

Oct. 13, 1936.

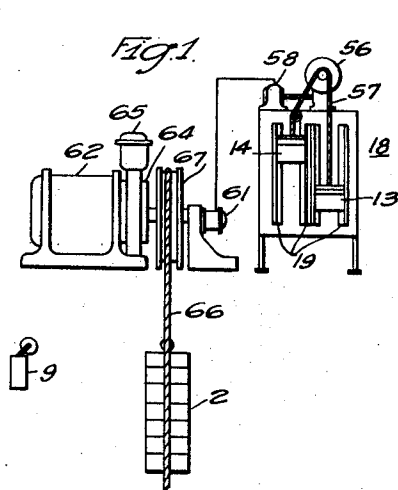
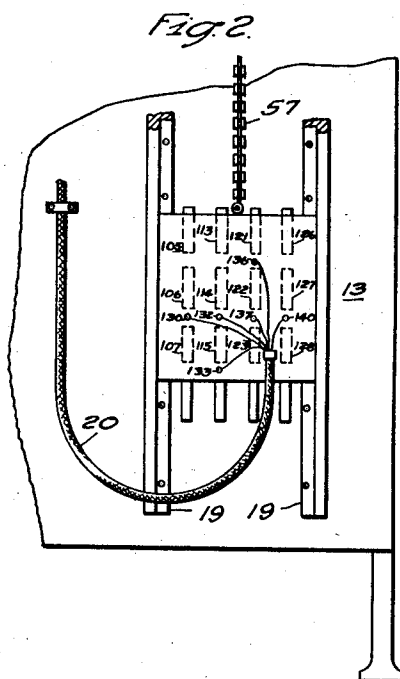
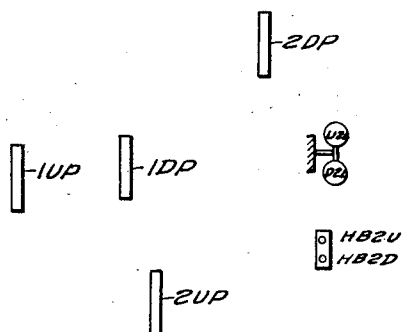
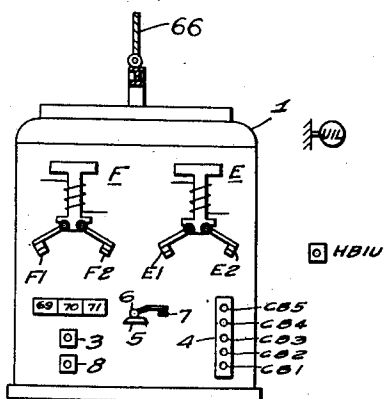
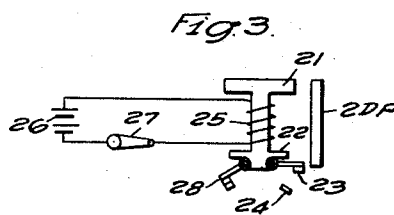
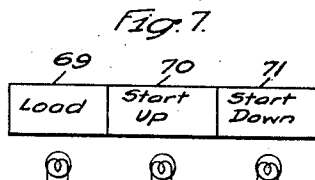
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2,057,480

CONTROL SYSTEM FOR A GROUP OF ELEVATORS

Filed Sept. 27, 1933

8 Sheets-Sheet 1



WITNESSES:

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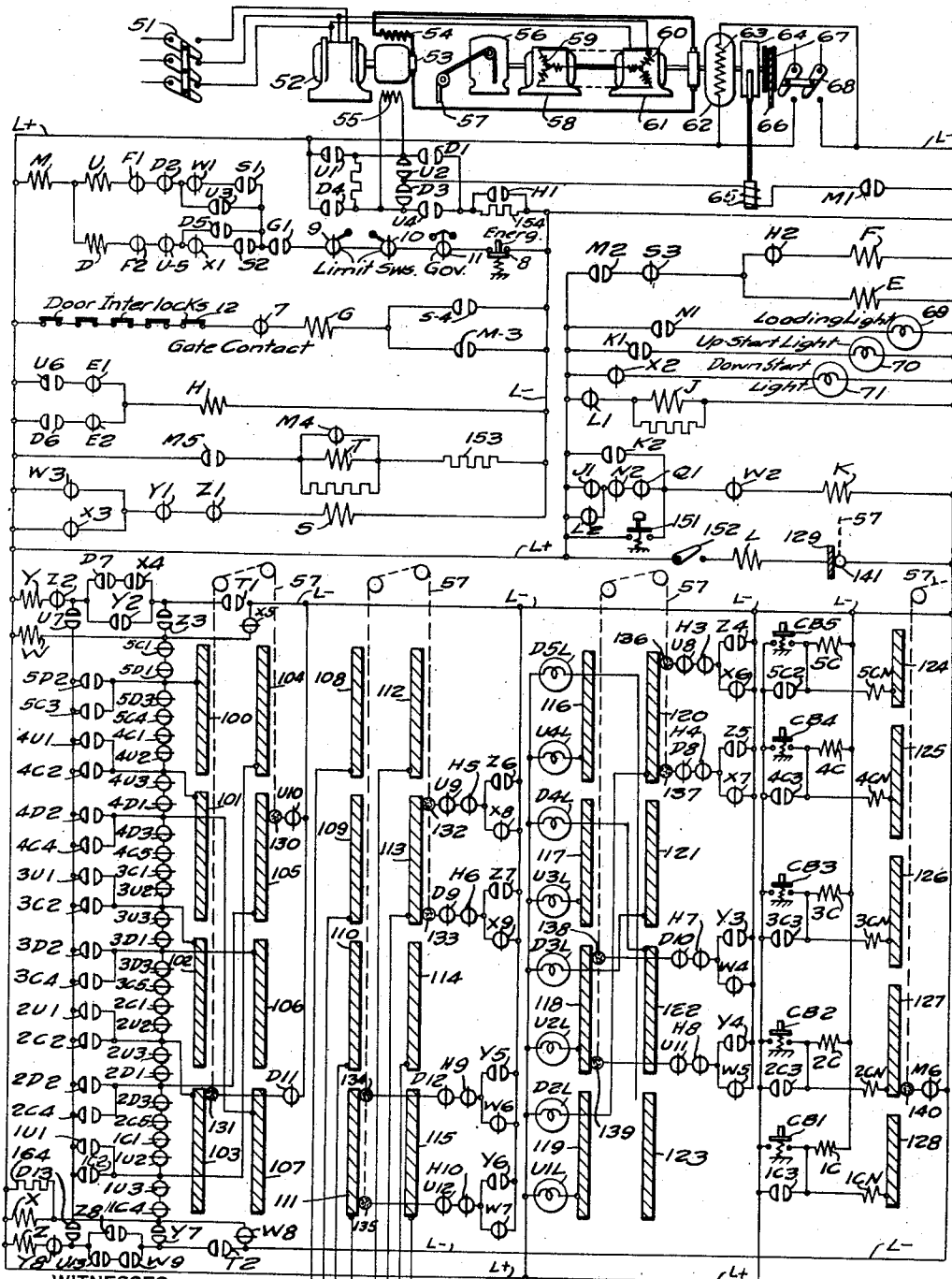
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CONTROL SYSTEM FOR A GROUP OF ELEVATORS

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8 Sheets-Sheet 2



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Fig. 4.

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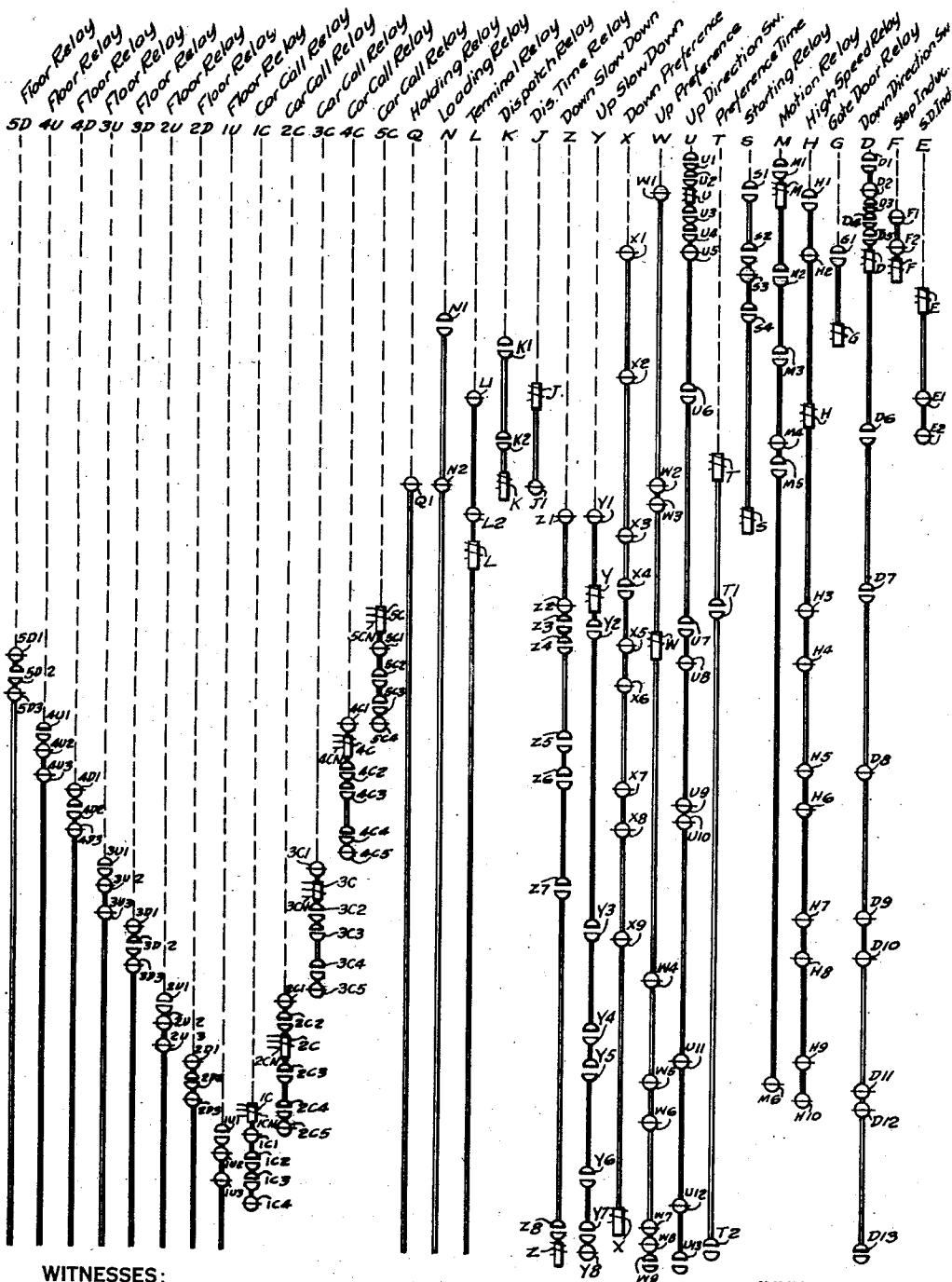
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2,057,480

CONTROL SYSTEM FOR A GROUP OF ELEVATORS

Filed Sept. 27, 1933

8 Sheets-Sheet 3



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Fig. 4A.

