The present invention relates to improvements in multiple double break switches and is particularly concerned with switches adapted for remote operation. The construction of such switches has tended to favour the use of simultaneous double break contacts particularly for small power. In these contacts, the two distances between the fixed contacts and the movable contact add up, so that the opening speed is doubled, and therefore the extinguishing of the arc is more efficient than in the simple break types. For this purpose, the solenoid type of electro magnet with a linearly movable armature generally working vertically, is used in preference to electro magnets with hinged armatures. With such linearly moving electromagnet devices it is necessary to take particular care that the strains on the movable plates are perfectly balanced, because unbalanced loads would cause seizing of the movable core. The magnet must be exactly in a central position in relation to the load distribution. and this problem has been solved heretofore by adopting special armatures to support the two parts of the magnet. It is evident that, with this system, every difference in the load distribution, as for instance an addition of contacts for special purposes, is either structurally impossible, as in most of the types in use, or requires the construction of a different armature for every required modification. An object of the present invention is to provide a switch of the described character formed of similar, superposed, contact units operated by a common electromagnet which is constructed and arranged so that the electro magnet may be centrally disposed irrespective of the number of contact units embodied in the switch.

Another object is to provide a switch of the described character wherein one or more operating electromagnets may be conveniently mounted on the stacked or superposed contact units to work in parallel.

Another object is to provide a switch of the described character which is constructed and arranged so that the various assembled parts thereof may be put together and separated in a simple manner and without the use of tools.

Another object is to provide a switch of the described character wherein the movable core of the operating electromagnet is easily connected to, or separated from, the movable contact carrying member and further serves to hold the magnet coil in operative position.

Still another object is to provide a switch of the described character wherein the movable and fixed contacts may be easily removed or replaced and are formed to be adjustable to permit the exposure of fresh contact surfaces from time to time.

A further object is to provide a switch of the described character wherein the various terminals may be connected or disconnected without the use of tools.

The above and other objects, features and advantages of the present invention will be apparent from the following detailed description of illustrative embodiments thereof, which description is to be read in connection with the accompanying drawings forming a part hereof and wherein:

Figure 1 is a perspective view of a switch device embodying the present invention, and with certain of the parts removed to afford a clearer view of others.

Figure 2 is a top plan view of a switch device similar to that of Figure 1, but with an assemblage of three elements instead of the four seen in Figure 1.

Figure 3 is a vertical sectional view taken on the line X-X in Figure 2.

Figure 4 is a side sectional view of the device of Figure 3 and

Figure 5 is a perspective view of a pair of small plates of refractory material which form an arc-chute.

Referring to the drawings in detail, the improved switch device in general terms comprises a series of contact-carrier elements, all similar, and assembled together to form a supporting frame. The number of contact-carrier elements assembled together depends upon the number of switch contacts and terminals required by the associated electrical circuit. These elements are connected to the operating magnet by screw threaded assembling rods, which secure the elements to each other and are also used to clamp the device to its support. Each of the carrier elements is composed of a pair of plates of insulating material, stamped Bakelite for example, mounted face to face. The plates are shaped in such manner that when assembled together as pairs they enclose hollow spaces adapted to receive all the metallic parts used for the electric contacts and terminals. The device comprises as many pairs of plates or basic elements as there are sets of contacts. The paired plates are clamped together by means of three through rods arranged at the points of a triangle, that is, with two threaded rods extending through the corner portions of the superposed plates at one side and with a single centrally located rod at the
The rods 2 pass through suitable holes 3 provided in the plates 1 and their screw threaded ends receive the respective tightening nuts to clamp the stacked plates therebetween.

The plates 1 are formed with relatively shallow recesses on both faces on which the rods 2 pass to provide hollow spaces 6 equidistantly spaced vertically along the corners of the assembled plates. The magnet includes end plates, enclosing the laminae of its fixed core, and each formed with two perforated lugs 8, Figure 3, spaced laterally spaced to 21 into the 15 recesses 6 of the assembled pairs of plates 1. The end plates of the magnet are themselves spaced apart a distance equal to the distance between the successive spaces 6 so that it is always possible to put the electromagnet in a central position relatively to the supporting frame, whether the number of the basic elements is odd or even. The electromagnet is connected to the supporting frame by the two assemblying rods 2 passing through the corner portions of the plates 1 and which extend through the openings of the lugs 5, so that any further magnet supporting member is unnecessary. In addition, the hollow spaces 4 may be used for the fastening to the device, by means of the rods 2, any other accessory parts, as for instance, push-buttons, additional clamps and the like. The rods 2 may be appropriately extended beyond the outermost plates 1 to serve for fastening the whole device to walls, frames and other supports.

