

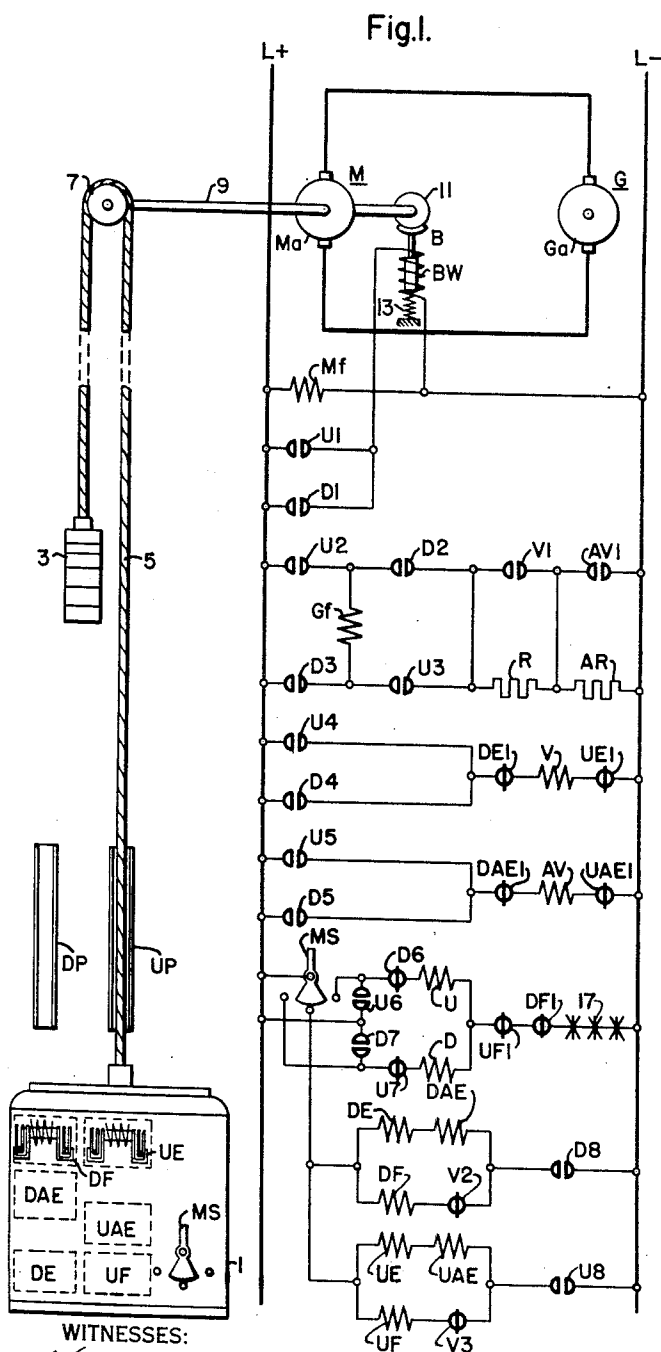
Jan. 12, 1954

H. BERKOVITZ
ELEVATOR INDUCTOR SWITCH

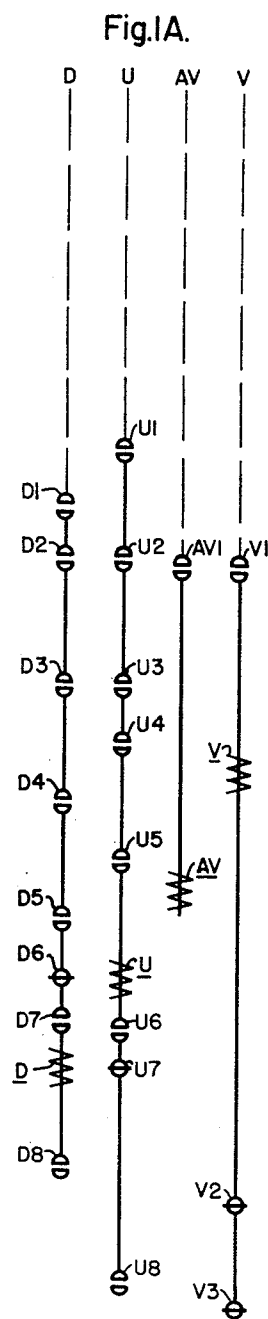
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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig.2.