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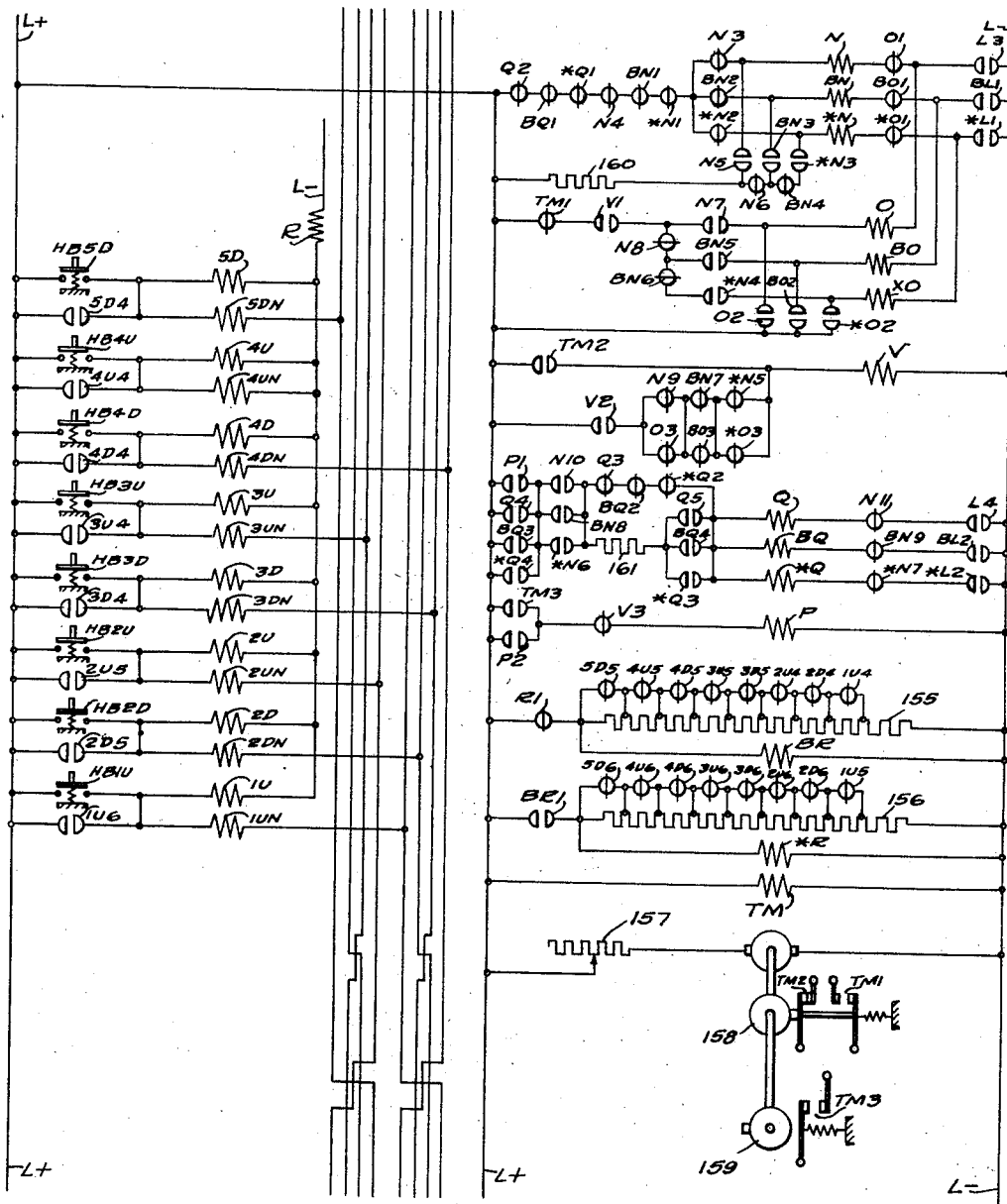
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CONTROL SYSTEM FOR A GROUP OF ELEVATORS

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Fig. 5.



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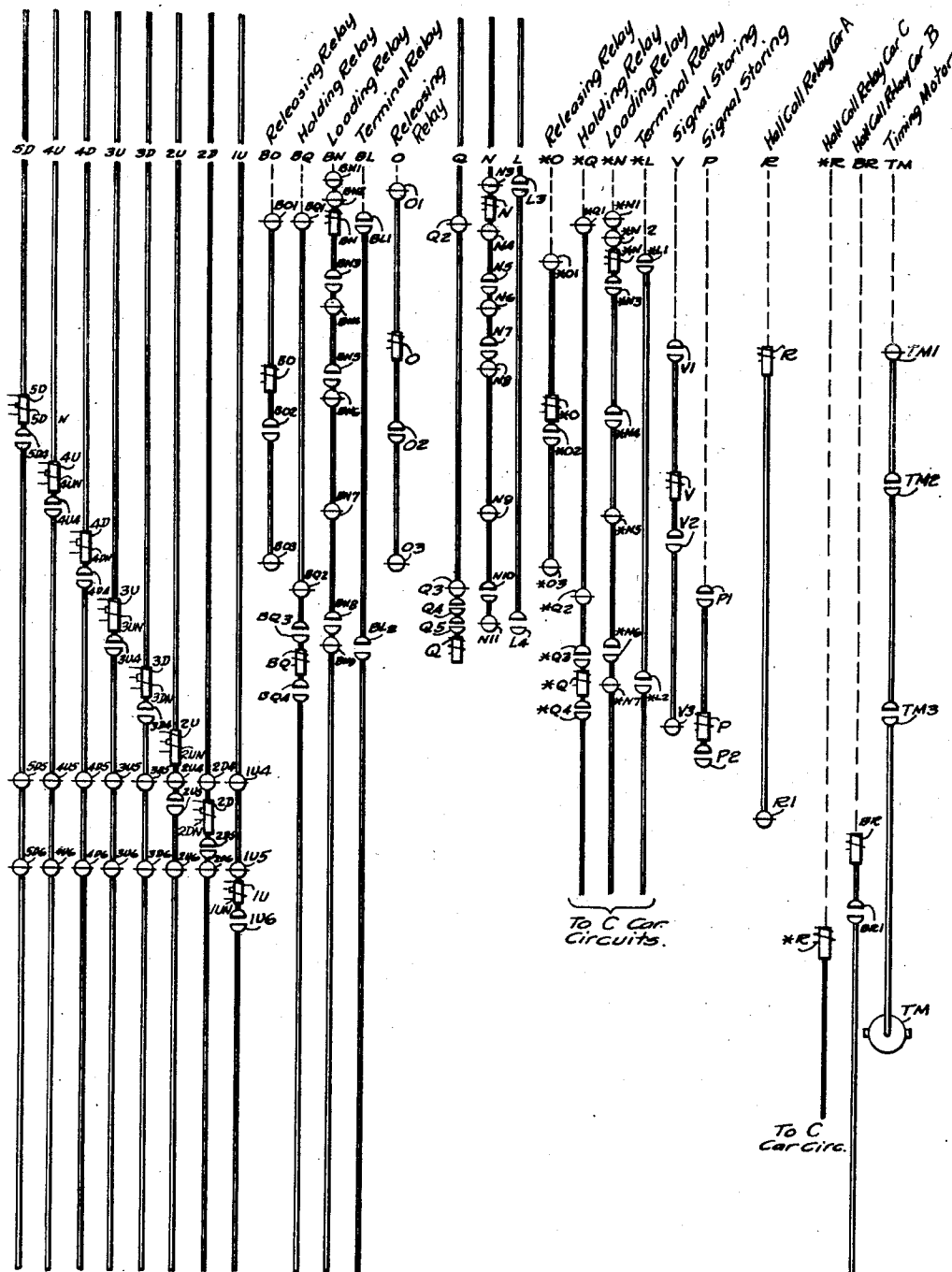
W. F. EAMES

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CONTROL SYSTEM FOR A GROUP OF ELEVATORS

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Fig. 5A.

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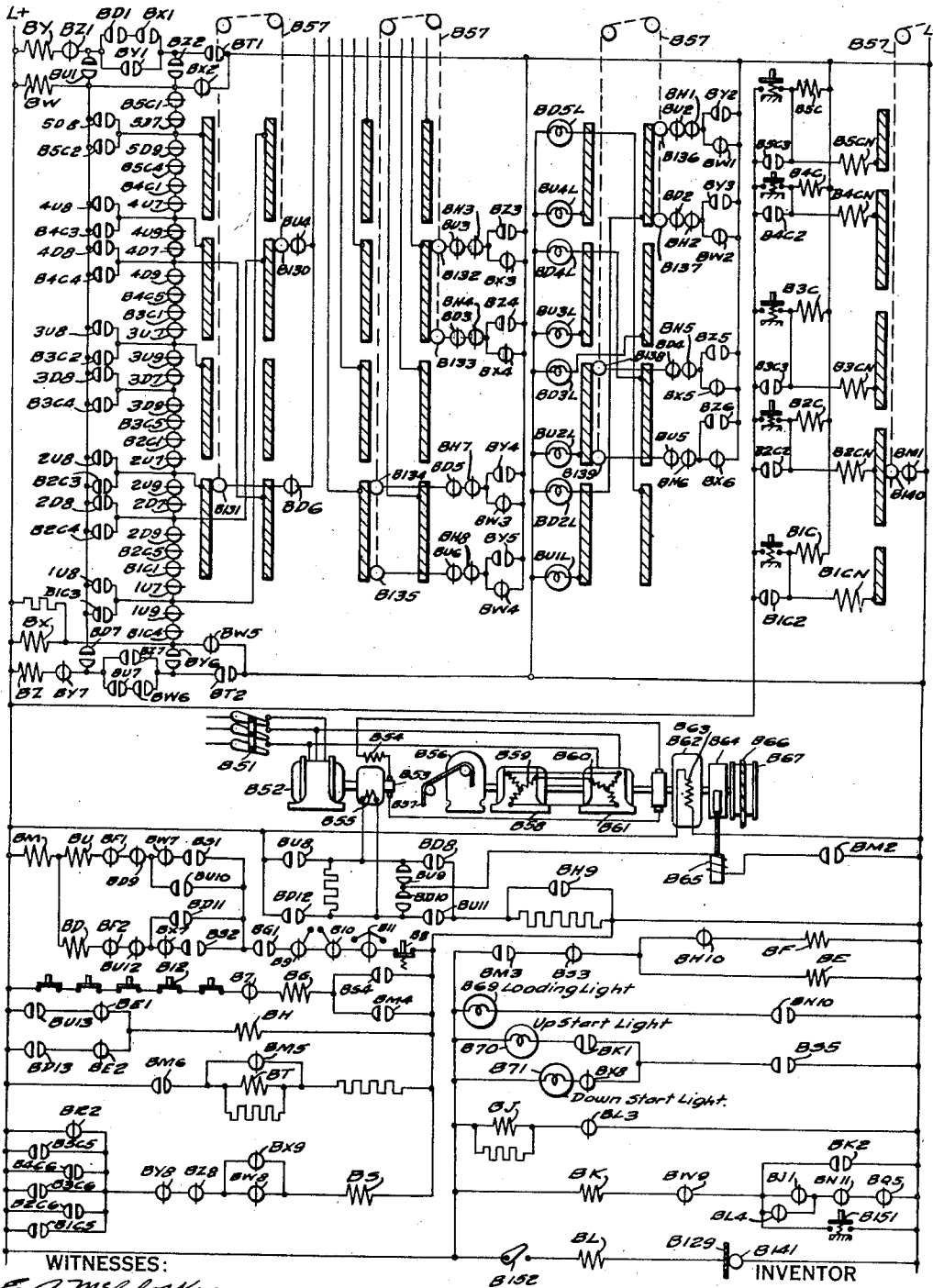
W. F. EAMES

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CONTROL SYSTEM FOR A GROUP OF ELEVATORS

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Oct. 13, 1936.

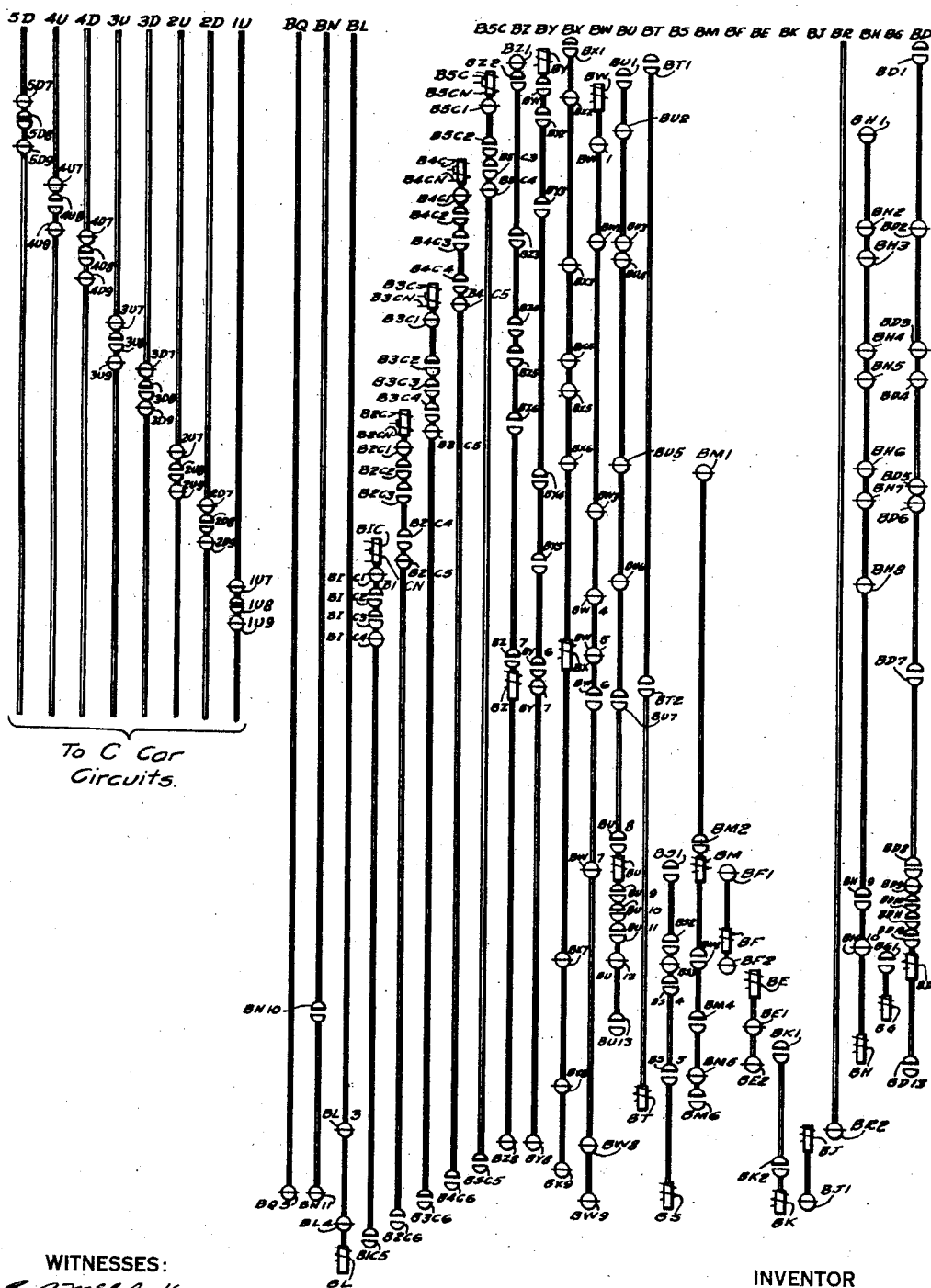
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2,057,480

CONTROL SYSTEM FOR A GROUP OF ELEVATORS

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Fig. 6A.

