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ELEVATOR DISPATCHING AND CONTROL SYSTEM

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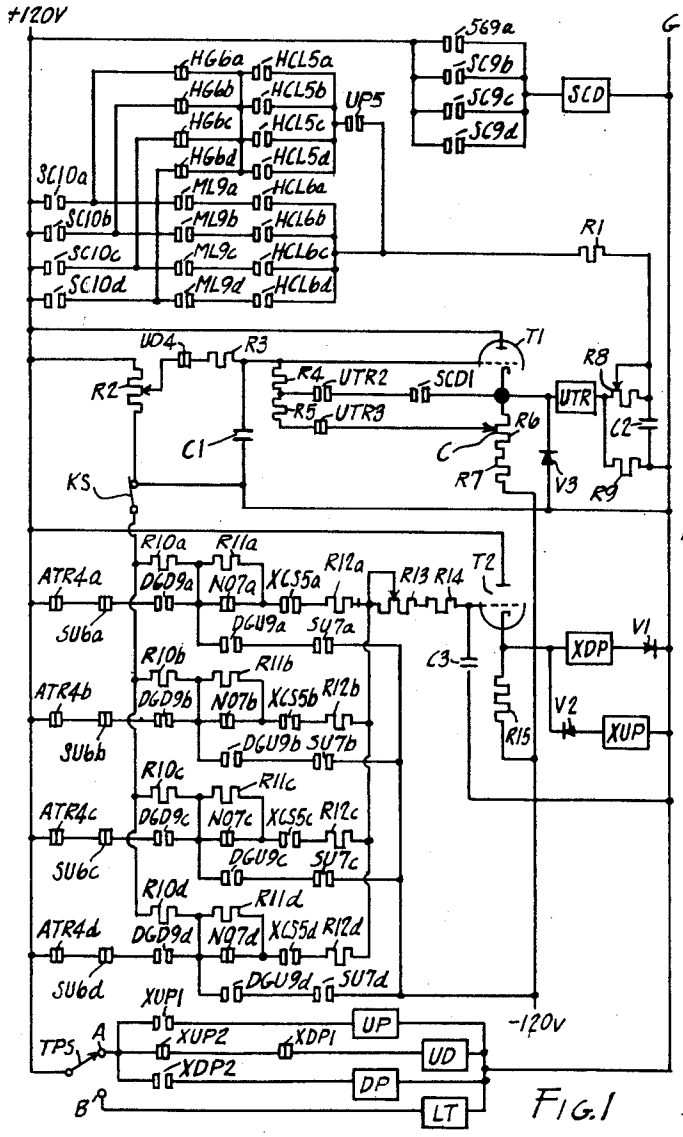


FIG. 1

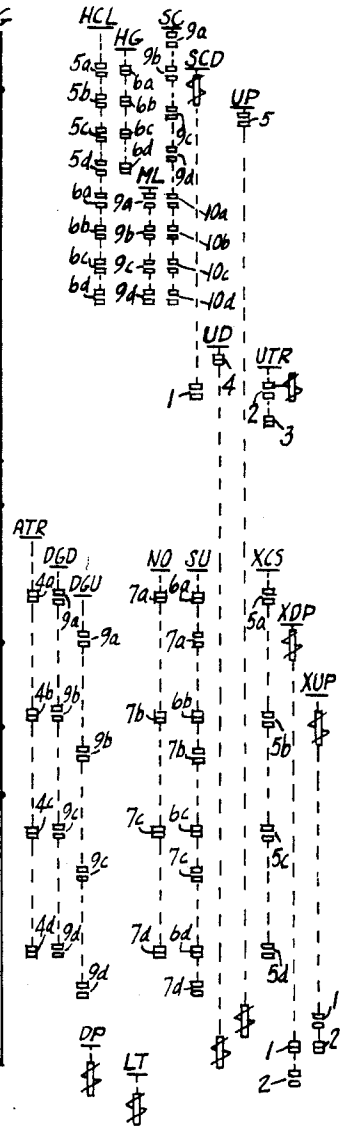


FIG. 1a

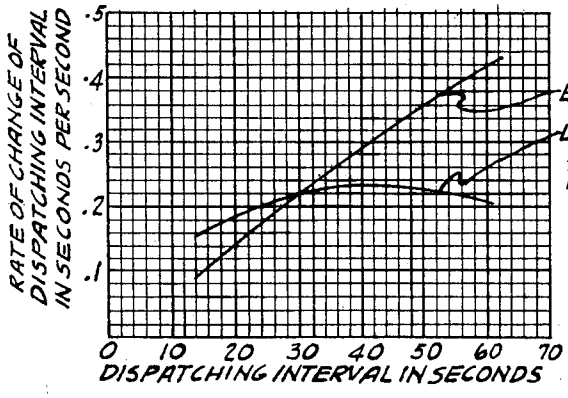


FIG. 2

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ELEVATOR DISPATCHING AND CONTROL SYSTEM

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The invention relates to control systems for elevators operating together as a group.

In plural elevator installations, it is usual to co-ordinate and control the movement of the elevator cars. In such systems, the cars are arranged to be operated in accordance with predetermined operating programs which are calculated best to serve the different traffic conditions. Occasionally the selection of the program by which the cars are to operate is made manually in accord with the observations of the starter or someone charged with that duty. More frequently, the change is made automatically as the traffic demand varies.

Dispatching apparatus is also usually provided in such plural elevator installations, to aid in co-ordinating the operation of the cars. This apparatus selects which of the several cars will be the next to start its trip and generates timed intervals by which the successive starts are separated. The cars are dispatched on their upward trips from the lower dispatching landing, usually the lobby of the building, and are dispatched on their downward trips either from the top terminal landing or from some landing below that terminal. Since the time interval between successive trips is not uniform as between the various operating programs, or, for that matter, during the same program, it is customary to provide some means or mechanism to adjust its duration.

It is, therefore, an object of the invention to provide mechanism for automatically selecting a program of operation, during conditions of substantial traffic, in accordance with the requirements of that traffic.

Another object of the invention is to provide mechanism for automatically controlling the dispatching time interval in accordance with variations in traffic conditions.

One feature of the invention involves automatically selecting from several operating programs, each of which is predetermined to be best suited to a particular traffic pattern, the particular program best suited to the traffic conditions then existing as measured by a comparison of the travel time of the cars for the two directions of movement and the loads in these cars.

Another feature of the invention involves co-ordinating and controlling the operation of the cars, under conditions where the cars are timed dispatched from a dispatching landing, by automatically adjusting the dispatching time interval in accordance with how early and how late the cars are in arriving at that landing.

The invention is useful in a system in which any one of several predetermined programs which govern the movements of the cars is to be selected for use at a given time—the particular operating program which is selected depending upon the actual traffic conditions which exist at that time. These traffic conditions may be measured in terms of a number of factors. In a preferred embodiment, either or both the travel time of the cars and the load being carried by the cars may be measured as an indication of the then existing traffic. Thus the load in upwardly moving cars may be compared to that in the downwardly moving cars or, the elapsed time since leaving the lower terminal of all upwardly moving cars may be compared to the elapsed time since leaving the terminal of all downwardly moving cars. Optionally, both the time and the load factors may be combined as a measurement of the existing traffic.

In either method of calculation, when the total measured quantity of the upwardly moving cars exceeds that of the downwardly moving cars by a predetermined amount, the system operates to select an operating program adapted to care for the upwardly moving traffic. Conversely, if the net differential between the measured factors is in favor of the downward direction, the system operates to select an operating program which facilitates the movement of passengers in the downward direction. For those periods in which the net difference between the upward and downward traffic measurements do not exceed one another by a predetermined amount, the system operates to select an operating program which is adapted to handling traffic equally well in both directions of movement.

If desired, the standing of the cars at the dispatching landings awaiting their dispatch may be given effect by reducing the net differential between the measured traffic indications.

