Jan. 24, 1961 O. DEISSLER 2,969,444

ELECTROMAGNETICALLY ACTUATED SWITCH

Filed July 16, 1956

4 Sheets-Sheet 1

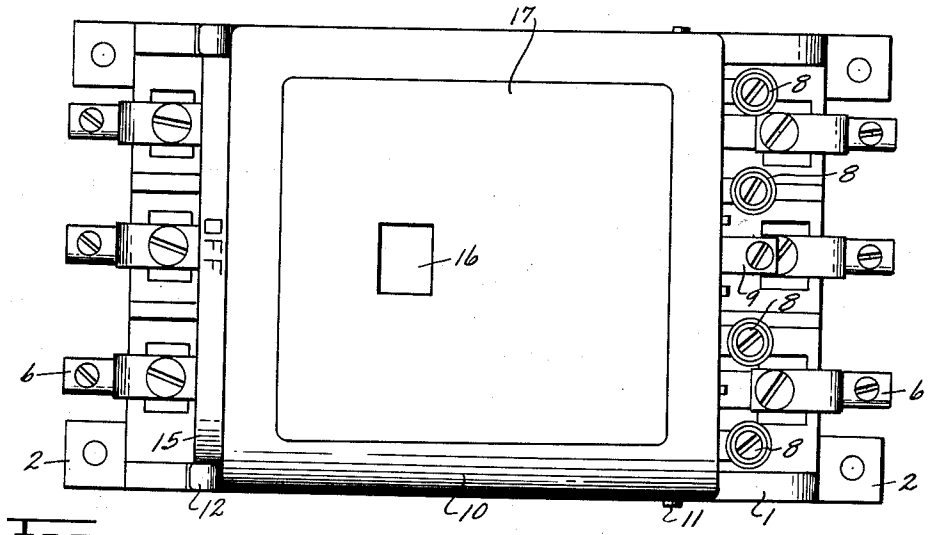


Fig 1

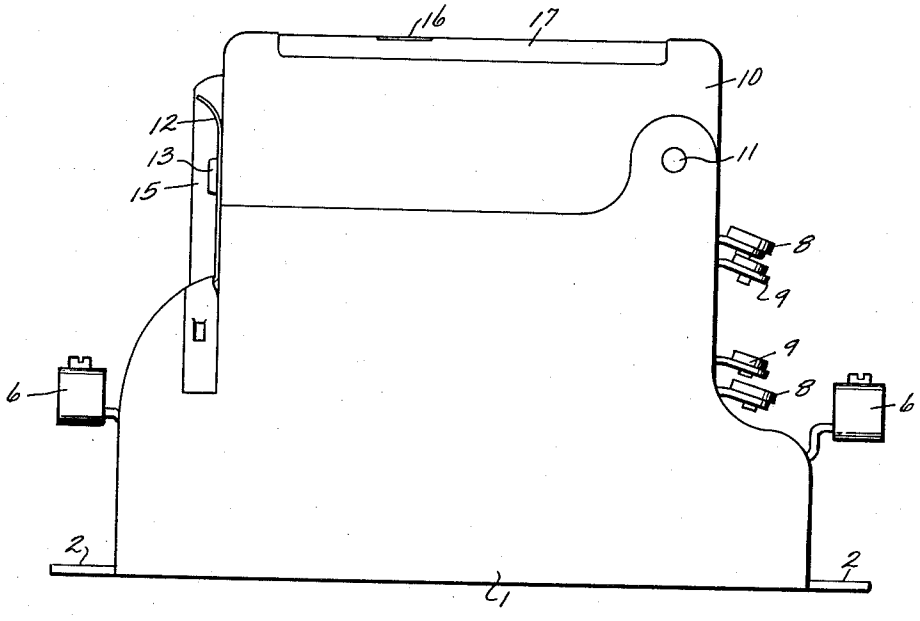


Fig 2

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ELECTROMAGNETICALLY ACTUATED SWITCH

