Nov. 6, 1951 W. McLEOD 2,573,920

COUPLING ACTUATED MAGNETIC SWITCH

Filed April 25, 1949 2 SHEETS--SHEET 1

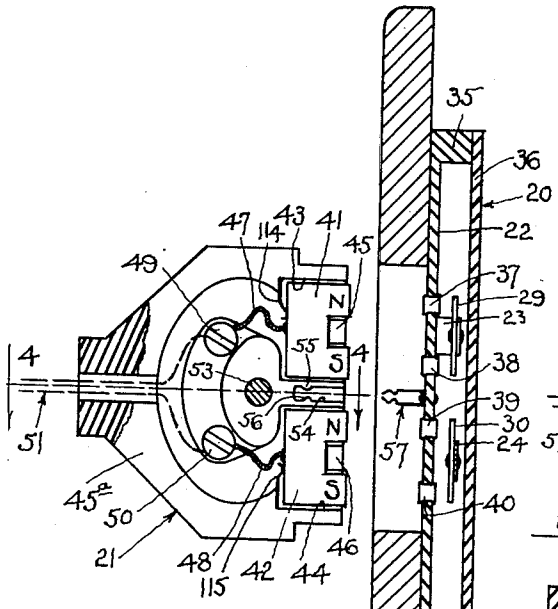

Fig. 1.

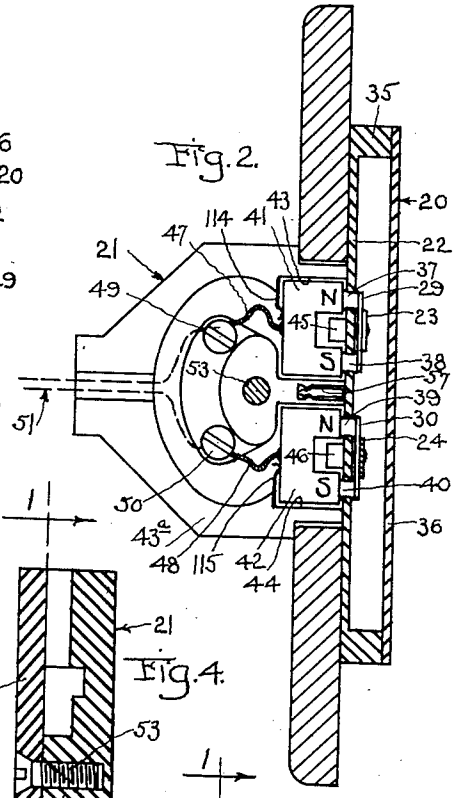

Fig. 2.

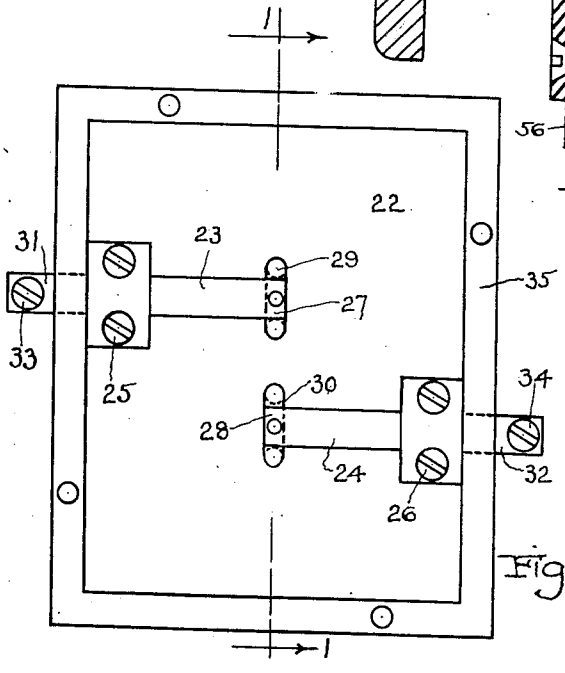

Fig. 5.

