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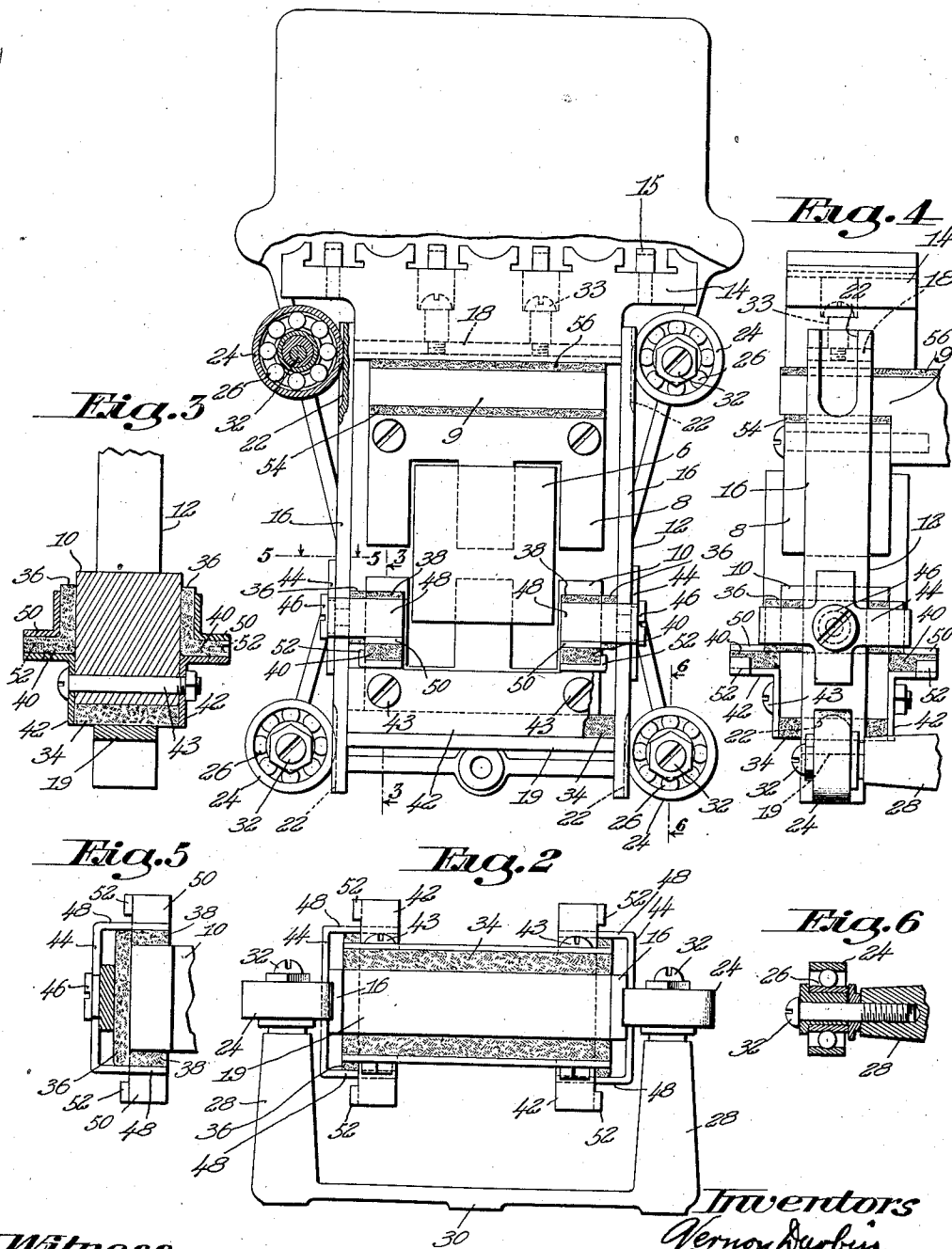
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MAGNETIC SWITCH

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Fig. 1



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MAGNETIC SWITCH

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The present invention relates to magnetic switches.

Magnetic switches or power relays usually comprise an armature, a contact carrier and a frame or other means by which the attraction and retraction of the armature operate the contact carrier to engage and disengage the electrical contacts. The frame is usually constructed to move up and down, being loosely guided by means of pins or ears carried by the frame and received in slots in the main base or casing.

Switches of this character are frequently employed as limit switches for machine tools. It has been found that the switches occasionally fail to operate, and thus cause serious damage in automatic drilling, tapping and similar machines. The causes of failure are very difficult to determine, since a switch, after failure, can usually be put into service again and operated for many thousand cycles without another failure.

In investigating causes of failure, we have discovered that although no single cause appears to be responsible for unsatisfactory operation, the primary contributing factors are mechanical in their nature. It is probable that through the excessive racking to which the equipment is subjected, the guides become slightly worn or roughened, and while this is insufficient in itself, it may, in combination with other effects, result in a failure. Thus, the operation may be affected by excessive residual magnetism in the core or by a momentary weak or excessive current in the coil, or even by the fact that the current is established or cut off in a coil at a particular instant in the cycle. These latter factors depend on chance, and hence may be viewed as contributing to a failure when they happen to occur in combination with the previously-noted mechanical faults.

The object of the present invention is to devise a magnetic switch in which the chances of failure are practically negligible. With this object in view the present invention comprises the magnetic switch hereinafter described and particularly claimed in the claims.

In the accompanying drawings, Fig. 1 is a front elevation of the preferred form of magnetic switch; Fig. 2 is a bottom plan view; Fig. 3 is a section on line 3-3 of Fig. 1; Fig. 4 is a side elevation of a portion of the frame; Fig. 5 is a section on line 5-5 of Fig. 1; and Fig. 6 is a section on line 6-6 of Fig. 1.