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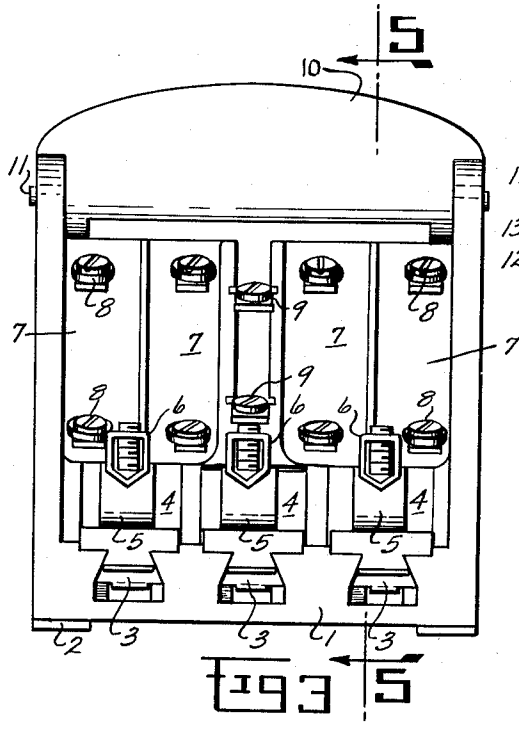