In a system such as is being described, it is customary to provide a mode of operation which is especially adapted to night service or intermittent traffic. This period is usually characterized by a scarcity of traffic requirement for either direction of travel. Although it forms no especial part of this invention, in a system as is here concerned, the transfer from an appropriate operating program to the intermittent service or night program may be made either by manual means or by any one of other available means, such as, for example, the recognition that no service demand has existed for a predetermined time. For purposes of simplicity, such transfer has been illustrated herein as being made manually by means of switch TPS being moved into position B.

In any such system it is to be expected that the demands made upon the system will fluctuate from time to time, thereby requiring a greater or lesser amount of time for the cars to make their round trips. Under such conditions, it is desirable that the dispatching interval, which separates adjacent cars in their departure from the terminal, may be varied to compensate for these fluctuations. In the system of this invention, this variation in the dispatching interval is made in accordance with whether the cars are late or early with respect to the expiration of their respective dispatching intervals in their arrival at the dispatching landing. This determination is made continually; that is, for each car and each determination is given a continuous effect until the subsequent determination is made. The effect of each determination in lengthening or shortening the dispatching interval depends upon the amount by which the car was early or late as well as the magnitude of the dispatching interval then existing. Furthermore, the dispatching interval is lengthened or shortened continuously throughout the time during which the car is late or early, respectively.

In the preferred embodiment, when the dispatching interval is what is considered a "normal" interval, say 30 seconds, a car arriving early decreases the interval at the same rate that that car would increase the interval had it arrived late. After the interval has already been shortened from the "normal" value by cars which have arrived early, a car subsequently arriving late will increase the dispatching interval at a greater rate than would that car have decreased the interval had it arrived early. Conversely, when the dispatching interval has already been lengthened from the "normal" value by cars which arrived late, a car subsequently arriving early decreases it at a faster rate than would that car have increased the interval had it been late.

In the description which follows, the pertinent parts of an elevator system incorporating the invention will be described with reference to previously known systems.

In general, these references will be with respect to the systems of Glaser Patent No. 2,589,242 and Glaser and Lusti Patent No. 2,682,318. Reference to the systems of these patents is made in order to facilitate an understanding of the invention in an operative elevator system and for that reason, the disclosure of these patents is incorporated herein, by reference. Reference will be made to these systems merely for the operating result that may be obtained in an elevator system when an appropriate control is operated in accordance with the invention to be described. Thus, for example, when the operation of the invention herein results in the actuation of a switch, for example, the up peak traffic switch UP, the effect of that actuation may be visualized by reference to the effect that is obtained in the system of Patent No. 2,682,318 by the actuation of the like designated traffic switch therein or in Patent No. 2,589,242 by the actuation of its up peak traffic switch (which, in this case, happens to be designated VPU).

Features and advantages of the invention will be seen from the above, from the following description of the operation of the preferred embodiment when considered in conjunction with the drawings, and the appended claims.

In the drawings:

FIGURE 1 is a simplified schematic wiring diagram of the automatic program selection circuits and the up dispatching timer circuits;

FIGURE 1*s* is a spindle sheet for use in side-by-side alignment with FIGURE 1 for locating the coils and contacts in FIGURE 1; and

FIGURE 2 is a graphic representation of how the dispatching interval is varied by early or late cars.

In the explanation which follows, and in the drawings, reference is made to the contacts only of certain relays or switches. This is done for purposes of simplification of explanation. These relays or switches and their designations are:

ATR—Auxiliary time relay
DGD—Auxiliary down direction switch
DGU—Auxiliary up direction switch
HCL—Up dispatching relay
HG—Highest car call switch
ML—Main landing switch
NO—Non-stop relay
SC—Selection relay
SU—Spacing relay
XCS—Dispatching removal relay

These correspond to like designated relays or switches of Glaser and Lusti Patent No. 2,682,318 to which reference should be made for their complete circuit diagrams and a complete description of the circumstances under which the coils are energized or de-energized. In the description which follows the complete circuit for these coils will not be described but reference will be made to the operation of the elevator which results in the energization or de-energization of each coil and the actuation of its contacts.

In the wiring diagram, identifying letters are applied to the coils of the electromagnetic switches and relays and, with reference numerals appended thereto, are applied to the contacts of the switches and relays to differentiate between different sets of contacts on the same switch or relay, all contacts being shown for the unoperated condition of the switch or relay.

Differentiation will be made between the circuits for the different elevators by appending to the characters employed to designate various elements of the system, lower case letters "*a*," "*b*," "*c*" or "*d*," as indicative of the different elevators.

Unidirectional power of positive and negative polarity from a 120 volt source (not shown) is supplied to the circuits of FIGURE 1. Resistors are designated generally as R, capacitors are designated generally as C and rectifiers are designated generally as V. T1 and T2 designate electron triode tubes and both may be in one tube envelope, such as the double triode type 6SN7, each triode having control grid, anode and cathode electrodes. +120 volts is applied to the anode circuits of each tube, while −120 volts is applied to their respective cathode circuits. KS and TPS designate manual switches.

For a 120 volt supply and for the type of electronic tube specified, the following ohmic values of resistors and capacities of condensers in the electronic circuits have been found satisfactory:

Resistors

R1	ohms	250	R9	ohms	50,000
R2	do	100,000	R10	do	47,000
R3	do	50,000	R11	do	120,000
R4	megohms	1.8	R12	do	220,000
R5	do	3.6	R13	megohms	5.0
R6	ohms	10,000	R14	do	5.0
R7	do	60,000	R15	ohms	60,000
R8	do	10,000			

Condensers

C1	microfarads	10
C2	do	500
C3	do	10

Capacitors designated C1 and C3 are, preferably, of the paper insulated type which characteristically allow less leakage current to escape than the electrolytic type.

An understanding of the invention can best be gained from a description of the sequences of operations. Assume that all four cars are in group operation. Under such conditions, the non-stop relay NO and the dispatching removal relay XCS, for each car, are in operated condition, indicating that that car is in service and subject to dispatching. With manual switch TPS in position A, the system is preset to operate according to any one of three programs determined to be best suited for periods of substantial traffic. These programs may be designated as "up peak" for use when substantially all of the traffic is in the up direction, as when the building is being filled; "down peak," to be used when substantially all of the traffic is in the down direction, as when the building is being emptied and "up and down," for use where there is substantial traffic in both directions.

In order to best describe how the automatic program selector continuously measures traffic and, in response to such measurement, automatically selects the program previously determined to be best suited for the existing traffic conditions, first will be described its response to one car, say car *a*, as it is dispatched from the lower dispatching landings, travels to the top terminal and back.

Assume that car *a* is at the lower dispatching landing, set for up travel and has been dispatched. Under such conditions, auxiliary up direction switch DGU*a* is in operated condition, indicating that car *a* is set for up travel and auxiliary time relay ATR*a* is in released condition, indicating that the car has been dispatched. As car *a* leaves the dispatching landing, spacing relay SU*a* operates and remains operated until the car reverses its direction of travel to down.

Relay SU*a* engages its contacts SU7*a*, completing a negative charging circuit for grid condenser C3 from the −120 volt supply through contacts SU7*a*, DGU9*a*, resistor R11*a*, contacts XCS5*a*, resistors R12*a*, R13, R14 and grid condenser C3 to line G. Resistors R13 and R14 exert a limiting influence to restrain this charge to a predetermined slow rate.

Incident to the car arriving at the top terminal, auxiliary time relay ATR*a* operates, separating its contacts ATR4*a*. As car *a* arrives at the top terminal and becomes conditioned for travel in the down direction, auxiliary down direction switch DGD*a* operates, engaging its contacts DGD9*a* and spacing relay SU*a* releases, engaging its contacts SU6*a*, without effect at this time. Relay SU*a* also separates its contacts SU7*a* to interrupt the negative

charging circuit of grid condenser C3. Switch DGU*a* releases, separating contacts DGU9*a*, without effect at this time.

While car *a* is at the top terminal landing, awaiting dispatching downward, grid condenser C3 discharges at a predetermined slow rate through resistors R14, R13 and R12*a*, contacts XCS5*a*, resistors R11*a*, R10*a* and manual switch KS to ground.