Each element has between its pair of plates 1, at the side remote from the magnet, two fixed contact rollers 6, which are connected with respective wire binding clamps or terminals. Each contact roller 6 with its respective clamp is called contact-clamp CB, comprises a roller 6 of good conducting material, copper for example, forming the actual contact. At the ends of each roller, two side plates 7, Figure 1, are tightly fixed by screws having countersunk heads 8. The plates 1, at their ends remote from the roller 6, are connected together by a small tube 9 (Figures 1 and 4). On each of these tubes 9 are mounted a coil spring 11 interposed between a bearing plate 40, and a washer 42. Between the washer 12 and the adjacent side plate 7 a forked metallic terminal 13 may be removably inserted. The terminal 13 preferably has its ends curved to suit the radius of the washer, and is held in place by the spring urged washer itself. To the terminals 13 are connected the inlet and outlet wires of the electric circuit. Each bearing plate 10 is preferably T-shaped to provide lateral ears which engage against the fixed core for centering the coil. The bobbin 14 defines an internal open ended space of rectangular form to carry the carrier, and the two others bent downwards or towards the magnet for a purpose to be described. The upper ends of the two upwardly bent wings are bent inwards until they just touch, in order to enclose a rectangular part of the cross and the bent ends (Figure 1); receiving a plate 18 formed with ends of reduced width which are slidable in two openings formed in the two above mentioned wings. Between the plate 16 and the bottom of the contact carrier 17 there is a spiral spring 19 which presses the plate 18 towards the inwardly bent wings. The conducting rods 10 are introduced between the plate 18 and the inwardly bent ends of the wings of the contact carrier 17. The interior edges of the projection 8, Figures 1 and 5, of the refractory plates 15, are engaged by the ends of the contact rod 16 for avoiding the lateral shifting of the latter. The two downwardly bent wings of the contact carrier 17 form what may be described as an inverted U, and therebetween receive two pieces 20 of insulating material each having the cross-sectional shape of an irregular trapezoid (Figure 1). The insulating pieces 20 present on their external side, a projection which penetrates a suitable opening formed in each of the downwardly bent wings, so that these pieces 20 remain connected to the said wings. A single movable bar 21, formed by an elongated member of C-shaped cross-section and providing a channel opening towards the magnet, corresponds in its external shape to the internal hollows of the insulating material pieces 20 and is movable longitudinally within the latter. The movable bar 21 as long as the supporting frame assemblage and is kept centered by two elastic plates 22, placed on the two outer faces of the supporting frame itself. The operating electro-magnet, the insulating mounting of which has been previously described, is of the type having a linearly movable core drawn into the coil when the latter is energized, with self-adjusting pole pieces which are the subject of United States Letters Patent No. 2,510,296. The electromagnet comprises an inverted U-shaped fixed core 23, provided with two self-adjusting pole pieces 24 and with a movable core 25, having end side plates 26. The pole pieces 24 are the magnetic poles of a horseshoe-like body closing the magnetic laminae of the core. These plates 26 extend beyond the movable magnetic core 25 and pass through two openings formed between the central part of the fixed core 23 and the respective end plates of that core. The extending portion of side plates 26 are formed with slots which serve to connect the movable core 25 to the bar 21. The opposite edges of C-shaped bar 21 are provided with two pairs of similar notches 27, Figure 1. The distance between two notches 27 in the same edge is equal to the distance between the two end plates 26 of the moveable core. In the extreme end part of each of the end plates 26 of the movable core, lateral notches 27A, Figures 1 and 3, are formed to receive the opposite edges of the bar 21. The bar 21 has a hook 28 Figures 3 and 4 formed on one end protruding from the surface 29 caused by the breaking arc. In the spaces between the refractory plates 15 the contacts 16 are movable linearly; these contacts 16 being rectangular conductive rods disposed on a contact-carrier 17 (Figures 1 and 3). The contact-carrier 17 may be formed from a metal blank of cross shape, two opposite wings being bent upwards or in the direction away from the magnet to form the carrier, and the two others bent downwards or towards the magnet for a purpose to be described.
in cross section, in which the movable core 25-26 is linearly slidable. In extensions of the end plates 23 of the fixed core there are placed two small insulating blocks 22 (stamped Bakelite for instance), for supporting the two self-adjusting pole pieces 24. The blocks 23 are engaged in the end plates of the fixed core 23, by means of the two projections 33, Figure 4, and each contains a contact clamp 35 with a respective spring 39, washer 33 to provide a wire terminal. In the extensions of the end plates 23 of the movable core 25-26 remote from the ends attached to the bar 21, a movable contact 39 is supported, by means of two insulating blocks 22, for engagement against the two fixed contact-clamps 36. The electromagnet, however, could be of a different type and shape from the above described, provided that it operates to draw the movable core further into the coil when the latter is energized.

