Jan. 12, 1937. A. A. CHUBB 2,067,378

ELECTRICAL SYSTEM OF LIFT CONTROL

Filed March 21, 1935

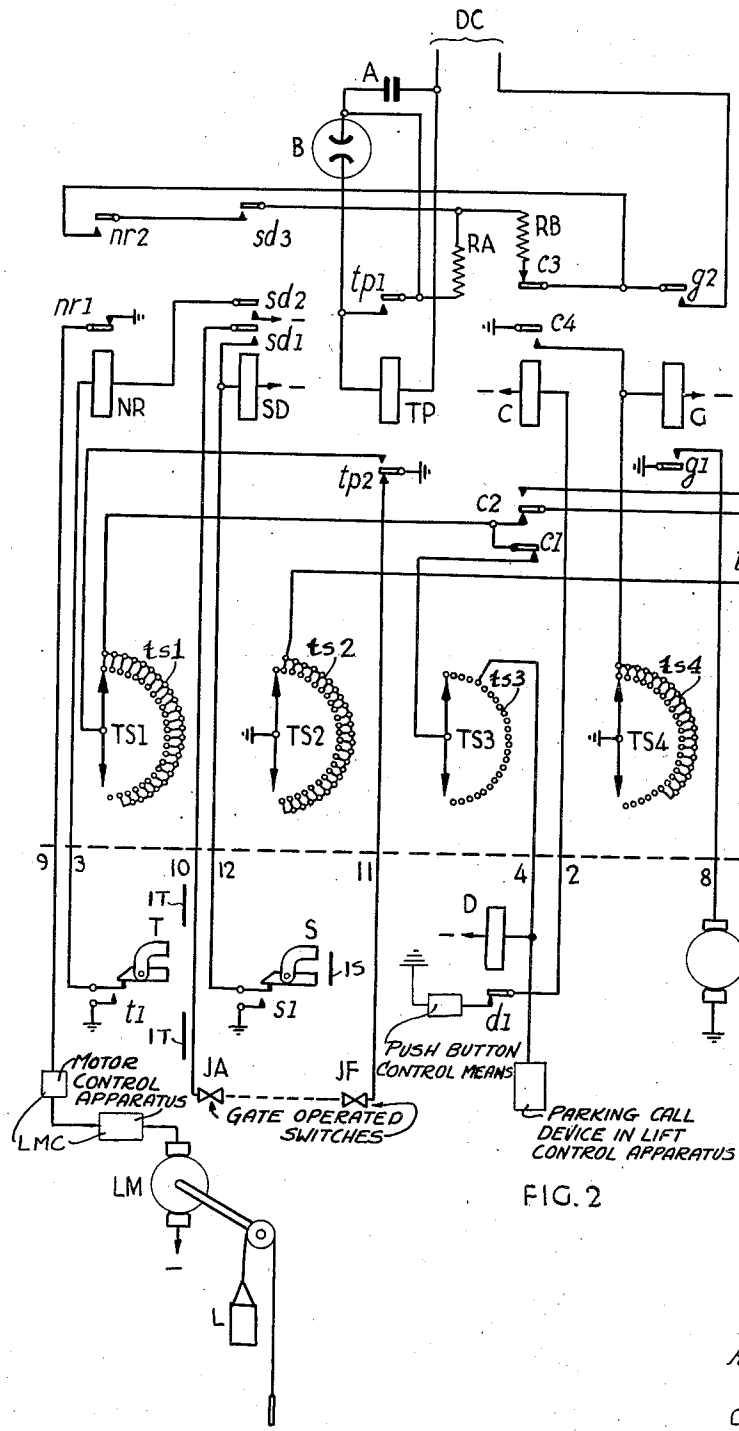


FIG. 2

FIG. 1

INVENTOR
Alexander A Chubb
M. H. Lockwood
ATTORNEY

Patented Jan. 12, 1937 2,067,378

UNITED STATES PATENT OFFICE

2,067,378

ELECTRICAL SYSTEM OF LIFT CONTROL

Alexander Albert Chubb, Coventry, England, assignor to The General Electric Company Limited, London, England

Application March 21, 1935, Serial No. 12,332
In Great Britain March 26, 1934

8 Claims. (Cl. 187—29)

My invention relates to electrical systems of control of lifts and like limited travel mechanisms, and has for its object the provision of means enabling certain operations to be performed after a specified delay.