Fig 3

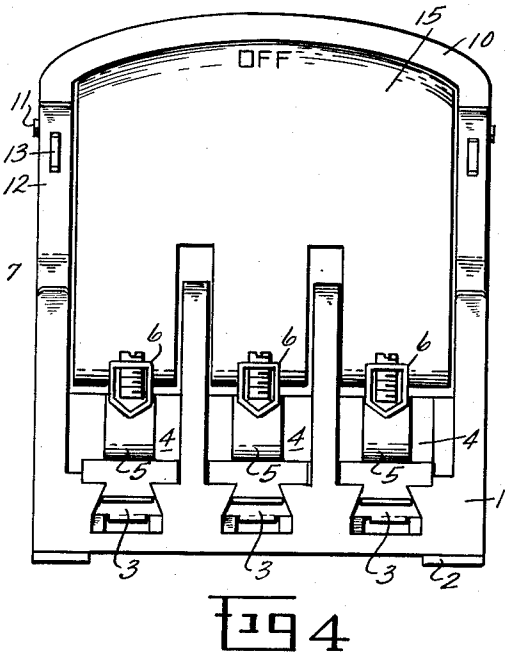


Fig 4

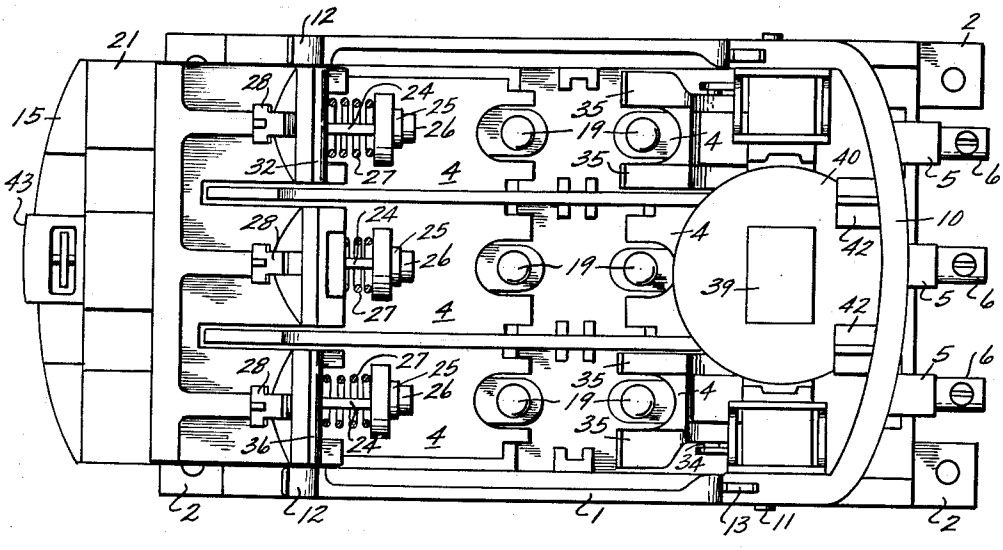


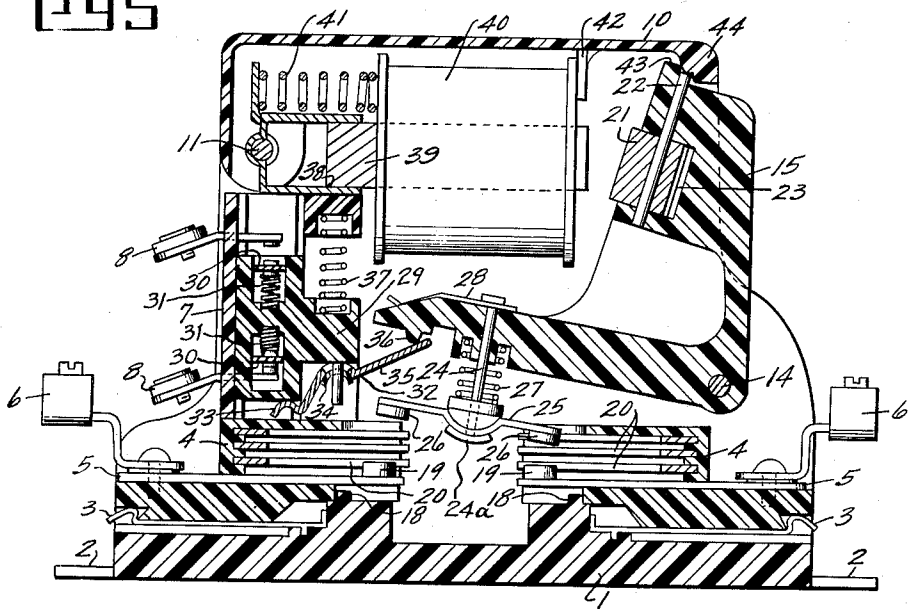
Fig 7

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Fig 5



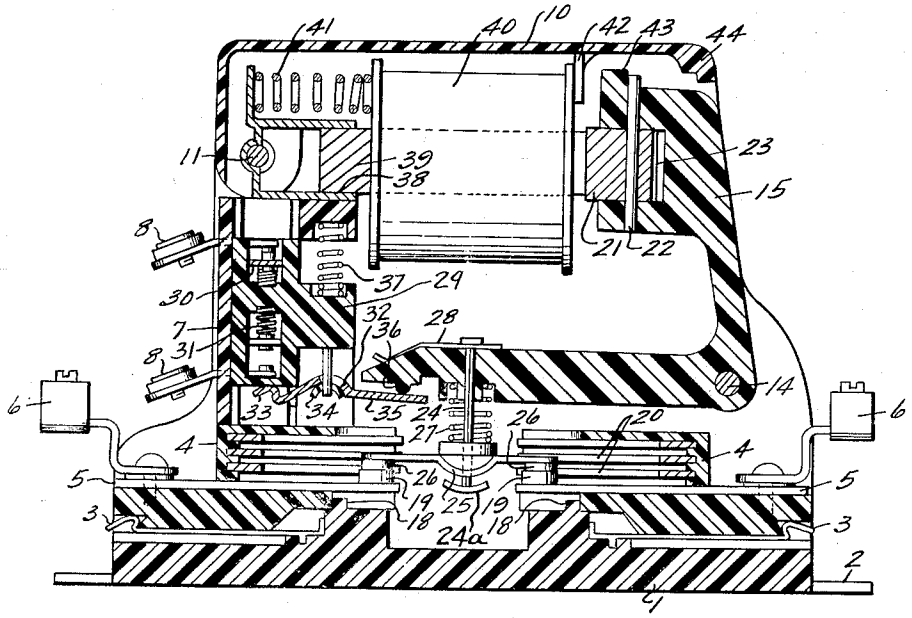


Fig 6

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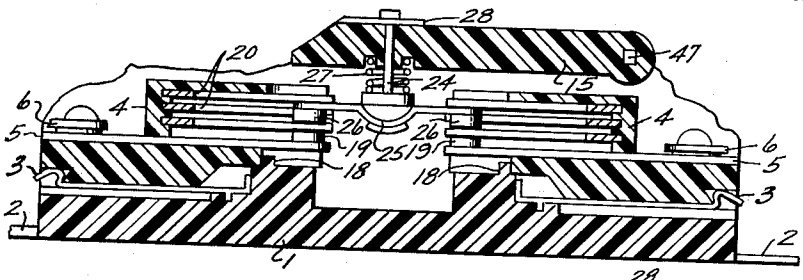


Fig 10

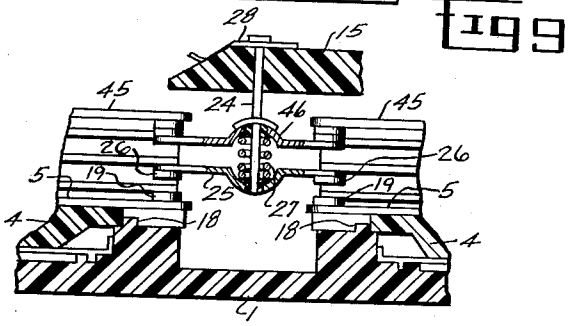


Fig 9

Fig 8

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ELECTROMAGNETICALLY ACTUATED SWITCH

Otto Deissler, Gummersbach-Niedernhagen, Germany

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24 Claims. (Cl. 200—87)

The invention relates to an electromagnetically actuated switch or "contactor" designed to serve as a control relay, power relay or remote-control motor-protection switch where a thermal relay is subsequently installed.

