Sept. 19, 1944. W. C. FURNAS ET AL 2,358,568

MAGNETIC REVERSING SWITCH

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Fig. 1.

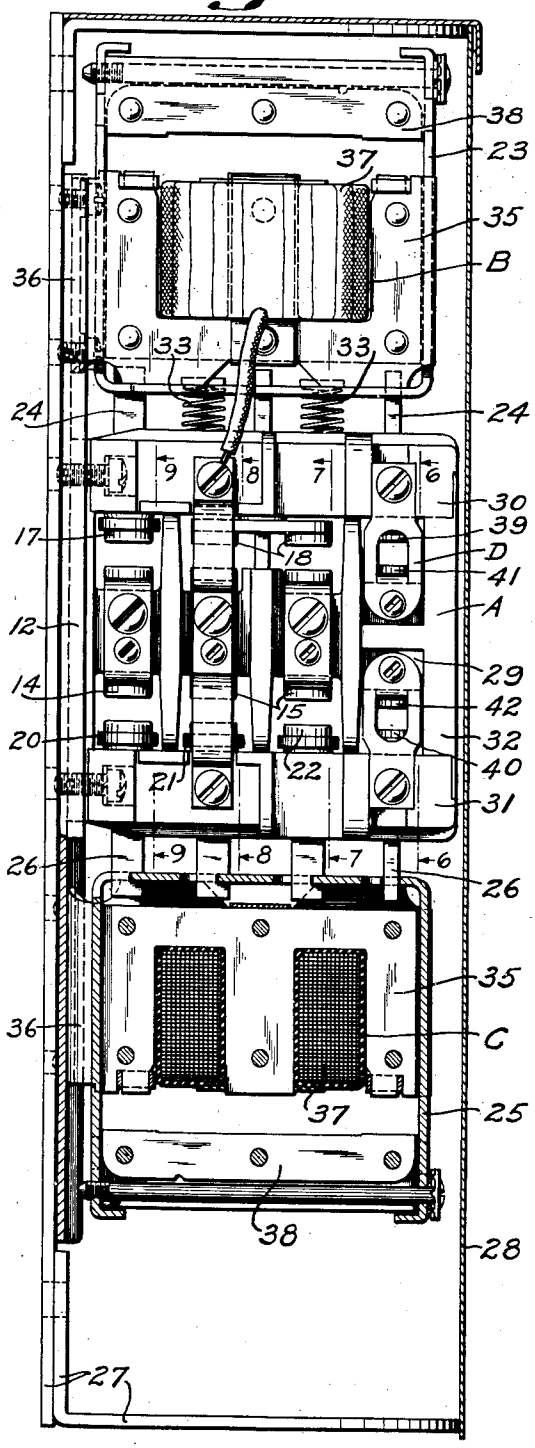
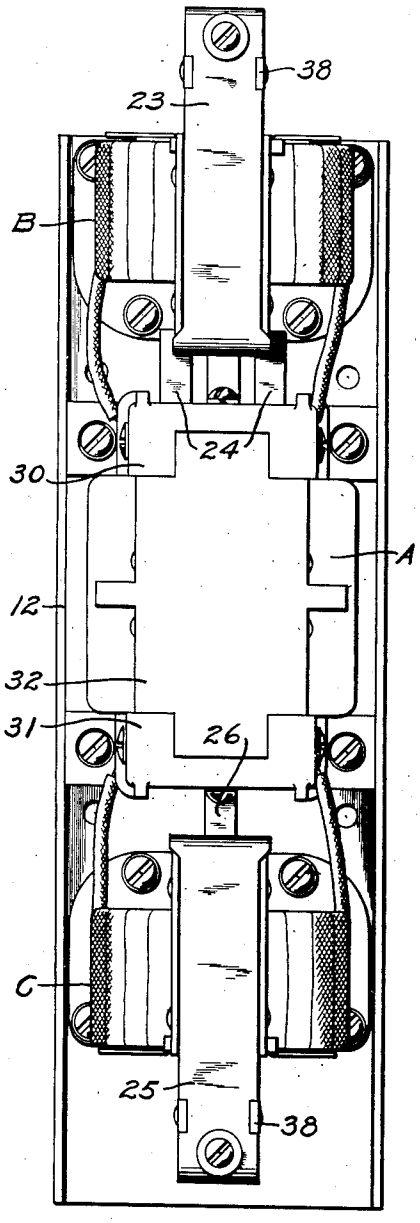


Fig. 2.