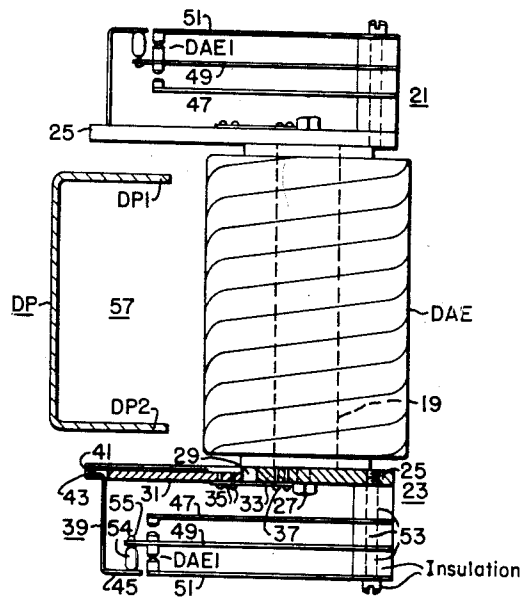
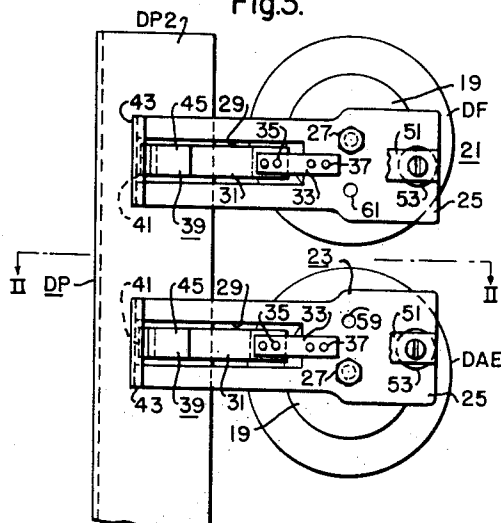


Fig.3.



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ELEVATOR INDUCTOR SWITCH

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This invention relates to electromagnetic devices, and it has particular relation to inductor switches suitable for use in controlling the operation of electrical elevators.

Inductor switches or relays have been employed widely in the control of electrical elevators. As an example of an elevator control system employing inductor switches, reference may be made to the Mattingly Patent 1,844,514.

For efficient operation of an elevator system, an inductor switch should initiate a slowdown or stopping operation at a predetermined distance from a floor at which an elevator car is to stop. The accuracy of the inductor switch should not be affected by lateral movements of an elevator car in its hoistway. Similar comments apply to inductor switches employed for leveling an elevator car at a floor.

In accordance with the invention, magnetic channels are employed as inductor plates. Each channel extends in a direction parallel to the path of travel of the elevator car. The inductor switch employs a coil mounted with its axis transverse to the direction of travel of the elevator car. This coil has a magnetic structure which includes a pair of spaced polar magnetic plates which define a non-magnetic gap therebetween. When the coil is energized, the polar plates are excited with opposite magnetic polarities to produce a magnetic field in the non-magnetic gap. Each polar plate may have a slot within which a magnetic armature is positioned for movement toward and from the non-magnetic gap. Each magnetic armature thus is effectively shielded by its associated polar plate.

During the travel of the elevator car in its hoistway, a channel enters the non-magnetic gap and has each of its flanges adjacent a separate one of the polar plates. The magnetic reluctance between the polar plates thus is substantially reduced, and sufficient magnetic flux flows to actuate the magnetic armatures. Preferably, the polar plates are offset from the axis of the coil to permit the inductor switches to be stacked in the direction of travel of the elevator car for successive operation within a short distance by a common channel.

It is therefore an object of the invention to provide an improved, simple and sturdy inductor switch.

It is a further object of the invention to provide an inductor switch having a magnetic armature provided with a magnetic circuit which is completed by a relatively movable magnetic channel.

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It is a further object of the invention to provide an inductor switch having a coil, a magnetic core and spaced polar plates extending transversely of the coil to provide a gap therebetween, the polar plates having slots within which movable magnetic armatures are positioned for actuation in response to the entry of a magnetic channel into the gap between the polar plates.

It is an additional object of the invention to provide an inductor switch having a coil and a pair of polar pieces which are offset from the axis of the coil in the same direction.

It is a still further object of the invention to provide an elevator control system which includes an inductor switch which includes a magnetic channel for each floor of the building served by an elevator car and which includes an inductor switch mounted on the car and having spaced parallel polar plates positioned for reception therebetween of the channels during movement of the elevator car in its hoistway, the polar plates having slots within which magnetic armatures are positioned for actuation in response to entry of a channel between the polar plates of the inductor switch.