As auxiliary time relay ATR releases to initiate starting of car *a* in the down direction its contacts ATR4*a* engage, completing a positive charging circuit for grid condenser C3 through contacts ATR4*a*, SU6*a*, DGD9*a*, resistor R11*a*, contacts XCS5*a*, resistors R12*a*, R13 and R14. Grid condenser C3 slowly charges positively at a predetermined rate and continues to do so, until the car arrives at the lower dispatching landing. Incident to the car arriving at the lower dispatching landing, relay ATR*a* operates, separating its contacts ATR4*a*, thereby interrupting the positive charging circuit for grid condenser C3.

Incident to the car becoming conditioned for up travel from the lower dispatching landing, switch DGD*a* releases and switch DGU*a* operates separating contacts DGD9*a* and engaging contacts DGU9*a*, respectively. This is without effect at this time, since contacts SU7*a* of the spacing relay are separated and will remain separated until the car leaves the lower dispatching landing.

As at the top terminal, while car *a* remains at the lower dispatching landing, awaiting dispatching, grid condenser C3 discharges to ground at a predetermined slow rate through the previously traced discharge circuit.

From the foregoing it will be seen that while the car is on its "up" trip condenser C3 is subjected to a charge from the −120 volt source. Conversely, when the car is on its "down" trip the condenser is subject to charge from the +120 volt source. Also, during the time the car is standing at the upper or lower terminal the condenser receives neither negative nor positive charge, but, rather, is discharged toward ground potential. This charging, either positively or negatively or the discharging toward ground potential is made possible by the common connection to each in the circuit of condenser C3 which exists at the junction of contacts DGU9*a*, DGD9*a*, NO7*a* and resistors R10*a* and R11*a*. This arrangement is hereinafter sometimes referred to as differential measuring or integrating means.

From FIGURE 1 it will be seen that identical circuits, such as have been described for car *a*, exist for cars *b*, *c* and *d* and are independent to the point that their condition at any given instant is dependent only upon the position and direction of movement, if any, of the associated car and not upon the condition of one of the conjugate circuits. These individual car circuits are connected in parallel at the junction of resistors R12*a*, *b*, etc. and R13. Thus it will be appreciated that the condenser C3 is subjected to negative charging potential by all upwardly moving cars, is subjected to positive charging potential by all downwardly moving cars and is discharged toward ground potential by all cars while they are standing at one or the other of the terminals.

The charging rate of condenser C3 is made responsive to the load in each car, irrespective of its direction of movement, by the action of contacts NO7 which are associated with the load weighing switch actuated by the load in the respective car. These contacts when moved to their closed position short-circuit resistor R11 to increase the charge rate of the condenser. Although, for purposes of simplicity, only a single load-activated pair of contacts NO7 are described, if desired a series of such contacts, each of which is actuated for different load conditions, can be provided to short-circuit progressively larger portions of resistor R11 as the load increases. It may be worth noting that each resistor R11*a*, *b*, etc. is in the common portion of the charging circuit for each car to condenser C3, such that the effect of a load in an upwardly moving car may be offset by the effect of a similar load in a downwardly moving car.

From the foregoing it will be understood that the polarity and amount of charge on condenser C3, and on the control electrode of vacuum tube T2, is the algebraic summation of the charges resulting from all cars in service at any time regardless whether moving or standing. An excess of positive charge is indicative of an excess of time required for the down trips and the direction in which the load in the cars predominates and is a measure of the downwardly moving traffic. Similarly, an excess of negative charge is an indication of the magnitude of the upwardly moving traffic. Through the action of manual switch KS these results can be made responsive to cars standing at the terminal or not, as desired.

The determination of traffic movement is gainfully employed through the action of program selection switches XDP and XUP to select a predetermined operation program appropriate for the then measured traffic. The coils of program selection switches XDP and XUP are connected through rectifiers V1 and V2, respectively, between the cathode electrode of tube T2 and ground to cause switch XDP to operate when the potential at the cathode electrode of tube T2 becomes positive a certain amount with respect to ground and switch XUP to operate when the potential at the cathode electrode becomes sufficiently negative with respect to ground. Thus, as down moving traffic predominates and the potential on capacitor C3, and the control electrode of cathode-follower tube T2, becomes sufficiently positive, the coil of program selection switch XDP becomes sufficiently energized (as the cathode electrode follows the control electrode in the positive direction) to cause this switch to close its contacts XDP2 in the circuit of down peak switch DP and open its contacts XDP1, in the circuit of up and down switch UD. This action places the elevators on the down peak program and "locks-out" the up and down program.

Conversely, as the down peak of traffic subsides the charge on capacitor C3 becomes less positive to a point where the potential of the cathode electrode is no longer sufficient to maintain switch XDP in its operated condition. This switch releases separating its contacts XDP2 to take the system off of "down peak" operation, and it closes its contacts XDP1 which in conjunction with contacts XUP2 of now released switch XUP completes an activating circuit for the coil of up and down switch UD. This results in selection of the program predetermined to be best suited for substantially balanced traffic.

If now, it is assumed the balance of traffic shifts to the up direction by a sufficient amount, the potential of capacitor C3 (and the control electrode of tube T2) becomes sufficiently negative to lower the potential of the cathode electrode to a value adequate for the operation of switch XUP. Such operation causes contacts XUP2 to open in the circuit of switch UD and contacts XUP1 to close in the circuit of switch UP. In this way the elevators are removed from the influence or direction of the up and down program and are caused to operate in accordance with the parameters of the up peak program.

If at some later time the traffic reverses its pattern the reverse switching process will occur and either the up and down or up peak program will be selected.

If, perchance, it is desired to select from more than three programs, for example five programs, it is merely necessary to add additional switches, the coils of which become sufficiently energized at graduated voltages intermediate the values which operate switches XDP and XUP. The contacts of the added switches would be inserted in the circuit of the coils of appropriate program switches.

The subject automatic program selector, by continuously measuring the number of cars travelling in a given direction, their load condition and the duration of their travel in that direction, and continuously balancing that

measurement against a like measurement for cars travelling in the opposite direction and, if desired, by reducing any net unbalance by the time during which the cars are standing at the dispatching landings arrives at a summation value which reflects the existing traffic pattern at any given instant in an extremely accurate manner. It then utilizes the measured information to select automatically the particular program of operation for the cars, which program it is deemed will best serve the existing traffic pattern. It will automatically transfer the system to the other predetermined operating programs, as the traffic pattern changes.

In the embodiment that is being described, the cars are dispatched, during the up peak and up and down programs, from the lower dispatching landing at intervals timed from the occurrence of some one or more events.

On the up peak program it is desired that under conditions where the next car to be dispatched is at the dispatching landing when the preceding interval expires, the start of the next interval be delayed until a condition occurs which has been judged to require a car soon to leave the terminal. In this described arrangement this has been taken to be the earlier of either the registration of a call on the selected car's car button or the reversal of the last up travelling car. During this program the timing interval is preferably maintained substantially constant from car to car, although the interval between successive departures will vary in dependence upon the happening of the controlling conditions.

On the up and down program it is desired, in the described arrangement, that sufficient time be provided for the cars to complete their round trips and be available when their dispatching time next arrives. The time interval is started by the initiation of the dispatching process; specifically, it is started as the selection for dispatch is transferred from the car that is about to leave the terminal to the one that will follow it. During this program the time required for the cars to move from the lower to upper terminal and to return will increase and decrease as the traffic using them becomes greater or less. In order to maintain dispatching discipline over the cars it is desirable to increase the interval between cars as the traffic increases, thereby allotting greater time for the round trip and to decrease it as the traffic lessens, thereby improving the frequency of service for those wishing to use the cars.