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Fig. 3.

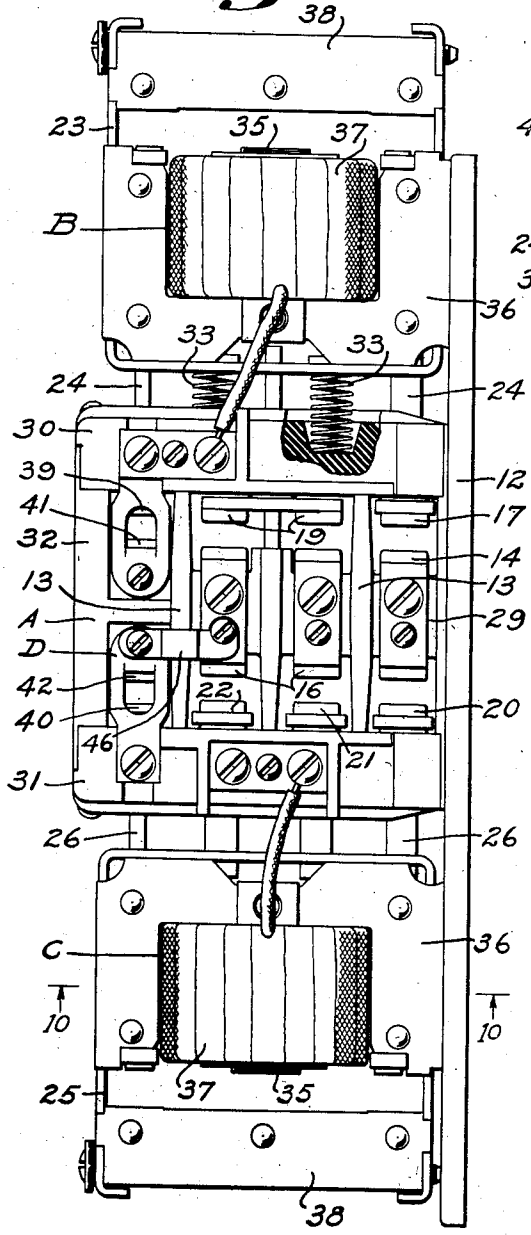


Fig. 4.

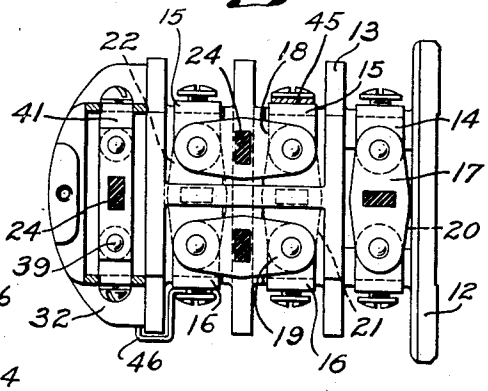
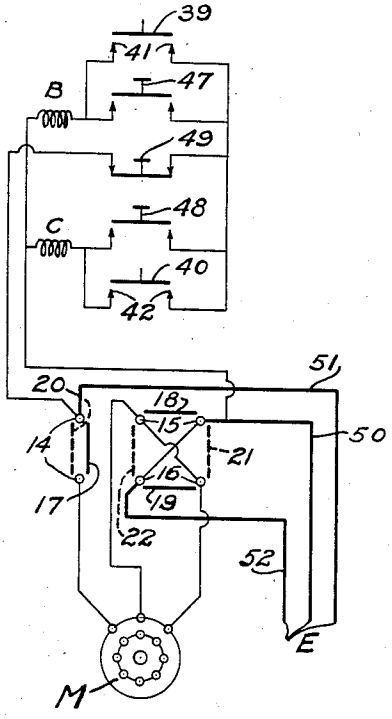


Fig. 5.



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Fig. 6.