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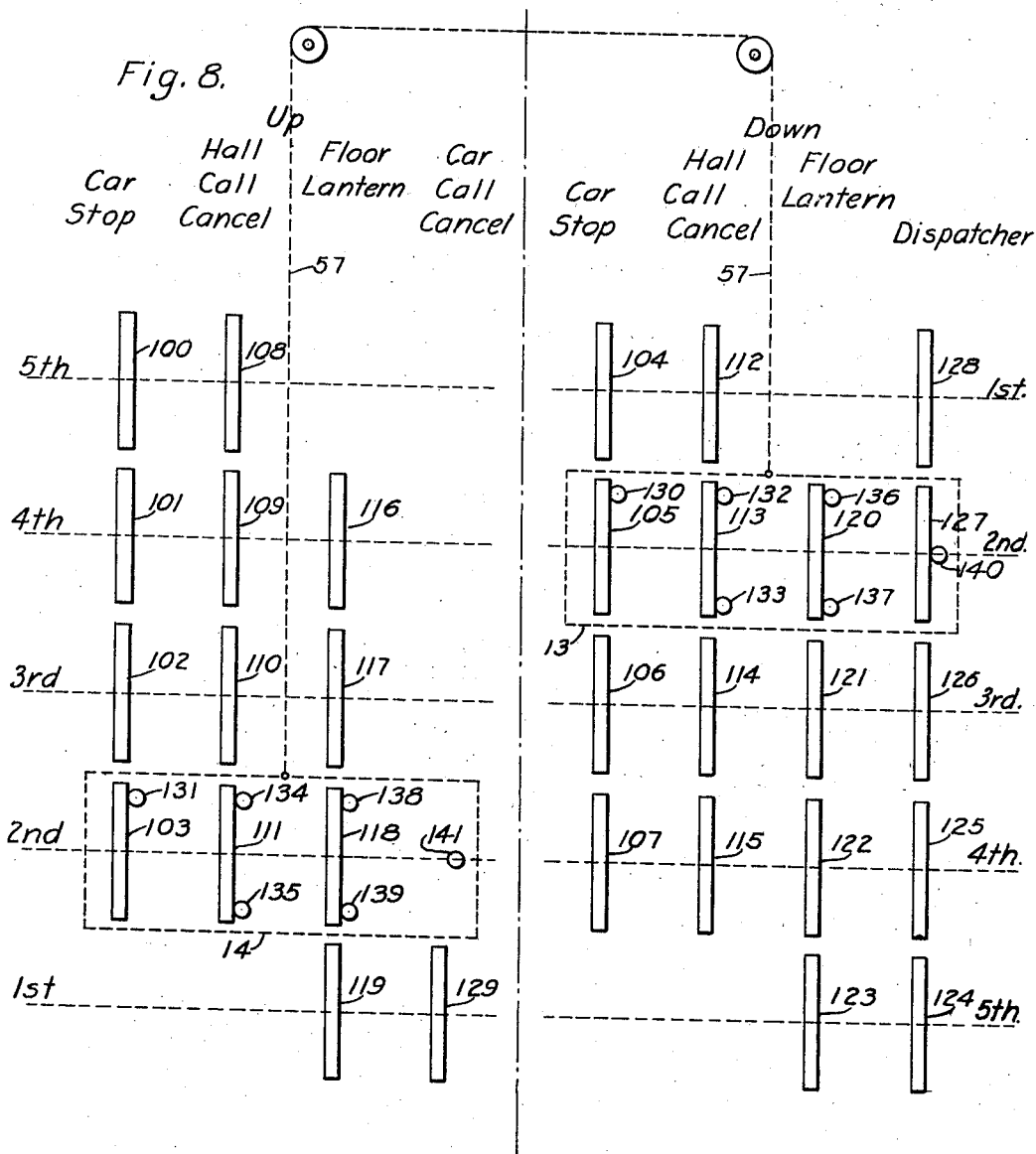
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2,057,480

CONTROL SYSTEM FOR A GROUP OF ELEVATORS

Filed Sept. 27, 1933

8 Sheets-Sheet 8



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UNITED STATES PATENT OFFICE

2,057,480

CONTROL SYSTEM FOR A GROUP OF ELEVATORS

William F. Eames, Edgewood, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application September 27, 1933, Serial No. 691,151

29 Claims. (Cl. 187—29)

My invention relates to a control system for a group of elevators and it has particular reference to a system in which the cars are started by an operator and stopped in response to push buttons.

In the past, control systems for groups of elevators have required each car in a group to make a complete round trip of the shaft for the purpose of intercepting calls that may be registered at the various floors. It frequently happens that during periods when the elevators are not being operated to their full capacity, that any individual car will make a round trip and collect only one or two passengers. Frequently, a car will take on a load at the lower floor and travel only about half the length of the shaft until the last passenger is discharged, and frequently this elevator will then make a trip to the top of the shaft and at least part way down the shaft without receiving any passengers.

Operations such as these represent lost motion and wasted energy. I have devised an elevator control system in which these lost motions are eliminated and by which the efficiency of a group of elevators is considerably increased.

One of the objects of my invention is to eliminate all travel of elevators, in a group, that is not useful in causing the system to respond to passenger calls in the most efficient manner.

A second object is to cause the movements of the cars in the group to always be towards floors for which calls are registered.

A further object is to reduce the time required by the system to respond to any individual call.

A still further object is to attain the maximum number of car arrivals and departures at the busiest floor.

Another object is to cause any car in the group to remain stopped at the floor where the last passenger has been discharged if further travel in either direction serves no useful purpose.

Another object of my invention is to cause any car in the group to reverse its direction of travel at any given floor when its services are no longer required in that direction, provided that they are required in the reverse direction.

Another object is to provide signals for the operator which will keep the operator advised when he should start his car and what his next direction of movement will be.

A further object is to provide a system of operation for the floor signals that will operate in conjunction with the car's motion most efficiently.

A still further object of my invention is to automatically adjust the movement of cars responding to the demands of the system to be proportional to the demands.

Another object is to provide a sequence of dispatching signals for the cars of the bank when stationed at the main floor that will produce the most efficient response of the system to the demands.

A further object is to prevent the cars in the system accumulating at the main floor when their services are more urgently needed at other floors.

Other objects of my invention will become evident from the following detailed description taken in conjunction with the accompanying drawings, in which—

Figure 1 is a diagrammatic view showing the relationship of certain mechanical and electrical elements for any one of the individual cars of an elevator system embodying my invention.

Fig. 2 is a diagrammatic view of part of the floor selector shown in Fig. 1.

Fig. 3 is a diagrammatic view illustrating the operation of an inductor relay used in the practice of my invention.

Figs. 4, 4A, 5, 5A, 6 and 6A collectively show the mechanical relation between parts and diagrammatic connections for an embodiment of my invention for two cars A and B serving two terminal floors and three intermediate floors (not shown in the drawings). It will be evident that the system can be extended to include any number of cars serving any number of floors.

Figure 7 is an enlarged view of the signal fixture in the elevator car.

Figure 8 is a detailed view of the selector segments and brushes intended to bring out the mechanical relation between parts more clearly.

Fig. 4 shows connections individual to car A; the connections being made as short and direct as possible. Fig. 4A furnishes a key to the mechanical relation between the coils and contacts in Fig. 4. Fig. 4A should be laid beside Fig. 4 and inspection will show that a relay coil appearing in Fig. 4 also appears on Fig. 4A on the same level.

Above and below this coil in Fig. 4A appear all of the contacts operated by this coil, their levels coinciding with those of the contacts as they occur in Fig. 4. The simplification and elimination of lines obtained by separating these two properties of the diagram give a mental grasp of the functions of the circuits that is necessary to a full understanding of my invention.

Fig. 5 shows in a similar manner the connections that are common to the bank of cars. Fig. 5 should be placed below Fig. 4 and Fig. 5A should be placed below Fig. 4A. Fig. 5A shows the relation between contacts and coils that are shown in Fig. 5. Where certain coils that appear in Fig. 5 have operating contacts occurring in Fig. 4, the relation is shown in Figs. 4A and 5A by extending the mechanical connections between drawings. Thus certain contacts appear in Fig. 4A whose operating coils are in Fig. 5A.

Fig. 6 shows the individual operating circuit for car B. Fig. 6 should be placed below Fig. 5 and Fig. 6A showing the mechanical connections between parts should be placed below Fig. 5A. The elements shown in Fig. 6 are nearly a duplicate of those shown in Fig. 4. The purpose of the few differences will be explained later. To distinguish the characters in Fig. 6 a letter B has been placed before the number referring to the same element in Fig. 4. For instance where the brake coil in Fig. 4 is 65 in Fig. 6 it is B65. Similarly coil H becomes coil BH and contacts of relay U bear the initial letter B. As the two diagrams are arranged differently for a matter of convenience in showing the connections to the common circuits and as the contacts are numbered 1, 2, 3, 4, etc. in sequence starting with the highest contact, it will be found that the final numbers of the same contact do not agree in Figs. 4 and 6. It is believed that this should not lead to confusion as the parts function the same when similarly connected.

Referring to Fig. 1 of the drawings, the apparatus shown therein comprises an elevator car 1 suspended by means of a cable 66 which passes over a hoisting sheave 67 to a counterweight 2. The hoisting sheave 67 is mounted on a shaft with an elevator motor 62, a spring-applied electromagnetically released brake 65, and a telemotor transmitter 61 of the self-synchronizing type.

The telemotor transmitter 61 is electrically connected with a telemotor receiver 58 of the same type in a well known manner, so that any rotation of the armature of the transmitter produces a proportional rotation, in a corresponding direction, of the armature of the receiver 58.

The telemotor receiver 58 serves as a driving device for a mechanical switch or floor selector 18, the purpose of which is to commutate certain circuits of the system in accordance with the position of the car 1.

A complete description of a floor selector similar to the present one is given in my Patent No. 1,930,514, filed January 7, 1932 and assigned to the Westinghouse Electric & Manufacturing Company. The operation and the parts will be only briefly described here.

Two moving carriages 13 and 14 are shown attached to the ends of a chain 57 which is driven by the telemotor receiver 58 through a reducing gear 56. The carriages move up and down on rails 19 and a complete motion of the car from the top to the bottom of the elevator shaft causes a corresponding motion of the carriages from the top to the bottom of the rails.

Fig. 2 shows a detailed view of the down carriage 13. This carriage carries fingers 130, 132, 133, 136, 137 and 40 which are connected to various circuits of the elevator controller, by a flexible cable connection 20. These fingers make sliding contact with segments shown in Fig. 4

associated with numerals 104, 105, 106, 107, 112, 113, 114, 115, 120, 121, 122, 123, 124, 125, 126, 127 and 128. Similarly carriage 14 carries fingers 131, 134, 135, 138 and 139 which makes sliding contact with segments 100, 101, 102, 103, 108, 109, 110, 111, 116, 117, 118 and 119. The circuits commutated by the fingers on the carriage are segregated so that circuits concerned with the down motion of the car are operated by carriage 13 and those for the up motion are operated by carriage 14. See also Fig. 8 which shows the exact physical relation between floor heights, selector segment lengths, and locations, and brush locations. In Figure 8 it is assumed that the car is standing at the second floor.