The magnetic switch shown in Fig. 1 comprises a coil 6, having an E-shaped core 8 and an opposed E-shaped armature 10. The core 8 is secured beneath a ledge 9 projecting forwardly from the

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main base to be described later. The armature is secured to a rectangular frame 12 by means to be later described, which frame carries at its upper end a contact carrier 14. Movable contacts 15 are mounted in any suitable manner on the carrier 14 for engagement with fixed contacts in the upper portion of the switch.

The frame 12 on which the armature is mounted comprises side bars 16 and top and bottom struts 18 and 19, these parts being welded or otherwise secured together to form a rigid structure. As shown in Fig. 4, each side bar 16 is formed at the top and bottom with a groove 22. Into each groove extends the ring 24 of a ball, roller or other anti-friction bearing 26. The four bearings are mounted on posts 28 extending forwardly from the main base plate 30.

As shown in Fig. 6, each bearing 26 is supported on an eccentric bushing which in turn is mounted on the post 28 by means of a bolt 32. The opening through the bushing is eccentric to the outside diameter thereof, whereby the position of each bearing may be adjusted laterally with respect to the groove 22 in the frame. The width of each bearing is only slightly less than that of each groove 22, whereby the frame is constrained against any back and forth motion. The bearings are adjusted to constrain the frame against any sidewise motion, but without interposing any material resistance against up and down motion upon attraction or retraction of the armature. The contact carrier 14 is secured to the strut 18 by screws 33.

In operation it is necessary that the opposed faces of the core 8 and armature 10 engage in close contact when the armature is attracted. Since the rigidity of the frame provides no play for this effect, the invention makes use of slightly yielding connections between the armature and the frame, which connections also afford some shock-absorbing properties against the vibration encountered in operation.

To this end the frame and armature are separated by layers of felt or other damping material. One layer of felt 34 is placed between the horizontal bottom leg of the armature and the bottom strut 19 of the frame. A layer of felt 36 is placed between each side wall and the adjacent vertical leg of the armature. As shown in Fig. 5 at 38, each layer 36 is preferably wrapped part way around the armature leg. Portions of the pad are bent outwardly, as indicated at 40 in Figs. 3 and 4, to form horizontal wings. These wing portions rest on L-shaped brackets 42 which are secured to the bottom leg of the armature by

bolts 43. The side pieces 38 are held in place by a clip or bracket 44 attached to the side bar by a screw 45 and provided with arms 48 to grip the portions 38 of the felt. Extending from each arm 48 is a ledge 50 overlying the felt wings 40 opposite to the L-shaped brackets 42. As shown in Fig. 4, each bracket 42 is provided with ears 52 to retain the felt wings 40 against sidewise movement.

By this construction, there is no metal-to-metal contact between the armature and the frame, and hence the motion of the armature is transmitted to the frame through the felt pad, mainly through the wing portions 40 thereof.

A felt pad 54, preferably placed between the upper end of the core 8 and the ledge 9, extends forwardly from the main base 30. Similarly, the upper part of the ledge 9 is provided with a felt pad 56 to absorb the impact of the contact carrier 14 upon a retracting movement.

The construction heretofore described has been found to operate satisfactorily and without failure over an indefinite period. The invention is based on the fact that while failure of existing types of switches is probably due to a fortuitous combination of factors, the chances of failure can be made negligible by substantial elimination of mechanical contributing factors.

The frame 12 is rigid and is constrained to up-and-down motions without any material play in other directions. There is no consequential wear on the parts because of the anti-friction mounting of the frame.

Furthermore, any contributing factors of failure arising from the magnetic circuit are substantially eliminated. The felt insulation permits enough yield to insure a proper seating of the core against the armature without the necessity of allowing any looseness or play in the frame. The effect of the insulation in damping vibrations is also important, in that there is no tendency for the component parts to be shaken loose or out of alignment by the vibration to which the device is subjected.

Having thus described our invention, we claim:

1. In a magnetic switch having a stationary coil and core and a movable armature and contact carrier, the combination of a rigid frame on which the armature and contact carrier are mounted, yielding vibration-damping material connecting the armature and the frame without metal-to-metal contact between the armature and frame to permit the armature to engage in

close contact with the core notwithstanding the rigidity of the frame, and anti-friction members to permit free attractive and retractive movements of the frame and to restrain lateral and back-and-forth movements thereof.

2. In a magnetic switch having a stationary coil and core and a movable armature and contact carrier, the combination of a rigid frame on which the armature and contact carrier are mounted, yielding vibration-damping material connecting the armature and the frame without metal-to-metal contact between the armature and frame to permit the armature to engage in close contact with the core notwithstanding the rigidity of the frame, the frame having side bars, each provided with grooves, and anti-friction bearings mounted on the frame and having rings extending into said grooves to permit free movements of attraction and retraction and to restrain lateral and back-and-forth movements of the frame, one of said bearings being mounted at each of the four corners of the frame.

3. In a magnetic switch having a stationary coil and core and a movable armature and contact carrier, the combination of a rigid frame on which the armature and contact carrier are mounted, yielding vibration-damping material connecting the armature and the frame without metal-to-metal contact between the armature and frame to permit the armature to engage in close contact with the core notwithstanding the rigidity of the frame, said material being wrapped partly around the armature and having wing portions bent outwardly, clip members secured to the frame and bracket members secured to armature to engage said wing portions, and anti-friction bearings engaging the frame to permit free attractive movements of the frame and to restrain lateral and back-and-forth movements thereof.

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