The manner in which the interval timer shown in the upper half of FIGURE 1 accomplishes this dual purpose will be better understood if it is first understood how the potential of the cathode electrode of T1 is caused to increase, decrease or remain substantially constant. This cathode electrode is connected to −120 volts through resistors R6 and R7. Resistor R6 is variably tapped at point C and is connected at that point through normally closed contacts UTR3 to the lower end of serially connected resistors R4 and R5. The electrode end of resistor R6 is connected to the junction of R4—R5 through normally open contacts SCD1 and UTR2. The upper end of resistor R4 is connected to one terminal of capacitor C1 and to one terminal of resistor R3. The junction of resistors R4 and R3 and capacitor C1 is connected to the grid or control electrode of tube T1. The other terminal of resistor R3 is connected through normally closed contacts UD4 to a variable tap on resistor R2, which in turn is connected between +120 volts and ground. The remaining terminal of capacitor C1 is connected to ground potential, thereby placing this capacitor between ground and the voltage dividing resistance network from +120 volts to −120 volts when contacts UD4 of the up and down traffic switch UD are closed by virtue of the relay coil not being energized. This condition exists when the system is operating on the up peak program, during which time the charge on capacitor C1 and the potentials of the control electrode and cathode electrode of tube T1 are virtually constant. The manner in which this constant potential on the cathode electrode produces successive timing intervals of substantially the same duration will be explained shortly in connection with the up peak operating program.

When the system is operating on the up and down program, during which it is intended to shorten or lengthen the succesive intervals to provide for increased or decreased travel time, the contacts UD4 are separated by the energization of the coil of switch UD. When this happens capacitor C1 is no longer charged from the previously described voltage divider, but, rather, is charged from the voltage divider which includes the effective resistance of the anode-cathode circuit of tube T1 and resistors R6, R7. These voltage divider networks and the capacitor C1 are hereinafter sometimes referred to as integrating or continually measuring means.

For the 6SN7 type of tube used in this described embodiment the cathode electrode is about 4 volts positive with respect to its control electrode when its potential is the correct value to produce a normal dispatching interval, for example 30 seconds, as used on the up peak program. This normal relationship between the two electrodes is varied up or down as the length of the round trip travel time of the cars is increased or decreased by traffic. This variation depends upon whether capacitor C1 is being charged from the cathode electrode potential or from that of point C on cathode load resistor R6. This, in turn, depends upon whether the cars are arriving at the dispatching terminal before or after the initiation of the process which results in their being dispatched from the terminal. This is accomplished through the interplay of contacts UTR2, UTR3 and SCD1 as well as the difference in potential between the cathode electrode and point C on resistor R6, which for a normal dispatching interval in this described arrangement is 16 volts. (The potential at point C being 12 volts negative with respect to the control electrode potential.)

As will be later referred to, contacts SCD1 are closed when a selected car is at the dispatching terminal and are open when there is no car at that terminal to be selected. Contacts UTR2 are closed and contacts UTR3 are separated during the timed interval. Upon the expiration of the timed interval these contacts reverse their prior positions, contacts UTR3 closing. Therefore, if a car becomes available and contacts SCD1 close before the interval expires, capacitor C1 is charged toward the potential of the cathode electrode over the charging path including contacts SCD1, UTR2, and resistor R4. This condition exists as the cars arrive "early," before the interval expires. The longer this condition exists the closer the potential on capacitor C1 approaches that of the cathode electrode—which in turn increases as its control electrode rises in potential to produce a shortened interval, as will be explained in connection with the up and down program operation.

Conversely, if no car is available at the terminal for selection after the timing interval expires, the charging circuit is opened at contacts SCD1 and UTR2 and a discharging circuit is closed at contacts UTR3, causing capacitor C1 to discharge toward the potential at point C over the path from point C on resistor R6, contacts UTR3 and resistors R4, R5. When this happens the cars are said to be "late" in arriving at the terminal and the potential of the cathode electrode (and that of point C) becomes progressively lower with respect to ground as the cathode electrode follows the grid electrode to produce an interval that increases in duration, as will be later explained.

In this described arrangement the potential of the cathode electrode can vary between a maximum of +80 volts with respect to ground to a minimum of −3 volts, so measured—this minimum being controlled by the voltage drop in the forward or current carrying direction of the dry plate rectifier V3.

The timing interval for any given condition is determined by the time that is required for the potential across the coil of timing relay UTR to decrease below the "hold-in" or sustaining value for the relay that is used. In this described embodiment this value was about 10 volts; the operating voltage being somewhat greater, say in the neighborhood of 30 volts. This relay's coil is connected between the cathode electrode of tube T1 and the junction of resistors R8—R9 which shunt capacitor C2. Resistors R8 and R9 and capacitor C2 constitute an R-C circuit having a definite "time-constant" which controls the exponential decrease of voltage across the capacitor when the charging voltage is removed. Thus, whenever the difference in potential between the cathode electrode and the junction of resistors R8, R9, between which the coil is connected, exceeds its "operate" value, the relay operates. Conversely, when the charging connection to capacitor C2 is removed, the potential above ground at the junction of R8—R9 starts to decrease at its characteristic exponential rate and when it reaches a value such that the difference between it and that of the cathode electrode is 10 volts or less, the relay releases. From this it will be understood that the length of time the timing relay UTR remains operated after the timing process is initiated depends upon the potential of the cathode electrode. This, in turn, depends upon whether capacitor C1 is being charged from point C on resistor R6, from the higher potential at the cathode electrode or, as on the up peak program, from the voltage dividing circuit which includes the UD4 contacts. As the cars continue to arrive early the cathode potential increases and less time is required for the R-C circuit R8, R9 and C2 to discharge to a value where relay UTR releases. Conversely, as the cars continue to arrive late, the time required to reach this difference voltage is increased, as is the timing interval.

The manner in which this arrangement functions will become more apparent if it is recalled that in the control system of the Glaser-Lusti Patent No. 2,682,318 certain switches and relays are operated incident to the presence of a car at the terminal, the registration of a call in the selected car, the operation or release of the timing relay UTR and the movement of a car toward or away from the top terminal. If it is assumed that the system is energized from an inactive period when all four cars were at rest at the lower terminal, one car, for example car *a*, will be dispatched immediately. This occurs because capacitor C2 has timed out during the inactive period and timing relay UTR has released closing its contacts UTR1*a* in the circuit of up dispatch relay HCL*a*, (see Glaser-Lusti patent) which through the agency of switch ATR is effective to actuate the starting switch SR*a* for car *a*. Capacitor C2 is recharged immediately over the circuit extending from C2 through R1, HCL6*a*, ML9*a*, SC10*a* since the selection of car *a* has not yet been released. Whether or not the charging circuit is maintained depends upon which of the operating programs is in effect. If the up peak program is effective the charging action is maintained, though this circuit is transferred at the time the car selection transfer occurs. If car *b* becomes the selected car, (closing contacts SC10*b*), the new circuit is through contacts SC10*b*, HG6*b*, HCL5*a*, UP5, resistor R1 to capacitor C2 and ground. This circuit is maintained until a car call is registered in car *b* (thereby separating contacts HG6*b*) or car *a* reaches its uppermost point of travel and reverses (which separates contacts HCL5*a*). Whichever occurs first will be effective to open the circuit to capacitor C2 and initiate its discharge cycle.

Contemporaneously, capacitor C1 has charged over the circuit from +120 volts, resistor R2, contacts UD4, resistors R3, R4, R5, contacts UTR3 and resistors R6 and R7 to −120 volts. This circuit is changed to short-circuit resistor R5 and contacts UTR3 as selection relay SCD closes its contacts SCD1 (in response to car *a* or car *b* being selected). Because of the relative magnitudes of the elements in the voltage dividing network the inclusion or exclusion of resistor R5 in the network has no practical effect on the duration of the timing interval. This means that during the up peak program there is virtually no change in the dispatching interval regardless whether cars arrive early or late with respect to the release of timing relay UTR which initiates the dispatching process. During all this process timing relay UTR has been operated by reason of the nearly instantaneous charging of capacitor C2.

As has been previously described, the potential on capacitor C1 and the control electrode of tube T1 determines the potential that will exist at the cathode electrode of that tube to which the coil of timing relay UTR is connected. For operation on the up peak program on this tested embodiment it was decided that a timing interval of about 30 seconds was appropriate. Accordingly, the circuit parameters were chosen such that during this program the cathode electrode was held at a substantially constant value of +28 volts with respect to ground. Just what this voltage would be for any other given circuit configuration would, of course, depend upon the circuit parameters and the voltage that is required across the coil of the up time relay UTR to maintain it operated.