In systems of electrical control of lifts it occasionally happens that a certain action is required to be performed after a predetermined interval of time. Examples of such delayed action are the return of a lift to a parking position after having been left at any floor for a predetermined time, and the shutting down of the motor-generator set used to supply power to the lift motor, where such a set is employed. Such delays have previously been performed in this or other connections by devices such as dashpots or thermostat relays, though such devices are by no means satisfactory and are apt to be expensive, in addition to which a separate dash-pot is required for each time delay, and a certain amount of wear and uncertainty is involved in each action of the relay.

According to my invention a time delay for an electrical system of lift control is provided by means including essentially a source of current, a condenser, a resistance, a relay which will be referred to as an impulse relay and a gas discharge tube. These items are so connected as to cause the tube to be in a state of relaxation oscillation when the delay period is required, each discharge through the tube causing operation of the impulse relay and partial or complete discharge of the condenser.

According to a further feature of my invention and for prolonged delays the impulse relay is adapted to impulse the stepping magnet of a step-by-step switch having a plurality of contact banks, one or more banks being connected to give a series of current impulses as the wipers pass over the banks of contacts. The impulses from each bank may be at different intervals from those of the other banks. By this means delay period of various lengths may be supplied to the lift control mechanism by a single common delay device.

Fig. 1 is a diagram of the impulse relay circuit.

Fig. 2 is a diagram of the stepping relay circuit.

I employ preferably a gas discharge tube (B in Fig. 1) containing two cold electrodes in an atmosphere of neon under reduced pressure, which, in the present instance, provides a tube in which a discharge commences to flow when the potential between the electrodes is approximately 170 volts. The discharge is preferably obtained from a large capacity condenser connected in parallel with the neon tube, the impulse relay being operated by the discharge since it is preferably connected in series with the condenser. As, however, the extinguishing potential of the neon tube is approximately 130 volts a considerable quantity of charge may remain in the condenser at the end of the discharge. This would cause the initial delay period involving the complete charge of the condenser from zero to 170 volts to be longer than that of subsequent charging periods which would be only from 130 volts to 170 volts. In addition, the impulse relay would require to be very sensitive to operate during the discharge of the condenser only through a 40 volt range.

I, therefore, arrange that a contact (*tp1*, Fig. 1) of the impulse relay (TP) is connected across the neon tube in such a fashion that as soon as this contact makes, the tube is short-circuited and the full potential of the condenser is applied to the impulse relay (TP in Fig. 1) which thus will remain operated substantially throughout the whole of the discharging period of the condenser.

The delay circuit for charging the condenser can be operated from a direct current supply, or by means of a simple rectifier circuit from an alternating supply, and preferably a contact (*g2* of shut down relay G) is connected in series with the supply.

In order that the nature of my invention may now be more particularly described and ascertained, reference should be made to the accompanying drawing in which Figure 1 is a delay circuit according to my invention and Figure 2 is a portion of a typical lift control system, the circuit being applicable to any system of lift control employing inductor type switches or like devices in the lift shaft for levelling, floor counting and like purposes, and in which the lift driving motor is supplied with current from a Ward-Leonard motor-generator set. My invention, is, of course not limited to this particular type of lift controlling system, but can be applied with suitable modification to any form of electrical lift controlling system which requires one or more delay periods.

In the drawing, a neon tube B, substantially as described above, is connected in series with an impulse relay TP, the combination being in parallel with condenser A. The combination is further connected in series with two resistances RA and RB to a source of direct current D. C. which may be a public supply, or which may be ob-

tained from an A. C./D. C. converter of any known form operated from A. C. mains. The supply is preferably in the region of 200–250*v*.

Under these conditions, when the supply is connected to the circuit shown and the contact *g2* of the shut down relay G is closed, the condenser A commences to charge at a rate determined by the combined value of the resistances RA and RB. After a time, the potential across the condenser reaches a value equal to that of the striking potential of the neon tube B, which then becomes conductive, allowing a current to flow through the tube from the condenser A and through the coil of the impulse relay TP, thereby operating the relay. Assuming, for the moment, that contact *tp1* is not present, then when the potential across the condenser, which during discharge falls rapidly, reaches the extinguishing value of the neon tube B, this value being usually between 30 and 40 volts lower than the striking value, the neon tube becomes once more non-conductive and the relay releases. This operation will be repeated, the condenser charging once more to the striking potential of the tube and discharging through it, at a rate proportional to the size of the condenser, the value of the resistance in series and the supply voltage, so that a time delay of a predetermined value is obtained between the application of the supply voltage to the resistance-condenser combination and the operation of the impulse relay TP.

