Switch LGS, upon operation, engages its contacts LGS2, preparing an energizing circuit for its reset coil, and its contacts LGS1, preparing the down controls for the loading station side and end barriers for operation.

Loading gap lifter down switch LGD, upon operation, engages its contacts LGD3, LGD4 (FIGURE 11), energizing loading gap lifter motor LGLM to move the loading gap lifter to its fully lowered position, and its contacts LGD1 (FIGURE 12), completing a circuit for coil LGD of the loading gap lifter up-down switch. Switch LGUD, upon operation, engages its contacts LGUD1 (FIGURE 10), completing a circuit for gap lifter brake release coil LGLB releasing the brake from motor LLM, thereby permitting the loading gap lifter to be lowered. Loading gap lifter down switch LGD also separates its interlock contacts LGD2 (FIGURE 12) in the loading gap lifter up circuits.

As the loading gap lifter moves downward it actuates mechanical switch LGUP (FIGURE 12) to open its contacts LGUP, completing a circuit for coil LGUP of the auxiliary loading gap lifter up position switch to close its contacts LGUP, preparing the gap lifter gap lifter up control circuits for subsequent operation. Switch LGUL, upon releasing, separates its contacts LGULUP1 (FIGURE 18), without effect at this time.

As the loading hoistway door arrives at its fully closed position it actuates mechanical switch LGDP (FIGURE 10) completing circuit for coil LGDP of the auxiliary loading gate down position switch. This switch operates, engaging its contacts LGDP4 (FIGURE 24) preparing the elevator main control circuits for operation, and engages its contacts LGDP3 (FIGURE 12), preparing the loading side and end barrier circuits for operation. Switch LGDL, in addition, separates its contacts LGDL1, interrupting the circuit for coil LGC of the loading gate down switch which releases. Switch LGC separates its contacts LGC3, LGC4 (FIGURE 10), de-energizing hoistway door motor armature LGMA, and its contacts LGC2 (FIGURE 10), de-energizing brake release coil LGB, thereby applying the brake to the door motor and stopping the hoistway door in its fully closed position.

As the loading gap lifter arrives at its fully lowered position, it actuates mechanical switch LGDLP1 (FIGURE 12) to open position, interrupting the energizing circuits for coil LGD of the loading gap lifter down switch and coil XLGD of the auxiliary loading gap lifter down switch. Switch LGD, upon releasing, closes its interlock contacts LGD2 (FIGURE 12) in the gap lifter up controls. It also separates its contacts LGD3, LGD4 (FIGURE 11), de-energizing gap lifter motor LGMA, and its contacts LGD1 (FIGURE 12), interrupting the circuit for coil LGD of the loading gap lifter up-down switch. Switch LGUD releases and separates its contacts LGUD1 (FIGURE 10), de-energizing gap lifter release brake coil LGLB thereby applying the brake to motor LGMA to stop the loading gap lifter in its fully lowered position.

Auxiliary loading gap lifter down switch XLGD, upon releasing, separates its contacts XLGD3 (FIGURE 12), without effect.

The loading gap lifter, as it arrives at its fully lowered position, also actuates mechanical switch LGDLP2 (FIGURE 12) to closed condition, completing energizing circuits for coils LSBD and LEBD of the loading side and end barrier down switches, respectively, to initiate downward movement of the loading barriers. Switches LSBD, LEBD, upon operation, energize their respective contacts LSBD5, LSBD6 (FIGURE 11) and LEBDS, LEBD6, energizing side and end barrier motors LSBM, LEBM, respectively, for movement of the barriers toward their fully lowered position. They also engage their respective contacts LSB1, LSB1D (FIGURE 10), completing circuits for coils LEB, LSB of the loading side and end barrier up-down switches, respectively. Switches LEB, LSB operate and engage their respective contacts LSB1, LSB1C (FIGURE 10), completing energizing circuits for side and end barrier brake release coils LSB, LEB, respectively, thereby releasing the brake from side and end barrier motors LSBM, LEBM, permitting the side and end barriers to be moved downward.

As the loading station side and end barriers move downward from their fully raised positions they actuate mechanical switches LSBUL1 (FIGURE 12) and LEBUL1 for the side and end barriers, respectively, to closed condition, preparing the loading side and end barrier up-down switches for subsequent loading operation. The barriers also actuate mechanical switches LSBDL2 (FIGURE 10) and LEBUL2 for the side and end barriers, respectively, to open condition, interrupting the circuit for coil LEBUL of the loading barrier up limit switch.

Switch LBLU, upon releasing, separates its contacts LBLUL3 (FIGURE 1G) in the circuit of set coil SO, preparing switch SO for release. Switch LBLU also separates its interlock contacts LBLUL1 (FIGURE 12) in the loading hoistway door and gap lifter up control circuits.

As the loading station side and end barriers approach their fully lowered position they actuate mechanical switches LSBDL1 (FIGURE 12) and LEBDL1 for the side and end barriers, respectively, to open condition, interrupting the respective circuits for coils LSBD and LEBD of the loading side and end barrier down switches, respectively, to stop the loading barriers. Switch LSBD, upon releasing, separates its contacts LSBD5 (FIGURE 11) and LSBD6, de-energizing loading side barrier motor LSBM, and its contacts LSBD1 (FIGURE 10), interrupting the circuit for coil LSB of the loading side barrier up-down switch, which releases, separating its contacts LSBD1C (FIGURE 10), interrupting the circuit for gap lifter brake release coil LSB, thereby applying the brake to loading side barrier motor LSBM to stop the loading side barriers in their fully lowered position. Switch LSBD also en-
gages its contacts LSBD2 (FIGURE 12), preparing the loading side barrier up controls for a subsequent loading operation, and its contact LSBD7, preparing the loading barrier obstruction detecting circuits for operation.

Loading end barrier down switch LEBD, upon releasing, similarly separates its contacts LEBD5 and LEBD6 (FIGURE 11), de-energizing end barrier motor LEBM, and separates its contacts LEBD1 (FIGURE 10), causing switch LEBD to release and, in turn, through its contacts LEBD1 (FIGURE 10) cause application of brake LEB to the loading end barrier motor LEBM, thereby stopping the loading end barriers in their fully lowered position. Switch LEBD also engages its contacts LSBD2 (FIGURE 12), preparing the loading end barrier up control circuits for subsequent loading operations, and its up contacts LSBD7 (FIGURE 12) in the barrier obstruction detecting circuits.

As the side and end barriers arrive at their fully lowered position they actuate mechanical switches LSBDL2 and LEBDL2 (FIGURE 10), respectively, to closed condition, completing a circuit for coil LBDL of the loading barrier down limit switch. Switch LBDL, upon operation, engages its contacts LBDL2 (FIGURE 12), completing the circuit for reset coil LGS of the loading gap lifter sequence switch which releases, separating its contacts LGS1, thereby preventing operation of the down control circuits for the side and end loading station barriers. Switch LBDL also engages its contacts LBDL4 (FIGURE 16) in the circuit of set coil HLK of the high car light ray power switch, preparing the high car detection circuits for scanning the height of the next incoming car.

In addition, switch LBDL engages its contacts LBDL3 (FIGURE 13), energizing the "DRIVE SLOWLY" sign at the loading station platform (shown as 107 in FIGURE 11), which sign illuminates, and its contacts LBDL5, (FIGURE 10), completing a circuit for reset coil PSS of the parking station switch.

Switch PSS, upon releasing, separates its contacts PSS5 (FIGURE 13), de-energizing the "STOP" red signal at the entrance to the loading station platform, which signal extinguishes, and engages its contacts PSS4, energizing the "GO" green sign which illuminates (both signs being shown as 102 in FIGURE 1), signalling the driver of the next incoming car that he may proceed onto the loading station platform into loading position. Switch PSS also recloses its contacts PSS3 (FIGURE 10), completing a circuit for reset coil SO of the sequence operation switch which releases in preparation for the next loading operation.

It may be noted that, in the prior description of a loading operation, before the front conveyor lift fingers are extended to "pick up" the automobile from the fully raised and extended loading gap lifter, the attendant, if he desires, may return the loading station, hoistway door, gap lifter and side and end barriers to their respective fully closed and lowered positions. This may be accomplished by his holding loading barrier down button LBDB (FIGURE 12) continuously depressed, thereby completing a circuit for coil LBD of the loading barrier down button switch which operates. Switch LBDS separates its contacts LBDS3, disabling (while button LBDB is held depressed), the loading station gap lifter up and hoistway door open controls, thereby stopping upward movement of the gap lifter and hoistway door. It also engages its contacts LBDS6 (FIGURE 12), completing energizing circuits for coil LGC of the loading gate down switch through contacts 1LGDIP1 to close the hoistway door, and coil XLGD of the auxiliary loading gap lifter down switch through mechanical switch LGLDP1 (closed, when the gap lifter is not in its fully lowered position). Switch XLGD engages its contacts XLGD2, completing a circuit for coil LGD of the loading gap lifter down switch, causing lowering of the loading gap lifter, as has been previously described.

It may also be noted that provision has been made for detecting open doors of the automobile which is to be parked. To accomplish this two light rays are provided on the elevator in position to direct their respective beams along each longitudinal side of the automobile which is to be parked, as may be seen in FIGURE 9. Interruption of either beam by an open door of the automobile causes its associated light ray receiver contacts 1CDLR, 2CDLR (FIGURE 15) to separate (the light ray receivers being shown in FIGURE 9 as 216A, 216B), interrupting the circuit for coil CDO of the car door open switch. Switch CDO, upon releasing, is effective to interrupt the energizing circuits of elevator potential switch TC (FIGURE 22) wherein it forms part of the safeties generally indicated in block form. Potential switches C and TC, upon releasing, prevent operation of the tower and elevator until the automobile doors are closed and the light beam of the door open detector is re-established (the automobile having been transferred from the loading gap lifter to the elevator, switch CDO is maintained in operated condition, preventing its affecting the tower and elevator potential switches should the door open light beams be interrupted by the transferring car. This is accomplished by the provision of normally open contacts CH3 of the common horizontal conveyor lift switch, whose operation has been previously described, and mechanical position switches FCRP2 for the front conveyor lift fingers and RCRP2 for the rear conveyor lift fingers, which mechanical switches under the influence of their respective biasing springs return to normally closed position, whenever their respective conveyor lift fingers are not in fully retracted position.

As has been previously described, the computer has designated the stall in which the automobile is to be parked by effecting the operation of certain stall designation switches, i.e., tier switch 4T (FIGURE 14), loading switch 6E and front call switch FC. Operation of these stall designation switches establishes the direction of travel of the elevator and tower and initiates their stopping at the proper stall, as will now be described. Tier switch 4T engages its contacts 4TS (FIGURE 16), completing a circuit from supply line B+ to line B0 for coil TEC of the tower control. Till automobile being transferred from the loading gap lifter to the elevator, switch 6E engages its contacts 6ES, completing a circuit for coil ECC of the elevator floor call cutout switch. Front call switch FC engages its contacts FC1 (FIGURE 15), completing a circuit for coil FOS of the front operation switch, the circuit extending through contacts ROS2 of the rear operation switch and TC3, C4 of the potential switches. Switch FOS, as has been previously described, was previously operated by the engagement of contacts PAC3 and HLS7. By means of engaged contacts FC1, it is maintained in such operated condition subsequent to the loading of the automobile, in consequence to the separation of contacts PAC3, HLS7, as has been previously described, so as to condition the garage controls to park the automobile in a front stall, as has been designated.

Switches ECC, TCC, upon operation, separate their respective contacts ECC1, TCC1 (FIGURE 15), preventing the releasing of a circuit for call FC until the registered call is cancelled, after the automobile has been parked, as will be described hereinafter. Switches ECC, TCC and FC also engage their respective contacts ECC3, TCC3 and FC3 (FIGURE 16), completing a circuit through contacts PAC6 (presently engaged) for set coil circuits for the car call request switch, which operates, indicating that a service demand is presently in registration.

Switches 4T, 6E also engage their respective contacts 4TS, 6ES (FIGURE 18), for purposes to be explained.
hereinafter, and 4T4, 6E4 (FIGURE 15), preparing the respective energizing circuits of their reset coils 4T, 6E. Switch FC permits to be explained herein before the energizing circuit for its reset coil FC and separates its interlock contacts FC4 (FIGURE 15) in the circuit of reset coil CCR of the car call registered switch. In addition switch FC engages its contacts FC5 (FIGURE 18), preparing a circuit for coil FLR of the front light ray switch and engages its contacts FC6.

Car call registered switch CCR, upon operating, separates its contacts CCR1 (FIGURE 14), interrupting the energizing circuits for the set coils of stall designation switches 4T, 6E and FC, and engages its contacts CCR11 (FIGURE 17), completing a circuit for coil CSS of the computer signalling switch. Switch CSS, upon operation, signals the computer that the computer orders have been received by the garage controls and, as will be explained in the description of the computer operation, prevents the computer giving further orders to the garage controls, i.e., until the present parking operation has been completed.

Switch CCR further engages its contacts CCR4 (FIGURE 20), CCR5 (FIGURE 23), preparing the direction control circuits for the tower and elevator, respectively, for operation, as will be described hereinafter. Switch CCR also engages its contact CCR6 (FIGURE 16), preparing a circuit for its reset coil CCR.

Tie switch 4T also engages its contacts 4T2 (FIGURE 26), preparing an alternate energization circuit for tower position indicating lamp TP14 associated with the 4th tier, while landing switch 6E also engages contacts 6E2, preparing an alternate energization circuit for elevator position indicating lamp EP16 associated with the 6th landing, and front call switch FC engages its contacts FC6, preparing an energization circuit for front call indicating lamp FCLP, for purposes which will be next explained. With such an arrangement, whenever a service demand is registered, the attendant may check whether or not the tower apparatus has received the correct stall designation by merely moving manual call test switch KCT (FIGURE 26) from its right to its left position, thereby transferring control of the energizing circuits of the elevator and tower position indicating lamps EP1 to EP16 and TP1 to TP19, respectively, from cam actuated toggle switches ESW1 to ESW7 and TS1 to TS16, respectively, to landing switches 1E–SE and tie switches 1T–9T, respectively. For the previously assumed registered stall designation 4T, 6E, front, movement of manual switch KCT to its left position causes an energizing circuit to be completed through tier switch contacts 4T2 for tower position indicating lamp TP14, through landing switch contacts 6E2 for elevator position indicating lamp EP16 and through contacts FC6 for front call indicating lamp FCLP, causing such indicating lamps to illuminate at the computer console, thereby visually indicating to the attendant that the designated stall is located at the 4th tier, 6th landing, front.

Since the tower and elevator operate independently of each other, the control of their movements will be described separately, taking the tower controls first, it being understood, notwithstanding, that both the tower and elevator movements are controlled by the same apparatus and that the elevator is propelled horizontally along its guide tracks into proper alignment with the tier of such designated stall.

Tie switch 4T, upon operating, also engages its contacts 4T1 (FIGURE 20), preparing an energizing circuit for coil TXR of the tower reverse direction switch. This energizing circuit is completed upon the release of home landing switch HLS, previously described, by the re-employment of contacts HLS1, thereby establishing the direction of travel of the tower to be northward toward designated tier 74; the circuit extending from supply line B+ through contacts CCR4, HLS1, 4T1 (all presently engaged), tower selector hook switch TH4 presently in engagement with the tower selector switch, conducting lower portion of tower advance cam TFD, (which can also presently maintain hook switches TH4, TH5 open), through coil TXR, contacts TXF3 and TXF4 to supply line BO. Switch TXR, upon operation, separates its interlock contacts TXR1 in the circuit of coil TXP of the forward direction auxiliary switch and engages its contacts TXR2 (FIGURE 22), preparing energizing circuits for coil TRX of the first auxiliary reverse direction switch and coil THX of the auxiliary field and brake switch.

Switch TXR also engages its contacts TXR3, completing circuits for coil TXFR of the forward and reverse direction switch and set coil TPM of the pawl magnet. In addition, switch TXR engages its contacts TXR4 (FIGURE 21), preparing a circuit for the brush advance motor of the tower selector for rotation of such motor in a direction to move the brush advance carriage downward, corresponding to northward, the north direction in which the tower is to move.

Forward and reverse direction switch TXFR, upon operation, separates its contacts TXFR2, TXFR3 (FIGURE 4G) in the hoistway door open control circuits for the loading and unloading stations, respectively, thereby disabling such door control until slowdown of the tower is initiated, as will be described hereinafter. Switch TXFR also separates its contacts TXFR1 (FIGURE 22) in the reset circuit of tower pawl magnet PM, preventing release of such pawl magnet until stopping of the tower at designated tier 4T is initiated, as will be described hereinafter.

Switch TPM, upon operation, engages its contacts TPM2 (FIGURE 22), preparing a circuit for its reset coil TPM, and its contacts TPM1, preparing a circuit for coil TPMY of the pawl magnet switch. Upon the front conveyor lift fingers arriving at their fully retracted position, causing operation of the first conveyor retract switch IFCSR (FIGURE 17), as has been previously described, switch IFCSR engages its contacts IFCSR2 (FIGURE 22), completing the previously prepared circuit of coil TPMY; the circuit extending from supply line BTA+ to supply line BO through contacts IFCSR3, IRCRF3 (presently engaged), SSR2 and contacts TPM1 (presently engaged).

Switch TPMY, upon operation, engages its contacts TPMY3 (FIGURE 21), completing the previously prepared energizing circuit for advance brush motor BM through tower directional contacts TXR4, causing the tower motor to move forward, the advance brush carriage downward in advance of the tower selector synchronous panel (not shown). Such relative movement between the advance brush carriage and the synchronous panel actuates slowdown of mechanical switches SLS5, SLS6, SLS1 and SLS4 (FIGURE 22) to closed condition. Slowdown switch SLS8 in closing, completes circuits for coils TXR and THX of the first auxiliary reverse direction and auxiliary field and brake switches, respectively; the circuits extending from supply line BTA+ to line BO, through contacts IFCSR2, IRCRF3 (both presently engaged), SSR2, TXR2 (presently engaged), mechanical switch SLS8 (presently closed), terminal limit mechanical switch S9, coils TRX and THX.

Switch TRX, upon operation, engages its self-holding contacts TRX2 and its contacts TRX9 and TRX10 (FIGURE 22), preparing the tower motor circuits for operation in a direction to move the tower northward toward designated tier 4T.

Switch TRX also engages its contacts TRX6 (FIGURE 22) which with the engagement of contacts THX2, upon simultaneous operation of switch THX, completes energizing circuits through contacts TF4 for coil TX of the reverse direction and leveling switch and coil TH of the field and brake switch. Switch TRX further engages its contacts TRX4 (FIGURE 22) in the circuit of coil TIE
of the first speed switch but without effect, since contacts TIXE1 of the first speed auxiliary switch are presently separated, as has been previously explained.

Switch THX also engages its contacts THX5, preparing the discharge circuit of the timing resistor RTGE for energization. In addition, switch THX engages its contacts THX1, completing a circuit for coil THY of the second auxiliary field and brake switch, and preparing the alignment, speed and stop control circuits for operation.

Switch THY, upon operation, engages its contacts THY5 (FIGURE 22), completing a circuit for coil TTL of the slow speed leveling switch. Switch THY also separates its contacts THY2 in the circuit of set coil TPM and engages its contacts THY3 in the circuit of reset coil TPM of the pawl magnet, preparing it for release. Switch THY further engages its contacts THY1 (FIGURE 18), in the circuit of coil WS of the wrong stall switch, thereby maintaining such switch in operated condition, for purposes to be explained hereinafter.

Switch TTL, upon operation, engages its contacts TTL3, for purposes to be explained hereinafter, and contact TTL2 (FIGURE 22) removing a portion of leveling field resistor RTLE1 and leveling field circuits in preparation for main operation of the tower. This switch also engages its contacts TTL1, preparing the circuit for coil TGF of the first timed leveling speed switch.

Switches TR and TH, upon operation, engage their respective contacts TR7 and TH2 (FIGURE 22), completing a circuit for brake release coil TR, thereby releasing the brake from the tower motive mechanism. In addition, switch TH separates its contacts TH4, disconnecting the suicide connection of tower generator field TGF from across motor armature TMA, thereby causing excitation of generator field TGF and movement of the tower northward; the excitation circuit extending through contacts TH2, resistor RTGA, contacts TRX9, THX5 and TRX10. Switch TH also engages its contacts TH3, TH1 completing a circuit for coil TGL of the timed leveling switch and the resistor-capacitor (RTGL, CTGL) timing circuit connected across coil TGL. In addition, switch TR engages its contacts TR3, TR6, completing a circuit through leveling resistor RTLF and contacts TH2 for tower generator leveling field windings TGLF, energizing such windings for movement of the tower in the northward direction.

Switch TGL, upon operation, engages its contacts TGL3, inserting a portion of resistor RTLF in series with tower generator field TGF reducing its excitation, and engages its contacts TGL1 (FIGURE 22), shunting contacts SSR2 of the stall signal switch to prevent such contacts from stopping the tower until it has been properly aligned with its designated tier 4T.

Field and brake switch TH also separates in contacts TIXE (FIGURE 22), interrupting the circuit for coil TIXE of the first speed auxiliary switch which is delayed in releasing for a certain time by the discharge of its timing condenser CIXE through timing resistor RXE and its coil. Switch TIXE, upon releasing, engages its contacts TIXE1, completing a circuit for coil TIE of the slow speed switch; the circuit extending from supply line BT+ through contacts TC4 and THX1 (both presently engaged), broken selector tape mechanical switch BTS1, terminal limit mechanical switch SS7, contacts TRX4 (presently engaged), slowdown mechanical switch SLS4 (presently closed), contacts TIXE1 and coil TIXE to supply line BO. Switch TIE, upon operation, engages its contacts TIE4, removing a portion of accelerating-decelerating resistor RTGA from in series with generator field winding TGF, thereby causing the tower motor to accelerate the tower northward. Switch TIE also engages its contacts TIE1, preparing a circuit for coil TIE of the full speed switch and separates its contacts TIE5 (FIGURE 16), without effect at this time.

Switch TIE also separates its contacts TIE3 (FIGURE 22), disconnecting coil TFXE of the full speed auxiliary switch from across the supply lines. However, switch TFXE is prevented from releasing for a certain time by the discharging of the timing capacitor CFXE through the timing resistor RFXE and its coil. Switch TFXE, upon releasing, engages its contacts RFXE1, completing a circuit for coil TFE of the full speed switch through contacts TC4, THX1, mechanical switches BTS1, SS1, contacts TFX1, mechanical switch SLS1 and contacts TIE1. Switch TFE, upon operation, engages coil TFE2, removing an additional portion of accelerating-decelerating resistor RTGA, thereby causing the tower to accelerate to a certain full speed. Switch TFE also engages its contacts TFE1, completing a circuit for coil TILV of the alignment switch which operates, retracting alignment contacts TILV1 to 12, carried by the synchronous panel, so that they will not engage the tier alignment cams TALC.

As the tower advance panel moves downward, advance cam TFDJC (FIGURE 20) releases hook switch TFDH5 for the 5th tier, allowing it to close. The conducting portion of advance cam TFDJC simultaneously moves out of engagement with hook switch TFDH4 for the 4th tier and into engagement with hook switch TFDH3 for the 3rd tier, causing the latter to open. As the insulated portion of cam TFDJC engages hook switch TFDH4, the circuit for coil TXR of the reverse direction switch is interrupted, initiating stopping of the tower at designated tier 4T.

Switch TXR, upon releasing, separates its contacts TXR3 (FIGURE 22), interrupting the circuit for coil TXFR of the forward and reverse direction switch. Switch TXFR releases, re-engaging its contacts TXFR1, thereby completing a circuit for reset coil TPM of the pawl magnet. The pawl magnet, upon releasing, separates its contacts TPM1, interrupting the circuit for coil TPMY of the pawl magnet switch. Switch TPMY, upon releasing, separates its contacts TPMYS (FIGURE 21), de-energizing and releasing motor CM, thereby stopping movement of the advance carriage. Switch TPMY also releases an pawl (not shown), latching the advance panel to the 4th tier selector bar in a well-known manner, thereby causing the synchronous panel to move downward and relative to the advance carriage, as the synchronous panel continues moving toward the 4th tier bar, in accordance with movement of the tower.

As the synchronous panel moves relative to the advance panel, slowdown mechanical switch SLS1 and SLS4 (FIGURE 22) are actuated by such relative movement in the sequence to open condition, interrupting in sequence the circuits of coils TFE and TIE of the full speed and first speed switches, respectively.

Switch TFE, upon releasing, separates its contacts TFE2, inserting a portion of accelerating-decelerating resistor RTGA in the circuit of generator field winding TGF to initiate slowdown of the elevator. Switch TFE also separates its contacts TFE1, interrupts the circuit for coil TILV of the tower alignment switch. Switch TILV releases, placing alignment contacts TILV1 to 12 (FIGURE 22) in position for engagement by alignment cam TALC for the 4th tier.

Switch TIE, upon releasing, separates its contacts TIE4, inserting the remainder of resistor RTGA in the circuit of tower generator field winding TGF, thereby reducing its excitation and, in turn, causing deceleration of the tower to slow speed. Switch TIE also reengages its contacts TIE3, completing a circuit for coil TFXE and its timing capacitor CFXE. Switch TFXE operates and capacitor CFXE recharges in preparation for subsequent operation of the tower. Switch TIE further reengages its contacts TIE5 (FIGURE 16), preparing a circuit for reset coil CCR of the car call registered switch.

As the tower enters the alignment zone of tier 4T,
relative movement between its synchronous panel and its advanced panel actuates mechanical selector switch SLS5 (FIGURE 22) to open condition, interrupting the circuits for coils TRX, THX. Switch THX, upon releasing, separates its contacts THX5, disconnecting the tower generator field windings TGF (FIGURE 22) from across supply lines B1+ and BO, while switch TRX, upon releasing, separates its direction control contacts TRX9, TRX10 in the generator field circuits. Switch TRX also engages its contacts TRX7, removing a portion of alignment field resistor RTLF, thereby increasing excitation of alignment field TGLF for alignment operation of the tower.

Switches TRX and THX also separate their respective contacts TRX6 and THX2 (FIGURE 22), interrupting the circuits of coils TR and TH of the tower reverse direction and alignment switch and field and brake switches, respectively. These switches are delayed in releasing by the discharge of their respective timing capacitors through their respective coils.

In addition, as the tower enters the alignment zone of tier 4T, alignment cam TALC (FIGURE 22) for such tier moves into engagement with selector alignment contacts TILV7 and 9, maintaining switches TTL, TR and TH operated to bring the tower into proper alignment with tier 4T under the control of generator alignment field TGLF (FIGURE 22).

Switch THX, upon releasing, also releases its contacts TIIIX (FIGURE 22), interrupting the circuit for coil THY of the second auxiliary field and brake switch, which switch releases, separating its contacts THY5 (FIGURE 22), without effect, since a circuit for coil TTL is maintained through contacts TTL3 and alignment cam TALC presently in engagement with stationary contact TILV9, as has been previously explained.

As the tower continues moving into the alignment zone, cam TALC moves off of alignment contact TILV9, interrupting the circuit for coil TTL of the slow speed alignment switch. Switch TTL, upon releasing, separates its contacts TTL2 (FIGURE 22), inserting a portion of alignment resistor RTLF in series with tower generator alignment field windings TGLF, decreasing their excitation, thereby reducing the alignment speed of the tower. This switch also separates its contacts TTL1, interrupting the circuit for coil TGL of the timed alignment speed switch which, however, is maintained in operated condition for a predetermined time by the discharge through its coil of its parallel timing capacitor CTGL.

As the tower moves into proper alignment with tier 4T, alignment cam TALC (FIGURE 22) moves off of stationary contact TILVS and into engagement with stationary contact TILV2, interrupting the circuits for coils TR of the reverse direction and leveling switch and TH of the field and brake switch. Switch TR, upon releasing, separates its contacts TR5, TR6 (FIGURE 22), interrupting the circuit for tower generator alignment field winding TGLF, while switch TH, upon releasing, separates its contacts TH2 disconnecting the generator power circuits from supply lines BT+ and BO, interrupting the circuit for brake release coil TB, thereby applying the brake to the tower motive to slow the tower into proper alignment with tier 4T. In addition, as the tower thus moves into proper alignment with tier 4T, mechanical switch TZ1 to 4 (FIGURE 17) mounted on the selector synchronous panel are actuated to closed condition while switch TH engages its contacts TH8, preparing the tower motive to stop the automobile in stall 4T, 6E front, as will be described hereinafter.

Switch TH also separates its contacts TH1 (FIGURE 22), disconnecting the resistor-capacitor (RTGF, CTGL) timing circuit from across coil TGL, causing switch TGL to release its contacts TGL3, still maintaining a portion of alignment resistor RTLF in the circuit of tower generator alignment field TGLF in preparation for the next operation of the tower. Switch TH further engages its contacts TH4, establishing a suicide connection of generator main field winding TGF across motor armature TMA.

While the tower is being moved toward designated tier 4T, as has been described, the elevator conveyor moves upward within the tower toward designated landing 6E, as will now be described. Landing switch 6E, upon operating, as has been previously described, engages its contacts 6E1 (FIGURE 23), preparing an energizing circuit for coil UX of the up direction switch. This energizing circuit is completed upon the release of home landing switch HLS, previously described, by the re-connection of contacts HLS4, thereby establishing the direction of travel of the elevator to be upward toward designated landing 6E; the circuit extending from supply line B1+ through contacts CCR5 (presently engaged), HLS3, 6E1 (presently engaged), elevator selector hook switches EH6 through 8 (presently closed) for the 6th through 8th landings, coil UX, contacts XDI and DXI to supply line BO. Switch UX, upon operation, separates its interlock contacts UX3 in the circuit of coil XD of the down direction switch, preventing operation of the down direction control circuits and engages its contacts UX1 (FIGURE 24), preparing energizing circuits for coil UX of the auxiliary up reversing switch, coil U of the up reversing and leveling switch, and coil H of the field and brake switch. Switch UX, in addition, engages its contacts UX2, preparing a circuit for coil FE of the full speed switch.

As first front conveyor retract position switch 1FCRP operates, engaging its contacts IFCRP1, as has been previously described, thereby indicating that the front conveyor lift fingers are in fully retracted position, the previously prepared energizing circuits for coils UX, U, and H are completed. Switch U, upon operation, engages its contacts U4, U5, preparing separately excited, generator leveling field windings GLF for excitation in a direction to move the elevator upward. This switch also separates its interlocking contacts U1 in the circuit of coil D of the down reversing and leveling switch, preventing operation of the elevator down direction controls while the elevator is set for upward travel. Switch U further engages its contacts U3, preparing a circuit for elevator brake release coil B.

Switch H, upon operation, engages its contacts H1, bypassing contacts ILGD4, 1UDP4 of the loading and unloading gap lifter down position switches, respectively. Switch H also separates its contacts H5 (FIGURE 16) in the circuit of coil SOS of the stall occupied switch, without effect at this time, and its contacts H10 (FIGURE 17), disabling the conveyor lift finger extend and retract control circuits while the elevator is in motion. In addition, it engages its contacts H4 (FIGURE 18) to maintain wrong stall switch WS in operated condition until the elevator arrives at its designated landing, for purposes to be explained hereinafter.

Switch H further engages its contacts H2 and H3 (FIGURE 24), preparing the elevator speed and leveling control circuits for operation, and contacts H7, completing energizing circuits for coil SUD of the suicide delay switch and its timing capacitor CSUD, brake release coil B and generator leveling field winding GLF, thereby releasing the brake from the elevator hoisting motor and exciting a separately excited generator leveling field winding GLF, thereby, in turn, preparing the self-excited elevator generator to move the elevator upward. Switch H also separates its contacts H8 (FIGURE 25), and engages its contacts H9, inserting resistor RG to an in parallel with self-excited generator field windings GSEF.

Suicide delay switch SUD, upon operation, separates its contacts SUD3 (FIGURE 25), removing the "suicide" connection of the generator self-excited field windings GSEF across hoisting motor armature MA in preparation for moving the elevator upward. Switch SUD also engages its contacts SUD1 (FIGURE 24), completing a
circuit for coil FE of the full speed switch through contacts C3, H2, terminal limit mechanical switch 2LS1, contacts D2 and XU2 (presently engaged).

Auxiliary up reversing switch UX, upon operation, engages contacts UX1, shutting off the leveling switch UX1 of the up direction switch. Switch UX also engages its contacts UX5, completing a circuit for the coil HX of the auxiliary field and brake switch which operates, engaging its contacts HX2 in the speed control circuits. Switch UX also engages its contacts UX4, completing a circuit for coil IES of the first speed switch through terminal limit mechanical switch 4LS and contacts HX2, H2, SUD1 and C3 (all presently engaged). Switch HX also engages its contacts HX1, shutting contacts SSR1 and H1, for purposes to be explained hereinafter.

Switch FE, upon operation, engages its contacts FE2, completing circuits for coils 1LV and 2LV of the lower and upper leveling zone switches, respectively, which operate, retracting their respective leveling contacts 1LV1-8, 2LV1-8 (carried by the selector crosshead) out of leveling cam (LZC, UZC) engaging position. Switch FE also engages its contacts FE1, disabling the leveling control circuits, and interrupting the circuit for coil LL of the leveling switch which releases, without effect at this time. Switch FE further engages its contacts FE6, removing a portion of speed control resistor RLF from the circuit of generator leveling field winding GLF, thereby hindering the excitation of the field winding, and engages its contacts FE4 (FIGURE 25), removing a portion of speed control resistor RGS from in series with self-excited generator field windings GSEF in preparation for full speed excitation of the generator. Switch FE also separates its contacts FE5, removing resistor RGEF for the generator self-excited field windings circuit.

Switch IES, upon operation, engages its contacts IES1 (FIGURE 24), completing a circuit for coil GL of the timed leveling speed switch and a charging circuit for its parallel timing capacitor CGL; the circuit extending from supply line B-1 to line BO through contacts C3, SUD1, H2, HX3 and IES1 (all presently engaged) and through contacts H3 (presently engaged) and timing resistor RGL for the capacitor charging circuit. Switch IES also engages its contacts IES3 (FIGURE 25), connecting generator self-excited field windings GSEF across generator armature GA through resistor RGS and generator series field windings GSF for excitation, thereby causing the elevator hoisting motor to move the elevator upward toward designated landing 6E.

Switch GL, upon operation, separates its contacts GL1 (FIGURE 24) in the generator leveling field circuit, without effect at this time. As the elevator arrives at the leveling zone at the 6th landing 6E, cam EFDC (FIGURE 23) (carried by the synchronous selector panel), moves upward in accordance with elevator movement into engagement with hook switch EFH6 for the 6th landing; its non-conducting upper portion, actuating switch EFH6 to open condition, thereby interrupting the circuit for coil UX of the up direction switch to initiate stopping of the elevator at the designated 6th landing 6E. Switch UX, upon releasing separates its contacts UX1 (FIGURE 24), without effect, since such contacts are presently shunted by contacts UX1 (presently engaged) and contacts LL1. Switch UX also separates its contacts UX2, interrupting the circuit for coil FE of the full speed switch.

Switch FE, upon releasing, separates its contacts FE2, interrupting the circuits for coils 1LV, 2LV of the lower and upper leveling zone switches, respectively, which switches release, allowing their respective leveling contacts 1LV1-8 and 2LV1-8 to move from retracted position into position to engage their associated leveling cam LZC, UZC for the 6th landing in preparation for leveling operation of the elevator at such landing. Switch FE also engages its contacts FE1, completing energizing circuits for coil LL of the leveling switch and coil HSL of the fast speed leveling switch, as upper zone cam UZC (in moving downward as the elevator enters the upper leveling zone), engages leveling contacts 2LV8, 2LV6 and 2LV2, the circuits extending through contacts LUS (presently energized), contacts UX1 and FE1 and maintaining energizing circuits for coils U of the upper reversing and leveling switch and H of the field and brake switch; the circuits extending through leveling contacts 2LV2, 2LV6 (presently engaged by cam UZC), up over travel mechanical limit switch OT1, contacts LUS (presently engaged), D1 and C5. It may be noted that, although as the elevator moves upward, lower leveling zone cam LZC engages its leveling contacts IES1, IES2, IES1 and IES2 before upper zone cam UZC engages its respective contacts, the low zone leveling control circuits are not effective, since lower leveling zone down switch LD is presently in released condition, maintaining its contacts LD1, LD2 and LD3 separated, as has previously described.

Switch FE also separates its contacts FE6, inserting a portion of resistor RLF in the circuit of generator leveling field GLF, thereby decreasing the field excitation for leveling operation. This switch also separates its contacts FE4 (FIGURE 25), inserting resistor RGS in the circuit of generator self-excited field GSEF, thereby decreasing the excitation of such field, and engages its contacts FE5, placing resistor RGEF in parallel with generator self-excited field GSEF through contacts H9 (presently engaged), thereby further weakening generator field GSEF and, in turn, reducing the speed of the elevator for leveling operation thereof.

Fast speed leveling switch HLSL, upon operation, engages its contacts HLS1 (FIGURE 24), shutting contacts IES1 of the first speed switch, for purposes to be explained later, and engages its contacts HLS3, removing a portion of resistor RLF from the circuit of generator leveling field GLF, thereby increasing its excitation for leveling operation of the elevator at a certain fast leveling speed to bring it level with landing 6E in the upper leveling zone of such landing. In addition, switch HLSL opens its contacts HLS2 (FIGURE 17), preventing the conveyor lift fingers from being extended, while the elevator is leveling at such fast leveling speed.

Switch LL, upon operation, separates its contacts LL1 (FIGURE 24) in the circuits of coil UX of the auxiliary up reversing switch and coils U and H. However, energizing circuits for coils U and H are maintained, as has been described, by means of the re-engagement of contacts FE1 in the circuit extending through coils 2LV2 and 2LV6 (presently in engagement with upper zone leveling cam UZC), up over travel mechanical limit switch OT1, contacts LUS, D1 and C5. Switch UX, upon releasing, transfers the elevator hoisting motor from main operation to leveling operation by separating its contacts UX4, thereby interrupting the circuit for coil IES of the first speed switch and separating its contacts UX5, thereby interrupting the circuit for coil HX of the auxiliary field and brake switch.

Switch IES, upon releasing, separates its contacts IES1, without effect, since contacts HLS1, as has been stated, are presently engaged, and separates its contacts IES3 (FIGURE 25), disconnecting generator self-excited field windings GSEF across generator armature GA.

Switch HX, upon releasing, separates its contacts HX2 (FIGURE 24), interrupting the circuit for coil GL of the timed leveling speed switch which is maintained operated for a predetermined time by the discharge of the timing capacitor CGL through its coil. Switch HX also separates its contacts HX4, inserting a portion of resistor RLF in the circuit of generator leveling field GLF, thereby decreasing the excitation of such field and, in turn, the leveling speed of the elevator to a predetermined lower amount.

As the car moves upward in the upper landing zone toward its proper level, upper zone cam UZC moves downward and out of engagement with leveling contact 2LV8, interrupting the circuit for coil HLS of the fast speed lev-
eling switch. Switch HSL, upon releasing, separates its contacts HSL3, inserting another portion of resistor RLF in the circuit of generator leveling field GLF, causing further reduction of the elevator leveling speed to a certain slow speed. This switch also engages its contacts HSL2 (FIGURE 17), preparing the control circuits for extending the conveyor lift fingers to deposit the car in designated stall 4T, 6E, front, as will be hereinafter described.

As the car moves into proper level in the upper leveling zone of the 6th landing, i.e., into what may be termed a "dead zone," upper zone cam UZC moves out of engagement with leveling contact 2LV6 and into engagement with leveling contact 2LV1, interrupting the circuit for coil U of the up reversing and leveling switch and coil H of the field and brake switch. It may be noted that at the same time low zone cam LZC moves out of engagement with leveling contact 1LV2 and into engagement with leveling contacts 2LV1, 2LV5. Upper zone cam UZC also actuates upper zone mechanical switches UZ1 to UZ4 (FIGURE 17) to closed condition, completing a circuit for coil UZS of the upper zone switch. Switch UZS, upon operation, engages its contacts UZS1, UZS2 (FIGURE 17), preparing the extend controls for the front conveyor lift fingers for operation.

Switch H, upon releasing, separates its contacts H7 (FIGURE 24), disconnecting the circuit for coil SUD of the suicide delay switch which is delayed in releasing by the capacitor-anticipating resistor and capacitor (CSUD) timing circuit, which is connected across its coil, and disconnecting generator leveling field GLF and brake release coil B from across supply lines B+, BO, thereby de-energizing the leveling field and causing application of the brake to the elevator hoisting motor to stop the elevator in the "dead zone." Switch H also engages its contacts H8 (FIGURE 25), preparing a "suicide" circuit for self-excited generator field GSEF and separates its contacts H9, disconnecting resistor RGSEF across such generator field.

When timing capacitor CSUD has discharged sufficiently, switch H releases, engages its contacts SUD3 (FIGURE 25), thereby completing the "suicide" connection of self-excited generator field GSEF across motor armature MA.

Switch H further separates its contacts H3 (FIGURE 24), disconnecting the resistor-capacitor (RGL CGL) timing circuit from across coil G, thereby causing switch G to release and re-engage its contacts GL1, removing a portion of resistor RLF in the circuit of generator leveling field GLF in preparation for the next leveling operation.

Switch U, upon releasing, separates its directional contacts U1, U2, removing the up direction control from the circuit of generator leveling field GLF.

In addition, switch H separates its contacts H4 (FIGURE 18), interrupting the circuit of coil WS of the wrong stall switch which starts to "time out," for purposes to be explained hereinafter, and engages its contacts H5 (FIGURE 16), preparing a circuit for coil SOS of the stall occupied switch, for purposes also to be explained hereinafter. Switch H, in addition, engages its contacts H10 (FIGURE 17), preparing a circuit for the conveyor front lift finger extend controls, in preparation to parking the automobile in designated stall 6E, 4T, front, as will be described hereinafter.

As the elevator and tower move into proper alignment with stall 6E, 4T, front, brush EFB (FIGURE 18) carried by the selector synchronous panel of the elevator engages its associated selector stationary contact EFC6 for the 6th landing, while brush TTB carried by the tower synchronous panel engages its associated selector stationary contact TTC4 for the 4th tier, thereby completing a circuit for coil SSR of the stall signal switch, indicating that the elevator and tower both have stopped at the designated stall; the circuit extending from supply line B1+ through potential switch contacts CT1, T1C, brush EFB in engagement with stationary contact EFC 6, 7 contacts 6E3 (presently engaged), stationary contact TTC4 engaged by brush TTB and coil SSR to supply line B0. Switch SSR, upon operation, engages its contacts SSR3 (FIGURE 18) again completing a circuit for coil WS of the wrong stall switch and its parallel timing capacitor CW on the capacitor has discharged sufficiently to cause the switch to release.

It may be noted that should either the elevator or tower stop at other than the designated stall, switch SSR would not be operated and its contacts SSR3 would remain separated, allowing switch WS to release when timing capacitor CW has discharged sufficiently.

Switch WS, upon releasing, engages its contacts WSI (FIGURE 17), completing an energizing circuit for strong stall lamp WSLP at the computer console, which lamp illuminates to indicate visually to the attendant that a stop has been made at a stall other than designated stall 4T, 6E, front.

Switch SSR also engages its contacts SSR4, preparing a circuit for coil SOS (FIGURE 16) of the stall occupied switch. Incident to stopping of the tower-end elevator at the stall, front and rear light ray stall occupied detectors carried by the elevator (shown in FIGURE 9 as light ray transmitters 217, 220 and associated receivers 219, 222) are activated to scan the designated stall to detect if it is already occupied. Therefore, as the tower and elevator stop at designated stall 4T, 6E, front, from front light beam receiver contacts FSLR (FIGURE 18) are engaged, indicating that the light beam projected into and intersecting designated stall 4T, 6E, front, is uninterrupted and therefore the stall is empty and available to receive the automobile which is to be parked therein. This engaged contacts FSLR complete a circuit for coil FLR of the front light ray switch through contacts MP8, and MUN8 and FCS (presently engaged).

Switch FLR, upon operation, separates its contacts FLR1 (FIGURE 16), preventing energization of coil SOS of the stall occupied switch, as contacts SSR4 of the stall signal switch engage.

Should the designated stall already be occupied by an automobile, the front stall light ray beam would be interrupted, maintaining contacts FSLR (FIGURE 18) separated, thereby, in turn, maintaining switch FLR in released condition. Under such circumstances, contacts FLR1 (FIGURE 16) would be engaged, preparing a circuit for coil SOS of the stall occupied switch, which circuit would be completed upon the engagement of contacts SSR4 of the stall signal switch, previously described. Switch SOS, upon operation, engages its contacts SOS1 (FIGURE 17), completing an energizing circuit and occupied lamp SOSLP at the computer console, which lamp illuminates, giving the attendant a visual signal that the designated stall is already occupied. Under such conditions, switch FLR would also maintain its contacts FLR2 (FIGURE 17) separated, preventing completion of a circuit for coil PCE of the front conveyor extend switch, thereby preventing extension of the conveyor front lift fingers to park the car in the occupied stall.

However, assuming that the designated stall is empty, switch FLR maintains its contacts FLR2 engaged, preparing a circuit for coils FCE of the front conveyor extend switch and CHC of the common horizontal conveyor switch. Switch SSR also separates its contacts SSR7 (FIGURE 17), preventing operation of the conveyor lift finger retract control circuits, and engages its contacts SSR5, completing a circuit for coil FCE of the front conveyor extend switch and coil CHC of the lift of the common horizontal conveyor switch. Switch SSR also engages its contacts SSR7 (FIGURE 17), preparing operation of the conveyor lift finger retract control circuits, and engages its contacts SSR5, completing a circuit for coil FCE of the front conveyor extend switch and coil CHC of the lift of the common horizontal conveyor switch. Switch SSR also engages its contacts SSR7 (FIGURE 17), preparing operation of the conveyor lift finger retract control circuits, and engages its contacts SSR5, completing a circuit for coil FCE of the front conveyor extend switch and coil CHC of the lift of the common horizontal conveyor switch.
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IRCDL1 and E2HC, contacts FLR2 (presently engaged), FCR4, coil FCE, mechanical slack cable switches 1FSCS, 2FSCS and coil CHC to supply line BO.