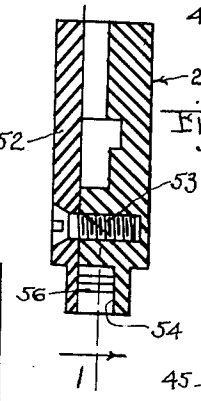

Fig. 4.

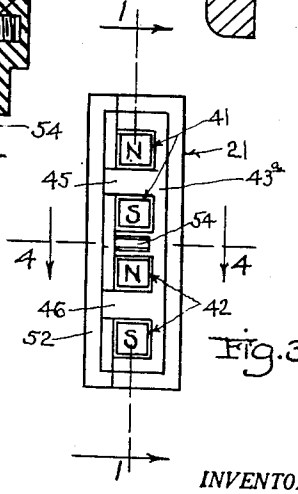

Fig. 3.

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COUPLING ACTUATED MAGNETIC SWITCH

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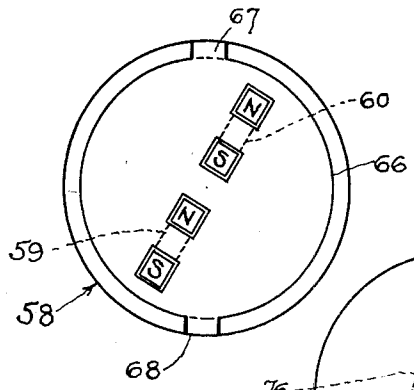

Fig. 6.

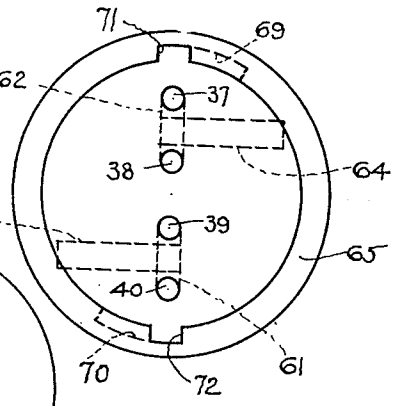

Fig. 7.

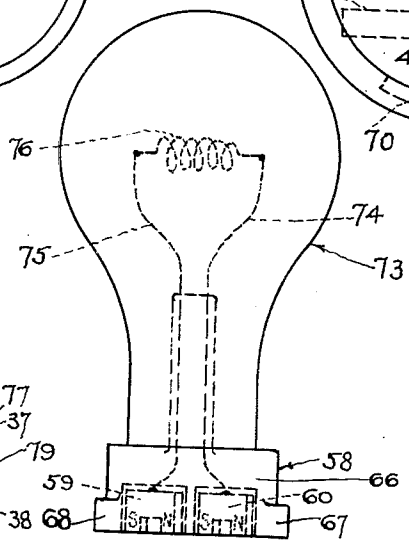

Fig. 8.

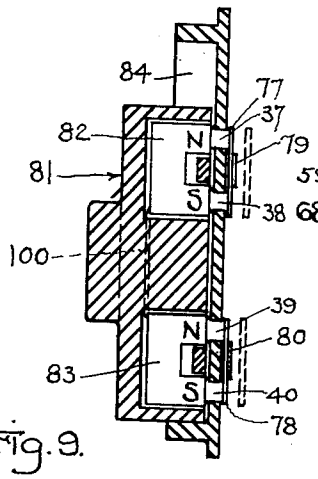

Fig. 9.

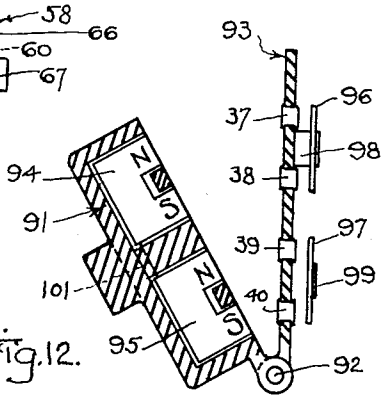

Fig. 12.