As may be seen from the foregoing description, however, the initial charging period of condenser A (ignoring the short circuit through contact *tp1*) is longer than that of subsequent periods since, in the first case, the voltage rise is from zero to the striking potential of the neon tube B, whereas in subsequent cases the voltage rises only from the extinguishing to the striking potential of the tube. In addition, the current derived from the condenser A during the rather limited fall of potential experienced while the condenser is discharging through the neon tube only to its extinguishing point, is apt to be small, and would require a delicate relay to respond adequately thereto. I therefore employ a connecting circuit through a contact *tp1* of impulse relay TP, which short-circuits the neon tube B when the impulse relay TP operates, thereby allowing the condenser A to discharge substantially fully and completely through the relay coil at each operation of the impulse relay, thus ensuring not only that the condenser will charge from zero each time, but also that the impulse relay will receive an adequate operating current.

The two resistances RA and RB, preferably having values which are such that the impulse relay TP will not remain held operated in series with them to the supply D. C. are employed in order to obtain two rates of delay. As will be seen later, different delay periods may be required to control different lift operations, and as the delay period obtained from the neon tube B increases with increase of resistance in the condenser circuit, it is so arranged that a short delay period is obtained by supplying current through the single resistance RA only, while the second resistance RB is included in series when a longer delay is required.

Referring now to the remainder of the circuit, it will be understood that delay periods of certain lengths are required, notably a relative short period, after the lift has reached a floor, during which the gates may be opened. This period is necessary in order to ensure that the lift does not restart, immediately it has stopped at a floor, to answer a call made from another floor. This period is usually of the order of 5 seconds.

A further delay period is that employed when the lift has been out of use for some time, say one minute. It is usually required to restore the lift (that is park it at) a particular floor at the end of this period, this floor being the one from which calls are most likely to originate, e. g. the ground floor.

After a still further period, it may be required to shut down the Ward-Leonard motor generator if no calls are made for the lift during that period, though should calls be made for the lift at any time during these last two delay periods, all delay apparatus must be restored to normal in readiness for repeating a cycle of operations, when the lift once more goes out of use.

While the lift is actually engaged in answering a call, the control apparatus, which may be of the type disclosed for example in British Patent No. 423,805 and U. S. Patent No. 2,056,626 maintains the service relay C operated, by means of potential applied to lead 2 by push button control means (not shown) so that when the lift stops at a floor, even though other calls may be stored so as to be answered later by the lift, relay C is released.

It will be understood that the service relay C, when operated, opens contact *c1* which in its closed position prepares an operating circuit for a suitable parking device (not shown) and for a preventing relay D, i. e. the preventing relay and the parking devices are arranged to be operated when the lift car is to be returned to a particular floor at which it is required normally to be parked and, as explained later, the preventing relay D operates to open contact *d1* in the lead 2 of the circuit of the service relay C.

The contact *c2* of service relay C, in the position shown (lower) connects a lead from the stepping magnet TS of step-by-step switches TS1—TS5 of a type used in telephone systems, having contact banks *ts1*—*ts5*, with a lead to the bank of contacts *ts1* and thence to the upper circuit connection at contact *tp2* in readiness for operation later when contact *tp2* is moved to close on the upper contact when the impulse relay TP is operated, which will step the switch. Contact *c3* of service relay C completes the circuit from the D. C. supply to the delay circuit including the condenser A and the grid glow tube B, which circuit functions, as previously described, to operate the impulse relay TP after a delay period of approximately 5 seconds. Contact *g2* of shut down relay G is at present closed as relay G is normally held operated from a bank TS4.

When the impulse relay TP operates momentarily at the end of the first delay period, the contact *tp1* of this relay, by closing the short circuit, acts to discharge condenser A completely through the coil of relay TP and at the same time contact *tp2* by closing energizes the switch stepping magnet TS via bank TS1. When the impulse relay TP releases later, that is upon the complete discharge of condenser A, contact *tp2*, by breaking the upper contact, de-energizes stepping magnet TS, which then makes one step, advancing all the wipers (banks TS1 to TS5) to the second contacts in their respective banks.