Other objects of the invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which:

Figure 1 is a schematic view with parts in elevation, parts in perspective and parts broken away of an elevator system embodying the invention, circuits being shown in straight-line form;

Fig. 1A is a schematic view of certain relays or switches employed in the elevator system of Fig. 1. The contacts and coils of the relays in Figs. 1 and 1A are shown substantially in horizontal alignment with each other for the purpose of facilitating location of the various contacts and coils of the relays.

Fig. 2 is a sectional view taken along the line II—II of Fig. 3 with parts broken away; and

Fig. 3 is a view in side elevation with parts broken away of the inductor switch assembly embodying the invention.

Referring to the drawings, Figure 1 shows an elevator car 1 which is attached to a counterweight 3 by means of one or more flexible ropes or cables 5. The ropes or cables 5 pass over a sheave 7 which is secured to the shaft 9 of a direct-current motor M. The shaft 9 also has secured thereto a brake drum 11 which has a brake B normally biased against the brake drum by means of a spring 13. The brake B has a

winding BW which, when energized, releases the brake to permit rotation of the shaft 9.

The armature Ma of the motor M is connected in a loop with the armature Ga of a direct-current generator G. In operation, the armature Ga is rotated at a constant rate by means of a suitable motor (not shown). It will be understood that the motor and generator of Fig. 1 comprise parts of a conventional variable-voltage drive for an elevator car.

Energy for the various control circuits is provided by a pair of buses or conductors L+ and L- which are connected to a suitable source of direct-current energy. It will be noted that the field Mf for the motor M is connected across the buses L+, L- for energization therefrom. It will be understood that the motor M is suitably energized to move the elevator car along its hoistway to serve the floors of a building in which the elevator system is installed.

In order to land the elevator car accurately at each floor served thereby, a plurality of similar inductor switches and inductor channels are provided. For example, two inductor switches DE and DAE are provided to control the slowdown of the elevator car as it approaches a floor at which the elevator car is to stop.

An inductor channel DP is provided for each floor served by the elevator car. Each of the inductor channels DP is positioned to initiate slowdown of the elevator car by cooperation with the inductor switch DE at a suitable distance from the associated floor when the elevator car is to stop at such associated floor.

After slowdown of the elevator car is initiated by one of the inductor channels DP, the elevator car, as it nears the desired landing, again is slowed down by means of the same inductor channel at a suitable distance from its associated floor. The inductor channels DP cooperate with the inductor switch DAE to slow the elevator car to a landing speed during its travel in a down direction.

The elevator car is stopped during its travel in a down direction by means of a stopping inductor switch DF. This switch DF also is positioned for cooperation with the inductor channels DP.

Each of the inductor channels DP operates the stopping inductor switch DF shortly after the inductor channel has actuated the second slowdown inductor switch DAE.

The following relays or switches are disclosed in Fig. 1:

U—up direction relay
D—down direction relay
V—first speed relay
AV—second speed relay
DE—down direction first slowdown inductor switch
DAE—down direction second slowdown inductor switch
DF—down direction stopping inductor switch
UE—up direction first slowdown inductor switch
UAE—up direction second slowdown inductor switch
UF—up direction stopping inductor switch

Each of the relays may have one or more sets of contacts associated therewith. These contacts may be of the "break" type which are effective for opening a circuit upon energization of a relay. Also, the relays may have "make" contacts which are effective for completing an electrical circuit upon energization of a relay. Each

set of contacts for a relay is identified by the letter associated with the relay followed by a numeral specific to the set of contacts. The relay coils are identified by the same symbols employed for the complete relays. The relays are illustrated in their deenergized condition.

The generator field Gf may be energized from the buses L+ and L- through a reversing switch made up of contacts of the up direction and the down direction relays U and D. When the generator field is connected through the contacts U2 and U3 of the up direction relay, the generator field is energized with proper polarity for producing travel of the elevator car in an up direction. Conversely, when the generator field Gf is energized through the contacts D2 and D3, the polarity of the energization is suitable for producing travel of the elevator car in a down direction.

The energization of the generator field Gf is controlled in magnitude by two resistors R and AR. These resistors are shunted respectively by operation of the speed relays V and AV.

The up direction and down direction relays U and D are energized in response to operation of a master switch MS which is mounted in the elevator car. Rotation of the master switch in a clockwise direction completes a circuit for the down direction relay D whereas rotation of the master switch in a counterclockwise direction completes a circuit for the up direction relay U.

In its neutral position, the master switch MS is effective for energizing suitable inductor switches to initiate a slowdown and stopping operation of the elevator car.