Referring further to Fig. 1, two inductors E and F are shown mounted on the car which cooperate with stationary inductor plates 1UP, 2UP, 1DP and 2DP mounted in the shaftway. These inductors are preferably of the type disclosed in the Harold W. Williams, et al., Patent 1,902,602, filed May 22, 1928 and assigned to the Westinghouse Electric & Manufacturing Company. The action of the inductors is made clear by referring to Fig. 3. The circuit extending from the supply 26 to the coil of the inductor 25, may be closed by any suitable switch 27 at some time before the inductor passes the associated inductor plate illustrated as 2DP. As the car's motion carries the inductor past the plate, a magnetic circuit is partially completed from the core extension 21 through the coil, through the core extension 22 and magnetic finger 23 across the air gap of the plate 2DP and across a second gap to the core extension 21. The magnetic attraction between the plate and the finger 23 causes it to move to the position shown, breaking the contact between finger 23 and contact 24. A similar movement of the inductor past a plate located on the left-hand side of the inductor will operate finger 28 in a similar manner.

Referring again to Fig. 1, other accessories required in the operation of each car are shown located on the car. Car attendant-actuated stopping switches are illustrated as push buttons on a car panel 4 with car buttons CB1, CB2, CB3, CB4 and CB5 each corresponding to a different floor. These are pressed by the car attendant to cause the car to stop at the associated floors. These buttons or switches are arranged to be held in the pressed position magnetically and, when the car responds by stopping at the associated floor, the corresponding button is released; as explained in detail herein-after. A car attendant-actuated starting switch or contact 7 is also shown. In the embodiment of my invention illustrated in the drawings this switch 7 is shown as a contact operated by a cam 5 carried by the car gate, engaging roller arm 6 when the gate is closed. The gate may be closed manually or preferably by a power mechanism (not shown) operating in response to a switch 3 in a well known manner. As the method of operating the gate and the starting switch is immaterial, my invention should not be limited to the use of any particular type. A car attendant actuated emergency stopping switch 8 is provided which is connected in the emergency circuit of the elevator controller and is intended to be used for emergency stops.

A signalling device for the car attendant is illustrated as three indicators 69, 70 and 71 located on the car preferably in front of the operator. These may be illuminated by lamps, not

shown in the figure, to advise the operator when he should start his car from the loading floor, when he should prepare to take on passengers and when his direction of motion will be reversed when travelling in the shaft. Such a signalling device is illustrated in Fig. 7.

Passenger actuated control means are provided at each of the floors served to control the bank of cars. In the form of my invention illustrated in the drawings they are shown as hall push-buttons which are operated by the intending or prospective passengers at the floors. The button for the first floor is shown as HB1U. One button is provided at the terminal floors and two buttons are provided at intermediate floors. These are illustrated as buttons HB2U and HB2D for the second floor. Symbol HB2U refers to the second floor "up" hall button and is the button operated by the passenger to stop a car when he wishes to travel in the "up" direction.

A signalling device for prospective passengers in the form of floor lanterns is provided for each car at each floor to advise the intending passenger the direction the car will move in leaving the floor. The floor lantern for the first floor is shown as U1L in Fig. 1. A single lantern is provided for each terminal floor as the car can move in only one direction from these floors. Floor lanterns for the second floor are indicated as U2L and D2L. The U2L lantern serves to indicate "up" motion of the car at the second floor, and the D2L serves to indicate down motion.

The upper portion of Figure 4 shows landing control connections of the variable voltage type and the necessary circuits for starting and stopping the car. Connections for the car indicating lights are shown and the lower portion of the diagram shows the connections between the floor selector 18 and various contacts and coils of the control system. The power supply for driving the motor is connected to the alternating current driving motor 52 of the variable voltage motor-generator set by switch 51. This motor, when connected, runs continuously and drives the variable voltage generator 53. The armature of generator 53 is connected in loop circuit with the armature of the main elevator motor 62 for car A. Excitation for the generator is provided by a shunt field 55. A degree of self-excitation is provided through a series field 54. This field produces the excitation necessary to produce good speed regulation in the motor 62 as is well known in the art.

Elevator motor 62 has mounted on its shaft a driving sheave 67, a brake sheave 64 and the telemotor transmitter 61 mentioned in the description of Fig. 1. The driving sheave 67 drives by traction a cable 66 which is fastened, one end to the elevator car and the other end to a counterweight. The brake sheave 64 is provided with friction shoes which are applied by springs (not shown) and released by a brake magnet 55. When control switch 68 is closed the shunt field 63 of the elevator motor receives continuous excitation from L+ and L-.

The rotor windings 60 of telemotor transmitter 61 are shown connected to the rotor windings 59 of telemotor receiver 58. The latter drives the reducing gearing 56, which in turn drives the chain 57 to produce motion in the selector carriages 13 and 14. The direction of excitation for the shunt field 55 of the generator 53 is controlled by switches U and D. When the elevator is to run in the "up" direction, contacts U1

and U4 energize it in one direction and contacts D1 and D4 energize it in the other direction to cause the car to move downwardly. The brake magnet 65 is controlled by the contact M1 and by contacts U2 and D3 of the U and D switches.

The circuits to the lights for the operator's signals 69, 70 and 71 are shown controlled by contacts N1, K1 and X2 respectively. In the lower left hand portion of the diagram, coils W, X, Y and Z are shown connected to the selector circuits. Floor lanterns D5L for the fifth terminal floor to U1L for the bottom terminal floor are shown connected to selector segments 116 to 123 respectively. Car push buttons CB5 to CB1 are shown connected to selector segments 124 to 128 through coils 5CN to 1CN of relays 5C to 1C respectively.

Fig. 4, as mentioned previously, shows the circuits to various relays required for the operation of car A. Relay coils D, G, H, J, K, L, M, T, U, W, X, Y, Z are shown. Each contact shown carries a composite letter and number designation. The letter indicates which coil causes an operation of the contact and the number serves to distinguish the contact from others operated by the same coil.

Coil D controls primarily the direction of energization of the generator shunt field to produce down motion of the elevator. Coil D when energized closes contacts D1, 3, 4, 5, 6, 7 and 13 and opens contacts D2, 8, 9, 10, 11 and 12.

Coil G becomes deenergized when the opening of a corridor door opens an interlock 12 or the car gate opens its contact 7. Coil G when energized closes contact G1.

Coil H controls the energization of the generator shunt field to produce high speed in the elevator. Coil H when energized closes contact H1 which short circuits field resistor 154 and opens contacts H2, 3, 4, 5, 6, 7, 8, 9 and 10.

Coil J operates a time relay in conjunction with the operation of a car attendant's signal device. Coil J when energized opens contact J1.

Coil K is responsive to the automatic dispatching control and actuates the up start signal for the car attendant. Coil K, when energized, closes contacts K1 and K2.

Coil L is responsive to car position and becomes energized when car A arrives at the dispatching floor which starts the dispatcher into operation. Coil L when energized closes contacts L3 and 4 and opens contacts L1 and L2.

Coil M is responsive to the starting and running of the elevator, and controls primarily the energization of the elevator brake. Coil M when energized closes contacts M1, 2, 3 and 5 and opens contacts M4 and 6.

Coil S must be energized to cause the car to start. Coil S when energized closes contacts S1, 2 and 4 and opens contacts S3.

Coil T operates a time relay which holds the direction preference for the elevator for a predetermined time. Coil T when energized closes contacts T1 and T2.

Coil U controls primarily the direction of energization of the generator shunt field to produce up motion of the elevator. Coil U, when energized, closes contacts U1, 2, 3, 4, 6, 7 and 13, and opens contacts U5, 8, 9, 10, 11 and 12.

Coil W controls the up direction preference for the elevator when deenergized. Coil W when energized closes contact W9 and opens contacts W1, 2, 3, 4, 5, 6, 7 and 8.

Coil X controls the down direction preference for the elevator when deenergized. Coil X when

energized closes contact X4 and opens contacts X1, 2, 3, 5, 6, 7, 8 and 9.

Coil Y is responsive to calls and causes the stopping of the elevator primarily when the car is on its up motion. Coil Y when energized closes contacts Y2, 3, 4, 5, 6 and 7 and opens contacts Y1 and Y8.

Coil Z is responsive to calls and causes the stopping of the elevator primarily when the car is on its down motion. Coil Z when energized closes contacts Z3 to Z8 and opens contacts Z1 and 2.

Two inductor coils E and F, mentioned previously, are shown in the upper right-hand portion of Fig. 4. Coil E when energized, in conjunction with passing the associated inductor plates, opens contacts E1 or E2 to produce the slow-down of the elevator. Coil F, in conjunction with its associated inductor plates, opens contacts F1 or F2 to produce the final stop of the elevator.

Five car call registering relay coils are shown, namely 1C, 2C, 3C, 4C and 5C. One is associated with each floor served by the elevator. Associated with each of these coils are respectively coils 1CN, 2CN, 3CN, 4CN and 5CN. Coil 1C when energized closes contacts 1C2 and 3 and opens contacts 1C1 and 4. Coil 2C when energized closes contacts 2C2, 2C3 and 2C4 and opens contacts 2C1 and 5. Coil 3C when energized closes contacts 3C2, 3 and 4 and opens contacts 3C1 and 5. Coil 4C when energized closes contacts 4C2, 3 and 4 and opens contacts 4C1 and 5. Coil 5C when energized closes contacts 5C2 and 3 and opens contacts 5C1 and 4. Coil 1CN when energized reverses the operation of the contacts produced by coil 1C. The other CN coils operate similarly on their associated relays.

Five push buttons are shown, namely, CB1, 2, 3, 4 and 5. These are located on the car operators panel 4 and control the previously mentioned coil circuits. Eight floor lanterns are shown associated with the five floors, namely, down lanterns D5L, D4L, D3L and D2L and up lanterns U4L, U3L, U2L and U1L.

Fig. 6 shows similarly marked coils and contacts for car B except in each case the symbol bears the letter B to distinguish it from the similar marking of car A. There are a few differences in connections which will be explained later.

Fig. 5 shows connections to the coils of relays common to the bank of cars and individual relays associated with each car that are used in the dispatching connections, dispatcher coils are N, BN, *N, O, BO, *O, P, Q, BQ, *Q, R, BR, *R and V.

Coil N is responsive to car A arriving at the dispatching floor and causes an operation of the dispatching signal of the car. Coil BN is associated with car B and coil *N with any other car in the bank and perform the same functions. Coil N when energized closes contacts N1, 5, 7 and 10 and opens contacts N2, 3, 4, 6, 8, 9 and 11. Coil BN when energized closes contacts BN3, 5, 8 and 10 and opens contacts BN1, 2, 4, 6, 7, 9 and 11. Coil *N when energized closes contacts *N3, 4 and 6 and opens contacts *N1, 2, 5 and 7.

Coil O when energized causes the operation of the dispatching signal on the car A. Coil BO performs the same functions for car B and coil *O for any other car. Coil O when energized closes contact O2 and opens contacts O1 and 3. Coil BO when energized closes contact BO2 and opens contacts BO1 and 3. Coil *O

when energized closes contact *O2 and opens contacts *O1 and 3.

Coil P functions to store up dispatching signals for any car. Coil P when energized closes contacts P1 and P2.

Coil Q is responsive to the arrival of car A at the dispatching floor and determines whether car A should leave immediately or wait for a subsequent dispatching signal.

Coil BQ functions similarly for car B and coil *Q for any other car. Coil Q when energized closes contacts Q4 and 5 and opens contacts Q1, 2 and 3. Coil BQ when energized closes contacts BQ3 and 4 and opens contacts BQ1, 2 and 5. Coil *Q when energized opens contacts *Q1 and *Q2 and closes contacts *Q3 and *Q4.

Coil R is responsive to the registration of a floor call and functions in the starting of the cars. Coil R when energized opens contact R1.

Coil BR operates a time relay which produces a delay in the starting of car B. Coil BR when energized closes contact BR1 and opens contact BR2.

Coil *R operates a timing relay for delaying the starting of any other car. No contacts are shown in the diagram of coil *R.

Coil V functions to store a dispatching impulse. Coil V when energized closes contacts V1 and 2 and opens contacts V3.

Fig. 5 also shows eight passenger actuated switches associated with eight floor relays. The passenger actuated switches are located at each floor as mentioned previously. Coils for the floor relays are illustrated as down coils 5D, 4D, 3D, 2D and up coils 4U, 3U, 2U, 1U. Associated with each of these respectively are call cancelling coils 5DN, 4DN, 3DN, 2DN, 4UN, 3UN, 2UN and 1UN. A floor relay functions to store a signal caused by the operation of the associated floor push button until some car responds to the signal by stopping. When this occurs the associated cancelling coil deenergizes the relay as will be explained later.