Under the invention, construction is such that with exception of the terminal screws of the main and auxiliary contacts, screw joints have been eliminated, which makes for economical production. Both coil and main and auxiliary contacts may be replaced without the use of tools after their electrical connections have been released. Moreover, the condition of the contacts may be checked without the aid of tools. Furthermore, all connections of the main and auxiliary contacts and of the coil are accessible from the front of the contactor.

The device utilizes a pivotally mounted bell crank lever, one of whose arms supports the moving main contacts and actuates spring biased auxiliary contacts, while the other arm supports the armature of the magnet, whose core, around one leg of which the coil is wound, is placed parallel with and above the main contacts. Since the bell crank lever pivots, the device may be mounted in any position, with friction largely eliminated. The pressure springs of the auxiliary contacts also act upon the bell crank lever, so that regardless of the position of the electromagnetically actuated switch the angle lever is brought into its normal position when the pull coil is disconnected.

To provide a favorable ratio between magnet pull and contact pressure of auxiliary contacts as well as pressure upon the bell crank lever, the movable contacts of the auxiliary contacts are actuated by means of a rocking lever which translates the long stroke of the bell crank lever arm acting on the auxiliary movable contacts into the short stroke required by the auxiliary contacts.

The movable main contacts are pivotally mounted on the bell crank lever and are formed as a bridge across two stationary contacts for each pole. The stationary contacts are located in quenching chambers where the points of contact are encircled by rings made of iron or a similar material shaped in such a way that the electric arc is drawn into the chamber, where it is cooled, broken down and rapidly destroyed. For cleaning or replacement of the stationary main contacts, the quenching chambers containing the fixed main contacts are removable from the lower section of the device by means of a sliding motion, but are normally secured in operating position by a leaf spring detent. In operating position, the stationary main contacts are prevented from sliding inwardly by a stop in the lower section of the device as well as by the terminal screw. For replacement, each fixed contact is pulled out of its respective quenching chamber, without the use of tools, after removal of the terminal screws.

The quenching chambers are constructed in such a way that two stationary contacts may be inserted one on top of the other, with a certain separation between

the two, so that one fixed contact is at the top and the other at the bottom of the quenching chamber. Similarly, the movable-contact holder will accommodate two moving contacts spaced to correspond with the stationary contacts so that the compression contact spring is located between the two movable contacts. In the normal position, with the pull coil cut out of the circuit, the upper main contacts will then be closed, while upon energizing the coil they are opened and the lower ones are closed.

The movable-contact holders are mounted on the bell crank lever by specially shaped leaf springs fixing the movable contacts on the lever arm. The securing of the contacts is effected merely by inserting the springs at a 90 degree angle to the movable contact bridge and thereafter turning the spring to a position parallel with the main contacts.

The fixed auxiliary contacts are mounted in a removable block. A movable block is slidably mounted in the removable block and carries the movable auxiliary contacts. The fixed auxiliary contacts may be set in each removable block, without the aid of tools so as to establish two single pole normally closed circuits, two single pole normally open circuits or one normally closed and one normally open circuit.

The device is so encased and covered by the lid in such a way that coarse dust cannot penetrate into its inside. The lid is so constructed and fitted that when viewed from the front the bell crank lever will indicate whether the device is switched on or off. For this purpose, the lever bears the marking "off," which disappears under the lid and becomes invisible when the device is connected. The lid also serves as a limit stop for the bell crank lever, aside from holding the plate showing the model number, manufacturer's name and ratings, with a blank space for identification of the device.

The lid is hinged and attached to the hinge pin is the magnet-core holder which supports magnet core and pull coil. A spiral spring forces the pull coil against a detent in the lid. In operating position, the lid rests on the lower section, enclosing magnet core and coil as well as armature. To replace the coil, the lid is raised and the coil forced against the spiral spring so as to swing magnet core and coil clear of the detent. After releasing the coil connections, the coil is pulled off the leg of the magnet.

The complete assembly of the electromagnetically actuated switch is mounted by means of steel rails fixed to the assembly which may be screwed or otherwise secured to supporting structure.

A thermal relay used, for example, to protect a motor against overloads may be attached to the base of the device in such a way that after the main contacts have been brought out for control purposes, the bell crank lever rests above it. Therefore, the thermal relay will not require extra space.