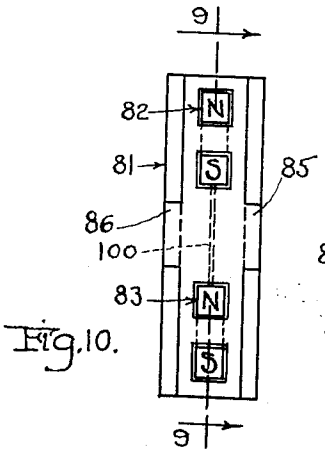

Fig. 10.

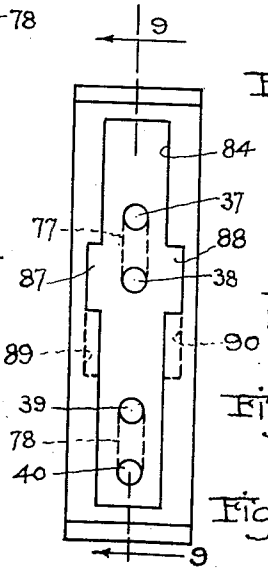

Fig. 11.

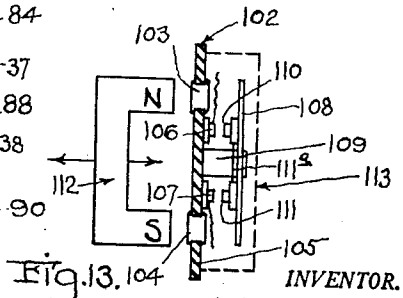

Fig. 13.

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COUPLING ACTUATED MAGNETIC SWITCH

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Application April 25, 1949, Serial No. 89,386

2 Claims. (Cl. 200—51.09)

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This invention relates to improvements in electrical connectors, switches, fixtures, and like devices or units. Generally speaking the invention herein disclosed has to do with such devices as sockets and plugs intended for use as outlets for so-called base-boards and like installations, and for other similar installations wherein an extension circuit is to be established; but it will also appear that my present improvements are also well adapted for use in many other locations, and for many other purposes. For example these improvements are well adapted for use in connection with lamp sockets and bases intended for introduction into such sockets; and for use in switches and like circuit controlling units. Some of these applications of the present invention will be illustrated and described hereinafter.

One object of the invention is to provide a socket element and plug for use in connection therewith, both of such form that when the plug is not in place in the socket the electrical terminals of such socket will be "dead" or non-electrified, and such that when the plug is set into place in or in connection with such socket the terminals of the socket will immediately become electrified so as to establish and complete the electrical circuit between the socket and the plug. By this means the terminals of the socket will be at all times electrically dead when such terminals are exposed due to the absence of the complementary plug. Thus danger of improper connection to such socket terminals will be completely avoided, and resulting short-circuiting will be prevented. In like manner, danger of shocks occasioned by contact with the exposed socket terminals will be prevented. Many other advantages resulting from this arrangement will manifest themselves from a study of the present disclosures.

It is a further object of the invention to enclose the connections to the socket terminals within a sealed container or compartment having only sealed and non-moving connections to the outside of such compartment, so that perfect sealing of the compartment may be effected, and so that the perfectly sealed condition of this compartment will be maintained for an indefinitely long interval and after a great number of attaching and detaching operations of the complementary plug with the socket. By this means, also, said connections within said compartment may be perfectly sealed against entrance of water, dirt, and other foreign matter, thus ensuring perfect and continuous protection of said connections from the effects of such water, dirt, and other foreign matter.

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In addition to the use of my present improvements in connection with sockets and plugs therefor, there are many other applications wherein said improvements are or will be of great value. One specific application of said improvements relates to their use in connection with lamps and the sockets therefor.

When the features of my present invention are embodied in switching units, as such, the actual circuit closing and opening operations may be produced completely within the housing or enclosure, or through elements which reach to the outside thereof. Both of these forms are illustrated in the drawings to be presently described.

Other objects and uses of the invention will appear from a detailed description of the same, which consists in the features of construction and combinations of parts hereinafter described and claimed.