Coil 5D when energized closes contacts 5D2, 4 and 8 and opens contacts 5D1, 3, 5, 6, 7 and 9.

Coil 4D when energized closes contacts 4D2, 4 and 8 and opens contacts 4D1, 3, 5, 6, 7 and 9.

Coil 3D when energized closes contacts 3D2, 4 and 8 and opens contacts 3D1, 3, 5, 6, 7 and 9.

Coil 2D when energized closes contacts 2D2, 5 and 8 and opens contacts 2D1, 3, 4, 6, 7 and 9.

Coil 4U when energized closes contacts 4U1, 4 and 8, and opens contacts 4U2, 3, 5, 6, 7 and 9.

Coil 3U when energized closes contacts 3U1, 4 and 8 and opens contacts 3U2, 3, 5, 6, 7 and 9.

Coil 2U when energized closes contacts 2U2, 5 and 8 and opens contacts 2U1, 3, 4, 6, 7 and 9.

Coil 1U when energized closes contacts 1U1, 6 and 8 and opens contacts 1U2, 3, 4, 5, 7 and 9.

Coil 1UN when energized reverses the operations of the contacts caused by the operation of coil 1U. The other UN and DN coils function similarly with their associated relays.

To aid in the understanding of the control circuits shown, an example of the operation obtained with a single car will be given. The simplest operation is the response to a car call. In Figure 4 the selector brushes are located on

the segments in positions corresponding to the car at the second floor. We will assume that no calls are registered in the system and that switches 51 and 68 have been closed. Relay coils W, X and J will be energized under these conditions. Coils W and X are energized through either of two circuits in parallel, the first extending (Fig. 4) from L— through normally closed contact U10, brush 130, segment 105 to a junction point in the series of normally closed contacts extending from contact 5C1 to contact 1C4, and a second circuit extending from L— through contact D11, a brush 131 and segment 103 to a junction point in the series of back contacts. From these junction points the circuit extends in both directions to energize coils W and X. Coil J will be energized from a circuit extending from L— through the coil and through normally closed contact L1 to L+. The coil L is deenergized at all times except when the car is positioned at the first floor, which, in this example is assumed to be the main floor.

Assuming now that a passenger enters the car at the second floor and expresses a desire to go to the fourth floor, the operator will press the button CB4 corresponding to the fourth floor. This operation results in energizing coil 4C through a circuit extending from L+ through the push button CB4 through coil 4C to L—. Relay 4C establishes a holding circuit for itself through its contacts 4C3, and the relay remains in the energized position. Relay 4C in picking up opens its contacts 4C1 and 4C5 in the series of back contacts previously mentioned. As both feeds to this circuit energizing the relay coil W lie below these contacts, the circuit to coil W is broken and the relay drops to the deenergized position. The closing of normally closed contacts W4 and W5 provides two feeds to segment 118 which causes the floor lantern U2L to illuminate. Closing of the normally closed contacts W3 provides a circuit for energizing relay coil S through normally closed contacts Y1 and Z1. The closing of normally closed contacts W2 provides a circuit for energizing relay K extending from L— through coil K, normally closed contacts W2, Q1, N2 and L2 to L+. When relay K picks up it closes its normally open contact K1 which provides a circuit to illuminate the up start light 70 in the car, indicating to the car attendant that the car will start upward in response to this call. Contact K2 establishes a self-holding circuit for coil K.

The operator now closes the car door and gate and contact 7 causes relay G to pick up through a circuit extending from L— through contact S4, coil G, gate contact 7 and the door interlocks 12 to L+. Relay G closes its contact G1 and through the conjoint action of this contact closing to start, and relay S becoming energized as a result of the stopping circuit being set up, a circuit is provided to start the car by energizing coils U and M. This circuit extends from L— through safety devices indicated as an emergency stop button 8, governor contact 11, top and bottom over-travel limit switches 9 and 10, through contact G1, contact S1, normally closed contacts W1, D2 and F1 and through coils U and M to L+. Relay U in picking up closes its contact U3 which provides a self-holding circuit. Contact U6 in closing provides a circuit for energizing coil H extending from L+ through contacts U6 and E1 and through coil H to L—. Relay M in closing closes its contacts M5 and

provides a circuit for energizing coil T extending from L+ through contact M5, coil T and protective resistance 153 to L—. The closing of contacts U1 and U4 provides a circuit for energizing the generator shunt field 55 for up motion extending from L+ through contact U1 through shunt field 55, contact U4, resistance 154, to L—. This circuit provides only partial energization for the generator field and produces the landing speed for the elevator which is also the first step in the acceleration. As relay H closed immediately after relay U, contact H1 in closing shorts out resistance 154 and provides full field excitation for the generator which causes the elevator motor to accelerate to full speed. Relay M in picking up provides a circuit for energizing the brake release coil 65 extending from L— through contacts M1, brake coil 65 and contacts U2 and U1 to L+.

The elevator is now started in an up direction and has accelerated to full speed. When relay H picked up contacts H7 and H8 opened and broke the feeds to the floor lantern U2L and the floor lantern light was extinguished. The up start light 70 in the car remains lighted. The car moving in the upward direction causes a proportionate movement of the selector carriages as mentioned previously, and brush 131 finally comes in contact with segment 101 when the car approaches the slow-down distance for the fourth floor. The feed to brush 130 was opened when relay U picked up and opened its contact U10. When brush 131 engages segment 101 a circuit is completed to energize coil Y extending from L— through normally closed contact D11, brush 131, segment 101, contacts 4C2, U7, Z2 and through coil Y to L+. Relay Y in picking up establishes a self-holding circuit through contacts Y2 and T1 to L—. It also opens its normally closed contact Y1 in the energizing circuit to relay S, which causes relay S to drop to the deenergized position. Relay S in dropping out closes its normally closed contacts S3 and provides a circuit for energizing slow-down inductor coil E extending from L+ through contact M2, contact S3 and coil E to L—. The inductor contacts E1 and E2 do not respond immediately as explained previously.

The car then moves an additional distance at high speed until contact E1 passes the 2UP plate for the fourth floor, at which time contact E1 opens and deenergizes the circuit to coil H. Relay H then drops to the deenergized position and inserts the resistance 154, which causes the elevator to slow-down to its landing speed. Relay H in dropping out closes its contacts H2, which provides a circuit for energizing inductor coil F in parallel with inductor coil E. A circuit is also completed for energizing the U4L floor lantern at the floor extending from L— through contacts W4, H7, D10, brush 138, segment 116 and floor lantern U4L to L+. The car continues its upward movement reducing its speed until it arrives at its landing speed and about this time inductor coil F passes the 1UP plate for the fourth floor and inductor contact F1 picks up and opens the circuit to coils U and M. Relay M in opening disconnects the circuit to the shunt brake coil 65. Relay U in opening deenergizes the shunt field of the generator. The car comes to rest at the floor level. Relay M in dropping out opens its contact M5 and closes its contact M4. Although contact M5 opens the energizing circuit for coil T, contact M4 causes a short-circuited discharge path

around the coil which, prevents the relay armature dropping to the deenergized position until the stored energy in the magnetic circuit of the relay has expended itself in the short circuit discharge path through contact M4. Thus a delay is produced in the opening of relay T. Contact M2 in opening deenergizes the inductor coils E and F. Normally closed contact M6 closes and energizes brush 140 which is at this time in contact with segment 125 of the selector and which provides a circuit for energizing the demagnetizing coil 4CN of relay 4C extending from L— through contact M6, brush 140, segment 125, coil 4CN and contact 4C3 to L+. The 15 ampere turns of coil 4CN oppose those of coil 4C with the net result that the flux in the relay armature drops to such a low value that the armature falls to the open position. In so doing, it opens contact 4C3 which deenergizes both 20 coils simultaneously. Relay 4C in dropping out closes its contacts 4C1 and 4C5, completing the back contact circuit of the relays and permitting coil W to become energized. The circuit for energizing coil W now extends from L— through contact D11, brush 131, segment 101, contacts 4U2, 4C1, 5C4, 5D3, 5D1, 5C1 and through coil W to L+. Coil W in picking up opens its contact W2 which deenergizes coil K. Contacts K1 in opening deenergize the operator's up-start 30 light 10 indicating to the operator that no further calls exist. The car being at rest, the operator opens the door and permits his passengers to get off. After a time delay relay T drops to the deenergized position and in so doing, opens the holding circuit to coil Y that extends from L— through contacts T1, Y2 and Z2 and through coil Y to L+. Relay Y now drops to the deenergized position and in so doing, extinguishes the U4L floor lantern by opening contact Y3. 40 The car is now standing at the fourth floor and the control is in the same condition as it was when standing at the second floor, and the operator should close his doors to await further calls.

45 Until relay T drops, relay Y is held in through a circuit extending from L— through contacts T1, Y2, Z2 and the coil of relay Y to L+. With relay Y energized, a circuit is provided for holding coil X in the energized condition through 50 a circuit extending from L— through contacts T2, Y7 and coil X to L+. It will be noted that relays W and X were both energized when the car came to rest at the fourth floor. However, until relay T drops coil W may become deenergized again but relay X cannot. Thus, as the deenergization of coil W represents an up direction preference in the controller, only an up motion can become effective until relay T drops. Thus the car may be said to be biased for up 60 motion until relay T's time element is expended. Another call can affect the controller only in case it is a call above the fourth floor as only calls above the fourth floor have contacts in the back contact circuit capable of deenergizing coil W. If the call had been registered either in the 65 car or at a floor station for a floor above the fourth previous to energization of coil W, noted in the example given, when the car came to rest relay W would not have been reenergized. A call 70 for a floor below the fourth will be ineffective until relay T has dropped out. If no call had been registered in the system previous to the time relay T had dropped out, a subsequent call will be effective to start the car in a direction 75 corresponding to the location of the call with

respect to the fourth floor. Either direction preference relay W or X becoming deenergized will set up a circuit for holding the other relay energized until the car has moved in the direction set up and cancelled the call. The circuit for holding in relay W under these circumstances extends from L— through contact X5 and through coil W to L+. Similarly, the circuit for relay X extends from L— through contact W8 and through coil X to L+.

In the system as shown in the diagram, relay T is held for a definite time after the stopping of the car and this time is assumed to be long enough to permit the operator to open the car doors, allow a passenger to step on the elevator, and permit the operator to register the passenger call. Under some circumstances, it may be desirable to have relay T held in, until the car is ready to make its next start. To accomplish this, it is only necessary to connect a 20 break contact of relay G in parallel with contact M5 and a normally open contact of relay G in series with contact M4. If the door or gate is open, relay T will be held energized until they are closed. 25

The response of the control system to floor calls is the same as the response for the car call given in the illustration provided that the floor call is for the direction of travel of the car. This will be apparent from examination of the 30 diagram as floor relay contacts parallel the car relay contacts that are connected between the floor segments and relay Y or Z which causes the car to stop.

If the car starts in the up direction to answer 35 a call, a subsequent registered call for the up direction between the car's position and the position of the first registered call will cause the car to stop when it approaches the floor where the second call is registered. Thus, the 40 car in traveling through the shaft will answer calls in their numerical order regardless of the order in which they were registered.

If the car is moving upward, a down floor call will not stop the car if up calls exist beyond 45 the position of the down call. The down floor relay contacts are all connected to segments 104 to 107 which are contacted by a brush 130 and the circuit to this brush is interrupted when the car is moving in the up direction by the 50 opening of contact U10. When a floor call for the opposite direction of travel is registered and happens to be the farthest call registered in the direction the car is traveling, the car will stop. Under these conditions if the car is traveling up, 55 a down preference will be set up when the car is stopped which will not be cancelled until relay T has dropped, as in the previous example.

The sequence of operation that will be obtained under these conditions can be illustrated 60 by assuming that the car which stopped at the fourth floor in the previous example starts in the down direction in response to an up call at the second floor. If we assume that the car attendant had closed the doors before the call 65 was placed, relays J, W and X will be energized as noted in the previous example and relay G will be energized by the closing of the doors. As relay S will be deenergized by contacts W3 and X3 being opened, the car will not start even though the doors are closed. When a call is placed on the button HB2U, relays 2U and R become energized by a circuit extending from L+ through floor button HB2U, coils 2U and R to L—. The energizing of relay R causes 75

additional cars to start into service as will be explained later. Relay 2U establishes a self-holding circuit when contact 2U5 closes in parallel with the floor button contact HB2U. Contacts 2U2 and 2U3 open in the series of back contacts and disconnect the feed to coil X, which drops to the deenergized position.

Contact X2 in closing lights the operator's down start light 71.