The operation of the system illustrated in Fig. 1 now may be set forth. If it is desired to move the car in a down direction from the upper terminal, the master switch MS is rotated in a clockwise direction, as viewed in Fig. 1, to complete the following circuit for the down direction relay D:

L+, MS, U7, D, UF1, DF1, 17, L-

The devices 17 are safety devices normally employed in elevator systems, such as door contacts, which necessitate closure of all doors of the elevator system before the elevator car can be started.

Upon being energized the down direction relay D closes its make contacts D1 to energize the brake winding BW for the purpose of releasing the brake B. The make contacts D2 and D3 close to connect the generator field Gf for energization with proper polarity to move the elevator car in a downward direction. The energizing circuit for the generator field is as follows:

L+, D3, Gf, D2, R, AR, L-

Since rapid acceleration of the car is desired, the make contacts D4 are closed to complete the following energizing circuit for the speed relay V:

L+, D4, DE1, V, UE1, L-

Consequently, the energized speed relay V closes its contacts V1 to shunt the resistor R. In a similar manner the make contacts D5 are closed to complete the following energizing circuit for the second speed relay AV:

L+, D5, DAE1, AV, UAE1, L-

The relay AV closes its contacts AV1 to shunt the resistor AR. Consequently, the generator field Gf is connected directly across the buses L+ and L- and rapid acceleration of the eleva-

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for car to its full speed in a downward direction is assured.

The energization of the down direction relay D also results in opening of the break contacts D6 to prevent energization of the up direction relay U. In addition, the make contacts D7 close to complete a holding circuit for the relay D around the master switch MS. Also, make contacts D3 close to prepare the down direction inductor switches for subsequent energization.

The speed relay V upon energization also opens its break contacts V2 and V3. However, such opening has no immediate effect on the operation of the system.

With the elevator car traveling downwardly, let it be assumed that the car attendant desires to stop the car at the third floor of the building in which the elevator system is installed. As the car passes the fourth floor, the car attendant centers the car switch MS for the purpose of completing the following energizing circuit:

L+, MS, DE, DAE, D8, L—

Although the coils of the inductor switches DE and DAE are energized, it will be understood that the contacts of these inductor switches do not close until the inductor switches reach an associated inductor channel DP. The centering of the master switch MS does not interrupt the energization of the down direction relay D for the reason that the contacts D7 maintain a holding circuit around the master switch for the relay D.

As the car continues toward the third floor, the inductor switch DE finally reaches its associated inductor channel DP for the third floor, and the inductor switch contacts DE1 open to deenergize the speed relay V. The speed relay V opens its make contacts V1 to introduce the resistor R in series with the generator field Gf, thereby initiating slowdown of the elevator car. Also, the contacts V2 close to energize the coil of the stopping inductor switch DF. The contacts V3 close but have no immediate effect on the operation of the system.

The elevator car continues downwardly at reduced speed until the inductor switch DAE reaches the inductor channel DP for the third floor. At this point, the break contacts DAE1 of the inductor switch open to deenergize the speed relay AV. Upon deenergization, relay AV opens its make contacts AV1 to introduce the resistor AR in series with the generator field Gf and the resistor R. The reduced energization of the generator field further decreases the speed of the elevator car to a suitable landing speed.

When the stopping inductor switch DF reaches the inductor channel DP for the third floor, the break contacts DF1 are opened to deenergize the down direction relay D. The down direction relay D opens its make contacts D1 for the purpose of applying the brake B and thereby bringing the car to a stop. The contacts D2 and D3 open to interrupt the energization of the generator field Gf. The contacts D4, D5 and D7 open but have no immediate effect on the system. The break contacts D6 close to prepare the up direction relay U for subsequent energization. The make contacts D8 open to interrupt the energization of the coils of the inductor switches DE, DAE and DF. The elevator car now comes to a stop at the third floor with the circuit components in the positions illustrated in Fig. 1.

Let it be assumed next that the elevator car is to be moved in an upward direction. The mas-

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ter switch MS is rotated in a counterclockwise direction to complete the following circuit:

L+, MS, D6, U, UF1, DF1, 17, L—

Upon energization, the up direction relay U closes its make contacts U1 to energize the brake winding BW for the purpose of releasing the brake. The make contacts U2 and U3 close to complete the following energizing circuit for the generator field:

L+, U2, Gf, U3, R, AR, L—

The generator field now is energized with proper polarity to produce upward motion of the elevator car.