In the drawings:

Figure 1 shows a longitudinal section through a typical form of socket unit and complementary plug member, embodying the features of my present invention, the plug member being separated from the socket unit a distance sufficient to non-influence the magnetically responsive elements of the socket unit, and to thus bring the exposed contacts of the socket unit into "dead" condition, and the plug contacts being disengaged from the exposed contacts of the socket unit;

Figure 2 shows a section similar to that of Figure 1, but with the plug member engaged with the socket unit to thus electrify the exposed contacts of the socket unit, and to bring the contacts of the plug member into engagement with the exposed contacts of the socket unit;

Figure 3 shows an end view of the plug member of Figures 1 and 2;

Figure 4 shows a cross-section taken on the lien 4—4 of Figures 1 and 3;

Figure 5 shows a face view of the socket unit plate, with the housing removed therefrom to show the form of the magnetically responsive elements, and the spring elements for normally moving the movable contacts of the socket unit into open circuit position to thus de-electrify the exposed contacts of the socket unit;

Figure 6 shows a modified form of plug member in which the plug member is intended to make engagement with the socket unit by a rotary

movement instead of by a linear movement as in the case of the construction of Figures 1 to 5;

Figure 7 shows a face view of the socket unit corresponding to and intended for use with the plug member of Figure 6; these parts being locked together by means of a "bayonet" type of connection;

Figure 8 shows a plug member of the form shown in Figure 6 provided directly with a lamp, so that said plug member constitutes in reality a lamp of the plug base type intended for use in connection with a socket unit of the type shown in Figure 7;

Figure 9 shows a longitudinal section through another form of socket and plug combination in which the engagement of the plug with the socket is by a sliding action, this figure being a section taken on the lines 9—9 of Figures 10 and 11, looking in the directions of the arrows;

Figure 10 shows an end view of the plug member of the arrangement of Figure 9;

Figure 11 shows a face view of the socket unit of the arrangement of Figure 9;

Figure 12 shows a longitudinal section through still another form of socket and plug combination in which engagement of the plug with the socket is by a rocking movement, the "plug" member being shown in disengaged or open circuit condition; both the arrangements of Figures 9, 10 and 11, and of Figure 12, being in effect switch constructions; and

Figure 13 shows another form of embodiment of my invention into a switch construction in which the movable or permanent magnet element carries no portion of the current being controlled, all circuits and contacts being fully enclosed in the housing of the "socket" unit.

Referring first to the embodiment of the invention shown in Figures 1 to 5, inclusive, I have therein shown my invention as embodied in a construction including the "socket unit" and the "plug member" designated in their entireties by the numerals 20 and 21, respectively. The socket unit is shown as including the insulating plate 22 to the back side of which there are secured the spring leaf conductors 23 and 24, respectively, by the rivets or screws 25 and 26. The free or movable ends 27 and 28 of these leaf spring conductors come into substantial alignment as well shown in Figure 5. These free or movable ends carry the armatures or "keepers" 29 and 30 of soft magnetic iron or magnetizable material which will respond readily to induced flux from another source. The secured ends 31 and 32 of these spring leaf elements readily provide terminal connectors to which the opposite poles of the source of current are connected in well understood manner. Set screws 33 and 34 are shown for effecting such connections.

The insulating plate 22 comprises one wall of a housing for the parts just described, and a suitable enclosure is provided in connection for this wall. In the arrangement shown in Figures 1 to 5, inclusive this plate 22 is provided with the integral backwardly extending flange 35 and a removable cover plate 36 is secured in water tight fashion to the edge of this flange to complete the housing enclosure. It will be noted that terminal connections may be made to the connectors 31 and 32 without having to open the enclosure or housing.