Contact X3 in closing establishes a circuit for energizing relay S, extending from L+ through contacts X3, Y1 and Z1 and relay S to L-. Contact S2 on closing establishes a circuit for energizing coils D and M through a circuit extending from L- through safety circuit contacts 8, 11, 10 and 9 through contacts G1, S2, X1, U5 and F2 and coils D and M to L+. Coils H and T become energized in a manner similar to that given in the previous example. The car now accelerates to high speed in the down direction and brush 130 leaves segment 107, passes segment 106 and comes into contact with segment 105. At this point, a circuit is completed to reenergize coil X extending from L- through contact U10, brush 130, segment 105 to the junction point of the back contact circuit through contacts 2D3, 2C5, 1C1, 1U2, 1U3 and 1C4 and through coil X to L+. It will be noted, as we have assumed no other call in the system, that none of these contacts will be opened. As relay W was previously energized, and relay X now being energized, both contacts W3 and X3 will be opened and the circuit to coil S will be interrupted momentarily. At the same time, a circuit is established to energize coil Y extending from L- through contacts T1, X4, D7 and Z2 and through coil Y to L+. Relay Y in closing establishes a self holding circuit through contact Y2. Also contact X5 in opening deenergized coil W as its other feed through the back contact circuit is opened by contacts 2U2 and 2U3. Relay W in dropping out energizes coil K through the circuit extending from L- through coil K and contacts W2, Q1, N2 and L2 to L+. Contact K1 illuminates the up start light 70 on the car. Contact X2 opened when relay X became energized and extinguished the down start light 71. Relay S in dropping out energizes the slowdown inductor E to the circuit extending from L+ through contacts M2, S3 and coil E to L-. The car now continues on at high speed until inductor E passes the 2DP plate for the 2nd floor and initiates slowdown as noted in the previous example when contact E2 deenergizes coil H. Contact H2 in closing energizes the stop inductor F. Contact H8 in closing lights lantern U2L on the second floor through a circuit extending from L- through contacts W5, H8, U11, brush 139, segment 118 and lantern U2L to L+. It should be noted that brush 139 came in contact with segment 118 simultaneously with brush 130 engaging segment 105. The lighting of lantern U2L advises the passenger at the floor that the car is responding to his call. Contact H10 in closing establishes a circuit for the cancellation of the call on relay 2U through a circuit extending from L- through contacts W7, H10, U12, brush 135, segment 111, coil 2UN and contact 2U5 to L+. Brush 135 engaged segment 111 simultaneously with brush 130 engaging segment 105. It will be noted that coils 2U and 2UN are energized simultaneously and that the coils are so proportioned that their ampere turns are equal and oppose each other. Relay armature 2U drops to the deenergized position,

which opens contact 2U5 and deenergizes both coils simultaneously. Coil R also was deenergized in this operation as we have assumed no other calls registered on floor relays. Contacts 2U3 and 2U2 close to provide a circuit to reenergize coil W. Contact W2 in opening deenergizes coil K and contact K1 extinguishes the up start light 70. The up start light has been illuminated momentarily, indicating to the operator that his car is stopping on down motion in response to an up call. The car now slows down to landing speed and when inductor F passes the 1DP plate for the second floor, contact F2 opens to deenergize coils M and D. The car comes to rest at floor level. Contact M2 opens to deenergize inductors E and F. Contact M5 opens to deenergize relay coil T. Relay T1 as in the previous example opens after a time element. The operator now opens the doors and the passenger steps on the car and gives the operator a request for a floor above the second floor. As relay Y still remains energized, relay X is held in through the circuit extending from L- through contacts T2 and Y1 and through coil X to L+. Thus, calls below the car's position registered subsequent to the start of the slow down in response to the up call at the second floor are ineffective to deenergize coil X and start the car with a down preference. On registration of a call, on the car for a floor above the second, the car will start on an up trip as in the first example. If no car call is registered and no floor call is placed at a floor above the second after the expiration of the time required by relay T to drop to its deenergized position, the holding circuit is broken by contact T2 opening and the car can then receive a down motion preference and respond to calls below the second floor.

Thus far I have described how one car in my control system will start from any position for any floor for which a call may exist; how it will continue in motion until all registered calls are answered; how it will stop at floors in their numerical order and collect passengers as its motion progresses; how it will stop at the floor at which the farthest removed call is registered, whether it be a call for an up direction or a down direction; and how it reverses after a time element at that floor if calls requiring the opposite direction of motion exist.

It is apparent that when traffic becomes heavy a single car in operation will result in long waits by prospective passengers. However, when the duty is light a single car will give all the service required. As it is customary to have a number of cars operating as a bank where the traffic is normally too heavy for one car to handle satisfactorily, I have provided a mechanism for automatically starting additional cars into service when the traffic becomes heavy enough to warrant their use.

Referring to Fig. 6, it will be noted that car B cannot start until relay BS has been energized. For car A a similar relay S is provided which responds when any single call was placed on the system. Relay BS, however, will not become energized except under either of two additional conditions, the first is that one of the car call relays B1C to B5C is energized, the second that relay BR becomes deenergized. The first of these conditions will be obtained when the operator of car B presses one of his car operating buttons in response to the request of a car passenger. Thus the car can be started any time

in response to a call originating on the car. Relay BR becomes deenergized in the following manner. The circuit for relay BR is shown in Fig. 5. It is energized through contact R1 of relay R through a circuit extending from line L+ through normally closed contact R1 and through coil BR to line L-. When any floor call is registered, relay R becomes energized causing coil BR to become deenergized. However, the armature of relay BR will not drop immediately to the deenergized position, as this relay is provided with a large coil and a heavy iron circuit and a discharge path through a variable resistance 155 which produces a time delay.

Portions of resistance 155 are short circuited by normally closed contacts on the various floor relays. If only one call is registered, one additional section of this resistance will be connected in the circuit with coil BR furnishing a relatively low resistance discharge path for the coil. The energy stored in the magnetic circuit of relay BR expends itself in the current flowing through the discharge resistance, and, as this is of low value, a comparatively long time will be required for the energy in the magnetic circuit to become low enough to permit relay BR to drop to the deenergized position. On the other hand, if a considerable number of floor calls are registered either simultaneously or close together, a considerable number of sections of resistance will be connected in series providing a high resistance discharge path for relay coil BR. As the energy stored in the magnetic circuit will be expended more rapidly in flowing through this high resistance, the magnetic circuit will become deenergized sooner and a relatively short time will be required for the armature relay BR to drop to the deenergized position.

Thus it will be seen that contact BR2 of relay BR will drop to the closed position in a predetermined time after a single call has been registered at some floor station, or after a number of floor calls are registered, it will drop to this position in a predetermined shorter time. On the closure of this contact, relay coil BS will become energized through a circuit extending from L+ through contacts BR2, BY8, BZ8, either of BX9 or BW8, depending upon the direction preference and coil BS to L-. With this circuit established, car B will function with the operation previously described for car A. When relay BS becomes energized, a circuit is provided through contact BS5 for energizing the upstart light B10 and the downstart light B11 in a manner similar to that previously described for car A.

As soon as relay BR drops to the deenergized position, its contact BR1 opens and deenergizes a relay *R, which after a time limit determined as described for relay BR will cause relay *R to drop to the deenergized position, starting a third car C. The circuits for car C will be similar to those for car B, as shown in Fig. 6. Thus any number of cars can be started into service depending upon the persistency and the numerical number of the floor calls registered.

In this system, once a car has been started into service it will continue until all floor calls have been responded to at least momentarily. That is, when all floor call circuits have been deenergized, relay R will become deenergized which will then permit relays BR and *R to become energized. In the event that no car calls have been registered, the energization of relay BR will cause contact BR2 to open which will

deenergize relay BS. If it happens that car B is running at the time in response to the last floor call registered and this call was answered and cancelled by some other car, relay BS, will become deenergized and car B will stop at the next nearest floor. Inductor BE will be energized by the closing of contacts BS3 and a stop will follow as described previously.

Similarly, if cars A and B, are both travelling toward the only floor call registered and car B arrives at the floor canceling the call, car A will stop at the next floor at which it can stop, for in this case the canceling of the last floor call permits the series of back contacts mentioned previously to form an electrically continuous circuit and both relays W and X will become energized and relay S will, therefore, become deenergized through the opening of contacts W3 and X3. Relay S will then initiate a stop as described for car B.

When a car makes a stop under these conditions neither its Y nor Z relay becomes energized, and the car will come to rest without any direction preference established. It will then be in condition to respond immediately to the first subsequent floor call registered, regardless of its direction from the position at which it stopped.

If two calls should now be placed simultaneously one for a floor above the car's position and one for a floor below both relays W and X would tend to become deenergized at once. However, as soon as they drop out a normally closed contact on each (X5 and W8) establishes a pick-up circuit for the other. Under these conditions the relays would tend to telegraph or chatter until one became deenergized when the other was in the energized position. When this occurs they will retain the connection. To prevent this chattering and in cases where indecision of direction preference might occur I have provided a resistor 164 connected in parallel with coil X. The effect is to cause relay X to be slightly slower than relay W in dropping out and to give a predominance to the up direction preference.

When a car stops in response to another car answering the last call registered at a floor as previously described, the car cannot be restarted until a call is registered either on that car's buttons or at some floor. Thus assuming car A stops under these conditions, its relays W and X will be energized and relays Y and Z will be deenergized. Relay S will be deenergized by contacts W3 and X3 being open and contacts S1 and S2 will prevent starting. No signal will appear either in the car or at the floor where the car stopped. Thus until another call is placed on the system the car can only remain parked at this last floor. It is evident that this will prevent useless running.

From the description of these operations, it will be apparent that any car's motion is always towards a floor for which some call is registered. This characteristic tends to keep the cars near the floors at which the demands for service are greatest. Since the majority of passengers getting on the cars at the floors other than the first floor, assuming this is the main floor, wish to go to the first floor, and as the first floor is the point at which the greatest number of people board the cars, there will be a tendency for the cars to congregate at this floor. I have found it necessary to provide means for causing an orderly dispatching of the cars from the first floor.

One form of dispatcher that is well known which might be used under these conditions, dispatches a car at the end of each successive predetermined time interval. Which car is dispatched is dependent upon the order of arrival of the cars at the floor. If several cars arrive at about the same time, the first car to arrive is dispatched first, while the subsequent arriving cars are held there for subsequent intervals of time to be expended. In my system, this would be likely to cause cars to be held at the first floor when their services could be used to greater advantage in other parts of the system. To take care of this condition, I have provided means for immediately dispatching cars arriving at the first floor in excess of a predetermined number. With my dispatcher, it is possible to have the first car to arrive await the expiration of the time interval, while all subsequent arriving cars will be immediately dispatched up to the time the first car leaves. After that the first arriving car will be held until the expiration of the next time interval.

However, with this arrangement, it is possible to have given a car an immediate dispatch signal just before the car being held by the time interval was given its dispatch signal, which would cause two cars to leave almost simultaneously and perhaps leave no car at the main floor to receive passengers. I have provided means to hold a car for a subsequent dispatch interval if that car arrives within a predetermined time before a previously held car is scheduled to leave. This makes it possible to have a car available at the loading floor at practically all times, as is required in some types of buildings.

Thus only the cars that can be spared from the loading floor are dispatched immediately and then only if their services are required in other parts of the building. The circuits for accomplishing these results are shown in Fig. 5. Any car arriving at the first floor will energize an L relay through a brush carried on its selector which energizes a segment only when that car is at the first floor.

Referring now to Fig. 4, car A energizes its L relay through a circuit extending through L— through selector brush 141, first-floor segment 129, coil L and switch 152 (which is intended to be used to disconnect car A from dispatching sequence) to L+. Relay L starts the dispatcher into operation for car A. Relay K through its contact K1 controls the dispatch signal 70 for car A, and when relay K becomes energized upstart light 70 illuminates and the operator of car A is advised to leave the first floor. If contacts N2 and Q1 remain closed, coil K will become energized immediately at the expiration of the time element of relay J, described previously. Relay K may also be energized by the manual closing of push button 151. This button is provided for operation by an attendant at the first floor who may wish to release car A from the dispatching sequence to meet some special demands of the service.

Upstart light 70 serves three purposes. At floors other than the loading floor, it advises the car attendant that calls exist at floors above his present position. When it goes out he knows no further calls above him exist and he also knows he will either park or reverse at the floor at which his car is stopping. When the light comes on at an intermediate floor it advises him that a call above him has been registered

and that he should start his car into operation by operating the start switch 7 if he has not already done so. When his car stops at the loading floor, light 70 is responsive to the automatic dispatcher instead of calls and it becomes a dispatching signal operating in conjunction with the preparatory signal 69.

