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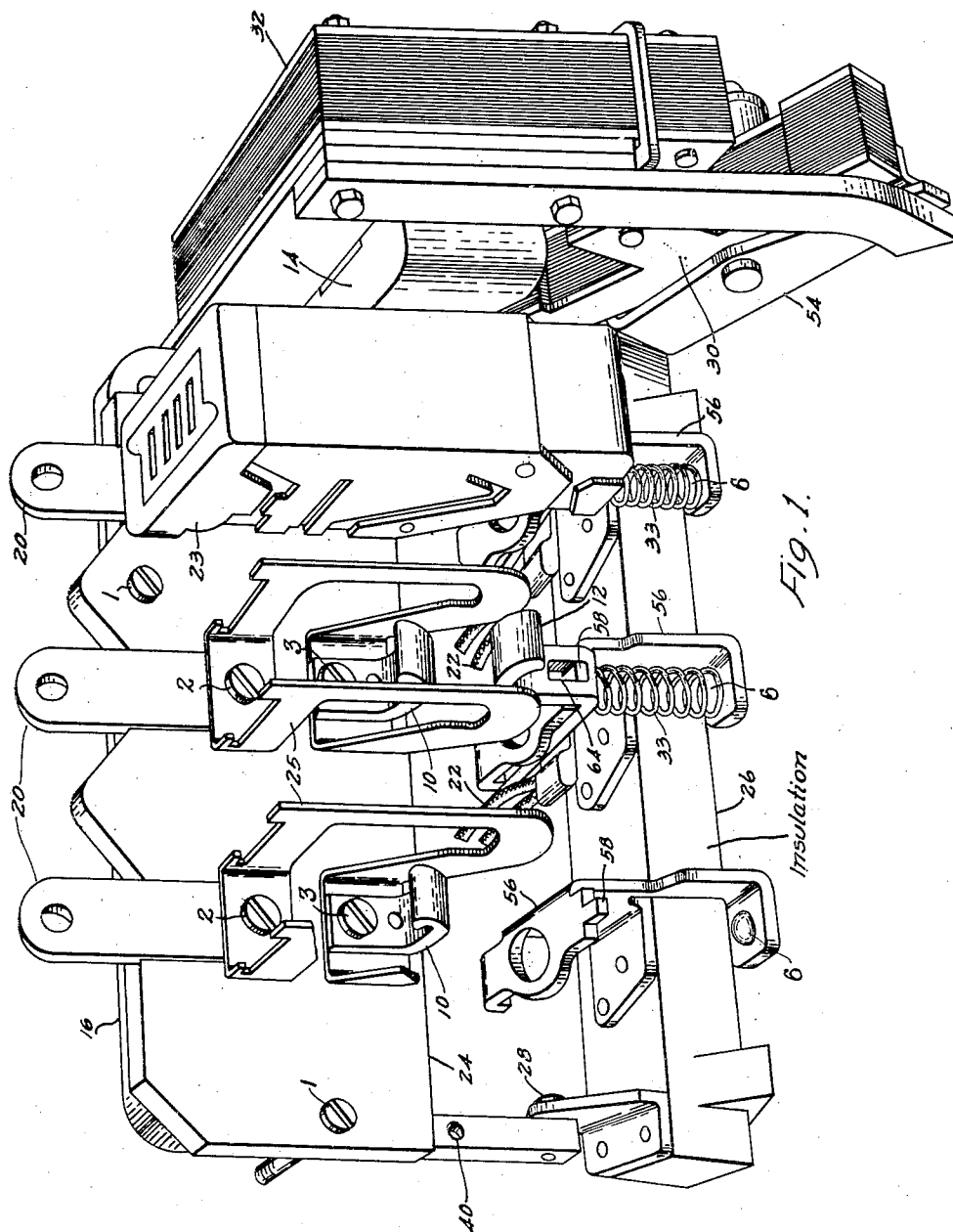
G. C. ARMSTRONG ET AL

2,157,843

ELECTRICAL CONTACTOR

Filed Aug. 28, 1936

3 Sheets-Sheet 1



WITNESSES:

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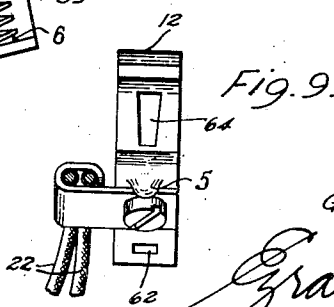
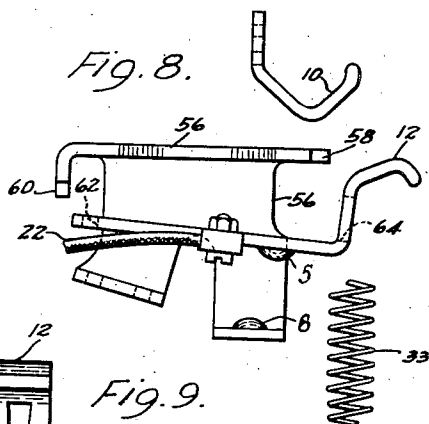
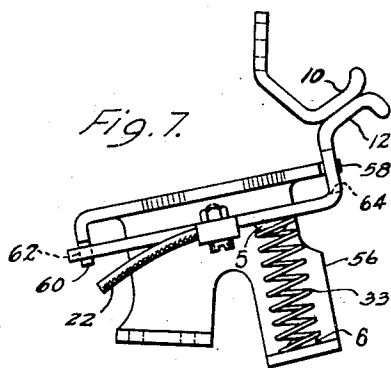
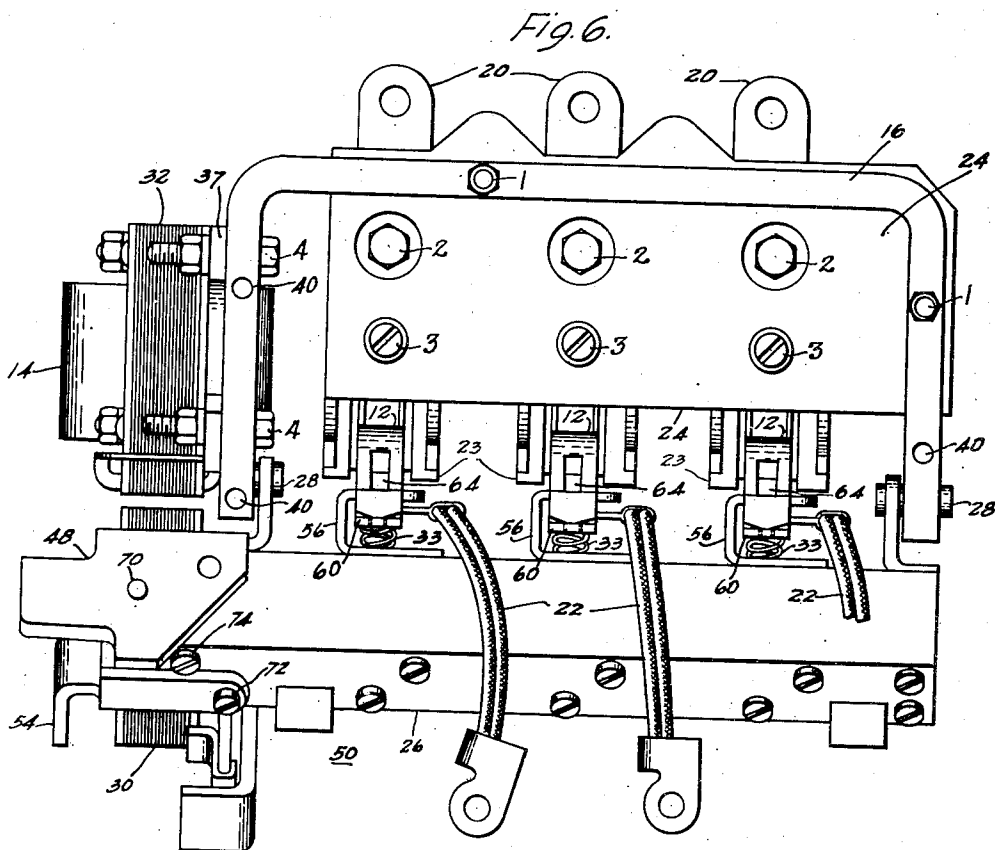
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UNITED STATES PATENT OFFICE

2,157,843

ELECTRICAL CONTACTOR

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Application August 28, 1936, Serial No. 98,322

11 Claims. (Cl. 200—104)

Our invention relates to magnetically-actuated switches or contactors, and it has particular relation to improvements in the design and construction of contactors adapted for use in alternating-current circuits.

Generally stated, the object of our invention is to facilitate the manufacture, installation and repair of such contactors.

A more specific object is to provide a self-contained unit-constructed contactor which in multi-pole designs of high current rating may be completely assembled, adjusted and tested before being mounted upon a panel or other supporting structure.