Switch SSR also separates its contacts SSR1 (FIGURE 12) and SSR2 (FIGURE 22), preventing main operation of the elevator transfer switch tower respectively, while the conveyor fingers are placing the automobile into the designated stall. In addition, this switch engages its contacts SSR6, preparing circuits for the reset coils of tier switch 4T and landing switch 6E to cancel the stall designation after the automobile is parked in the designated stall, as will hereinafter be described.

Switches FCE and CHC, upon operation, engage their respective contacts FCE1, CHC1 (FIGURE 18), completing a circuit through contacts C1 and TCI for front conveyor brake release coil FCB, releasing the brake from the front conveyor lift fingers. These switches also engage their respective contacts FCE6, FCE7 and CHC7, CHC8 (FIGURE 19), energizing front conveyor lift finger motor FCM, thereby causing extension movement of the front conveyor lift fingers into the designated stall. Switch FCE also separates its interlock contacts FCE5 (FIGURE 17), preventing energization of the coil FCR of the front conveyor retract switch.

Switch CHC also engages its contacts CHC6, shorting contacts UZS2 of the upper zone switch, for purposes to be explained hereinafter. Switch CHC further engages its contacts CHC5, shorting contacts FLR2 of the front light ray switch, thereby preventing interruption of the front light ray by the automobile presently being placed into the designated stall from interfering with the front conveyor extend operation.

As the front conveyor lift fingers move from their fully retracted position, front conveyor retract position mechanical switch FCRP1 is released and moves, under the influence of its biasing spring, to its open position, interrupting the circuit for coil FCRP1 of the front conveyor retract position switch. Switch 1FCRP, upon releasing, separates its contacts 1FCRP1 (FIGURE 16), disabling the energizing circuit for coil SOS of the stall occupied switch while the automobile is being placed into the designated stall.

Switch 1FCRP also separates its contacts 1FCRP10 (FIGURE 18) and 1FCRP4 (FIGURE 15) without effect at this time. In addition, this switch separates its contacts 1FCRP2 (FIGURE 22) in the tower direction control circuits, preventing operation of the tower until the front conveyor lift fingers are again in their fully retracted position.

As the front conveyor lift fingers continue moving toward their fully extended position, a cam carried by such fingers moves off of front conveyor retract limit mechanical switch FCRL (FIGURE 17), which switch, under the influence of its biasing spring, closes, preparing the front conveyor lift finger retract control circuits for operation. As the front conveyor lift fingers approach their fully extended position, they actuate front conveyor extend limit switch FCEL to open condition, interrupting the coil circuits of switches FCE and CHC. These switches release, de-energizing front conveyor motor FCM (FIGURE 19) and applying the front conveyor brake FCB (FIGURE 18) to stop the front conveyor lift fingers at their fully extended position. Switch FCE also engages its contacts FCE5 (FIGURE 17), preparing a circuit for coil FCR of the front conveyor retract switch. As the front conveyor lift fingers at their fully extended position, front conveyor extend position mechanical switch FCEP is actuated to closed condition by a cam carried by the front conveyor lift fingers, completing a circuit for coil 1FCEP of the auxiliary front conveyor extend position switch.

Switch 1FCEP, upon operation, engages its contacts 1FCEP2 (FIGURE 18), completing a circuit through contacts XLO3 (presently engaged) for set coil LO of the zone transfer holding switch to initiate downward movement of the elevator conveyor from its upper zone to its low zone at the 6th landing in order to transfer the automobile, presently carried by the extended front conveyor lift fingers to the designated stall. Switch LO, upon operation, separates its contacts LO4 and engages its contacts LO5, preparing a circuit for reset coil XLO of the zone transfer switch, for purposes to be explained hereinafter.

Switch LO also separates its contacts LO1 (FIGURE 24), interrupting the circuit for coil LU of the lower leveling zone up switch which releases, separating its contacts LU1, LU2, and LU3, thereby disabling the upper zone elevator leveling controls. In addition, switch LO engages its contacts LO2, preparing a circuit for coil LD of the lower leveling zone down switch. Switch LU also engages its contacts LU4, completing a circuit for coil LD of the lower leveling zone down switch which operates, engaging its contacts LD1, LD2 and LD3, thereby transferring control of the leveling operation from the upper to the lower zone leveling controls.

Since the elevator is parked in the "dead zone" of the upper leveling zone at the 6th landing, low zone cam LZC, as has previously been stated, is presently in engagement with leveling contacts ILV1 and 5. Therefore, the engagement of contacts LD3 completes a circuit for coil D of the down reversing and leveling switch and coil H of the brake switch to move the elevator downward into its lower zone.

It may be noted that mechanical overtravel limit switches OT1, OT2 are provided on the elevator selector for the upper and lower leveling zones, respectively, to prevent the elevator in moving from one zone to the other from overtraveling and causing possible injury to the automobile. Such switches are actuated to open condition by movement of the elevator synchronous panel beyond their respective zones and are effective to disable the leveling control circuits and stop the elevator, thereby preventing overtravel and possible injury to the automobile and garage equipment.

To move the elevator from its upper zone to its lower zone at the 6th landing, switch H, upon operation, engages its contacts H7 and switch D, upon operation, engages its contacts D3, D4 and D5, lifting brake B and energizing generator leveling field GLF for downward movement of the elevator. As the elevator moves out of its upper leveling zone, mechanical upper leveling zone switches UZ1 to 4 (FIGURE 17) are actuated by cam UZC (FIGURE 24) to open condition, interrupting the circuit for coil UZS of the upper zone switch.

As the elevator arrives at the "dead zone" of the lower level zone, cam LZC moves out of engagement with leveling contact ILV5 and into engagement with leveling contact ILV2, interrupting the circuits for coil D and H, thereby causing their respective switches to release. Switches D and H de-energize generator leveling field GLF and apply brake B to the hoist motor to stop the elevator in the "dead zone" of the lower leveling zone. In this manner, the front conveyor lift fingers are moving downward pass through corresponding gaps provided between the stationary stall fingers, previously described, of the designated stall, transferring the automobile to the stall fingers, thereby parking the automobile thereon. The front conveyor lift fingers may now be retracted.

Switch 1FCEP, in addition to causing the elevator to move downward to deposit the automobile in the stall, engages its contacts 1FCEP1 (FIGURE 15), preparing circuits for reset coils 4T and 6E of the tier and landing switches, respectively, to cancel the stall designation. As the elevator arrives in the "dead zone" of the lower leveling zone, low zone cam LZC (FIGURE 24) actuates low zone mechanical switches LZ1-4 (FIGURE 17) to closed condition, completing a circuit through coil LZS zone switch. Switch LZS, upon operation, engages its contacts LZS2 (FIGURE 15), completing reset circuits for
tier switch 4T and landing switch 6E; the circuits extending from supply line B1+ through contacts TC3, C4, 1FECP4, SSR6 and L2S2 (both presently engaged), RA4 (previously engaged), RPA9 (presently engaged), reset coil 4T and resistor R to supply line B0, and through contacts 6E4 (presently engaged), reset coil 6E and resistor R to supply line B0. Switch L2S also engages its contacts L2S1, L2S3 (FIGURE 17), without effect at this time.

Switch 4T, upon releasing, separates its contacts 4T1 (FIGURE 20) and 4T4 (FIGURE 15), without effect at this time. This switch also separates its contacts 4T5 (FIGURE 16), interrupting the circuit for coil TCC of the tower call cutout switch. Landing switch 6E, upon releasing, separates its contacts 6E4 (FIGURE 15) and 6E41 (FIGURE 23), without effect. This switch, in addition, separates its contacts 6E5 (FIGURE 16), interrupting the circuit for coil ECC of the floor call cutout switch. Switches 4T and 6E, in addition, separate their respective contacts 4T3, 6E3 (FIGURE 18), interrupting the circuit for coil SSR of the stall signal switch.

Switches ECC and TCC, upon releasing, engage their respective contacts ECC1, TCC1 (FIGURE 15), preparing the reset circuits for parking switch PA and front call switch FC. Switches ECC, TCC, also separate their contacts ECC3 and TCC3 (FIGURE 16), interrupting the circuit for set coil CCR of the car call registered switch, without effect since it remains latched in operated condition. Switch SSR, upon releasing, engages its contacts SSR1 (FIGURE 24), SSR2 (FIGURE 27) and separates its contacts SSR6 (FIGURE 15), preparing the control circuits for recuperation upon the registration of subsequent demand. This switch also separates its contacts SSR3 (FIGURE 18), interrupting the circuit for coil WS of the wrong stall switch and timing capacitor CWS, which capacitor starts to discharge through coil WS and timing resistor RWS, thereby maintaining the wrong stall switch in operated condition for a predetermined time. Switch SSR, in addition, separates its contacts SSR4 (FIGURE 16), disabling the circuit for coil SOS of the stall occupied switch, until a subsequent demand is registered. In addition, switch SSR separates its contacts SSR5 (FIGURE 17), disabling the conveyor lift finger extend control circuits, and engages its contacts SSR7, completing a circuit for coil FCR of the front conveyor retract switch and coil CHC of the common horizontal conveyor switch. Switches FCR and CHC operate, causing the front conveyor lift fingers to be moved to their fully retracted position, as has been previously described.

Switch CHC also engages its contacts CHC2 (FIGURE 18), reconnecting coil WS of the wrong stall switch and timing capacitor CWS across supply lines B1+ and B0, thereby preventing the switch from releasing.

As the front conveyor lift fingers move from their fully extended position, front conveyor extend position mechanical switch FCFP (FIGURE 17) is released and returns to its open position, interrupting the circuit for coil FCFP of the front conveyor extend position switch which releases, without effect at this time.

As the front conveyor lift fingers approach their fully retracted position, front conveyor retract limit mechanical switch FCR1 is actuated to open condition, interrupting the circuit for coils FCR and CHC, causing their associated switches to release, thereby de-energizing the front conveyor lift finger motor FCM (FIGURE 19) and applying brake FCB (FIGURE 18), thereby stopping the front conveyor lift fingers in their fully retracted position.

Switch CHC also separates its contacts CHC2 in the circuit of coil WS of the wrong stall switch which again starts to times out, as has been previously described.

As the front conveyor lift fingers arrive at their fully retracted position, front conveyor retract position mechanical switch FCRP1 (FIGURE 17) is actuated to closed condition, completing a circuit for coil 1FCRP of the front conveyor retract position switch. This switch operates and engages its contacts 1FCRP4 (FIGURE 15), completing a circuit for reset coil PA of the parking switch and reset coil FC of the front call switch to cancel the designated parking operation in a front stall; the circuit extending from supply line B1+ through contacts TC3, C4 (presently engaged), ECC1, TCC1 and 1FCRP4, 1RCRP2 (both presently engaged), and for reset coil PA, through contacts PA5, PRLK2, RPAC6 and PA4 (presently engaged) and reset coil PA to supply line B0, and for reset coil FC through contacts FC2 (presently engaged), coil PA and resistor R to supply line B0. This switch also engages its contacts 1FCRP1 (FIGURE 24) and 1FCRP2 (FIGURE 22), preparing the elevator and tower control circuits for subsequent operation.

Switch 1FCRP also engages its contacts 1FCRP10 (FIGURE 18), completing a circuit through contacts 1RCRP7, L05 and XLO4 (all presently engaged) for reset coil XLO of the zone transfer switch. Switch XLO, upon releasing, engages its contacts XLO2 and separates its contacts XLO3, preparing a circuit for reset coil LO of the zone transfer holding switch in preparation for a subsequent automobile "pickup" operation, i.e., loading operation for parking an automobile, as has been described, or an unloading operation for unparking an automobile, as will be described hereinafter.

Switch 1FCRP also engages its contacts 1FCRP8 and 1FCRP9 (FIGURE 16) and engages its contacts 1FCRP6 (FIGURE 17), without effect at this time. Switch FC, upon releasing, separates its contacts FC1 (FIGURE 15), interrupting the circuit for coil FOS of the front operation switch which releases, cancelling the indication that a front operation is to be performed, without effect at this time. Switch FC also engages its contacts FC5 (FIGURE 18), disabling the actuating circuits for front light ray switch FLR, and engages its contacts FC4 (FIGURE 16), preparing a circuit for reset coil CCR of the car call registered switch.

Switch PA, upon releasing, re-engages its contacts PA1, PA3 (FIGURE 14) and separates its contacts PA2, preparing the park and unpark operation control circuits for subsequent operation. Switch PA also engages its contacts PA7 (FIGURE 16), completing a circuit through contacts T1E5, FE3, RET5, FC4, RC4, UNP7 and CCR9 (presently engaged) for reset coil CCR of the car call registered switch to cancel the indication of a service demand.

Switch CCR, upon releasing, engages its contacts CCR1 (FIGURE 17), completing a circuit for coil CSS of the computer signaling switch which operates placing the computer in condition to transmit further operation orders to the garage controls, as has been previously described. Switch CCR also engages its contacts CCR8 (FIGURE 18), re-establishing a circuit for coil WS of the wrong stall switch and its parallel timing capacitor CWS, thereby preventing the switch from timing out. Switch CCR also re-engages its contacts CCR1 (FIGURE 14) and CCR13 (FIGURE 18) and separates its contacts CCR4 (FIGURE 20), CCR5 (FIGURE 23), preparing the control circuits for registration of a subsequent demand. Switch CCR also engages its contacts CCR3 (FIGURE 16) without effect, since manual switch KHL5 is presently open. Thus, during its further service demand, the tower remains parked at tier 4T with its elevator conveyor positioned at landing 6E in the lower leveling zone.

During periods when automobiles arrive at the garage for parking at a relatively high frequency compared to the number of automobiles which are to be unparked, i.e., during periods of heavy incoming traffic relative to outgoing traffic, it may be desired that the elevator conveyor and tower immediately after completing a call for service be made to return automatically to the loading station to
pick up the next incoming automobile rather than be left parked at the stall of their last call. This may be accomplished by closing manual switch KHLS (FIGURE 16). This switch is a circuit breaker switch CCR3 releases and engages its contacts CCR3 at the completion of the prior call, as has been previously described, a circuit is completed for coil HLS of the home landing switch; the circuit extending from supply line B1+ through manual switch KHLS, contacts CCR3, RE5, RPAC2, EL5 (presently engaged, signifying that the elevator conveyer is now empty) and coil HLS to supply line BO.

Switch HLS, upon operation, separates its contacts HLS1 (FIGURE 20), preventing tier switch contacts T1 to T9T from affecting direction control of the tower, while engaging its contacts HLS2, HLS6, completing a circuit for coil TXF of the forward direction auxiliary switch; the circuit for coil TXF extending from supply line B1+ through contacts HLS2, HLS6, DR6, tower selector mechanical hook switches TFH5 to TFH9 (all presently closed with the tower positioned at tier 4T), coil TXF; contacts TXR1 and TXR1 to supply line BO. Switch TXF, upon operation, controls the tower motive mechanism to move the tower in the forward direction from its present position at tier 4T to tier 5T where the loading station is located in a manner similar to that described for direction control of the tower by switch TXR for the reverse direction.

Switch HLS also separates its contacts HLS3 (FIGURE 23), preventing landing switch contacts IE1 through 8E1 from affecting the direction control circuits of the elevator, while engaging its contacts HLS4, HLS5, completing a circuit for coil XD of the down direction switch, the circuit extending from supply line BO through the contacts HLS4, HLS5, elevator selector mechanical hook switches EFH1 through EFH4 (all presently closed for the present position of the elevator landing 6E), through the portion of selector mechanical hook switch EFH5 presently in engagement with the conducting lower portion of elongated cam EFDS (which can presently maintain selector hook switches EFH6 and 5 open), coil XD, contacts XU 3 and UX2 to supply line BO. Switch XD, upon operation, causes the elevator hoisting mechanism to move the elevator downward to the first landing in its lower leveling zone in position to “pick up” the automobile from the landing station gap lifter, in a manner similar to that described for up direction control of the hoisting mechanism by up direction switch XU.

Switch HLS, in addition, engages its contacts HLS7 (FIGURE 15), completing a circuit through contacts TC3, C4 (both presently engaged) and ROS2 for coil FOS of the front operation switch. Switch FOS, upon operation, separates its contacts FOS1, disabling the circuit for coil ROS of the rear operation switch to prevent rear operation of the conveyer lift fingers, and engages its contacts FOS4 (FIGURE 17), energizing energizing circuits for coils FCE and CHC in the front conveyer lift finger control circuits in preparations for extending the front conveyer lift fingers to pick up the next incoming automobile, upon registration of a parking order. Switch ROS, in addition, engages its contacts ROS2 (FIGURE 18), completing a circuit through contacts TC3 and landing switch contacts IE3 through 8E3 from affecting the circuit for coil SSR of the stall signal switch; which circuit at the loading station must be completed to initiate the loading of an automobile through, as has been previously described, contacts LBL4, ILGLU1 (which before separation separate the barriers and loading gap lifter are in their respective fully raised positions).

Upon registration of a subsequent demand, car call registered switch CCR (FIGURE 16) operates, as has been previously described, separating its contacts CCR3, thereby interrupting the circuit for coil HLS of the home landing switch. Switch HLS then releases, having served its function of returning the elevator and tower automatically to the loading station.

During periods when it is desired to cause the tower and elevator to remain at the stall of their last call, such as stall 4T, 6E in the previously described parking operation, until the registration of subsequent demand for their services. Should the subsequent call require the elevator and tower to move to the loading station to pick up an incoming automobile, such as for a parking operation, previously described, or for a “bypass” operation, which will be described hereinafter, a circuit is completed for set coil PAC (FIGURE 14) of the loading platform call switch (either through any other order contacts PK and contacts PA3 for a parking operation, as has been previously described, or through one of several other actuating circuits to be described hereinafter). In such a case, the tower and elevator are returned to the loading station by operation of switch PAC which engages its contacts PAC2 (FIGURE 16), completing a circuit through contacts EL5 (presently engaged) for coil HLS of the home landing switch. Switch HLS, in turn, operates causing the tower and its elevator conveyer to move to the loading station in position to “pick up” an incoming automobile, as has been previously described.

On the other hand, should the next demand for service be an order to unpark an automobile from a stall, the elevator and tower proceed from the stall of their last call, i.e., stall 4T, 6E in the previously described parking operation, directed to the stall in which the automobile is to be unparked is located. In order to describe an unparking operation, assume that the computer designates that an automobile presently positioned in stall 6T, 5E rear is to be unparked. Under such conditions, computer order switches UPP, UFP, USP4 and USP5 (FIGURE 14) are engaged, completing a set coil circuits for unparking switch UNP, tier switch ST, landing switch SE and rear call switch RC, respectively, through contacts B1P, CC1 and manual switch KMDS1, thereby designating stall 8T, 4E rear, as the stall from which the automobile is to be unparked.

Unparking switch UNP, upon operation, separates its contacts UNP1 (FIGURE 14), UNP2 (FIGURE 15), UNP3 (FIGURE 16) and UNP8, without effect. This switch also engages its contacts UNP4 (FIGURE 18), preparing a circuit for set coil UNPC of the unloading platform call switch, and its contacts UNP6 (FIGURE 16), preparing a circuit for set coil CCR of the car call registered switch, for purposes to be explained hereinafter. Switch UNP, in addition, engages its contacts UNP3 (FIGURE 20), preparing the tower direction control and start initiating circuits for operation. Switch UNP also engages its contacts UNP9 (FIGURE 15), preparing the reset coil circuits of tier switch ST and landing switch SE. Switch UNP further engages its contacts UNP5, preparing a circuit (temporarily as will hereinafter be explained) for its reset coil UNP through potential switch contacts TC3, C4 (presently engaged), contacts EC1, TC1 and landing switch contacts IE3 through 8E3 (presently engaged) and UNP5. The completion of the circuit for reset coil UNP is without effect on switch UNP, since the reset coil produces insufficient electromagnetic forces to overcome the electromagnetic forces of its set coil which is at present maintained energized.

Rear call switch RC1, upon operation, engages its contacts RC1 (FIGURE 15), completing a circuit through contacts TC3, C4 (presently engaged), RPAC1, UNPC4, PAC4 and FOS1 for coil ROS of the rear operation switch. Switch RC also engages its contacts RC2 (FIGURE 15), temporarily completing a circuit for its reset coil RC through contacts ECC1, TCC1 and 1FCR4,
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1RCRP2 (both presently engaged), without effect, since its reset coil produces electromagnetic forces of insufficient magnitude to switch and coil the trolley line, which trolley line is presently energized set coil. Switch RC further engages its contacts RC3 (FIGURE 16), preparing a circuit for set coil CCR of the car called registered switch, and its contacts RC5 (FIGURE 18), preparing a circuit for coil RKL of the rear light ray switch, for purposes to engage the relay and complete the care circuit. In addition, switch RC opens its interlock contacts RC4 (FIGURE 16) and RC6, without effect at this time.

Tier switch 8T, upon operation, engages its contacts 8T1 (FIGURE 20), preparing the tower direction control circuits for operation. This switch also engages its contacts 8T3 (FIGURE 18), without effect at this time, and its contacts 8T4 (FIGURE 15), preparing a circuit for its reset coil 8T. Switch 8T further engages its contacts 8T5 (FIGURE 16), completing a circuit for coil TCC of the tower call cutout switch.

Landing switch 4E, upon operation, engages its contacts 4E1 (FIGURE 23), preparing the elevator start and direction control circuits for operation, and engages its contacts 4E4 (FIGURE 15), preparing a circuit for its reset coil 4E. This switch also engages its contacts 4E3 (FIGURE 18), preparing a circuit for coil SSR of the stall signal switch, for purposes to engage the control. In addition, switch 4E engages its contacts 4E5 (FIGURE 16), completing a circuit for coil ECC3 of the floor cutout circuit.

Switches TCC and ECC, upon operation, separate their respective contacts TCC1, ECC1 (FIGURE 15), interrupting the control circuits for reset coils UNP and RC, without effect for the reasons previously stated. Switches TCC and ECC also engage their respective contacts TCC3, ECC3 (FIGURE 16), completing a circuit for set coil CCR of the car called registered switch.

Rear operation switch ROS, upon operation, separates its contacts ROS2 (FIGURE 15) in the circuit of coil FOS of the front operation switch, and engages its contacts ROS4 (FIGURE 16), preparing a circuit for coil SOS of the stall occupied switch, for purposes to be explained hereinafter. Switch ROS also engages its contacts ROS8 (FIGURE 17), preparing a circuit for coil RC7 of the rear conveyor switch and coil CHC of the common horizontal conveyor switch in preparation for extending the rear conveyor lift fingers to unpark the automobile. In addition, switch ROS engages its contacts ROS3, completing circuits for coil CUV of the conveyor operation, cause the conveyor lift to move upward and extend switch and coil CHC of the common horizontal conveyor switch; the circuits extending from supply line B+ through presently engaged potential switch contacts TC2, C2, vertical slack cable mechanical switches 1RVSC, 2RVSC, contacts 1FCR6, 1RCRP5 and ROS3 (all presently engaged), cam actuated rear conveyor up limit mechanical switch 1RCUL2, interlock contacts CVD3 of the conveyor down switch and coils CUV and CVC to supply line BO.

Car call registered switch CCR, upon operation, engages its contacts CCR4 (FIGURE 20), completing a circuit for coil TXF of the auxiliary tower forward direction switch; the circuit extending from supply line B+ to line BO through contacts CCR4, HLS1, 8T1 (presently engaged), tower selector hook switches THF8 and THF9, coil TXF and contacts TXR1, TXR1; it being noted that the circuit for coil TXR of the tower rear direction switch is prevented from being completed by cam TFP1 present engagement with hook switches THF4 and THF3 for the present position of the tower at tier 4T, which hook switches are thereby maintained in open condition.

Switch CCR also engages its contacts CCR5, completing a circuit for coil XD of the elevator down direction switch; the circuit extending from supply line B+ through contacts CCR5, HLS3, 4E1 (presently engaged), elevator selector mechanical hook switch EFH4, the portion of hook switch EFH5 presently engaging the lower conducting portion of cam EFDC (which cam for the present position of the car at landing 4E engage and maintains hook switches EFH5, EFH6, EFH7, disabling the elevator up direction switch), coil XD and contacts XU3, XU2, to supply line BO.

In addition, switch CCR engages its contacts CCR11 (FIGURE 17), completing a circuit for coil CSS of the computer signal switch, which operates signaling the computer that its orders have been registered by the garage control and preventing the computer, as has been previously explained, from issuing further orders until the present ordered operation has been completed. Switch CCR also separates its contacts CCR1 (FIGURE 14), interrupting the circuits for set coils UNP, 8T, 4E and RC without effect, and engages its contacts CCR9 (FIGURE 16), preparing a circuit for reset coil CCR. Switch CCR further separates its contacts CCR8 (FIGURE 18), interrupting the circuit for coil WS of the wrong stall switch which starts to "time out," its circuit being re-completed prior to its release by means of brake contacts H4, THY1 of the elevator and tower, respectively, incident to their being moved to stall 4T, 4E, rear, as will be hereinafter described.

Conveyor up switch CUV and common vertical conveyor switch CVC, upon operation, engage their respective contacts CUV1 (FIGURE 17), interrupting the circuit for brake release coil VCB, thereby releasing the brake from vertical conveyor motor VCM (FIGURE 19). These switches also engage their respective contacts CUV6, CUV7, CVC3 and CVC2, energizing vertical conveyor polyphase motor VCM, thereby causing the rear conveyor lift fingers to be moved upward toward their fully raised position. Switch CUV also separates its interlock contacts CUV4 (FIGURE 17) in the circuit of coil CVD of the conveyor down switch, preventing energization of the down direction controls for the rear conveyor lift fingers.

The rear conveyor lift fingers, in moving upward, release rear conveyor down position mechanical switch 1RCDL1, allowing it to return to its normally open position under the influence of its biasing spring, thereby disabling the extend controls for the front conveyor lift fingers while the rear conveyor is in other than its fully lowered position.

At the same time that the rear conveyor lift fingers move toward their fully raised position, elevator down direction switch XD (FIGURE 23) and tower forward direction auxiliary switch TXF (FIGURE 20), upon energizing, separate their respective contacts in the energizing circuit of vertical conveyor polyphase motor CVM (FIGURE 19), de-energizing it, and separate their respective contacts CUV1, CVC1 (FIGURE 18), interrupting the circuit for brake release coil VCB, thereby causing the application of the brake to vertical conveyor motor CVM (FIGURE 19), completing the rear conveyor lift fingers. Switch CVCV also re-engages its interlock contacts CUV4 (FIGURE 17), preparing a circuit for coil CVD of the conveyor down switch and coil CVC in preparation for lowering the rear conveyor lift fingers to their normal position, as will be hereinafter described.

In addition, as the rear conveyor lift fingers arrive at their fully raised position, rear conveyor up lift mechanical switch 1RCUL1 (FIGURE 17) is actuated to closed
position by a cam carried by the conveyor lift fingers, completing a circuit for coil RCUS of the rear conveyor up limit switch which operates, thereby indicating that the rear conveyor lift fingers are presently in position to be extended. Switch RCUS engages its contacts RCUS3 (FIGURE 17), preparing a circuit for coil SSR of the stall signal switch, and contacts RCUS2 (FIGURE 17), preparing a circuit for coil RCE of the rear conveyor extend switch.

As the elevator and tower move into proper alignment with stall 8T, 8E, rear, in the 4th landing lower leveling zone, position by a cam carried by the conveyor lift fingers, completing a circuit for coil RCUS of the rear conveyor extend switch. Switch RCUS, upon operation, engages its contacts RCUS1 (FIGURE 17), preparing a circuit for coil RCE of the rear conveyor extend switch. This switch, upon operation, engages its contacts RCRP1, RCRP3 (FIGURE 15), preparing the circuits for reset coils 8T and 8E. Switch 8RCR also engages its contacts RCRP1 (FIGURE 18), completing a circuit through contacts XL02, LO3 (presently engaged) for reset coil LO of the zone transfer holding circuit.

Switch LO, upon releasing, separates its contact LO3 in the circuit of reset coil XL0 of the zone transfer switch, and re-engages its contacts LO4, preparing a circuit for set coil XL0 of such switch. Switch LO also separates its contact LO2 (FIGURE 24), interrupting the circuit for coil LD of the low leveling zone down switch, and re-engages its contacts LO1, preparing a circuit for coil LU of the low leveling zone up switch.

Switch LD, upon releasing, engages its contacts LD4, completing a circuit for coil LU, thereby transferring control of the elevator hoisting mechanism from zone L0ZC to upper cam U0ZC, thereby, in turn, causing the elevator to be moved upward into its upper leveling zone at slow leveling speed; the presently extended rear conveyor lift fingers are, in turn, being carried upward by the elevator, thereby passing through corresponding gaps provided between the stall 8T, 8E rear, and transferring the automobile from the stall to the elevator conveyor, as has been previously described for “picking up” the automobile at the loading station from the unloading gap lifter.

As the elevator moves from its lower leveling zone at stall 8T, 8E, rear, to its upper leveling zone, mechanical switches LZ1 through LZ4 are actuated by such movement to open condition, interrupting the circuit for coil LZS of the low zone switch, while mechanical switches UZ1 through UZ4 are similarly actuated to closed condition, completing a circuit for coil UZS of the upper zone switch.

Switch UZS, upon operation, engages its contacts UZS2, UZS1 (FIGURE 17), energizing energizing circuits for coil FCE and CHC to extend the front conveyor lift fingers at the unloading station to place the automobile on the unloading platform, as will be hereinafter described. Switch UZS also engages its contacts UZS3 (FIGURE 15), energizing energizing circuits for reset coil UNP of the unloading switch and reset coil RC of the rear car switch. Switches TCC and ECC also separate their contacts TCC3, ECC3, interrupting the circuit for set coil CCR of the car call registered switch, without effect, since the switch remains latched in operated condition.

Switches 8T and 8E, upon releasing, separate their respective contacts 8T5, 8E5 (FIGURE 16), interrupting the circuit for coil ECC of the floor call cutout switch and TCC of the tower call cutout switch. Switches TCC and ECC, upon releasing, re-engage their respective contacts TCC1, ECC1 (FIGURE 15), energizing energizing circuits for reset coil UNP of the unloading switch and reset coil RC of the rear car switch. Switches TCC and ECC also separate their contacts TCC3, ECC3, interrupting the circuit for set coil CCR of the car call registered switch, without effect, since the switch remains latched in operated condition.

Switches 8T and 8E also separate their respective contacts 8E3 (FIGURE 18) and 8T3, interrupting the circuit for coil SSR of the stall signal switch, thereby indicating that the automobile has been removed from the stall. Switch SSR, upon releasing, separates its contacts SSR5 (FIGURE 17) in the conveyor lift finger extend control circuits and engages its contacts SSR1, SSR2 (FIGURE 24), preparing a circuit for coil RCR of the rear conveyor retract switch and coil CHC of the common horizontal conveyor switch through presently closed mechanical switch RCR and contacts RCUS. Switch SSR also re-engages its contacts SSR1 (FIGURE 24) and SSR2 (FIGURE 22), preparing the elevator and tower main motor control circuits, respectively, for operation.

Switches RCR and CHC, upon operation, engage their respective contacts in the circuits of brake release coil...
RCB (FIGURE 18) and conveyor motor RCM (FIGURE 19) for the rear conveyor, thereby releasing the brake and energizing the rear conveyor motor for movement of the rear conveyor lift fingers toward their fully retracted position to carry the automobile from the stall into the elevator confines.

As the rear conveyor lift fingers move from their fully extended position, rear conveyor extend position mechanical switch RCPE (FIGURE 17) is released by the fingers, moving to its open position, thereby interrupting the circuit for coil IRCEP of the rear conveyor extend position switch. Switch IRCEP, upon releasing, separates its contacts IRCPE1, IRCPE2, IRCPE3 (FIGURE 17) and IRCPE4 (FIGURE 18), while energizing RCPE (FIGURE 17).

Rear conveyor retract switch RCR also engages its contacts RCR2 (FIGURE 18), completing a circuit for set UNPC of the unloading platform call switch to register a call for the elevator and tower to carry the automobile to the unloading station.

Switch UNPC, upon operation, engages its contacts UNPC6 (FIGURE 15), preparing a circuit for its reset coil UNPC. This switch also separates its contacts UNPCC, interrupting the circuit for coil ROS of the rear operation switch, and engages its contacts UNPC3, preparing a circuit for coil FOS of the front operation switch. Switch UNPC further separates its contacts UNPC5 in the circuit of reset coil UNP of the unparking switch, thereby preventing such switch from being reset upon the rear conveyor lift fingers being fully retracted, as will be hereinafter described.

Switch UNPC, in addition, engages its contacts UNPC7 (FIGURE 18), preparing a circuit for coil SSR of the stall signal switch. Switch UNPC also engages its contacts UNPC1 (FIGURE 20), completing a circuit for coil TXR of the tower reverse direction switch through cam TFDC, the lower conducting portion of which is presently in contact with selector hook switch TFH7 (which hook switch along with hook switch TFH8 is maintained in open condition by cam TFDC), hook switch TFH6, contacts DRS4, UNPC1 and CCR4 (presently engaged). Switch UNPC, in addition, engages its contacts UNPC2 (FIGURE 23), completing a circuit for coil XD of the elevator down direction switch through cam EPDC, the lower conducting portion of which is presently in engagement with selector hook switch EFH3 (cam EFDC presently maintaining hook switches EFLH4 and EFLH3 in open condition for the present position of the elevator at the 4th landing) through hook switches EFH2, EFLH1 and contacts UNPC2, CCR2 (both presently engaged) reverse direction switch TXR and elevator down direction switch XD, upon operation, prepare the tower and elevator motor circuits, respectively, for movement of the tower and elevator toward the unloading station located at the 6th landing, in a manner similar to that previously described for control of the tower and elevator motors.

Rear operation switch ROS, upon releasing, re-engages its contacts ROS2 (FIGURE 15), completing a circuit through contacts UNPC3 (presently engaged) for coil FOS of the front operation switch.

FOS, upon operation, opens its interlock contacts FOS1 (FIGURE 15) in the circuit of coil ROS of the rear operation switch, preventing and extend operation of the rear conveyor lift fingers. Switch FOS also engages its contacts FOS3 (FIGURE 17), preparing a circuit for coil CVD of the rear conveyor down switch through coil CVC of the conveyer switch in preparation for returning the rear conveyor lift fingers to their normally lowered position, after they arrive at their fully retracted position, as will be hereinafter described. Switch FOS further engages its contacts FOS4, preparing the front conveyor extend control circuits of the tower and elevator arriving at the unloading station, as will be hereinafter described, and separates its contacts FOS5 (FIGURE 18), preventing a circuit from being completed for coil SSR of the stall signal switch until the tower and elevator have both arrived at the unloading station.

As the rear conveyor lift fingers approach their fully retracted position, rear conveyor retract limit mechanical switch RCRL (FIGURE 17) is actuated by the fingers to open condition, interrupting the energizing circuits for coils RCR and CHC, thereby causing their associated switches, i.e., rear conveyor retract switch RCR and common horizontal conveyor switch CHC, to release, de-energizing rear conveyor motor RCM (FIGURE 19) and reapplying the rear conveyor brake RCB (FIGURE 18) to stop the rear conveyor lift fingers in their fully retracted position at the automobile inside the confines of the elevator.

As the rear conveyor lift fingers arrive at their fully retracted position, mechanical switch RCRP1 (FIGURE 17) is actuated by the fingers to closed condition, completing a circuit for coil IRCRP of the rear conveyor retracted position switch. Switch IRCRP, upon operation, engages its contacts IRCRP2 (FIGURE 24) and IRCRP3 (FIGURE 22), completing the main motor control circuits for the elevator and tower, respectively, causing the elevator and tower, in a manner similar to that previously described, to be propelled to the unloading station at the 6th landing, and arriving at the unloading station in its upper leveling zone.

Switch IRCRP also engages its contacts IRCRP5 (FIGURE 17), completing energizing circuits through mechanical limit switches IRVSC, 2RVSC, contacts 1IRCPR6, 2IRCPR6, 1FOS3 (both presently engaged), cam actuated switch IRCDL2 (presently closed for the raised position of the rear conveyor) and contacts CVU4 for coil CVD of the conveyor down switch and coil CVC of the common vertical conveyor switch. Switches CVU and CVC operate, lifting brake VCB (FIGURE 18) and energizing the vertical conveyor motor VCM (FIGURE 19), causing the rear conveyor lift fingers to be moved to their normally lowered position while the elevator and tower are moving toward the unloading station; the circuits for coil CVD, CVC (FIGURE 14) being interrupted to de-energize vertical conveyor motor VCM and reapply the brake VCB, as the rear conveyor lift fingers in arriving at their fully lowered position actuate mechanical limit switch IRCDL2 to its open position. The rear conveyor lift fingers, in arriving at their fully lowered position, also activate mechanical switch IRCDL1 to its closed condition, preparing the extend controls of the front conveyor lift fingers for operation.

Switch IRCRP, in addition, engages its contacts IRCRP6 (FIGURE 18), preparing a circuit for coil SSR of the stall signal switch. Switch IRCRP also engages its contacts IRCRP4 (FIGURE 15), completing a circuit through contacts ECC1, 1CC1, 1IRCPR4 and RC2 (both presently engaged) for reset coil RC of the rear call switch. Switch RC releases, cancelling the rear call order and engages its contacts RC4 (FIGURE 16), preparing a circuit for reset coil CCR of the car call registered switch in preparation for cancelling the unparking order upon completion of the unparking operation, as will be hereinafter described.

Switch IRCRP further engages its contacts IRCRP7 (FIGURE 18), completing a circuit through contacts IRCRP10 (presently engaged) and LO4 for set coil XLO of the zone transfer switch. Switch XLO, upon operation, separates its contacts XLO2 and engages its contacts XLO3, preparing a circuit for set coil LO of the zone transfer holding switch in preparation for moving the elevator from the upper leveling zone to the lower leveling zone at the unloading station when its front conveyor lift fingers arrive at their fully extended position at such unloading station for transferring the automobile from the elevator to the unloading station gap lifter, as will be described hereinafter. Switch XLO also engages
its contacts XLO4, preparing a circuit for its reset coil XLO.

The attendant, after visually scanning the unparking station to make sure that it is empty, causes the unload- ing station side and end barriers to be raised by de- pressing the unloding barrier button, thereby closing its associated contacts UBUB1 (FIGURE 12) in the up control circuits for the unloding station barriers, and its contacts UBUB2 (FIGURE 10) in the unloding station safety circuits. These button contacts remain closed so long as the barrier button is held depressed by the attendant. Button contacts UBUB1 (FIGURE 12), upon closing, are effective to cause the unloding station barrier motors USBM, UEBM (FIGURE 10) to move their associated barriers to their respective fully raised positions, in a manner similar to that previously described for the loading station barrier controls, in order to pre- vent anyone from entering the unloding station plat- form area while the automobile is being unloded from the elevator.

As the unloding station barriers arrive at their re- spectively fully raised positions, mechanical barrier position switches UUBU2, UUBUL2 are actuated to close contact position by the barriers, completing a circuit for coil UBUL of the unloding barrier up limit switch. Switch UBUL, upon operation, engages its contacts UUBU2 (FIGURE 12), preparing a circuit for coil UGO of the unloding gate open switch in preparation for opening the hoistway door at the unloading station, and completes a circuit for coil UGU of the unloding gate/lift up switch; the circuit extending from supply line B1- through contacts C6, TC5, UBDS3, UUBL2 (all pres- ently engaged), DR53, LK8, contacts UULPb of unloding gate lift upper position mechanical switch UGLUP, contacts SL2 and coil UGU to unloding gate line LO.

Switch UGU, upon operation, is effective to cause unloding gate lift motor UGLM (FIGURE 10) to move the unloding gate lift to its fully raised and ex- tended position for receiving the automobile to be un- parked, in a manner similar to that previously described for the up controls of the loading gate lift. As the unloding gate lift arrives at its fully raised and extended position, unloding gate lift up position mechanical switch UGLUP (FIGURE 12) is actuated thereby to open its contacts UGLUPb and close its contacts UGLU, completing a circuit for coil UGU of the auxiliary unloding gate lift upper position switch, which operates. Unloading barrier up limit switch UBUL (FIGURE 10) and auxiliary unloding gate lift upper position switch IUGULP engage their respective contacts UUBL3, IUBLU1 (FIGURE 18), preparing a circuit for coil SSR of the stall signal switch in preparation for the arrival of the tower and elevator at the unloding station.

As the tower stops at tier 6T with its elevator at land- ing 1E in the upper leveling zone, i.e., at the unloding station in position to transfer the automobile to the unloding gap lifter, selector brush EFB (FIGURE 18) of the elevator moves into engagement with selector sta- tionary contact TFC1 for the 1st landing while tower selector brush TTB moves into engagement with selector stationary contact TTC for the 6th tier, completing a circuit for coil SSR of the stall signal relay; the circuit extending from supply line B1+ through contacts TC1 (presently engaged), elevator selector brush EBF presently in engagement with stationary contact EFC1, contacts RPLK7, LK6 and UNCP7, LCRP6 (both presently engaged), DR58 and UBUL3, IUBLU1 (both presently engaged), stationary contact TTC presently engaged, by tower selector brush TTB to supply line BO. In addition, mechanical switch EHH (FIGURE 17) mounted on the elevator selector is actuated to open condition, preventing the front con- veyor extend circuits from operating until the hoistway door at the unloding station arrives at its fully open position, as will be described hereinafter. At the same time, brush EMBF (FIGURE 16) carried by the elevator synchronous panel engages its corresponding stationary contact EMFP for the 1st landing, while tower selector brush TPTC6 engages its corresponding stationary contact TPTPC for the 6th tier, completing a circuit for coil LUN (the unloding up switch circuit which operates, indicating that the elevator and tower are both at the unloding station, the circuit extending through contacts TIE5, FE5, DR52, LZE5 and PA5. Also, elevator se-lector elongated brush EUZD (FIGURE 12) moves into engagement with its associated stationary selector con- tact EUZLc for the 6th tier, completing a circuit for coil UGO of the unloding gate up switch. Switch UGO, upon opera- tion, is effective to cause unloding gate motor UGM (FIGURE 10) to move the hoistway door of the unloding station to its fully open position, in a manner similar to that previously described for opening of the loading station hoistway door by loading gate up switch LGO (FIGURE 12).

Unloading station switch MUN engages its contacts MUN12 (FIGURE 17), preparing the front conveyor extend control circuits for operation, and its contact MUN5 (FIGURE 15), preparing a circuit for reset coil UNPC of the unloding platform call switch. Switch MUN also separates its contacts MUN4 (FIGURE 18), preventing the unloding platform call switch (when the switch is subsequently operated, as will be described hereinafter) from completing a circuit for coil UNPC, and its contacts MUNE, disabling the energizing circuit for coil FLR of the front light ray switch which therefore remains in released condition while the car is at the unloding station.

Stall signal switch SSR, upon operation, separates its contacts SSM (FIGURE 24), SSM12 (FIGURE 22), dis- abling the main motor control circuits of the elevator and tower, respectively, from operation while the car is being transferred from the elevator to the unloding gap lifter. Switch SSR also engages its contacts SSR5 (FIGURE 18), completing a circuit for coil WS of the wrong stall switch, the switch having started to time out upon the arrival of the elevator and tower at the unloding station, thereby maintaining the switch operated, indicating that the ele- vator and tower have transferred to the proper designated stall position. Switch SSR, in addition to its sepa- rations SSR6, preparing a circuit for the reset coil UNPC of the unloding platform call switch. Switch SSR sepa- rates its contacts SSR7 (FIGURE 17), disabling the front and rear conveyor retract circuits from operation, and engages its contacts SSR5, preparing a circuit for coil PCE of the front conveyor extend switch and coil CHC of the common horizontal conveyor switch.

As the hoistway door of the unloding station arrives at its fully open position, mechanical switch UGUP (FIGURE 17) is actuated by door movement to closed position, indicating that the door is fully opened and completing energizing circuits for the coils of switches RCE and CHC; the energizing circuits extending from supply line B1+ through contacts TC2, C2 (both presently engaged), mechanical tower alignment switches T31 through T24, contacts T85, HSL2, H10, UZ52, all presently engaged, bridge switch UZS is energized for the position of the elevator in the upper leveling zone), SRS5, FOS5 and MUN12 (all three presently engaged), mechanical door open position switch UGUP (presently closed), mechanical switches FCEL, IRCDL1 and EHC, contacts MUN6, UZ51 (both brush TTB and IUBLU1, FC54, coil PCE, slack cable mechanical switches 1FSCS and 2FSCS and coil CHC to supply line BO. These switches operate, causing the front conveyor lift fingers to be moved to their fully extended position, as has been previously described, thereby placing the automobile directly above the
previously raised and extended unloading gap lifter which is to receive the automobile. As the front conveyor lift fingers arrive at their fully extended position, the elevator is caused to move downward at a slow vertical speed from the upper leveling zone to the lower leveling zone at the 1st landing by the operation of zone transfer holding switch LO (FIGURE 18) of the zone transfer controls, as has been previously described in parking an automobile in a selected stall. As the elevator and, in turn, the extended front conveyor lift fingers, move downward, the front conveyor lift fingers pass through corresponding slots provided in the unloading gap lifter, thereby transferring the automobile from the elevator conveyor to the unloading gap lifter.

As the elevator conveyor stops in the lower leveling zone, low zone switch L2S (FIGURE 17) is operated, as has been previously described, engaging its contacts L2S2 (FIGURE 15), thereby completing a circuit for reset coil UNP of the unloading platform call switch through contacts 1FCP1 (presently engaged for the fully extended position of the front conveyor lift fingers), SSR6, MUN5 (both presently engaged) RPLK6 and UNP of (presently engaged). Switch UNPC, upon releasing, separates its contacts UNPC3, interrupting the circuit for coil FOS of the front operation switch which releases in preparation for subsequent service demand. Switch UNPC, upon releasing, separates its contacts UNPC3, preparing a circuit for reset coil UNP of the unparking switch. Switch UNPC, in addition, separates its contacts UNPC7, interrupting the circuit for coil SSR of the stall signal switch which releases, engaging its contacts SSR7 (FIGURE 17), completing energizing circuits for coil FCR of the front conveyor retract switch and CHC of the common horizontal conveyor switch. Switches FCR and CHC, upon operation, cause the front conveyor lift fingers to be moved to their fully retracted position, as has been previously described.