During this up peak program when either a car call is registered in car *b*, or car *a* reverses its direction of travel, the charging circuit to capacitor C2 is interrupted. The capacitor starts discharging toward ground potential and the voltage difference across the coil of timing relay UTR starts decreasing. At such time as the voltage at the junction of resistors R8—R9 reaches a value of approximately +38 volts, the voltage across the coil of relay UTR drops below its hold-in value of 10 volts and relay UTR releases to actuate up dispatching relay HCL*b* for car *b* to initiate its departure on an upward trip. Immediately capacitor C2 is recharged over a circuit comparable to that which has been previously described (since identical parallel circuits are provided for each car) and the selection process is repeated to prepare another car for its dispatching operation after a car call has been registered on its car buttons or all previously up travelling cars have been reversed.

As subsequent cars re-arrive at the lower terminal the charging circuit to capacitor C1 may vary to include or exclude resistor R5 depending upon whether the arrival precedes or follows the release of timing relay UTR but, as has been explained, this change is without substantial effect upon the potential at the cathode electrode of tube T1. For this reason a substantially constant time interval elapses between the happening of the event (car call or car reversal) which initiates the timing interval and the subsequent dispatch of the selected car.

The operation of the circuit which has been described for the up peak program varies from its operation during the up and down program. If it is now assumed that the traffic demands change, the operation of tube T2 in the program selection portion of the circuit (lower half of FIGURE 1) will change in the manner that has been previously described. If this change is such that neither direction of travel predominates and neither the up or down program selection switches XUP and XDP are operated, the up and down program switch UD operates to cause the system to function on the up and down program. Under these circumstances the charging circuit to capacitor C1 is revised by the separation of contacts UD4 in the lead to the +120 volts supply. In the manner which has been previously described the potential on capacitor C1 and the control electrode of tube T1 are now dependent upon whether the charge is derived from the cathode electrode potential or that which exists at point C on resistor R6. Under these circumstances the late or early arrival of cars at the terminal affects the potential of the cathode electrode, the time required for the voltage across the coil of timing switch UTR to de-

crease to its drop-out value and, hence, the duration of the timing interval.

The operation of the described arrangement on the up down program may be visualized, if it is assumed that main landing switch ML*a* is operated, indicating that car *a* is at the lower terminal; that selection relay SC*a* is operated as a result of the selection of this car as the next to be dispatched and up dispatching relay HCL*b* is operated indicating that car *b* has been previously dispatched and is travelling upward. The operation of these relays are as described in the aforesaid Glaser-Lusti patent. Condenser C2 is in its fully charged condition, the charging circuit having extended from C2 and R1 through contacts HCL6*b*, ML9*b* and SC10*b* to the +120 volt supply. The timing interval is initiated by the transfer of selection from car *b* to car *a*, the circuit to capacitor C2 being interrupted because contacts SC10*b* separate and there is no comparable circuit for car *a* since that circuit is open at contacts HCL6*a*. Capacitor C2 starts its discharge and the time that is required for timing relay UTR to release will depend upon the potential at the cathode electrode of tube T1. This cathode potential will in turn depend upon whether the other cars of the group as they arrive at the lower terminal precede or follow the release of timing relay UTR. If the cars arrive and are selected before that relay's release opens its contacts UTR2, the charging voltage to capacitor C1 will be derived from the cathode potential. Conversely, if the cars arrive and are selected after relay UTR has released, which action closes its contacts UTR3 and opens contacts UTR2, the charging voltage will be derived from the lower potential of point C on resistor R6. In this way the time of arrival and selection of each next car to be dispatched during the up and down program is given effect to increase or decrease the timing interval appropriately. The change being to shorten the interval for early arriving cars, since these cars raise the potential of the cathode electrode and decrease the amount by which capacitor C2 must discharge to reach a value which differs from the potential of the cathode electrode by an amount insufficient to hold relay UTR operated. Similarly, late arriving cars decrease the charge on capacitor C1 and the potential of the cathode electrode thereby increasing the time that capacitor C2 must discharge to release timing relay UTR. In the manner which has been previously described the maximum excursions of the potential at the cathode electrode are limited in this described embodiment between the values of approximately +80 volts (at which point the potential difference between the cathode and grid electrodes is substantially zero) and −3 volts (which represents the internal drop in the forward direction of rectifier V3 shunted between the cathode electrode and ground).

It is worthy of note that the change in interval per second of earliness or lateness in arrival while continuous is not uniform. That is to say, the effect of an "early" car's arrival after a protracted period of "late" cars is greater than would have been the case had the car merely been another "late" car. The converse of this is also true. This comes about because of the exponential character of the charging and discharging cycles of capacitors C1 and C2, the fact that capacitor C1 does not always start its charge or discharge from the same potential and has different time constants for its charging paths as well as the fact that the potential difference between the control and cathode electrodes of tube T1 does not remain at 4 volts as their potentials vary from those corresponding to the normal interval. It will be recalled these potentials were about +24 and +28 volts, respectively, for that interval.

In FIGURE 2 there are displayed two curves which show the effect of earliness or lateness for varying time intervals (corresponding to varying cathode potentials). From these curves it will be seen, for example, that when the interval has been lengthened to 40 seconds the effect of an additional late car is further to increase the interval at the rate of .23 second for each second of lateness; whereas, the effect of an early car is to decrease the interval at the rate of .29 second for each second of earliness.

At this time it should be said that the curves of FIGURE 2 are individual to the described arrangement. However, the subject timer is extremely flexible in that by proper selection of the circuit parameters and adjustment of the tap on resistor R2, the position of the tap on resistor R6 and the tap on resistor R8, the dispatching interval may be varied by early or late cars in practically any desired fashion. For example, the foregoing parameters may be selected and adjustments made so that early or late cars, respectively reduce or increase the dispatching interval at a constant rate throughout the range of the dispatching interval duration. Or, if it is desired, a late car may be effective to increase a substantially shortened interval at an extremely fast rate, while increasing a substantially lengthened interval at an extremely slow rate. Such flexibility is highly desirable for application of the subject timer in various elevator installations, having varying characteristics.

If it is now assumed that the traffic demands change so that traffic predominates sufficiently in the down direction, the operation of tube T2 in the program selection portion of the circuits (lower half of FIGURE 1) operates down program selection switch XDP to cause the system to function on the down peak program, as has been described. Under these circumstances, the operation of the dispatching timer circuits (top half of FIGURE 1), which has been described, is not involved in the dispatching of the cars from the lower terminal. Instead, the upward dispatching of a car, say car *a*, is initiated by the operation of up dispatching relay HCL*a* as soon as that car is brought to a stop at the lower terminal and becomes set for upward travel, as described in the Glaser-Lusti patent.

It is thus seen that the subject control system effectively co-ordinates the operation of the elevator cars during periods of substantial traffic by automatically selecting a program best to service existing traffic and by adjusting the up dispatching interval best to service that traffic under the selected program.

As changes can be made in the above described construction and many apparently different embodiments of this invention can be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown on the accompanying drawings be interpreted as illustrative only and not in a limiting sense.

What is claimed is:

1. In a control system for a plurality of elevator cars, control means having first and second conditions for causing said cars to be operated in accordance with a first pre-established operating program when in its first condition, and for causing said cars to be operated in accordance with a second pre-established operating program when in its second condition, means for continuously measuring the net differential of travel time of the cars on their up trips as compared to that of the cars on their down trips, and means controlled by said differential travel time measuring means for causing said control means to change from one to the other of its two conditions in accordance with changes in the measured differential time so as to change the operation of said cars from the operating program corresponding to the one of said conditions to that corresponding to the other of said conditions.

2. In a dispatching and control system for a plurality of elevator cars serving a plurality of floor landings from a lower dispatching landing, first means responsive to the movement and direction of travel of said cars for measuring at any given instant the net differential of time expended by the cars travelling in the up direction as

compared with the cars travelling in the down direction, second means responsive to cars standing at said lower dispatching landing for reducing said measured net differential at a predetermined rate under conditions where a car is standing at said dispatching landing to obtain a resultant net differential, means for causing said cars to be operated in accordance with a first pre-established operating program, means for causing said cars to be operated in accordance with a second pre-established operating program, and control means responsive to said first and second means for causing operation of said cars operating in accordance with one of said programs to be automatically changed to operation in accordance with the other of said programs under conditions where said resultant net differential exceeds a predetermined amount.