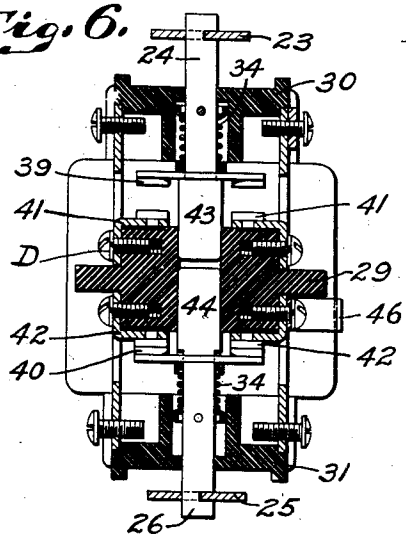


Fig. 7.

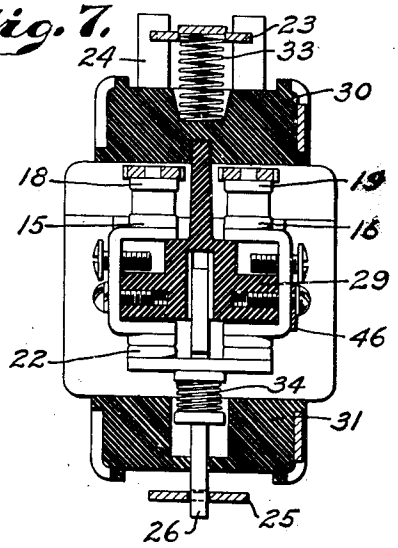


Fig. 8.

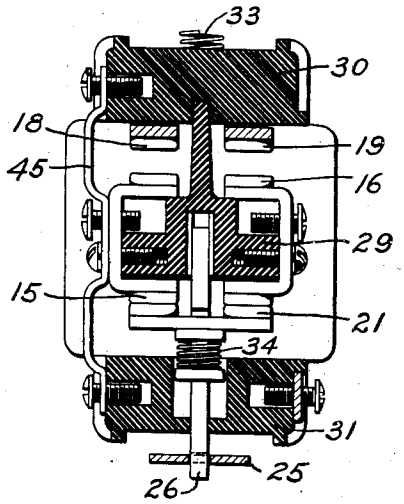


Fig. 9.

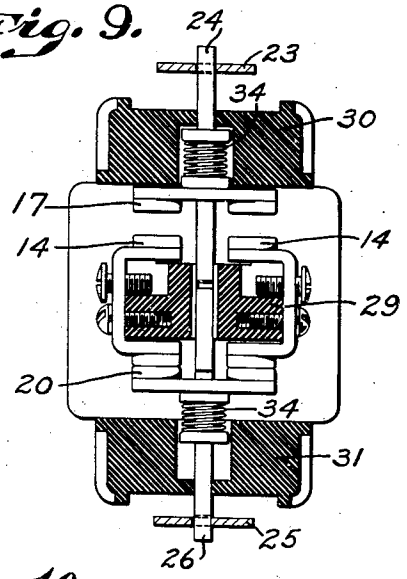
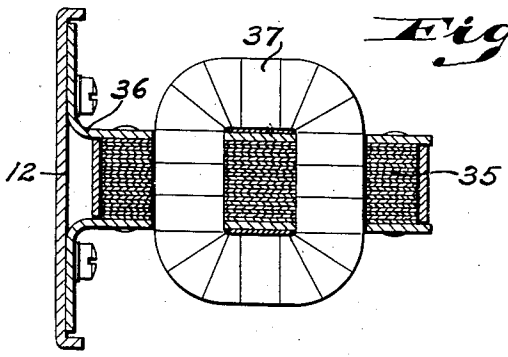


Fig. 10.



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UNITED STATES PATENT OFFICE

2,358,568

MAGNETIC REVERSING SWITCH

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Application May 21, 1941, Serial No. 394,486

4 Claims. (Cl. 200—98)

The present invention relates generally to improvements in electric switch assemblages, and relates more specifically to various improvements in the construction and operation of magnetically operable reversing switch mechanisms.

An object of this invention is to provide an improved magnetic reversing switch which is simple, compact and durable in construction, and which is also highly efficient in operation.