As the front conveyor lift fingers arrive at their fully retracted position, front conveyor retract position switch 1FCRP (FIGURE 17) operates, as has been previously described, engaging its contacts 1FCRP4 (FIGURE 15), thereby completing a circuit through contacts ECC1, TCC1 and 1FCP4, 1RCP2 (both presently engaged), UNP and UNP5 (presently engaged) for reset coil UNP of the unparking switch. Switch 1FCRP also engages its contacts 1FCRP10 (FIGURE 18), completing a circuit through contacts 1RCP7, LO5 and XLO4 (all presently engaged) for reset coil XLO of the zone transfer switch. Switch XLO, upon releasing, engages its contacts XLO2, preparing a circuit for reset coil LO of the zone transfer control, thereby preparing the elevator zone transfer controls for operation at the next stop of the elevator for an automatic "pickup" operation at such stop.

Switch 1FCRP (FIGURE 17) further engages its contacts 1FCRP12 (FIGURE 12), completing energizing circuits for coil UGC of the unloading down switch through contacts RAP15, UNP9, DR37 and 1UGD, and for coil UXGUD of the unloading gap lifter down switch through presently closed mechanical switch UGLDP1 and contacts DR545. Switch UXGUD operates, engaging its contacts UXGUD1, completing a circuit for coil UG of the unloading gap lifter down switch through contacts UG2. Unloading gate down switch UGC and unloading gap lifter down switch UXG, upon operation, cause the closing of the unloading station hoistway door and the return of the unloading gap lifter to its normally lowered position, respectively, in a manner similar to that previously described for the closing of the hoistway door and lowering of the gap lifter at the loading station by the operation of switches LGC and LGD. The unloading gap lifter, upon arriving at its fully lowered position, places the automobile on the unloading station platform in position to be driven out of the garage.

Upon the hoistway door and unloading gap lifter returning to their normally closed and lowered positions, respectively, contacts 1UGD of the auxiliary unloading gap down position switch engage and unloading gap lifter mechanical switch UGLDP closes, completing energizing circuits for coil USD of the unloading side barrier down switch and UED of the unloading end barrier down switch, causing the unloading switch barriers to move to their normally lowered position, thereby allowing the automobile to be driven out of the garage.

Unparking switch UNP, upon releasing, indicates that the unparking operation is complete by restoring the control circuits to a condition to receive subsequent orders, and by re-engaging its contacts UNP7 (FIGURE 16), completed a circuit for reset coil CCR of the car call registered switch. Switch CCR, upon releasing, separates its contacts CCR11 (FIGURE 17), interrupting the circuit for coil CSS of the computer signaling switch, which then engages, notifying the computer that the unloading operation has been completed and that the garage controls are in condition to receive further orders; the elevator and tower remaining at the unparking station until a further order is received.

Summarizing the unparking operation, upon registration of an unparking order, the elevator and tower are directed to a designated stall, the elevator arriving at such stall in its lower leveling zone; the conveyor lift fingers are extended into the stall beneath the automobile to be unparked and the elevator is then caused to move from the lower to the upper leveling zone, thereby transferring the automobile from the stall onto the extended lift fingers which are then retracted, causing cancellation of the stall designation and setting up of a second order to the tower and elevator to carry the car to the unloading station. The elevator arrives at the unloading station in the upper leveling zone. Incident to the arrival of the tower and elevator at the unloading station, the unparking station barriers are caused to be raised by the attendant, closing the unloading platform to traffic, the hoistway door is caused to move to its fully opened position and the unloading gap lifter is actuated to its fully raised and extended position for receiving the automobile to be unparked. Next, the front conveyor lift fingers are extended to a position above the raised and extended gap lifter, the elevator moves from the upper to the lower leveling zone, thereby transferring the automobile to the raised and extended gap lifter. The front conveyor lift fingers are then retracted, the unloading hoistway door is closed, the gap lifter is returned to its fully lowered position and the barriers are caused to be lowered to allow the automobile to be driven out of the garage. The return of the elevator conveyor front lift fingers to their fully retracted position cancels the unparking order and conditions the control circuits to receive subsequent orders.

Next assume that an automobile is driven onto the loading platform at the loading station and the driver of the automobile, after exiting therefrom, for one reason or another changes his mind about parking the automobile in the garage and desires instead to drive it out of the garage. In such a case, it is desirable to utilize the tower and elevator to move the car from the platform of the loading station at tier ST, landing IE, to the platform of the unloading station at tier 6T, landing IE, from which position the automobile may be driven without interfering with the incoming traffic. This may be accomplished by what may be termed a "bypass" operation which is basically an unparking operation, previously described, with the exception that the elevator and tower are directed to the loading station to pick up the car from the loading gap lifter instead of being directed to a stall, and a portion of the parking circuit is utilized to transfer the automobile from the loading station onto the elevator, from which point the bypass oper-
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EFC1, which switch operates, disabling the tower and elevator motor control circuits from main operation. As the hoistway door at the loading station arrives at its fully open position, loading gate up mechanical switch LUGUP is actuated by causing the engagement of contacts CB5 (FIGURE 14) which complete a circuit for set coil BP of the bypass switch. The attendant also depresses the loading barrier up button LBUB, closing its contacts LBUB1 (FIGURE 12) and LBUB2 (FIGURE 10), causing the loading station barriers to be raised and the landing gap lifter to place the automobile in position for transfer to the elevator, as has been previously described.

Switch BP, upon operation, separates its contacts BP1 (FIGURE 14), preventing the computer order circuits from giving further orders to the control circuits until the bypass operation has been completed. In addition, switch BP engages its contacts BP4 (FIGURE 17), completing a circuit for coil CSS of the computer signaling switch. Switch CSS operates, signaling the computer that the bypass order has been received by the garage controls and disabling the computer from issuing further orders until the bypass operation has been completed. Switch BP, in addition, engages its contacts BP2 (FIGURE 14), completing a circuit through contacts UNP1, PA1 for set coil PAC of the loading platform call switch.

Switch PAC, upon operation, engages its contacts PAC2 (FIGURE 16), completing a circuit through contacts EL51 (presently engaged since the elevator is empty) for coil HLS of the home landing switch which operates to move the elevator and tower from tier 6T, landing 1E, in the lower landing zone to tier 5T, landing 1E, in the lower landing zone in position to pick up the automobile, as has been previously described. Switch PAC also engages its contacts PAC3 (FIGURE 15), causing operation of the front operation switch FOS to prepare the front conveyor for front operation, and engages its contacts PAC6 (FIGURE 16), completing a circuit for set coil PA of the parking switch which operates, preparing the parking circuits for transferring the automobile from the loading gap lifter to the elevator, as has been previously described.

Bypass switch BP also engages its contacts BP3 (FIGURE 20), preparing the tower direction and start control circuits for an unloading operation at the unloading station and engages its contacts BP6, BP7 (FIGURE 16), completing the circuits for coils ECC, TCC of the floor call and tower cutout switches, respectively. These switches, upon operation, engage their respective contacts ECC3, TCC3, completing a circuit for coil CCR of the car call registered switch to indicate that the call for service has been registered by the control circuits, as has been previously described. Switch BP, in addition, engages its contacts BP4, preparing a circuit for coil MPA of the loading station switch for the arrival of the automobile at the loading station, and its contacts BP5 in the circuit of coil MUN of the unloading station switch, without effect at this time. As has been previously described, the tower and elevator are caused to move to the landing area landing zone at tier 5T, landing 1E. As they arrive thereto, elevator brush EMFB and tower brush TPTB move into engagement with their associated stationary selector contacts EMFC and TPTC5, completing a circuit through contacts DRS20, IFCP58, BP4 for coil MPA of the loading station switch. Switch MPA operates, indicating their arrival at the loading station. Such arrival also causes the loading station hoistway door to be moved toward its fully open position by the operation of loading gate up switch LGO (FIGURE 12), as has been previously described. In addition, as has been previously described, a circuit is completed for coil SSR of the stall signal switch through brush TTB in engagement with stationary contact TTC5 and brush EFB in engagement with stationary contact

As the elevator moves into the upper landing zone, switch UZS (FIGURE 17) is operated, engaging its contacts UZS3 (FIGURE 15), thereby completing a circuit through contacts MP9 (presently engaged) for reset coil PAC of the loading platform call switch, as has been previously described. This switch releases, re-engaging its contacts PAC1 (FIGURE 14), completing a circuit through contacts PA2, BP2 (both presently engaged) for set coil UNP of the up loading switch. Switch UZS, in addition, re-engages its contacts PAC5 (FIGURE 15), completing a circuit for reset coil PA of the parking switch. Switch UNP, upon operation, conditions the control circuits to perform an unloading operation at the unloading station, as has been previously described. As the extended front conveyor lift fingers are caused to move to their fully retracted position, previously described, contacts IFCP4 (FIGURE 15) of the front conveyor retract position switch engage, completing a circuit for reset coil PA of the parking switch. Switch PA releases, indicating that the parking operation portion of the bypass operation is complete. As has been previously described, switch IFCP5 also re-engages its contacts IFCP3 (FIGURE 12), causing the hoistway door, gap lifter and barriers of the loading station to return to their normally closed and lowered positions, respectively.

Switch IFCP5 also causes the tower main controls to move the automobile to the unloading station at tier 5T, landing 1E with the elevator in the upper landing zone, as directed by switch UNP (presently engaged, as has been stated). The automobile is then unloaded, being transferred from the elevator to the unloading station platform via the unloading gap lifter, as has been previously described, so that it may be driven out of the garage. As the elevator, in transferring the automobile to the unloading gap lifter, moves into the lower landing zone at the unloading station with its front conveyor lift fingers in their fully extended position, a circuit is completed for reset coil BP of the bypass switch through contacts IFCEP1, SSR6, LPS2, MUN5 (all presently engaged under such circumstances) and RPLK6. Switch BP releases, reseparating its contacts BGP4 (FIGURE 17) without effect. As the front conveyor lift fingers return to their fully retracted position, unparking switch UNP is caused to release through the engagement of contacts IFCP4 (FIGURE 15) indicating that the unparking operation has been completed and car call registered switch CCR is released through the engagement of contacts UNP (FIGURE 16), reenabling the garage control circuits for receiving subsequent orders. Switch CCR also reseparates its contacts COR1 (FIGURE 17), interrupting the circuit of coil CSS of the computer signaling switch. Upon releasing, signals the computer that the bypass operation has been completed and reenables it for giving further orders to the garage controls, as has been previously described.

Next assume that the driver of the automobile previously parked in stall 4T, 6E, from returns to the garage and informs the attendant that he wishes to procure a shopping bag from the trunk of his automobile. Under such circumstances the attendant by actuating the retrieve push button on the console, initiates what is termed a "retrieve" op-

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eration which consists of a normal unparking operation, e.g., the coded key for the stall in which the automobile is parked is inserted in the computer console and read by the computer and the automobile is unparked to the unloading station platform, with the exception that the unparking operation is not completed insomuch as the time and charges are not computed. In addition, when the completion of the operation which consists of a normal unparking operation, automatically initiates a reparking operation in which the garage controls, instead of receiving the stall designation from the computer and reparking the automobile in its stall from the unloading station platform. However, if the driver of the automobile instead of wanting it reparked desires to drive it from the garage, the attendant may, instead, initiate what is termed a "convert" operation by depressing the covert push button at the computer. This automatically cancels the reparking portion of the retrieve operation, and instead completes the unparking of the automobile by conditioning the garage controls to receive subsequent orders, signaling the computer to compute the parking time and charges and issue a corresponding charge to the credit card ticket.

In the processing of the retrieve operation, the computer reads the coded key for stall 4T, 6E, front into the computer key reading panel, causing the computer to engage its order contacts TS6 (FIGURE 14), FSE4 and FRONT8, thereby completing circuits for coil 6T, 4E and FC of the tier, landing and front coil stall designations switches, respectively. These switches operate, designating stall 4T, 6E, front as the stall from which the automobile is to be unparked and conditioning the elevator and tower control circuits for travel to the designated stall, as has been previously described.

Assume that the attendant initiates a retrieve operation, causing computer order contacts RETRPE (FIGURE 15) to separate while computer order contacts RETRE, mechanically interlocked therewith, simultaneously engage, completing circuits for coil RET of the retrieve switch and the rectifier V for coil URSX of the unpark release auxiliary switch and its timing capacitor CSX in the R-C timing circuit provided in parallel with coil URSX. Switch URSX, upon operation, separates its interlock contact URSX1 in the circuit of set coil RPAC of the retrieve reparking switch, for purposes to be explained hereinafter.

Retrieve switch RET, upon operation, engages its contacts RET2, preparing a circuit for set coil RPAC of the retrieve reparking switch, and its contacts RET1, preparing a circuit for coil URS of the unpark release switch. Switch RET further separates its contacts RET3, preventing front car call registered switch SCHR from releasing and signaling the computer that the operation is complete until either the reparking operation portion of the retrieve is initiated or the retrieve operation is converted to a complete unparking operation, as will be hereinafter described.

Switch RET, in addition, engages its contacts RET6, preparing a circuit for coil MUN of the unloading station switch which switch, when actuated upon the arrival of the elevator and tower at the unloading station, is thereby maintained actuated while the front conveyer lift fingers are fully extended and the elevator moves from its upper leveling zone to its lower leveling zone to transfer the automobile to the unloading gap lifter, as has been previously described. Switch RET also engages its contacts RET8, completing a circuit through rectifier V for coil LKS of the car call registered auxiliary switch and capacitor CKS of the R-C timing circuit connected across coil LKS. Switch LKS, upon operation, engages its contacts LKSI, preparing its self-holding circuit, and separates its contacts LKS2 (FIGURE 17), disabling computer signaling switch CSS from operation, so that the computer may give further orders to the garage to repark.

Switch RET, in addition, engages its contacts RET5 (FIGURE 15), preparing a circuit for its reset coil RET and engages its contacts RET4 (FIGURE 14), completing a circuit through contacts BPI, CCR1 and RPAC for set coil UNP of the unparking switch which operates, causing the automobile, once reparked in stall 4T, 6E, to be unparked to the unloading station platform, as has been previously described, in position to be driven out of the garage or reparked.

Switch UNP, in addition, engages its contacts UNP6 (FIGURE 16), completing a circuit for set coil CCR causing car call registered switch which operates, engaging its contacts CCR11 (FIGURE 17) in the circuit of the computer signaling switch CSS but without effect, since contacts LKS2 of the car call registered auxiliary switch are presently separated, as has been previously described. In addition, switch CCR, as has been previously described, separates its contacts CCR1 (FIGURE 14), preventing the computer from signaling subsequent stall designations or orders to the garage controls until the unparking portion of the retrieve operation is complete.

At the completion of the unparking portion, incident to the front conveyor lift fingers arriving at their fully extended position to transfer the automobile to the unloading gap lifter at the unloading station, a circuit is completed for coil LKY (FIGURE 15) of the lost key auxiliary switch which is completed through contacts IFCEP1, SSR6, UZ33 and MUN7 (all engaged when the elevator is in the upper leveling zone with its front lift fingers fully extended at the unloading station). Switch LKY, upon operation, separates its contacts LKY1 (FIGURE 16), disabling the self-holding circuit of car call registered auxiliary switch LKS until switch LKY releases, as the elevator moves from the upper to the lower leveling zone causing separation of contacts UZ33 (FIGURE 15), as has been previously described.

Incident to movement of the elevator from the upper to the lower leveling zone (in transferring the automobile to the unloading gap lifter), contacts LKS2 (FIGURE 15) of the zone transfer switch engages, completing circuits for reset coils 6T, 4E of the tier and landing stall designations switches, cancelling the stall designation, as has been previously described. Release of the tier and landing switches causes separation of their respective contacts 6T, 4E5 (FIGURE 16), interrupting the circuits for front call cutout switch ECC and tower call cutout switch TCC1, as previously described. These switches release and re-engage their respective contacts ECC1 and TCC1 (FIGURE 15), causing resetting of the front call switch FC and unparking switch UNP, as the front conveyor lift fingers in returning to their fully retracted position cause the reengagement of contacts IFCP4, as has been previously described. Switches ECC and TCC, in addition, reseparate their respective contacts ECC3 and TCC3 (FIGURE 16), interrupting the energizing circuit for set coil CCR of the car call registered switch, preparing the switch for release through energization of its reset coil at the initiation of a reparking operation or the cancellation of the remainder of the retrieve operation, as will be described hereinafter.

Next assume that, while the retrieved automobile is standing on the unloading platform, its driver decides to pay his parking charges and drive out of the garage, and so informs the attendant. In such a case, the attendant initiates what may be termed a "convert" operation to cancel the remainder of the retrieve operation, i.e., the reparking portion, return the garage controls to a condition where they may receive subsequent orders and
direct the computer to compute the parking time and charges for the customer. Upon the attendant’s pressing the convert button at the computer console, computer contacts CONE (FIGURE 15), engage, completing a circuit across coil URSX1 and MUN1 (both presently engaged) for coil URS of the unpark release switch which operates, engaging its self-holding contacts URS1. Simultaneously, computer contacts RETRE reseparate and their mechanically interlocked associated contacts RETRPKE re-engage, the latter contacts having no effect, since contacts URSX1 are already separated. Computer contacts RETRE, upon separating, interrupt the circuits for set coil RET of the retrieve switch, coil URSX of the unpark release auxiliary switch and its timing capacitor CSX which starts to discharge through coil URSX, maintaining the switch operated for a predetermined time in order to allow the convert operation to be registered by the garage controls.

Switch URS also engages its contacts URS3, completing a circuit through contacts RET5 for reset coil RET of the retrieve switch which releases, reseparating its contacts RET2 in the circuit of set coil RPAC of the retrieve parking switch, thereby preventing actuation of the latter switch upon contacts URSX1 re-engaging when switch URSX “times out” and releases.

Switch RET, in addition, separates its contacts RET4 (FIGURE 14), without effect, and re-engages its contacts RET3 (FIGURE 16), enabling the home landing return circuit for operation, if desired, at the conclusion of the convert operation. In addition, switch RET re-engages its contacts RET7 (FIGURE 16), completing a circuit for reset coil CCR of the car call registered switch and separates its contacts RET8, interrupting the circuit for coil LKS of the car call registered auxiliary switch which, however, is maintained operated for a certain time by the discharge of its timing capacitor through its coil.

Car call registered switch CCR, upon releasing, re-separates its contacts CCR1 (FIGURE 17) in the circuit of coil CSS of the computer signaling switch but without effect, since contacts LKS2 are already separated. Switch CCR also, as has been previously explained, engages its contacts CCR1 (FIGURE 14) and conditions the garage control circuits for receiving further operation orders from the computer.

Car call registered auxiliary switch LKS, upon timing out and releasing, re-engages its contacts LKS2 (FIGURE 17) without effect. At the completion of the convert operation, the computer reopens its order contact CONE (FIGURE 15), as has been previously described, interrupting the circuit of coil URS of the unpark release switch which releases in preparation for subsequent operations.

Next assume that the driver of the automobile retrieved in the previous example, after obtaining his parcel from the automobile positioned on the unloading platform, instead of deciding to drive the automobile out of the garage, moves out of the unloading platform area and signals the attendant to repark the automobile. In such a case the attendant causes the unloading station barriers to be raised to their uppermost position, the hoistway door to be opened and the unloading gap lifter to raise and extend, placing the automobile in position for reparking in stall 41, 6E, front, the stall from which it was retrieved. The attendant next pushes the retrieve button at the console a second time, causing computer order contacts RETRPKE (FIGURE 15) to re-engage, preparing a circuit for the set coil RPAC of the retrieve reparking switch. At the same time, computer contacts RETRE (mechanically interlocked with contact RETRPKE) reseparate, interrupting the circuit for the set coil RET of the retrieve switch and coil URSX of the unpark release auxiliary switch which, however, is maintained operated for a certain time by the discharge of timing capacitor CSX through coil URSX. When capacitor CSX has discharged sufficiently, switch URSX releases, re-engaging its contacts URSX1, completing a circuit for set coil RPAC of the retrieve reparking switch through contacts CRPAC and RET2, CCR2 (both presently engaged) and UNP2.

Switch RPAC, upon operation, engages its contacts RPAC7 (FIGURE 16), completing a circuit for set coil PA of the parking switch, which operating, conditioning the garage controls to perform a parking operation, as has been previously described. Switch RPAC also separates its contacts RPAC3, disabling the actuating circuit for set coil CCR of the car call registered switch until the attendant has been transferred from the unloading gap lifter to the elevator conveyor, as will be hereinafter described, and engages its contacts RPAC9, completing a circuit for reset coil CCR of the car call registered switch.

Switch RPAC further engages its contacts RPAC10 (FIGURE 18), completing a circuit through contacts 1RCR6, 1BURL3 and 1UEGLUP1, for coil SSR of the stall signal switch. Switch RPAC, in addition, engages contacts RPAC11 (FIGURE 16) in order to maintain unloading station switch MUN in operated condition until the automobile has been transferred to the elevator conveyor, as will be described hereinafter. Switch RPAC also engages its contacts RPAC4 (FIGURE 15), completing a circuit for coil FOS of the front operation switch and separates its contacts RPAC5, disabling the energizing circuit for rear operation switch ROS.

Switch RPAC also engages its contacts RPAC12, preparing a circuit for its reset coil RPAC, and separates its contacts RPAC6, disabling the actuating circuit for reset coil PA of the parking switch. Switch RPAC also separates its contacts RPAC8 (FIGURE 15), disabling the stall designation reset circuits, engages its contacts RPAC3, preparing a circuit for reset coil RET of the retrieve switch, and separates its contacts RPAC2 (FIGURE 16), disabling the automatic home landing return circuit. Switch RPAC further separates its contacts RPAC1 (FIGURE 14), disabling the energizing circuit through contacts RET4 for set coil UNP of the unparking switch.

Car call registered switch CCR, upon releasing, re-engages its contacts CCR1 (FIGURE 14), completing circuits through computer order contacts TS4, FS6E and FRONT E (all presently engaged to indicate the code of the key presently in the computer console “read-out” slot) for set coils of stall designation switches 6E and FC, which switches operate, designating the stall in which the car is to be reparked, as has been previously described. Switch CCR also separates its contacts CCR4 (FIGURE 20) and CCR5 (FIGURE 23), disabling the tower direction and main control circuits from operation. Switch CCR separates its contacts CCR9 (FIGURE 16) in the circuit of reset coil CCR and re-engages its contacts CCR3 in the automatic home return landing circuit without effect. Switch CCR also separates its contacts CCR2 (FIGURE 15) in the circuit of set coil RPAC of the retrieve parking switch and re-engages its contacts CCR7, completing a circuit for reset coil RET of the retrieve switch through contacts RPAC3 and RET5 (both presently engaged). Switch RET releases, separating its contacts RET8 (FIGURE 16), thereby interrupting the circuit for coil LKS of the car call registered auxiliary switch and its timing capacitor CLKS which starts to discharge through coil LKS, maintaining the switch in operated condition for a predetermined time.

Parking switch PA, upon operating, besides conditioning the garage controls for a parking operation, has been previously described, engages its contacts PA10, completing a self-holding circuit for coil LKS of the car call registered auxiliary switch, thereby maintaining switch LKS operated.

Front operation switch FOS, upon operation, engages its contacts FOS4 (FIGURE 17), preparing a circuit for the front conveyor lift finger extend control circuits. Stall signal switch SSR, upon operation, separates its
contacts SSR7, disabling the conveyor lift finger retract circuits, and engages its contacts SSR5, completing a circuit for coil FCE of the front conveyor extension horizontal position conveyor switch, thereby causing the front conveyor lift fingers to be extended to a position beneath the automobile, as has been previously described. As the front conveyor lift fingers arrive at their fully extended position, the elevator conveyor is caused to move from the lower to the upper leveling zone, as has been previously described, transferring the automobile from the unloading gap lifter to the elevator. As the elevator moves to the upper leveling zone, switch UZ5 operates and engages its contacts UZ53 (FIGURE 15), as has been previously described, completing circuits through contacts IFCEP1, SSR6, MUN9, (all presently engaged) for reset coil RPAC of the retrieve reparking switch. Switch LKY, upon operation, separates its contacts LKY1 (FIGURE 16), interrupting the self-holding circuit for coil LKS of the car call registered auxiliary switch. Switch LKS, upon releasing, energizes its contacts LKS2 (FIGURE 17), preparing a circuit for coil CSS of the computer signaling switch.

Retrieve reparking RPAC, upon releasing, separates its contact RPAC4 (FIGURE 15) but without effect, since contacts FCI of the front call switch (previously energized) maintain front operation switch FOS in operated condition for reparking the automobile in the designated front stall, and separates its contacts RPAC7 (FIGURE 16), interrupting the energizing circuit for set coil PA of the parking switch which, however, remains latched in operated condition. Switch RPAC also engages its contacts RPAC9, completing a circuit through contacts RPLK9 and presently engaged contacts ECC3, TCC3, FC3 and PA6 for set coil CCR of the car call registered switch. In addition, switch RPAC separates its contacts RPAC10 (FIGURE 18), interrupting the circuit for coil SSR of the stall signal switch.

Car call registered switch CCR, upon operation, engages its contacts CCR11 (FIGURE 17), completing a circuit through contacts LKS2 for coil CSS of the computer signaling switch. Switch CSS operates, informing the computer that the garage controls are responding to the retrieve reparking order and preventing the computer from giving further orders to the garage controls until the retrieve reparking operation has been completed. Switch CCR also separates its contacts CCR1 (FIGURE 14), disconnecting the set coils of the stall designation switches from supply line B1+, thereby preparing the stall designation switches for release at the end of the present operation. Switch CCR, in addition, engages its contacts CCR4 (FIGURE 20), completing a circuit through contacts HLS1 and tier switch contacts 4T1 (presently engaged) for coil TXR of the reverse tower direction switch which operates, thereby preparing the tower main operation circuits for movement of the tower from unloading station stall 6T to the designated stall 4T, as has been previously described, and engages its contacts CCR5 (FIGURE 23) completing a circuit through contacts HLS3 and landing switch contacts 6E1 (presently engaged) for coil XU of the elevator up direction switch which operates, thereby preparing the elevator main control circuits for movement of the elevator upward from landing 1 to designated landing 6, as has been previously described.

Stall signal switch SSR, upon operation, engages its contacts SSR7 (FIGURE 17), completing circuits for coil FCR of the front conveyor retracted switch and coil CHC of the conveyors switch, which switches operate, causing the front conveyor lift fingers to move to their fully retracted position bringing the automobile within the elevator confines, as has been previously described.

As the front conveyor lift fingers arrive at their fully retracted position, front conveyor retract position switch 4T, 6E, front, into which stall the automobile is retracted, and the stall designation and parking order are cancelled, as has been previously described. Incident to the cancellation of the stall designation, contacts FC4 (FIGURE 16) of the front call switch and PA7 of the parking switch re-engage, completing a circuit for reset coil CCR of the car call registered switch which releases re-engaging its contacts CCR1 (FIGURE 14), thereby enabling the garage controls to receive subsequent orders from the computer and reengages its contacts CCR11 (FIGURE 17), interrupting the circuit for coil CSS of the computer signaling switch. Switch CSS, upon releasing, notifies the computer that the retrieve reparking operation is completed and reenables the computer to provide further order outputs to the garage controls.

Next assume that the driver, whose automobile was previously parked in stall 4T, 6E, front, returns to the garage desiring to have his automobile unparked, and informs the attendant that he has lost the coded key which identifies which stall in which the automobile is parked. Under such circumstances, the attendant, in an effort to pick out the stall in which his automobile is parked, checks those transactions which were printed on the computer tape at approximately the time of day that the automobile was driven into the garage for parking. Upon selecting a certain stall in which he thinks the automobile may be parked, he takes the duplicate coded key for that stall out of his console drawer, inserts it into the computer coded key "read-out" slot and initiates what is termed a "lost key" operation by pressing the lost key computer button on the console. Assume that the attendant luckily selects and inserts the correct duplicate coded key, i.e., the key for stall 4T, 6E, front. This causes operation of tier switch 4T, landing switch 6E and front call switch FC, as has been previously described, to designate such stall as the one from which the automobile is to be unparked.

Pressing the lost key button also causes computer order contacts LOSTRKE (FIGURE 15) to separate, for purposes to be explained hereinafter, and computer order contacts LOST KE, which are mechanically interlocked with contacts LOSTRKE to engage, completing circuits for set coil LK of the lost key switch and coil URSX of the unpark release auxiliary switch and its parallel timing capacitor CSX.

Switch URSX, upon operation, separates its contacts URSX2, disabling the circuit for set coil RPLK of the repark lost key switch, for purposes to be explained hereinafter.

Lost key switch LK, upon operation, engages its contacts LK2 (FIGURE 14), completing a circuit through contacts BPI and CCR1 for set coil UNP of the unparking switch, initiating an unparking operation of the automobile parked in the stall designated by the duplicate coded key, i.e., stall 4T, 6E, front, which unparking operation proceeds in the same manner as has been previously described for the "retrieve" operation with the exception that the automobile, after it is unparked from the designated stall and brought to the unloading station at tier 6T, landing 1E, remains on the elevator in position to be viewed by its driver instead of being unloaded. In other words, the front conveyor lift fingers are prevented from being extended and the unloading gap lifter is caused to remain in its fully lowered position. This is accomplished by means of contacts LK6 (FIGURE 16) of the lost key switch, which contacts separate, preventing completion of the actuating circuit for coil SSR of the stall signal switch when the elevator and tower arrive at the unloading station, thereby maintaining switch SSR in unoperated condition and preventing extension of the front conveyor lift fingers, and by the separation of contacts...
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LK8 (FIGURE 12) of the lost key switch, which contacts prevent completion of an energizing circuit for coil UGU of the unloading gap lifter up switch, preventing the unloading gap lifter from being raised, when the attendant causes the unloading station booth door and barriers to be raised, as has been previously described.

Switch LK also engages its contacts LK1 (FIGURE 15), preparing a circuit for coil URS of the unpark release switch, and engages its contacts LK8 (FIGURE 16), completing circuits for coil LKS of the car call registered auxiliary switches and its parallel timing capacitor CKS. Switch LKS operates, separating its contacts LKS2 (FIGURE 17), disabling the actuating circuit for coil CSS of the computer signaling switch until the lost key switch is released.

Switch LK further separates its contacts LK5 (FIGURE 16), preventing completion of an actuating circuit for set coil PA of the parking switch through contacts RPLK3 of the repark lost key switch until switch LK is released. Switch LK, in addition, engages its contacts LK3 (FIGURE 15), preparing a circuit for set coil RPLK of the repark lost key switch and engages its contacts LK4, preparing an actuating circuit for its reset coil LK. Switch LK also separates its contacts LK7 (FIGURE 19), disabling the actuating circuit for coil CC of the call cancellation switch, thereby preventing the call from being canceled until lost key switch LK is released.

It may be noted that the lost key operation is similar to the order contacts described herein after be described. In addition, the exception that the automobile is not unloaded at the unloading station, i.e., with the automobile on the elevator at the unloading station and the hoistway doors in their fully opened position, the driver may look at the automobile and inform the attendant whether or not it is his automobile. If the automobile which has been brought to the unloading station is the correct one, the attendant may, by activating the convert button at the console, as was described for the retrieve operation, complete the unparking operation to deliver the automobile to the unloading station platform in position to be driven out of the garage.

Next assume that the automobile brought to the unloading station is the correct one, and the attendant, desiring to complete the unparking operation, activates the convert button at the console. Such actuation causes computer order contacts CONE to engage, completing a circuit through contacts LK1, MUN1 (both presently engaged) for coil URS of the unpark release switch which operates, engaging its self-holding contacts URS1. Operation of the convert button, as has been previously described, simultaneously causes computer order contacts CLK to reseparate, interrupting the circuit for set coil LK of the lost key switch and coil URSX of the unpark release auxiliary switch, the latter switch being maintained operated for a certain time by the discharge of its capacitor CSX through its coil. In addition, computer contacts order CRPLK, mechanically interlocked with computer order contacts CLK, re-engage without effect, since contacts URSX2 are presently separated.

Switch URS also engages its contacts URS2, completing a circuit for reset coil LK of the lost key switch which releases, separating its contacts LKS3 in the actuating circuit of coil RPLK of the repark lost key switch. Thus, resetting timing capacitor CSX having discharged sufficiently through coil URSX, switch URSX releases, re-engaging its contacts URSX2 without effect. Switch LK, in addition, re-engages its contacts LK8 (FIGURE 12), completing a circuit for coil UGU of the unloading gap lifter up switch, thereby causing, as has been previously described, the unloading gap lifter to be moved to its fully raised and extended position in preparation for receiving the automobile from the elevator.

Switch LK also re-engages its contacts LK6 (FIGURE 18), preparing a circuit for coil SSR of the stall signal switch. When the unloading gap lifter arrives at its fully raised and extended position, contacts UGGLUP1 of the auxiliary unloading gap lifter up position switch engage, as has been previously described, completing a circuit for coil SSR through elevator selector brush EFB in engagement with selector contacts EFC1, contacts RPLK7, LK6 and UNFC7, IRCP6 (both presently engaged), DRS18 and UUBL3, UGGLUP1 (both presently engaged), and tower selector brush TTB in engagement with selector contact TCC6.

Stall signal SSR, upon operation, engages contacts SSR5 (FIGURE 17), completing actuating circuits for coils FCE of the front conveyer extend switch and CHC of the common horizontal conveyer switch, causing the front conveyer lift fingers to be extended, thereby placing the automobile directly over the raised and extended unloading gap lifter to which the car is, in turn, transferred and then lowered to the unloading station platform, as has been previously described. Incident to the transfer of the automobile from the elevator to the unloading station platform, the stall designation and unparking operation are cancelled and computer order contacts CONE (FIGURE 15) are reengaged, as has been previously described for its reset circuit.

Next assume that in the previous example of the lost key operation the attendant, instead of selecting the correct duplicate key, has selected a duplicate key for another stall, and inadvertently has brought to the unloading station for viewing an automobile parked in stall 6T, 4E, front. The customer informs the attendant that such automobile is not his. Under such circumstances, the attendant, desiring to repark such car in the stall from which it was taken, i.e., 6T, 4E, front, instead of actuating the convert button at the console to complete the unparking operation, again actuates the lost key button to initiate a reparking lost key operation which will now be described. The attendant also actuates the unloading barrier down button UBBDB1 (FIGURE 12), causing the unloading station hoistway door, gap lifter and barriers to be closed and lowered, respectively, in sequence, in a manner similar to that previously described for control of the loading station mechanism by loading barrier down button LBBB.

Reactivation of the lost key button causes computer order contacts LOST KE (FIGURE 15), to reopen, interrupting the circuit for set coil LK of the lost key switch and coil URSX of the unpark release auxiliary switch which starts to time out. Simultaneously, mechanically interlocked computer order contacts LOST KE engage, preparing a circuit for set coil RPLK of the repark lost key switch. Upon switch URSX timing out and reseparating, its contacts URSX2 re-engage, completing a circuit for set coil RPLK of the repark lost key switch through contacts RPLK7 and LK3, MUN2 (both presently engaged) and ROSI.

Switch RPLK, upon operation, engages its contacts RPLK1, completing a circuit through contacts CCR6 and LK4 (presently engaged) for reset coil LK of the lost key switch which releases, conditioning the garage controls to perform a reparking operation. Switch RPLK also engages its contacts RPLK3 (FIGURE 16), completing a circuit through contacts LK5 for set coil PA of the parking switch, which operates, initiating a parking operation of the automobile in the stall from which it was obtained, as was previously described for the reparking retrieve operation.

Switch RPLK further engages its contacts RPLK4, preparing a circuit for its reset coil RPLK and separates its contacts RPLK9, interrupting the circuit for set coil CCR of the car call registered switch, and its contacts RPLK6, without effect. Switch RPLK, in addition, separates its contacts RPLK2 (FIGURE 15) in the circuit of reset coil PA of the parking switch, which remains in the open position from being released until the car has been reparked in its stall and the stall designation has cancelled, as will hereinafter be described. Switch RPLK also separates its contacts RPLK8 (FIGURE 14), disabling the actuating cir-
suit for call cancellation switch CC during the reparking lost key operation. Upon the car being reparked into its stall 6T, 4E, front, as has been previously described for the repark retrieve operation, the stall designation is cancelled, causing floor call cutout and tower call cutout switches ECC, TCC, respectively, to release and engage their respective contacts EC1, TCC2 (FIGURE 16), completing a circuit through contacts P5, RPLK4 (presently engaged) for reset coil RPLK of the repark lost key switch. Switch RPLK releases, re-engaging its contacts RPLK2 (FIGURE 15), thereby preparing a circuit for reset coil PA of the parking switch. Switches TCC and ECC also re-engage their respective contacts TCC1, ECC1, completing a circuit for reset coil PA of the parking switch and reset coil FC of the front call switch, which switches release, indicating that the reparking operation has been completed. Front call switch FC, upon releasing, also re-engages its contacts FC4 (FIGURE 16), completing a circuit for reset coilCCR of the car call registered switch which, in turn, releases, separating its contacts CCR1 (FIGURE 17), thereby interrupting the circuit for coil CSS of the computer signaling switch. Switch CSS, upon releasing, as has been previously described, indicates to the computer that the operation has been completed and enables the computer to send subsequent orders to the garage controls. Switch CCR also engages its contacts CCR1 (FIGURE 14), preparing the stall designation circuits for subsequent orders.

Next will be described semi-automatic operation of the garage controls. Assume that manual switch KMDS1 (FIGURE 14) is moved to its left, disconnecting the computer order contacts which control the stall designation and garage operation from supply line B1+, and connecting supply line B1+ instead to the circuitry associated with manual rotary switches RSA, RSB and RSC for semi-automatic operation of the garage controls. Manual switch KMDS1 also completes a circuit for coil LGA1 of the transfer switch which operates, separating its contacts LGA1 (FIGURE 15), for purposes to be explained hereinafter. In addition, manual switch KMDS2 (FIGURE 15) is moved down to its lower position, disconnecting the computer order contacts associated with the circuits for the retrieve, lost key and convert operations from supply lines B1+, thereby preventing them from affecting the garage controls and preparing such circuits for semi-automatic operation by means of manually operated switches TOG and RSD.

Next assume that an automobile is driven onto the loading station platform; the loading station barriers and raised platform are moved to their fully raised and extended position, placing the automobile in “pick-up” position, and the loading station hoistway door is moved to its fully opened position. Also assume that the elevator and tower are parked at the loading station, tier 5T, landing 6E. Under such conditions, the attendant manually selects a stall in which the automobile is to be parked, for example, stall 4T, 6E, front, by first moving brush RSB2B (FIGURE 14) of rotary switch RSB into engagement with stationary contact RSB4, preparing a circuit for set coil 4T of the tier switch; then moving rotary brushes RSB1A, RSB2B (which brushes are mechanically interlocked) of rotary switch RSB into engagement with their respective stationary contacts RSB6B and RSC6B, thereby through brush RSB2B and stationary contact RSC6B, preparing a circuit for set coil 6E of the landing switch, and finally moving brush RSB3B of rotary switch RSA into engagement with stationary contact RSA2B, preparing a circuit for set coil FC of the front call switch.

The attendant next actuates push button PAB, completing a circuit for coil PAM of the manual parking registration switch; the circuit extending from supply line B1+ through manual switch KMDS1, contacts LPSX3 (presently engaged indicating that the car is in “pickup” position), brush RSA1B of rotary switch RSA, which brush is in engagement with stationary contact RSA1A; push button PAB, contacts CCR12, UNM5, and coil PAM to supply line BO. Manual parking registration switch PAM operates to register the parking operation and complete the stall designation circuits for parking the car in stall 4T, 6E, front.

To register the stall designation, switch PAM engages its contacts PAM2, PAM3 and PAM4, completing the previously prepared circuits for set coil 4T of the tier switch, set coil 6E of the landing switch and set coil FC of the front call switch, which switches operate, conditioning the garage controls for movement of the elevator to designated stall 4T, 6E, front; the circuits for the foregoing set coils of the stall designation switches extending from supply line B1+ through manual switch KMDS1, contacts LPSX3 (presently engaged), contacts HHC2, PAM2 (presently engaged) and for set coil FC through rotary switch brush RSB3B presently in engagement with stationary contact RSB3C and set coil FC to supply line BO, and for set coil 6E through contacts PAM3 (presently engaged), rotary brush RSB2B presently in engagement with stationary contacts RSB6 and set coil 6E to supply line BO, and for set coil 4T through contacts PAM3, PAM4 (both presently engaged) and rotary brush RSB2B presently in engagement with stationary contact RSB4 and set coil 4T to supply line BO.

Switch PAM also engages its contacts PAM1, completing a circuit for set coil PAC of the loading platform call switch which operates, as has been previously described, to bring the tower and elevator to the loading station, if they are presently parked elsewhere, and to cause operation of parking switch PA (FIGURE 16) to initiate the parking of the automobile in the designated stall. With operation of switch PAC and stall designation switches 4T, 6E and FC, the attendant may push button PAB (FIGURE 14), interrupting the circuit for coil PAM of the manual parking registration switch which then releases. The garage controls then proceed to perform the registered parking operation, as has been previously described for fully automatic operation.

Next assume that in the foregoing described semi-automatic operation the automobile, upon being driven into the loading platform station, is detected as being what is termed a “high car”; i.e., one that may only be parked in stalls at the 1st or 5th landings, which stalls, in order to accommodate such “high cars,” are of a slightly greater height than the stalls at other landings. Under such circumstances, incident to the arrival of the automobile at the loading station and its detection as a “high car.” A circuit is completed for set coil HC (FIGURE 16) of the high car switch through the engagement of contacts HICL of the high car light ray receiver switch, as has previously been described, causing high car switch HC to operate. High car switch HC engages its contacts HCLC (FIGURE 18), preparing a circuit for reset coil HC of the high car switch, and separates its contacts HC2 (FIGURE 14), disconnecting supply line B1+ from rotary switch brush RSB2B, RSB2B and RSA1B, thereby preventing stall 4T, 6E, FC from being registered as the designated stall, upon actuation of push button PAB by the attendant and the consequent operation of manual parking registration switch PAM, as was previously described. In addition, the separation of contacts HC2 prevents contacts PAM1 of the manual parking registration switch from completing a circuit for set coil PAC of the loading platform call switch to initiate the parking operation.

It may be noted that should high car switch HC be in operated condition through failure of the high car light ray switch rather than through the actual detection of a “high car,” the attendant, after visually ascertaining that such is the case, may actuate push button PBP to closed condition, completing a circuit through brush RSB2B presently in engagement with stationary contact RSA1B.
for coil BPX of the high car bypass switch. In such a case, switch BPX operates, engaging its contacts BPX1, thereby bypassing presently separated contacts HC2 of the high car switch and enabling the stall designation to be registered and the parking operation to be initiated, as has been previously described.

Assuming that the high car light ray is functioning properly and a "high car" has been actually detected, in order to register the stall designations and initiate a parking operation on the attendant must manually mechanically interlocked brushes RSCB1 and RSCB2 of rotary switch RSC into engagement with either of their respective stationary contacts RSCa6, RSCb6 for an 8th landing stall or RSCa10, RSC10 for a 1st landing stall, in order to designate that the automobile is to be parked in a stall at either the 8th or 1st landings, as the case may be.

Assume that the attendant moves brushes RSCB1, RSCB2 into engagement with their respective stationary contacts RSCa6, RSCb6. With the foregoing rotary brushes thus in their assumed respective positions, actuation of push button PAB and the consequent operation of manual parking registration switch PAM causes completion of energizing circuits for the set coils of stall designation switches; tier switch 4T, landing switch 8E, front switch 4CF, and of loading platform call switch PAC. Their consequent operation initiates a parking operation on the "high car" and the "high car" stall 4T, 8E, front, in the manner previously described. Under such circumstances, the energizing circuit for set coil PAC extends from supply line B1+ through manual switch KMDS1, contacts LPSX6, PAM5 (both presently engaged), brush RSCB1 presently in engagement with stationary contact RSCa6, contacts PAM2 (both presently engaged), contacts PAM3, PAM4 and set coil PAC to supply line BO, while the energizing circuits for set coil FC, 8E and 9T follow the same route through brush RSCB1 and stationary contact RSCa6 up to and including the junction point of the electrical connection between contacts PAM2 and PAM3 (both presently engaged) from which junction point the circuit for set coil FC extends directly through brush rotary switch RSB2 presently in engagement with stationary contacts RSAa2c and coil FC to supply line BO; the one for set coil 8E extends through contacts PAM5 (presently engaged), brush RSB1 presently in engagement with stationary contact RSCb6 and set coil 8E to supply line BO, and the circuit for set coil 4T is through contacts PAM3, PAM4 (both presently engaged), brush RSB2 presently in engagement with stationary contacts RSb4 and set coil 4T to supply line BO.

High car switch HC is reset impingable to the front conveyor by the front conveyor extend switch, whose operation has been previously described; contacts FCE2 completing a circuit for reset coil HC of the high car switch through contacts MPA1 and HCI (both presently engaged).

Next assume that it is desired to unpark a car from stall 4T, 8E, front. The attendant moves the brushes of rotary switches RSB, RSA and RSC (FIGURE 14) into position to unlock such stall, as was previously described for semi-automatic parking operation, thereby preparing energizing circuits for set coils 4T of the 4th tier switch, 8E of the 6th landing switch FC of the front car switch. He then actuates push button UNB to closed position, completing a circuit for coil UNM of the manual unparking switch. Further, coil UNM is manually closed to a semi-automatic parking switch RSA2B of rotary switch RSA (FIGURE 14) into engagement with its associated stationary contact RSA2B, and then depresses push button BPK to closed position, completing a circuit for set coil BP of the bypass switch. Switch BP, upon operation, transfers the garage controls to perform a "bypass" operation, as has been previously described for the fully automatic operation of the controls, i.e., a automobile on the loading station platform is loaded into the elevator, moved to the unload station and there unloaded to the unloading station platform in position to be driven out of the garage. After switch BP has operated, the attendant releases push button BPK which, under the influence of its biasing spring, returns to its normally open position, interrupting the energizing circuit for set coil BP of the switch.