3. In a dispatching and control system for a plurality of elevator cars serving a plurality of landings from two terminal landings, up and down program means for causing the dispatching of the cars to be under a program suited for substantially equal up and down traffic, up peak program means for causing the dispatching of the cars to be under a program suited for more traffic in the up direction than in the down direction, down peak program means for causing the dispatching of the cars to be under a program suited for more traffic in the down direction than in the up direction, integrating means responsive to the movement of said cars for measuring the net differential of time consumed by the cars on up trip as against the cars on down trip and for reducing said so measured net differential at a predetermined rate in accordance with the cars standing at terminal landings to indicate the direction of predominant traffic, and selecting means controlled by said integrating means for selectively actuating the program means suitable for the direction of predominant traffic as indicated by said integrating means.

4. In a dispatching and control system for a plurality of elevator cars operating between two terminal landings, control means for causing the elevator cars to operate under a selected one of a plurality of predetermined operating programs, traffic measuring means for measuring the net differential of time consumed at any given instant by the cars travelling upwardly as compared with the cars travelling downwardly and for reducing said so measured net differential at a predetermined rate under conditions where the cars are standing at the terminal landings to indicate the direction of predominant traffic, and selecting means controlled by said traffic measuring means for selecting from said plurality of programs the program suitable for the particular traffic conditions so measured.

5. In a dispatching and control system for a plurality of elevator cars, first program means for causing the operation of the cars to be under a program to service substantially equal up and down traffic, second program means for causing the operation of the cars to be under a program to service more traffic in the up direction than in the down direction, third program means for causing the operation of the cars to be under a program to service more traffic in the down direction than in the up direction, traffic measuring means responsive to the movement of said cars for continuously measuring the net differential of time consumed by the cars on up trip as compared with the cars on down trip and for continuously reducing said so measured net differential at a certain rate under conditions where the cars are neither on their up trip or down trip to indicate continuously the direction in which service demand predominates and the magnitude of such predominance, and selecting means controlled by said traffic measuring means for selecting and actuating said first program means under conditions where the magnitude of said reduced net differential is less than a certain amount, for selecting and actuating said second program means under conditions where said reduced net differential is at least a predetermined amount and in the up direction, and for selecting and actuating said third program means under conditions where said reduced net differential is at least a second certain amount and in the down direction.

6. In a dispatching and control system for a plurality of elevator cars serving a plurality of floor landings from two terminal landings, control means for causing the movement of the cars to be under a selected one of a plurality of predetermined operating programs, first integrating means for continuously measuring the net differential of time consumed by up travelling cars as against down travelling cars, means responsive to cars standing at terminal landings for reducing said measured net differential in accordance with the time during which the cars are at said terminal landings to obtain a directional remainder of said net differential as a measure of traffic conditions, and selecting means operably responsive to said first integrating means for automatically selecting that one of said plurality of programs predetermined to be best suited for the particular measured traffic conditions in accordance with predetermined magnitudes and the direction of said remainder.

7. In a dispatching and control system for a plurality of elevator cars serving a plurality of landings including an upper terminal landing from a lower dispatching terminal landing, first program means for causing dispatching of the cars under a program to provide substantially equal up and down service, second program means for causing dispatching of the cars under a program to provide greater service in the up direction than in the down direction, third program means for causing dispatching of the cars under a program to provide greater service in the down direction than in the up direction, timing means for said dispatching landing for providing time intervals for dispatching, dispatching means for said dispatching landing operable on a time basis subject to said time interval means to initiate dispatching of the cars under said dispatching programs, summation means for said dispatching landing for continually measuring how early and how late the cars are in arriving at the dispatching landing with respect to the initiations of the dispatching operations, first control means operably responsive to said summation means for adjusting the timing interval providing by said timing means continuously throughout said measured earliness and lateness in accordance with the magnitude of the then existing time interval, integrating means for measuring at any given instant the net differential of time consumed by the cars on up trip compared with the cars on down trip and for reducing such measured differential in accordance with the time consumed by the cars standing at the terminal landings to obtain a directional remainder indicative of the magnitude and direction of service demand, and second control means operatively responsive to said integrating means for selectively actuating a predetermined one of said program means in response to predetermined variations in the direction and magnitude of service demand as indicated by said directional remainder.

8. In a control system for a plurality of elevator cars adapted for operation between two terminal landings in accordance with a selected one of several predetermined operating programs, a program selector for automatically selecting in accordance with continuous traffic measurements the operating program under which said cars are to operate and for automatically causing said cars to transfer from one selected program to another in accordance with certain changes in said traffic measurements, said program selector comprising, a source of unidirectional power having positive, negative and ground potential terminals adapted for supplying positive and negative polarity voltages at a certain magnitude, an electron tube having anode, cathode and grid electrodes, said anode electrode being connected to said positive terminal, a cathode resistor connecting said cathode electrode to said

negative terminal, a grid condenser connecting said grid electrode to said ground terminal whereby said tube conducts a predetermined amount of current, means responsive to the cars travelling in the down direction for applying to said grid condenser a charging voltage of a given polarity and of a certain magnitude proportional to the number of cars travelling down at any given instant and for removing said charging voltage of a given polarity in the absence of any down travelling car, means responsive to the cars travelling in the up direction for applying to said grid condenser a charging voltage of polarity opposite to said given polarity and of a certain magnitude proportional to the number of cars travelling upward at any given instant and for removing said charging voltage of opposite polarity in the absence of any up travelling car, means for resistively connecting a discharging circuit to said grid condenser, said latter means being effective under conditions where at least one car is at a terminal landing for decreasing the resistance of said discharge circuit in proportion to the number of cars standing at the terminal landings at any given instant, whereby tube conduction and in turn the cathode potential indicating the direction in which traffic predominates varies in accordance with the charge on said grid condenser, and control means operatively responsive to predetermined variations in said cathode potential and adapted for causing said cars to operate in accordance with predetermined operating programs corresponding to predetermined cathode potentials.

9. In a control system for a plurality of elevator cars adapted for operation from two terminal landings in accordance with a selected one of several predetermined operating programs, a program selector for automatically selecting in accordance with continuous traffic measurements the operating program under which said cars are to operate and for automatically causing said cars to transfer from one selected program to another in accordance with certain changes in said traffic measurements, said program selector comprising, a source of unidirectional power having ground, negative and positive terminals adapted for supplying negative and positive polarity voltages at a certain magnitude, an electron triode tube having anode, cathode and grid electrodes, said anode electrode being connected to said positive terminal, a cathode resistor connecting said cathode electrode to said negative terminal, a grid condenser connecting said grid electrode to said ground terminal, whereby said tube conducts a predetermined amount of current, means responsive to the cars travelling in the down direction for applying to said grid condenser a positive charging voltage of a certain magnitude directly proportional to the number of cars travelling down at any given instant and for removing said positive charging voltage in the absence of any down travelling car, means responsive to the cars travelling in the up direction for applying to said grid condenser a negative charging voltage of a certain magnitude directly proportional to the number of cars travelling upward at any given instant and for removing said negative charging voltage in the absence of any up travelling car. electric connecting means for resistively connecting a discharging circuit to said grid condenser, electric switching means responsive to cars standing at terminal landings for decreasing the resistance of said discharge circuit in proportion to the number of cars standing at the terminal landings at any given instant under conditions where at least one car is at a terminal landing, whereby tube conduction and in turn the cathode potential varies in accordance with the charge on said grid condenser, thereby indicating the direction in which traffic predominates, and control means operatively responsive to predetermined variations in said cathode potential and adapted for causing said cars to operate in accordance with predetermined operating programs corresponding to predetermined cathode potentials.

10. A program selector as set forth in claim 9 wherein said means responsive to cars travelling in the down direction comprise means for connecting through a certain resistance said grid condenser to said positive terminal of said power source, under conditions where at least one car is travelling down, and for decreasing the magnitude of that certain resistance by predetermined amounts in accordance with the number of cars travelling down at any given instant.