It has heretofore been common practice to operate various types of switches magnetically, and when magnetic operation is utilized to effect actuation of a reversing switch for motors or the like, it is necessary to provide some form of automatic interlock between the forward and reverse switch elements, in order to positively prevent both sets of contacts from closing simultaneously, since such action would produce short circuiting of the power line. In the prior commercial magnetic reversing switch assemblages, it has been customary to provide two separate and independent sets of contacts, one for forward and the other for reverse operation, connected in parallel; and when these assemblages are utilized in multi-phase systems, the three leads both of the main line and of the motor, are connected to both sets of contacts, and the movable contacts of both sets are mechanically interlocked so as to avoid short circuits. The mechanical interlock between the two sets of switch contacts of these prior multi-phase magnetic switch mechanisms, is ordinarily interposed between the movable cores of the two magnet assemblages, and the prior switches of this general type are therefore relatively cumbersome, complicated, costly, and insufficiently durable to withstand rapid and repeated operation for any great length of time.

It is therefore a more specific object of our present invention, to provide a new and useful poly-phase magnetic reversing switch assemblage, all of the elements of which are embodied in a single relatively simple and compact unit.

Another specific object of the present invention is to provide an improved magnetically operated reversing switch wherein the number of contacts and the number of terminal connections are reduced to a minimum, and in which the several contacts and terminals are effectively segregated and insulated from each other.

A further specific object of the invention is to provide an improved magnetic switch unit, in which the movable elements are of relatively light but durable construction, thereby enhancing the speed of action by minimizing the effects of inertia, and also prolonging the life of the switch to a maximum.

Still another specific object of our invention is to provide an improved reversing switch assemblage, the various parts of which may be conveniently manufactured and assembled, and which may be produced at moderate cost.

An additional specific object of this invention is to provide an improved multi-phase magnetic reversing switch in which the structure is simplified by making the mechanical interlock an inherent part of the switch assemblage, thus eliminating elements such as pull-rods, levers, and the like.

Another specific object of the invention is to provide a reversing switch mechanism wherein friction and resultant wear are reduced to a minimum, thus producing a durable and compact assembly having maximum capacity and which is operable at high speed.

A further specific object of the present invention is to provide a magnetic reversing switch unit wherein the actuating magnets are closely associated with the contacts, in alinement with each other, and in which all elements are effectively protected.

Still another object of our invention is to provide various other improvements in the details of construction and operation of poly-phase magnetic reversing switches, whereby the cost of construction is reduced to a minimum and the efficiency is enhanced to a maximum.

These and other objects and advantages will be apparent from the following description.

A clear conception of the several features constituting our present invention, and of the mode of constructing and of operating magnetic reversing switches built in accordance with the improvement, may be had by referring to the drawings accompanying and forming a part of this specification wherein like reference characters designate the same or similar parts in the various views.

Fig. 1 is a part sectional left side elevation of one of the improved magnetic reversing switch units;

Fig. 2 is a front view of the improved reversing switch mechanism of Fig. 1 removed from its housing;

Fig. 3 is a right side elevation of the switch mechanism with the housing omitted;

Fig. 4 is a top view of the switch contact as-

semblage, showing the contact actuating bars in section;

Fig. 5 is a winding diagram showing the improved magnetic reversing switch applied in a three-phase motor circuit;

Fig. 6 is a vertical section through the switch contact assembly, taken along the line 6—6 of Fig. 1 and showing the reverse interlock contacts closed;

Fig. 7 is a similar section through the contact assemblage, taken along the line 7—7 of Fig. 1, and showing the switch in reverse;

Fig. 8 is another similar section through the contact group similarly positioned in reverse, and taken along the line 8—8 of Fig. 1;

Fig. 9 is still another similar section with the elements in reverse, taken along the line 9—9 of Fig. 1; and

Fig. 10 is a transverse horizontal section through the lower magnet assemblage, taken along the line 10—10 of Fig. 3.

While our invention has been shown and described herein as having been specifically embodied in a unitary vertically disposed thereephase magnetic reversing switch assemblage of a specific type, it is not the intent to thereby unnecessarily restrict the scope or utility of the several features constituting the improvement.

Referring to the drawings, the improved polyphase magnetic reversing switch unit shown therein by way of illustration, comprises in general, an upright main support or base plate 12; a multiple switch assembly A firmly mounted upon the medial portion of the base plate 12 and having central sets of fixed contacts 14, 15, 16 interchangeably cooperable with upper sets of movable forward contacts 17, 18, 19, and with lower sets of movable reverse contacts 20, 21, 22; an upper magnet assemblage B associated with the base plate 12 above the switch assembly A and having a vertically slidable member 23 connected with the upper movable contacts 17, 18, 19 by means of insulating bars 24; a lower magnet assemblage C associated with the base plate 12 below the switch assembly A and also having a vertically slidable member 25 likewise connected with the lower movable contacts 20, 21, 22 by means of other insulating bars 26; interlock mechanism D also constituting a part of the switch assembly A; and a housing comprising a supporting frame 27 secured to the base plate 12, and a removable cover 28, coacting with the frame to enclose and protect the switch and magnet assemblages.