Semi-automatic operation of the garage controls to perform the previously described retrieval, lost key and convertible operations will next be described. In order to initiate a semi-automatic retrieval operation, say of an automobile presently parked in stall 4T, 8E, front, the attendant manually moves the front conveyor extend switch RSA2B (FIGURE 15) at the computer console into engaged position and its associated rotary contact RSD2, preparing circuits for set coil RET of the retrieve switch, coil URSK of the unpark release auxiliary switch and its associated timing capacitor CSX. The attendant next moves manual switch TOG to its upper position, closing contacts TOGn, thereby completing the previously prepared circuits for set coil
RET, coil RXS and capacitor CSX. Switches RET and URXS operate, conditioning the garage controls for performance of the operation, as has been previously described during the fully automatic operation. The attendant then releases switch TOG which, under the influence of its biasing spring, returns to its normally open mid position reestablishing its contacts TOG, thereby interrupting the circuits for set coil RET, coil RXS and its timing capacitor CSX. Switch RXS quickly "times out," without effect.

In addition, the attendant manually sets rotary switches RSA, RSB, RSC (FIGURE 14) in position to prepare energizing circuits for set coils 4T, 6E and FC of the stall designation switches, as has been previously described for the semi-automatic unparking operation. The attendant then depresses push button UNB to closed condition, completing a circuit for coil UNM of the manual unparking registration switch, as has also been previously described. Switch UNM, upon operation, engages its contacts UNM2 and 3 and 4, completing the previously prepared circuits for set coils 4T, 6E and FC of the stall designation switches which operate, registering the stall from which the automobile is to be retrieved. Switch UNM also engages its contacts UMNI, completing a circuit for set coil UNP of the unparking switch, as has been previously described for the semi-automatic unparking operation. Switch UNP, upon operation, is effective to cause the garage controls to perform a retrieve operation in a manner similar to that previously described for fully automatic unparking operation of the garage controls. Upon operation of switch UNP, the attendant releases push button UNB which returns to its normally open condition, thereby interrupting the circuit for coil UNM. Switch UNM returns to released condition, without effect.

The semi-automatic lost key operation is initiated by the attendant in a similar manner with the exception that brush RSD of rotary switch RSD (FIGURE 15) is in the lost key control circuit instead of with contact RSD2 in the retrieve control circuits, thereby preparing a circuit for set coil LK of the lost key switch. Thus, upon the attendant moving switch TOG into position to engage its contacts TOG, a circuit is completed for set coil LK of the lost key switch which operates, conditioning the garage controls to perform a lost key operation, as has been previously described for fully automatic operation. The attendant next by means of rotary switches RSA, RSB, RSC (FIGURE 14), as in the previously described semi-automatic retrieve operation, selects the stall from which the automobile is to be unparked, say stall 4T, 6E, front. He then depresses push button UNB, causing manual unparking registration switch UNM to operate, registering the stall designation and, in turn, causing operation of unparking switch UNP which, as has been previously stated, is effective to cause the garage controls to perform a lost key operation in a manner similar to that previously described for fully automatic, lost key operation of the garage controls.

It may be noted that, upon the automobile being delivered to the unloading station platform, during the semi-automatic retrieve operation, as has been previously described for the fully automatic unloading operation, actuate mechanical switch UPS (FIGURE 16), completing a circuit for coil UPLT of the unloading platform time switch. Switch UPLT operates, indicating that the automobile has been deposited on the unloading station platform, and energizing coil UNM (FIGURE 17), preparing a circuit for set coil RPAC of the retrieve unparking switch, for purposes to be explained hereinafter.

It may also be noted that, upon the unloading station hoistway doors arriving at their fully open position, incident to the automobile being delivered to the garage controls to the unloading station during the retrieve and lost key operations, as has been previously described, mechanical switch UGOS (FIGURE 15) is actuated by door movement to closed condition, preparing a circuit for set coil RPLK of the repair lost key switch, for purposes to be explained hereinafter.

After delivery of the automobile to the unloading station during either of the retrieve or lost key operations, a convert operation may be initiated if desired, to complete the unloading of the automobile, as has been previously described. In order to initiate a convert operation, the attendant moves brush RSD of rotary switch RSD (FIGURE 15) into engagement with its associated stationary contact RSD3, preparing a circuit through either of presently engaged contacts RET or LK1, as the case may be, for coil URS of the un park release switch. The attendant next moves mechanical switch TOG into position to close its contacts TOG, completing the previously prepared circuit for un park release switch URS. Switch URS, upon operation, is effective to cause the garage controls to complete the unloading of the automobile, in a manner similar to that previously described for fully automatic operation, and returns the garage controls to a condition to receive subsequent orders. Switch TOG, upon being released by the attendant, under the influence of its biasing spring, returns to its mid position, reopening its contacts TOG, without effect.

If it is desired instead to complete either of the retrieve or lost key operations after the automobile has been delivered by the garage controls to the unloading station, i.e., repair the automobile into the stall from which it was removed, either a retrieve reparking operation of a lost key reparking operation, as the case may be (which operations have been previously described for the fully automatic operation of the garage controls), must be semi-automatically initiated by the attendant. To do so, the attendant actuates mechanical switch TOG (FIGURE 15) to a position to close its contacts TOG, completing an energizing circuit for coil RET (FIGURE 17), the coil RPAC of the retrieve parking switch or set coil RPLK of the repair lost key switch, depending upon whether the automobile has been brought to the unloading station by a retrieve or lost key operation, as the case may be, as was previously described. The circuit for set coil RPAC for a repair lost key operation, extends through contacts UPLT2 (presently engaged for the position of the automobile on the unloading station platform after a retrieve operation, as has been previously described), contacts RET2 (presently engaged for a retrieve operation), URSX1, CCR2 (presently engaged) and UNP2. The circuit for set coil RPLK for a repair lost key operation, extends through mechanical switch UGOS (presently closed for the fully open position of the hoistway door, as has been previously stated), contacts LK3 (presently engaged for a lost key operation), URSX2, MUN2 (presently engaged) and RSO1. Switches RPAC and RPLK, as the case may be, upon operation, condition the garage controls to repair the automobile in a designated stall in a manner similar to that previously described for fully automatic reparking operation of the garage controls.

The attendant next selects, by means of rotary switch RSA, RSB, RSC (FIGURE 14), the coil in which the automobile is to be reparked, say stall 4T, 6E, front, as has been previously described, thereby preparing energizing circuits for stall designation switches 4T, 6E and FC. He next depresses push buttons BPB and PAB to closed condition, completing a circuit for coil BPX of the high car bypass switch, and preparing a circuit for coil PAM of the manualパーク switch. Switch BPX, upon operation, engages its contacts BPX, completing a circuit for coil PAM of the manual parking registration switch; the circuit extending from supply line BI through manual switch KMDS1, brush RSAB2 of rotary switch RSA (which brush is presently engaged in engagement with its stationary contact RSA), contacts of push button BPB (presently closed), contacts BPX1.
either from the computer or through the operation of the semi-automatic controls. The attendant may now either proceed to register a new service call and stall designation with the semi-automatic controls, or may move manual switches KMD51 (FIGURE 14) and KMD52 (FIGURE 15) back to their respective initial positions and proceed with fully automatic computer control of the garage, as has been previously described. In a similar manner, other stall designations and operating orders may be cancelled through the operation of call cancellation switch CC.

Means have also been provided for causing, if desired, the garage controls to handle traffic through the garage in a direction opposite to that which previously described; i.e., to receive incoming automobiles which are to be parked in the garage at tier 6T (the present location of the unloading station) instead of at tier 5T and to discharge automobiles which are being unparked at tier 5T (the present location of the loading station) instead of at tier 6T. Similarly, with such a reversal in the operation of the garage controls, automobiles, during the retrieve and lost key operations, are brought from their stalls to tier 5T (the present loading station) instead of to tier 6T, as was previously described. The garage controls may be conditioned to handle traffic through the garage in such a reverse direction by closing manual direction reversal manual switch KD5 (FIGURE 15), thereby completing a circuit for coil DRS of the direction reversal switch from supply line B1+ to line BO. Direction reversal switch DRS, upon operation, actuates its associated contacts provided in the various control circuits, thereby controlling the garage controls for traffic flow from tier 6T, as the loading station, to tier 5T, as the unloading station.

Before embarking upon an explanation of the operation of the various sections of the computer mechanism, a tabulation showing the various signals to which reference will be made may be helpful. This tabulation is as follows:

<table>
<thead>
<tr>
<th>Signal</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add-print motor bur.</td>
<td>&quot;By-pass&quot; operation (East or West).</td>
</tr>
<tr>
<td>&quot;By-pass&quot; East signal.</td>
<td>&quot;By-pass&quot; West signal.</td>
</tr>
<tr>
<td>Start lower computer active</td>
<td>Initiating signal.</td>
</tr>
<tr>
<td>&quot;By-pass&quot; pulse.</td>
<td>&quot;By-pass&quot; operational signal.</td>
</tr>
<tr>
<td>East lower computer active</td>
<td>West &quot;By-pass&quot; operational signal.</td>
</tr>
<tr>
<td>Initiating signal.</td>
<td>&quot;By-pass west&quot; signal.</td>
</tr>
<tr>
<td>Computer busy signal.</td>
<td>West lower computer active</td>
</tr>
<tr>
<td>Computer busy reset pulse.</td>
<td>Initiating signal.</td>
</tr>
<tr>
<td>Color code alarm.</td>
<td>Interdigit carry signal.</td>
</tr>
<tr>
<td>Card reader output (Card code).</td>
<td>Computer busy (Carry).</td>
</tr>
<tr>
<td>Dcdecoded operations signals from card keyboard.</td>
<td>Dcoutput signals from card keyboard.</td>
</tr>
<tr>
<td>Tenup hours time signals.</td>
<td>Hours time signals.</td>
</tr>
<tr>
<td>Days advance relay signals.</td>
<td>Two hours digital clock signals.</td>
</tr>
<tr>
<td>Digital shock control signals.</td>
<td>Years advance relay signals.</td>
</tr>
<tr>
<td>Months advance relay signals.</td>
<td>More &quot;correct&quot; operational signal.</td>
</tr>
<tr>
<td>Card reader output (Card number).</td>
<td>Index signals from card reader.</td>
</tr>
<tr>
<td>&quot;Correct&quot; operational signal.</td>
<td>&quot;Correct&quot; operational signal.</td>
</tr>
</tbody>
</table>

**Figure 15**

- **Name**: Add-print motor bur.
<table>
<thead>
<tr>
<th>Figure</th>
<th>Symbol</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>CVRW</td>
<td>West “Convert” output relay control signal.</td>
</tr>
<tr>
<td>46</td>
<td>CYX</td>
<td>Cycle counter clear.</td>
</tr>
<tr>
<td>44</td>
<td>CYL 2, 3, 4, 5, 6</td>
<td>Cycle counter outputs.</td>
</tr>
<tr>
<td>40</td>
<td>CYL O, 2, 3, 4, 5, 6</td>
<td>Cycle counter Steps (Counting Steps).</td>
</tr>
<tr>
<td>46</td>
<td>CYSP</td>
<td>Counter cycle 3th step pulse.</td>
</tr>
<tr>
<td>48</td>
<td>CYSPK</td>
<td>Parking time data control signal (Hour).</td>
</tr>
<tr>
<td>49</td>
<td>CYSPK</td>
<td>Parking time data control signal (Day).</td>
</tr>
<tr>
<td>87</td>
<td>C99</td>
<td>Card 999 special operation.</td>
</tr>
<tr>
<td>51</td>
<td>D12C</td>
<td>Memory data flip-flop output.</td>
</tr>
<tr>
<td>67</td>
<td>DCA</td>
<td>Digital clock advance.</td>
</tr>
<tr>
<td>60</td>
<td>DK</td>
<td>Serial output of digital clock.</td>
</tr>
<tr>
<td>48</td>
<td>DKS</td>
<td>Delayed DKS pulse.</td>
</tr>
<tr>
<td>71</td>
<td>D2110D</td>
<td>Digital time data (Day).</td>
</tr>
<tr>
<td>71</td>
<td>D212D0</td>
<td>Flashed hours.</td>
</tr>
<tr>
<td>68</td>
<td>DFS</td>
<td>Serializer subcounter output.</td>
</tr>
<tr>
<td>66</td>
<td>DFFP</td>
<td>Difference register output.</td>
</tr>
<tr>
<td>64</td>
<td>DFKP</td>
<td>Digital time - Days (Decimal).</td>
</tr>
<tr>
<td>43</td>
<td>DK5</td>
<td>Delayed key sprocket pulse.</td>
</tr>
<tr>
<td>64</td>
<td>DMI3DMS</td>
<td>Months (Decimal coded).</td>
</tr>
<tr>
<td>37</td>
<td>DPB</td>
<td>$+$ sign power line.</td>
</tr>
<tr>
<td>62</td>
<td>DT10</td>
<td>Digital time data (Hour).</td>
</tr>
<tr>
<td>55</td>
<td>EF'S</td>
<td>East-front column selection.</td>
</tr>
<tr>
<td>55</td>
<td>EFR</td>
<td>East relay output relay bus.</td>
</tr>
<tr>
<td>68</td>
<td>EHD</td>
<td>East tower output relays lock-in signal.</td>
</tr>
<tr>
<td>88</td>
<td>EHO</td>
<td>East tower operational relays holding signal.</td>
</tr>
<tr>
<td>75</td>
<td>FI</td>
<td>East indexing pulse.</td>
</tr>
<tr>
<td>76</td>
<td>F1L83</td>
<td>Elapsed time (Hours) indexing signals.</td>
</tr>
<tr>
<td>101</td>
<td>EMFI1</td>
<td>Feed display power relay signals.</td>
</tr>
<tr>
<td>37</td>
<td>EP</td>
<td>Emergency keyboard (Power line).</td>
</tr>
<tr>
<td>101</td>
<td>ER'S</td>
<td>End print pulse.</td>
</tr>
<tr>
<td>55</td>
<td>ER'S</td>
<td>East{return} column selection signals.</td>
</tr>
<tr>
<td>65</td>
<td>ER'S</td>
<td>East subcounter.</td>
</tr>
<tr>
<td>80</td>
<td>EFB</td>
<td>Floor selection signals from key reader.</td>
</tr>
<tr>
<td>81</td>
<td>FCB</td>
<td>Floor location signals (Floor number).</td>
</tr>
<tr>
<td>74</td>
<td>F1F</td>
<td>East tower floor relays.</td>
</tr>
<tr>
<td>80</td>
<td>FARE</td>
<td>East tower floor relays.</td>
</tr>
<tr>
<td>88</td>
<td>FARB</td>
<td>West tower floor relays.</td>
</tr>
<tr>
<td>88</td>
<td>FARBW</td>
<td>West tower floor relays.</td>
</tr>
<tr>
<td>101</td>
<td>FD1</td>
<td>Feed relay hold.</td>
</tr>
<tr>
<td>82</td>
<td>FWD</td>
<td>Feed display interlock.</td>
</tr>
<tr>
<td>82</td>
<td>F1W</td>
<td>East tower rear selection signal.</td>
</tr>
<tr>
<td>82</td>
<td>F21S</td>
<td>East tower rear selection signal.</td>
</tr>
<tr>
<td>90</td>
<td>FSW2</td>
<td>West tower output relay signal.</td>
</tr>
<tr>
<td>36</td>
<td>FUP</td>
<td>&quot;Convert up&quot;脉冲.</td>
</tr>
<tr>
<td>93</td>
<td>H</td>
<td>Hall signal.</td>
</tr>
<tr>
<td>70</td>
<td>HB</td>
<td>Select left or right half of indexing information.</td>
</tr>
<tr>
<td>71</td>
<td>HET</td>
<td>Hold elapsed time.</td>
</tr>
<tr>
<td>101</td>
<td>HM</td>
<td>Hold manually computed fee.</td>
</tr>
<tr>
<td>76</td>
<td>HOS-CN</td>
<td>Indexing signals - Charge card number.</td>
</tr>
<tr>
<td>76</td>
<td>IC's-DM</td>
<td>Indexing signals - Present time (Months and days).</td>
</tr>
<tr>
<td>76</td>
<td>IC's-DT</td>
<td>Indexing signals - Present time (Hours).</td>
</tr>
<tr>
<td>76</td>
<td>IC's-EE</td>
<td>Indexing signals - Calculated fee.</td>
</tr>
<tr>
<td>76</td>
<td>IC's-ST</td>
<td>Indexing signals - Statt number.</td>
</tr>
<tr>
<td>76</td>
<td>IC's-TO</td>
<td>Indexing counter output signals.</td>
</tr>
<tr>
<td>76</td>
<td>IC'S-PP</td>
<td>Index “Park” operation.</td>
</tr>
<tr>
<td>76</td>
<td>IC'S-PE</td>
<td>Index “Unpark” operation.</td>
</tr>
<tr>
<td>76</td>
<td>IC'S-UP</td>
<td>Index “Retrieve” operation.</td>
</tr>
<tr>
<td>76</td>
<td>IC5BR</td>
<td>Index manually computed fee signal.</td>
</tr>
<tr>
<td>101</td>
<td>IMM</td>
<td>Index manually computed fee pulse.</td>
</tr>
<tr>
<td>76</td>
<td>INCI</td>
<td>Input indexing signal.</td>
</tr>
<tr>
<td>76</td>
<td>INDI</td>
<td>Input interlock signal for intent flip-flips.</td>
</tr>
<tr>
<td>34</td>
<td>INI</td>
<td>Input interlock signal.</td>
</tr>
<tr>
<td>69</td>
<td>ITP</td>
<td>Input inhibit pulse from memory timer.</td>
</tr>
<tr>
<td>73</td>
<td>ITR</td>
<td>Input strobe.</td>
</tr>
<tr>
<td>73</td>
<td>IRS</td>
<td>Interlock strobe.</td>
</tr>
<tr>
<td>44</td>
<td>JLS</td>
<td>Card reader sprocket signal.</td>
</tr>
<tr>
<td>44</td>
<td>JSA</td>
<td>Card sprocket signals from card reader.</td>
</tr>
<tr>
<td>42</td>
<td>KFA</td>
<td>Key floor reader information (1 to 8).</td>
</tr>
<tr>
<td>42</td>
<td>KFP</td>
<td>Key parity reader output.</td>
</tr>
<tr>
<td>42</td>
<td>KLR</td>
<td>Key parity signal.</td>
</tr>
<tr>
<td>42</td>
<td>KPS</td>
<td>Key sprocket pulse.</td>
</tr>
<tr>
<td>42</td>
<td>KPSXPA</td>
<td>Key sprocket pulse.</td>
</tr>
<tr>
<td>42</td>
<td>KST</td>
<td>Tower information from key reader.</td>
</tr>
<tr>
<td>42</td>
<td>KSTPA</td>
<td>Key tier reader information (1 to 4).</td>
</tr>
<tr>
<td>42</td>
<td>KTS</td>
<td>Key sprocket signals from key reader.</td>
</tr>
<tr>
<td>42</td>
<td>LA</td>
<td>Lister advance pulse.</td>
</tr>
<tr>
<td>82</td>
<td>LAPI</td>
<td>Lister advance and spacing signal.</td>
</tr>
<tr>
<td>82</td>
<td>LAS</td>
<td>Lister advance and printing signal.</td>
</tr>
<tr>
<td>82</td>
<td>LAP</td>
<td>Stop digital clock signal.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Figure</th>
<th>Symbol</th>
<th>Name</th>
</tr>
</thead>
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<tr>
<td>76</td>
<td>LDO</td>
<td>Power lines to letter key sole-</td>
</tr>
<tr>
<td>86</td>
<td>LD9</td>
<td>&quot;Last key&quot; signal.</td>
</tr>
<tr>
<td>39</td>
<td>LKP</td>
<td>&quot;Last key&quot; input signal.</td>
</tr>
<tr>
<td>39</td>
<td>LKP</td>
<td>&quot;Last key&quot; pulse.</td>
</tr>
<tr>
<td>39</td>
<td>LKE</td>
<td>&quot;Last key&quot; output relay control signal.</td>
</tr>
<tr>
<td>86</td>
<td>KLBRW</td>
<td>&quot;Last key&quot; (West relay) output control signal.</td>
</tr>
<tr>
<td>88</td>
<td>LOSTK</td>
<td>East tower &quot;Lost key&quot; operational signal.</td>
</tr>
<tr>
<td>88</td>
<td>LOSTK</td>
<td>West tower &quot;Lost key&quot; operational signal.</td>
</tr>
<tr>
<td>88</td>
<td>LOSTKPE</td>
<td>East tower &quot;Initiate repackage&quot; after &quot;Lost key”.</td>
</tr>
<tr>
<td>88</td>
<td>LOSTKPE</td>
<td>West tower &quot;Initiate repackage&quot; after &quot;Lost key”.</td>
</tr>
<tr>
<td>10</td>
<td>MAC</td>
<td>Manual computation signal.</td>
</tr>
<tr>
<td>60</td>
<td>MCA</td>
<td>Memory data flip-flop clear.</td>
</tr>
<tr>
<td>67</td>
<td>MD</td>
<td>Start memory cycle.</td>
</tr>
<tr>
<td>81</td>
<td>MH10</td>
<td>Serially memory data output.</td>
</tr>
<tr>
<td>66</td>
<td>MIN</td>
<td>Minuced.</td>
</tr>
<tr>
<td>66</td>
<td>NAPR</td>
<td>Non-add print motor bar.</td>
</tr>
<tr>
<td>87</td>
<td>NTR</td>
<td>Output error.</td>
</tr>
<tr>
<td>87</td>
<td>OF</td>
<td>Half hour elapsed time signal.</td>
</tr>
<tr>
<td>87</td>
<td>OF</td>
<td>Output relays test.</td>
</tr>
<tr>
<td>90</td>
<td>OTR</td>
<td>Output relays set.</td>
</tr>
<tr>
<td>90</td>
<td>OTRW</td>
<td>Output to relays &quot;East&quot; after closed.</td>
</tr>
<tr>
<td>25</td>
<td>PA</td>
<td>Output to relays &quot;West&quot; after closed.</td>
</tr>
<tr>
<td>85</td>
<td>PARK E</td>
<td>Parity check signal. (First 3 bits are odd).</td>
</tr>
<tr>
<td>88</td>
<td>PARK W</td>
<td>&quot;East&quot; tower &quot;Park&quot; operational signal.</td>
</tr>
<tr>
<td>73</td>
<td>PBR0P2B49</td>
<td>&quot;West&quot; tower &quot;Park&quot; operational signal.</td>
</tr>
<tr>
<td>91</td>
<td>PB</td>
<td>Patchboard grouped time.</td>
</tr>
<tr>
<td>73</td>
<td>PFR0P2B49</td>
<td>Parity check signal. (First 5 bits are odd).</td>
</tr>
<tr>
<td>91</td>
<td>PE</td>
<td>Parity error signal.</td>
</tr>
<tr>
<td>73</td>
<td>PF</td>
<td>Parity error signal.</td>
</tr>
<tr>
<td>74</td>
<td>PK</td>
<td>Premature card withdrawal.</td>
</tr>
<tr>
<td>33</td>
<td>PK</td>
<td>Premature key removal alarm.</td>
</tr>
<tr>
<td>42</td>
<td>PK</td>
<td>Driving signals for elapsed hours grouping.</td>
</tr>
<tr>
<td>34</td>
<td>PK</td>
<td>East tower &quot;By-pass&quot; output relay control signal.</td>
</tr>
<tr>
<td>59</td>
<td>PK</td>
<td>East tower &quot;By-pass&quot; output relay control signal.</td>
</tr>
<tr>
<td>88</td>
<td>PKW</td>
<td>West tower &quot;By-pass&quot; output relay control signal.</td>
</tr>
<tr>
<td>59</td>
<td>PKW</td>
<td>&quot;Retrieve&quot; signal.</td>
</tr>
<tr>
<td>43</td>
<td>PKX</td>
<td>East tower &quot;Retrieve&quot; output relay control signal.</td>
</tr>
<tr>
<td>43</td>
<td>PKX</td>
<td>West tower &quot;Retrieve&quot; output relay control signal.</td>
</tr>
<tr>
<td>88</td>
<td>PKX</td>
<td>East tower &quot;Retrieve&quot; operational signal.</td>
</tr>
<tr>
<td>55</td>
<td>PRE</td>
<td>East tower &quot;Initiate repackage&quot; after &quot;Retrieve&quot;.</td>
</tr>
<tr>
<td>88</td>
<td>PRE</td>
<td>West tower &quot;Initiate repackage&quot; after &quot;Retrieve&quot;.</td>
</tr>
<tr>
<td>55</td>
<td>PRE</td>
<td>Repeat days subtraction.</td>
</tr>
<tr>
<td>60</td>
<td>RPA</td>
<td>&quot;Retrieve/Lost key&quot; signal.</td>
</tr>
<tr>
<td>60</td>
<td>RPA</td>
<td>&quot;Retrieve/Lost key&quot; steady signal.</td>
</tr>
<tr>
<td>60</td>
<td>RPA</td>
<td>Corrective Carry Interlock.</td>
</tr>
<tr>
<td>34</td>
<td>RPA</td>
<td>“Retrieve” pulse.</td>
</tr>
<tr>
<td>60</td>
<td>RPB</td>
<td>Read pulse from memory timer.</td>
</tr>
<tr>
<td>60</td>
<td>RSB1, 2</td>
<td>&quot;Retrieve/Lost key&quot; steady signal.</td>
</tr>
<tr>
<td>60</td>
<td>RSB</td>
<td>Read strobe pulse from memory timer.</td>
</tr>
<tr>
<td>60</td>
<td>RSB</td>
<td>Patchboard identification lines.</td>
</tr>
<tr>
<td>60</td>
<td>RSB</td>
<td>Common source for RS lines.</td>
</tr>
<tr>
<td>60</td>
<td>RSB</td>
<td>Memory data flip-flop control pulse.</td>
</tr>
<tr>
<td>60</td>
<td>RSB</td>
<td>Read strobe widened pulse from memory timer.</td>
</tr>
<tr>
<td>60</td>
<td>RSB</td>
<td>&quot;Retrieve intent&quot; signal.</td>
</tr>
<tr>
<td>60</td>
<td>RSB</td>
<td>&quot;Retrieve&quot; pulse.</td>
</tr>
<tr>
<td>60</td>
<td>RSB</td>
<td>&quot;Change patchboard&quot; alarm signal.</td>
</tr>
<tr>
<td>60</td>
<td>RSB</td>
<td>Decoded outputs of subtract counter.</td>
</tr>
<tr>
<td>60</td>
<td>RSB</td>
<td>Subtract counter flip-flop outputs.</td>
</tr>
<tr>
<td>60</td>
<td>RSB</td>
<td>Subtract difference output.</td>
</tr>
</tbody>
</table>
matic garage controls directly without the computer. The information which is passed to the garbage mechanism controls the mechanism to park and unpark vehicles in and from individual stalls corresponding to the particular key.

While the operations defined in the foregoing are taking place, the computer equipment stores information to enable it to compute a charge and produces two prints of the transaction. The first printing provides data relating to the parking operation, the second printing provides data relating to the unparking operation and the charge for the parking interval.

In order that the computer and garbage equipment can perform their functions properly, a number of checks are provided. In order to permit the mechanical garbage equipment to properly store a car, the car must first be oriented at a receiving station. If it is not so oriented, an alarm is sounded. It is necessary that tall cars be stored in stalls on particular floors arranged to accommodate them. If a selection of an improper floor is made by using a key which directs a tall vehicle to a floor which cannot receive it, an alarm is sounded. A signal indicating that a car is not properly oriented at the receiving station is received from the garbage equipment and impressed on the position check circuit. Similarly, an indication that a car is a tall car is obtained from the garbage equipment and impressed on the tall car check circuit. Both of these check circuits are shown at the top in FIGURE 114.

The various operations required by the computer, in response to the operations of any one of the functional control buttons in the computer, are performed during what is called a cycle of operation of the computer. Thus parking for instance, will be performed during a cycle of operation of the computer as will unparking and the other operations. A cycle is sub-divided into six sub-cycles by a control circuit and a counting circuit. During these subdivisions of a cycle, operations which are required to be performed in the computing circuitry during each subdivision are carried on. If the operation is performed successfully, the cycle control circuit is signalled to step the counter into the succeeding subdivision of the cycle.

It was mentioned in the foregoing that a car was checked for proper positioning and to guard against the direction of a tall car to the wrong floor. This is performed during the first counting cycle of the cycle counter. It is pointed out that the period prior to the start of cycle counting is known as the quiescent period. The first cycle is designated cycle 0, and the numbers run up to cycle 6. The position check and the tall car check are performed during cycle 0 and must be met or succeeding operations of the computer are prevented.

The serrations in each key are arranged so that there is an odd number of them. It is pointed out that each key produces three signal permutations which identify the number of the stall individual to the key and directs a car to or receives it from the stall. The total number of signal elements in the three permutations combined is ten. The signal elements are produced by notching or not notch ing ten assigned areas in the key. Each key is arranged so that it has an odd number of notches. This is tested by means of a parity checking circuit shown in the middle left portion of FIGURE 114. The parity check is made during cycle 0. The results of the tall car check, the position check, and the parity check are impressed on the halt control circuit shown in the upper middle portion of FIGURE 114. If any one of these checks is not met, the halt control circuit applies a halt condition on the cycle control sequencer shown in the middle of FIGURE 114. Each key has two areas which are employed to insure that the key is properly inserted in the reader. One of these areas is a notch area which permits flight to pass a key sprocket signal. The other is an un-notched area which intercepts a light beam when the key is properly inserted. The presence of these two signals insures that the key is properly inserted. At the lower left in FIGURE 114, there

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**Figure Symbol Name**

<table>
<thead>
<tr>
<th>Number</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>88</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Functional block diagram of the computing unit**

FIGS. 114 and 115 taken together comprise a functional block diagram of the computing unit. Conductors WT through W7 shown at the bottom of FIG. 114, each connect to correspondingly designated conductors shown at the top of FIG. 115.

As may be understood from the foregoing, the computer circuitry comprises a group of controls by means of which mechanical equipment in the garage may be actuated to convey the vehicles to and from the individual stalls. In addition to this, the control circuitry acts as a mechanism in the computer to compute a charge for each storage. The computer equipment also controls a lister which prints data relating to the transaction and controls circuitry which produces a display of the charges.

The computer control equipment is shown at the upper left in FIG. 114. The conductors which interconnect the computer equipment to the vehicle control equipment are indicated in a dotted rectangle at the right of FIG. 114 and, the display output is shown in another rectangle at the right in FIG. 115.

It has been explained in the foregoing that when a vehicle is parked in the garage, a device, call a key, is used to select a particular stall individual to each key. The key is inserted in a reading device which produces signals corresponding to those encoded in the key. This circuitry is indicated by the reading designated key reader, at the upper left in FIG. 114. As explained, the computer and garage equipment is capable of performing a number of different functions. These functions are under control of individual functional control buttons shown in a dotted rectangle at the upper left in FIGURE 114. The output of the key reader is impressed on a buffer relay circuit, shown at the middle right in FIGURE 114. A signal produced by each functional control button is also applied to the buffer relays. The output of the buffer relays is impressed on output storage relays, and this is passed through a disconnect relay to the garbage mechanism. The disconnect relay may be operated to disconnect at the computer from the garbage equipment when, as a result of malfunction, it is desirable to operate the auto-
are shown a number of signal lamps. One is the tall car error indicator. Another is a position error indicator. These have been described heretofore. Failures of a parity check lights another lamp under control of the parity check circuit. The signals which are impressed on the buffer relays by the key reader circuit are compared with signals stored in the output relay storage circuit in the output error detector. This check is performed in the output error detector shown in the middle of FIGURE 114. If these signals do not correspond, the output error detector lights the output error indicator lamp shown in the lower left hand portion of FIGURE 114.

Before information can be passed from the output relay storage circuit to the garage equipment, the garage equipment must be in condition to receive it. If it is not, a disabling signal is passed from the garage equipment and impressed on the output relay storage circuit. This is the function of the conductor designated "call accepted from tower" shown connected to the output relays storage at the upper right FIGURE 114. Under this condition, the signals will remain stored in the output relay storage circuit until the garage equipment is ready to receive them. While the garage equipment is busy and unable to receive information from the output relay storage circuit, the storage circuit lights a tower active indicator lamp at the lower left in FIGURE 114.

If a vehicle is directed to a stall which is already occupied, the condition is indicated by a stall occupied control circuit in the middle of FIGURE 115. Stalls are tested for occupancy during cycle 1, and if a stall is occupied when an attempt is made to park a vehicle, therein, the stall occupied control lights the stall full indicator lamp at the lower left in FIGURE 114. During an unparking operation, a stall is tested during cycle 1 and if the empty control circuit lights the stall empty indicator shown at the left in FIGURE 114. It is mentioned that the condition of the stall is recorded in a memory device to be described hereinafter.

When the key is inserted in the key reader circuit, the signals read from the key are impressed on the memory address control shown at the upper left in FIGURE 115. The computer is equipped with a magnetic core memory of the co-incident current type. There is an individual group of recording devices in the memory for each stall. In each group there is a single element which, as mentioned in the foregoing, stores information as to whether or not a stall is occupied. This is done during cycle 1. Whenever a vehicle is parked, in order to provide means for determining the duration of the interval during which it is parked signals defining the time when it is parked are impressed on ten elements of the group of memory elements individual to the particular stall in terms of hours and tenths of hours. This is done during cycle 2 of the parking operation. It is also necessary to know the day of the year when the car is parked. This is also written into ten other units of the memory individual to the particular stall in which the car is parked. This is done during cycle 3. In order to do this, it is necessary that a record of the time of day, and a record of the day of the year be available for sampling and reading into the memory. A permutation of signal elements defining the time of day in hours and tenths of hours is established on a bank of switches, the wipers of which are driven by a clock from row to row of the switcher banks. There is an individual group of three switches defining for the hours and tenths of hours information. There is another group of three switches which provides the day of the year information. This latter group is under control of the same clock through the hour switches. The digital clocks which provide this information are shown in the middle left hand portion of FIGURE 115. The day information provided by the digital clock is in terms of the number of the day in the sequence of the 365 or 366 days of the year. Another bank of switches defines the day information in terms of the number of the month in the year and the number of the day in the month. This is the digital calendar shown at the bottom left in FIGURE 115.

It was stated in the foregoing that the operation is performed in the computer under control of a cycle counter. It should now be mentioned that each of the cycles is further sub-divided into various intervals. This is performed in a circuit which is known as the memory timer shown at the upper left in FIGURE 115. This circuit produces a series of pulses at required intervals during various cycles to control such operations as are performed during the cycles. During a parking operation, for instance, during cycle 0, the signals read from the key are stored in the buffer relays and information stored in the memory is sampled to determine if the stall selected by the key is empty, and a signal indicating that the stall is now occupied is stored in the memory. During cycle 2, the present time, in hours and tenths of hours, is read into the memory. During cycle 3 the present day is read into the memory. During an unparking operation for instance during cycle 1 the memory is sampled to see that the selected stall is occupied and if so the bit which so informs is erased. During cycle 2 the parking hour information is read out of the memory and subtracted from the present hour information. During cycle 3 of the unparking operation the day of parking is subtracted from the present day. Other cycles during the parking and unparking operations are used to control the printing of data relating thereto.

The digital clock is shown connected to the memory device in FIGURE 115. This permits the storage of signals relating to the time of storage. In addition to providing information which is stored in the memory, the digital clock and the digital calendar supply information to the printer indexing control circuit.

The printer circuit is under the control of an indexing control circuit. The printer indexing control circuit includes a counter which produces a series of timed pulses to control the printing operation through a printer line control circuit and a printer driver circuit. Both of these units are shown at the upper right in FIGURE 115. The printer driver circuit drives the Lister.

The computing equipment computes a fee for the garaging service. In order to do this, it must be able to determine the length of time that a vehicle is garaged. It was stated in the foregoing that the time when a vehicle is parked is stored in its individual memory. This information is available for use in the digital subtractor in the middle of FIGURE 115, when a vehicle is unparked. First, the present time must be determined. This is obtained from the digital clock which supplies this information to the digital subtractor. The subtracting information is under control of a counter which translates the information, all of which is available simultaneously, into serial form in which each of the ten bits of information defining any of the four pieces of involved time information is supplied to the subtractor serially, one bit at a time, for reasons of economy. The digital subtractor effects the subtraction of the parking time from the present time. The results of subtracting each of these from the other is a series of ten signals in each instance, one of which defines the elapsed time in hours and tenths of hours, and the other of which defines the elapsed time in days. The results of the subtraction are impressed on an elapsed time register and grouping circuit shown in the middle of FIGURE 115. This circuit includes means for weighting different periods of time with different rates depending upon whether the parked interval is a relatively busy interval or a quiet interval. The elapsed time register and grouping circuit controls a fee display relay circuit which, in turn, controls the fee display shown both at the middle right in FIGURE 115. The elapsed time register and grouping circuit also controls the printer indexing control circuit, which in turn, controls the Lister through the printer line control and the printer driver shown at the upper right in FIGURE 115.

In the event that a vehicle is parked for longer than
twenty-four hours, this becomes known when it is unparked as a result of the subtraction process in a circuit which detects this fact. This detection circuit lights the manual cash compute lamp and the fee is then computed manually.

To properly weight the garbage intervals at various times for purpose of computing the fee, the circuitry includes a number of plug boards which are selectively inserted individually between the output of the subtractor and the fee display relays. This is shown at the lower right in FIGURE 115. The circuitry includes arrangements which provide an alarm at a particular time when it may be necessary to change the rate for the parking fee by substituting one plug board for another. Means are provided to check to insure that the plug board which is used is the one which is intended. Failure of the check produces an alarm by lighting the rate change indicator lamp at the lower left in FIGURE 115.

The computer circuitry provides special means for handling the charges for garage operations for charge customers. The actual transfer operations of the vehicle are carried out under control of any key which may be selected, as for a noncharge customer. In addition, however, each charge customer is provided with an individual card which is encoded with an individual card number. Each card is encoded also with an individual code for identification purposes. The charge card is read in a card reader shown at the lower left in FIGURE 115. When it is read the identifying code is checked by the comparator. The checking is performed by means of a plug board. If the check fails, the card code indicator lamp, shown at the left middle portion of FIGURE 115, is lighted as an indication. The card reader is equipped with another lamp circuit which indicates if the card is prematurely removed, and also with a lamp circuit which signals that a card has been burned and may be removed. The card reader controls the lister through the printer indexing control printer line control, and printer driver circuitry, but it does not produce a fee display. A record of the transaction is entered by the lister for billing purposes.

Construction of circuit components

Most of the components of the computer circuitry are solid state devices, well known in the art and it is considered, therefore, that it is unnecessary to describe them in detail. A short explanation of each is presented here.

The flip-flop circuit is shown in FIGURE 61. This is an Eccles-Jordan type flip-flop circuit. The flip-flop is in the reset state when the "1" output is at 0 v. and the "0" output at —6 v., corresponding to T1 on and T2 off. If the Allow Set terminal is held at ground for at least 4 microseconds and a negative pulse is applied to the Set terminal, the input capacitor develops a 6 volt charge (at which it arrives in about 4 microseconds). The positive-going edge of the pulse is transmitted via the diode D3 to the base of T1, turning it off and initiating the Eccles-Jordan flipping action. Similarly, the positive-going edge of a negative pulse of at least 4 microseconds duration applied to the Reset input turns the flip-flop off if it has been set on.

The inverter is shown on FIGURE 104. When the input is at or near ground (0 v.) the PNP transistor is biased off by the resistance network in the input circuit. This assures positive cut-off and offers noise rejection. In this state the transistor is non-conducting and the collector resistor pulls the load down against the —6 v. clamp voltage. It should be noted that if the inverter drives more buffer load than can be pulled down by the collector resistor, additional pulldown must be provided externally by use of a resistor car. This furnishes additional buffer capability at the expense of gate capability.

When the input is pulled down to the neighborhood of —6 v., the transistor is turned on fully and its collector approaches 0 v. The non-linear feedback diode from the collector into the base circuit keeps the transistor from becoming deeply saturated and minimizes the storage effect at the turn-off transition.

The capacitor from the input to the base is a speedup which helps during turn-on and turn-off.

The inhibit driver is shown on FIGURE 105. The input is pulsed from 0 to —6 when it is intended to prevent a one from being written in the particular plane during a write cycle.

The ID pulse must envelop the write pulse by 1 microsecond on either side, and is, therefore, 6 microseconds long.

The blocking oscillator is shown on FIGURE 106. This circuit is a monostable multivibrator circuit which accomplishes the function of logical differentiation and pulse forming. It may be driven by gates or buffers or power sources. Input differentiation is accomplished in the capacitor leading to the base of the input emitter follower. Note that the time constant for positive pulses is about 1.6 microseconds while that for negative pulses is about 5 microseconds. This is discussed below.

The emitter follower drives the input of a buffer in the base circuit of T2. A negative-going edge at the input will turn on T2 which in turn turns off T1 via the coupling capacitor. The collector of T1 falls to —6 v. and feedback to T2 is accomplished via the other input to the buffer in the base circuit of T2. When the coupling capacitor recovers via the charging resistors in the base circuit of T1, the latter transistor returns to its normal state and the feedback ends. Note that the circuit has not at this time recovered: rather the coupling capacitor must be brought to its steady state potential of 20 v. via the collector resistor associated with T2. Three-time-constant recovery is effected in about two times the pulse output width of the blocking oscillator, setting a 33% duty cycle upper limit on its proper use.

The input may be any negative-going edge with a fall time of less than 0.5 microsecond which follows a positive-going edge by more than 4 microseconds. (Shorter positive pulses leave the input capacitor partly charged leaving its output side positive and thereby diminishing the negative swing into the buffer at the base of T2 below the level required to overcome the built-in bias of that circuit resulting in unreliable triggering.)

The non-inverting amplifier is shown on FIGURE 107. It consists of a pair of inverters in tandem. The input stage has the properties of the inverter of FIGURE 104. The output stage is similar to the inverter of FIGURE 104 but is of the Eccles-Jordan type flip-flop variety.

A two input mixer gate is shown on FIGURE 108. It is like a two input gate except that it has a diode associated with it which is part of a following buffer.

FIGURE 109 is a two input gate and FIGURE 110 is a two input buffer neither of which, it is considered, require explanation.

FIGURE 111 shows the sensing amplifier which is used to amplify the signals from the windings of the magnetic cores in the memory. The sense windings on the cores are connected in series and then to the amplifier input.

Signals from the sense winding which threads one plane are on the order of 50 mv., very low impedance, and of either polarity.

The sense amplifier circuit first steps up the input signal in a transformer which feeds a grounded base stage (T1) which in turn feeds an emitter follower (T2) with a second transformer in its emitter circuit. This transformer has a center-tapped secondary and drives a full wave rectifier to produce a positive output for each input pulse regardless of polarity.

An emitter follower (T3) takes the buffered lobes and drives shaping output amplifier (T4). Both the outputs from T3 and the final output from T4 are available on test points.

Both the read and the write cycles produce outputs if a core is switched.

FIGURE 112 shows the bilateral switch. The bilateral
transistor T2 is kept normally conducting by the collector resistor of the NPN transistor T1. When the latter is turned on by switching the input from —6 to 0 v, the bistable circuit with monitoring resistor is provided for examining the current in a bilateral switch. This is usually used with a direct CRO probe using shielding and a local ground on the card.

**FIGURE 113** shows the signals employed in the application to designate a relay winding.

**The subtractor**

The subtractor comprises the subtract counter circuit and the subtraction circuit.

The subtract counter circuit shown on **FIGURES 65 and 66** will now be described. The function of **FIGURE 65** is to produce a series of timed pulses and from these pulses to produce 16 permutations of four element two condition signals. The first of these permutations defines the start of the subtraction cycle. Each of the 15 defines an interval during the subtraction process. Fifteen of the 16 permutations are applied to 15 gates, gates 180 through 194 in **FIGURE 66**, and the sixteenth, the final one in the series, designated ES, for end subtract, is applied to flip-flop 151 in **FIGURE 65** to stop the counting at the end of the subtracting operation.

The subtract counter circuit is used to control the subtraction of the days and hours during cycles 2 and cycles 3 of the 6 cycles produced in the cycle counter of **FIGURE 46**. During each of those two cycles, a condition is applied to a gate 150 of **FIGURE 65** and passes through the non-inverting amplifier 150 to a gate 151. The counting pulses which we are presently undertaking to produce are required only during the unparking cycle, so a signal UPK generated during the unparking cycle is applied through gate 151. A signal CP is also applied to this gate. The signal CP is the last signal produced in the delay circuit associated with the memory timer **FIGURE 60**.

When these three conditions applied simultaneously to gate 151, the CP signal passes through the gate and its tail sets flip-flop 151. This will occur at a random time with respect to the constantly running square wave generator, MV 154. At the end of the first pulse from the square wave generator which coincides with the setting of flip-flop 151, and which pulse has sufficient width, flip-flop 152 will be set by way of gate 152. The next pulse from the multivibrator will then pass through gate 153 and trigger blocking oscillator 153 to produce a four-microsecond pulse named SS which stands for subtraction strobe.

The succeeding pulses from the multivibrator will produce succeeding pulses SS. This will continue until flip-flop 151 is turned off by a pulse ES called the end subtract pulse, which is the last pulse produced in the circuit of **FIGURE 66** to be explained further hereinafter.