The several features of the invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

Fig. 1 is an elevational view taken in front of the invention;

Fig. 2 is a side elevational view thereof;

Fig. 3 is a top plan view thereof;

Fig. 4 is a bottom plan view thereof;

Fig. 5 is a cross sectional view taken along lines 5—5 of Fig. 3;

Fig. 6 is a view similar to that of Fig. 5 showing the contacts in closed position;

Fig. 7 is an elevational view taken from the front of the invention with the covering lid removed;

Fig. 8 is an elevational view partly in section showing the elements in partially disassembled relation;

Fig. 9 is a fragmentary view partly in section of an alternative embodiment; and

Fig. 10 is a fragmentary view partly in section showing an alternative mounting of the main contacts.

Referring to Figs. 1 through 4, the contactor of the present invention has a housing including lower section or body portion 1 which is in the form of a rectangular box open at the front and bottom faces thereof and to which are fixed mounting rails 2. The mounting rails have apertures in the ends thereof by which the whole device may be mounted to a supporting structure. The lower section 1 is enclosed by a cover lid 10 which is pivotally mounted to the lower section on a hinge pin 11. The lower section 1 has a leaf spring 12 (Fig. 4) the leaf spring being slotted at its free end to receive a projection 13 integral with the lid 10. The leaf spring 12 mounted on each side of the contactor secures the lid in the closed position shown in Figs. 1 to 4 but permits the lid to be swung easily to an open position as shown in Fig. 8. The lid 10 prevents the penetration of the contactor by coarse dust. Lid 10 has a recess 17 in which a plate identifying model, manufacturer and ratings may be disposed.

As best shown in Figs. 5 and 6, the lower section has trackways which slidably receive main stationary contact blocks 4, the blocks being secured to the lower section by leaf springs 3. Stationary contacts 5 are mounted on the blocks 4 and are fitted with solderless connectors 6 by which they may be connected into a support. The inner end portions of the blocks 4 engage lugs 18 projecting from the lower section 1 to limit inward movement of the blocks.

The stationary contacts 5 have contact tips 19 which are disposed within arc quenching chambers. The arc quenching chambers are formed by three spaced U-shaped iron strips 20 which are so related to the contact tips 19 that an electric arc is drawn into the chamber formed by the strips.

The lower section 1 also slidably receives removable auxiliary contact blocks 7. As shown in Fig. 3, a pair of blocks is received in the upper portion of the casing, each pair having two sets of contacts of the type shown in Figs. 5 and 6. The removable contact block has a slidable block 29 mounted therein, the slidable block 29 carrying movable contacts indicated at 30. The movable auxiliary contacts 30 are slidably mounted in the block 29 and are urged toward their respective stationary auxiliary contacts by means of compression springs 31 which are located between the slidable block 29 and the movable contacts 30.

The stationary block 7 has contacts 8 fixed therein, the contacts 8 being provided with terminals by which auxiliary line connections can be made to the contacts. The slidable block 29 is urged by a compression spring 37 toward the main stationary contacts 5. To operate the auxiliary contacts the block 29 is movable in the opposite direction by a lever 32 pivoted about a fulcrum bearing 34, the fulcrum 34 being fixed in the contact block 7. One arm 33 of the lever 32 bears against the slidable block 29, while the other arm 35 is operably engaged by a bell crank lever 15 pivoted to the lower section 1 on a pin 14 fixed in the lower section by the fixed ends of leaf springs 13. The arm 35 is bifurcated to permit main movable contacts to pass by.

The stationary contacts 8 are mounted in slots in the contact block 7 and are adapted to be removed and disposed in different positions so as to be either normally open or normally closed, depending upon the requirements of the particular circuit with which the contactor is used.

One arm of the bell crank lever 15 supports a magnetic armature 21 in a slot by means of a removable pin 22. As can be seen from Figs. 5 and 6, there is a space between the armature 21 and the bell crank lever 15, the space permitting slight pivotal movement of the armature about the pin 22 to permit the armature to adjust itself to the magnetic core to which it is drawn. A strip of material 23 is disposed in that space to damp the armature.

The other arm of bell crank lever 15 receives a pin 24 terminated in an arcuate member 24A on which a movable contact bar or bridge 25 is pivotally and slidably mounted. The contact bridge 25 has precious metal tips 26 which are engageable with the stationary contact tips 19 to close the circuit between the tips.

A compression spring 27 is located between the contact bridge 25 and the arm of the bell crank lever to provide pressure of engagement of the contact tips 26 with the stationary contact tips 19. The contact bridge 25 can rotate or pivot with respect to the member 24A so as to permit precise engagement of the tips 26 with the stationary tips 19, the spring 27 frictionally holding the bridge 25 in the proper position of alignment with respect to the stationary tips 19.