The compact central switch assembly A consists primarily of a central horizontal auxiliary supporting element or plate 29 upon which the fixed sets of contacts 14, 15, 16 are fixedly mounted, upper and lower horizontal elements or plates 30, 31 respectively spaced from the central plate 29 and being rigidly secured to the support or base plate 12, and a vertical front plate 32 which may be formed integral with the plate 29 and interconnects the plates 29, 30, 31. The blocks or plates 29, 30, 31, 32 are all formed of insulating material, and the medial plate 29 is provided with vertical fins or walls 13 which abut against the upper and lower plates 30, 31 and segregate the contacts 14, 15, 16 from each other. The upper plate 30 provides a reaction block for a pair of compression springs 33 which coact with the upper armature 23 but the lower plate 31 does not coact with such springs when the unit is disposed vertical, see Figs. 1, 3 and 7. The movable contacts are normally urged toward the adjacent fixed contacts by means of other compression springs 34 embracing the adjacent contact carrier bars 24, 26, see Figs. 7 and 8.

The upper and lower magnet assemblages B, C are spaced apart and are of similar construction but are reversely positioned in vertical alinement with each other, and each magnet assembly comprises a laminated E-shaped magnetic core 35 fixedly secured to the support or base plate 12 by means of brackets 36; a magnet winding or coil 37 cooperating with the core 35 to magnetize the same when the coil is energized; and a laminated armature or cross-bar 38 carried by and being movable with each of the movable members 23, 25, and cooperating with the adjacent magnet core 35, see Figs. 1 and 10. The yoke shaped members 23, 25, are preferably formed of relatively thin and light but durable non-magnetic metal; and these yoke members 23, 25 are slidably confined upon the fixed brackets 36. The movable contact carrier bars 24, 26 which are formed of insulating material, are detachably attached to the members 23, 25 respectively, as clearly shown in Fig. 1, and are slidably confined within the contact assembly plates 30, 31, see Fig. 4.

The improved interlock mechanism D comprises upper and lower sets of transverse movable contacts 39, 40 respectively carried by the adjacent actuating bars 24, 26, and being interchangeably cooperable respectively with sets of fixed contacts 41, 42 secured to the central contact assembly plate 29, see Fig. 6. The contact carrier bars 24, 26 which carry the movable interlock contacts have adjacent end portions 43, 44 respectively, which are slidable in slots in the medial plate 29, and are of such length that they will positively prevent simultaneous closing of both the upper and lower sets of movable contacts, as clearly illustrated in Figs. 6 and 9. The upper set of fixed interlock contacts 41 is connected in series with the upper magnet coil, while the lower set of fixed interlock contacts 42 is likewise connected in series with the lower magnet coil, see Figs. 3 and 6. These magnet coils are also connected with the set of fixed contacts 15 as shown in Figs. 1, 4 and 8, by means of a connecting conductor 45, so that closure of the upper movable interlock contacts 39 will energize the upper forward magnet, whereas closure of the lower movable interlock contacts 42 will energize the lower reverse magnet, but the adjacent end portions 43, 44 of the contact carrier bars 24, 26 will prevent simultaneous closing of the upper and lower contacts and will therefore positively prevent short circuiting. The contacts 16 are also permanently connected to the interlock contacts 42 by a conductor 46, see Figs. 3, 4 and 6.

The improved reversing switch is operable with the aid of a push button control to effect either forward or reverse operation, or stoppage, of an electric motor M or other reversely operable electric device, as shown in the diagram of Fig. 5. The push button control has a forward button switch 47, a reverse button switch 48, and a stop button switch 49; and when the switch 47 is closed, the magnet assembly B will be effective, whereas when the switch 48 is closed, the magnet assembly C will be active, as shown in Figs. 6 to 9 inclusive. When the stop button 49 is pressed, either magnet assembly B or C, whichever is energized, will be de-energized, and the reversing switch mechanism will assume inactive position with all contacts open as shown in Figs. 1, 3 and

5. The main line E may be introduced into the reversing switch housing through openings in the lower wall of the frame 27, and should have one lead 50 connected to one of the fixed contacts 16, another lead 51 connected to one of the fixed contacts 14, and the third lead 52 connected to one of the remaining fixed contacts 15, as shown in the diagram so that when either magnet assembly B, C is active, the corresponding movable contacts will engage the fixed contacts, and the corresponding interlock will become effective and remain so until positively broken either by reversing the operation or by actuating the stop switch.