The SS pulses thus produced are applied to a four-stage counter which consists essentially of four multivibrators of flip-flop circuits 160, 163, 166 and 169 connected in tandem. The four stages are all in the zero condition at the outset. The application of the first SS pulse shifts flip-flop 160 from the zero condition to the one condition and leaves flip-flops 163, 166 and 169 unchanged in the zero condition. The application of the second SS signal flips flip-flop 160 to the zero condition again and passes a pulse from flip-flop 160 to flip-flop 163 to register a one therein. A count is passed from counter 160 to counter 163 every second count of counter 160. A count is passed from counter 163 to counter 166 every second count of counter 163, which is every fourth count of the original counter 160, and so on. Each counting stage divides the count by two. The terminals designated 1 and 0 in each of the counting stages represent the output terminals. There is an inverting amplifier connected to each one of these terminals. The inverting amplifier connected to each terminal designated 1 has the effect of inverting the one signal and producing what in effect is a zero signal. The inverting amplifier connected to each zero terminal inverts to zero condition and produces a one condition. The one condition for the four stages are designated SFC1, SFC2, SFC3, and SFC4. The negatives of these are designated —SFC1, —SFC2, —SFC3 and —SFC4. When in the one condition each stage of the flip-flop applies minus six volts to the terminal designated 1 and zero volts to the terminal designated 0. For the zero condition these conditions are reversed.

Each one of the gates, 180 to 194 in **FIGURE 66**, and 195 in **FIGURE 65**, passes a pulse during a particular one of the 16 intervals. The four negative conditions of the four counting stages are applied together with an SS signal to gate 180 in **FIGURE 66**. The output is passed through blocking oscillator 180 to produce a signal identified as SIC which means subtract initial clear, which is the first pulse of the 16 in the subtraction cycle. Each one of 14 other permutations generated in the moment of **FIGURE 65** is applied to an individual gate in **FIGURE 66** and produces an individual signal. These signals are designated SCI through SCI14. The final permutation is fed back to gate 195 to stop the counting. The final signal is designated ES, signifying the end of the subtraction cycle. It is necessary also to apply a subtraction strobe signal SS, and further it is necessary to apply either a CA signal, indicating a carry operation, or an RD signal calling for a repeat operation of the days subtraction process when this has been found necessary by the failure of the subtraction operation to produce a positive difference which is indicated by its failure to produce a carry signal CA. The meaning of these latter two signals will be made clear hereinafter.

The subtraction circuit is shown on **FIGURES 61, 68, 69,** and 70. At this time, in the digital clocks hours circuit, **FIGURE 62** and more particularly on the wiper terminals DTI through DTI10 of the three switches in that circuit which record the present time. Since the information is set up in parallel form, so to speak, it would be possible, if we chose to use an individual circuit for each, to perform the subtraction directly. However, this would be quite expensive. Instead of doing this, the information as to the time when the car was parked and the information as to the present time, is serialized. By this is meant that instead of bringing out the information simultaneously, signals representing the tenths of hours, hours and ten hours, are produced in serial form, under control of the subtraction pulses described in the foregoing.

The serializers in **FIGURE 67** of the subtraction circuits, the subtract count pulses, SCI through SCI10 are...
gated individually with the data flip-flop outputs from the memory D1 through D10 in the ten mixer gates 510–1 through 510–10 respectively. D1 represents the least significant bit of the least significant digit in the memory. D2, D3, D7 and D8 represent the next more significant digit and D9 and D10 represent the only possible cases of the most significant digit in the memory. Note that in the case of the most significant digit, it is required to define only one or two numbers, while in the case of the most significant digit, only one of three in the hundreds position. This explains why there is no D11 or D12 as would be required for a complete representation of the third digit if it ranged from 1 to 9. If D1 is a 1, SCI will get through the mixer gate 510–1, through buffer 511, and appear at the output of the non-inverting amplifier 511, producing a signal MD. Similarly a 1 on any of the other digit lines, D2 through D10 will at the appropriate SC time also appear as an output at MD. This MD represents a pulse train conditional on the data, with a pulse for a 1 and no pulse for a zero at the various SC times.

Note also that the least significant bit is represented by the first possible pulse on the serialized output line and that other pulses follow in increasing order of significance. The first four pulses in each group constitutes a group representation of the least significant digit. The next four pulses represent the next to the least significant digit and finally, the last two represent the highest digit of the third or most significant digit. In precisely the same manner, the subtract clock is used to serialize the output of the digital clock registers and the result of a subtraction represented by mixer gates 512–1 through 512–10, buffer 513 and non-inverting amplifier 513 to form the signal DCK in FIGURE 14b.

It is emphasized that FIGURE 67 is used to first translate serially the contents of the memory with respect to the hours while the car was parked, but it is also used to produce a group of serialized signals representing the day when the car was parked. Ten signals in each group will appear at the terminal MD in FIGURE 67, first to define the hours and tens of the hours in binary notation and thereafter to define the particular day of the 365 days of the year when the parked car was parked, also in binary notation.

In order to complete the subtraction and to compute the charge, it is necessary to know the present day and to subtract from an indication of the present day an indication of the day when the car was parked. The information as to the present day is obtained from the ten wiper terminals DD11 to DD10 of the three switches designated Days, Ten Days and Hundred Days of the Digital Clock-Days circuit FIGURE 63. These signals are gated with signals SC1 through SC10 in gates 514–1 through 514–10 in FIGURE 68. They pass through buffer 515 and through non-inverting amplifier 515, the output of which represents the present day of the year from 1 through 366 in serialized form in binary notation.

In the present circuitry, in determining the elapsed hours, by subtracting the hour at which a car was parked from the present hour, it is sometimes necessary to borrow 24 hours. This is indicated by a failure to produce a carry and results in a negative answer in the circuit of the difference register FIGURE 58, in which the binary representation of the elapsed time is temporarily stored in ten flip-flops of which two only 521 and 53 are shown in detail. The same is true of the elapsed days, subtraction of which sometimes produces a negative answer. When this occurs, for reasons to be explained hereinafter, it is necessary to use the hundreds complement produced on the zero terminals —DF10, FIGURE 58, and perform a second subtraction. The signal elements for the minus in this second subtraction in each instance are reserialized in mixer gates 557–1 through 557–10 in FIGURE 68.

pass through buffer 558b and non-inverting amplifier 558 to appear as DFS in serial form. This will be made clear when the manner in which the circuits which perform the subtraction is explained in detail.

5

Subtraction rates

In explaining the manner in which the subtraction of the time at which the car was parked from the present time for both elapsed hours and elapsed days in the present circuitry, reference will be made to the following eight tables.

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>(a–b)</th>
</tr>
</thead>
<tbody>
<tr>
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(Numbers above “Staircase” line have been dropped from all numbers below the “Staircase” line)

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>(a+16–b)</th>
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(Numbers above “Staircase” line have been dropped from all numbers below the “Staircase” line)

<table>
<thead>
<tr>
<th>TABLE 3</th>
<th>(Same as Table 2 except that all possible 16’s have been dropped from all numbers below the “Staircase” line)</th>
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<table>
<thead>
<tr>
<th>TABLE 4</th>
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<table>
<thead>
<tr>
<th>TABLE 5</th>
<th>(Same as Table 4 except that 16 has been dropped from all numbers above “Staircase” line)</th>
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<table>
<thead>
<tr>
<th>TABLE 6</th>
<th>(Same as Table 4 except that 16 has been dropped from all numbers above “Staircase” line)</th>
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</tbody>
</table>
Table 6. (s-a-(b-1))

| b | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
|---|---|---|---|---|---|---|---|---|---|---
| a+b | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10
| 0   | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0
| 1   | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1
| 2   | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2
| 3   | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4 | 3
| 4   | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5 | 4
| 5   | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6 | 5
| 6   | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7 | 6
| 7   | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8 | 7
| 8   | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9 | 8
| 9   | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 9

Table 7. (s-(a-(b-1)))

| b | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
|---|---|---|---|---|---|---|---|---|---|---
| a+b | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6
| 0   | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6
| 1   | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7
| 2   | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8
| 3   | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9
| 4   | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10
| 5   | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11
| 6   | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12
| 7   | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13
| 8   | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14
| 9   | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15

Table 8. (s-(a-((b-1)-2)))

| b | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
|---|---|---|---|---|---|---|---|---|---|---
| a+b | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
| 0   | 0 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0
| 1   | 1 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1
| 2   | 2 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2
| 3   | 3 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3
| 4   | 4 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4
| 5   | 5 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5
| 6   | 6 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6
| 7   | 7 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7
| 8   | 8 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8
| 9   | 9 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9

In performing the subtraction in the present circuitry, it is pointed out that we do not directly subtract b \( \text{from} \) a. Instead of doing this, we form the sixteenth complement of b and add it to a and then subtract 16. It will be seen from the simple algebraic expressions below that this is equal to a minus b.

\[
a-b = a+(16-b) - 16
\]

The reason for doing this is that the present circuitry is more readily adaptable to perform the subtraction in this manner than to do it directly. As an introduction to a description of the subtraction process, attention is called to one of the peculiarities of binary notation which is that any number expressed in binary notation can be readily changed to its binary complement. For instance, a four digit number in binary notation can be changed to its fifteenth complement by changing all of the zeros in its binary permutation to one and all of the ones to zero.

Consider, for instance, the number 7 expressed in four digit binary notation. It is 0111. If we perform the operation mentioned above of changing the zeros to one and the ones to zero, we have 1000. The value of this number is eight which when added to seven gives fifteen.

It will be found that the same applies to all other four digit binary numbers, and in general, the complement of a number is one less than the value of the next higher digit, such as 31 for instance in the case of a five digit binary number may be formed in this same manner.

Consider the decimal digits a and b. Each may have a number range from 0 to 9. Table one represents the outcome of the subtraction of b \( \text{from} \) a for the various combinations. It is pointed out that we do not actually implement Table one as a step in the present process.

Table 1 simply shows the result of subtracting b \( \text{from} \) a when there has been no reduction of 1 from a to supply it to a less significant digit. This is not one of our processes, but is a plus 10 minus b. Attention is called to the fact that in the subtraction of Table 1, the numbers below the staircase line represent subtraction in which a carry has not been necessary. That is to say, it represents subtraction in which b is smaller than a. The numbers above the staircase line represent subtraction in which b has been greater than a and it has been necessary to borrow and increase a by 10.

In mechanizing the process, such as subtraction in digital equipment, some difficulty arises from the fact that while numbers are represented in true binary code within a digit, we prefer to treat groups of four bits as decimal groupings rather than by a true binary representation.

This use of a binary coded decimal creates the problem of gaps for disallowed numbers necessitating the need for correction to provide the correct differences and borrows at the right time.

As mentioned in the foregoing, it is simple to form the 16th complement of \( \text{b} \) in our equipment and to add this term to \( \text{a} \), all that is required to produce the 15th complement of a four digit number in binary notation is to pass the signals, "111\(\text{a}\)" and "000\(\text{a}\)" through an inverter. To change this to the 16th complement, all that is necessary is to add a "1" to the 15th complement. This, too, is a simple matter as will be made clear hereafter.

Table 2 shows the result of adding \((16-b)\) to \(\text{a}\). If we now examine our binary notation system, we note that the addition of 16 to any number has no influence on the least significant 4 bits. Consider the number seven, for instance, expressed in binary notation. It is 0111. If we add 16 to this to make 23, it is 10111. It will be observed that the four right-hand digits defining seven remain unchanged. The same is true when 16 is added to any number as the value of a one at the head of a five digit binary number automatically adds 16 to the four digit number. In subtracting a 16, all that is necessary is to disregard a one in the fifth position of a number after first determining that there is in fact a one in that position. This is shown in the circuitry. The carry indicates a carry. Thus, it is possible to add or subtract 16 at will from our number without affecting the least significant digits.

Refer now to Table 3. Table 3 is the same as Table 2 except that 16 has been subtracted from every number appearing in Table 2 which is equal to or greater than 16. Each of the numbers below the staircase line in Table 3 show the result of a subtraction of 16 from a number in the corresponding position in Table 2. Each of the numbers above the staircase line is the same as in Table 2. That is to say, where it was impossible to subtract 16 from a numeral in any position in Table 2, the number appears unchanged in Table 3. Attention is called to the fact that the numbers below the staircase line in Table 3 are identical with the numbers below the staircase line in Table 1. This would be expected from the algebraic expression in the foregoing. In each of the subtractions performed to produce the numbers below the staircase line in Table 3, it has not been necessary to borrow. In order to perform the subtraction of 16 from the numbers above the staircase line, it is first necessary to add 10 to each number. The result of this addition of 10 to the numbers above the staircase line in Table 3 is shown in Table 4. Table 5 shows the sub-
traction of 16 from each of the numbers above the staircase line in Table 4. It will be noted that Table 5 and Table 1 are now identical. The subtraction process implemented in our circuitry follows the process of Table 4. As was pointed out, the numbers above the staircase line in Table 1 represent borrowings from the next higher significant digit. The digit subtraction we have considered up to now has not included a borrow from the previous digit. When it is necessary to borrow in the present circuitry, we follow the method illustrated in Table 6. That is we produce a borrow. The expression \( a - (b+1) \) effects subtraction from a digit, such as the second digit in a three digit number from which a "1" has been borrowed to permit subtraction of a higher numeral from the first digit. Consider:

\[
\begin{array}{c}
384 \\
346 \\
\hline
238
\end{array}
\]

We are concerned with the subtraction of the four from the eight which has been reduced to seven by the borrow. The expression \( a - (b+1) \) gives the same result. Assume \( a = 8 \) and \( b = 4 \). If one has been borrowed from eight, the result of subtracting them is the same as \( a - (b+1) = 8 - 5 = 3 \). Table 6 is analogous to Table 1 for this case. As mentioned in the foregoing, in the present circuitry, it is simple to form 15 minus \( b \) and it is also simple to perform 16 minus \( b \). Table 7 represents the sum of \( a + (15 - b) \). This table is the equivalent of Table 2 except that it takes care of the borrow of one from \( a \). Table 8 shows Table 7 with the numbers below the staircase line reduced by 16 and the numbers above the staircase line representing the addition of ten and the subtraction of 16 to numbers in the corresponding position in Table 7. The steps performed in Tables 3 and 4 have been carried out but the corresponding tables have not been reproduced. Table 8 is identical with Table 6 except that it applies to a case where a borrow has been necessary. To summarize, then to subtract \( b \) from \( a \) when no borrow is involved, the steps are:

1. Form \( 15 - b \). This can be done by passing the numerals corresponding to \( b \) through an inverter.
2. Form \( 16 - b \) by pretending to carry into the digit. This is done by adding a one to the signal train by inserting it in the circuitry immediately ahead of the train resulting from the inversion.
3. Add \( a + (16 - b) \).
4. It is necessary to determine whether or not a correction of the result is necessary. A correction is not necessary if \( a \) is equal to or greater than \( b \). This will be shown by an indication that the addition process has produced a digit which would ordinarily appear in the 5th position in binary notation. If such is the case, it is indicated by a "carry." The digit is not actually written however. The digit is dropped. This has the effect of reducing the sum by 16 and automatically produces one of the steps shown in the algebraic expression above. If no "carry" is produced it indicates that \( b \) is greater than \( a \) and in this case, it is necessary to perform a correction.
5. If a correction is required, ten is added and inter-digit carries are prevented. This is equivalent to subtracting the 16. It may be noted that the addition of 10 and subtracting 16 is equivalent to subtracting 6 which is the appropriate correction for binary subtraction.

To subtract \( a - (b+1) \) in the case wherein there is a borrow from a digit, the procedure is the same as in the foregoing, except that there is no Step 2. That is to say, we add 15 minus \( b \) instead of 16 minus \( b \).

To summarize it has been shown how to form the 15th complement of the digit \( b \) and how by the addition of \( a + (15 - b) \) or \( (16 - b) \) depending upon the previous inter-digit borrow situation, we can produce correct difference and further borrow indications in the circuits.

The subtractor

The subtraction circuits, FIGURES 67, 68, 69 and 70 will now be described. It has been explained that terminal DCC shown in the middle of FIGURE 68, provides a series of pulses which define the present hours and tens of hours in binary form serially. This series of pulses is used as the minuend. It has also been explained that terminal MD shown in the middle of FIGURE 67, provides a series of pulses defining the hours and tens of hours in binary form serially, representing the time at which the car was parked. This is to be used after inversion in the manner explained in the foregoing to form the subtrahend. The DCK signals are gated through mixer gate 537 together with a minus RPS pulse, the explanation of which will be deferred for the present, and through amplifiers 539 and 540 to produce the signals -MIN and MIN. The signal MIN is the minuend. The MD signal is applied to gate 532, upper middle portion of FIGURE 67 and through inverter amplifiers 534 and 535 to produce the signal SUB and minus SUB. The signal SUB is the 15th complement of the original storage time of the car. That is to say it is the \((15 - b)\) term of the discussion in the previous section. It was stated that after \((15 - b)\) term was produced, in the case of the original digit, it was necessary to change it to \((16 - b)\) and then to add \( 10 \) to the minuend. The terminal MD signal effect changed to 16 is to first produce a signal element by gating one of the sub-cycle signals SIC into flipflop 593. FIGURE 56. Flipflop 593 is called the carry flipflop. A signal condition is stored in here to produce the carry signal except output pulse whenever it is necessary to carry. Since in our circuitry four bits define the least significant digit, there is a possibility for the necessity of a carry between the 4th and 5th bits. There is also this possibility between the eighth and ninth bits. When a carry signal is indicated, it is gated with the minuend and subtrahend signal element appearing at the instant to set a proper signal condition into the first flipflop 574 of a group of four flipflops including flipflops 577, 580 and 583. Although flipflop 593 is ordinarily used to produce the carries between digits as explained in the foregoing, it is also made use of in the case of the first signal element defining each digit of the subtrahend to produce a "1" which has the effect of changing the \((15 - b)\) term to the \((16 - b)\) term. The way this is accomplished is that the carry signal, which is injected into flipflop 593 before the first signal of the subtrahend train appears is gated through gates 552 and 553 into flipflop 574, to in effect, produce a "1" to the sum of the 15th complement of the digit representing the minuend and the digit representing the subtrahend. This same carry pulse and other carry pulses produced between the digits in a train are gated with minuend and subtrahend pulses to produce a carry when necessary in gate 593. This is necessary, as should be understood from the fact that the carry pulse will always effect the result of the addition and may or may not require the insertion of a carry condition in carry flipflop 593. The signals resulting from the addition of \( a \) and \( (16 - b) \) or \( a \) and \( (15 - b) \) as the case may be, are moved progressively from flipflop 574 to flipflop 577 to flipflop 580 and to flipflop 583. After the four bits in the first digit have been added, they are located in these flipflops with the least significant of the bits in flipflop 583.

It was explained in the foregoing that after the addition of \( a \) plus \((16 - b)\), one of two procedures was necessary to form the answer. In one case, it was necessary to subtract 16. This is done in our autoregressive circuitry by neglecting the digit which would ordinarily appear in the fifth place after the addition has been performed. That is to say, if a one would be produced by the operation of the carry process, it is simply used in the carry process and the remaining four bits define the digit as has been explained. Under certain circumstances it is necessary as explained in the foregoing, to add a ten before the 16 can be subtracted. This is indicated by a
failure to produce a carry at the end of the 10th bit. This failure is observed by the connection of gate 541 or 546 with flipflop 543 or 546 in a manner to be described to produce repeat subtraction signals for the hours or days.

Attention is called to the group of gates 560 through 566, inverting amplifiers 504, 505, gates 506 and 507, amplifier 508 and flipflop 509. This group of components is an add and carry circuit similar to the adder and carry circuit briefly described in the foregoing. Its function is to permit the addition of the ten when it is required and to produce carries resulting from the addition when necessary which are fed back to properly control the circuit. The ten which is required to be inserted is formed by passing sub-cycle signals through properly numbered sub-cycles through buffer 174 in FIGURE 70 to produce the correction pulse CR. This CR pulse is applied through gate 595 to produce the correction signal CSC which is the correction pulse CR gated as needed and —CSC. The correction signal CSC together with the signal CDF which is the carry output of the correction section of the adder are gated together in FIGURE 69 to produce the signal CDF and —CDF. These signals are applied as required to the output of flipflop 583 to produce a corrected output of the subtraction process. These signals are like the others in serial form and as a result of the operation which has just been considered represent the number of hours and tenths of hours during which the car was parked.

Case of negative answer

There is a complication involving the necessity for a carry of 24 hours which results when an attempt is made to subtract a larger number from a smaller when a car is parked, say at the twenty-third hour in the day and is taken out at the tenth hour for instance. This will be broadly explained after describing the operation of the circuit for determining the elapsed days during which a car was parked.

It will be recalled that it was mentioned in the foregoing that the signal MD appearing during the second cycle, FIGURE 67, represents hours and tenths of hours and during the third cycle represents days from one to 366 expressed in binary form serially. This has to be subtracted from the present day of the year. The present day of the year is expressed serially at the output of amplifier 515, FIGURE 68, after having been gated through gates 514–1 through 514–10. These signals form the minuend and a signal produced by gating the MD signals through gate 531 form the subtrahend, in another subtracting process which is performed in the same manner as described in the foregoing for the hours and tenths of hours subtraction. This is to say, the minuend and subtrahend and carry signals are applied to gates 550 through 556 and passed through flipflops 574, 577, 580, and 583 and appear during the third cycle as signal SD. It is necessary also to correct these signals at times by the addition of 10 if it is required to subtract the 16. This is performed in the correction adding and carry circuit which permits the 10 to be injected in the manner described.

When, as a result of carrying out the process described in the foregoing for the subtraction of the hours and tenths of hours, it is necessary to borrow 24 hours, complications are involved. First it should be explained that the output signals SD are applied to terminal SD shown in the difference register circuit, FIGURE 58. They are gated with subcycle signals SCS, SC14 and applied through gates 521 through 530 and inserted in flipflops 521 through 530 and applied to —DIF1 and —DIF4 through buffer 174. If there has been a borrow of 24 hours, the signals appearing at these terminals instead of being the correct signals are the hundreds complement of the negative answer of the first subtraction expressed in binary decimal form. This represents 76 hours more than the true parking interval, being the number that during the subtraction process in effect 100 was borrowed rather than 24. It is necessary then to subtract the 76. This is performed by going through substantially the same procedure as in performing the subtraction of the MD signals from the DCK signals for instance during the first subtraction. The signals appearing on the difference register terminals DIF1 through DIF10, FIGURE 57, are applied to the difference serializer, FIGURE 68, in the subtraction circuit. The fact that the subtraction process must be started by adding a second borrow to the hundreds complement of 24 is recognized in gate 541 by the absence of a carry signal CA from flipflop 593 during sub-cycle 11 of cycle 2 and the condition is stored in flipflop 543 to produce a RPS signal which is a repeat subtraction signal for the hours and tenths of hours. This signal is gated with the DFS signal which is the serialized output of the difference serializer and produces the signal MIN. This represents the minuend in the second subtraction and from this, it is necessary to subtract 76. The 76 is produced by buffing pulses produced at properly numbered sub-cycles in gate 535 in the upper portion of FIGURE 67 to produce the signal SUB at the output of inverting amplifier 534.

Attention is called to the fact that in performing the second subtraction, we follow the same method as in the first subtraction, that is to say, we add the minuend appearing at terminal MIN at the output of amplifier 540 in FIGURE 68 to the complement of 76 produced at the output of amplifier 534, FIGURE 67. The signals are applied to gates 550 through 556, FIGURE 69, and pass again through flipflops 574, 577, 580, and 583. The correction circuitry operates in the same manner as previously described and a corrected signal appears at terminal SD which is again applied in parallel to gates 521 through 530 in FIGURE 58 to produce a corrected difference in the hours and tenths of hours signals on terminal DIF1 through DIF10.

There is yet another complication in the process which is cared for in substantially the same way. This occurs when a car is parked say near the end of the year on the 355th day, for instance, and is removed on the 10th day, for instance, of the succeeding year. It is necessary again to borrow. It would be assumed that it would be necessary to borrow a 1000 and then to subtract the thousands component of 365. However, this is not necessary because of characteristics in the circuitry. In this particular case, the result which first appears on the difference register terminals DIF1 through DIF10 is greater than it should be. In the circuitry, assuming a 365 day year, in the subtraction process 100 has been added to the number of days in the tens of hours complement of the number of days in the old year. For instance, if there were 365 days in the old year, it is necessary to subtract the difference between 100 and 65 or 35 from the binary decimal quantity defined by the conditions appearing on terminals DIF1 through DIF10. In the case of a leap year, the number appearing will be 34 greater. It is necessary to subtract 35 in the one instance and 34 in the other from the negative answer on terminals DIF1 through DIF10. In order to do this, it is necessary to again go through the complete process defined for subtracting 76 in the case of the hours and tenths of hours. That is to say, the signals appearing on terminals DIF1 through DIF10 are applied through the difference serializer 557–1 through 557–10.

Here it should be mentioned that the necessity for performing the second subtraction is recognized in substantially the same manner as it is recognized in the incorrect answer in the hours and tenths of hours. That is to say, if no carry is produced in carry flipflop 593, FIGURE 56, during the last sub-cycle of the addition process during which the elapsed days is computed, the absence of a carry signal indicated by a —CA signal from the carry flipflop 593, with the signal C3 cycles 7 and C11 signals, and of the presence of the subtrahend process in effect 100 was borrowed rather than 24. It is necessary then to subtract the
traction signal RDS to indicate the necessity for repeating the days subtraction process. The RDS signals and the serialized DFS signals are applied during cycle 3 to gate 539, FIGURE 68, producing the minuend MIN and —MIN. Gate 534, FIGURE 67, produces the signal elements defining the 34 or 35 required, depending upon the setting of a switch which adjusts the gate for the leap year condition. The signals pass through amplifier 534 and are applied with the signal CV3 for cycle 3 and RDS representing the repeat day subtraction process to gate 534H and appear at the output of amplifier 534A, as signal CVx, the sub-combination. The signal appearing here is combined with the minuend in gates 550 to 556, FIGURE 69, and the corrected signals appear at the output terminal SD. They are applied to terminal SD of the difference register circuit, FIGURE 50, to produce a corrected signal DIF1 through DIF10, in the difference register.

Memory circuit

The memory unit will first be described generally before describing the circuitry in detail. The essential piece of apparatus in the memory unit is a standard RCA magnetic core unit of the core type. The core material is the RCA 222M2 material. In this piece of apparatus, there are 8640 individual magnetic memory rings arranged in a manner resembling the arrangement of the stalls in the garage. There are 36 vertical columns in the X direction, 24 horizontal rows or layers in the Y direction, three layers for each of the eight floors, and ten magnets in depth or in the Z direction. This affords 288 groups of 30 magnets each, of which 270 groups of 21 magnets each are actually used. The 270 groups provide an individual group permanently assigned to each Core. Each group has three layers of 10 magnets each. Of the 30 magnets in each group, one complete layer of ten is employed to store the ten bits of information which define the hours and tenths of hours. Ten other magnets in a second layer are used to store the ten bits which define the days from one to 366. Only one magnet of the ten available in the third layer is used to store the single bit which informs whether the corresponding stall is occupied or empty. Each magnet is magnetizable to either one of two conditions to define either a “1” or a “0.” Each magnet has four windings on it. One is the row selection magnet, another is the tier selection magnet. These are employed cooperatively to effect selection of a magnet corresponding to the allotted stall. The third winding is a sensing winding which senses the condition of a magnet, that is to determine whether it is in the “1” condition or the “0” condition. The fourth winding is an inhibit winding and is used to prevent the magnet from changing state during a write-in operation. This will become apparent hereinafter.

In the selection of a particular group of magnets individual to a particular stall, first a selection of one of the four groups of nine tiers is effected. Then a particular group of magnets corresponding to the one of the eight floors in the garage and to the one of the nine tiers in the selected group of four is chosen. There are two coacting windings on each magnetic ring to effect selection. One selects the horizontal row and the other selects the vertical tier. All of the windings for the different groups are connected in series and all of the windings for the different tiers in a group of nine are connected in series. The magnetic rings identifying a particular stall are selected by the application of a condition to the row selecting windings and to the tier selecting windings simultaneously, using the coordinate selecting arrangement employed in this circuitry. Only the cores which are individual to a particular garage stall can be selected at any one time. The ten rings employed to store bits of information defining the hours and tenths of hours are selected coordinate simultaneously during one cycle of operation.

The ten cores defining the days are also selected simultaneously in one operation.

The period during which each major function, such as parking or unparking, is performed is divided into six cycles. The six cycles are produced by the circuitry in FIGURES 45 and 46, and a control operation is controlled to produce six permutations to define each of the six cycles during each period while a parking or unparking or other operation is being performed. During certain of these six cycles, it is necessary to use the memory timer circuit, FIGURE 60, to subdivide the cycle so as to control the events during a cycle. The memory timer circuit of FIGURE 60 produces a group of pulses spaced in time during a cycle to control the events which occur during a cycle. How this is done will now be described.

The circuit which controls the production of the pulses necessary to control the events which occur during a cycle is shown on FIGURE 60. This circuit is under control of a group of five gates, gates 401 through 405, shown at the left of the figure. Various control conditions are applied to the gates together with the cycle pulse to produce these timed pulses during those portions of the cycle when they are required. Reference to gate 402, for instance, indicates that during cycle one a pulse, individual to cycle one, and three other conditions are necessary to produce the series of timed pulses. One of the three conditions is the application of an EP pulse, which is the minihit print pulse which occurs at the end of a parking operation. The second of these conditions is a —HI pulse which indicates the absence of a hold condition which is applied to the circuitry as a result of a malfunction. The third of the pulses is a —RELK pulse. This pulse is applied during the existence of a retrieve or lost key pulse. The other gates are conditioned during other cycles by other conditions, understanding of which will become apparent as the description progresses.

Assuming that during cycle one the other three necessary conditions prevail, a pulse will be passed through the inverting amplifier 402 and into the flip-flop 404, which triggers the blocking oscillator 406 and is applied through amplifier 404 on the delay line 405. Simultaneously, the pulse is passed through amplifiers 401 to produce the MC and the MCA pulses. The MCA pulse is applied to 10 flip-flops such as 451–1 and 451–2 in FIGURES 51 and 52 to rid these flip-flops of information obtained from the memory relating to a previous and unrelated transaction. The delay line is a device which delays the transmission of a pulse therethrough and which may be tapped at certain places along the line to produce a series of pulses at various intervals during the delay. The first tap on the delay line, representing the shortest increment of delay, triggers blocking oscillator 406 by way of inverter 406, resulting in a pulse designated RP which is the Read Pulse. It is used to transfer, or read out, the contents of the magnetic memory device, to a group of flip-flops where they may be temporarily stored. The second tap on the line, located in time approximately two microseconds after the read pulse, results in the production of a narrow pulse designated RS through blocking oscillator 407. This narrow pulse serves as the read strobe. This is employed to sense the output of the memory magnets during a selected very short period. These operations will be described in detail hereinafter. The fourth tap on the line is used to produce a wide pulse called the inhibit pulse IP, by way of inverter 413 and blocking oscillator 413. It is used to control the writing of information into the magnetic memory. The fifth tap on line 405 results in the write pulse WP at block-
order to effect selection, a write pulse for write in or a read pulse for read out generated in the magnetooptic pulse

timer generator, FIGURE 60, discussed hereinbefore is applied simultaneously to one terminal of each of the selection
windings, that is, to a terminal of the row selection winding and to a terminal of the tier selection winding.
The opposite end of each of these windings is connected to a bilateral switch such as the switch 470-2 in FIGURE 47, for the row selection, and to a corresponding
switch in the tier selection group, to be discussed hereinafter. If a positive going wave form is applied to a bilateral
switch, the winding connected to it will be effectively grounded, so that the read driver pulses will find a
continuous path through the one of the 24 bilateral switches that has been selected, while the other 23 look like open

switches.

Refer now to FIGURES 54 and 55. These figures show the circuitry for selecting the four tower sections and the
tier lines in each section. It was explained that permutations
of two signal conditions provide means for selecting
one of the four vertical sections into which the garage
is divided. At the top of FIGURE 54 there is shown a
gate and an amplifier. An individual one of each of the
four permutations produced by the key for the selection
of the four vertical sections of the tower, when applied to
each of these gates, selects an individual group of nine

towers in each tower section.

The manner in which the rows and columns are
selected will now be described.

During any one memory cycle, only one row and one
column is selected. This is accomplished by driving one
row bilateral switch and one column bilateral switch, FIGUE
55. It was mentioned that when a key was inserted in

a key reader slot, three sets of signals were produced
to define the section of the tower, the floor, and the tier.
Each of the four possible permutations of a set of two
two-condition signal elements define an individual one
of the four-tower sections, the east tower front, the east
tower rear, the west tower front, and the west tower rear.
Each of these permutations of two elements, including the
clear condition, defines one of the eight floors, and each
of nine permutations of four elements defines one of
the nine

Consider buffer 471-1 through 471-8 in the memory
row driver circuits FIGURE 47. The three signals defining
the floors are produced in the key and card reader circuit
FIGURE 42. They are designated FA, FB, and FC. The
eight permutations of these three signals are applied to
the eight buffers 471-1 to 471-8 in FIGURE 47. Each of
these eight buffers can effect the selection of three
bilateral switches of a group of 24. That is to say, there
are three bilateral switches assigned to each floor and select-
able by some particular one of the eight different
permutations.

The permutations pass through an individual inverting
amplifier 471-1 to 471-8 and are applied to three gates
for each floor. Since a selection is to be effected during
each of these cycles, cycle 1, cycle 2, and cycle 3, the
permutations are gated with signals produced in each of
these cycles. During cycle 1, cycle 2, and cycle 3, a signal
is passed on to another inverting amplifier such as 470-1,
and applied to some one of eight bilateral switches such as
switch 470-8.

The coding for floor 8 is FA, FB, and FC. Output from
buffers 471-8 represents selection of that floor. Similarly,
output from buffers 470-1, 470-2, and 470-3 represents
selection of floors 1, 2, 3, etc.

Refer to terminals F1-1, F1-2, and F1-3 shown at the
upper left in FIGURE 47. These terminals are associated
with upper layer and magnet layer 3 respectively. Each of these layers has ten magnets to re-
cord the information pertaining to a particular stall.

The selection of a particular group of magnets for an
individual stall is effected by the simultaneous selection of
a row winding and a tier winding on the same magnet. In
response to this, signals return to the input of amplifier 450–1 and the output of the amplifier is maintained for as long as the wider pulse RSW continues. This output is gated back through gate 451–1 for one of the conditions, and the wide read sprocket RSW will continue to be applied throughout its duration.

This re-circulating circuit constitutes a shaper, and its purpose is to greately lengthen a very short signal. The short signal is effective to prevent the simulation of a signal by noise, but it is too short to perform its succeeding function. This is overcome by the shaping circuit, which lengthens the short signal as has been explained.

The outputs of these shaper circuits are connected to the allow set line of ten flip-flops such as flip flop 453–1. Two microseconds after the recirculation of the signals begin, the set lines of the flip-flops are sampled by another binary RSP, which is also produced in the memory timing circuit of FIGURE 60. If an output occurs at the sense amplifier, this indicates no bit, and the recirculation loop will be active. Minus 6 volts is applied to the allow set lines of the flip-flops and prevents the setting of the flip-flops. If no pulse was read back, indicating the presence of a bit, the corresponding amplifier of the group such as amplifier 450–1 will be at ground, allowing a set of the corresponding flip-flop. Thus, the ten flip-flops such as flip-flop 453–1 represent static versions of the contents of the ten selected cores.

The conditions of the ten cores which are read are indicated by the conditions applied to ten terminals such as terminal D1, in FIGURE 51. The function of the circuit of FIGURE 51 is to read out the contents of a group of magnets to indicate the time in hours during one cycle and to indicate the particular day of the year in another cycle. It has been explained that under certain conditions, a car is taken from a stall and returned to the same stall. When this happens, the contents of the memory are read out and applied to the ten terminals corresponding to terminal D–1 in FIGURE 51. They are stored there, pending the decision to return the car to the stall. When the car is returned to the stall, these conditions are re-applied to the magnets individual to the stall, to restore the information as to the hours and the days when the car was parked.

Another function of the circuits such as FIGURE 51 is to write into the magnets the information as to the hour and tens of hours when the car was parked, and as to the day when the car was parked. This information is obtained by means of the three switches which define the hours and by means of three other switches which define the days. The information as to the hours and tens of hours is impressed in binary form on wipers DT–1 through DT–10 on the digital clock hours circuit of FIGURE 62. The information as to the days of the year is stored on the wipers DD–1 through DD–10 of the days digital clock which is in FIGURE 63. This information is written into the memory rings during cycle 2 and cycle 3 of the six cycles into which each functional memory time period is divided.

During cycle 2, a signal indicating the cycle is gated with signals indicating other necessary conditions through gate 465 to produce the signal CY2PK. This signal is applied to a group of ten gates such as gate 456–1 in FIGURE 51, and the signals from the ten wipers DT–1 through DT–10 are gated through these same gates at this time and written into the memory to define the time of parking in hours and tens of hours in binary permutations.

During cycle 3, a signal produced by the application of a signal corresponding to cycle 3 with other conditions is gated through gate 466 to produce the signal CY3PK. This is applied to ten gates such as gate 455–1, together with signals DD–1 through DD–10 from the wipers of the digital clock which records the days, and their simultaneous occurrence passes these signals through the ten inhibit drivers such as driver 458–1 and impresses them on the inhibit windings of the memory magnets which thereby selects the magnets.

Information is written into the group of ten magnetic cores in the following manner:

When the cores are selected, an attempt is made to set them all into the one condition by the application of conditions to the two select windings simultaneously. In addition to these two windings, as has been mentioned heretofore, there are two other windings, one is the sensing winding, the function of which is to perform the reading during the read cycle, that is to say, to determine what condition a core has recorded. Whether it has recorded a one or a zero. The fourth winding is a so-called inhibit winding, and it is really the winding which controls the setting of the one or zero condition into the magnets. While the attempt is being made to set all of the cores in a group of ten, say, which record the time in hours and tens of hours, to the one condition, such cores as are to be set in the zero condition are prevented from being set to the one condition by the direction of a pulse through the inhibit winding of the core which pulse straddles the pulse which is attempting to set all the cores to the one condition. An inhibit winding on each of the ten cores is connected to the terminals of the ten inhibit drivers, such as driver 458–1. These drivers will be in one or the other of two conditions, depending upon whether or not a bit of information is to be written into its connected core. During cycle 2 and cycle 3, the ten cores which store the hours and tens of hours as the hours information, and as days information respectively, will be selectively set in either the one or the zero condition by the application or the non-application of a pulse to their inhibit windings. The inhibit windings will prevent the magnetic core from being changed from the one condition to the zero condition in the case of such inhibit windings as has proper conditions applied to the gates which control their inhibit drivers.

In the case where information is recirculated, that is when temporarily retrieving the car and restoring it to its stall, it is necessary to preserve the contents of any memory address which has been read, as mentioned heretofore. After such a reading, the write cycle following the read cycle, will force all ten cores to the one condition except those cores which are prevented by a pulse from any of the ten inhibit drivers, such as driver 458–1. This is accomplished by ten mixer gates, such as gate 455–1. Those of these mixer gates which correspond to flip-flops having zero will be enabled, during the inhibit time, whenever it is necessary to rewrite information in a particular memory group from which the information has been temporarily read out. Gate 460, inverter 461, and mixer gate 455–1, shown at the top of FIGURE 51, control the storing of the single bit of information in a single magnet which indicates that the stall is occupied. The opposite condition of the magnet obviously indicates that the stall is unoccupied.

Digital clock and calendar

In order to provide a record of the time during which a car is parked a digital clock, FIGURE 62, and two digital calendar systems, FIGURE 63 and FIGURE 64, are provided.

When a car is parked, a record of the time of parking is impressed on 20 magnetic memory devices individual to the stall in which the car is parked during the second and third cycles of the parking interval. Ten of these memory devices were used to record the hours and the tens of hours at which the car was parked and ten others to record the particular day of the 365 or 366 days of the year on which the car was parked. The information as to the hours is obtained from three multibank stepping switches, FIGURE 62, one of which indicates the time in tens of hours, another of which indicates the time in hours, and a third of which indicates the time in ten hours segments up to 24 hours. The basic control for the
switches is a clock timer which steps once every six minutes, or, once every tenth of an hour. The horizontal rows of terminals on the switch are required to define the ten tenths of hours. There are 11 sets of terminals numbered from 1 through 11, from the top down, on each bank. Only ten of these sets on the tenths of hours switch are used. Ten of the 11 sets on the tenths switch are used and three of the 11 sets on the ten-hour switch are used. The tenths of hours switch when in the first position has no output from any of its terminals, and this is used to define zero tenths of hours. When the switch is in Position 2, 3, 4, 5, 6, 7, 8, 9, and 10, it defines the tenths of hours, from 1 through 9 inclusive. By this it is meant that voltages are applied to conductors connected to the various bank terminals, and the terminals of each horizontal level of the bank are so wired that the voltages applied by the terminals to the switch wipers, when the wipers of the switch are in each one of the individual horizontal positions, that in each such position the wipers generate one multi-element, two-condition permutation code defining one of the numerals from 0 through 9.

After the tenths of hours switch is stepped into the tenths position and a clock pulse is applied to one of the terminals in the tenths position, a condition is passed to a relay which actuates the stepping mechanism of the hours switch. The wipers of the hours switch are stepped from row to row on the hours bank and in doing so, at each level, generate an individual code signal permutation to define a corresponding one of the hours from 0 through 9.

When in position on row 10, the switch transmits a condition to the stepping mechanism associated with the ten hours switch. The ten hours switch operates through two steps each defining ten hours and a third step defining four hours. At the end of 24 hours it is stepped to the fourth level from which it is returned to the home position by a condition defined through the right-hand terminal of banks 4 through 11 of the hours switch. The ten hours switch is thus returned to the starting position at the end of each 24-hour interval.

Refer to FIGURE 57. The clock timer, at the left in FIGURE 57, is actuated so that it transmits an impulse once every six minutes to flip-flop 601. The flip-flop is set by the pulse and remains in the set condition until the following pulse. The timing mechanism is used during certain cycles of operation of the 6 cycle timer. It is important that the time should not be changed while the timing mechanism is being employed in conjunction with the memory to write in the time at which a car is stored or in conjunction with the subtracting circuit to write the time at which a car is unparked or at any one of the other times when the timer is being used for any purpose.

In order to prevent interference with the timing mechanism at such times, a gate 602G, an amplifier 602H and a flip-flop 602F are provided. The gate 602G conditions flip-flop 602F so that it prevents passage of the timing signal which has been stored in flip-flop 601F at any time while the signal is being employed for purposes other than the control of the timing switches. When the condition of flip-flop 602F permits, the timing signal from flip-flop 601F will pass through the right-hand terminal 603 and amplifier 604 to generate the signal —SDC, and SDC the step digital clock signal. The signal will be impressed through a gate conditioned upon the instantaneous impression or signal CBR and signal —LAP and through delay flip-flop and amplifier 605 to appear as signal DCA, the digital clock advance upon the presence of signal DCA, the digital clock advance signal condition upon the instantaneous appearance of signal FDI, the fee display interlock signal and upon the appearance of the lister advance interlock signal LAL. The reasons for these conditions will be made clear hereinafter. A function of amplifier 605 is to block the start of a further cycle which requires use of the clock before the start of the new cycle.

Refer now to FIGURE 62. The step digital clock signal SDC mentioned in the foregoing is applied, at the top left in FIGURE 62, through relay driver 604 on the wind-

of relay R604 operating the relay and applying voltage through its contacts to its terminals CLDI and CL2D. The voltage applied to terminal CLDI is impressed on stepping switch 605, at the bottom left in FIGURE 62. This is the tenth of hour switch. The wipers of switch 605 connected to conductors DT1, DT2, DT3, DT4, DT5, DT6, DT7, DT8, DT9 are normally in engagement with terminals in vertical positions 1 through 4, from right to left, on row 11 at the bottom of switch 605. These terminals are open and therefore produce no binary signal permutation. The wipers are actuated from row to row of the switch once every six minutes. Voltage is shown connected to various terminals in the different rows in accordance with the binary code mentioned heretofore. After the wipers engage the terminals that produce the binary permutation defining each of the ten tenths of hours, when the wipers arrive at the bottom row, which is the eleventh row and the home position, they do not remain there. When the switch is in this position a circuit is established, as seen beneath the switch bank, which extends from battery through the off normal contacts, which are closed when the switch is in the home position, interrupter spring terminal INT SPR and the winding of stepping switch 605 to ground. This steps the switch to position 1.

When the wipers of the tenth of hours switch are in engagement with row 10 thereof, a circuit is established from battery through contacts of relay R604, shown at the top left in FIGURE 10, conductor CLD2, the left-hand terminal of row 10 of the tenths of hours switch the wiper thereon, and the winding of relay R606 to ground, operating relay R606. The operation of relay R606 establishes circuits through its contacts to be explained hereinafter. Battery through contacts 5 of relay 606 is applied to the winding of the hours stepping switch 608 to ground operating stepping switch 608.

Wipers DT5, DT6, DT7, and DT8 of the hours switch would normally be in engagement with terminals in corresponding position on the home position on row 11 at the bottom of the hours switch. It is controlled so as to step over the terminals of Row 11 by the application of battery through off normal contacts 7, interrupter spring contacts INT SPR and the winding of stepping switch 608 to ground after the wipers are stepped from the terminals on row 10 to row 11 of the hours switch.

The hours switch operates in substantially the same manner as described for the tenths of hours switch. It generates a binary permutation code defining the hours when in each one of the positions of the switch except position 11.