It is assumed that when a car arrives at the first floor, if the operator receives no light, that he will discharge whatever passengers he may have in his car and close his car doors until the automatic dispatcher gives him further instruction. A preparatory or loading light 69 becomes illuminated when an N relay picks up (Fig. 5). In response to this light, the operator should reopen his doors and take on whatever passengers arrive up to the expiration of the time interval. At the end of the time interval, the loading light will be extinguished and the car's K relay will give the up start signal. This operation is controlled by relays O, BO or *O, as will be described later.

Under normal operation, the energizing of relay K will be determined by the closing of contacts N2 and Q1 which are the dispatcher relays. BN and *N are relays for cars B and C corresponding to relay N for car A, which control the giving of the loading light in the associated cars.

Relay V serves to store a dispatching signal in the event that no car is at the first floor to receive it at the time the signal was given. Relays Q, BQ and *Q function to prevent the giving of an immediate start signal to a car that arrives within a predetermined time before a previous car is to be dispatched. Relay P serves to store the impulse which controls this operation. The timing motor TM runs continuously and controls the giving of the starting impulses. The interval between any two impulses can be adjusted by changing adjustable resistance 157 in series with the armature TM. Three contacts TM1, TM2 and TM3 are provided which are operated by the timing motor through a set of gears (not shown).

Contacts TM1 and TM2 function to give the dispatching intervals. Contact TM3 determines the time after which a second car arriving at the loading floor will not be given an immediate start signal. The operation of contact TM3 is adjustable with respect to contacts TM1 and TM2. This adjustment is obtained by turning the cam 159 to various positions on the shaft with respect to cam 158.

The operation of the dispatcher can best be understood from an example of the operation under assumed conditions. With the dispatcher in its normal condition as shown in Fig. 5, assume that three cars A, B and C are approaching the dispatching floor and that the dispatcher is adjusted to give a signal to some car once every 20 seconds and that the contact TM3 is set to close 10 seconds after each dispatching signal is given, that is, this contact will close midway between successive closings of contact TM2. Assume that car A arrives first and, as described previously, energizes relay L through brush 141 and segment 129. Contact L1 de-energizes coil J which drops to the deenergized position after a few seconds delay with no action resulting. Contact L3 energizes coil N through a circuit extending from L— through contacts L3 and O1, coil N and contacts N3, *N1, BN1, N4, *Q1, BQ1 and Q2 to L+. When relay N picks up it establishes a self-holding circuit

through its contact N5 and resistance 160. Resistance 160 is of sufficient value to pass a current that will hold coil N energized but will not energize relay BN if contacts N3, BN3 and BL1 should all be momentarily closed. Contact N1 illuminates the loading light 69 on car A, and the operator of this car receives passengers while waiting his dispatching signal, which will be described later. Assume that two seconds after car A arrives that car B arrives. Relay BL becomes energized in response to brush B141 engaging segment B129. Contact BL3 in opening deenergizes coil BJ, contact BL1 closes but does not energize relay BN as its pick up circuit has been opened by contact N4 which opened in response to relay N being energized. After two seconds relay BJ drops to the deenergized position and the circuit is now established for energizing coil BK (Fig. 6) extending from L- through contacts BQ5, BN11, BJ1, BW9 (this assumes that there are sufficient cars in the system to require the services of car B and that relay BW has become deenergized giving car B an up preference) through coil BK to L+. Contact BK1 closes a circuit to illuminate the up start light B70 in car B. On receipt of the start light, the operator leaves the floor as soon as he can, relay BK remains energized through a holding circuit established by contact BK2 and keeps the up start light B70 illuminated until car B receives a down direction preference and relay BW becomes energized. If we assume that car B leaves six seconds after it arrives, it will leave eight seconds after the sequence being described started. Due to car B leaving the floor, its relay BL becomes deenergized when brush B141 leaves segment B129. Relay BJ becomes energized in response to the closing of contact BL3. Two seconds later, the timing motor closes contact TM3 and a circuit is provided for energizing relay P extending from L+ through contacts TM3, and V3 and coil P to L-. Relay P in picking up establishes a self holding circuit through contact P2 so that when contact TM3 opens in response to the rotation of cam 159, relay P remains in energized position.

Assume now that car C arrives three seconds later and energizes its relay *L (any characters with * refer to car C operation) through the first floor segment as described for the other cars. Relay *L in picking up deenergizes relay *J but before relay *J's time element is expended, relay *Q becomes energized through a circuit extending from L+ through contacts P1, N10, Q3, BQ2, *Q2, coil *Q and contacts *N7 and *L2 to L-. When relay *Q picks up, it breaks the pick up circuit by contact *Q2 opening and closes a self holding circuit through contact *Q3 and resistance 161. When relay *J drops to the deenergized position at the expiration of its time, the circuit for energizing relay *K will not become energized as it is interrupted by one of *Q's contacts. Therefore, car C will receive no signal when it arrives at the first floor and under these conditions, the operator should close his car doors and wait for his loading light to come on. At the end of the 20th second, the timing motor opens its contacts TM1 and closes contacts TM2. In response to contact TM2 closing, relay V picks up through a circuit extending from L+ through contacts TM2 and coil V to L-. Relay V establishes a self holding circuit for itself through contacts V2 and O3, contacts BN7 and BO3 in parallel and contacts *N5 and *O3 in parallel.

Relay V in picking up deenergizes relay P by opening its contacts V3. After a short time, the timing motor recloses contact TM1 and opens contact TM2. Contact TM2 opens the pick up circuit for coil V. In response to the reclosing of contact TM1, the circuit is provided for energizing coil O extending from L+ through contacts TM1, V1 and N7, coil O and contact L3 to L-. Relay O in picking up deenergizes coil N by opening its contact O1. Contact O3 deenergizes relay V as contact N9 is still open. Relay V drops to deenergized position opening its self holding circuit. Relay N, in dropping out, opens its contact N1 and interrupts the circuit to the loading light for car A. A circuit is also provided for energizing relay K (Fig. 4) extending from L+ through contacts J1, N2, Q1, W2 and coil K to L-. Relay K in picking up closes contact K1 and illuminates the up start light 70 for car A. Contact N10 opens and deenergizes relay *Q which picked up through a circuit including this contact. *Q in dropping to the deenergized position closes the pick up circuit for relay *N and *N becomes energized through a circuit extending from L+ through contacts Q2, BQ1, *Q1, N4, BN1, *N1, *N2, coil *N and contacts *QO1, and *L1 to L-. Relay *N in picking up establishes a self holding circuit through its contact *N3 and contacts BN4, N6 and resistance 160 to L+. Contacts *N2 and *N1 in opening interrupt the pick up circuit for relay *N. Contacts on relay *N energize the loading light *69 for car C in a manner similar to that described for the other cars. If we assume now that 6 seconds later car A leaves the floor, its relay L becomes deenergized when brush 141 leaves segment 129. Relay O becomes deenergized through contact L3 opening and relay J becomes energized through contact L1 closing. Relay K remains energized through a self-holding circuit established by its contact K2, and the up start light 70 remains illuminated.

Thirty seconds from the start of the sequence, contact TM3 closes for the second time and energizes relay P which retains itself energized through the self holding circuit. At forty seconds after the start of the sequence, contact TM1 reopens the second time, and contact TM2 closes. Contact TM2 in closing energizes coil V and deenergizes coil P as described previously. The timing motor now reopens contact TM2 and recloses contact TM1. In response to contact TM1 closing, relay *O becomes energized through a circuit similar to that described for relay O and car C receives a start up light. Car C in leaving the floor deenergizes relay *O.

So far, in the sequence being described car A arrived and received a normal dispatching signal, car B arrived shortly after car A and before contact TM3 had closed and received an immediate dispatching signal. Car C arrived before car A had received its dispatching signal but after contact TM3 had closed and car C was held for the subsequent dispatching interval. As we have assumed no other cars arriving at the floor, when car C leaves there will be no car at the dispatching floor. This is a condition which will occur occasionally when the demands on the elevator system at floors other than the first floors are so heavy that no car will have returned to the first floor. If another car should arrive before the next dis-

patching signal is given, it would receive an immediate loading light similar to that described for car A and at the end of the timing interval would receive a start light.

5 However, if we assume that the demands on the elevator system are so heavy that this car is delayed beyond the time when the next dispatching signal is given, the dispatching signal will be stored and the car arriving late will be
10 given an immediate start signal. This results in a car leaving the first floor as near on schedule as possible under the existing conditions. The action will be as follows: At 50 seconds from the beginning of the sequence contacts
15 TM3 will close for the third time energizing relay P. At 60 seconds, the timing motor will open contact TM1 and close contact TM2 for the third time. Closing contact TM2 will pick up relay V and drop out relay P as described
20 previously. The reclosing of contact TM1 will not cause an N relay to pick up as no car is at the floor. Therefore, relay V will remain energized through its self holding circuit established by contact V2, until a subsequent car
25 arrives. Assume that at 66 seconds, car B returns to the first floor, it will energize its relay BL which in picking up will deenergize relay BJ and will energize relay BN (Fig. 5) through a circuit extending from L— through contacts
30 BL1, BO1, coil BN, contacts BN2, *N1, BN1, N4, *Q1, BQ1 and Q2 to L+. Relay BN in picking up establishes a self holding circuit through its contact BN3 and contact N6 and resistance 160. It also opens its energizing circuit by opening contacts BN1 and BN2. As
35 contact TM1 has closed and relay V is in the energized position, a circuit will be provided immediately for energizing relay BO extending from L+ through contacts TM1, V1, N8, BN5, coil BO and contact BL1 to L—. When relay
40 BN picks up, it closes a circuit for the loading light B59 through its contact BN10. However, relay BO in picking up deenergizes contact BN by opening contact BO1, relay BN therefore
45 drops to the deenergized position and extinguishes the loading light. At the expiration of the 2 second time element of relay BJ, its contacts closes and provides a circuit for energizing relay BK extending from L— through
50 contacts BQ5, BN11, BJ1, BW9 and coil BK to L—. Relay BK in picking up causes the start up light B70 to illuminate and car B prepares to leave the floor.

The above sequence demonstrates how my
55 dispatcher will cause cars to leave the dispatching floor at regular intervals determined by a dispatching timer; how a car arriving when another car is waiting for its dispatching signal will receive an immediate dispatch signal
60 if it arrived more than a certain percentage of the timing interval before the first car is scheduled to leave; how it will be held for a subsequent timing interval if it arrives less than a certain percent of the timing interval
65 before the first car is scheduled to receive its dispatching signal; and how a car arriving late at the dispatching floor for a dispatching signal will be advised to leave as soon as possible.

While the illustrated example constitutes one
70 specific embodiment of my invention, I realize that modifications can be made without departing from the spirit of my invention and I do not desire to be limited to the precise construction described, except as defined in the ap-
75 pended claims.

I claim as my invention:

1. In a control system for operating a plurality of elevator cars past a plurality of floors, car-attendant actuated means associated with each car, passenger-actuated control means associated with each floor common to all the cars and means associated with each car responsive to the conjoint operation of the associated car-attendant actuated means and the common passenger-actuated means for starting the cars, and means responsive to the operation of any passenger-actuated control means to start one car immediately in response to an operation of the said car's attendant operated means and to start a second car in response to said second car's attendant operated means at the expiration of a predetermined time.

2. In a control system for operating a plurality of elevator cars past a plurality of floors, car attendant actuated means associated with each car, passenger actuated control means at each floor common to all the cars, and means associated with each car responsive to the conjoint operation of the associated car attendant actuated means and the common passenger actuated means for starting the cars, and means responsive to the operation of any passenger actuated control means to start one car immediately in response to an operation of said car's attendant actuated means and to start a second car in response to said second car's attendant actuated means at the expiration of a predetermined time, car attendant actuated switches on each car each associated with a different floor, and means associated with said second car conjointly responsive to said second car's attendant actuated switches and said attendant actuated means for starting said second car immediately regardless of the expiration of said predetermined time.

3. In a control system for operating a plurality of elevator cars past a plurality of floors, car-attendant actuated means associated with each car, passenger-actuated control means associated with each floor common to all the cars and means associated with each car responsive to the conjoint operation of the associated car-attendant actuated means and the common passenger-actuated means for starting the car, and means responsive to the operation of any passenger-actuated control means to start one car immediately in response to an operation of the said car's attendant operated means and to start a second car in response to said second car's attendant operated means at the expiration of a predetermined time, and means responsive to the operation of more than one passenger-actuated control means to start one car immediately in response to said car's attendant-operated means and to start a second car in response to an operation of said second car's attendant-actuated means at the expiration of a predetermined shorter time than said first mentioned time.