11. A program selector as set forth in claim 9 wherein said means responsive to cars travelling in the up direction comprise means for connecting through a certain resistance said grid condenser to said negative terminal of said power source and for decreasing the magnitude of that certain resistance in accordance with the number of cars travelling up at any given instant.

12. A program selector as set forth in claim 9 wherein said control means comprise electromechanical switching means having at least two coils connected between said cathode electrode and said ground terminal, said coils being adapted for energization of one of said coils sufficient to cause said switching means to operate from a first condition to a second condition, under conditions where the potential at said cathode is at least a certain value at a given polarity with respect to said ground potential and for energization of the other one of said coils sufficient to cause said switching means to operate from said first condition to a third condition, under conditions where the potential at said cathode is at least a predetermined value at a polarity opposite to said given polarity.

13. In a control system for a plurality of elevator cars adapted for operation between two terminal landings in accordance with a selected one of several predetermined operating programs, a program selector for automatically selecting in accordance with continuous traffic measurements the operating program under which said cars are to operate and for automatically causing said cars to transfer from one selected program to another in accordance with certain changes in said traffic measurements, said program selector comprising, a source of unidirectional power having positive, negative and ground potential terminals adapted for supplying positive and negative polarity voltages at a certain magnitude, an electron tube having anode, cathode and grid electrodes, said anode electrode being connected to said positive terminal, a cathode resistor connecting said cathode electrode to said negative terminal, a grid condenser connecting said grid electrode to said ground terminal, whereby said tube conducts a predetermined amount of current, means for resistively connecting said grid electrode to said ground terminal, means responsive to at least one of said cars standing at a terminal landing for decreasing the resistance of said grid to ground terminal circuit in proportion to the number of said cars standing at terminal landings, means responsive to at least one car travelling in the up direction for resistively connecting said grid electrode to said negative terminal, means responsive to more than one car travelling in the up direction for decreasing the resistance of said grid to negative terminal circuit in proportion to the number of cars travelling up at any given instant, means responsive to a car travelling in the down direction for resistively connecting said grid electrode to said positive terminal, means responsive to more than one car travelling in the down direction for decreasing the resistance of said grid to positive terminal circuit in proportion to the number of cars travelling downward at any given instant, whereby tube conduction varies in accordance with the charge on said grid condenser, and electromechanical switching means connected between said cathode electrode and said ground terminal, said switching means being responsive to predetermined changes in the potential at said cathode as said tube conduction varies for causing said cars to operate in accordance with predetermined operating programs corresponding to certain potentials at said cathode.

14. In a control system for a plurality of elevator

cars, means for causing said cars to be operated in accordance with a first pre-established operating program, means for causing said cars to be operated in accordance with a second pre-established operating program, a plurality of load responsive means for each car for indicating various predetermined load conditions of the car for which they are provided, means operably responsive to said load responsive means for continuously measuring the net differential of the indicated loads of the cars on up trips as compared with the indicated loads of the cars on down trips, and means controlled by said differential measuring means for causing operation of said cars operating in accordance with one of said pre-established programs to be automatically changed to operation in accordance with the other of said pre-established programs.

15. In a control system for a plurality of elevator cars adapted for operation in accordance with a selected one of several predetermined operating programs, a program selector for automatically selecting in accodance with continuous traffic measurements the operating program under which said cars are to operate and for automatically causing said cars to transfer from one selected program to another in accordance with certain changes in said traffic measurements, said program selector comprising, a source of unidirectional power having ground, negative and positive potential terminals adapted for supplying negative and positive polarity voltages at a certain magnitude, an electron tube having anode, cathode and grid electrodes, said anode electrode being connected to said positive terminal, a cathode resistor connecting said cathode electrode to said negative terminal, a grid condenser connecting said grid electrode to said ground terminal, whereby said tube conducts a predetermined amount of current, load responsive means for each car for indicating the load condition of the car for which it is provided, means responsive to said load responsive means for the cars travelling in the down direction for applying to said grid condenser a charging voltage of a given polarity and of a magnitude directly proportional to the indicated loads of said cars travelling down at any given instant, and for removing said charging voltage of a given polarity in the absence of down travelling cars, means responsive to said load responsive means for the cars travelling in the up direction for applying to said grid condenser a charging voltage of polarity opposite to said given polarity and of a certain magnitude directly proportional to the indicated loads of said cars travelling upward at any given instant and for removing said charging voltage of opposite polarity in the absence of up travelling cars, electric connecting means resistively connecting a discharging circuit to said grid condenser, electric switching means responsive to at least one car standing at the terminal landings for decreasing the resistance of said discharge circuit in accordance with the number of cars standing at the terminal landings at any given instant, whereby tube conduction and in turn the cathode potential varies in accordance with the charge on said grid condenser, thereby indicating the direction in which traffic predominates, and control means operatively responsive to predetermined variations in said cathode potential and adapted for causing said cars to operate in accordance with predetermined operating programs corresponding to predetermined cathode potentials.

16. In a control system for a plurality of elevator cars adapted for operation in accordance with a selected one of several predetermined operating programs, a program selector for automatically selecting in accordance with continuous traffic measurements the operating program under which said cars are to operate and for automatically causing said cars to transfer from one selected program to another in accordance with certain changes in said traffic measurements, said program selector comprising, a source of unidirectional power having positive, negative and ground potential terminals adapted for supplying positive and negative polarity voltages at a certain magnitude, an electron tube having anode, cathode and grid electrodes, said anode electrode being connected to said positive terminal, a cathode resistor connecting said cathode electrode to said negative terminal, a grid condenser connecting said grid electrode to said ground terminal, whereby said tube conducts a predetermined amount of current, means responsive to the cars travelling in the down direction for applying to said grid condenser a positive charging voltage of a certain magnitude directly proportional to the number of cars travelling down at any given instant and for removing said positive charging voltage in the absence of any down travelling car, means responsive to the cars travelling in the up direction for applying to said grid condenser a negative charging voltage of a certain magnitude directly proportional to the number of cars travelling upward at any given instant and for removing said negative charging voltage in the absence of any up travelling car, load responsive means for each car for indicating when that car is loaded to at least a certain percentage of its capacity, modifying means for each car controlled by said load responsive means for that car and operable for increasing said positive charging voltage by a predetermined amount under conditions where the car for which it is provided is loaded to said certain percentage and is on its down trip and for increasing said negative charging voltage by a predetermined amount under conditions where the car for which it is provided is loaded to said certain percent and is on its up trip, means resistively connecting a discharging circuit to said grid condenser, electric switching means responsive to at least one car standing at terminal landings for decreasing the resistance of said discharge circuit in proportion to the number of cars standing at the terminal landings at any given instant, whereby tube conduction and in turn the cathode potential varies in accordance with the charge on said grid condenser, thereby indicating the direction in which traffic predominates, and control means operatively responsive to predetermined variations in said cathode potential and adapted for causing said cars to operate in accordance with predetermined operating programs corresponding to predetermined cathode potentials.

17. In a dispatching and control system for a plurality of elevator cars serving a plurality of floor landings and an upper terminal landing from a lower dispatching landing, first means for integrating the time consumed by the cars on up trip, second means for integrating the time consumed by the cars on down trip, load responsive means for each car for indicating the load condition of the car for which it is provided, means controlled by said load responsive means for modifying said first integrating means by adding a certain amount to said integrated up time in accordance with the indicated loads of the cars on up trip and for modifying said second integrating means by adding a certain amount to said integrated down time in accordance with the indicated loads of the cars on down trip, balancing means controlled by said first and second integrating means for measuring at any given instant the net differential of said integrated times, control means responsive to the cars standing at said upper terminal and said lower dispatching landing for reducing said net differential of integrated times at a certain rate determined in accordance with the cars so standing at any given instant, means for causing said cars to be operated in accordance with a first pre-established operating program, means for causing said cars to be operated in accordance with a second pre-established operating program, and means controlled by said balancing means for causing operation of said cars operating in accordance with one of said programs to be changed automatically to operation in accordance with the other of said programs in response to a predetermined magnitude and direction of said reduced net differential.