When each of groups of wipers on the tenths of hours switch and hours switch is in engagement with its respective row 10, a circuit is established to operate relay R606 and this, in turn, establish a circuit from battery through contacts 6 of relay 606; a wiper and the left-hand terminal of row 10 of the hours switch and the winding of stepping switch 609 to ground operating stepping switch 609. The ten-hours switch resembles the other two switches in FIGURE 62. However, it is distinguished from them in its operation in that it is stepped over rows 4 to 11 to engage row 1 without stepping on any of these rows after it is stepped from row 3 of the switch. This is due to the application of battery through the right-hand terminals of each of banks 4 through 11, the corresponding wiper interrupter spring INT SPR and the winding stepping switch 609 to ground. The wipers of the ten hours switch will engage the terminals of row 11 and row 2 thereon for ten hours each. When they are stepped to row 3 they will be removed therefrom and returned to the starting position on row 1 at the end of four hours by a circuit which extends from battery through terminals 7 of relay R606, the left-hand wiper of the hours switch, the left-hand terminal of row 4 of the hours switch, the left-hand terminal of row 3 of the ten hours switch, a wiper, and the winding of relay R610 to ground operating relay R610. The operation of relay R610 establishes
a circuit from battery through its contacts conductor CLD10 and the winding of relay R607 shown in the lower middle portion of FIGURE 62, to battery operating relay R607. With the circuit in this condition, relay R607, is locked, as the off normal springs 8 of stepping switch 608 are engaged, and a circuit is established from battery through off normal springs 8, the now operated contacts 5, of relay R607 and the winding thereof to battery, holding relay R607 operated. The operation of relay R607 returns the hours switch to the starting position through a circuit which may be traced from battery through contact 7 of relay R607, interrupter springs INT SPR and the winding of stepping switch 608 to ground. The operation of relay R610 serves as a command to step the digital clock days circuit, FIGURE 63, and the digital calendar days and months switch, FIGURE 64, in a manner which will now be explained.

The digital clock which counts the 365 days, FIGURE 63, in a normal year and 366 days in leap year is used to count the days used in the computations by the computer. It works in a manner very similar to the digital hours clock. It was explained in the foregoing that relay R610 operates at the end of the 24 hour interval. Its operation established a circuit from battery, through its contacts, conductor CDI1, from FIGURE 62 to FIGURE 63, and the winding of stepping switch 611 to ground operating stepping switch 611. Stepping switch 611 is arranged in substantially the same manner as each of the tens of hours and hours switch on the digital clock-hours circuit, FIGURE 62. By this is meant that it comprises 11 rows of terminals and its wipers do not remain on the 11th or home row but are stepped over this position and returned to the starting position row 1. The same is true of the ten days switch. The 100 days switch resembles the ten hours switch in the sense that only a few rows of the top of each are used. In the case of the 100 days switch, 4 rows are used to define the three groups of hundred days and the fourth group which may comprise 65 or 66 days. Wipers DD-1, DD-2, and DD-3 and DD-4 are on the days switch define day number permutations by binary notation. Wipers DD-5, DD-6, DD-7 and DD-8 define groups of ten days in binary permutations. Wipers DD-9 and DD-10 define the four groups of the 100 days in binary permutations.

When the left-hand wiper on the days switch engages the left-hand terminal of row 9 thereof, a circuit is established from battery through contacts 6 of relay R613, shown below the days switch in FIGURE 63, and the winding of stepping switch 616 to battery operating stepping switch 616. Stepping switch 616 actuates the ten days switch so that its wipers engage each of the rows of the terminals thereon every ten days and impress a permutation of signals on wipers DD-5, DD-6, DD-7, and DD-8 which define each group of ten days in 100 days. When a wiper of the ten days switch engages the left-hand terminal of row 10 of the ten days switch, battery is impressed on the winding of relay R614 operating the relay. A circuit is then established from battery through contact 7 of relay R613, contacts of relay R614 and the winding of stepping switch 617 to ground operating stepping switch 617. This happens every 100 days, on the first day of each of the three groups of 100 days in a year. During the last 65 or 66 days of each year, the left-hand wiper of the 617 switches switch terminal on bank level 4. When the left-hand wiper of the ten days switch engages the left-hand terminal of row 7 thereof, which will be during the interval from the 60th to the 70th day in each group of 100 days, a circuit will be established, from battery on the wiper through the terminal and the winding of relay R618 to ground operating the relay. When the left-hand wiper of the day switch engages terminal 5 thereof in a normal year or terminal 6 thereof in a leap year, a circuit will be established to one or the other of these terminals.

When relay R610 of FIGURE 62 is operated as described at the end of the 24th hour of a day a circuit is established from battery through a contact of relay R610 to terminal CLD12 which connects to the left-hand wiper of the day switch on FIGURE 63. When this wiper engages the left-hand vertical row of terminals 10 or 19 of the year, a circuit is established through a switch actuated between these terminals to terminal conductor CLD20. Under these conditions a circuit will be established from terminal CLD20 through contacts of relay R618, conductor CLD30, the left-hand terminal of horizontal row 4 and a wiper on the 100 days switch when the wiper engages this terminal and through the winding of relay R619 to ground operating relay R619. This happens at the end of the last hours of the last day of a year. The operation of relay R619 closes a circuit from battery through contacts 5 of the 100 days switch and the winding of stepping switch 611 to ground operating the stepping switch to its row 5 and the switch is thereafter stepped successively from row to row by battery connected through terminals of its right-hand vertical row, the wiper, the interrupter springs INT SPR, and the winding of stepping switch 617. For every ten days switch and the days switch are returned to normal in a manner which should be understood from the previous discussion of corresponding operations.

It has been mentioned that the patron is provided with a record of the transaction. This is produced in printed form by a printer which prints in numerals 1 to 12 and of days of the month from 1 to 28, 29, 30 or 31 depending upon the month. This is produced in part through the medium of another digital calendar clock shown in FIGURE 64. It comprises two switches, one of which is the days switch, which defines the days from 1 to 31 and the other of which defines the months from 1 to 12, both in encoded form. The days switch is under control of relay R610 on FIGURE 62 which, as has been explained, is operated once every 24 hours. The operation of relay R610 connects battery through terminal CLD13, FIGURE 62, which connects to ground which activates the lower middle portion of FIGURE 64, and through the winding of the digital calendar days stepper switch 630 to ground, actuating the switches once every 24 hours. The terminals on the days stepper switch are encoded to define any one of 31 days. The conductors designated DK1, DK2, DK3 and DK4, shown connected to terminals on the day switch, have values of 1, 2, 4 and 8, respectively. The top ten rows are encoded in binary form from the top downward in a manner to define the numerals from 1 to 10. Terminal DK5 may be considered to have a value of 10. It is connected in parallel to corresponding terminals in each of rows 10 to 19 and a wiper engaging this vertical column, combined with wipers engaging other active terminals on the same horizontal row, for horizontal rows 10 through 19, define the numerals from 10 to 19. The same process is followed in defining numerals 20 to 29 and in defining the next group 30 and 31.

How the day and month switches interact will now be explained.

Relay R610 on FIGURE 62 when operated once each 24 hours, connects battery through its contacts to terminal CLD14. This connects to terminal CLD14 on the wiper which engages the left-hand vertical row of terminals on the month switch on FIGURE 64. Reference to this vertical column, and to the coordinate rows on the switch, numbered 1 to 12, shows that months of the year, in the sequence from 1 to 12, which have 31 days are joined in one group on the month switch. The terminals in this
vertical row corresponding to months having 30 days are joined together in a second group, while the left-hand terminal of the second horizontal row of the bank, corresponding to the second month, February, which may have 28 or 29 days is unconnected to any other. As the wiper engages each of these terminals, the battery from contact CLD14 of relay R610 is extended directly to engage terminal 30 or 31 on the day switch, depending upon the row on which the switch is set which the wipers on the month switch are connected. In the case of February, when the wiper of the month switch engages the left-hand terminal of its second row, battery is extended to switch SW28 at the bottom right of the day switch. This may be adjusted to connect it to a terminal on row 28 for normal years or to a terminal on row for leap year. The wiper which engages the left-hand vertical row of terminals on the day switch in FIGURE 64, upon engaging any of terminals 28, 29, 30 or 31 to which battery has thus been connected will further extend the circuit through the winding of relay R631 on FIGURE 64 to ground operating the relay. The operation of relay R631 will connect battery through its contacts to terminal CLD61, and through the winding of the month stepper switch 633 to ground operating the stepper switch. The operation of the stepper switch steps the month switch to the row defining the next month.

The terminals on the horizontal rows are arranged to encode the numerals from 1 to 12 for the month. Thus terminals DM1, DM2, DM3 and DM4 taken together will form 9 different binary permutations defining the first 9 months of the year, Terminal DM5 combined with others defines months 10, 11 and 12 in the year.

When relay R631 is operated as described, at the end of any month, it connects battery to terminals CLD60 and the winding of relay R632 to ground operating the relay. The operation of relay R632 connects battery through contacts 5 and the winding of day stepper switch 630 to drive the stepper switch which steps off row 12, battery is connected to each lower terminal in the vertical second row from the left on this switch and through the wiper, when connected, thereto, and the interrupter spring INT SPR of switch 633 through the winding of stepper switch 633 driving it to its home position. The coded permutation set up on terminals DM1, DM2, DM3, DM4 and DM5 of the month switch, together with the permutation established on terminals DK1, DK2, DK3, DK4, DK5 and DK6 of the day switch in FIGURE 64 will be applied to correspondingly designated terminals of the index decoding circuit of FIGURE 84, to be described hereinafter.

Elapsed time replays, plug board and automatic fee computation equipment and fee display time difference relays

It has been explained how the subtractor circuit, FIGURE 69, produced trains of signals at terminals SD which is the correct output of the subtraction process and represents in serial binary form the subtraction of the time stored in the memory, which is the time at which the car was stored, from the present time as stored on the digital clock. The result is the elapsed parking time. From terminal SD in the subtraction circuit we obtain two trains of pulses. The first represents the difference in the parking time in terms of tenths of hours, hours, and ten hour intervals and then the succeeding train represents the difference between the day of the year when the car was parked and the day of the year when the signal is valid. The first digit of the tenths of hours is first applied to the terminal SD at the bottom of FIGURE 58 followed by the other signals in the train in ascending order of significance. It has also been explained that each complete interval of the subtraction operation is divided into sixteen cycles by the cycle counter of FIGURES 45 and 46. It has also been mentioned that the first pulse of each of the trains does not appear at output terminal SD until during cycle 5 because of the delay of four cycles required for the signals to pass through the first stage of the shift register in the subtraction circuits. The signals of each train are applied successively to terminal SD at the bottom of the difference register elapsed time circuit (FIG. 58). They are applied in parallel to each of gates 521 to 530. During each of cycles 5 to 14, a cycle signal SC5 through SC14 will be applied to an individual one of the gates. If there is a condition present for instance on terminal SD during cycle 5, it will be gated through gate 521 into flip-flop 521F. If such a signal is present during any other cycle, it will be passed through a corresponding gate and stored in a corresponding flip-flop for each of the ten signals which constitute each train. Before storing, flip-flops 521F through 530F were reset by signals SC–1 through SC–10 respectively. When the signals relating to the hours, for instance, are stored, there will be three groups of permutations established on three groups of flip-flops. The first permutation defining the tenths of hours will be established in flip-flops in circuit branches 521 through 524. The next group of four signals defining the permutation for the hours will be established in corresponding flip-flops in circuit branches 525 through 528 and the permutation defining the ten hours intervals will be established in flip-flops in branches 529 and 530.

When defining the elapsed time, each binary permutation impressed on terminal SD at the bottom of the difference register, FIGURE 58, flip-flops in circuit branches 521 through 524 will establish a permutation defining the number of days in the units position of the three digit number from 0 to 366. The flip-flops in the next four circuit branches 525 through 528 will define the numeral in the tens position of the number and flip-flops in circuit branches 529 and 530 will define the numeral in the hundreds position in the number.

The conditions appearing on terminal DFI through DFI0 defining the end result of the subtractions will be impressed in FIGURE 71 through relay drivers 701 through 708 on relays R707 through R710 in the three groups corresponding to the binary arrangement, setting these relays in the operated or unoperated condition to correspond with each of the permutations. Relays R701 through R704 each control a group of contacts which are cooperatively interconnected to encode the tenth of hours expressed in binary manner but, the outputs, representing tenths of hours, are then joined together to define only two different half-hour intervals in each hour. The four sets of terminals on relays R705 through R708 are interconnected so that each binary permutation on their windings is encoded to define a different decimal number, representing the hours from 0 through 9. These ten decimals appear on terminals PR0 through PR9. The terminals of relays R709 and R710 are arranged so as to translate the binary permutation into any one of three decimal numbers which appear on terminals designated PR10, PR11, and PR12 representing the two ten hour intervals from 0 through 9 hours and from 10 through 19 hours, and the interval from 20 to 24 hours. One contact circuit on each of relays R701 through R710 and outputs D01 through DE10 are reserved for the indexing process to be described later. In the middle half-hour portion of FIGURE 71, there is shown a gate 713 to which three conditions are applied, CY2 for cycle 2, ES for the end of a subtraction cycle and UPK for the unpark operation. These signals are applied to flip-flop 713F and a relay driver 714D to operate relay R714. The operation of relay R714 applies voltages to the contacts of the relays R701 through R710 to their output terminals to provide an indication of the elapsed time.

Refer now to FIGURE 72 which shows the elapsed hours, groups of relays. It should be explained that the present circuitry provides means whereby various time intervals at various periods may be grouped together, in what is effectively a weighting of the parked time, to apply different rates of
charges thereto. One of the circuits which is employed in performing this function is the elapsed hours grouping relay circuit, FIGURE 72. In this circuit the relays R721, R722, and R723 together with relays R730 through R739 control the grouping of the elapsed hours into 20 groups. The signals are placed in the difference register relay circuits, FIGURE 71, signals PH00 through PH15 are applied to terminals PR0 through PR12 of the windings of relays R730 through R739, R721, R722, and R723. The appearance of the hold elapsed time signal HET at the output terminal of flip-flop 713F in FIGURE 71 supplies power to FIGURE 72 through delay flip-flop 723, inverter 722 and delay flip-flop 722 to the contacts of these relays after a short delay. Assuming that relay R721 is operated, which represents the group of ten hours, from 0 to 10, and that relay R730 which represents the period of the first hour is also operated, battery will be connected through terminal 6 of relay R721 and terminal 7 of relay 730 to armature 8 of relay K1 at the bottom left in FIGURE 72. Relay K1 is in the normal unoperated position, as shown, during the first half hour of any hour, and under such conditions during the first hour an output will appear at terminal PH00. During the second half-hour of any hour, however, the battery will be operated through contacts 1 of relay R714, in FIGURE 71, contacts 1 of relays R702, R703, R701 and contacts 2 of operated relay R704, for instance, to conductor OF in FIGURE 71 which connects to terminal OF in FIGURE 72 and the winding of relay K1 both shown at the lower left in that figure. The operation of relay K1 has the effect of adding one-half hour to the time produced by the operation of relay R721, in combination with relays R730, R731 and R732 for the first three hour intervals only by operating its armatures 8, 9 and 10 from engagement with their right-hand contacts to engagement with their left-hand contacts. The operation of relay R732, when relay R721 is operated, will extend the circuit through contacts 7 on each of these relays to armatures 8, 9 or 10 of relay K1. During each first-half hour of the first three hours these armatures will each engage their right-hand contacts to connect to output conductors PH00, PH10 and PH20. During the second half-hour of each of these hours the relay K1 will be operated and the circuit will extend through output conductors PH10, PH15 or PH25. Assuming relay R721 is operated and any of relays R730 through R739 is also operated, the circuit will be extended through contacts 7 of each of these relays to terminals PH30, PH60, PH100, and PH150, respectively, each representing an increased charge for a longer storage interval. The operation of relay R722 represents the ten hour interval from hour 10 to hour 20 and this together with the operation of any of relays R730 through R739 will establish a circuit from battery through contacts 6 of relay R722 and contacts 9 of any of relays R730 through R739 which happens to be operated, to apply a condition to output terminal PH120, PH140, PH160, PH180 and PH200. It will be observed that contacts 9 of each of relays R731 and R732 are paired together to operate an output at terminal PH120. Contacts 9 of relays R730, R733 and R732 are similarly paired together to produce a single output at terminal PH140. Contacts 9 of relays R735 and R736 are paired together to produce a single output at terminal PH160. Contacts 9 of relays R737 and R738 are paired together to produce a single output at terminal PH180. Relay R739, similarly, is not operated and its operation provides a single output at PH200.

The operation of relay R723, assuming any of relays R730, R731, R732 or R734 is operated, establishes a circuit extending through contacts 6 of relay R723 and contacts 11 of each of these relays. Contacts 11 of relay R731 and R732 are paired to provide a condition to output terminal PH120 and contacts 11 of relays R733 and R734 are paired to provide a single output at conductor PH240.

The effect of the described inter-connection of the contacts relays R730 through R739, R721, R722, R723 and K1 is to control the grouping of the elapsed hours into 20 groups represented by the outputs appearing on terminals PH00, PH10, PH15, PH20, PH25, PH30, PH40, PH50, PH60, PH70, PH80, PH100, PH120, PH140, PH160, PH180, PH200, PH220 and PH240.

Refer now to the patchboard scanning string switching switches, FIGURE 72. The 20 sets of signals which we have just described, signals PH00 to PH240 are divided into two groups. One comprises the group from PH00 to PH60 and the other comprises the group from PH70 through PH240. These signal conditions are each applied to a wiper on an individual one of two stepping switches, switches 30 and 31, in FIGURE 74. These stepping switches are stepped in unison, one step per hour. Each of the wipers engages an individual point on one or the other of the two switches each hour. The wipers represent elapsed time groupings.

The 24 hour period of parking time in a day has been divided into 20 groups identified by 20 signal conditions as described with reference to FIGURE 72. Each of these 20 conditions is now applied to an individual wiper of the 20 wipers on the two switches. The position of the wipers on patchboard scanning circuit stepping switches, FIGURE 74, is then changed every ten minutes or each hour by a switch. The reason for this is that the two switches, switches 30 and 31, in FIGURE 74, are stepped in unison by the hours advance relay of the digital clock system. This is relay R606, shown at the lower left in FIGURE 62. This relay, as has been explained, is operated once every hour after its controlling switch has counted ten tens of hours in each hour. At such time a circuit is established from battery through contacts of relay R606 to conductor CLD8 in FIGURE 62 which is connected to terminal CLD8 at the lower left in FIGURE 74 and the circuit extends through stepping magnet KSS740 of stepping switch 30 to ground operating switch R730. As stepping switch 30 steps one step per hour, battery is connected to a wiper which successively engages the left hand terminal of each horizontal row on switch 30 for hours one to 24. This extends the battery to a corresponding terminal on switch 31. Upon engagement of the left hand wiper of switch 31 with each of these terminals the battery is extended through the winding of relay R59 which controls stepping switch 31 so that the two switches 30 and 31 advance in unison. The terminals of switches 30 and 31 are connected to the terminals of different patchboards such as shown in FIGURE 73. It will be observed that the patchboard terminals shown on FIGURE 73 are arranged in a corresponds to the terminals shown on the banks of switches 30 and 31. At the left hand side of the patchboard, FIGURE 73, there are shown 24 horizontal rows of terminals and, at the right in this figure, a corresponding group of 24 horizontal rows in terminals. These terminals are designated HR1 to HR24 for each of the 24 hours in the day. In the left hand portion of the figure there are ten vertical rows numbered from one to ten and designated also PB0 through PB10 in a manner corresponding generally to the arrangement of the wipers on the left-hand switch on FIGURE 74. There are also ten vertical rows shown at the right in FIGURE 73 designated 25 to 34 and designated PB10 through PB240 in a manner generally corresponding to the designation of the ten wipers on right-hand switch 73. It should be explained that there are a number of different patchboards provided with the equipment. The function of the patchboards, as with any other timer, is to elapse time during various periods into a group of selected charges applicable to the period. In order to effect this, the terminals on the left hand and right hand portion of each patchboard such as FIGURE 73 are connected in a pre-determined manner to other terminals shown connected in parallel in the central portion of FIGURE 73 which represent fees for the elapsed time. These fees will vary for the different measured elapsed intervals for the different patchboards.

The patchboard which is in use at a particular time depends upon the economic importance of the time during
which the car is parked. Rush hours and relatively quiet intervals understandably will have different rates of charges. At particularly busy times, during holidays, yet another group of charges may be applied. The horizontal level to which a particular terminal corresponding to a switch bank is connected determines the charges. At any time, therefore, the PH-signals are connected via the switches to point on rate schedule panel. Because only one of the 20 PH-lines is actually energized, only one point on the rate schedule patchboard will have voltage applied thereto. This point represents one of 20 elapsed time conditions as a function of the present time. Therefore, it corresponds to a fee. All points with equal fees are patched together by means of a patchboard insert and inserted into one of the sets patchboard exit hubs, corresponding to the appropriate fee. On the patchboard drawing, FIGURE 73, these fees, shown in a vertical column near the center of the figure, range in 25¢ increments, from 25¢ to 475¢, although other fees are obviously possible.

The fee is identified with the line which is energized must now be encoded into an actual cash amount for fee display and for print-out. How this is performed will be explained with reference to fee display circuit FIGURE 82.

In addition to decoding, memory of the cash amount is also required, since the difference relays which originated this process will be reused in the elapsed day indexing process. It will be observed from reference to the patchboard circuit, FIGURE 84, that all of the possible charges ending in multiples of 25¢. That is to say, only the last two digits are either 00, 25, 50, or 57. This permits an economy to be effected in the circuitry. All lines corresponding to money amounts ending in 25¢, that is PB0025, PB25, PB50, PB75, and PB25 are applied to buffer 770B in FIGURE 78. Each of these passes through the connected non-inverting amplifier 771 and produces a signal PFC25. Similarly, all amounts ending in 5¢, namely, PF050, PF150, PF250, PF350, and PF450 are applied to FIGURE 79 to buffer 771B and non-inverting amplifier 771, and each produces the signal PFC50. Similarly, all amounts ending in 75¢, namely PF075, PF175, PF275, PF375, and PF475 are applied in FIGURE 80 to buffer 772B. Each passes through non-inverting amplifier 772 and each produces the signal PFC75.

Refer now to the fee display memory relays in FIGURES 96, 97, 98 and 99. The PF outputs from the patchboard or the equivalent PFC output, which we have just considered, are buffered in the three most significant digit groupings of these fee display relay memory circuits. Memory is achieved by having these relays self-holding. An FCX signal, which is produced in a manner which will be described in this section is applied to the FCX terminal in each of the four relay sections of FIGURES 96, 97, 98 and 99. For the most significant digit, the second digit, the third digit, and the least significant digit. Upon the operation of any of the relays R751 through R754, R753 through R752, R755 through R753, and R756, the signal FCX will be applied through a buffer and a relay driver as such as buffer 754 and relay driver 754, shown at the upper left in FIGURE 96, through a relay winding, such as the winding of relay R754 to battery, holding the relay operated after it has once been operated. The most significant digit array comprises drivers 751A, 751B, 752A, 752B, 753 and 754 together with their relay drivers 751, 752, 753, 754, and the relays R751, R752, R753, and R754. This array is controlled to define the most significant digit. The most significant digit may be any digit from 0 through 4 and the relays will be operated to define the digit by applying battery to terminal L1 shown connected to terminal 6 of relay R752 and through the contacts of the relays which are cooperatively activated to decode the binary permutation applied to them. The outputs of each of the selecting paths in each of the relays 97, 98 and 99 extends through the filament of an individual fee display lamp to ground. A few of these lamps only are illustrated in FIGURE 96. Battery is not applied immediately to the LL1 conductor or to the corresponding contacts LL2, LL3, or LL4 for the second digit, the third digit, and the least significant digit. The conditions under which battery is applied to these contacts will also be explained in this section hereinafter.

In order to illuminate the 0 lamp for the most significant digit all of the relays R751, R752, R753, and R754 are in the released condition. A circuit may then be traced, when battery is applied to terminal LL1, through contacts 6 of relay R752, contacts 6 of relay R753, contacts 8 of relay R751 and contacts 8 of relay R754 to terminal FL10 which connects to the filament of lamp 0 and then to ground illuminating the 0 in the most significant digit array. In order to illuminate the lamp designating the digit 1 in the most significant array relay R751 only is operated. This establishes a circuit from battery on terminal LL1 through contacts 6 of relay R753, contacts 6 of relay R751, contacts 9 of relay R751 and contacts 6 of relay R754 to terminal FL11 illuminating the 1 lamp. To illuminate the 2 lamp, relay R752 only is operated. A circuit is then established from battery on terminal LL1 through contacts 7 of relay R752, contacts 12 of relay R753 and contacts 12 of relay R755 to terminal FL12 illuminating the 2 lamp. In order to illuminate lamp 3 relays R751 and R752 are both operated. The circuit then extends from battery on terminal LL1 through contacts 7 of relay R752, contacts 11 of relay R757 and contacts 8 of relay R753 to terminal FL13 illuminating the 3 lamp. Similarly, as mentioned heretofore, as each of the groups of relays R751 through R754 is operated in accordance with some particular binary permutation from 0 through 9, battery will be applied to some one of terminals FL10 through terminal FL19 to light some lamp from 0 through 9 for the most significant digit.

A group of lamps from 0 through 9 defining the second digit and a group of lamps from 0 through 9 defining the third digit, are controlled in substantially the same manner as described for the lamp identifying the most significant digit through their respective groups of buffers and relays, which apply the binary permutation through the relays to the relay contacts, to connect battery through terminal LL2 and LL3 to terminals FL20 through terminal FL29 for group 2 and terminals FL30 through FL39 for group 3 to illuminate lamps 0 through 9 for the second and third digit, respectively.

The least significant digit circuit is controlled manually by the application of conditions to terminals designated circuit 41 and circuit 43. This will be made clear herein after in the present section.

Attention is directed to certain terminals connected to the various buffers for the four digits fee display circuit of FIGURES 96, 97, 98 and 99. Thus there are terminals designated CK11, CK12, CK13, and CK14 connected to the various buffers which define the most significant digit. Correspondingly, there are other terminals designated CK—connected to the buffers which produce the second digit, the third digit, and the least significant digit. The conditions represented by these CK—terminals are produced manually in the cash keyboard circuits of FIGURES 90 and 101 which will now be described.

If the time elapsed exceeds 24 hours, the output relays will be reset as a consequence of the days computation and a manual cash compute light will come on. How this is performed will now be explained.

During cycle CY3, if a positive output of the subtraction exists, the function control circuit FIGURE 37 at gate 019G passes a signal which sets flip-flop FP057. At the end of subtraction is indicated by an ES signal at gate F3H, flip-flop 019 as set to produce the minus computation signal MAC. This operates relay 976 through its driver to light a lamp indicating that a manual computation is required.

In this mode of operation or in the case of a transaction in which money is collected and no car is parked, the cash amount is first set up on the cash keyboard of the
cash keyboard circuits in FIGURE 90. The essential part of this keyboard consists of ten switches which when operated, and when a condition is applied to terminal ENK, to be described hereinafter, produces the signals CKO, CK1, CK2, CK3, CK4, CK5, CK6, CK7, CK8 and CK9. Four of these terminals may be actuated to apply conditions to terminals CK6, CK4, CK2, and CK5, for instance, corresponding to the amount of $64.25. The CK6 is shown applied to buffers 774 and 775 to energize terminals CKB and CKC leaving terminals CKA and CKD at the output of buffers 773 and 776 unenergized. The buffer CK10 is connected so that CKB and CKC will be impressed on two wipers shown connected to the bottom row of terminals on stepping switch RS777 in the cash keyboard circuit, FIGURE 101. These will energize circuits CK12 and CK13. Circuits CK11 and CK14 will be unaffected. Terminals CK12 and CK13 are connected to buffers 753A and 753 in the fee display relay circuit FIGURE 96. This, as should be understood from the foregoing, will operate relays R752 and R753 while relays R751 and R754 remain released. Battery will thereupon be connected through terminal LLI contacts 7 of relay R752, contacts 12 of relay R751 and contacts 12 of relay R778 in FIGURE 101, and pass through relay driver 777 actuating relay R777. This, in turn, steps stepper switch RS777. The wipers of the stepping switch will normally be in engagement with the terminals on row 11, which is the home position of the switch. In response to the first operation of a button on the cash keyboard, which actuates the assumed decimal point 6, the wipers of switch RS777 will be actuated to engage its bottom row of terminals to produce the 6 and to light the corresponding lamp in the most significant digit array, as described. Each time a button is pressed, relay R777 and stepping switch RS777 will be actuated. When the switch moves from the bottom row to the next row from the bottom it engages with terminals designated CK21, CK22, CK23, and CK24. These will be energized in accordance with the particular permutation corresponding to the cash keyboard button which is actuated, and the signal which is thereby produced from CKO to CK9. It will be observed that the terminals CK21 through CK24 of switch RS777 connect to buffers in the fee display relay circuit, FIGURE 97, which define the second digit. The terminals CK31 through CK34 of switch RS777 connect to buffers in FIGURE 98 which define the third digit. There are just two terminals selectable when the wipers are in engagement with the terminal on the fourth level of switch RS777. These are terminals 41 and 43 which connect to buffers B763 and B764, respectively, to apply conditions through relay drivers 763 and 764 to control relays R763 and R764. The contacts of relays R763 and R764 are arranged so that permutatively they define either an 0 or 5 in the least significant position by applying battery to terminal FL40 and FL45. When neither relay R763 or R764 is operated, battery is applied through conductor LL4 contacts 15 of relay R764 and contacts 15 of relay R763 to terminals FL40 to illuminate the 0 lamp. In other words numeral 5, both relays are operated, and battery is applied through terminal LL4 contacts 16 of relay R764 and contacts 12 of relay R763 to terminal FL45 illuminating lamp 5.

There are two other switches on the cash keyboard switch in FIGURE 90. One is the signal correction button which is the signal FIG 90 of this is actuated when an error has been made in pressing the buttons in order to wipe out the erroneous display thereby produced and to start anew. The other is the switch which produces the signal MOTOR BAR. This switch sets the circuitry in motion to effect the display. These operations will be made clear hereinafter.

When a fee is set up manually, in the manner just described, it is not possible for the circuitry to know in advance the number of digits which must be displayed. This affects the position of the decimal point, which must be illuminated in the proper position. The fee display may be of two or three or four digits. All numbers are determined in the normal fashion, that is with the most significant digit first, followed by the lesser significant digits. We have seen that the signal permutations defining the most significant digits are directed to the relay which most significant digit array in FIGURE 96 and each permutation will illuminate an individual lamp for this array in the display box. When an entry is made manually, the lamp identifying each digit will be illuminated immediately by the action of one of the relays R780, R781, R782, or R783 shown on FIGURE 101 at the lower right. It will be observed that battery is connected to a wiper which engages each of the terminals on the right-hand vertical row of terminals of stepper switch RS777. When this wiper engages its associated terminal on row 2, battery is connected to terminal EMF1 and through the winding of relay R7830 of FIGURE 101 to operating the relay. While relay R788 in FIGURE 101 is released after relay R780 is operated, battery is connected through contacts 6 of relay R788, contacts 6 of relay R780 and the winding of relay R780 to ground operating relay R780. This, in turn, connects battery through contacts 9 of relay R780 to conductor LLI, which is the condition which, connected through contacts 6 or 7 of relay R752 on the fee display relay circuit, FIGURE 96. This, as has been shown, effects the illumination of the selected fee display lamp. It is to be observed that in the case of the manual operation of the circuit, battery is connected to terminal LLI immediately after the first lamp of the fee display has been selected. This distinguishes from the operation when the selection of the lamp is made, without manual intervention, through the operation of the computer circuitry. In that case the lamps are not illuminated until all of the lamps defining the amount have been selected, whereupon all of the lamps are illuminated simultaneously. This will be made more clear hereinafter. The effect of the holding condition applied to the relays, such as relay R780, is to maintain the illumination of the selected lamp during manual operation of the cash keyboard.

After two numbers have been written up on the manual keyboard, the wiper associated with the second vertical row from the right on stepping switch RS777 will engage terminal L1DP. This effects the illumination of the decimal point which is located to the left of the most significant digit. If now another numeral is written up on the cash keyboard, as the wipers move to the next higher row, the second wiper from the right on the switch will engage terminal L2DP. This will illuminate a decimal point one position to the right. If, now, one further number is written up on the cash keyboard terminal L3DP will be engaged which will have the effect of moving the illumination of the decimal point one further position to the right. The reason for this may be understood from the following. Suppose the total amount were 75¢; the first number which would be written up would be a 7 followed by a 5. Then a decimal point would be illuminated to the left of the 7. If, instead of this, the amount were $7.50, after the first two numerals were entered, a decimal point would appear before the 7, but on writing up of the 0 as the third of the three numerals the decimal point lamp would be lighted one position to the right. If the total fee involved four places, such as $75.00, for instance, in the case of protected storage, the decimal point would appear before the 7 after the 780 is grounded through the circuit. While relay R787 would be moved one step to the right to read $7.50 when the 0 was entered as the third digit. Finally, it would be moved one further step to the right to read $75.00 when the final 0 was entered as the fourth digit.
If the operator notices an error in the fee display digit that has been entered, it is possible for him to wipe out the display by pressing the motor control knob on the cash keyboard, corresponding to the FIG CORR or figure correction signal. This signal is applied to gate 78SG, in the middle of FIGURE 101. It passes a signal through delay flip-flop DF78E, amplifier 788A, gate 787, amplifier 789, relay driver 788RD and the winding of relay 788E operating it. This disconnects battery from contact 6 of relay R785, releasing the lock which is holding relay R785 and extinguishes the lamps which have been lighted in error. This permits the operator to start the manual display operation again from the beginning.

If the operator is satisfied as to the correctness of the number he has entered, he depresses the switch which produces the signal MOTOR BAR as a go-ahead signal. This starts the automatic indexing process.

In the automatic mode of operation, the lamps designating the fee will not be illuminated until the circuitry is satisfied that the numerals which have been set up on the fee display relays is the complete fee and not just a portion of it. This condition arises when more than a day of parking is involved. After it is determined that the entire fee rather than a fraction has been set up in the circuitry, the entire fee display will be illuminated at once by relay R786 and relays E5 and E6 controlled by relay R786. Once illuminated, the fee will remain on display until the relays are later reset.

Gate 78SG on the cash keyboard circuit, FIGURE 101, sets delay flip-flop DF78E through buffer 785B upon the occurrence of an end print pulse PE during cycle CY4. This same flip-flop may be set in response to the production of an IMF signal applied through buffer 785B. The IMF signal is produced when the motor bar on the manual cash input key array is operated to produce signal MOTOR BAR. This signal when impressed during cycle CY5 while the manual computation signal MAC exists, will pass a pulse through a non-inverting amplifier 630, FIGURE 101, to produce the IMF signal which is the index manual fee signal. This signal is impressed on buffer 785B and also on flip-flop 788 in the middle of FIGURE 101. The operation of the cash keyboard circuit FIGURE 101 in response to the production of the signal IMF will be made clear hereinafter. While delay flip-flop 785 is providing an output, the output will persist for approximately 100 milliseconds and during this interval, relay driver 786 will operate relay R786. When relay R786 is operated, a circuit is established from battery through contacts 6 of relay R786 to parallel branches. One branch extends through a 250 micro-farad capacitor 785C to ground charging the condenser. Another branch extends through the winding of relay E7, contacts C2 and C5 of switch SW57 to ground operating relay E7 and closing its contacts 1. The operation of relay R786 also establishes a circuit from battery through contacts 9 of relay R786 and the windings of relays E5 and E6 in parallel, contacts 1 of relay E7 and through contacts C4 of switch SW57 to ground operating relays E5 and E6. Relays E5 and E6 when operated are held operated over a circuit which extends from battery through contacts 11 of relay R786 and over a path heretofore traced through the windings of relays E5 and E6 to ground. The operation of relay E6 establishes parallel circuits from battery, through contacts 15 of relay E6 to terminal LL1, through contacts 12 to terminal LL2 and through contacts 13 to terminal LL3. It will be recalled that in describing the fee display relay circuit of FIGURES 96, 97, 98 and 99, it was mentioned that battery would be connected under certain circumstances to terminals LL1, LL2, and LL3. The operation of relay E6, as described, performs this function.

The least significant digit circuit, FIGURE 99, is under control of the manual operation of the cash keyboard switches, and battery will be connected to terminal LL4 when these switches are operated in a manner which will now be described. Conductors EM1, EM2, EM3, and EM4, FIGURE 101, are energized and relays R780, R781, R782 and R783 are closed when step switch RSS77 in the cash keyboard circuit, FIGURE 101, operates its wipers to engage the terminals on its second, third, fourth, and fifth horizontal row respectively. If each of these relays is operated, battery is connected through contacts 9 of each relay to the conductors LL1, LL2, LL3, and LL4. It will be observed that conductors LL1, LL2, LL3, and LL4 are connected in parallel to contacts 15, 12 and 13 on relays E6, as well as to contacts 9 on relays R780, R781 and R782, whereas terminal LL4 is connected to contacts 9 of relay R783 only. These conductors are the conductors which are applied to the contacts of relays in FIGURES 96, 97, 98 and 99 to light the fee display lamps as mentioned heretofore.

During the 100 milliseconds delay introduced by delay flip-flop 785, FIGURE 101, inverter 786 connected to its output blocks mixer 786. During an unparking operation, when the cash display is controlled manually, producing signal MAC, as explained, this signal with the end print pulse PE during cycle 3 passes a condition through mixer 785H to operate delay flip-flop DF78E and to produce a 500 millisecond delay through the flip-flop. This signal controls inverter 788A and amplifier 788 so that during the interval while the 500 millisecond delay persists, signal FCX will be absent. Reference to the fee display relay circuit, FIGURES 96, 97, and 98, shows that signal FCX is connected in parallel to terminals 15 of each of the relays for the most significant digit, the second digit and the third digit to lock these relays when they are once operated. The same signal is connected to contacts 6 of the relays for the least significant digit in FIGURE 99. In the absence of signals FCX none of these relays can be locked if operated. The function of the hold circuits applied to these relays is to preserve the illumination of the lamps which are lighted to display the fee. However, under the condition presently being described, it is not desired to do this.

Switch 57, shown at the middle right portion of FIGURE 101, may be operated to reset the fee display timer. The operation of switch 57 by opening contact C5 de-energizes relay E7, releasing its contacts 1, which, in turn, releases relays E5 and E6. The opening of contacts 9 of relay E5 blocks mixer gate 786H. This, in turn, causes inverter 789A to produce an output which enables gate 789C. It will be observed that gate 789C, when the computer is not busy, and signal —CB therefore exists, causes blocking oscillator 787 to be turned on. The FIG CORR key in the keyboard switch panel is actuated whenever the operator observes that the fee display circuit shows an error. The FIG CORR switch may also be operated to erase any display which has been written up manually. However, if the computer is busy, it is necessary to prevent the release of the fee display relays in FIGURES 96, 97, 98 and 99. The reason for this is that the relays which control the fee display also produce other signals which are used in indexing and these signals are required to be maintained when the computer is busy. At any time, when the computer is not busy, the signal from blocking oscillator 787 controls delay flip-flop 788 so that the FCX signal is erased and the hold which it applies to fee display relays is removed, extinguishing the display and restoring the fee display relays to normal. Note that the inverter 786, mixer gate 789F, inverters 789A and 789C produce the fee display interlock signal IFLD to prevent reference to the fee display until the fee display is reset. This occurs by way of contacts 9 of relay E5 and mixer gate 786F upon the operation of relay R786.

In the top middle portion of FIGURE 101, the index manual fee signal IMF is produced through gate 630C and amplifier 630 as a result of the operation of the motor bar. Signal IMF is impressed on flip-flop 782 in the lower middle portion of FIGURE 101 and produces the HMI signal, which is the hold manually computed
fee signal. This signal is buffered into relay R976 shown in Figure 37, which is one of the function control circuits. Relay R976 is the manual cash relay and it is held operated for the duration of the interlock applied to the fee display to prevent the generation of a normal decimal point signal DPB. This prevents the decimal point from lighting up after the fee display circuitry has been controlled manually.

In the control of the fee display during a manual cash transaction, the index manual fee signal IMF, on Figure 101, sets flip-flop 788. This produces the index magnet 12 of relay R977 and the flip-flop 787. At the same time, relay R977 enters mixer gate amplifier 789 and relay driver 788RD to operate relay R788.

The operation of relay R788 establishes a circuit from battery through contacts 7 of relay R788 and the interrupter springs INT SFX and winding of stepping switch RSS777 to actuate the stepping switch and to return it to its home position. In normal operation, if the figure correction button FIG CORR is not depressed, relays E5 and E6 will be released at the expiration of the operation interval of relay E7 which will occur when the 250 micro farad capacitor 250C is discharged and contacts 1 of relay E7 are re-indexed open.

Refer now to the rate schedule circuit, Figure 102a. At two o'clock in the morning, for instance, the rate schedules are changed. At this time, battery is applied to contacts 9 of relay RK5 and the circuit extends through contact 5 of relay RK5 and the winding of relay RD2 to ground operating relay RD2. The operation of relay RD2 opens its contacts 12 and its contacts 6 thereby releasing relays RK3 and RK4 which are normally operated. The release of relay RK3 by opening its contacts 6 disconnects battery from the circuit extending through contacts 12 of relay RD1 and its winding to ground, thereby releasing relay RD1 which is normally energized. The release of this relay, by closing its contacts 8 sounds an alarm to call the operator's attention to the fact that it may be necessary to operate the rate schedule switch SW32 to change the rate. The release of relay RD1 also connects battery through its contacts 6 and the filament of the rate charge lamp to ground, lighting the lamp as a further indication of the condition.

The release of relay RK4 establishes a circuit from battery through its contacts 6 and the winding of relay RK5 to ground operating relay RK5. Once operated, relay RK5 is locked by battery through its contacts 10 and its winding to ground. The operator now operates the rate schedule switch SW32, shown at the right in Figure 102a. The patchboard which is in use is changed if it is required to be changed and the rate change switch, SW36, is depressed momentarily. This closes a circuit from battery through contacts 6 of relay RD2, terminal NO1 and the armature of the rate change switch SW36 and the winding of relay RD1 to ground operating relay RD1. Relay RD2 had energized momentarily when battery was applied to contacts 6 of relay RD1 when the change hour occurred. However, relay RD2 was released when relay RK5 operated opening its contact 6 and disconnecting battery from the winding of relay RD2. Upon the release of relay RD2, battery was available at its contacts 6 to operate relay RD1 as just described. Relay RK5 and relay RD2 comprise a relay delay circuit which causes the momentary release of relay RD1 so as to sound the alarm and light the lamp as described. The depression of switch SW36 provides only for the momentary operation of relay RD1 and upon the restoration of switch SW36 to its normal position, it is necessary for relay RD1 to remain operated. This will be possible only if switch SW32 has been properly actuated and if a circuit has been established through the correct patchboard to terminal RS. Assuming that this has been done, a circuit will be established from battery through contacts 7 of relay RD1, contacts 12 of relay RK5, contacts 14 of relay RD2 through the armature and a selected terminal on switch SW32 and through a path in the proper patchboard to terminal RS. The timing circuit now is set for a rate change switch SW36 and through the winding of relay RD1 to ground, maintaining relay RD1 in the operated condition. The battery connected to conductor THR of relay RK5 will remain connected until the end of the second hour when it will be disconnected and relay RK5 will release. Relay RD1 under such conditions will be maintained operated from battery through contacts 14 of relay RK5, contacts 9 of relay RD2, through the rate schedule switch SW32 and the patchboard to terminal RS. From this point the path has been traced through the switch SW36 and the winding of relay RD1. It should be noted however that if the switch SW32 is not in engagement with the proper one of its terminals and if the proper patchboard is not used, it will be impossible to maintain relay RD1 operated. This serves as an automatic check on the manual operations of the operator.

*Lister and indexing circuits*

The serial lister operates by having one digit at a time entered into it with the most significant digit first. Any number of digits up to ten may be indexed and at the conclusion of this indexing, one of two kinds of print cycle must be initiated by striking either the add or non-add motor bar. In the case of non-add, the symbol N will appear in the column to the right of the least significant digit. No symbol appears in the case of the add print out.

In the foregoing description, it has been explained how various elements which constitute the print-out information are formed. Thus, it has been explained how the stall information, elapsed hour and elapsed day information, present time information, cash print-out information, and the change code number is all set up at varying times during the appropriate transaction for indexing. This information is established in the 1, 2, 4, 8 binary coded decimal code. Therefore, a single de-coder which translates the binary code into a 1 out of 10 relay translation array suffices to indicate the appropriate decimal value and the supply energy to a corresponding element. Refer now to the indexing circuits. These are shown in Figures 75, 76, 77, 81, 82, 83 and 84.

Indexing is started by the production of the IND pulse in Figure 75. Since indexing is required in connection with many operations, the IND pulse may be produced by the application of a proper group of signals to any one of 14 gates. The production of these signals and the conditions governing their application of these gates is described in other sections in connection with the description of other circuits involved. The output of these gates is applied through non-inverting amplifier 040 to produce signal IND, the start indexing signal. Signal IND is applied to the index timing control flip-flop 910S. This produces the INDX signal which is applied to gate 923. Simultaneously with the application of signal INDX when the gate 910S, it is applied through gate 918 to set delay flip-flop 919. The chain consisting of delay flip-flop 919, inverter 920, delay flip-flop DF921 and inverter 921 with gate 923G, to which the INDX signal was applied, comprise the index timer. Amplifier 921 produces the index strobe signal IS. Each time this signal is produced it is fed back to gate 923. This resets delay flip-flop 919. This condition will continue until flip-flop 910S is set to the 0 condition in
a manner to be shortly explained. Each time an IS signal is produced, it is applied to delay flip-flop D922 which in turn, through inverter 922 and blocking oscillator 922 to produce the index strobe pulse IPP. This is a 4 microsecond pulse which occurs 10 milliseconds after the end of the index strobe pulse IS. As a result of the setting of flip-flop 9105, therefore, a series of index strobe pulses IPP will be produced until flip-flop 9105 is reset.

The index counter circuit consists of flip-flops R959 through flip-flop F963. The start indexing pulse IND is applied to the set terminal S of flip-flop 959 to set it in the 1 condition. This output signal of flip-flop 959 is applied through amplifier 959 to produce the index signal IC1. Each of the signal IC1 is produced in sequence thereafter, will set a respective one of the flip-flops 960, 961, 962 and 963 to the 1 condition. These signals produced will pass through amplifier 960, 961, 962 and 963 to produce signals IC2, IC3, IC4 and IC5, respectively. These signals are applied to the contacts of relays in the indexing relay circuit FIGURE 76. The index counter circuit may be reset by the application of either the clear index counter signal EE or the listener advance pulse LAP. Both of these signals are produced in the index timer circuit (FIGURE 81) in a manner to be described in that section hereafter.