Another object is to provide a mechanically rugged and compact construction wherein all parts of replaceable or adjustable character are accessible from the front of the mounting panel.

A further object is to provide a contactor of the type above described which is tilt and shock proof and different ratings of which use common parts.

An additional object is to facilitate the coupling for parallel operation of two or more unit-constructed contactor assemblages.

A still further object is to improve the design and arrangement of the movable-contact parts which are employed in the above and other contactors.

Our invention itself, together with additional objects and advantages, will best be understood through the following description of a specific embodiment when taken in conjunction with the accompanying drawings in which:

Figure 1 is a perspective view of a contactor which incorporates the several improvements of our invention,

Fig. 2 is a view in side elevation of the device of Fig. 1 showing its adaptability for mounting upon and complete access from the front of a supporting panel,

Fig. 3 is a view in rear elevation showing two unit-constructed contactors coupled together through the improved means of our invention,

Fig. 4 is a view showing further details of the coupling device of Fig. 3,

Fig. 5 illustrates other features of our novel bearing and magnet bracket arrangement,

Fig. 6 is a view in rear elevation of the device of Fig. 1, and

Figs. 7, 8 and 9 are views showing our improved design of moving contact assemblage.

The several features of our invention are disclosed as applied to a three-pole contactor of the shaft-driven vertical-lift type illustrated in the

drawings. As best shown in Figs. 1, 2 and 6, the contactor includes three stationary contact members 10 and three cooperating movable contact members 12 for controlling a three-phase circuit. This circuit is completed through three lugs 20 that are electrically connected, respectively, to the stationary contact members 10 and flexible shunts 22 that are electrically connected, respectively, to the three movable contact members 12.

As best shown in Figs. 1, 2 and 6, the contactor parts are supported from a U-shaped bar or frame 16 mounted with the spaced ends extending downwardly. This frame may also serve as means for mounting the contactor upon a panel or supporting structure 18 shown in Fig. 2. A slab of insulating material 24 is mounted on the frame 16 by means of screws or bolts 1 extending therethrough. The insulating slab 24 serves as a support for the lugs 20 that are attached thereto by means of bolts 2, and for the contact members 10 that are attached thereto by means of bolts 3. Blow-out coils 25 are provided that are electrically connected between lugs 20 and contact members 10 and are also attached to the slab 24 by the bolts 2 and 3.

Associated with each set of contacts 10—12 is an arc box 23 supported by a blow-out coil 25. These boxes form a part of an improved arc-quenching equipment more completely shown and described by our copending application Serial No. 98,324, filed August 28, 1936. In order better to show the construction and arrangement of the device contact parts, the view of Fig. 1 illustrates only one of the three boxes 23 in position and shows only two of the three moving contact members 12.

A shaft 26 of insulating material is pivotally supported from the lower ends of the frame 16 by bearing pins 28, which shaft carries the three movable contact members 12 positioned in operative relation respectively to their three cooperating stationary contact members 10. At one end of the shaft 26 a bracket 54 is attached by means of a bolt 10, which bracket carries a movable armature 30 of magnetic material that cooperates with a fixed E-shaped magnet structure 32 that is supported on the outer side of the frame 16 by means of bolts 4. An operating winding 14 is carried on the middle leg of the E-shaped core for actuating the contactor to a circuit closing position when energized. The operating magnet, including the magnetic portions 30 and 32 and the winding 14, may correspond to that illustrated and described in greater detail in our copending application for electrical contactors, Serial

No. 98,323, filed August 28, 1936, and assigned to the same assignee as this application.

Our invention also contemplates improvements in the moving contact assembly for circuit controlling devices. In our preferred construction, the moving contact member 12 is carried by a bracket 56 that is supported on the shaft bar 26. The bracket 56 is of a comparatively heavy and rugged construction and is provided with a pair of extensions 58 and 60 which project therefrom in planes at substantially right angles to each other in the manner shown for example in Figs. 7 and 8. An opening 62 is provided in the end of the body portion of the moving contact member 12 into which the projection 60 may be fitted. The front portion of the contact member 12 is provided with a slot 64 adapted to accommodate the projection 58. The extension 60 that fits into the opening 62 forms a pivot point about which the contact member 12 moves and this pivot point is slightly displaced from the axis of the bearing pin 28, as shown in Fig. 2, so that as the contact member 12 moves, a small sliding movement to the engaging surfaces of contact members 12 and 10 takes place.