The pin 24 to which the contact bridge 25 is secured is mounted on the arm of bell crank lever 15 by means of a leaf spring 28 which is fitted on the end of the pin in a direction perpendicular to the contact bridge and then swung through 90° to the position shown in Figs. 5 and 6 to secure each contact bridge in position.

The end of the bell crank lever arm adjacent the contact bridge 25 has a projection 36 which is engageable with the arm 35 of the lever 32 by which the auxiliary contacts are operated as described above.

Referring to Figs. 5 and 6, the hinge pin 11 by which the cover lid 10 is pivotally supported to the lower section 1 also supports a channel shaped holder 38 by which a magnetic core 39 is mounted on the lid. A coil 40 is slidably mounted on the core 39. A helical compression spring 41 engaging a flange on support 38 at one end thereof has its other end in engagement with the coil 40 to force the coil against a projection 42 on the lid 10, whereby the coil and magnetic core are held in place. The coil is removable by pivoting the core and coil assembly away from the projection 42 so that the coil may be slid off the core 39.

The edge of the cover lid 10 remote from its pivot axis at 11 has a projection 44 which is engageable by a projection 43 on the bell crank lever 15 to prevent the bell crank lever from swinging farther than the position shown in Fig. 5. The edge of the angle lever bears a marking "off" which is visible through an opening 16 in the lid 10 when the coil 40 is de-energized.

An alternative form of the main contacts is illustrated in Fig. 9. In this form of the invention, an additional fixed contact 45 is mounted in spaced relation to the stationary contact 5 and within the arc quenching chamber. A second contact bridge 46 is mounted on the pin 24. When the magnetic coil is energized, contact tips 26 will be moved into engagement with contact tips 19. When the coil 40 is de-energized, the bell crank lever 15 moves to the position illustrated in Fig. 9 in which the circuit at contact tips 19 and 26 is opened and the circuit across contacts 45 is closed.

Another form of the invention is shown in Fig. 10. In accordance with Fig. 10, an extended shaft 47 is mounted on the side of the contactor and carries with it arms 15 to which are mounted additional contact bridges 25. Rotation of the bell crank lever will cause a rotation of the shaft 47 and effect the closing of the additional contacts at the site of the contactor, the only requirement being that the contact pressure provided by the core and coil be sufficiently great to provide adequate contact pressure.

Fig. 8 shows the contactor with the lid 10 swung to open position and the bell crank lever 15 swung to its open position. As seen from this view, it is possible to mount a small thermal relay or the like 48 immediately

adjacent the contactor for the location and design of the bell crank lever **15** is such as to permit its operation without interference from such a thermal relay.

It can be appreciated from the foregoing discussion that the contactor admits of manufacture by first assembling the sub-assemblies, such as the lid **10** with its core and coil, the auxiliary contact block, the bell crank lever **15** and the slidable main contacts. Once assembled, the sub-assemblies may be quickly inserted or mounted on the lower section **1** so that the parts appear as shown in Fig. 8. When the bell crank lever **15** is swung to its operating position as shown in Fig. 5, the cover lid **10** may be closed as shown in Fig. 5, and secured in closed position by the leaf springs **12** which engage projections **13** on the lid as shown in Fig. 4. In the closed assembled position, the coil leads are secured to connectors **9** as illustrated in Fig. 9 where they are accessible for ready connection to appropriate circuits.

As illustrated in Fig. 5, the bell crank lever **15** is maintained in the position shown by the pressure of spring **37** acting on lever **32** through slidable auxiliary contact block **29**. The contact bridge **25** with its tips **26** are moved into engagement with stationary contact tips **19** upon energization of the coil **40**. When coil **40** is energized, the bell crank lever **15** is caused by the movement of the armature **21** toward the core **39** to move to the position of Fig. 6. The movement from the position of Fig. 5 to the position of Fig. 6 is against the pressure of the compression spring **37**.

Spring **37** is compressed by the lever **32** acting on slidable block **29**, the movement of the slidable block **29** causing the operation of the auxiliary contacts.

I claim:

1. A switch comprising a housing having a removable front cover, fixed contacts mounted on the rear vertical surface of said housing, a bell crank lever and having a vertical and horizontal leg pivotally mounted in said housing, movable contacts fixed to the end of said vertical leg and engageable with said fixed contacts by movement substantially perpendicular to said surface, a coil mounted in the front cover of said housing and cooperating with an armature on the horizontal leg of said lever, whereby energization of said coil will close said contacts.