Each of the index counter signals IC1, IC2, IC3, IC4 and IC5 corresponds to a separate index position for sequential digits on the listener. In FIGURE 76 relay drivers 950 through 956 and relays R950 through R956 are operated during various cycles while listing for various operations is being performed. Only one of these relays will ever be operated at any one time.

During cycle 1, for instance, relay R950 in FIGURE 76 will be operated and the counter circuit in FIGURE 75 will step through a cycle, producing each one of the cycles signals IC1 through IC5 while relay R950 is maintained operated, to index the stall number. While the signal IC1 persists and contacts 14 of relay R950 are closed, the signal IC1-ST will be produced.

Refer to the index decoding circuit, FIGURE 84. This circuit is used to decode the indexing information. The indexing information is applied as a permutation of four signal elements through four sets of gates to relays R940, R941, R942 and R943. As a result of this, the relays are actuated in accordance with the permutations to apply a condition to an individual one of ten terminals LD0 through LD9 to produce the digit 0 through 9.

In the case of the signal IC1-ST, the production of which has just been explained, it is desired to print an "S" signifying stall. The listing is arranged so that a 1 in this particular position will effect the printing of an "S." The signal IC1-ST is applied through buffers 931 and 940B, and relay driver 940D to the winding of relay R940 operating the relay. In the decoding relay circuit, ground is applied to conductor XG from the contacts of relay R935 in FIGURE 84 in a manner which will be made clear in this section. The operation of relay R940 establishes a connection from conductor XG through contacts 5 of relay R941, contacts 5 of relay R942, contacts 10 of relay R940 and contacts 5 of relay R943 to select lister conductor L1 which effects the printing of an "S." In conductors LD0 through LD9 connect to the lister solenoids at the upper right in FIGURE 84. In order to apply ground to conductor XG, signals INDEX and XG must be applied to gate 934 at the bottom right in FIGURE 84. This passes a signal through relay driver 935D and to the winding of relay R935 operating the relay. This applies ground to conductor XG, and dependent upon the selection effected by relays R940 through R943, grounds one of the lister solenoids.

After the production of an "S" for the first symbol when a stall number is indexed, the next position must be blank. This is accomplished by splitting the lister fields into two groups, the right-hand group of which consists of four digits. In order to define the stall number, it is necessary to first produce an "S" followed by a blank and then by the three numerical digits which identify the stall number. It has been explained how the one which corresponded to the "S" was indexed and how it is necessary to index four more digits in order to shift the one into the least significant position of the left hand field of the lister. In order to produce the blank, an unconditional 0 is indexed as the second digit. It is produced by producing the XG signal in the manner explained. The IND signal will be maintained as long as flip-flop 9105 in FIGURE 75 remains set in the 1 condition. The IS signal will be produced at intervals while the IND signal persists. Therefore, relay R935 which is controlled by these signals jointly will be operated successively to produce a series of XG signals as required. During the indexing of the second digit, none of relays R940 through R943 will be operated and the ground supplied through terminal XG will pass through contacts 5 of relay R941, contacts 5 of relay R942, contacts 8 of relay R940 and contacts 8 of relay R943 to conductor LD0. This causes an O to be set up and the O solenoid of the listener will be energized. After the three digits of the stall number are indexed, the zero which was produced as the second digit will be in the least significant position of the right-hand zero suppression field and will, therefore, be zero suppressed.

It was explained in the foregoing that relays R940 through R943 in FIGURE 84 would be operated while the second digit was being indexed. The reason for this is that the IC2 signal which is impressed on the second vertical row of contacts from the right of relays R951 through R955 is not impressed on corresponding contacts of relay R950. Therefore, the index count produces no output during cycle 1 while the stall number is being indexed, and no condition is therefore applied to any of the four gates which control the index decoding circuit, FIGURE 84. This as has been shown effects the operation of the O solenoid. When the index counter of FIGURE 75 reaches a pattern of flip-flop 961 delivers an output to the third vertical row of terminals from the right of relays R950 through R956, a signal will pass through contacts 10 of relay R950 to terminal IC-ST. This signal is applied to terminal 6 of relay R809 on FIGURE 85. Relay 809 and 809- set operatively determines the first numeral of the stall number which may be any one of but four numerals 1, 2, 3 and 4. Depending upon the manner in which these relays are operated, a condition will be applied to terminal ST1, ST2, ST3 or ST4 and this condition will be applied to the gates in the manner determined by FIGURE 84. If ST1, for instance, is produced, it will be applied to buffer 930, pass through buffer 940B and will energize relay R940 which effects the production of a 1, as heretofore explained. If ST3, for instance, is produced, it will be applied to both buffers 930 and 934 which energizes relays R940 and R941. This establishes a circuit from ground on terminal XG through contacts 7 of relay R941, contacts 13 of relay R940 and contacts 8 of relay R942 to lister digit terminal LD3. The production of signal ST2 or ST4 will control the relays in FIGURE 84 to apply ground to lister digit terminals 2 and 4 respectively in a manner which may be understood from the foregoing.

When the index counter products signal IC4-ST by passing a condition through contacts 8 of relay R950, the signal will be applied to armature 6 of each of buffer relays R804, R805, R806 and R807 in parallel, FIGURE 86. These relays will have been operated in accordance with the permutation applied to the lister and the stall number so that all of them are in the tens position of the stall number. Similarly, when the index counter circuit, FIGURE 75, reaches count 5, a condition will be applied through contact 6 of relay R950 and applied to armature 6 of relays R801, R802 and R803 in parallel in FIGURE 86. Thus, when these relays are operated, a permutation of conditions will be generated on certain terminals of the group ST5, ST6,
The output of flip-flop 972F is passed through amplifier 972A to produce the linter advance interlock signal LAI. The output of non-inverting amplifier 971 is also applied to blocking oscillator 974 to produce the linter advance and print signal LAP and to set flip-flop 974. The set condition of flip-flop 974 applies a signal to blocking oscillator 975 to produce the linter advance signal LA when the linter advance interlock signal LA is applied to gate 975.

In order to space the paper, it is necessary to index a zero and perform a non-add print and then wait the appropriate time in order to allow the linter to finish its non-add cycle. The linter advance pulse is applied through diodes 039C and 039D in FIGURE 75 to the non-inverting amplifier 940 to produce another start indexing signal IND. The IND signal is applied to flip-flop 910S to produce the INDX signal and to again start the index timer chain. This, as it has been shown, produces the signals ICI through IC5 in the indexing counter circuit in this same figure. At this time, none of linter decoding relays, R940 through R943 in the index decoding circuit, FIGURE 84, will be operated. It has been shown that when they are all in the released condition and an XG signal is produced, a circuit will be established through the contact 943 to release to terminal LD6 in this figure. This will result in the indexing of a zero during the IC1 interval of the indexing timer. During the IC2 interval, the IC2 pulse will be applied to gate 912 on index circuit FIGURE 83. When the linter advance and spacing signal LAI and the index strobe pulse IS are present, this will pass a signal through relay driver 912D and operate relay R912. The operation of relay R912 will apply ground through its front contacts and contacts 7 of relay 913 to produce the non-add print pulse NAPR which will initiate a non-add print cycle. The interval taken up by the next several steps of the index print cycle is consumed by this non-add cycle allowing the linter to finish its cycle. In FIGURE 82, when the IC5 interval occurs and the linter advance and spacing signal LAI is applied to gate 974G, blocking oscillator BO974 will produce the linter advance pulse LAP. This sets flip-flop F974 which applies a condition to the blocking oscillator BO975 which, in turn, impresses a pulse on gate 975G which, during the existence of linter advance interlock signal LAI, again produces the linter advance signal LA. This restarts the index counter. The linter advance pulse LAP is applied through a diode and amplifier 965 in the indexing circuits, FIGURE 75, to clear flip-flops 959, 960, 961, 962 and 963 which constitute the index counter. In the left-hand lower portion of FIGURE 75 during the IC4 interval of the index counter, when the linter advance interlock signal LAI exists, the IC4 and LAI signals applied to gate 976G and inverting amplifier 976 produce a pulse LAP from blocking oscillator BO976. This signal is buffered through buffer 910B into non-inverting amplifier 910 to reset flip-flop 910S. This cycle of indexing an O and producing a non-add print continues for a period determined by the three second delay flip-flop DF971. When this flip-flop restores to the normal condition after the three second interval, a signal is passed through non-inverting amplifier 973 and the waiting time to gate 972. When signal —LAP exists, gate 972 passes a condition which resets flip-flop 972 and terminates the linter advance interlock signal LAI. This prevents further operations of the paper spacing circuitry.

The manual linter advance signal is shown on the index circuit, FIGURE 82. When switch SW63 applies a condition to a buffer 1560 in this circuit, which produces a pulse from the blocking oscillator 1580 to create the manual linter advance signal MLA. When the linter is advanced manually, the MLA signal is applied to gate 971HA, and when the computer is not busy, and the digital clock is not advancing, as indicated by the signal being 0 on the digital read out —DCA, a signal is passed through non-inverting amplifier 971 which, as has been shown, produces the linter advance interlock signal LAI to perform a paper
spacing sequence of the type just described. The switch SW56 shown on the index timer circuit, FIGURE 83, is the total printout switch. When this switch is actuated, it applies a condition of the output of the flip-flop 1583 on a second delay flip-flop 1585. This passes a signal through relay driver 912D to operate relay 913. This same signal from the output of delay flip-flop DF is applied through relay driver 913D to operate relay 913. This applies ground through the front contacts of relay R912 to contacts 5 of relay 913 to produce an add print signal APR. This operates the add print solenoid and holds for several seconds to permit the printing of the accumulated total and the spacing of the paper.

Gates 1930, 1931 and 1932, shown on the index circuit, FIGURE 84, are part of the manual input circuits. These gates co-operate to control the number of indexing cycles of the cash total when the number of digits entered are variable in order to place the digits in the correct position so that they may be added in the right columns on the lister.

Indexing circuit, FIGURE 116, shows a circuit which controls the products of HB and —HB signals. These are the select left half of indexer signal and the select right half of indexer signal. During the first interval, IC5, of the index timer circuit, during both cycle 4 CY4 and cycle 5 CY5, conditions are passed through gates 958–1G or 958–2G and the non-inverting amplifier 958 to set flip-flop F958. The condition of the 1 output of flip-flop F958 when set produces the HB signal and the condition of the 0 output produces the —HB signal. These signals are used to control cycles during which the index counter must be operated twice in sequence in order to space the information to the left-hand side of the format.

On the indexing circuit, FIGURE 77, there is also shown the circuits which translate the card reader data output signals CN1 through CN12 into the signals CNG1 through CNG12. Signals CN1 through CN4 are applied through gates 964–1 through 964–4 during the count clock interval three, IC3, to produce signals CNG1 through CNG4. During index counter interval four, IC4, signals CH5 through CH18 are gated through gates 964–5 through 964–8 to produce the signals CNG5 through CNG8 and during index clock interval five, IC5, signals CN9 through CN12 are gated through gates 964–9 through 964–12 to produce the signals CNG9 through CNG12. CNG1 through CNG12 are the index signals from the card reader.

Key and card reader circuits

The signals produced in the key reader are applied to individual amplifiers illustrated on FIGURE 42. A single photo-electric plug-in key reader is used to communicate stall information to the computer. The two key socket signals, key socket signal A and key socket signal B are applied to two non-inverting amplifiers 420KA and 421KA shown at the top left in FIGURE 42 to produce signals KTPSA and KTPSB. The east-west tower signal is applied to amplifier 422KA to produce the tower signal KT. The front and rear sections of tower signal is applied through a non-inverting amplifier 423KA and an inverting amplifier 424KA to produce the signal —KT. The signal passing through a binary comparator to binary the number of the floor pass through corresponding amplifiers, not shown, to produce the signals —KFA, —KFB, and —KFC. The four signal conditions corresponding to the binary number of the tier pass through corresponding amplifiers, not shown, to produce signals —KTA, —KTB, —KTC, and —KTD. The signal corresponding to parity also passes through corresponding amplifiers, not shown, to produce a signal —KTP. Directions as to what to do with respect to this stall information are imparted by a set of instruction switches shown on the function control circuits, FIGURES 34, 35, 36, 38, 39, 40, and 41. The computer is so arranged that the key is inserted in the key reader first and the instruction switch depressed after.

When the function or operation switch or button in any one of the various function control circuits numbered above is operated, it applies a condition through an individual buffer, an individual blocking oscillator, an individual gate, if required, and sets an individual flip-flop in the 1 condition to produce an intent of operation signal corresponding to the function. When flip-flop 821 in the park circuit, FIGURE 34, is set in the 1 condition the park intent signal PKF is produced. Flip-flop 804 in the unpark circuit, FIGURE 35, produces the unpark intent signal UPF. When the retrieve button is operated flip-flop 824 produces the retrieve intent signal RTF. When the loss key button is operated flip-flop 854 produces the lost key intent signal LKF. If any one of the four buttons, park, unpark, retrieve, or lost key is operated, a corresponding one of these four intent signals will be applied to buffer 221B in the key and card reader circuit, FIGURE 42. This will pass a pulse through the non-inverting amplifier 222A and apply a condition to gate 218G. Gate 218G is controlled by the presence of one of these signals and the simultaneous application to the gate of a number of other conditions. One of these conditions is that the computer is not busy which is indicated by a —CB signal. Another of the conditions is that the digital clock should not be in the change. This is indicated by the presence of a —DCA signal. Another condition is that neither of the east or west output relay circuits corresponding to the operated key is busy. This is controlled by signal ERB applied to gate 216G and signal WRB applied to gate 215G. The output of these gates is joined and connected to inverter 217. If either of the relay circuits is busy, therefore, there will be no output from inverter 217 and the absence of such an output will prevent the passage of a signal through gate 218G. Another condition which is necessary to control gate 218G is the production of proper key socket signals, KTPSA and KTPSB. The KTPSA signal is applied directly to gate 210G. The KTSPB signal is applied first through an inverting amplifier and then to gate 210G. In order that the gate pass a signal, there must be no KTSPB signal present. The existence of proper conditions on each of the inputs to gate 210G applied to non-inverting amplifier 210 will apply a condition to gate 218G to tend to enable the gate. The non-inverting amplifier 210 at its output also produces key socket pulse KS and the —KS. Another condition which must be applied to gate 218G is that flip-flop 241F in FIGURE 44 should be in the rest condition as a result of the application of a key socket signal KCS which is applied to gate 218G. If all of these conditions prevail, a pulse will be passed through blocking oscillator BO218 and inverter 1241, amplifiers 1219 and 1218 to produce key socket signals KS and KSP respectively. Signal KSP is applied in parallel to the set 1 terminal of each of flip-flops 231 through 235 in parallel. Auxiliary key socket signal KS is applied to the set 1 terminal of each of amplifiers 230, 236, 237, 238, and 239. Simultaneously, with the application of signals KSP and KS to this group of flip-flops, ten signals produced in the key reader and amplifier circuit shown at the left in FIGURE 42 are applied to the allow set terminals A of these flip-flops. These signals are the —KFA, —KFB, and —KFC permutations which designate the floor, the —KTA, —KTB, —KTC, and —KTD signal permutations which designate the tier and the —KL signal which designates the front or rear section of the tower and the KTPS signal which designates the east or west tower. The key parity check signal —KTP controls the operation of the parity circuit to be explained hereinafter.

A one bit from the key reader circuit when applied to the flip-flops in FIGURE 42 will result in an 0 signal, while an 0 signal on the key reader will produce a 1 signal condition which is a —6 volt signal in the flip-flop.
Any of the flip-flops that have a 1 bit will be set when the key sprocket pulses KSP and KSPA are applied to the set terminals S of the flip-flop. It is pointed out that there is a key sprocket pulse KSP, a delayed key sprocket pulse DKS and a double delayed key sprocket pulse DDKS. DDKS is produced by blocking oscillator 375 in FIGURE 43 in response to the application of an ORT pulse, which is a delayed key sprocket pulse.

Refer now to FIGURE 43. The KS signal, applied through gate 211, produces a output from block relay D211 to set flip-flop F212. If, at this time, signal DDSKs is present, it is buffered through buffer 212 and non-inverting amplifier 212A to reset flip-flop F212. If flip-flop F212 is reset while signal KS persists, a signal is passed through gate 214 and relay driver D214 to operate relay R214. This establishes a circuit from battery through the filament of the remove key lamp and the front contacts of relay 214 to ground, lighting the lamp as a signal that the key may be removed. If, however, a DDSKs signal is not available to reset flip-flop F212 a condition from the terminal of flip-flop F212 applied to gate 212G simultaneously with a—KS signal, actuates relay driver D213 to operate relay R213. This establishes a circuit from battery through the filament of the premature key removal lamp PK and the front contacts of relay R213 to ground, lighting the lamp as an indication that the key has been removed prematurely. An audible alarm is simulated in this instance, will warn the operator of the condition.

If a key is inserted in the key reader and one of the busy conditions controlling gate 218 exists, nothing happens until the termination of the busy condition, at which time normal operation proceeds. Further, if the operator neglects to operate an appropriate function instruction button as the key is inserted, nothing happens and gate 218 remains inactive until one of these buttons is pressed. This produces the necessary key sprocket pulse to enable gate 218Q and allow the setting of the key reader flip-flops.

It was mentioned in the foregoing that the registration of the key reading which is now established in flip-flops 230 through 239 is checked for parity, that is, to insure that it contains an odd number of ones. By this is meant that there must be one, three, five, seven, or nine of the ten flip-flops 230 through 239 in FIGURE 42, set in the 1 condition and the remainder in the 0 condition. It should be explained that each key is arranged so that it has an odd number of perforations. Each perforation in a key results in the setting of one of the flip-flops 230 through 239 in the 1 condition. An odd number should therefore be so set in response to the reading of each key. This, while not guaranteeing the accuracy of the registration of the key conditions in the flip-flop array in FIGURE 42 at least guarantees that the registration is plausible. It is necessary to check to insure that an odd number of these flip-flops are, in fact, set to the 1 condition. How this is achieved will now be explained.

Refer now to the parity checking circuits, FIGURE 91. Three of the ten signals, namely signals WT, RE, and FA are first examined as a group to determine whether there is a signal 1 condition among the three signals which would provide an odd condition or whether there are no signals 1 conditions among the three signals which would provide another odd condition. Signal WT and signals—RE and —FA are applied to gate 325. If signal WT is a 1 condition signal and signals RE and FA are both 0 condition signals, gate 325 will pass an output through inverting amplifiers 329A and 330A to produce the signal —RE and —FA signals. Signal WT, RE, and FA are applied to gate 326. This gate will pass a signal if signal RE alone is a 1 and the other two signals are both zeros. Signal FA, signal—RE and signal—WT are applied to gate 327. This gate will pass a signal if signal FA is a 1 and the other two signals are both zeros. As a result of the caochation of gates 325, 326, and 327, it will be possible to produce an output from the three of them combined if one, and only one of the signals WT, RE, and FA is a 1 condition signal. Inspection of these three gates will indicate that one of the three signals RE or FA or WT is not produced at the output of gate 325, if one or three of the signals are ones, or none of the signals is a one, none of gates 325, 326, or 327 will pass a signal.

Refer now to gate 328. Signals WT, RE, and FA are applied in parallel to gate 328. In order for gate 328 to have an output, it is necessary that all three of them be in the one condition. This will result in the production of parity signal PA. Thus, it will be seen that the interaction of gates 325, 326, 327, and 328 will produce a parity pulse PA if one of these three signals or all three of these signals is a 1 condition signal. The signal PA together with two of the more of the signals produced in the ten flip-flop registers of the key and card reader circuits, FIGURE 42, namely, signals FA and FB are tested in gates 331, 332, 333, and 334 to determine whether the two signals FA and FB, when combined with signals WT, RE, and FA provide an odd number of ones. It will be understood that the production of the signal PA indicated that the first three signals produced an odd number of ones. The production of a signal —PA, indicates that the first three signals tested produced an even number of ones. Signal PA and the signal —PA may, therefore, be applied to gates 331 to 334 to determine whether or not these five signals taken together are odd or even. Gate 331, for instance, will provide an output only if the first three signals tested provided an odd indication and signals FB and FC were both zero signals. Gate 332 will provide an output if the first three signals combined were even, signal FC is a zero signal, and signal FB is a one signal. Gate 333 will produce an output only if the result of testing the first three signals produced an odd number of ones and that signal FB was a zero signal and signal FC was odd. Gate 334 would provide an output only if the first three signals tested provided an odd indication and each of signals FB and FC were odd. In the event that there is an output from any one of gates 331 through 334, inverting amplifier 336 will produce signal PB indicating that there are an odd number of ones in the first five signals tested. An output from inverter 335 producing the signal —PB indicates that the number of 1 conditions in the first five signals tested is even.

Now the signals PB and —PB are tested with two more of the ten signals, namely signals TA and TB. If these seven signals have an odd number of ones among them, it will be indicated by the production of signal PC. Finally signals PC and —PC are combined with signals TC and TD and —TC and —TD in mixer gates 343, 344, 345, and 346. An output from this array means that the number of ones in these nine bits is odd. If inverting amplifier 347 produces an output, therefore, it indicates that the number of ones among these nine signals is even.

The output of inverter 347 is applied to gate 349 where it is combined with the tenth signal which is the KP signal which is produced by the notch in the key allotted to insure that the number of notches are odd. The minus version of this signal —KP is applied to the gate 349. If this results in the passage of a signal through gate 349, which is examined while the cycle zero interval CYO prevails, gate 349 will pass a signal. It indicates that the total number of ones in the ten signals is even and that the parity check circuit has discovered the error. This signal will pass through non-inverting amplifier 349A and relay driver 349D to operate relay R349. The operation of relay R349 establishes a circuit from battery through the relay R349, the relay R349 contacts, and the front contact of relay R349 to ground, lighting the lamp as an indication of the erroneous parity condition.

Refer now to FIGURE 77. It was mentioned in the foregoing that charge customers are provided with a card which is used instead of a key. Twenty bits are read from
controlled by the outputs of the buffer relays shown on FIGURES 86 and 87. One set of output relays is shown on FIGURE 85. These are to encode each of the ten numerals in each of the units, tens and hundreds places in a card number in accordance with an individual binary permutation group for each of these three places, it is necessary that it be possible to produce ten permutations of four two-element signal conditions for each of the three positions in the three digit number. In order to do this, it is necessary that 12 signals be produced. Twelve perforated or unperforated areas in the card provide a total of 12 zero or one condition signals. Those 12 signals are signal CN1 through CN12 in FIGURE 77. Signals CN1 through CN4 provide four elements of a permutation signal combination defining any of the ten numerals 0 to 9 in a first position of the number. Signals CN5 through CN8 form 10 permutations defining any of the ten numerals in a second position in the number and signals CN9 through CN12 provide ten permutations defining any of the numerals in the third position in the number. Refer to FIGURE 85. In one case, the card is internally wired in such a manner that a disagreement between the one and zero conditions applied to the terminals CC1 through CC8 of the test plug and what is anticipated as a result of the pre-wiring of the test plug produces an alarm. In order to achieve this, the terminals CC1 through CC8 are cross-connected to gate 351 and buffer 352. If the proper conditions are not applied to the terminals CC1 through CC8, relay 352 will be operated. This applies battery through the filament of the card code lamp and contacts 9 and 10 of relay R352 to ground, lighting the lamp as an indication of the failure of the card identification check.

Refer now to FIGURE 44. When a charge card is properly inserted in a card reader, two cards sprocket signals KC5A and KC5B are produced. In FIGURE 44 these two signals are applied to inverter 242A, gate 242G, blocking oscillator BO243, and flip-flop 245 setting the flip-flop and producing card sprocket signal CS as its output terminal and its signal KC5A and -KC5. These signals record the fact that the charge card has been inserted in the reader. This condition must be taken into account in an unpark operation.

The KC5 signal thus produced is applied to the reset terminal flip-flop 241F. While this signal is present, the output from the 0 terminal of flip-flop 241LS blocks gate 218 and prevents the production of a K5P signal. This prevents further transactions after a charge card transaction until the card is removed. When the card is removed, signals KC5A and KC5B will terminate as will signals KC5 and the condition from the 0 terminal of flip-flop 241 will change to remove the block from gate 218.

Output relays

Refer now to the buffer relay circuit, FIGURES 86 and 87. In these figures conductors W1, W2, W3, W4, W5 and W6 are interconnected.

The signals which control this circuit are produced in the key reader circuit, FIGURE 42. It is the function of the relays in the buffer relay circuit relays R801 through R814 to transmit instructions as to the stall information obtained from the key and the manual control function buttons. Two sets of output relays are furnished and are

When a key sprocket pulse KSP occurs, it actuates delay flip-flop DF82 shown in the middle of FIGURE 87. This, in turn, drives relay driver 82D and operates relay R820 closing its front contacts. This applies battery through the front contacts of relay R820 to armature 15 of relay R809 which controls the selection of the east or west tower. Assuming that relay R809 is released, battery will be applied through contacts 14 of relay R809 to armature 15 of each of relays R801 through R808 and to armature 9 of each of relays R810 through R814. If on the other hand, relay R809 is operated, the west tower will be selected, and battery will be applied through contacts 16 of relay R809 to armature 12 of each of relays R801 through R808 and to armature 6 of each of relays R810 through R814. If any of one of relays R801 through R804 or relay R810 through R814 is operated and the west bus-bar has had voltage applied thereto, a circuit will be established through contacts 16 of each of relays in the group of relays R801 through R808 and through contacts 10 of each of such relays in the group of relays R810 through relay R814. If on the other hand, the west bus-bar is connected to voltage, such of the relays R801 through R808 as are operated will have voltage applied through their contacts 12 and 13 and such of the relays R810 through R814 as are operated will have voltage applied through their terminal 7. If for instance, the relay R809 is operated and relay R801 is also operated for a 1 condition, voltage will be applied through contact 13 of relay R801 to terminal FARM. This will be applied to the winding of relay R831 in the west output relays of FIGURE 88 operating that relay. Similarly, any other one of the relays in the group R801 through R808 which is operated while relay R809 is operated, will effect the operation of a corresponding one of relays R832 through R837 of the west output relays, FIGURE 88. When one of the functional relays R810 through R814 which is operated while relay R809 is operated, it will apply voltage through its respective terminal 7 to operate a corresponding one of the relays in the group of relays R832 through R837 in the west output relays. In the corresponding one of relays R810 through R814 is released and any of relays R801 through R808 or R810 through R814 is operated, conditions will be impressed on the windings of the output relays east in FIGURE 85 to control relays R851 through R861.

The stall number portion of these directing relays is also used to effect a minor modification in the coding for
purposes of print-out. The reason for this is that when only 3 bits are assigned to the floor designating portion of the stall information, the three bits can produce eight permutations which ordinarily define the numbers 0 through 7. However, it is preferred to refer to the floors as numbered through 8. We therefore assign the numbers of the floors 1 through 7 to the binary permutations corresponding to the decimal numbers 1 through 7 and assign the binary permutation corresponding to the decimal 0 to identify floor 8. Numbers 1, 2, 3, and 4 are assigned to the vertical arrays which are respectively from left to right, east to west, rear to front, and front to rear, and west tower rear to the purposes of print-out and key numbering.

After the first set of relays has been securely operated, relay R820 shown in the middle of buffer relay circuit, FIGURE 87, is operated. This connects voltage to the front contact and armature of relay R820 and so applies power to the east or west bus-bar and so causes the selected east or west relays to be set up. As mentioned, the output relays for the east tower are shown on FIGURE 85 and the corresponding relays for the west tower are shown on FIGURE 88. If relay R801 is operated, for instance, and relay R801 is selected by relay R809, voltage will be applied through contacts 16 of relay R809, contacts 13 of relay R801 to terminal FARW. This terminal connects through a diode and the winding of relay R831, FIGURE 88 of the west output relays to ground, operating the relay. Similarly, any other one of the relays R832 through R844 shown on FIGURE 88 may be selected by the operation of an individual relay on FIGURE 86. Any one of these relays which is operated will be locked by voltage which will be applied, in a manner to be described, to terminals WHO and WHD of relay R880 and through contact 6 of any relay which is operated and through R833 to ground. The three relays, R831, R832, and R833, shown at the upper left of the west output relays in FIGURE 88, are controlled as a group by three permutations applied to them to define any one of the eight floors in a particular section of the west tower. This group of three relays when operated will translate the binary permutation into the selection of an individual floor. In order to achieve this, relay R848 shown at the bottom middle portion of FIGURE 88, is operated, in a manner to be described, to apply voltage to its front contact. It will be assumed that it is desired to select floor 8. In this case, none of the relays R831, R832, or R833 will be operated. A circuit, not shown, furnishes a resetting source of voltage through the front contact of relay R848 to conductor voltage west VW. This connects to a corresponding designated conductor, at the top right in FIGURE 88, and the circuit continues through contact 9 of the west by-pass relay R844. In order to effect a selection of a floor and to perform any one of the operations involving the movement of a car to or from a stall in the garage, it is necessary that the by-pass relay R844 be unoperated. If the relay is unoperated, the circuit will continue through contacts 9 of relay R832, contacts 9 of relay R833, and contacts 12 of relay R831 to conductor FW58 which effects the section of the eighth floor of the west tower. It has been explained that this selection is effected by assigning it arbitrarily to whatever ordinarily corresponds to the binary numeral 0.

In order to effect the selection of any one of the other floors from 1 to 7, relays R831, R832, and R833 must be operated in accordance with the binary permutation corresponding to the decimal number. Thus, for instance, if floor 7 is to be selected, all three of relays R831, R832, and R833 must be operated, and the circuit after passing through contacts 9 of relay R844, to which point it has heretofore been traced, extends through contacts 10 of relay R832, contacts 16 of relay R831 and contacts 13 of relay R833 to terminal F58 which effects the selection of floor 7 of the west tower.

The selection of the tiers is accomplished similarly by

the impressing of a permutation combination corresponding to the decimal numeral on the group of relays R834, R835, R836, and R837 which are the west tier selection relays. Four relays are required for the tier selection since each of nine floors must be defined. As an example of the selection of a particular tier, we will assume that tier 9 is to be selected. In order to achieve this, it is necessary that relay R834 which has a binary value of 8 and relay R835 which has a binary value of 1 should be operated and that relays R836 and R837 should be released. A circuit may then be traced from a source of voltage through the Parrs of relay R844 to conductor V West, contacts 9 of relay R836, contacts 9 of relay R837, contacts 12 of relay R835 and contacts 8 of relay R834 to conductor TSW9 which corresponds to tier 9 of the west tower. It should be mentioned that relay R836 has a value of 2 when operated and relay R837 has a value of 4. As another example, let it be assumed that tier 6 is to be selected. Voltage on the front contact of relay R848 will then pass through conductor V West, contact 10 of relay R836 and contacts 16 of relay R835 and contact 15 of relay R837 to conductor TSW6 which corresponds to tier 6 in the west tower.

The relay R848 shown in the selection of the front or rear section of the west tower. When relay R838 is operated, the voltage on the front contact of relay R848 is applied through conductor V West, and contact 9 of relay R838 to conductor REAR W to select the rear section of the west tower. When relay R839 is unoperated, the circuit extends through contact 8 of relay R838 to conductor FRONT W to select the front section of the west tower.

The buffer relay circuit of FIGURES 86 and 87 has a group of relays R810, R811, R812, R813, and R814. These are controlled by the parking signals PK, the unparking signal UPK, the lost key signal LK, the unpark signal UTPK, the lost key signal LTPK, the non-reversing signal NRTW, and the reversing signal RRTW. Each one of these relays is operated, dependent upon whether or not the tower relay R809 is operated or released, voltage is applied through the west bus-bar or the east bus-bar respectively to contacts 6 or contact 10 on each of these relays to produce the signals PWRK, UPWRK, LPRK, CVWRK, and RTRW which represent the west tower park output control relay, the west tower unpark output control relay, the west tower lost key output control relay, the west tower convert output control relay and the west tower retrieve output control relay. A corresponding group of signals PKRE, UPKRE, LKRE, CVWRK, and RRTRW represent the functions of key in the east tower. The west group of signals are applied to the operating relays R838 to R844 in the west output relays, FIGURE 88 and the group of signals for the east tower are applied to the windings of relays R858 through R864 on the east output relays, FIGURE 85.

The east output relays and the west output relays, once operated, will remain operated until the signals which they are transmitting are properly received by the relays associated with the elevator equipment. Thereafter, the relays will be released and they will be ready for the reception of another signal. Each group of relays is designed to perform a function in a particular tower section, floor, and tier. The separate set of relays for the east tower and for the west tower permits operations to be carried on simultaneously in each tower.

As long as a set of output relays is busy, that is to say, as long as the east output relays of FIGURE 85 or the west output relays of FIGURE 88 are operated, holding voltage for these relays will be supplied from a source to be explained, through terminals EHO and EHD of relay R870 on FIGURE 85 and terminals WHO and WHD of relay R870 on FIGURE 88 when these relays are in the released condition. After the information has been properly received by the elevator equipment, the signal will be passed from the elevator circuitry through conductor SBW, the winding of relay CSSW, to battery.
operating the relay. The operating of relay CSSW will establish a circuit from ground through contact 6 of relay CSSW to the junction of a diode which is connected to one terminal of a resistor, the opposite terminal of which is connected to +85 voltage. This will permit current to pass from the delay flip-flop D8F80 through relay driver 880D and the winding of relay R880 to battery operating relay R880 momentarily. This will break the circuits which are supplying battery through terminal WHO and WHD to contacts 4 and 8 of relay R880. This, in turn, will release such relay R880 through R884 which have been locked in the operated condition. As long as the east output relays or the west output relays are busy, signal ERB is produced under the joint control of relays R865 and R870, on FIGURE 85, to indicate that the east output relays are busy, and signal WRB is produced on FIGURE 88 under joint control of relays R845 and R880 to indicate that the east output relays are busy. This prevents a further transaction affecting the particular tower until the output relays have been cleared. As long as signal ERB or signal WRB is present it will be applied through gate 216G or 215G in FIGURE 42 to disable gate 218 in the key and card reader circuit, FIGURE 42. Attention is called to the fact that when any of the east output relays, FIGURE 85, or west output relays, FIGURE 88, is operated, a signal is produced to contact 5 of each of the operated relays. These signals are designated in the case of the east output relays — FAHE, —FBHE, —FCHE through gates 790-1 790-2, and 790-3 and with signals —TAHE, —TBHE, —TCHE, and —TDHE are gated through gates 790-4 through 790-7 and with signal —REHE through gate 790-8. A group of eight gates 791-1 through 791-8 are similarly arranged for the west floor and tier selection signals. The signals FA, FB, and FC for the floor and the signals TA, TB, TC, and TD for the tower are operated in the key and card reader circuit, FIGURE 42. If the relays in the output circuits, FIGURES 85 and 88 and the elements in FIGURE 42 have been properly operated, each relay will have produced a minus signal for each positive signal produced in FIGURE 42. These opposite signals will be paired at individual gates in FIGURE 89. If the opposite signals are produced in each instance, no signal will be passed through the corresponding gate. If any one of the floor selecting signals or if any one of the tier selecting signals for the east or the west tower has not produced a corresponding negative signal in its respective output relay in the east or west group, the associated gate will pass a signal through non-inverting amplifier 790 or 791 which will be applied to gate 792 or 793. The signal will be gated with the signals WT and —WT and with the output relay test signal ORT. The test signal ORT is produced in the buffer relay circuit FIGURE 89 at the output of delay flip-flop P166, 456. Immediately after the KSP signal is applied to flip-flop 820. Signal ORT is applied to gates 792 and 793 in the output error check circuit. If a signal is passed through either inverter 790 or 791 it will be passed through gate 792 or 793 and non-inverting amplifier 794 to set flip-flop F795 which produces the minus signal at output terminal 1. The production of this output error signal, OE, causes the computer to halt its cycling. If no error is produced in the east or west output relays, flip-flop F795 will be reset by the computer busy reset signal CBBR. This would produce an output at the 0 terminal of flip-flop F795 which would tent to enable gate 197 in FIGURE 89. When the CP signal is produced, signifying the end of the cycle for cycle 1, and these two signals CY1 and CP are present together with a minus hold, this will produce a signal indicating the absence of a hold due to any error condition, such as a tall card assigned to a wrong floor, or an unsatisfactory positioning of a car, etc., delay flip-flop 197 is set. This produces the ORT signal which lasts 25 milliseconds. This is the output of relays check signal. At the same time, the signals OTR and OTR are produced at the outputs of gates 198 and 199. The production of these signals indicates the absence of an error and that it is satisfactory to pass the information to the elevator equipment. Signals OTR and OTR are applied to relay driver 865D on west output relay circuit, FIGURE 85 and to relay driver 845D on west output relay circuit, FIGURE 88, operating relays R865 and R845 respectively. The operation of relay R865 operates relay R866 and the operation of relay R845 operates relay R848 on FIGURES 85 and 88 respectively. The operation of relay R865 and the operation of relay R848 applies battery to the selector of the floors and the tiers for the east output relays and for the west output relays as explained herefore. On the output error check circuit, FIGURE 89, there is an alternate path for producing the output relay after check signal OTR. Attention is directed to the function control circuit, FIGURE 56. This shows that the signal LK and the reference signal RET being buffered in buffer 027 to produce the RLK and the —RLK signals. The —RLK signals will exist only if there is no lost key or retrieve signal present. This signal —RLK and the repair signal RPA are employed in FIGURE 89 during a repair at the end of a lost key transaction during which the output relay information may be varied in the middle of an operation to produce the OTR signal. There are 30 conductors on the east output relays, FIGURE 85 and 30 conductors on the west output relays, FIGURE 88 which must be connected to the elevator equipment to control the selection of the various stalls and the performance of the various functions. The 30 conductors from the east output relays are connected through 30 make contacts in an east disconnect relay to 30 conductors in the elevator equipment to effect the necessary selections. There are also 30 conductors on the west output relays which connect through 30 make contacts on a west disconnect relay to 30 conductors in the elevator equipment to perform the necessary functions in the west tower. The 30 conductors in the east output relays consist of eight conductors designated TSE-1 through TSE-8 which are the eight floor selection terminals. There are nine other conductors designated TSE-1 through TSE-9 for the nine tier selections. In addition to this, there are ten conductors which control the performance of the various functions. These are conductors REAR E for the selection of the rear tower east, FRONT E for the selection of the front tower east, PARK E for the performance of the parking function in the east tower, UNPK for the performance of the unpark function in the east tower, LOSTKE for the performance of the lost key function in the east tower, CONE for the control of the convert function in the east tower, RETRE for the control of the retrieve function in the east tower, BYPASS E for the performance of the by-pass function in the east tower, LOST-RPKE for the performance of a repair function after a lost key operation in the east tower, and RET-RPKE for the performance of a repair function after a retrieve function in the east tower. In addition to these signals, there are several connections between the computer and the elevator equipment, including the passage of all signals between the computer equipment and the elevator equipment. One is conductor VE which supplies voltage from the elevator equipment through the contacts of relay R868 at the middle bottom of FIGURE 85 to the east output stall and tier selecting signal.
relays and the function relays. These signals are passed back to elements in the elevator circuitry to effect the selection and perform the functions. One other conductor which connects the elevator equipment to the east output relays is conductor SBE which connects to relay CSSE in the east. This sends a break signal from the elevator equipment to the east output relays after the information has been successfully transferred from the computer equipment to the elevator equipment, to unlock a hold condition in the east output relay circuit, FIGURE 88.

Conductors VW and SBW inter-connect the west output relays and the elevator equipment to perform corresponding functions in the west output circuit, FIGURE 88. One other interconnection is the ground connection.

In order to control the elevator equipment in the west tower, it is necessary to interconnect 30 conductors on the west output relays corresponding to those described for the east through 30 sets of contacts on a west disconnect relay. The east disconnect relay and the west disconnect relay may each be operated independently to connect either tower from the computer. In order to achieve this, an individual switch is connected in series with each of these two relays. At these points it may be desirable either for maintenance purposes or because of malfunction of the equipment to disconnect both towers from the computer. In order to achieve this, a third relay is provided under control of a switch which, when operated, disconnects battery from the east disconnect relay and the west disconnect relay in parallel releasing both relays.

It is pointed out that in case of malfunction, the elevator equipment is arranged so that it may be operated without the computer.

Refer now to the check circuits, FIGURE 92. It has been mentioned that the present circuitry is arranged to halt the operation of the computer in the event of any one of a number of erroneous conditions. In order to do this, signals produced by the erroneous conditions are applied through buffers 361 and 362 and through buffer 363B and non-inverting amplifier 363D and through diode 363 to produce the hold signal H and the minus hold signal, -H.

Reference to buffer 361 shows that five signals are applied thereto. The first is signal TCE which is produced by a tall car error; that is to say, when a tall car is assigned to floors other than floor 1 or floor 8. The second is signal SE which is produced on failure of the parity check. The third is signal CCA which is the card code alarm signal. This is produced upon the failure of a charge card to match the wiring of its individual plugboard. The fourth is signal SF. This is the stall full signal which is produced when an attempt is made to park a car in a stall which is already occupied. The fifth is signal SE. This is the stall empty signal which is produced when an attempt is made to retrieve a car from a stall which is empty. There are three signals applied to buffer 362. The first is signal OE. This is the output error signal which is produced in the output error check circuit upon failure of any floor selection or tier selection signal to match the check signal for each. The second of these signals is signal POS. This is the position error signal which is produced on failure to properly position a car in an assigned area in the input position of the elevator. The last of these signals is signal PRE. This is the premature key withdrawal alarm signal which is produced when a key is prematurely withdrawn from the key reader.

Since the information for the selection of the stalls is set up almost instantly upon the insertion of a key in the key reader to allow time for performance of a parity check on the input flip-flops in the west relay, the occurrence of an error, such as a parity error, stall occupied, stall full error, etc., must effect the resetting of the output relays for the appropriate tower. The circuitry for this is shown on the buffer relay circuit, FIGURE 87.

URE 86 and 87. The errors are sensed during cycle 1 by applying pulse CY1, the count pulse CP and the halt signal H to gate 591 sets delay flip-flop DF591. The output of this flip-flop is gated into gates 892G and 893G. The signal WT for the selection of the west tower and the signal 55 sends a break signal from the elevator equipment to the west output relays after the information has been successfully transferred from the computer equipment to the elevator equipment, to unlock a hold condition in the west output relay circuit, FIGURE 88.

Conductors VW and SBW inter-connect the west output relays and the elevator equipment to perform corresponding functions in the west output circuit, FIGURE 88. One other interconnection is the ground connection.

In order to control the elevator equipment in the west tower, it is necessary to interconnect 30 conductors on the west output relays corresponding to those described for the east through 30 sets of contacts on a west disconnect relay. The east disconnect relay and the west disconnect relay may each be operated independently to connect either tower from the computer. In order to achieve this, an individual switch is connected in series with each of these two relays. At these points it may be desirable either for maintenance purposes or because of malfunction of the equipment to disconnect both towers from the computer. In order to achieve this, a third relay is provided under control of a switch which, when operated, disconnects battery from the east disconnect relay and the west disconnect relay in parallel releasing both relays.

It is pointed out that in case of malfunction, the elevator equipment is arranged so that it may be operated without the computer.
have potential connected to them directly when relays R848 or R686 operated in each of these circuits. These direct connections will produce a lost key repaint operation or a retrieve repaint operation directly. On the buffer relay circuit, at the end of the signal from the delay flip-flop DF873, a pulse will be produced in blocking oscillator 875. This signal is buffed into delay flip-flop DF820, FIGURE 87, to operate relay R820.

The operation of this relayconnects voltage to either the east or west bus bars depending upon whether the east relay section or the west relay section is released or operated and through the contacts 7 or contacts 16 of each of relays R810 through R814 to apply voltage to the windings of the corresponding functional relays in the east output or west output relay group.

On the buffer relay circuit, FIGURE 87, the by-pass east signal BYE is applied to gate 899C and the by-pass west signal is applied to gate 898C to control the operation of relay R127 which produces the signal RBYE and of relay R128 which produces the signal RBYW for the east and west by-pass operation, respectively.

**Function controls**

Refer now to the function circuits, FIGURES 34, 35, 36, 37, 38, 39, 40 and 41.

There are four functions which require both car motion to or from a stall and computer operation. These four functions are the park, unpark, retrieve and lost key functions. If the park button PARK, FIGURE 34, is operated, the park signal PKP is produced at the output of blocking oscillator 001. If the unpark button UNPARK, FIGURE 35, is operated, the unpark pulse UPP is produced at the output of blocking oscillator 011. If the retrieve button RETRIEVE, FIGURE 38, is operated, the retrieve pulse RTP is produced at the output of blocking oscillator 021. If the lost key button LOST KEY, FIGURE 36, is operated, the lost key pulse LKP is produced at the output of blocking oscillator 051. Each of these four signals control circuitry to produce a corresponding park signal PK, an unpark signal UPP, a retrieve signal RET, and a lost key signal LK. The parking pulse signal PKP is applied to the set terminal of flip-flop 021, the output of which produces the park intent signal PKF. The signal passes through gate 021 and non-inverting amplifier 023 to produce the signal SPK which is applied to the set terminal of flip-flop 023. The output from the 1 terminal of flip-flop 023 is impressed on amplifiers 021A and 022A to produce the park signal PK.

The output from the 0 terminal of flip-flop 023, under this condition, is the signal —PK.

The unpark pulse signal UPP is applied to the set terminal of flip-flop 014. The output of the 1 terminal of flip-flop 014 then produces the unpark intent signal UPF. This signal is applied through gate 016 and non-inverting amplifier 017 on the set terminal of the unpark flip-flop F018. The output from the 1 terminal of flip-flop F018 is then applied through inverting amplifiers 016A and 018A to produce the unpark signal UPP, while the output from the 0 terminal produces the signal —UPP. The unpark pulse signal RTP from FIGURE 38 is applied, in FIGURE 36, through gate 024G on the set terminal of flip-flop F024. The output from the 1 terminal produces the retrieve intent signal RTF and is applied through gate 025G on the set terminal of flip-flop F025. The output from the 1 terminal of flip-flop F025 is the signal RTF.

The output from its 0 terminal is the signal —RTF.