During normal use of the improved polyphase reversing switch, when the system is in the condition shown in the diagram of Fig. 5, with the stop button switch 49 closed, all other contacts will be open, both magnet assemblages B, C will be de-energized, and the motor M will be idle.

If the reverse push button switch 48 is then closed, the lower magnet assembly C will be energized and the lower member 25 will be elevated to quickly close the lower interlock contacts 40, 42, and to simultaneously bring the lower movable contacts 20 into engagement with the two fixed contacts 14, and the lower movable contacts 21, 22 into engagement with one of each of the fixed contacts 15, 16. The motor M will then be connected to the main line E for reverse operation, and will remain thus connected until the stop push button switch 49 is opened, whereupon the magnet assembly C will be de-energized and the lower member 25 together with the lower bars 38, 26 and movable contacts 20, 21, 22, 40 will drop by gravity, thus breaking the interlock and line circuits and restoring the switch elements to inactive position.

If, on the other hand, the forward push button switch 47 is closed after the stop switch 49 has been closed, the upper magnet assembly B will be be energized and the upper member 23 will be moved downwardly to quickly close the upper interlock contacts 39, 41, and to simultaneously bring the upper movable contacts 17 into engagement with the two fixed contacts 14, the upper movable contacts 18 into engagement with both fixed contacts 15, and the upper movable contacts 19 into engagement with the two fixed contacts 16. The motor M will then be connected to the main line E for forward operation, and will remain in this condition until the stop push button switch 49 is again opened, whereupon the magnet assembly B will be de-energized and the upper member 23 together with the upper bars 38, 24 and movable contacts 17, 18, 19, 39 will be elevated by the springs 33, thus breaking the interlock and line circuits and again restoring the switch elements to inactive position.

From the foregoing detailed description of the construction and operation of the improved magnetic reversing switch, it will be apparent that the relatively simple and compact switch assembly operates quickly and positively for both forward and reverse operation, and can be readily restored to neutral or inactive position with the aid of the stop button switch 49. While the magnet assemblages B, C are located closely adjacent to the central switch and inkerlock assemblages A, D, the various contacts are thoroughly insulated from the magnets and from each other, wherever necessary, by the insulated motion transmission bars 24, 26 and by the insulation plates 29, 30, 31, 32. The use of the insulated bars 24, 26 is therefore important, and the formation of the sliding armatures 23, 25 of light non-magnetic sheet metal is also important in order to enhance the speed of operation and to eliminate delay due to inertia. While the lower movable contacts are returned to open position by gravity and the upper movable contacts are thus returned by the springs 33, this mode of returning the movable contacts is primarily applicable to vertically arranged switches; and if the improved switch assembly is to be used in horizontal position, then springs 33 should also be provided between the fixed plate 31 and the movable member 25. The springs 34 which embrace the bars 24, 26 and coact with the adjacent movable contacts, serve only to insure proper seating of all of these contacts, and the projections 43, 44 at the adjacent ends of the bars 24, 26 are extremely important since they positively prevent possibility of short circuiting by preventing simultaneous closing of both forward and reverse contacts. The improved contact supporting and housing assembly comprising the insulating plates 29, 30, 31, 32, may be readily constructed, assembled and dismantled, and provides a compact and highly effective switch assembly A, and the additional housing afforded by the frame 27 and cover 28 also protects the switch mechanism and provides a neat and attractive unit, while permitting convenient access to the normally concealed parts. The improved magnetic switch assemblage may obviously be manufactured and sold at moderate cost since the metal parts are formed primarily of sheet metal stampings, and has proven highly practical and efficient in actual use.