Finally, the plates 1 are internally shaped, so as to enclose hollow spaces 43, Figure 1, designed to receive the fixed parts of lower contact-clamps, that is, contacts that are closed when a remote operated switch is opened. A contact 41 is slidable through an opening in a box-shaped frame 42 which is open at the outer side and at the facing toward the magnet and has an inner side wall formed with projections at its opposite ends for engagement in corresponding grooves formed in the plates 1. Moreover, the frame 42 is provided with a bent tab at the side of the opening through which the contact 41 extends in order to guide the latter during its movement under the influence of a foreign spring 43. The latter is wound on a guide tube 45 in the interior of which is placed a pressure spiral spring 38A of the same type as spring 35, arranged to press against a terminal forming washer 36A, both mounted on a small pin 65 riveted to the two side walls of the contact frame 42.

To insure the continuity of the electric connection between the contact 41 and its frame 42, a flexible plate, not shown in the drawing, is electrically connected therewith. A wire terminal 37, similar to those marked 13, but of smaller size, may be engaged between the washer 36A and the adjacent wall of the frame 42. The electric connection between two of these lower contact-clamps, placed between a pair of plates 1, is formed by the rods 18 of the movable main contact, in its usual rest position.

In assembling the described device it is necessary, first of all, to put together the supporting frame with as many basic elements as the number of the needed contacts, held initially together by the single centrally located rod 2; then, a movable fitting for each pair of plates 1, each fitting being formed of a pair of the insulating pieces 22, is mounted on the bar 21, and the contact-carriers 17 provided with springs 19 and plates 18 are assembled with the mounted movable fittings. It should be noted that these movable parts can freely move along the bar 21; and the assembly formed by the bar 21 and the various parts 17 to 20 is then inserted in the channel of the supporting frame defined by suitable cutouts formed in the plates 1 to receive and guide the various movable parts during the working stroke. To complete the movable contact section of the switch assembly, the rods 18 that form the movable contacts, are simply introduced into the hollows 14 of the frame and inserted between the related plates 18 and the contact-carriers 17. When thus assembled, lateral removal of the bar 21 is prevented by the rods 16 which rest against the internal wall surfaces of the plates 1. The fixed core of the electromagnet is now inserted by introducing the ears 5 thereof into selected spaces 4 of the frame, as has been already described, in order to locate the fixed core centrally relative to the supporting frame. The two rods 2 extending through the corners of the plates 1 are introduced into the respective holes 3 and the assembly is secured together by tightening the nuts on the ends of rods 2, after having fixed the elastic plates 22 at the two ends of the supporting frame. Two pairs of refractory plates 15 are next introduced from opposite sides into the hollows 14 defined between each pair of plates 1. These refractory plates protect the internal walls of the plates 1 of the supporting frame from the arc, and by means of their 8-shape, form the utmost limits of movement of the rods 18, whilst keeping them centered. The previously assembled main contact-clamps CM are now inserted from the top, that is, at the side of the frame remote from the magnet, into the spaces 45 formed between the plates 1 of each element, and each roller 6 is simultaneously introduced into the hollow 47 formed by the two refractory plates 15 so that the latter are thereby fixed in their respective places. The coupling of the supporting frame of each contact-clamp CM, with respect to the related plates 1, is simply obtained by pressing it down in the respective hollow, so that the bearing plate 16, sliding on the sloping projecting edges 48 of the plates, compresses the spring 41 until the projections or lugs in the T-shaped plate 18 engage under the corners of the projecting edges 48 and thus lock the contact-clamps CM in place within the supporting frame. In order to remove each contact-clamp CM, the plate 19 is depressed against the force of the spring 41 until it is clear of the corners of the protruding edges 48, and then the contact-clamp is free to be pulled out of the frame. If necessary, it is possible to change the distribution of the hollows in the elements, in order to introduce the contact-clamps from the sides rather than from the top in a manner similar to that described above.