2. A contact having two tips for bridging a second pair of contact tips comprising, a bar having a contact tip at each end, said bar having a circular portion intermediate the ends thereof, a mounting having at least one surface cooperating with said circular portion, and means resiliently holding said circular portion in frictional engagement with said cooperating surface, whereby said contact bar may rotate about said mounting and remain in its rotated position to provide simultaneous engagement of said contact tips.

3. A contact comprising, a contact bar having a contact tip at each end adapted to bridge two spaced contact tips, a movable member for moving said bar into engagement with said contact tips, and means for pivotally and frictionally mounting said bar to said member to permit said bar to rotate at least in the plane defined by said pairs of contact tips and to remain in the position to which it has been rotated.

4. A contact according to claim 3 and spring means biasing said arm into its pivotal mounting.

5. A magnetically operated switch comprising a rectangular box open at the front and bottom faces, a bell crank lever pivoted at the bottom of said box and having an armature fixed to one end of a normally horizontal leg of said lever, vertical trackways in the rear of said box, fixed contacts slidable into position in said trackways, movable contacts mounted on the normally vertical leg of said lever and engageable with said fixed contacts, a removable front cover for said box, and an electromagnet mounted in said cover and adapted to cooperate with said armature to operate said switch.

6. An electromagnetically operated switch comprising, a box, fixed contacts mounted in said box, movable contacts mounted on a contact carrier, means movably mounting said carrier in said box whereby said contacts can be engaged and disengaged, an armature mounted on said carrier, a cover movable between open and closed positions for said box, and an electromagnet mounted on said cover, said electromagnet cooperating with said armature, when said cover is in closed position, to operate said carrier, and when said cover is in open position said electromagnet being exposed for repairing operations.

7. A magnetically operated switch comprising a rectangular box open at the front and bottom faces, a bell crank lever pivoted at the bottom of said box and having an armature fixed to one end of a normally horizontal leg of said lever, vertical trackways in the rear of said box, fixed contacts slidable into position in said trackways, movable contacts mounted on the normally vertical leg of said lever and engageable with said fixed contacts, a removable front cover for said box, an electromagnet mounted in said cover and adapted to cooperate with said armature to operate said switch, trackways formed in the top of said box, and at least one auxiliary contact slidable in said trackways.

8. A switch according to claim 7 further comprising an operating lever depending from said auxiliary contact and disposed adjacent said normally vertical leg, said operating lever being moved by said vertical leg when said electromagnet is energized to operate said auxiliary contacts simultaneously with said first mentioned contacts.

9. A magnetically operated switch comprising a rectangular box open at the front and bottom faces, a bell crank lever pivoted at the bottom of said box and having an armature fixed to one end of a normally horizontal leg of said lever, vertical trackways in the rear of said box, fixed contacts slidable into position in said trackways, movable contacts mounted on the normally vertical leg of said lever and engageable with said fixed contacts, a removable front cover for said box, an electromagnet mounted in said cover and adapted to cooperate with said armature to operate said switch, trackways formed in the top of said box, at least one auxiliary contact slidable in said trackways, said auxiliary contacts forming the top of said box, and said normally horizontal leg of said lever extending between the vertical sides of said box to form the bottom of said box.

10. A magnetically operated switch comprising a rectangular box open at the front and bottom faces, a bell crank lever pivoted at the bottom of said box and having an armature fixed to one end of a normally horizontal leg of said lever, fixed contacts mounted in the rear of said box, movable contacts mounted on the normally vertical leg of said lever and engageable with said fixed contacts, an electromagnet mounted in the front of said box and adapted to cooperate with said armature to operate said switch, auxiliary contacts mounted in the top of said box, an operating lever depending from said auxiliary contact and engaging the end portion of said normally vertical leg, and spring means urging said operating lever against said vertical leg in a direction to hold said leg away from said fixed contacts.

11. A switch according to claim 10 in which said operating lever is bifurcated and said movable contacts pass between the legs of said operating lever.

12. A magnetically operated switch comprising a rectangular box open at the front and bottom faces, a bell crank lever pivoted at the bottom of said box and having an armature fixed to one end of a normally horizontal leg of said lever, vertical trackways in the rear of said box, fixed contacts slidable into position in said trackways, movable contacts mounted on the normally vertical leg of said lever and engageable with said fixed

contacts, a removable front cover for said box, means pivoting said cover to the top of said box, and an electromagnet mounted in said cover and adapted to cooperate with said armature to operate said switch, said bell crank lever being pivotable approximately 90° toward the front of said box when said cover is pivoted away from said box, said cover being adapted to positively block said switch from closing operation when said lever has been pivoted to its position toward the front of said box.