It should be understood that it is not desired to limit this invention to the exact details of construction or to the precise mode of use, herein shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

We claim:

1. In combination, an elongated rigid support, a pair of independent electro-magnets having spaced-apart oppositely facing E-shaped magnet cores fixedly mounted upon said support and each core having an energizing coil mounted therein, a group of stationary forward and reverse and interlock contacts mounted upon said support between said electro-magnets, a rectilinearly movable set of forward and interlock contacts disposed between one of said electro-magnets and said group of fixed contacts, another rectilinearly movable set of reverse and interlock contacts disposed between the other of said electro-magnets and said fixed contacts, the interlock contacts of both of said movable sets being directly cooperable to positively prevent simultaneous closing of said forward and reverse movable contacts, a magnetic armature bar spanning the open side of each of said E-shaped cores remote from said contacts, and a light non-magnetic one-piece U-shaped yoke connecting each of said armature bars with the nearest set of said movable contacts, each of said yokes having side arms slidably coacting with the adjacent magnet core and also having an integral transverse portion of approximately the same thickness as the side arms connected to the adjacent set of movable contacts.

2. In combination, an elongated rigid support, a pair of independent electro-magnets having spaced-apart oppositely facing E-shaped magnet cores fixedly mounted upon said support and each core having an energizing coil mounted therein, a group of stationary forward and reverse and interlock contacts mounted upon said

support between said electro-magnets, a rectilinearly movable set of forward and interlock contacts disposed between one of said electro-magnets and said group of fixed contacts, another rectilinearly movable set of reverse and interlock contacts disposed between the other of said electro-magnets and said fixed contacts, the interlock contacts of both of said movable sets being directly cooperable to positively prevent simultaneous closing of said forward and reverse movable contacts, a magnetic armature bar spanning the open side of each of said E-shaped cores remote from said contacts, and a light non-magnetic one-piece U-shaped yoke connecting each of said armature bars with the nearest set of said movable contacts, each of said yokes having side arms slidably coacting with the adjacent magnet core and also having an integral transverse portion of approximately the same thickness as the side arms connected to the adjacent set of movable contacts, and each of said movable contacts having a supporting bar slidably mounted upon said rigid support and detachably attached to the transverse portion of the adjacent yoke.

3. In combination, an elongated rigid support, a pair of independent electro-magnets having spaced-apart oppositely facing E-shaped magnet cores fixedly mounted upon said support and each core having an energizing coil mounted therein, a group of stationary forward and reverse and interlock contacts mounted upon said support between said electro-magnets, a rectilinearly movable set of forward and interlock contacts disposed between one of said electro-magnets and said group of fixed contacts, another rectilinearly movable set of reverse and interlock contacts disposed between the other of said electro-magnets and said fixed contacts, the interlock contacts of both of said movable sets having alined projections rectilinearly slidable with respect to said support and directly cooperable with each other to positively prevent simultaneous closing of said forward and reverse movable contacts, a magnetic armature bar spanning the open side of each of said E-shaped cores remote from said contacts, and a light non-magnetic one-piece U-shaped yoke connecting each of said armature bars with the nearest set of said movable contacts, each of said yokes having side arms slidably coacting with the adjacent magnet core and also having an integral transverse portion of approximately the same thickness as the side arms connected to the adjacent set of movable contacts.

4. In combination, an elongated rigid support, a pair of independent electro-magnets having spaced-apart oppositely facing E-shaped magnet cores fixedly mounted upon said support and each core having an energizing coil mounted therein, a group of stationary forward and reverse and interlock contacts mounted upon said support between said electro-magnets, a rectilinearly movable set of forward and interlock contacts disposed between one of said electro-magnets and said group of fixed contacts, another rectilinearly movable set of reverse and interlock contacts disposed between the other of said electro-magnets and said fixed contacts, the interlock contacts of both of said movable sets having alined projections rectilinearly slidable with respect to said support and directly cooperable with each other to positively prevent simultaneous closing of said forward and reverse movable contacts, a magnetic armature bar spanning the open side of each of said E-shaped cores remote from said contacts, and a light non-magnetic one-piece U-shaped yoke connecting each of said armature bars with the nearest set of said movable contacts, each of said yokes having side arms slidably coacting with the adjacent magnet core and also having an integral transverse portion of approximately the same thickness as the side arms connected to the adjacent set of movable contacts, and each of said movable contacts having a supporting bar slidably mounted upon said rigid support and detachably attached to the transverse portion of the adjacent yoke.

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