In assembling the parts (see Figs. 7 and 8), the projection 58 is first inserted into the slot 64 and the opening 62 is then aligned with the projection 60 which fits into it. The compression spring 33 is next placed in position between the knob 5 on the underside of the contact member 12 and the knob 6 on the downwardly extending forward portion of the bracket 56, as shown in Figs. 1, 2 and 7. The spring 33 serves to hold the contact member 12 and the bracket 56 in operative relation without the aid of screws, bolts or clips. This arrangement allows the parts to be readily assembled or replaced. It also increases the life of the moving contact structure.

The contact member 12 is preferably made of copper and the bracket 56 is preferably made of steel or other wear resisting material. As the parts wear during use, the comparatively long length of these parts prevents any substantial change in contact alignment. The contact members may, therefore, be used for a longer period of time than would otherwise be possible. The bracket 56 shows practically no wear over a long period of time.

In order to increase the speed with which the contact members separate and to prevent wear along the sides of slots 64 of the copper contact member 12, the slot 64 is made wider at the top than at the bottom. The projection 58 occupies the lower and narrower portion of the slot 64 when the contactor is in the open circuit position, as shown in Figs. 1 and 6.

When the magnet winding 14 is unenergized, the force of gravity acting on the armature 30 holds it in its lower position as illustrated in Figs. 1, 2 and 6, in which position the movable contact members 12 are separated from their cooperating stationary contact members 10. The energization of the winding 14 by any suitable circuit (not shown) attracts the armature 30 upwardly to rotate the bar 26 about the pivot pins 28 to move the contact members 12 into engagement with their respective cooperating contact members 10, thereby completing the controlled circuit. As the bar 26 is moved to cause engagement of the contact members and after the initial contact between the members 12 and 10, a further movement of the bar 26 causes the forward end of the contact member 12 to be moved downwardly with respect to the bracket 56 and cause compression

of the spring 33. That is to say, after contact member 12 has engaged the contact member 10, a further upward movement of the bracket 56 takes place in which the projection 58 is moved upwardly within the slot 64 and the slight further upward movement of the step of the bracket upon which the knob 6 is carried affects a compression of the spring 33. Also during this part of the movement of the bar 26 and bracket 56, during which the spring 33 is being compressed, a slight sliding movement between the contact members 10 and 12 occurs, as previously explained, due to the fact that the projection 60, about which the contact member 12 pivots, is out of alignment with the axis of the pivot pins 28 about which the bracket moves. This sliding movement prevents these members from freezing. Since the slot 64 in the contact member 12 is wider at the top than at the bottom, the advance of the projection 58 upwardly along the length of the slot 64 during compression of the spring 33 completely separates it from frictional engagement with the sides of the slot, thus eliminating wear along the sides of the slot.

Upon deenergization of the magnet winding 14, the magnetic attraction between the armature 30 and the magnetic structure 32 is released and the force of gravity, together with the force of the springs 33, urges the armature downwardly, causing the contact members 12 to operate from engagement with the contact members 10 with a rapidity and through a distance sufficient to interrupt the controlled circuit current. The freedom of motion of the projection 58 in the slot 64 caused by the slot being wider at the top than at the bottom allows the moving shaft bar 26 and brackets 56 to accelerate during the first part of the movement thereof in an opening direction. After a sufficient movement of the bracket 56 to relieve the increased tension on the spring 33 caused after initial engagement of the contact members during closing of the contactor, a sudden impact or hammer blow is imparted to the contact member 12 by the projection 58, causing the contact member 12 to separate rapidly from engagement with the cooperating stationary contact members 10. This quick separation of the contact members prolongs the life of the contactor and raises its rupturing capacity.

The moving contact parts are so designed that during the opening operation the projection 58 strikes the member 12 at its center of percussion. This further increases the maximum speed of separation of the contact members and eliminates chattering.

The presence of the slot 64 in the particular position shown also accomplishes an electrical function. In order that the arc quenching apparatus 23 may function most effectively, it is desirable that the blow-out coil 25 urge the arc into the box interior in a substantially central position. However, the contact members 10 and 12 may, in separating, initiate the arc at practically any point along their line of contact or width.

When the portion of member 12 which carries slot 64 is solid as in prior art constructions, an initiation of the arc at one side of the contact center results in a direction into the arc box toward that side. Instead of tending to bring the arc back into the desired center, the tendency is to cause it to depart further from the center. This is due to magnetic interactions resulting from unequal current distribution through the moving contact body.