18. In a dispatching and control system for a plu-

rality of elevator cars, timing means for providing timed intervals for dispatching said cars from a landing, means for initiating the dispatching of said cars on a time basis subject to said timing means, integrating means for continuously measuring how late and how early said cars are in arriving at said landing, and means controlled by said integrating means for controlling the operation of said timing means to adjust continuously said time intervals in accordance with how late and how early said cars are in arriving at said landing.

19. In a dispatching and control system for a plurality of elevator cars, timing means for providing timed intervals for dispatching the cars from a landing, means for initiating the dispatching of said cars on a time basis subject to said timing means, means for measuring how late and how early said cars are in arriving at said landings, and means controlled by said measuring means for controlling the operation of said timing means to lengthen continuously said time intervals in proportion to the measured lateness of said cars and to shorten continuously said time intervals in proportion to the measured earliness of said cars.

20. In a dispatching and control system for a plurality of elevator cars, timing means for providing timed intervals for dispatching said cars from a landing, means for initiating the dispatching of said cars on a time basis subject to said timing means, means for continually measuring the amount of lateness and the amount of earliness of said cars in arriving at said landing, and means controlled by said continually measuring means for modifying the operation of said timing means to adjust continuously the duration of said timed intervals in proportion to the measured amount of earliness and lateness of said cars.

21. In a dispatching and control system for a plurality of elevator cars, timing means for providing timed intervals for dispatching said cars from a landing, means for initiating the dispatching of said cars on a time basis subject to said timing means, means for continually measuring the amount of lateness and the amount of earliness of said cars in arriving at said landing with respect to the expiration of their respective dispatching intervals, and means controlled by said continually measuring means for modifying the operation of said timing means to adjust the duration of said timed intervals in proportion to the measured amount of earliness and lateness of said cars by continuously decreasing said duration of said timed intervals under conditions where a car is early and continuously increasing said duration of said timed intervals under conditions where a car is late, said modifying means decreasing and increasing said timed interval durations at certain rates determined in accordance with the magnitude of the present timed interval and applied continuously throughout said measured earliness and lateness, respectively.

22. In a dispatching and control system for a plurality of elevator cars, timing means for providing certain timed intervals for dispatching, means for initiating the dispatching operations of successive cars from a dispatching landing at the expiration of said certain time intervals provided by said time interval means, means for detecting whether the cars are early and whether they are late in arriving at said dispatching landing with respect to the expiration of their respective timed intervals, integrating means operably responsive to said detecting means for continually measuring the amount of said earliness and lateness, and means responsive to said integrating means upon early arrivals of the cars at said dispatching landing for controlling the operations of said timing means to decrease said interval continuously and in accordance with the measured amount of earliness and upon late arrivals of the cars at said terminal landing to increase said interval continuously and in accordance with the measured amount of lateness.

23. In a dispatching and control system for a plurality of elevator cars, means for providing adjustable time intervals for dispatching, means for initiating the dispatching operations of successive cars from a dispatching landing at the expiration of predetermined time intervals provided by said time interval means, means for detecting whether the cars are early and whether they are late in arriving at said dispatching landing with respect to the expiration of their respective time intervals and for measuring the amount of said earliness and lateness, and means responsive to said detecting and measuring means for controlling the operations of said time interval means to decrease said intervals under conditions where the next succeeding car is detected as early and to increase said intervals under conditions where the next succeeding car is detected as late in accordance with said measured amount of earliness and said measured amount of lateness, respectively, said decrease and increase of said intervals being continuous throughout said detected lateness and earliness, respectively.

24. In a dispatching and control system for a plurality of elevator cars, timing means adapted for providing adjustable time intervals for dispatching, means for initiating the dispatching of the cars from a dispatching landing at the expiration of successive time intervals provided by said timing means, means for detecting whether the car next to be dispatched is early and whether it is late in arriving at said dispatching landing with respect to the expiration of the dispatching interval of that next car and for measuring the amount of said earliness and lateness, and means responsive to said detecting and measuring means for modifying the operation of the timing means under conditions where said next car is detected as early to decrease the unexpired portion of the unexpired interval and successive intervals in accordance with said measured amount of earliness and under conditions where said next car is detected as late to increase the duration of succeeding time intervals in accordance with said measured amount of lateness, said decrease and increase being effected continuously throughout said earliness and lateness, respectively, of that next car.

25. In a dispatching and control system for a plurality of elevator cars serving a plurality of floor landings from a dispatching landing, timing means for providing adjustable time intervals for dispatching said cars from said dispatching landing, initiating means for initiating the dispatching of the cars from said dispatching landing at the expiration of successive timed intervals provided by said timing means, means for detecting and measuring the earliness and lateness of the next car to be dispatched in arriving at said dispatching landing with respect to the expiration of the dispatching interval presently being timed for that car, and control means responsive to said detecting and measuring means upon early arrival of that next car for modifying the operation of said timing means to decrease the duration of said present dispatching interval and succeeding dispatching intervals in proportion to said measured earliness and at rates of decrease predetermined in accordance with the duration of said present interval and upon late arrival of that next car to increase succeeding dispatching intervals in proportion to said measured lateness and at rates of increase predetermined by the duration of said present dispatching interval.

26. In a dispatching and control system for a plurality of elevator cars serving a plurality of landings from a dispatching landing, said system including dispatch initiating means for initiating the dispatching of the cars from said dispatching landing; a dispatching timer for controlling said dispatch initiating means to provide initiation of dispatching of successive cars on a timed basis, said timer comprising, a source of unidirectional power having positive, negative and ground polarity terminals adapted for supplying postive and negative polarity voltages at a certain magnitude, an electronic tube having

anode, cathode and grid electrodes, said anode electrode being connected to said positive terminal, a cathode resistor connecting said cathode electrode to said negative terminal, a grid condenser connecting said grid electrode to said ground terminal, means for charging said grid condenser to a predetermined initial positive value with respect to ground, whereby said tube conducts a predetermined amount of current, means for indicating whether the next car to be dispatched is early and whether it is late with respect to initiation of its dispatching, means responsive to said indicating means for continuously increasing the charge on said grid condenser at a predetermined rate under conditions where said next car is early until its dispatching is initiated, means also responsive to said indicating means for continuously decreasing the charge on said grid condenser at a certain rate under conditions where the next car is indicated as late until the dispatching of that next car is initiated, whereby tube conduction and in turn the cathode potential varies continuously in accordance with the indicated earliness and lateness of that next car, and timing means for providing a certain fixed time interval measured from the dispatching of a car, said timing means being responsive to said variations in cathode potential and adapted for modifying the duration of said fixed time interval in accordance with said variations in said cathode potential.

27. A dispatching timer as set forth in claim 26 wherein said timing means comprises a condenser having two terminals, one of said terminals being connected to said ground terminal of said power source, a resistive discharge circuit for said condenser connected across said condenser, an electromechanical switch having an energizing coil, one side of which is connected to said cathode electrode and the other side of which is connected to a predetermined point in said resistive discharge circuit of said condenser, and switching means controlled by said dispatch initiating means for connecting the other terminal of said condenser to said positive terminal of said source for charging said condenser and causing said switch to operate and then disconnecting said condenser from said positive terminal, whereby said condenser discharges through said resistive circuit at a certain rate, thereby lowering the potential applied across said coil from said predetermined point to said cathode electrode at said certain rate, thereby causing said switch to release at the expiration of a certain time, said release time establishing the duration of said time interval.

28. A dispatch timer as set forth in claim 26 wherein said means for increasing the charge on said grid condenser comprises means for resistively connecting said grid electrode to said cathode circuit at a certain point that is positive a certain amount with respect to said grid electrode, thereby causing said grid condenser to charge at a certain rate, and said means for decreasing the charge on said condenser comprises means for interrupting such charging circuit and for resistively connecting said grid electrode to a predetermined point in said cathode circuit, said point being selected so that that point is negative a predetermined amount with respect to said grid electrode, whereby said grid condenser discharges at a certain rate.

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