In the plate 22 there are securely carried the four rivet-like plugs or studs 37, 38, 39 and 40. These are preferably made of magnetic iron of soft character, so that these studs may be readily magnetized and these studs will readily transmit flux between a permanent magnet located externally of the socket unit to act on the armatures 29 and 30, drawing them towards such studs for the circuit closing operation. In Figure 1 the studs are non-magnetized, and the armatures 29 and 30 are seen to be sprung back away from the plugs 37, 38, 39 and 40 so that the armatures 29 and 30 are out of electrical connection with these studs. On the contrary, in Figure 2 the armatures have been drawn towards and into contact with these studs 37, 38, 39 and 40, said studs having been magnetized by flux induced in them. Thus said studs are normally non-electrified or "dead," since they are normally not contacted by the armatures 29 and 30, which armatures comprise electrical connecting means attached to the spring leaves 23 and 24, respectively.

The plug member 21 includes the two permanent magnet elements 41 and 42. These are shown as being of horse-shoe form, and the legs of these two horse-shoes align with the studs 37, 38, 39 and 40 when the plug member is brought into circuit connecting condition, as shown in Figure 2. These permanent magnets may be of any suitable material, such as Alnico 5 or other permanently magnetizable material of high retentive character. These two permanent magnets are carried within sockets 43 and 44 of an insulating plug element 45a; and conveniently these horse-shoe magnets are retained within such sockets 43 and 44 by means of the cross bars 45 and 46 comprising a portion of such element 45a, which is made of insulating material such as a synthetic moulded product. Examination of Figures 1 and 2 shows that these horse-shoe magnets are rather loosely set into their respective sockets 43 and 44, so that said magnets may move slightly back and forth, and side to side, and with slight rocking movements while being still retained within the sockets by the cross bars 45 and 46. These horse-shoe magnets are connected by the short and flexible pig-tail connectors 47 and 48 with the terminal screws 49 and 50, to which the double wire extension cord 51 is connected in well understood manner. The plug element 45a is readily formed of synthetic insulating material by a moulding process or other means; and a removable cover plate 52 is secured on to this element in convenient manner as by means of the screw 53.

As already stated the legs of the two horse-shoe magnets are spaced to align with the studs 37, 38, 39 and 40 of the socket unit when the plug member is to be brought into connection with said socket unit. This fact is well shown in Figures 1 and 2. As the plug member is moved close to the socket unit with the magnet legs aligned as just explained, there will be flux induced through magnetic circuits including the studs 37, 38, 39 and 40, and through the armatures 29 and 30, thus drawing these armatures towards and into contact with the studs, the armature 29 engaging the studs 37 and 38, and the armature 30 engaging the studs 39 and 40. As soon as this condition occurs it is evident that said studs will be electrified or cease to be "dead," the studs 37 and 38 being of one electrical polarity, and the studs 39 and 40 being of opposite electrical polarity.

This movement of the armatures 29 and 30 into contact with the studs will generally anticipate actual engagement of the magnet legs with the studs 37, 38, 39 and 40, so that by the time said

magnet legs come into actual contact with the studs, said studs have become electrified. The slight freedom of movement of the magnets within the sockets 43 and 44 wherein they are accommodated is such as to allow said magnet legs to come into good and even contact with the exposed ends of the studs without exercise of great care by the user, so that when insertion of the plug member into the socket unit has been completed good electrical contacts will be produced between the studs and the magnet legs. Thus the necessary connections are effected through the socket unit and the plug member to place the conductors of the cord 51 into connection with the current supply lines.

As soon as the plug member is withdrawn sufficiently from the socket unit to disengage the magnet legs from the studs 37, 38, 39 and 40 air gaps will be created between the magnet legs and said studs so that great and sudden increase of reluctance of the magnetic circuits will occur, and the spring forces of the spring leaves 23 and 24 will at once swing the armatures 29 and 30 away from the studs, thus breaking the electrical connections between said armatures and studs. This will de-electrify said studs, so that they will again become dead and harmless.