In order to expedite acceleration of the car, the contacts U4 close to complete the following circuit:

L+, U4, DE1, V, UE1, L—

Also, the contacts U5 close to establish the following circuit:

L+, U5, DAE1, AV, UAE1, L—

The speed relays V and AV being energized close their contacts V1 and AV1 to bypass the resistors R and AR.

The make contacts U6 close to establish a holding circuit for the up direction relay U around the master switch MS. The break contacts U7 open to prevent energization of the down direction relay D. The contacts U8 close to prepare the inductor switch windings UE, UAE and UF for subsequent energization.

When the speed relay V was energized, it also opened its break contacts V2 and V3, but such opening had no immediate effect on the operation of the system.

If the car attendant desires to stop at the sixth floor of the building during the upward travel of the car, he centers his master switch MS as the car passes the fifth floor. This completes the following energizing circuit:

L+, MS, UE, UAE, U8, L—

The inductor switches UE, UAE and UF cooperate with their inductor channel UP for the sixth floor to open successively the break contacts UE1, UAE1 and UF1 in a manner similar to that previously discussed for the down inductor switches. The resulting successive deenergization of the relays V, AV and U stops the car accurately at the sixth floor by a sequence of operations which will be understood from the discussion of the stopping of a down traveling elevator car.

For the purpose of clarity in illustration, the inductor switches DF and DE in the car 1 are shown rotated 90° about the axis of their coils from the positions which they normally occupy. The construction of the inductor switches and the association of the inductor switches with the inductor channels will be discussed in detail with reference to Figs. 2 and 3 of the drawings.

Since all of the inductor switches and inductor channels are similar in construction, it will suffice to describe in detail only the inductor switch DAE and one of its associated inductor channels DP. The coil of the inductor switch DAE has a magnetic core 19 extending therethrough which is provided at each end with a polar assembly 21 and 23, respectively. Since all of the polar assemblies are similar in construction, it will suffice to describe the polar assembly 23 alone.

The polar assembly 23 includes a magnetic plate 25 which is secured to the magnetic core 19 by means of a machine screw 27. The magnetic plate 25 has a slot 29 therein which extends parallel to the axis of the coil to give the plate 25 a forked configuration. A magnetic strip armature 31 is movably located in the slot 29. The magnetic armature may be mounted for movement in any suitable manner. Preferably, a thin spring ribbon 33 has one end secured to an end of the magnetic armature 31 by means of rivets 35. The remaining end of the ribbon 33 is secured to the plate 25 by means of rivets 37.

The magnetic parts thus far mentioned may be made of any soft magnetic material, such as soft iron or soft steel. The ribbon 33 may be constructed of a magnetic material, such as steel, but a bronze spring ribbon has been found satisfactory.

The magnetic armature 31 has secured thereto in any suitable manner an arm 39 which may be constructed of a non-magnetic material, such as brass. The arm has a fold 41 which is biased by means of the spring ribbon 33 against a stop 43 secured to the plate 25. At its end, the arm 39 has a lip 45 positioned to operate a suitable switch or contact device. The switch may include either make or break contacts, or may include both make and break contacts. In the specific embodiment shown, the switch includes three parallel spaced strips 47, 49 and 51 which are constructed of an electroconductive material. These strips are insulated from each other by means of suitable insulating spacers 53. The spacers are secured in any suitable manner to the plate 25. The strip 49 constitutes a resilient, leaf spring. At their free ends, the strips 49 and 51 have contacts which normally are biased into engagement with each other. At their free ends, the strips 47 and 49 have contacts which normally are biased out of engagement with each other. (The elements 47 and 51 need not be resilient. They may be rigid to provide fixed spaced contacts between which the spring 49 may be moved.) The end of the leaf spring 49 overlaps the lip 45, and a link or spacer 54 is interposed between the lip and the end of the leaf spring 49 for the purpose of transmitting motion between the lip 45 and the leaf spring 49. Over an appreciable range, the link has substantially a universally movable engagement with the lip 45 and the leaf spring 49. This universal coupling minimizes frictional losses. The spacer 54 has a rounded end in engagement with the lip 45 and is secured loosely to the leaf spring 49 by means of a rivet 55 which passes loosely through an opening in the leaf spring 49. The play between the spacer 54 and the leaf spring 49 permits substantially frictionless transmissions of forces producing motion of the lip 45 and the leaf spring 49.

The strips 49 and 51 constitute the break contacts DAE1 employed in the system of Fig. 1. Although a switch associated with only one of the polar assemblies need be employed, the normally closed contacts DAE1 associated with each of the polar assemblies 21 and 23 may be connected in series for operation as the contacts DAE1 of Fig. 1.