Contact *tp2* of impulse relay TP also performs

a function additional to that of operating the stepping magnet TS to advance the switches. Prior to the stoppage of the lift at a floor, closing of the contact *s1*, which is operated by an inductor type switch S in the control apparatus by an inductor plate IS at a point prior to the floor at which slowing down operations are initiated, operates sequence determining relay SD over lead 12, which by operating its contact *sd1* locks operated to the positive potential at contact *tp2* of impulse relay TP (which at this time is in its lower position) via the contacts JA—JF which are gate switches, and leads 10 and 11. When the lift reaches the floor at which it is required to stop, sequence determining relay SD can be released either by opening one of the lift gates, which will open one of the contacts JA—JF, or by the operation of the impulse relay TP at the end of the previously described predetermined delay period. It will be noted that the sequence determining relay SD also operates contact *sd2* to prepare a circuit for a stopping relay NR which is operated over line 3 by the closing of contact *t1* when the desired floor is reached. Releasing the sequence determining relay SD by opening a gate or otherwise allows its contact *sd2* to open, thereby releasing the stopping relay NR, which was operated when the lift reached the required floor; stopping relay NR having been operated over lead 2 by another inductor switch T in the control apparatus, this latter switch being operated by an inductor plate IT when the floor level is reached. The inductor switch T obviously remains operated while the lift is situated at any floor.

Operation of the stopping relay NR performs two functions. Contact *nr1*, operated by relay NR, opens the circuit over lead 9, controlling the lift driving motor LM through the usual or any preferred control devices represented by the rectangles LMC, so that so long as stopping relay NR is operated, the driving motor cannot be energized. In addition, stopping relay NR, by operating a contact *nr2*, in cooperation with a contact *sd3* of sequence determining relay SD, provides a short circuit for the resistance RB, so that the first delay period, that is the one employed to hold the sequence determining relay SD operated until a gate is opened, is determined by the resistance RA only.

After the first delay period operation of impulse relay TP, which as described released sequence determining relay SD and stopping relay NR, the contacts *nr2* and *sd3* by opening will open the short circuit for the resistance RB, and if no further calls are made for the lift, i. e., if service relay C remains deenergized, the delay circuit is supplied through both resistances RA and RB and the impulse relay TP will be operated at a longer period of delay e. g. 15 seconds, instead of 5 seconds. At the end of each delay period the stepping magnet TS is operated by contact *tp2* to advance all the wipers of switches TS1—TS5 one step. Nothing further happens until the wiper TS3, which as indicated is stepped each time the contact *tp2* is operated, reaches the 5th contact in its bank *ts3* to which lead 4 is connected. At the commencement of the 5th impulse when wiper TS3 is standing on the contact *ts3* of lead 4, current potential from contact *tp2* will be delivered via connected contacts *ts1* on bank TS1, contact *c1*, and wiper of bank TS3 to lead 4 momentarily, thereby operating a parking call device in the lift controlling apparatus which has the effect of calling the lift to the parking floor at which it is required normally to rest. An essential difference between a parking call and one made by an intending passenger should be noted, that is, the stepping magnet TS is not operated to re-set the switches TS1—TS5 to a zero position, owing to the operation of a special preventing relay D in the control apparatus, a contact *d1* of which by opening prevents service relay C from being energized.

The lift now runs to its required floor and there stops, service relay C remaining deenergized. Impulse relay TP continues to impulse the stepping magnet TS via bank TS1 until the wiper of bank TS4 leaves the end of the row of connected contacts *ts4* over which it has been operating while maintaining shut down relay G operated, thus breaking the circuit of this relay. Shut down relay then releases the contacts *g1* and *g2*, and the contact *g1* breaks the circuit of the motor DM of the Ward-Leonard set over lead 8, causing shut-down of all the energized plant. Contact *g2* by opening disconnects the current supply to the timing circuit, discontinuing operation of impulse relay TP so that stepping magnet TS is no longer impulsed by contact *tp2*.

Everything remains in the deenergized condition until a further call is made for the lift. Service relay C then reoperates, whereupon its contact *c2* connects the stepping magnet TS with the positive potential of wiper TS2 via the interrupter contacts *ts* and the contacts of bank TS2, all the contacts *ts2* of which, except the first, are connected together. The stepping magnet TS then steps the wipers of all the switches TS1—TS5 by self-interruption in known manner, until the wiper of bank TS2 passes off the connected contacts and rests on its first contact, when stepping ceases. In the meantime, contact *c4* closes a circuit which operates shut down relay G and its contact *g1* restarts the motor-generator set. All the apparatus is now once more ready to repeat the foregoing cycle of operations.

If a call is made for the lift at any time prior to the shut down of the motor generator, such for example as during the "parking" or "shut down" delay periods, service relay C is operated by positive potential current delivered over the lead 2 by the push button control apparatus as above described. Contacts *c2* and *c4* perform functions as hereinbefore described, causing the stepping magnet TS to return the wipers of TS1—TS5 to a normal position, and contact *c1* will prevent false operation of the preventing relay D and false storage of a "parking" call while the stepping magnet TS steps the wiper of TS3 over the contact *ts3* to which the relay is connected.