Evidently the magnetic attraction between the horse-shoe magnets and the studs and armatures will produce a holding force tending to prevent the plug member from being disconnected from the socket unit. This holding force will be considerable. However, it is desirable to provide for further and greater holding force between these parts, and I have made provision for the same. Thus, in the form shown in Figures 1 to 5, inclusive I have provided the inwardly reaching socket or opening 54 in the end of the plug element 45a, the opposite walls of this opening being provided with the inwardly extending ribs 55 and 56. The socket unit is provided with a companion spring catch element 57, carried by the plate 22, so that as the plug member is set into engagement with the socket unit this catch element will enter the socket 54 and provide sufficient holding force between the plug member and the socket unit to meet normal holding requirements, but will not prevent intentional withdrawal of the plug member from the socket unit.

It is noted that although the studs 37, 38, 39 and 40 are normally dead or un-electrified, they become electrified prior to actual contact of the horse-shoe magnets with these studs, since normally the attraction exerted on the armatures 29 and 30 will become sufficiently great to draw said armatures towards the plugs prior to actual engagement of the magnet legs with said plugs. Likewise, upon withdrawing the plug member from the socket unit the initial break will normally occur between the magnet legs and the outer ends of the studs, since the magnetic flux will not begin to reduce until an airgap has actually been created between the magnet legs and the outer or exposed ends of the studs. However, when these improvements are used in connection with so-called extension cords, said cords are usually connected to a current consuming or using implement which is provided with a switch whereby the current is actually turned on and off. Therefore when so used the breaking of connection between the magnet legs and the studs 37, 38, 39 and 40 does not of itself open the current since such current has already been discontinued by use of such a switch as just referred to. It is, however, emphasized that whenever the plug

member is disconnected from the socket unit these studs become de-electrified and dead, with the benefits already referred to.

The movement of the plug of the arrangement shown in Figures 1 to 5 inclusive, with respect to the socket unit is a direct forward or backward movement. In Figures 6 and 7 I have shown a modified arrangement in which the movement of the plug member with respect to the socket unit is rotary. In this case the plug member 58 carries the two horse-shoe magnets (permanent), 59 and 60, and the socket unit is provided with the two companion armatures 61 and 62 carried by the spring leaf elements 63 and 64, the arrangement being thus similar to that of Figures 1 to 5, inclusive. However, in the present case the socket unit is provided with the circular flange 65 which is of diameter to receive the base portion 66 of the plug member. The plug member is provided with the oppositely located lugs 67 and 68 which are adapted to engage with the flange 65 of the socket unit. For this purpose the flange 65 is provided with the two arcuate undercut grooves 69 an 70 within which the lugs 67 and 68 will be accommodated; and suitable notched openings 71 and 72 are provided in the flange to permit the lugs 67 and 68 to pass during insertion or removal of the base portion of the plug member into or from the socket unit.

The lugs 67 and 68 are so located with respect to the notches 71 and 72, and with respect to the line along which the studs 37, 38, 39 and 40 are located that when the plug is originally inserted into the base element the magnet legs are not in alignment with said studs. Then, by rocking or turning the base or plug member through approximately 30 degrees of turn the magnet legs are brought into engagement with the exposed faces of the studs for the purposes already explained in full detail. Thus the final positioning of the plug member with respect to the socket unit is by a rotating movement. This form of device also is such that as long as this proper alignment exists between the magnet legs and the studs, the plug member is locked to the socket unit, by what may be called a "bayonet-coupling" arrangement.

The two magnets of the arrangement of Figures 6 and 7 may be connected to the two wires of a cord in the well understood manner. However, if desired this plug member of Figures 6 and 7 may carry the current consuming unit itself. Thus, in the case shown in Figures 6 and 7 and 8 there is an incandescent lamp 73 carried by this plug member, the terminals 74 and 75 of the filament 76 being connected to these magnets so that such filament is supplied directly with the required current.

Evidently the lamp arrangement shown in Figures 6, 7 and 8, and the socket unit thereof, may be used in connection with a circuit which is provided with a suitable control switch for normally turning the current on and off. However, by use of the socket unit embodying the features of the present invention it is evident that when the lamp element is removed from the socket unit the studs 37, 38, 39 and 40 are dead, so that all danger of short-circuiting or improper connection to the electric supply lines is eliminated.