When the coil of the inductor switch DAE is energized, the polar assemblies 21 and 23 have opposite magnetic polarities and establish a magnetic field in the non-magnetic gap or air gap 57 therebetween. Since a substantial air gap is provided, the reluctance offered to the flow of mag-

netic flux is substantial. The inductor switch is positioned adjacent the path of travel of the associated inductor channels DP for the purpose of receiving the inductor channels DP in the non-magnetic gap 57 as the elevator car moves through its associated hoistway.

By inspection of Fig. 2, it will be observed that each inductor channel has flanges DP1 and DP2. When an inductor channel is in the non-magnetic gap 57, each of the flanges thereof is adjacent to, and parallel to, a separate one of the plates 25. The presence of the inductor channel reduces the reluctance offered to the flow of magnetic flux produced by current flowing in the coil of the inductor switch. As a result, the magnetic forces acting on the magnetic armatures increase to a value sufficient to move the magnetic armatures against the biases of their associated spring ribbons 33. Each magnetic armature in moving operates the switch associated therewith.

Since the magnetic armatures of each inductor switch are in series, substantially the same magnetic flux flows therethrough. Should one of the magnetic armatures be moved against its spring bias in advance of a second magnetic armature associated with the same inductor switch, the first magnetic armature to move reduces somewhat the magnetic reluctance offered to the flow of magnetic flux and increases slightly the magnetic force acting on the remaining magnetic armature.

It should be noted that the channel DP is constructed of soft magnetic material and that the flanges provide large areas parallel to and adjacent each of the plates 25 of the inductor switch DAE. The channel construction permits the substantial separation of the plates 25 without necessitating a heavy or bulky inductor plate construction. Displacement of the channel DP in a lateral direction relative to the inductor switch has little effect on the reluctance of the magnetic circuit of the inductor switch. For example, if the inductor channel DP were to move upwardly, as viewed in Fig. 2, the resultant air gap would remain substantially unchanged. Since the inductor channel has large areas adjacent the plates 25, substantial movement of the inductor channel relative to the inductor switch to the left or right, as view in Fig. 2, can be tolerated.

As clearly shown in Fig. 3, the plate 25 provides a magnetic shield adjacent the upper and lower sides of the associated magnetic armature. As the inductor channel enters the non-magnetic gap of the inductor switch, the armatures are effectively shielded from the entering channel until the entering edge of the channel virtually reaches a position adjacent the magnetic armatures. By this construction, it has been found possible to limit the operation of the magnetic armature to a predetermined position of the entering edge of the inductor channel with respect to the associated magnetic armatures within a tolerance of plus or minus $\frac{1}{32}$ of an inch. Furthermore, the shielding permits the same accuracy in an operation of the inductor switch for either downward or upward movement of the inductor channel relative thereto.

After relative movement of an inductor channel and an inductor switch has operated the inductor switch, a slight return movement suffices to return the inductor switch to unoperated condition. For example, in Fig. 3 let it be assumed that in its downward movement the inductor switch DF moves over the entering end of the inductor channel DP just enough to operate or

attract the armatures of the inductor switch. It will be found that a small return movement of the inductor switch of the order of $\frac{1}{16}$ to $\frac{1}{8}$ inch suffices to return the armatures to their unoperated positions. This accurate and sensitive operation is particularly desirable for inductor switches employed in releveling. An example of inductor switches employed for releveling will be found in the Eames Patent 2,293,111.

It is sometimes desirable to mount the inductor switches for successive operation in response to small relative movements of the associated inductor channel. Such mounting of inductor switches is facilitated by offsetting the polar assembly with respect to the associated coil. Each of the plates 25 is provided with two spaced mounting holes 59 and 61. For any one inductor switch, a mounting screw 27 would be inserted in the hole 59 for the plate 25 at one end of the coil, and a mounting screw 27 would be inserted in the hole 61 for the plate 25 at the opposite end of the coil. Since the screws 27 are located on the axis of the associated coil, it follows that the plates 25 are offset in the same direction from the axis of the associated coil.

In Fig. 3, the coils of the inductor switches DAE and DF are shown mounted adjacent each other with their axes parallel and horizontal. These inductor switches are exactly the same, but the inductor switch DAE is reversed relative to the inductor switch DF about a line transverse to its axis. By inspection of Fig. 3, it will be observed that the spacing between the pairs of plates 25 of the two inductor switches DAE and DF is substantially smaller than the spacing between the coils of these switches. This permits the mounting of the inductor switches for successive operation in response to movement of the inductor channel DP through a distance smaller than the spacing between the coils of the two inductor switches. Furthermore, the horizontal mounting of the coils permits the retention of a large non-magnetic gap despite the small spacing between the successive inductor switches.