By placing the slot 64 in the position shown, however, a very beneficial compensating action results. An arc started at the side of the contacts tends to be restored toward the center of the arc box interior. Here again, the explanation is magnetic interaction.

The presence of the slot requires that the total current divide through the two parallel paths around the slot. The distribution between these two paths varies with the point at which the arc is drawn. If this point is at the center, the distribution is uniform. If at one side, a major portion of the current flows through the path at that side since that path is shorter in effective length than is the other.

The magnetic interactions resulting under these conditions strongly tend to restore the arc, in its movement away from the contacts, to a path approaching the center of the arc box 23. In practice, this effect is found greatly to increase the efficiency of arc extinction.

The form of construction just described offers a number of advantages. The support by frame 16 of all essential parts of the contactor in full operative relation permits the device to be completely assembled, adjusted and tested before being mounted on a panel. The single-piece frame 16 shown may, of course, be replaced by a multi-piece form of construction. In either case this frame constitutes the backbone of the complete unit-assembled contactor. It is rigid, has no loose joints, and is not subject to distortion. The ends may, by a single operation during manufacture, be drilled and line-reamed to constitute the bearings which accommodate shaft-bar pins 28.

Attachment of the contactor to the panel is readily effected. On preferred manner utilizes tapped spacers 34, shown in Fig. 2, and cooperating screw bolts 35 and 36. The three front-inserted bolts 36 pass through holes 49 (Fig. 6) in the frame 16. Instead of using the two spacers shown at the magnet end of the contactor, separation of that end of the device from the mounting panel may also be effected by a bracket 37 (Figs. 2 and 6). In that case the two referred-to members 34 need serve only to interconnect screw bolts 35 and 36.

Our improved contactor is also adapted for mounting on a steel or other metal panel. The only changes required in the form of attachment illustrated are the provision of insulating bushings (not shown) for the circuit-connecting studs or terminals.

In our improved design all parts requiring adjustment or replacement are completely accessible from the front of the mounting panel. With the form of mounting shown in Fig. 2, the complete device may be removed and replaced by a duplicate unit without disturbing the rear of the panel. This minimizes the danger and inconvenience incident to work on the contactor.

The use of moving parts adapted for vertical lift results in a device which is substantially shock and tilt proof. Even the most severe horizontal jars produce no tendency toward a change of position on the part of movable contacts 12. Tilts of 45° or more are found not to alter the operation of the device.

The new device is both compact and mechanically rugged. The structure illustrated may be built to withstand several million operations under load with replacement of contact tips only. It is capable of very frequent operation under full load. The design is such that contactors hav-

ing different current ratings use many common parts.

Our improved unit or self-contained form of design readily lends itself to the construction of contactors having from one to five or more poles. Thus, a one or a two-pole contactor may be built in exactly the same manner as is the three-pole device illustrated, except that the number of sets of contacts 10-12 is reduced. The lengths of frame 16, moving contact bar 26 and stationary contact slab 24 are correspondingly reduced. By similarly increasing these lengths over those illustrated in the drawings, it is possible to construct a device having more than three sets of cooperating contacts.

We have found that when the number of poles or pairs of contact members exceeds 3 or 4, it is preferable to incorporate the extra poles into a separate unit and mechanically couple its contact-actuating bars 26' to the shaft-bar 26 of the major or magnetically-actuated device.

Such an arrangement is shown in Fig. 3. There the auxiliary pole carrying unit is represented at 42. The contact-carrying bar 26' thereof carries a coupling bracket 44 through the end of which a bolt 46 is passed in the manner shown. The end of this bolt bears against an extension of bearing bracket 43 fixed to the shaft-bar 26 of the main device 50. The head of the bolt abuts against a plate 52 secured to the armature bracket 54 which also is carried by bar 26.

This novel form of coupling constitutes a universally adjustable coupling which takes care of misalignments between the sets of bearings 28 of the two coupled devices 42 and 50 and also allows for variations in relative longitudinal position. It further permits the relative angular positions of the coupled bars 26' and 26 to be adjusted to the point where the moving contacts of both devices simultaneously engage with the stationary contact members. To effect this adjustment, the bolt 46 is changed in longitudinal position with respect to the tapped bracket 44 by which it is carried.

The projecting portion of the bearing bracket 43 is also adapted to drive mechanical means (not shown) for interlocking the operation of the contactor with other related units.