4. In a signalling system for dispatching a plurality of elevator cars from a selected dispatching floor, a signalling device associated with each car, said device comprising a preparatory signal and a dispatching signal, means responsive to the arrival of one car at the selected floor for operating the preparatory signal associated with said car and responsive to the arrival of a second car for operating the dispatching signal associated with said second car.

5. In a signalling system for dispatching a

plurality of elevator cars from a selected dispatching floor, a timing mechanism for automatically operating a circuit controlling contact at predetermined intervals of time, a signalling device associated with each car, said device comprising a preparatory signal and a dispatching signal, means responsive to the arrival of one car at the selected floor for operating the preparatory signal associated with the car and responsive to the arrival of a second car for operating the dispatching signal associated with said second car in the event that less than a predetermined part of the time between successive operations of the timer contact has elapsed at the time of the arrival of the second car.

6. In a signalling system for dispatching a plurality of elevator cars from a selected dispatching floor, a timing mechanism for automatically operating a circuit controlling contact at predetermined intervals of time, a signalling device associated with each car, said device comprising a preparatory signal and a dispatching signal, means responsive to the arrival of one car at the selected floor for operating the preparatory signal associated with the car and means responsive to the arrival of a second car for preventing the operation of the signals associated with said second car in the event that more than a predetermined part of the time between successive operations of the timer contact has elapsed.

7. In a signalling system for dispatching a plurality of elevator cars from a selected dispatching floor, a timing mechanism for automatically operating a circuit controlling contact at predetermined intervals of time, a signalling device associated with each car, said device comprising a preparatory signal and a dispatching signal, means responsive to the arrival of one car at the selected floor for operating the preparatory signal associated with the car and means responsive to the arrival of a second car for preventing the operation of the signals associated with said second car in the event that more than a predetermined part of the time between successive operations of the timer contact has elapsed, and means responsive to the arrival of a third car at the dispatching floor for operating the dispatching signal of said third car regardless of the time of arrival of the said third car with respect to the operation of the said timer contact.

8. In a control system for operating a plurality of cars past a plurality of floors, means to start all of the cars, stop control means common to all the cars at one of the floors, a signal device associated with each car at each floor effective to indicate direction of car travel, means responsive to an operation of said stop control means to cause a stopping of one of said cars at said floor and to operate the signal device associated with said car at said floor to indicate the preferred direction of motion of the car in leaving said floor, and means responsive to said operation of said stop control to cause a stopping of a second car at a different floor without causing an operation of the signal device associated with said second car at said different floor.

9. In a control system for operating a plurality of cars past a plurality of floors, means to start all the cars, stop control means common to all the cars at one of the floors, a signal device associated with each car at each floor, effective to indicate the direction of car travel,

a signal device associated with each car effective to indicate direction of car travel, means responsive to an operation of said stop control means to stop the first car to arrive at said floor and to operate said signal devices to indicate on the car and at the floor the preferred direction of said car in leaving the floor, and means responsive to said first car stopping to stop a second car at a different floor without operating said signal devices for said second car.

10. In a control system for a plurality of elevator cars operating past a plurality of floors, control means associated with each floor effective to control the starting and stopping of the cars, means responsive to the operation of one of said controls for starting all cars and for stopping the first car to arrive at said floor and for biasing said car to start in a predetermined direction thereafter and automatic means for rendering said bias ineffective after a predetermined time.

11. In a control system for operating a plurality of elevator cars past a plurality of floors, an up control switch and a down control switch associated with each floor for controlling the starting and stopping of all the cars, car attendant actuated means associated with each car for controlling the starting of the cars, means associated with each car responsive conjointly to an up-switch at one of the floors and the associated attendant actuated means to start the associated cars towards said floor, to stop the car first to arrive at said floor, and to bias said car for a predetermined time to start only in an up direction in response to the conjoint operation of either an up or a down control switch for a floor higher than said first-mentioned floor and the attendant actuated means for said car, and means for rendering said bias ineffective after the expiration of said predetermined time so that said car can start in either direction in response to the attendant actuated means depending on the relative location of the floor for which an up or a down control switch is subsequently operated.

12. In a control system for operating a plurality of elevator cars past a plurality of floors, a passenger actuated switch at each floor, a self-holding electromagnetic switch associated with each passenger operated switch responsive to an operation of said switch for becoming energized, means responsive to the energization of one of said electromagnetic switches for starting all the cars towards the associated floor and for slowing down the first car to arrive within a predetermined distance of said floor, means responsive to the slowing down of said car at said floor for deenergizing said electromagnetic switch, and means responsive to the deenergization of said switch for causing a slowdown of the other cars.

13. In a control system for operating a plurality of elevator cars past a plurality of floors, an up control switch and a down control switch associated with each floor, means associated with each car responsive to operated control switches for starting said car towards any floor for which a control switch has been operated and for causing said car to respond to up control switches on its up motion and down control switches on its down motion by stopping at the associated floors provided said switch has not been responded to by some other car since its last actuation, means associated with each car for continuing said car's motion in starting

after each stop in said car's last direction of motion until said car reaches the floor farthest in its direction of motion for which either an up switch or a down switch has been operated but not responded to by some other car since its last actuation, and for causing said car to respond to said last-mentioned switch, and means associated with each car for causing it to start in the opposite direction on the subsequent start in response to unresponded to switches in the rear of the car's original direction of motion.

14. In a control system for operating a plurality of cars past a plurality of floors, a plurality of stopping switches one associated with each floor, means responsive to the operation of any one of said switches for starting one car immediately and for starting another car after a predetermined time, and means responsive to the operation of said switch for stopping said first of said cars to arrive at said floor.

15. In a control system for operating a plurality of cars past a plurality of floors, a plurality of stopping switches one associated with each floor, means responsive to the operation of any one of said switches for starting one car immediately and for starting another car after a predetermined time, additional means to start said second car before the expiration of said time, and means responsive to the operation of said switch for stopping the first of said cars to arrive at said floor.

16. In a control system for a plurality of elevator cars operating past a plurality of floors; an up switch and a down switch at each of said floors effective to control the starting and stopping of the cars; means responsive to operation of a control switch for starting all the cars, means individual to each car and responsive to the operation of either control switch at one of the floors to stop the associated car at said floor; means for causing the operation of the stopping means for but one of the cars approaching the floor, said means effective to stop said car regardless of its direction of travel provided no other control switch is operated at any floor beyond said floor in the direction of travel of said car, and means for preventing the operation of said stopping means for the other cars in response to the operated control switch until after the first named car has stopped at the landing.

17. In a control system for a plurality of elevator cars operating past a plurality of floors; an up switch and a down switch at each of said floors effective to control the starting and stopping of the cars; means responsive to operation of a control switch for starting all the cars, means responsive to the operation of an up control switch at one of the floors to stop one of said cars depending on the relative positions of said cars, said means effective to stop said car regardless of its direction of travel provided no other stop switch is operated at any floor beyond said floor in the direction of travel of said car, and means for preventing the stopping of the other cars at said floor in response to the operation of said up control switch until after the first named car has stopped at said floor.

18. In a control system for a plurality of elevator cars operating past a plurality of floors; an up stop switch and a down stop switch at each of said floors, means responsive to operation of the stop switches for starting the cars, means responsive to the operation of an up stop

control at one of the floors to stop one of said cars depending on the relative positions of said cars, said means being effective to stop said car regardless of its direction of travel provided no other stop switch is operated at any floor beyond said floor in the direction of travel of said car, said means also being effective to cause the preferred direction of the next start of said car to be in the up direction, and means for preventing the stopping of the other cars at said floor in response to the operation of said up stop control until after the first named car has stopped at said landing.

19. In a control system for a plurality of elevator cars operating past a plurality of floors; an up stop switch and a down stop switch at each of said floors, means responsive to operation of the stop switches for starting the cars, means responsive to the operation of an up stop control at one of the floors to stop but one of said cars depending on the relative positions of said cars, said means effective to stop said car regardless of its direction of travel provided no other stop switch is operated at any floor beyond said floor in the directions of travel of said car, said means also effective to cause the preferred direction of the next start of said car to be in the up direction provided said next start is initiated within a predetermined time.

20. In a control system for operating an elevator car past a plurality of floors, the combination; an up and a down switch at each floor; means responsive to said switches for starting the car in either direction; means movable in accordance with movements of the car and means responsive to operated switches of said switches and said movable means for determining in which direction the car will start from any floor; an up signal and a down signal at each floor; and means operably responsive to said operated switches and said movable means for operating only the signal at the floor where the car is stopped, said signal being the one which indicates the next direction of start.

21. In a control system for operating an elevator car past a plurality of floors, in combination, an up and a down switch at each floor; means responsive to said switches for starting the car in either direction; means movable in accordance with the motion of said car; an up signal and a down signal at each floor; means responsive to an operation of a down switch at any one of said floors and to the movable means to slow down and stop said car at the associated floor while said car is on an up trip and to operate only the down signal associated with said floor while the car is slowing down to stop at said floor.

22. In a control system for operating an elevator car past a plurality of floors, in combination, an up and a down switch at each floor; means including said switches for starting the car in either direction; means movable in accordance with the motion of said car; an up signal and a down signal at each floor; means responsive to an operation of a down switch at any one of the floors and to the movable means to slow down and stop said car at the associated floor while said car is on an up trip and to operate only the down signal associated with said floor while the car is slowing down to stop at said floor; and additional means to prevent said down signal from being operated in the event that both the up and down switches at said floor have been operated.

23. In a control system for operating an elevator car past a plurality of floors; an up passenger actuated control means and a down passenger actuated control means at each floor; car attendant actuated means associated with the car, starting means responsive to the conjoint operation of either one of the passenger actuated control means at one of the floors and the attendant actuated means for starting the car from any other floor towards said floor; means movable in accordance with the position of the car; slow-down and stopping means responsive to the conjoint operation of said passenger actuated means and said movable means to slow down and stop said car at said floor; a signal device at the floor effective to indicate direction of car travel; means responsive to the down passenger actuated control means to bias the starting means to the down direction when the car slows down on an up trip in response to an operation of said down passenger actuated means, and to operate the down signal at said floor while the car is slowing down.

24. In a control system for operating an elevator car past a plurality of floors; passenger actuated control means at each floor and means controlled thereby for starting the car; means responsive to operated passenger actuated means for determining the direction of starting; means movable in accordance with movements of the car; an up signal device and a down signal device at each of said floors; slow down and stop means responsive to the movable means and the passenger actuated means at one of the floors for slowing down said car and stopping it at said floor, and means responsive to said operated passenger actuated means for operating only one of the signal devices said device being one of those located at the floor corresponding to the said operated means and being that one which corresponds to the direction of the next start as determined by the said direction determining means.

25. In a control system for operating an elevator car past a plurality of floors; an up and a down switch at each floor; a switch for each floor on the car; means for starting the car; means responsive to operated switches for determining the direction of start; means movable in accordance with the movements of the car; means for slowing down and for stopping the car responsive to the movable means and any operated switch for stopping the car at the associated floor regardless of its direction of travel in the event that no switches are operated for floors beyond said floor in the direction of the car's motion; an up signal device and a down signal device at each of said floors; an up signal device and a down signal device on the car;

a circuit for each of said signal devices; said circuits being responsive to the said direction preference means for operating the signals corresponding to the next direction of start, and responsive to the movable means and the slow-down means for operating only the floor signal of the floor at which said car is decelerating.

26. In an elevator control system for operating a car past a plurality of floors; switches at each floor; switches on the car for each floor; means responsive to said switches for starting the car and stopping it at the floors corresponding to the operated switches including direction preference means for continuing upward motion of the car as long as there are operated switches for floors above the position of said car; a signal device on said car; means responsive to said direction preference means for operating said signal device; dispatching mechanism for giving timed impulses at intervals; and means responsive to the position of said car at one of the floors for rendering said signal device responsive to said dispatching mechanism.

27. In a control system for operating an elevator car past a plurality of floors, the combination; passenger actuated control means at each floor; car attendant actuated means on the car; means operably responsive to said control means including a plurality of pairs of normally closed contacts connected in series circuit, there being two pairs of contacts for each of said control means; and means for starting the car, said starting means being operably responsive to said series circuit means for determining the direction of movement and to said attendant actuated means for starting the car.

28. In a control system for operating an elevator car past a plurality of floors, the combination; passenger actuated control means at each floor, car attendant actuated means on the car; means operably responsive to said passenger actuated control means including a plurality of normally closed contacts connected in series circuit, there being two contacts for each passenger actuated control means; a signal device on the car, effective to indicate direction of car travel; said signal device being operably responsive to said series circuit means for causing an indication to be given.

29. In a control system for operating a plurality of cars past a plurality of floors, passenger control devices at the floors, means responsive to operation of a passenger control device for starting the cars, and means responsive to the number of operated passenger control devices for determining the time delay between the starting of the cars in accordance with the number of operated control devices.

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