It will be noted that the magnetic armatures are mounted for movement substantially toward and from the associated non-magnetic gaps. The spring ribbons 33 provide a substantially frictionless pivot construction which has virtually no lost motion. Each of the magnetic armatures may be said to move about an axis substantially transverse to the axis of the associated coil.

Although the invention has been described with respect to certain specific embodiments thereof, numerous modifications falling within the spirit and scope of the invention are possible.

I claim as my invention:

1. In an elevator control system for an elevator car structure mounted for movement in a hoistway structure of a building to serve a plurality of floors of the building; a magnetic channel member mounted on a first one of the structures parallel to the path of movement of the car structure; a plurality of electromagnetic devices secured to a second one of the structures and spaced apart in the direction of movement of the car structure; each of the electromagnetic devices comprising a coil having its axis transverse to said direction of movement, a magnetic structure for the coil having a pair of spaced, parallel magnetic members for directing magnetic flux produced by the coil when energized into a non-magnetic gap for receiving therewithin the channel member with one magnetic member adjacent and substantially parallel to each flange

of the channel member, at least one of the magnetic members being mounted for movement toward the non-magnetic gap in response to entry of the channel member into the non-magnetic gap, while the coil is energized; and translating means responsive to movement of the movable magnetic member; the pairs of magnetic members of two successive electromagnetic devices being spaced apart by a distance less than the spacing of the coils of said two successive electromagnetic devices in said direction of movement of the car structure.

2. In an electromagnetic device, an electrically-energizable coil, a magnetic structure establishing a path having a non-magnetic gap for magnetic flux produced by current flowing in the coil, said magnetic structure comprising a magnetic core disposed in the coil, a magnetic polar structure adjacent an end of the magnetic core, said polar structure having a slot extending therethrough in the direction of the axis of the coil, a magnetic armature disposed in said slot for movement relative to the polar structure substantially in the direction of the axis of the coil toward and from the non-magnetic gap, the polar structure and the magnetic armature being disposed on one side of the non-magnetic gap, said polar structure constituting a magnetic shield for the armature in directions substantially transverse to the axis of the coil, and translating means responsive to said movement of the armature relative to the polar structure.

3. A device as claimed in claim 2, wherein the magnetic polar structure comprises a slotted magnetic plate which with the armature is disposed substantially in a common plane transverse to the axis of the winding.

4. A device as claimed in claim 3, wherein the armature comprises a strip of magnetic material, and a spring having one end secured to the strip and one end secured to the polar structure to permit movement of the armature relative to the polar structure, said spring comprising a ribbon disposed in a plane substantially parallel to said common plane.

5. In an electromagnetic device, a coil, a magnetic structure establishing a path including a non-magnetic gap for magnetic flux produced by current flowing in the coil, the magnetic structure comprising a magnetic core in the coil, a pair of spaced, parallel magnetic polar plates each adjacent a separate end of the magnetic core, the polar plates being substantially in parallel, spaced planes transverse to the axis of the coil, one of the plates having a slot extending therethrough in a direction parallel to the axis of the winding, a magnetic armature strip positioned substantially in the slot, a spring having a first end secured to the armature and having a second end secured to the associated plate to guide movement of the armature relative to the associated plate toward and from the non-magnetic gap, said non-magnetic gap being located between the plates, whereby the armature is magnetically shielded to a substantial extent by its associated plate from magnetic fields in directions other than toward the non-magnetic gap, and a translating device responsive to movements of the armature.

6. In an electromagnetic device, a pair of spaced, parallel, magnetic plates having a non-magnetic gap therebetween, an electromagnet for establishing a magnetic field between said plates, each of said plates having a slot extending therethrough in a direction substantially parallel to

said magnetic field, a pair of magnetic armatures, each located substantially entirely in a separate one of the slots for movement relative to its associated plate, whereby the magnetic plates shield the armatures substantially from magnetic fields transverse to the first-named magnetic field, means pivotally mounting the armatures for movement relative to the plates in the direction of the first-named magnetic field, said armatures when the electromagnet is energized being normally biased away from the first-named magnetic field, said plates and armatures being so proportioned that an increase in the permeability of the non-magnetic gap increases the magnetic field sufficiently to overcome the bias, and a pair of translating devices each responsive to movement of a separate one of the armatures.