In order to permit bracket 54, which carries the magnet armature 30, to be removed without detaching bearing bracket 43 from the shaft bar 26, we further arrange these parts in the manner shown in Fig. 5. Two bolts 70 and 72 hold bracket 54 in place. The ends of these bolts engage tapped holes in bearing bracket 43. A third bolt 74, which is independent of bracket 54, also secures bearing bracket 43 to the shaft bar 26.

By removing bolts 70 and 72 this armature carrying bracket 54 may be completely detached from the shaft bar. At such a time, however, the independent bolt 74 holds the bearing bracket 43 in place on the bar, thereby maintaining proper bearing alignment. This feature greatly facilitates repair or replacement of the magnet armature 30.

Although we have shown and described certain specific embodiments of our invention, we are fully aware that many modifications thereof are possible. Our invention, therefore, is not to be restricted except insofar as is necessitated in the prior art and by the scope of the appended claims.

We claim as our invention:

1. In a circuit-controlling device comprising stationary and movable contact members and an engagement-determining magnet therefor, the combination of a U-shaped frame adapted to position all of said elements in full operative relation and to support the complete device from a panel or other mounting structure.
2. In a device comprising stationary and movable contact members and an engagement-determining magnet therefor, the combination of a U-shaped frame adapted to support the magnet from the side of one of its two legs, the movable contact member pivotally between the ends of said legs and the stationary contact member in a position intermediate the leg ends and the leg-joining portion of the frame.
3. In a device comprising stationary and movable contact members and an engagement-determining magnet therefor, the combination of a U-shaped frame adapted to be mounted in an inverted position, means for pivotally supporting the movable contact between the ends of the frame legs, means for supporting the stationary contact from the frame at a point above said ends and means for attaching the magnet to the side of one of said frame legs.
4. A contactor comprising a U-shaped frame adapted for attachment in inverted position to a panel or other mounting structure, bearings formed in the ends of the two downwardly extending frame legs, a bar rotatably supported by said bearings, a contact mounted on said bar to be movable therewith, a stationary contact supported from said frame above and in cooperative relation with the movable contact, and a magnet for rotating said bar into contact-engaging position supported from one of said end legs of the frame.
5. A contactor comprising a U-shaped frame adapted for attachment in inverted position to a panel or other mounting structure, bearings formed in the end of the two downwardly extending frame legs, a bar of insulating material supported by said bearings, a contact carried by said bar, a cooperating stationary contact insulatedly mounted on said frame above the contact first named, and a magnet attached to one end of said frame and adapted to rotate said bar into contact-engaging position.
6. Means for coupling together the rotatable actuating bars of two contactors comprising a bracket fixed to one of the bars and having a tapped hole therein, a threaded bolt extending through said hole, and extensions supported from

opposite sides of the other of said bars in such manner as to abut respectively with the head and end of the bolt.

7. Means for coupling together in adjustable manner the rotatable actuating bars of two contactors comprising a bracket having a tapped hole fixed to one of the bars, a threaded bolt extending through said hole and brackets fixed to the other of said bars which abut with the head and end of the bolt, the extent of advancement of the bolt through said hole determining the relative rotative positions of the coupled bars.

8. Means for coupling together in misalignment-compensating manner the rotatable actuating bars of a pair of contactors comprising a bracket carried by one of the bars, a bolt extending through the end of said bracket, and brackets carried by the other of said bars which abut with the extremities of the bolt in a manner permitting slidable movement therebetween.

9. In a device comprising a contact-carrying shaft bar and an electromagnet having a movable armature adapted to rotate the bar into contact-engaging position, the combination of a bearing, a bracket for supporting the bar from said bearing, a second bracket for connecting the bar with the magnet armature, and common means for securing said brackets to opposite sides of the shaft bar.

10. In a device comprising a contact-carrying shaft bar and an electromagnet having a movable armature adapted to rotate the bar into contact-engaging position, the combination of a bearing, a bracket for supporting the bar from said bearing, a second bracket for connecting the bar with the magnet armature, and common means for securing said brackets to the same longitudinal section of the shaft bar in a manner which permits the armature bracket to be removed without detaching the bearing bracket.

11. In a device comprising a contact-carrying shaft bar and an electromagnet having a movable armature adapted to rotate the bar into contact engaging position, the combination of a bearing, a bracket for supporting the bar from said bearing, a second bracket for connecting the bar with the magnet armature, common means for securing said brackets to opposite sides of the shaft bar, and means independent of the armature bracket for further securing the bearing bracket to the shaft bar whereby the armature bracket may be removed without detaching the bearing bracket.

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