13. A magnetically operated switch comprising a rectangular box open at the front and bottom faces, a bell crank lever pivoted at the bottom of said box and having a transverse slot across one end of the horizontal leg thereof, an armature disposed in the slot in said horizontal leg, and a pin removably locking said armature in said slot, vertical trackways in the rear of said box, fixed contacts slidable into position in said trackways, movable contacts mounted on the normally vertical leg of said lever and engageable with said fixed contacts, a removable front cover for said box, and an electromagnet mounted in said cover and adapted to cooperate with said armature to operate said switch.

14. A magnetically operated switch comprising a rectangular box open at the front and bottom faces, a bell crank lever pivoted at the bottom of said box and having an armature fixed to one end of a normally horizontal leg of said lever, vertical trackways in the rear of said box, fixed contacts slidable into position in said trackways, movable contacts mounted on the normally vertical leg of said lever and engageable with said fixed contacts, a removable front cover for said box, means pivoting said cover to the top of said box, an electromagnet mounted in said cover and adapted to cooperate with said armature to operate said switch, said bell crank lever being pivotable approximately 90° toward the front of said box when said cover is pivoted away from said box, said cover being adapted to positively block said switch from closing operation when said lever has been pivoted to its position toward the front of said box, said movable contact comprising a contact bar having a contact tip at each end adapted to bridge said two spaced fixed contacts, said bar having a circular portion intermediate the ends thereof, a mounting on said lever having at least one surface cooperating with said circular portion, and means resiliently holding said circular portion in engagement with said cooperating surface, whereby said contact bar may rotate about said mounting to provide simultaneous engagement of said fixed contacts.

15. In a switch having a housing and an electromagnetically operated armature for carrying contacts, a removable cover and magnet construction for said housing comprising a magnetic core pivotally mounted in said housing cover, said core having at least one open ended leg, a winding slidably mounted on said leg, and slidably removable therefrom when said core is pivoted away from said cover, and means for securing said core and winding to said cover.

16. In a switch having a housing and an electromagnetically operated armature for carrying contacts, a removable cover and magnet construction for said housing comprising a magnetic core pivotally mounted in said housing cover, said core having at least one leg open at an end remote from the pivotal mounting, a winding slidably mounted on said leg and slidably removable therefrom when said core is pivoted away from said cover, and cooperating latching means on said cover and winding for securing said core and winding on said cover.

17. A switch according to claim 16 and spring means urging said winding into latched position.

18. In a switch having a housing and an electromagnetically operated armature for carrying contacts, a cover, a hinge pin extending through the top portion of said cover for pivotally mounting said cover on said housing, and a magnetic core carried by said cover and pivotally mounted on said hinge pin.

19. A switch according to claim 18, and a pair of slots at the top portion of said housing for removably receiving said hinge pin, whereby said cover may be removably and pivotally mounted on said housing.

20. In a switch having a housing, an electromagnetically operated armature for carrying contacts comprising a bell crank lever pivotally mounted in said housing, contacts mounted on one leg of said lever, an armature bar mounted on the other leg of said lever, a cover for said housing mounted generally perpendicular to said other leg, an E-shaped core carried by said cover and having the open ends of the legs of the E adjacent said bar, and a winding slidably mounted on the middle leg of said E.

21. A magnetically operated switch comprising a rectangular box open at the front and bottom faces, a bell crank lever pivoted at the bottom of said box and having an armature fixed to one end of a normally horizontal leg of said lever, vertical trackways in the rear of said box, fixed contacts slidable into position in said trackways, spring latch means securing said fixed contacts in position, and movable contacts mounted on the normally vertical leg of said lever and engageable with said fixed contacts.

22. A switch according to claim 21 in which each said trackways is a dove tail groove, each said fixed contacts having a complementary projection, and said spring latch means comprising a leaf spring lying in said groove and having a projection at one end thereof engageable with the end of said complementary projection.

23. A switch according to claim 8 in which said operating lever is spring biased to resist movement of the vertical leg of said bell crank lever, thereby decelerating the contact closing movement of said bell crank lever.

24. A magnetically operated switch comprising a housing, fixed contacts in said housing, a magnetically operated armature movably mounted in said housing and carrying contacts adjacent said fixed contacts, electromagnetically operated means for moving said armature in a "closing" direction to effect the engagement of said armature contacts with said fixed contacts, an auxiliary contact mounted in said housing, an operating member on said auxiliary contact engageable by said armature to operate said auxiliary contact, and spring means biasing said operating member to decelerate the movement of said armature in "closing" direction.

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