To finish the assembling of the essential parts of the remote operated switch, it is necessary to complete the electromagnetic core. For this purpose the coil, with its bobbin, is moved into the central space of the fixed core 23 until the stops 51 of the bobbin rests against the adjacent end plate of the fixed core. The two self-adjusting pole pieces 24 are fitted on their seats and they are supported by the insulating blocks 22 that have been introduced in the lower corners of the fixed core end plates. The movable core 25-26 is then slidably introduced from the bottom, through the hollow of the coil and through the two guide openings provided in the fixed core. To couple the movable core 25-26 to the bar 21, it is necessary to depress the hook 28, Figure 4, completely, so that the bar 21 moves longitudinally, against the resistance of the lower elastic plate 22, to a position in which the two ends of the end plates 23 are aligned with the four notches 27 provided in the two lower edges of the bar 21, so that, the ends of the end plates 25, may pass through these notches 27 to engage against the internal surface of the bar 21. Upon releasing the hook 28, the elastic plate 22 returns the bar 21, with the lower bent of the bar sliding freely in the notches 27A of the end plates 20, so that the movable core 25-26 remains thus suspended from, or locked to, the bar.
2,616,998

21. The movable core 25, 26, when thus locked to the bar 21, serves to prevent the insulating blocks 22, 23, from support the self-adjusting pole pieces 24, from being removed from their seats, and also to retain the coil 28 in its place. To remove the coil, it is necessary to disconnect the movable core, by depressing the hook 29 until the notches 27 of the bar 21 are again aligned with the two end plates of the movable core so that the latter may be withdrawn to permit the coil to be removed from the fixed core.

If it is necessary to provide the remote operated switch with an auxiliary self-sealing contact, the assembly hereinafter described has added to it, in the insulating blocks 23, set in the lower corners of the end plates of the fixed core, the contact-clamps 34 complete with all their parts for the coupling of the wire terminals 37 and, in the lower part of the movable core 25—26, the blocks 38, and the movable contact-clamp 39. If it is necessary to provide auxiliary contacts, the contact-clamps 41—42 and press, in the spaces 40 between the plates 3, before introducing the pairs of the refractory plates 15 which serve to secure them in place.

The remote operated switch is then ready to operate. When the coil is energized, the movable core is attracted upwards, and, by consequence, it pushes the bar 21 until it presses the rod 18 against the lower part of the rollers 6 of the contact-clamps CM.

If lower contacts are mounted on the device, in the backward stroke towards their lower positions, the rods 18 close the contact against the corresponding contact-clamps 41—42 and press, in the last portion of the stroke, upon the contact 41.

From the foregoing description of preferred embodiments, it is apparent that the present invention provides a double-break switch of multiple element construction wherein: The electro-magnet can always be mounted centrally on the supporting frame without requiring a special frame or casing for each of the assemblies having different numbers of contacts.

The movable armature or core can be fixed to or removed from the contact-carrier bar without difficulty and without the use of any tools.

The arrangement of the parts provides the possibility of connecting to the supporting frame two or more electro-magnets working in parallel, if it is necessary to use a large number of simultaneously operated contacts.

The fixed contact-clamps CM and the movable contact rods (which need inspection and maintenance as they are subject to natural wear), are easily removable and replaced by withdrawing the contact clamps CM from their respective seats.

The possibility, in case of wear of the roller 6 of the fixed clamps CM, of rotating the roller through a small angle, in order to present, at the contact point, a non-used part; so that, as the roller can be partly rotated several times before having used it all around its circumference, it insures a very long working life to the fixed contacts, and, likewise, the movable contacts can be reversed and used on both faces, as they are formed by bars, rectangular in cross section; so that, in effect several spare contacts are provided within the switch itself.

Connection of the wires of both main and auxiliary clamps by means of wire terminals, which are held by spring pressure in contact-clamps to provide a secure physical and electrical connection without employing the usual tightening screws.

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The possibility of adding auxiliary contacts in the hollows provided between the plates 1 of the device is present without requiring modification or increase of the overall dimensions.

The essential parts of the device, once inspected, are bound together only by the order of assembly and their own interlocking construction and are free to positionally adjust themselves relative to each other so that the assembling and the good working of the device, and also the inspection of the different parts, requiring normal maintenance, is facilitated and is possible without requiring the use of tools.

While preferred illustrative embodiments have been shown and described in detail, it is to be understood that the present invention is not limited to those preferred embodiments and that many changes and modifications, obvious to one skilled in the art, may be effected therein without departing from the scope or spirit of the invention, which is intended to be defined in the appended claims.