The alignment of the magnet legs of the arrangement of Figures 6, 7 and 8 with the studs of the socket unit is by sliding movement, although such sliding is rotary in direction. In Figures 9, 10 and 11 I have shown another modified form of construction in which the sliding

movement between the plug member and the socket unit is rectilinear. In this case the socket unit includes the studs 37, 38, 39 and 40 as before, and also includes the two armatures 77 and 78 carried by the spring leaves 79 and 80 in manner similar to that of the previously described arrangements. In the present case the plug member includes a moulded unit 81 wherein the two horse-shoe magnets 82 and 83 are carried similar to previously described arrangements. In the present case the socket unit is provided with a straight-line opening 84 somewhat longer than the plug member unit 81, so as to permit endwise movement of the plug member with respect to the socket unit. The plug member is provided with laterally extending lugs 85 and 86 which may be set down through notches 87 and 88 of the socket unit to bring the face of the plug member into contact with or close to the surface of the socket unit. The socket unit is also provided with undercut grooves 89 and 90 to accommodate these lugs for a sufficient amount of endwise movement of the plug to bring the magnet legs into alignment with the studs 37, 38, 39 and 40, for the purposes which have already been explained.

In the arrangement shown in Figure 12 the plug member 91 is carried by a pivoted connection 92 to the socket unit 93, said socket unit being provided with the studs 37, 38, 39 and 40 and the plug member 91 being provided with the magnets 94 and 95. The socket unit is provided with the armatures 96 and 97 carried by the spring leaves 98 and 99, in manner similar to the arrangements hereinbefore disclosed.

It is noted that in the arrangements of Figures 6, 7 and 8, and Figures 9, 10 and 11, and Figure 12, the magnet elements are accommodated within sockets of the plug members of size to allow some movement of such magnet elements to enable them to come into good contact with the studs 37, 38, 39 and 40, as will be readily understood.

Each of the plugs 81 or 91 of the arrangements of Figures 9, 10 and 11, or of Figure 12, may be provided with wire connections to the wires of extension cords in well understood manner. However, in Figures 9 and 10 I have shown cross connections 100 joining the two magnets 82 and 83 directly together, and in Figure 12 I have shown the cross connection 101 joining the two magnets 94 and 95 directly together. When these cross connecting wires are provided these plugs and their companion socket units may be used as switches for controlling circuits in well understood manner.

I have already pointed out that in such arrangements as that of Figures 1, 2, 3, 4 and 5 the actual breaking of circuit, when no other circuit breaking means is provided, takes place between the magnet legs and the exposed faces of the studs 37, 38, 39 and 40. This would also be true of the arrangements of Figures 9, 10 and 11, and Figure 12. When such devices are to be used as switches, such action will occur; but generally such devices will be used in connection with circuits which are provided with other and special switch means.

In Figure 13 I have shown still another modified arrangement in which the actual circuit making and breaking operations are effected by means other than the engagement of the magnet legs with the studs 37, 38, 39 and 40. In the case of Figure 13 the socket unit 102 is provided with two studs 103 and 104 reaching through the wall 105 of the socket unit; and said wall also carries the two additional contacts 106 and 107 which are insulated from each other and constitute the two terminals of the circuit to be switched. This arrangement also includes the armature 108 carried by the spring leaf 109; and this armature also carries the two movable contacts 110 and 111 connected by the wire 111a and which are insulated from the armature as shown in the figure. In the case of Figure 13 I have provided the magnet 112 which is movable towards and from the socket unit, and the legs of this magnet move into alignment with the studs 103 and 104 so that when the magnet is close to the socket unit the studs are magnetized and the armature is drawn towards the magnet, that is, towards the wall 105 of the socket unit. As this occurs the armature carried contacts engage the stationary contacts to close the circuit; and vice versa, as the magnet is moved away from the socket unit the armature is released, and is withdrawn by the leaf spring, to thus open the circuit. The socket unit of this arrangement may be provided with a housing 113 which provides, in connection with the wall 105, a water tight enclosure for the movable parts and for the contacts, both stationary and movable. If desired the enclosure 113 of Figure 13 may be filled with oil or other suitable electrically insulating liquid to thus provide an oil-switch arrangement by use of the construction of that figure.