7. In an electromagnetic device, a magnetic structure having a pair of spaced, parallel pole pieces defining a non-magnetic gap therebetween, and a magnetic core extending transversely relative to the pole pieces to establish with the pole pieces a magnetic path for directing magnetic flux into said non-magnetic gap, said core being displaced in a first direction from the gap, a coil surrounding the magnetic core for producing when energized magnetic flux therein, a magnetic armature movably associated with one of the pole pieces for movement by magnetic flux produced by the coil in a direction substantially parallel to the axis of the coil, the centers of the pole pieces being displaced in the same direction substantially transverse to said first direction from the axis of the coil to permit the pole pieces to be placed adjacent the pole pieces of a similar device with the coils of the devices adjacent each other, and a translating device responsive to movement of the armature.

8. In an electromagnetic assembly, a magnetic channel member, an electromagnetic device comprising a pair of spaced parallel pole pieces having a non-magnetic gap therebetween, means mounting the channel member and the device for relative movement in a direction parallel to the channel member to pass the channel member through the gap with a separate one of the channel flanges adjacent each of the pole pieces, the spacing between said pole pieces being larger than the depth of the channel, said flanges during their movement past the device being located substantially between the pole pieces, said device including a coil having an axis transverse to said direction for directing, when energized, magnetic flux through the gap and through the channel member when the member is in the gap, a magnetic armature element associated with a first one of the pole pieces for movement relative thereto toward and away from the non-magnetic gap, and a translating device responsive to movement of the armature, said translating device comprising a switch having an operating element and means including a force transmitting link for transmitting operating forces between the magnetic armature element and the operating element, said link being secured to one of the elements with a substantial amount of loose play, whereby the link may tilt with little friction in response to relative movement by the elements in directions resulting in tilt of the link.

9. In an electromagnetic assembly, an electromagnetic device having a movable armature element, a switch device having an operating element biased in a predetermined direction relative

to the armature element, and a link coupling the elements for transmitting operating forces therebetween, said link having a substantial range of universal movement about each of the points of contact of the link with the two elements, whereby the link transmits forces between the elements with little frictional loss.

10. An assembly as claimed in claim 9, in combination with a fastener securing the link to one of the elements, said fastener permitting substantial play between the link and the element to which the link is secured, said bias being in a direction maintaining the link in engagement with said elements, whereby the operating element follows movement of the armature element with negligible frictional losses.

11. In an inductor relay designed for operation in response to passage of a magnetic member adjacent thereto, a magnetic structure having a non-magnetic gap, said magnetic structure comprising stator means including a coil for establishing a magnetic field in said gap, said gap being completely open in a direction transverse to the coil axis, whereby a magnetic member may be moved through the gap in said direction to vary the magnetic reluctance offered to magnetic flux produced by the coil, and a magnetic armature positioned adjacent said gap, a resilient ribbon positioned in a plane substantially parallel to said direction and secured to the stator means and to the magnetic armature for permitting pivotal movement of the magnetic armature in a direction transverse to the plane of the ribbon towards and from the gap in response to an increase followed by a decrease in the magnetic permeability of the gap while the coil is energized, and translating means responsive to said movement of the magnetic armature.

12. An inductor relay as claimed in claim 11 wherein the magnetic armature has first and second ends and the ribbon is secured to a first end of the magnetic armature, said translating means having an operating member engaging the second end of the armature for operation in accordance with movement of said second end.

13. In an elevator system for an elevator car structure mounted for movement in a hoistway structure of a building to serve a plurality of floors of the building; a magnetic member mounted on a first one of the structures, an electromagnetic device secured to a second one of the structures for movement through a path passing adjacent to the magnetic member, said electromagnetic device having a non-magnetic gap, said gap being substantially bridged magnetically when the magnetic member is adjacent thereto, said magnetic structure comprising stator means for establishing a magnetic field in said gap, and a magnetic armature positioned adjacent said gap, a resilient ribbon secured to the stator means and to the magnetic armature for permitting pivotal movement of the magnetic armature in a direction transverse to the plane of the ribbon towards and from the gap when the magnetic member substantially magnetically bridges the gap and is removed from the vicinity of the gap, and translating means responsive to said movement of the magnetic armature, the plane of said ribbon being substantially parallel to the direction of movement of the elevator car.

14. A system as claimed in claim 13 wherein the magnetic armature has first and second ends and the ribbon is secured to a first end of the magnetic armature, said translating means hav-

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ing an operating member engaging the second end of the armature for operation in accordance with movement of said second end.

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