What is claimed is:

1. A multiple switch comprising a plurality of superposed switch contact assemblies, each of said assemblies including a pair of substantially rectangular insulating plates each having recesses at the opposite faces of the corners at one side thereof so that series of corner spaces are defined at said one side between the confronting faces of each of said pairs of plates and between the meeting faces of the plates of adjacent switch contact assemblies, an electro-magnetic operating device including a fixed core formed with a pair of supporting ears located at each of the opposite ends of one side thereof and spaced apart a distance substantially equal to twice the distance between successive one of said corner spaces so that said ears may be received in selected ones of said corner spaces to position said core centrally relative to the superposed switch contact assemblies, securing bolts extending through said corners of the plates for securing together the latter and for holding said fixed core to the superposed plates, fixed contact means having means thereon engageable with detent means on said insulating plates for removably mounting fixed contact means between each of said pairs of insulating plates, refractory means held between each of said pairs of plates by the associated fixed contact means and defining arcing chambers at each of the latter, movable contact means disposed between each of said pairs of plates and extending into said arcing chambers for contact with said fixed contact means, movable contact carrying means including a common actuating member for simultaneously moving the movable contact means of each of said switch contact assemblies, a coil removably mounted in said fixed core, a movable core linearly slidable in said fixed core and said coil, and interdigitating means on said core and said common actuating means separately connecting said movable core to said common actuating member.

2. A multiple switch according to claim 1, wherein each of said fixed contact means includes a contact member, a pair of spaced conducting plates extending from the opposite ends of said contact member, the confronting faces of said insulating plates having grooves opening at a side thereof to slidably receive and guide said conducting plates during insertion of the latter between said insulating plates, a pin extending between said conducting plates, a pressure disc slideable on said pin, and a coil spring on said pin.
and interposed between said disc and one of said conducting plates for urging said disc against the other of said conducting plates so that a terminal plug may be removably engaged between said spring urged disc and said other conducting plate for electrical connection to the related contact member.

3. A multiple switch according to claim 2; wherein said fixed contact means further includes a bearing plate slidable on said pin between said coil spring and said other conducting plate, said bearing plate being formed with ears projecting laterally past the side edges of said other conducting plate; and wherein the insulating plate adjacent said other conducting plate is formed with projections adjacent the edges of the groove therein to engage behind said projecting ears of the bearing plate for holding said fixed contact means between said insulating plates.

4. A multiple switch according to claim 1; wherein said confronting faces of the pairs of insulating plates have right angularly related grooves formed therein and opening at the side remote from the said fixed core and at sides disposed substantially at right angles to said remote side, said fixed contact means being slidable received in said grooves opening at said remote side and said refractory means being slidable received in said grooves opening at said right angularly disposed sides, each of said refractory means including a hollow box-shaped member having an opening in the direction facing toward the related fixed contact means, each of said fixed contact means including a contact member extending into said box-shaped member of the related refractory means through said opening thereof so that said contact member prevents withdrawal of said box-shaped member from between said insulating plates, and interengagable locking means on said fixed contact means on one of said insulating plates for preventing withdrawal of said fixed contact means from the latter.

5. A multiple switch according to claim 1; wherein each of said fixed contact means includes two laterally spaced fixed contact members located adjacent the corners of said insulating plates remote from said recessed corners of the latter, and said movable contact means include bars of conducting material extending laterally between the related pair of insulating plates and movable towards and away from the related laterally spaced fixed contact members; and wherein said movable contact carrying means includes a bar support member for each of said movable contact means slideable linearly between the related pair of insulating plates in the direction toward and away from said fixed contact members, said bar support member opening laterally to slidably receive the associated contact bars and having a through opening at right angles to said contact bars for slidably receiving said common actuating member.

6. A multiple switch according to claim 5; wherein said common actuating member includes an elongated channel of C-shaped cross-section opening in the direction toward said fixed core, and said means for separably connecting said movable core to said common actuating member includes extensions formed on said movable core to extend into said channel and having laterally opening notches at the sides thereof to slidably receive the edge portions of said channel, the edge portions of said channel having notches therein registering with said extensions in one longitudinal position of said common actuating member to permit separation of the latter from said extensions of the movable core, resilient means acting on said common actuating means for yieldably urging the latter to a longitudinal position in which said notches of the channel are out of registration with respect to said extensions, and an operating member on said common actuating member and extending out of the uppermost of the superposed pairs of insulating plates to provide for manual displacement of said common actuating member to the first mentioned longitudinal position.

7. A multiple switch according to claim 6; wherein said fixed core is substantially rectangular and defines a central space open at the end remote from the superposed pairs of insulating plates and at its opposite sides, said coil fitting into said central space through either of said open opposite sides of said fixed core and having an open ended longitudinal passageway extending centrally therethrough to register with said open end of said fixed core when said coil is disposed centrally in the latter, and stop means on said coil engageable with said fixed core to position said coil centrally in the latter, said movable core extending slidably through said open end of the fixed core and through said longitudinal passageway of the coil to prevent removal of said coil from said fixed core so long as said movable core is connected to said common actuating member.

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