In Figures 1 and 2 I have shown the springs 114 and 115 located behind the magnet elements 41 and 42, respectively, said springs being in the form of leaf springs anchored to the plug body 21, and having their free ends pressing against said magnets. These springs therefore exert a slight pressure tending to move the magnets towards the studs 37, 38, 39 and 40 when the plug member is engaged with the socket unit, so as to ensure good contact between the magnets and the studs. It is noted that the pig-tails 47 and 48 have a slight stiffness tending to retain the magnets back away from the cross members 45 and 46; but in case such stiffness should be found excessive, tending to prevent good engagement of the magnets with the studs when the plug member is brought into engagement with the socket unit, these springs 114 and 115 may be made of sufficient strength to ensure good engagement of the magnets with the studs to give good electrical contact between these parts.

It is noted that in each of the embodiments herein illustrated the magnets are shown as being carried by the movable element, previously designated as the "plug" and the armatures corresponding to these magnets are shown as being carried by the stationary element, previously designated as the "socket." It will be evident, however, that this arrangement might be reversed, the magnets being carried by the stationary element, and the armatures being carried by the movable element.

It will be noted that in the embodiment shown in Figure 13 there are shown only two stationary contacts, 106 and 107, and two corresponding contacts 110 and 111 carried by the armature 108. However, the number of such contacts may be either greater or smaller than shown, as for example, three or four, or more stationary contacts, and a corresponding number of movable contacts.

It is also noted that in each of the embodiments herein illustrated provision has been made for two conductors which are controlled for cir-

cuit opening and closing purposes. It will be evident, however, that each of these embodiments might be provided with either contacts for a single conductor, or for more than two conductors, for example, three, as in the case of making provision for a three phase circuit, or for a three wire system of distribution.

While I have herein shown and described only certain embodiments of the features of my present invention, still I do not intend to limit myself thereto, except as I may do so in the claims to follow.

I claim:

1. A detachable electric fixture comprising in combination a socket element and a companion plug element, said socket element including a partition of insulating material, two pairs of studs of magnetizable material extending through said partition, two leaf springs corresponding to said pairs of studs and located at one side of said partition and having their anchored ends secured to the partition and their free ends in proximity to the corresponding pairs of studs and normally retracted from said studs by the bias of said leaf springs and movable towards said studs against such spring bias, a magnetizable armature carried by the free end of each leaf spring in position for energization by magnetic flux flowing through the corresponding pair of studs to thereby draw said armature into engagement with said studs when said studs are magnetically energized to thereby electrically contact said armature with said studs at such time, and electrical terminals in connection with said leaf springs, and said plug element comprising a housing, a pair of permanent U-shaped magnets individually movably mounted within said housing and electrically insulated from each other and said magnets being spaced apart to correspond to the spacing apart of the pairs of studs, and the poles of each magnet being spaced to correspond to the spacing

of the studs of the corresponding pair of studs, the poles of said magnets facing outwardly from said housing and being directly engageable with the ends of the studs opposite to the stud ends engageable by said armatures aforesaid to thereby establish electrical engagement with said studs, and to subject the studs to magnetization by said magnet poles, whereby when the plug element is brought into position with respect to the socket element to register the magnet poles with the studs magnetic influence is transmitted through the studs to draw the armatures into engagement with the studs to thereby complete electrical circuits to the magnets from the electrical terminals aforesaid, and whereby the U-shaped magnets are individually movable into contact with the corresponding studs, together with electrical connections from the magnets to suitable delivery lines.

2. A structure as defined in claim 1, together with means to limit the movement of each magnet with respect to the housing.

WILLIAM McLEOD.

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