The lost key pulse LKP is applied to gate 054G, the output of which when applied to the set terminal of flip-flop F054 produces the lost key intent signal LKF. This signal is applied through gate 055G on the set terminal of flip-flop F056 to produce the lost key signal LK at the 1 terminal of the flip-flop. The signal —LK is produced at the 0 terminal of flip-flop F056.

It was shown in the foregoing how an intent signal for each of the Park, Unpark, Retrieve and Lost Key operations was produced. In FIGURE 34, these signals PKF, UPF, RTP and LKF are applied together with the cash transaction intent signal CSIF through blocks 059A, 059B and 059C on the inputs 059 and 060 to produce the input interlock signal INI. This signal is applied through another buffer and two inverter amplifiers in tandem to produce the signal INH. The presence of signal INH indicates that some one of the five intent signals has been produced. The INH signal is applied to the allow set terminal of flip-flop 021, the unpark flip-flop 014, the retrieve flip-flop 024, and the lost key flip-flop 054. Therefore, if any of the intent signals has been produced and the INH signal has been produced as a result, and applied to all of these flip-flops, it prevents any one of them from being set after another has already been.

The occurrence of the delayed key sprocket signal DKS, derived from signal KSP, sets each of the actual operational flip-flops corresponding to the intent flip-flops in the circuits just described. Thus, signal DKS applied to mixer gate 021 and non-inverting amplifier 023 sets flip-flop F023, the park flip-flop. These operation flip-flops for the park, unpark, retrieve and lost key functions remain set until the end of the transaction, which is signalled by the production of a computer busy reset signal CBR which resets each of these flip-flops.

It will be noted that the park flip-flop has two additional special set gates. One of these gates, gate 023G, causes a car to be returned to its stall during a lost key operation upon a second depression of the lost key button. The first operation of the lost key button produced the lost key signal LK as heretofore described. This signal LKP produced at the output of flip-flop F056 will persist. It is applied to the input of gate 023. If, while signal LKP persists, the lost key button is again operated, signal LKP will again be produced and will be applied to gate 023. When these two signals exist simultaneously, a condition is applied through non-inverting amplifier 023 to set the parking signal PK which effects the parking of the car involved. In the same manner, a second depression of the retrieve button will cause a retrieved car to be reparked. The first depression of the retrieve button, FIGURE 38, produced the signal RTP, which, in turn, in FIGURE 36 produced the retrieve signal RET. This signal persists and is applied to gate 022. If, while it endures, the retrieve button is again depressed, a second signal RTP will be applied to gate 022 and this will produce the parking signal PK. This reenacts the car.

A special gate 015 to the unpark flip-flop 018 causes the unpark convert button to convert either a retrieve or a lost key operation to an unpark operation.

In FIGURE 35 the lost key signal LK is produced at the 1 terminal of flip-flop F056 and the retrieve signal RET, which is produced at the 1 terminal of flip-flop F026, are buffed together through buffer 027 to produce signal RLK at the output of inverting amplifier 028 and signal —RLK at the output of inverting amplifier 027. The signal RLK is applied to gate 015. If, while signal RLK endures, the unpark convert button is operated, signal UPC will also be applied to gate 015. The simultaneous existence of these two signals at gate 015 will produce the unpark signal UPK and effect the unparking of the car in question. By this means, a car which has been brought to the unpark position as a result of the retrieve or lost key operation may be permanently unparked.

**The cycle controls**

The cycle counter circuit, FIGURES 45 and 46, control the various events which constitute a computer transaction. These circuits comprise, in FIGURE 45, a three stage binary counter whose main elements are flip-flops CX1, CX2 and CX3, are decoded in FIGURE 46 by
means of gates 120G, 122G, 124G, 126G, 128G, 130G, 101G and 104G and impressed on their associated amplifiers 1120, 1122, 1124, 1126, 1128, 1130, 1102 and 1105 to form the various numbered cycle steps. These steps are CYX to CYO through CY6 for the active stages. In FIGURE 45, mixer gates 140H, 132H, 113H and 182H and mixer gates 133H, 134H, 153H and 163H feed non-inverting amplifier 109. Mixer gates 137H, 135H and 159H feed non-inverting amplifier 110. The various step pulses are here collected which in turn conditions the three stage counter from one step to the next. Thus, for instance, pulse KSP which is produced as a result of the insertion of the key in the key reader and the access of all of the interlocks which have theretofore been applied, steps the computer from the quiescent condition during which signal CYX is produced to the condition in which the cycle zero signal CY0 is produced. The delay key sprocket pulse, DKS, when applied with the cycle 0 pulse CYO to gate 140H, steps the counter from the 0 condition CYO to the cycle 1 condition CY1, etc. The various stepping pulses are best understood from a detailed analysis of the various functional characteristics in which they in part control.

To describe the operation of the cycle counter in somewhat more detail, when the three stages of the counter are in the 0 condition, terminal 1 of each of flip-flops 110, 111 and 112 produces signals —CX1, —CX2 and —CX3 respectively. These three signals will be applied in FIGURE 46 to gate 120G and through non-inverting amplifier 1120 to produce signals CYX and —CYX.

When the KSP pulse is applied to the input of flip-flop 110, signal CX1 is produced at the output of its terminal 1. The output of flip-flops 111 and 112 remain unchanged. These three signals are applied to gate 122G and produce the signal CYO. The signals CYO and DKS are applied to gate 124G. The flip-flop 110 is restored to its original condition. The —CX2 signal at the output of flip-flop 111 is changed to signal CX2. The output from terminal 1 of flip-flop 112 remains unchanged, as signal —CX3. These signals —CX1, CX2, and —CX3 are applied to gate 124 and produce the signal CY1 at the output of amplifier 125.

The signal CY1 is gated under various conditions through gates 113, 132 and 182 to produce an output which is applied through amplifier 109 and 110 on the first stage of the counter flip-flop 110. This changes the output terminal 1 of flip-flop 110 so that it again produces the signal CX1. The output from terminal 1 of flip-flops 112 remains unchanged. These signals CX2 and —CX3 respectively. These three signals CX1, CX2, and —CX3 are applied to gate 126 and pass a signal through amplifier 126 and 127 to produce the signal CY2.

It should be apparent from the foregoing that, in order to cause the three stage binary counter to progress through its various counting stages, the signals produced in the series of gates and amplifiers in the gate and amplifier array in FIGURE 46 will be gated with other necessary signals in the mixer of gates amplifier at the left in FIGURE 45 to change the count progressively through the required counting range. The portion of the cycle counter comprising flip-flops 113F, 114F and gates 114G and 115H comprise a storage circuit which stores impulses to the cycle counter which occur while the digital clock is advancing and must therefore be stored until it has stopped advancing. This condition occurs at the end of cycle 1, when it is necessary to read the present time in the memory.

In FIGURE 45 gates 175H, 177H, 179H, 180H and 181H are controlled by the various conditions which are necessary for the production of the computer busy reset signal CBR, representing the end of a transaction which occurs normally. The buffered output of the clock oscillator 175H and its drivers to produce the computer busy reset pulses CBR, CBRA and CBRR which perform the various reset functions. One function is to reset the cycle counter in this same figure.

This is achieved by applying pulse CBR through amplifier 110F to clear terminals of flip-flops 110, 111 and 112. The computer busy signal CB is produced in the output flip-flop 142F at the top of FIGURE 42 in response to the various pulse and reset conditions, namely, signals CSPH which is the cash pulse, signal BYP, which is the bypass pulse and signal KSRA, which is the key sprocket pulse. Flip-flop 142 is reset by the computer busy reset signal CBRB.

Check and Test Circuits

The check and test circuits are shown on FIGURES 91, 92, 93, 94 and 95. The key parity check circuit and the card code circuits have previously been described. Another check circuit is the tall car check circuit which prevents further operation of the system when a tall card has been directed to any floor other than floor 1 or floor 8 in any of the four sections of the garage.

Refer to FIGURE 94, the tall car error check circuit. A tall car must be parked on either floor 1 or floor 8 of the various tower sections. If a tall car is directed to be parked on any other floor of the west tower, relay C4 is operated applying a condition to gate 323H. If a tall car is directed to be parked on any other floor of the east tower, relay E7 is operated applying a condition to gate 322. Floor signals F1 and F8 are applied to amplifier 322, and in parallel to gates 322 and 323H. If a tall car is directed to the wrong floor, flip-flop 323F is set and its output drives relay driver 323A to operate relay 323 and bring in the 323A error lamp. Flip-flop 323F, which is the tall car error flip-flop, stores the signal guarding against its loss in the middle of a cycle.

Refer now to the memory data circuit, FIGURE 51. Flip-flop 45331 produces the D1 signal and the —D1 signal. The D1 signal indicates that a stall is occupied. Gates 346D and 346B on the stall empty check circuits, FIGURE 92, with their amplifiers 361 and 364 control relays R361 and R364 to produce the stall empty error indication and the stall full error indication by applying battery through the filament of individual lamps and contacts 6 of each relay to ground lighting one or the other lamp to indicate the condition.

Refer to the position error indicating circuit, FIGURE 93. If a car is improperly parked in the receiving station of the west tower, relay D3 is operated and similarly relay D4 is operated for an improperly parked car in the east tower. The D1 signal indicates that a stall is occupied. Gates 346G and 346H on the stall empty check circuits, FIGURE 92, with their amplifiers 361 and 364 control relays R361 and R364 to produce the stall empty error indication and the stall full error indication by applying battery through the filament of individual lamps and contacts 6 of each relay to ground lighting one or the other lamp to indicate the condition.

Refer again to the position error indication circuit, FIGURE 93. It has been explained that at times a car is directed from the parking station out of the garage without being parked. Mechanism is provided to do this in the east and west towers. In order to do this, the car must be properly oriented in the receiving station of each tower. In the event that the car is not so oriented and a bypass operation is in order at either the east or west tower, this condition is indicated by signals impressed through gate 355-3 for the west tower and 355-4 for the east tower of these gates. These signals pass through the oscillators as previously mentioned to operate relay R355 and bring in the position error lamp.

Provisions are made in the present circuitry for testing the various functional switches. This is performed by the
test control circuit shown on FIGURE 102. In operating the test control circuit, the rotary switch 9 is first set on some one of the terminals of its bank. The switch 3 is first connected to its lower terminal to charge the connected condenser and then is operated to engage its upper terminal. This provides a pulse which is impressed through the armature and the particular contact to which switch 9 is connected to pass a pulse through some one of the terminals OFF, TPK, TUPK, TRET, TLK or TUPC. These terminals connect the various function control circuits. The TPK terminal connects to buffer 001 of the park circuit. Signal TUPK connects to buffer 011 of the unpark circuit. Terminal TRET connects to buffer 021 of the relay circuit. Terminal TLK connects to buffer 031 of the lost key circuit and terminal TUPK connects to the blocking oscillator 050 in the unpark convert circuit. These testing pulses when thus applied, produce the same effect on the associated blocking oscillator as do the depression of the corresponding buttons in the same circuit and thus provide a means for testing these circuits. Refer now to the east output relays, FIGURE 85. Switch 29 shown at the bottom middle portion of this figure provides a means for testing the operation of relay R867 by supplying a simulated break pulse to the relay winding R867. Switch 4 also provides a means for testing relay R867. The west output relays, FIGURE 88, have two corresponding switches, switch 29 and switch 4, which are used to test relay R847. The operation of switch 5 in the memory data circuit, FIGURE 51, will erase the staff occupied bit in the memory.

**Park operation**

The operation of the circuitry in performing the functional operations, such as the park, unpark operations, etc. have already been described in detail in connection with the description of the various circuits. The parking operation will be summarized in this section and the other operations in other sections to follow.

Refer now to the key reader circuits, FIGURE 42 and to gate 218G thereon. This gate is a major control element for the various operations which control motion of a vehicle within the garage. In order to activate the gate, a number of conditions are required as for these circuits explained. The computer must not be busy. This is indicated by the presence of the -CB signal. The digital clock must not be advancing. This is indicated by the presence of the -DCA signal. A key sprocket pulse must be present. This is produced by the presence of signals KTSFA and KTSFB which are produced through gate 480G and enterverting amplifier 210 to gate 218G. Gate 218G is also controlled by the presence of some one of the four signals which produce car motion. These are the unpark intent signal, UPF, the park intent signal PKF, the retrieve intent signal KTF, and the lost key intent signal LKF. Each of these signals is buffered through buffer 221B and non-inverting amplifier 222A to gate 218G. It will be assumed that the parking intent signal PKF is present and that all of the other conditions necessary for the passage of a signal through gate 218G are also present. Each of these operate intent signals is produced in the function control circuits. It will be remembered that when the park button is pressed, the signal PKP is produced at the output of blocking oscillator 001 and the park intent signal PK of the output terminal of flip-flop 031. It was explained also that the four intent signals were applied to the input of the two gate 462 in the memory data circuit, FIGURE 51, controls a staff occupied and a staff empty check and the staff occupied bit is written into the memory. On the start index control circuit, FIGURE 75, gate 031 allows the count pulse during cycle 1 to produce the start indexing signal IND and the staff number is indexed. On receipt of the end print pulse EP after the printing of the staff number, gate 132H on cycle counter circuit, FIGURE 45, allows a stepping of the cycle counter to cycle 2 and gate 402 on the memory timer circuit, FIGURE 60, starts another memory cycle, during which the present time is written into the memory. The end memory cycle counter, FIGURE 60, restarts the memory chain and the park signal PK at gate 133H on the cycle counter, FIGURE 45, allows a stepping from cycle 2 to cycle 3. During cycle 3, the present is written into the memory and upon receipt of the end of the memory cycle timing signal CP at the end of cycle 3, gate 135H in the cycle counter, FIGURE 45, is stepped into cycle 4, CY4. In the start indexing circuit, FIGURE 75, gate 036 produces the start indexing signal IND and the present time is indexed and printed. On the cycle counter circuit, FIGURE 45, the end print EP during cycle 4 of the parking operation at gate 179H produces the computer busy reset pulse CBR to reset the computer busy flip-flop 142F, FIGURE 42, and the park flip-flop 023 on the park function control circuit, FIGURE 34. When the break signal is supplied from the elevator equipment, the east relay bus signal ERB, the east output relays, FIGURE 88, the computer busy signal on the west output relay circuit, FIGURE 88, will be cleared and another transaction may proceed at either tower.

**Unpark operation**

During the quiescent interval of the cycle counter CYX and the 0 interval CYO, the unpark operation is the same as during these same intervals for the park operation with the exception that the unpark button in the unpark func-
tion control circuit, FIGURE 35, is operated instead of the park button. The operation of the unpark button produces the unpark pulse UPP which sets the unpark intent flip-flop 018 in the unpark function control circuit, FIGURE 56. This produces the unpark signal UKP at the output of the circuit. The computer is advanced into cycle 1 by the same method as described for the parking operation and a memory cycle occurs. The stall occupied bit is erased from the memory. On the park control circuit, FIGURE 60, gate 042 allows a recycle of the memory and gate 132H on the cycle counter, FIGURE 45, again allows stepping into cycle 2. During cycle 2, the subtraction of the present time from the stored time is performed and indexing is initiated by way of gate 032 of the index control circuit, FIGURE 72, upon occurrence of the end signal ES. The difference register relay circuit, FIGURE 71, gate 713 sets flip-flop 713F to produce the hold elapsed time signal HET upon completion of a successful transaction. Flip-flop 713F drives relay drive 714D to operate relay R714. This, as has been heretofore described, produces the signals which control the elapsed hours grouping relays, FIGURE 72, and produces various group signals for the elapsed time PH—to automatically calculate the fee. Upon occurrence of the end index signal EI at the output of blocking oscillator 916, in the upper middle portion of the index control circuit, FIGURE 73, and memory timer circuit, FIGURE 60, is restarted by way of gate 402. The cycle counter, FIGURE 45, is restarted by gate of 134H and is advanced to cycle 3. Again, the subtraction operation is set in motion, and this time, the present day is subtracted from the stored day. At this point, there are two paths which may be taken. If the elapsed time is greater than twenty-four hours, as signified by an output or gate 019G on the function control circuit, FIGURE 37, flip-flop F057 is set and upon completion of the subtraction, as signified by the production of the end subtraction signal ES, flip-flop 019, the manual cash flip-flop is set to produce the manual cash compute signal MAC. Signal MAC operates relay R976. The operation of relay R976 closes a contact which illuminates a lamp on the free display equipment to indicate that the fee must be entered manually. Another pair of contacts on relay R976 produces a signal which energizes the flip-flop 034 on the index control circuit, FIGURE 75, and will again produce the start signal index IND to start indexing, and the elapsed time will be printed. Upon receipt of the end print signal EP at mixer gate 037, the cycle counter will step into cycle 4, and the present time will index the new data. If no charge card was given by signal —CS, and if the fee was calculated automatically, as indicated by signal —MAC, mixer gate 035 on the index control circuit, FIGURE 75, will again produce the start indexing signal IND for the normal fee print out. If, however, the manual fee signal MAC is produced, the fee must be entered manually, and the print motor bar signal together with the manual computation signal MAC and the cycle 5 signal CY5 are applied to gate 030G of the cash keyboard circuit, FIGURE 101. This would start the indexing of the fees when applied to flip-flop F788 which operates relay R788 and also produces the index manually computed fee signal IMP on the cash keyboard circuits, FIGURE 101. If a charge card was read, the card reader sprocket signal CSA would be produced. This signal when applied to gate 138H of the cycle counter, FIGURE 45, together with the counter signal, fifth stage pulse CY5P and the minus cash transaction signal —CSH advances the three stage binary counter in the cycle counter circuit into cycle 6. On the index control circuit, FIGURE 75, at mixer gate 039G, if a charge card was still in the reader, as indicated by the presence of a card sprocket signal CS and the card reader signal MAC, a start indexing signal IND would again be produced to print a charge card number. If a charge card were prematurely withdrawn, there would be no card reader sprocket signal KCS applied to gate 039G of the index control circuit, FIGURE 75. In order to pass a signal through gate 039G to start indexing under this condition, it would be necessary to reinsert the card. The KCS signal produced under this condition would pass a signal through a blocking oscillator at 1038 at the lower left in FIGURE 75 to mixer gate 038. The cycle counter would be in the sixth counting stage, and the presence of signal CY6 at gate 038G would again produce the start indexing signal IND. At the end of the sixth cycle, when CY6, during a unpark operation, mixer gate 180 or 175 will pass a signal depending on whether or not a charge card was employed to produce the computer busy reset pulse CBR. Note that on a charge transaction signal —CS at gate 785C on FIGURE 101 prevents setting of the fee display lights.

Cash transaction

There are two types of cash transactions performed by the present circuits. One transaction is under control of a charge card. In this case, the fee is added into the accumulation of the lister. The other transaction is the normal cash transaction in which a charge card is not used, and in this case, there is no addition in the accumulator.

The cash transaction starts with the computer in the quiescent cycle condition CYX.

On the cash transaction circuit FIGURE 41 of the function computer, the transaction switch is operated and blocking oscillator 008 produces an output. This sets the cash transaction intent flip-flop 008 to produce the cash transaction intent signal CSIF. If the computer is not busy, as indicated by the presence of signal —CB, and if the digital clock is not advancing as indicated by the presence of signal —DCA, when flip-flop 008 is set, a signal is passed to set the cash transaction flip-flop 009 and produce the signal CS. On the cycle counter circuit, FIGURE 45, the cash transaction pulse CSHP is applied through buffer 107B, amplifiers 107 and 110 to the input of the three stage binary cycle counter and operates the cycle counter into step four by setting flip-flop 110 and 112.

On the index control circuit FIGURE 75, at mixer gate 037, signal CSHP produces the start indexing signal IND to index the present time. On FIGURE 44, signal CSHP occurs, at the output of blocking oscillator 243 and signal CS is set at the output of flip-flop F243 because a card is in the reader. Upon occurrence of the end print pulse from the end present time indexing and printing, the cycle counter, FIGURE 46 will be stepped to cycle CY5 by way of gate 139H on the cycle counter control circuit, FIGURE 45 read, as indicated by FIGURE 37. Signal CSH applied to amplifier 019 produces signal MAC at the output of flip-flop F109, to illuminate a lamp as a signal to indicate a manual fee entry and to energize the keyboard. After appropriate entry of the fee and depression of the motor bar, the IMF signal is impressed through diode 039H to start indexing. Occurrence of the end print pulse EP during cycle 5 will again produce the IND pulse to index the charge card number.

The cash correction form of cash transaction is similar to the one just described in the foregoing except that no charge card is present, and thus signal —CS, which denotes this condition, by way of gate 013 on FIGURE 41, produces the correction signals CORR and —CORR. This, by way of gate 181H on FIGURE 45 allows a computer busy reset pulse CBR at the end of cycle 5. On FIGURE 85, signal —CORR blocks gates 913H to prevent the operation of relay 585. This in turn prevents the operation of the add print solenoid APR while printing the fee.

Retrieve operation

The retrieve operation is initiated by depressing the retrieve button on FIGURE 38 which causes flip-flop 024 on FIGURE 36 to set, producing the intent to retrieve signal RTF. On occurrence of the delayed key socket pulse signal DKS, the retrieve signal RET is produced at the out-
put of flip-flop 0265. The retrieve signal, RET, and the lost key signal, LK, are buffered through buffer 027B. This produces signal RLK at inverter 028. On the output relay, the retrieve conductor has been energized, and after completing cycle 1 the presence of signal —RLK at gate 132H of the cycle counter control circuit FIGURE 45 prevents a step of the cycle counter to cycle 2, CY2. At this time, it is necessary to decide whether to rework the car or permanently unmark the car. To rework the car, it is necessary to depress the retrieve button a second time.

When signal RLK is produced, signal —RLK had set flip-flop H2B in FIGURE 34. When the retrieve button is depressed, the second time in order to rework the car, the park flip-flop F023 in FIGURE 34 is set by way of gate 022, and the start park operation signal SPK appears at the output of amplifier 023 in the same figure. On FIGURE 86, at the lower left, buffer 871B responds to signal SPK by passing a signal through amplifiers 871 and 872. This signal together with the cycle 1 signal CY1 are applied to gate 873G to actuate delay flip-flop 873. This, as has been heretofore described, operates relay R892 or R893 to drop out the retrieve signal and to, therefore, produce the retrieve regur signal from the back contact of the corresponding tower relays. Upon occurrence of the park signal, the retar flip-flop H2B, FIGURE 34, resets and therefore produces the reen signal pulse RPK is on. On FIGURE 35, signal RPK with signal RYK at mixer gate 404 starts the memory chain to produce a memory cycle to write the stall occupied bit back into the memory. Upon occurrence of the count pulse, a pulse occurs at mixer gate 405, FIGURE 60, by way of the output of gate 400 to allow the starting of the memory cycle for cycle 2. Meanwhile, when signal RLK, the memory cycle for cycle 2, is produced by flip-flop pulse CP at the end of cycle 1, with the park signal PK and cycle 1 signal CY1 are all applied to gate 182 on FIGURE 45, the cycle counter is stepped into cycle 2, and the relay operation continues exactly as described for a parking operation except that signal CY2 is applied to gate 465 and 466 on FIGURES 48 and 49 prevents writing of the present time and the present day into the memory. Signal RLK with signal PK and IP on gate 467–1 FIGURE 50 allows recirculation of the previous time and previous day information in the memory.

If, instead of depressing the retrieve button a second time, it is desired to convert the operation into an unpark operation, this is achieved by deactivating the unpark convert signal in FIGURE 39 which produces an unpark convert signal UPC. This signal at gate 057 on FIGURE 36 produces a reset of the retrieve flip-flop 062. Simultaneously, at gate 015, FIGURE 35, it produces a set of unpark signal UPK. The convert unpark signal FUP is produced at the output of amplifier 057 in FIGURE 36. This signal is turned off at diode 405B, FIGURE 60, to start the memory timer. The unpark convert signal UPC, in FIGURE 45, steps the cycle counter by way of gate 113H into cycle 2, and the unpark operation proceeds thereafter normally.

Upon depression of the unpark convert button to convert the retrieve operation to an unpark operation, the same delay flip-flop 873 at the lower left on FIGURE 66 was set to allow the retrieve signal to drop out. This time, however, amplifier 873 through conductor W3 sets flip-flop 876 at the middle left on FIGURE 87. The output of flip-flop 876F is applied to gate 813H and since the unpark signal UPK is present, a signal passes through relay driver 813D to operate relay R813 and since the unpark is set, this provides the convert signal to transfer to the output relays.

Lost key operation

The operation of the circuitry in the case of a lost key operation is identical to that of a retrieve operation so far as the computer is concerned with the exception of the print out code in the present time line of the printer which is printed during cycle 4, CY4 and the input storage circuits for the operation shown in FIGURE 76.

Bypass operation

Refer to FIGURE 40. Upon depressing the west bypass switch a signal is passed through blocking oscillator 002, gate 003 and inverting amplifier 003A to set flip-flop F063 and produce the west bypass signal BY. If the bypass east button is operated, in the same figure, a similar circuit sets flip-flop F066, to produce the east bypass signal BYE. These two signals BY and BYW are applied to buffer 012B and passed through amplifier 012 to produce signal BY which is the bypass operation signal or west. This signal when applied to blocking oscillator 012 produces the bypass pulse BYP. On the cycle counter circuit, FIGURE 45, signal BYP applied to gate 107B and amplifier 1107 steps the cycle counter directly into cycle 4 CY4 and also sets the computer busy flip-flop, at the middle left, on FIGURE 87, signal BYP at buffer 820B allows a set of delay flip-flop D820. A simultaneous signal, either BYE or BYW depending on which tower is to do the bypassing, permits a signal to pass either through gate 899G and amplifier 898 to produce signal BYWP, or through gate 899G and amplifier 899 to produce signal BYEP. Signal BYEP is shown at the bottom left in FIGURE 88 where it passes through relay driver 845D to operate relay R845. This permits the holding voltage to be applied through the front contact of relay R845. Signal BYEP is shown at the bottom left in FIGURE 85 where it performs the same function for the east output relays. Signal BYWP passes through relay driver 183 to operate relay R128. Signal BYEP will pass through relay driver R12 to operate relay R127. Relay R128 when operated applies voltage to conductor RBYE which connects to the winding of the east bypass relay R864 on the east relay output circuit FIGURE 85 operating relay R864. Relay R127 when operated, applies voltage to conductor RBYWP which connects to the winding of the west bypass relay R844 on the west output relay circuit FIGURE 88, operating the relay.

It will be appreciated by this time that the subject invention may, notwithstanding it has been described as being embodied in an automated mechanism for the operation of automobiles, be gainfully employed in a number of different but related arrangements. For this reason it is emphasized that many seemingly different arrangements employing the invention may be used without departing from its spirit and scope. Thus, portions of the described apparatus may be eliminated from such arrangements or, if circumstances so dictate, additional apparatus may be incorporated without departing materially from this invention. For these reasons it is desired that the foregoing description be taken as explanatory only and not as a limiting definition of the invention.

1. An automatic garage, a memory therein for memorizing data relative to a parking transaction, means in said garage for unmarking a vehicle therefrom permanently, means in said garage for unmarking a vehicle temporarily, of said permanent unmarking means and said temporary unmarking means for controlling the data in said memory to distinguish between said permanent and temporary unmarking.

2. In a garage in accordance with claim 1, charge computing means responsive to said memory control means for effective upon the permanent unmarking of a vehicle for computing a charge proportionate to the interval the vehicle was parked, and means for disabling said computing means when a vehicle is unmarking temporarily.

3. In an automatic garage having a plurality of vertical tiers and a plurality of floors in each a plurality of stalls on each of said floors, a stall selecting device, a first control for said device, a mechanism for imparting a plurality of different motions
to a vehicle in said garage, a second control for said mechanism, said first control being an individual element for each stall and encoded with an individual code for its stall, said second control being a switch individual to each of said motions, and cooperative means in said stall selecting device and in said mechanism, joint responsible to said first and said second controls, for selectively imparting any desired one of said motions to a vehicle with respect to any desired one of said stalls.

4. A garage in accordance with claim 3 having in said stall selecting device a decoding device for decoding the codes of said first control element and also having a relay circuit responsive to said decoding, for effecting a selection of a stall defined by said decoded signal.

5. A garage in accordance with claim 4 having a relay circuit in said mechanism, responsive to said second control, for selecting the desired motion of said vehicle.

6. An automatic garage in accordance with claim 5 having a memory instrumentality individual to each of said stalls, means responsive to said decoding device for selecting the instrumentality individual to the selected stall, and means responsive to the selection of said one of said instrumentalities for recording therein the time of selection of the stall defined by said decoding.

7. A garage in accordance with claim 4 wherein there is provided storage means operative in response to the decoded stall identifying signal from said control and to the operational signal from said second control for preserving said signals until said motion imparting mechanism accepts said signals, said motion imparting mechanism being operative to restore said signal storage means to its inoperated state after acceptance of said signals, whereby said signals may be recorded in and remain stored in said storage means while said motion imparting mechanism is proceeding to previously produced such signals.

8. An automatic garage having a plurality of parking stalls on each of a plurality of floors, an individual selecting control device for each of said stalls, said device having codings therein identifying its individual stall, a common reading device for reading said codings, a decoding device for decoding said reading, a selecting device responsive to said decoding device for selecting the stall corresponding to the particular control device and a vehicle parking device responsive to said selecting device and operative to effect parking of a vehicle in a selected stall.

9. An automatic garage in accordance with claim 8 having a memory instrumentality individual to each stall, means responsive to said decoding for selecting the instrumentality individual to the selected stall and means associated with said instrumentality for testing said memory to determine whether said stall is indicated to be occupied before parking said vehicle.

10. An automatic garage having a plurality of individual parking stalls, a parking control, means responsive to the actuation of said parking control for selectively parking a vehicle in any desired one of said stalls, one or more of said stalls in said garage being reserved for a vehicle having predetermined characteristics, means for testing to identify said vehicle, and automatic means responsive to said testing means for preventing the storing of said identified vehicle except in a reserved stall.

11. An automatic garage in accordance with claim 10 wherein for testing, means act to indicate whether the height of a tested vehicle exceeds a predetermined maximum and wherein said automatic means responsive to said testing means act to prevent storage of said vehicle in any space not prejudged to have sufficient height clearance to accommodate it.

12. An automatic garage having a plurality of floors, one of said floors being reserved for vehicles whose height exceeds a predetermined value, vehicle height testing means in said garage, transport control means in said garage, selective means responsive to said transport control means for automatically conveying vehicles to any selected one of said floors and disabling means responsive to said height testing means for preventing said transport means from responding to said control means when a vehicle whose height exceeds said predetermined value is directed to another than said floor.

13. An automatic garage having a plurality of stalls on a plurality of floors, a vehicle entrance orienting station in said garage, automatic means in said garage for selectively transporting vehicles from said station to any desired one of said stalls, and means for inhibiting said automatic means if a vehicle is not properly oriented in said station.

14. A garage having a plurality of floors and a plurality of vehicle parking stalls on each of said floors, a first control, a vehicle transport mechanism responsive to said first control for selectively moving a vehicle automatically to any of said stalls, a vehicle entrance orienting station in said garage for the reception of vehicles and a vehicle discharge station for the delivery of vehicles leaving said garage, a second control, and mechanism responsive to actuation of said second control for causing said vehicle transport mechanism to transport a vehicle from said entrance station to said discharge station without depositing it in any of said stalls.

15. A materials handling and storage installation including a multi-landing structure having a plurality of storage spaces aligned side by side at each landing adjacent to and defining a hoistway extending the length of said storage areas and having the storage spaces adapted to be complete with motive means and adapted for horizontal movement in said hoistway and itself enclosing an elevator conveyor complete with motive means arranged for vertical movement in a hoistway defined within said movable tower, said elevator conveyor having permanently affixed and adapted to effect extension of a load bearing member carried by it beyond the confines of its hoistway into an adjacent storage space to deposit and retrieve articles in and from said space, a control arrangement including means for registering a demand for said elevator conveyor to accept a burden at one location and to deposit said burden in a designated one of said storage spaces, a first control means responsive to said registered demand and controlling said motive means to move said tower and elevator conveyor to a position adjacent to and extend said load bearing member into said designated space, a second control means effective when returned to said first cause movement of said elevator conveyor and sequentially later to cause retraction of said load bearing member from a storage space to within the confines of said elevator conveyor, and means responsive to the extension of said load bearing member into a storage space for effecting transfer between said first and second control means and actuation of the latter causing said elevator conveyor to effect the transfer of an article between said conveyor and said storage space.

16. In an installation in which an elevator is arranged for serving a plurality of landings, extension means mounted on said elevator, said extension means including a horizontally extending member and being adapted for extending said member outside of said elevator confines in a horizontal direction and for retracting said horizontal member to a position within said elevator confines, motive means for moving said elevator between said landings served, elevator control means act to indicate said motive mechanism, call registering means for registering a call for service for said landings, said control means being operatively responsive to said call registering means for controlling said motive mechanism to propel said elevator to a landing for which a service call is registered and stop said elevator at such landings wherein said zones extending a certain distance above and below a predetermined level at the landing at which a stop is to be made, and zone transfer means operable at a landing stop incident to extension movement by said extension means of said horizontal member for causing said control
means to energize said motive mechanism to move said elevator from the zone at which the stop has been made to the other of said two certain zones, and for conditioning said control system to stop said elevator in said other zone at the next succeeding landing stop made in response to subsequent service demand registered by said call registering means, said zone transfer means further being operable in response to extension of said horizontal member for causing said elevator at each of said landing stops to move from a first one of said zones to the other of said zones at alternate succeeding stops and from the other of said zones to said first zone at succeeding stops made between said alternate stops.

17. In a material handling and storage and retrieval system having a plurality of storage spaces for reception of the stored articles, a receiving station and a delivery station and transport means operative between said stations and each of said storage spaces, a control and supervisory system adapted to control automatically said transport means and to provide a record of each storage and retrieval operation, said system including means common to all such spaces for generating a coded signal individual to each of the several spaces, means for generating an operational signal for said transport means, means responsive to said generated operational and coded space signals for causing said transport means to remove an article from said transport it to the storage space identified by said coded signal and deposit it in that space, and additional means also responsive to said generated operational and coded signals for producing a recoverable record of the identity of the space utilized and the time utilization started.

18. In a material handling and storage arrangement having a plurality of storage spaces arranged in spaced apart relation, unit receiving and discharging stations and transport means operative between said stations and said spaces for conveying units theretwixt and depositing them in or withdrawing them from selected ones of said spaces wherein there is provided a centralized electrical control system for said transport means, said system including means common to all such spaces and productive when actuated to produce selectively any of a plurality of electric signals each of which identifies an individual one of said spaces from all other such spaces, said control system also including means which in combination are productive of a plurality of operational control signals each of which in conjunction with a space identifying signal is effective to control said transport means in one or another of different operational programs including one in which the transport means moves automatically an article from the receiving station to said storage it in the identified storage space and another in which the transport means removes automatically an article from the identified space and moves it to the discharging station, information storage means individual to each space having two operating conditions which in response to a space identifying signal in combination with one of said operational signals changes from one to another of its operating conditions to correspond with the deposit in or withdrawal of an article from said space, and means responsive to said space identifying signal for selecting for actuation the information storage means individual to said space.

19. In a material handling and storage arrangement according to claim 18 wherein said control means also includes means responsive to actuation of said information storage means for preventing actuation of said transport means until said information storage means has changed to its operating condition corresponding to the actuating operational signal.

20. In a material handling and storage arrangement according to claim 19 wherein there are provided means effective to prevent actuation of said transport means to move an article to and deposit it in a selected space if the information storage means individual to the selected space is already in its condition corresponding to the deposit of an article.

21. A material handling and storage arrangement according to claim 19 wherein the control system includes means effective to prevent actuation of said transport means to withdraw an article from a selected space if the information storage means individual to the selected space is already in its condition corresponding to the withdrawal of an article.

22. A material handling and storage arrangement according to claim 18 and including means responsive to the combined space identifying and operational signals for recording in the information storage means corresponding to the indicated space an indicia of the chronological time of identifying said space in which said article is deposited.

23. A material handling and storage arrangement according to claim 22 including means productive of indicia of the chronological time at any instant and interval determining means responsive to the combined operational signal for the withdrawal of an article from a designated space and the control signal designating said space for calculating the interval indicated between the indicia of chronological time recorded in the information storage means and the indicia of chronological time at withdrawal of the article.

24. In a material handling and storage arrangement according to claim 23 wherein there are provided fee computing means responsive to the interval determining means and effective to calculate and indicate a monetary charge fee equivalent to the calculated interval.

25. A material handling and storage arrangement according to claim 24 wherein said fee computing means is effective for automatically varying the fees computed for equal intervals occurring in different time periods.

26. A material handling and storage arrangement having a plurality of storage spaces arranged in spaced apart relation, unit receiving and discharging stations and transport means operating between said stations and spaces for conveying units theretwixt and depositing them in or withdrawing them from selected ones of said spaces wherein there is provided a centralized electrical control system common to all of said storage spaces and having means common to all such spaces for producing a plurality of operational signals, said system each of which combination of signal components identifies an individual one of said spaces from all other such spaces, said control system also including means which in combination is productive of a plurality of operational control signals each of which in conjunction with a space identifying signal is effective to control said transport means in one or another of different operational programs including one in which the transport means moves automatically a single component signal, means for generating an operational signal which in conjunction with said space identifying signal is effective to actuate said transport means to effect its movement between said identified space and said unit receiving or discharge station and load bearing means conveyed by said transport means and operative in response to said transport means attaining a predetermined position adjacent the identified storage space to effect deposit in or withdrawal of a unit from said identified space.

27. A material handling and storage arrangement according to claim 26 wherein each storage space identifying signal is encoded in binary counting form and said additional means includes decoding means effective to convert each such signal to a single component signal suitable to control said transport means in movement between said stations and a storage space identified by said encoded signal and wherein said operational signal determines whether said load bearing means deposits or withdraws a material unit in or from said identified space.

28. A material unit handling and storage arrangement according to claim 27 wherein said additional means includes information storage means having a plurality of memory cells, each one of which is individual to and associated with a different one of each of said storage
spaces, and means differently responsive to each of said encoded signals for selecting the memory cell associated with the storage space designated by said encoded signal and activating it to a state corresponding to the occupied state of said storage space.

29. A material unit handling and storage arrangement according to claim 28 wherein said additional means includes testing means responsive to each of said encoded signals for testing the state of the selected memory cell to determine whether its state corresponds to an occupied or an unoccupied condition of said selected storage space.

30. A material unit handling and storage arrangement according to claim 29 wherein said additional means includes means responsive to said testing means and to said operational signal and effective to prevent actuation of said transport means to effect the deposit of a unit in a selected storage space when the corresponding memory cell indicates the space to be unoccupied.

31. A material unit handling and storage arrangement according to claim 29 wherein said means responsive to the testing means and the operational signal is also effective to prevent actuation of the transport means to effect withdrawal of a unit from a selected storage space when the corresponding memory cell indicates the space to be unoccupied.

32. A material unit handling and storage arrangement according to claim 29 wherein said additional means also includes timing means productive of present-time indicative signals in binary coded form and means for impressing said time-coded signal on elements of said memory cell to record therein the present-time impression.

33. A material unit handling and storage arrangement according to claim 32 wherein said means effective after selection of a memory cell corresponding to a storage space identified by said encoded signal and before impressing thereon one of said time defining signals for testing said cell to detect whether there are previously impressed time defining signals impressed thereon.

34. A material unit handling and storage arrangement according to claim 33 wherein said selected memory cell contains a previously impressed signal for thereafter preventing said produced encoded signal and said operational signal from activating said transport means.

35. A material unit handling and storage arrangement according to claim 27 wherein the operational signal producing means also produces upon manual manipulation of one or another of the controls thereof one or another of a plurality of operational signals, which signals in consort with said space identifying encoded signals act to control said transport means either selectively to deposit or withdraw a unit in a selected space to withdraw permanently a unit from a selected space or retrieve temporarily a unit from a selected space with its later return to said space to be subsequently effected.

36. A material unit handling and storage arrangement in accordance with claim 35 wherein said time-coded binary signal is impressed on said selected memory cell only when the deposit operational signal is present and is effective to record therein the then present time.

37. A material unit handling and storage arrangement in accordance with claim 36 wherein said stored time information is in binary form representing the numerical day of year and hour of day when space selection was made.

38. A material unit handling and storage arrangement according to claim 37 wherein the additional means includes means which are responsive to the combined presence of an encoded storage space and memory cell identifying signal and a permanent withdrawal operational signal for extracting from said memory cell the previously impressed time-identifying signal contained therein and subtracting it from a present-time indicating signal as then produced by said timing means to compute the total time elapsed between deposit and withdrawal of said unit in and from the identified storage space.

39. A material unit handling and storage arrangement according to claim 35 wherein said means responsive to a space identifying encoded signal for a temporary retrieval is effective to activate said transport means to withdraw from said identified space the material unit stored therein and transport it to said discharge station and to relocate from the associated memory cell the time indicating data in such form that it can be reinserted into said cell if the withdrawn material unit is returned to the space.

40. A material unit handling and storage arrangement according to claim 39 wherein after the unit is transported to said discharge station a second actuation of said jointly responsive means by the same signals is effective to actuate said transport means to remove said unit from said station and to return it to and deposit it in its original space location.

41. A material unit handling and storage arrangement according to claim 39 wherein the additional means is productive of a fourth operational signal which in conjunction with said space identifying encoded signal is effective after said unit has been transported to said discharge station to extract from their repository the relocated time signals indicative of the day and hour said unit was deposited in its storage space and to subtract said time from a present-time indication signal and means for deriving the time interval said unit was deposited in its storage space.

42. A material unit handling and storage arrangement according to claim 38 wherein said unit is provided a charge-computing means which is effective to apply a predetermined rate per-unit of time to said computed storage interval to calculate a monetary charge for the time said unit was stored.

43. A material unit handling and storage arrangement according to claim 41 wherein the charge-computing means is effective to apply different rates for different but equal portions of the storage interval in calculating said total charge.

44. A material unit handling and storage arrangement according to claim 36 wherein printing means effective concurrently with the deposit of a unit in an identified storage space is effective to produce a record of the numerical designation of the deposit space and the then present-time when the deposit is made.

45. A material unit handling and storage arrangement according to claim 38 wherein printing means effective whenever a permanent withdrawal is made or a temporary withdrawal is converted to a permanent withdrawal produces a printed record of the numerical designation of the deposit space, the time of withdrawal, elapsed storage interval and total charge for storage.

46. A material unit handling and storage arrangement according to claim 42 wherein there is provided visual charge display means and means responsive to the calculation of the charge for storage for displaying the calculated amount on said display means.

47. A material unit handling and storage arrangement according to claim 27 wherein a portion and said storage spaces are not suitable for storage of a certain type or types of units that will be received for storage and wherein there are provided means for surveying predetermined characteristics of said received units to detect those that are not within a predetermined standard, and means jointly responsive to actuation of said survey means and the selection of a memory cell associated with a space that is unsuitable for storage of said non-standard unit for preventing the actuation of said transport means to convey said unit.

48. A material unit handling and storage arrangement according to claim 27 wherein each such space identifying signal is produced by a cooperating key and key reader unit, each such key having a distinctive combination of
57. A material handling and storage arrangement having a plurality of storage spaces arranged in spaced apart relation, unit receiving and discharging stations and transport means including an elevator conveyor means and an article conveyance means mounted thereon operating between said stations and spaces for conveying unit to be deposited in or withdrawn from selected ones of said storage spaces wherein there is provided a centralized electrical control system common to all of said storage spaces and having means common to all such spaces for registering a demand for said elevator conveyor to deposit an article in a designated one of said storage spaces, said centralized electrical control system including a first control means effecting when actuated to control the movement of said elevator conveyor and a second control means effective when actuated to control the movement of the article conveyance means on said elevator, said first control means being responsive to registered demands to effect the movement of said elevator conveyor to a position adjacent a designated one of said spaces, said second control means being effective when actuated by said first control means to effect extension of said article conveying means into the adjacent storage space and sequentially later to actuate said first control means to alter the vertical position of the elevator conveyor, said second control means being sequentially responsive to said first control means after alteration of the vertical position of said elevator to effect the withdrawal of said article conveyance means from said storage space to within the confines of said elevator conveyor whereby the transfer of an article between said article conveyance member and said storage space is effected.

58. A material handling and storage arrangement in accordance with claim 57 wherein said first means in response to said registered service demand causes said elevator conveyor to stop within one or the other of two certain zones, one above the other, each of which extends a predetermined distance above or below a position level with the load bearing surface of said storage spaces, and wherein said second control means always actuates said first control means to alter the vertical position of said elevator conveyor between said upper and lower zones in inverse manner on consecutive stops whereby said elevator is always positioned in the lower of the two zones at the completion of either a deposit or withdrawal operation.

59. In a material handling and storage arrangement having a plurality of floors and a plurality of storage spaces on the floors defining a storage hoistway in which an elevator operates adjacent to each such space, unit receiving and discharging stations and transport means comprising an elevator and a load bearing conveyor operative between said spaces and said stations for conveying units therebetween and depositing them in or withdrawing them from selected ones of said spaces, wherein there is provided a centralized electrical control system for said transport means, said system including means which when actuated produces selectively a plurality of electric signals each one of which identifies an individual one of said spaces different from all other such spaces, said control system also including means which when actuated are productive of a plurality of operational control signals each of which in conjunction with a space identifying signal is effective to control said transport means in one or another of different operational programs including one in which the transport means moves automatically an article from the receiving station to and deposits it in the identified storage space and another in which the transport means removes automatically an article from the identified space to the discharging station, information storage means individual to each such space and having two operating conditions which in response to a space identifying signal in combination with one of said operational signals changes from one to another of its operating conditions to correspond with the deposit in or withdrawal of an article from said space, means responsive to said space
Identifying signal for selecting for actuation the information storage means individual to said identified space, means responsive to said operational signal in conjunction with said space identifying signal for testing the then operated condition of said information storage means corresponding to said identified space, and means responsive to said testing means for preventing actuation of said transport means in response to its combined actuating signals under circumstances where the operating condition of said information storage means is not consonant at the time of testing with the operational control signal supplied to said transport means.

D. W. COOK, Primary Examiner.

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