Bank TS5 which may or may not be necessary, is provided so that an indication of a lapse of a certain period or periods of time may be given to the lift controlling apparatus over leads 5, 6 or 7. These indications may operate controlling devices of any particular nature, or may be used to control devices employed in any interworking between individual members of a battery of lifts, or for any like purpose.

My invention may be modified in various manners to suit varying conditions. For example, the resistances RA and RB may be made variable in order that different delay periods are afforded at various times of the day. In addition, if the lift is not driven by a Ward-Leonard set, the contact *g1* of shut down relay G

may shunt off a supply, e. g. of current employed for lighting the lift car or the landing gates.

I claim:

1. In an electric system of lift control, the combination, with a motor operated lift, of a gas discharge tube, a condenser, resistance for effecting delay periods and a D. C. source, a switch arranged to connect said discharge tube, condenser and resistance to the current source, the tube being in a state of relaxation when the switch is open, means arranged to be operated when stopping the lift at a floor for closing said switch so as to charge the condenser from said source, an impulse relay in series with the tube and condenser and arranged to be operated by discharge of the condenser, said condenser discharging when the tube strikes, circuits and relays for stopping the lift at a floor and means cooperating therewith for preventing movement of the lift to another floor until said impulse relay is operated.

2. In an electric system of lift control, the combination, with a motor operated lift, of a gas discharge tube, a condenser, delay period resistance and a D. C. source, a contactor arranged to connect said discharge tube, condenser and resistance to the current source for charging the condenser, the tube being in a state of relaxation until the condenser charge causes it to strike, means arranged to be operated when stopping the lift at a floor for closing said contactor so as to charge the condenser, a step-by-step switch having a plurality of contact banks, an impulse relay arranged to be operated by discharge of the condenser for operating said step-by-step switch, said condenser being discharged when the tube strikes, and circuits arranged to be closed by said step-by-step switch for controlling operating of the lift according to predetermined delay periods.

3. The combination as in claim 2, wherein said step-by-step switch has a circuit connected to one contact of a bank which when the contact is reached by stepping of the switch is adapted to effect the return of the lift to a predetermined floor.

4. The combination as in claim 2, wherein said step-by-step switch controls circuit connections through one of said banks by contacts which are, when the switch reaches a predetermined position on said bank, adapted to effect the de-energization of the system.

5. In an electric system of lift control, the combination, with a motor operated lift, of a gas discharge tube, a condenser, delay period resistance coils and a D. C. source, a contactor arranged to connect said discharge tube, condenser and the resistance coils to the current source for charging the condenser, the tube being in a state of relaxation until the condenser charge is sufficient to cause it to strike, means brought into operation by stopping the lift at a floor for closing said contactor, control relays arranged to be operated when the lift is stopped at a floor for preventing movement of the lift to another floor before lapse of a predetermined delay period, means operated by the control relays for controlling operation of the resistance coils for determining the delay period, an impulse relay arranged in series with the tube and condenser so as to be operated by the condenser charge when the tube strikes, the first operation of said impulse relay after the lift arrives at a floor being arranged to deenergize said lift control relays so that the lift may respond to further calls, and means rendered effective by successive operations of said impulse relay for determining further delay periods and subsequent operation of said lift.

6. The combination as in claim 5 wherein means arranged to be operated by the lift on stopping at a floor is adapted to cut out part of said resistance and the first operation of said impulse relay is adapted to reinsert said cut out part of the resistance.

7. The combination as in claim 5 wherein means is provided whereby said impulse relay is arranged to short-circuit said tube after it strikes and establish a circuit to effect substantially complete discharge of the condenser through said relay.

8. In an electric system of lift control, the combination, with a motor operated lift, of a gas discharge tube, a condenser and an impulse relay in series and so arranged that the relay is operated by discharge of the condenser through the tube, a D. C. source arranged for charging the condenser, resistance coils for controlling the time required for charging said condenser, lift control means controlling the starting and stopping the lift, switches operated by the lift control means upon stopping at a floor for cutting out part of said resistance and for starting the charging of the condenser from the current course, means adapted at the first operation of said impulse relay to reinsert the cut out resistance and place said control means in position for the lift to respond to another floor call and means rendered effective by subsequent operations of said relay, if the lift does not move to another floor, for establishing circuits for restoring the lift to its home position and disabling it until another floor call is registered.

ALEXANDER ALBERT CHUBB.