Oct. 24, 1961 W. J. POWELL 3,005,889

ELECTROMAGNETIC DEVICES

Filed Oct. 28, 1958 2 Sheets-Sheet 1

Fig.1.

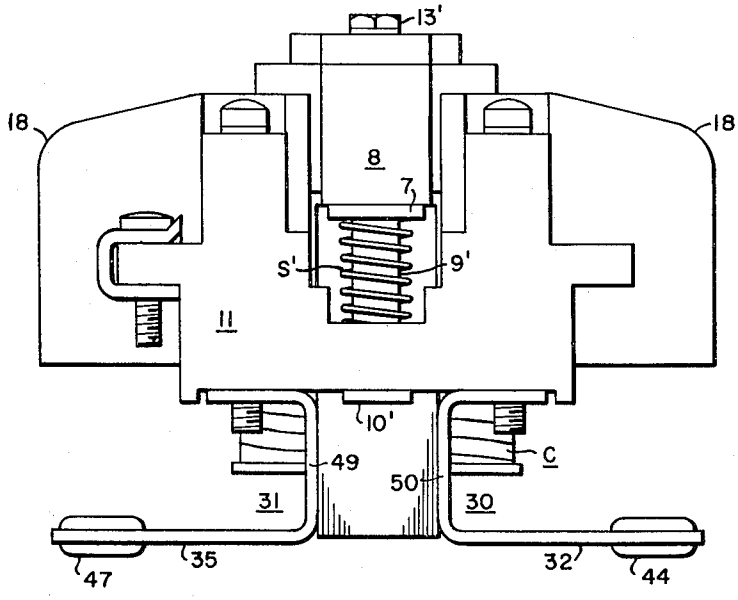


Fig.2.

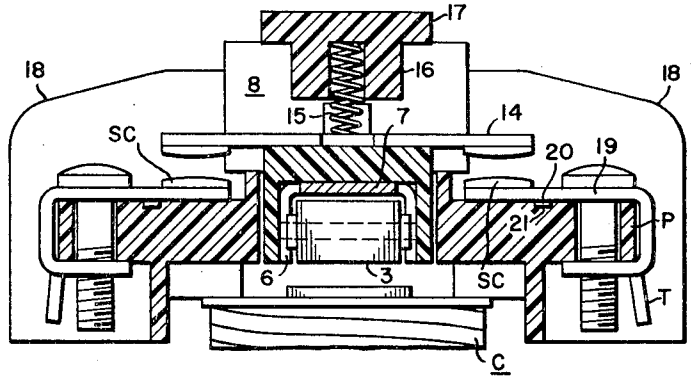
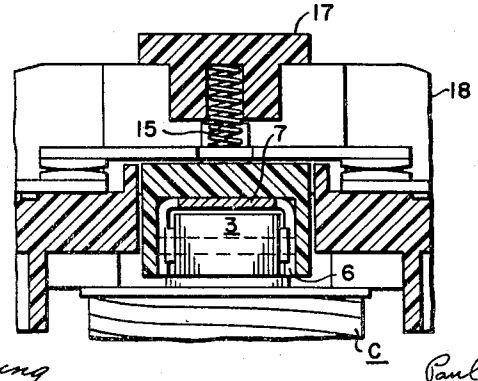


Fig.3.



WITNESSES

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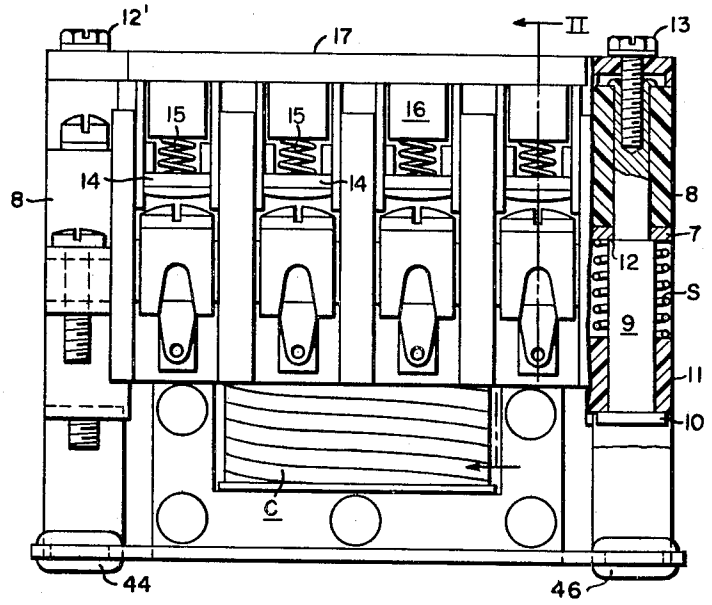
ATTORNEY

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ELECTROMAGNETIC DEVICES

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Fig. 4.



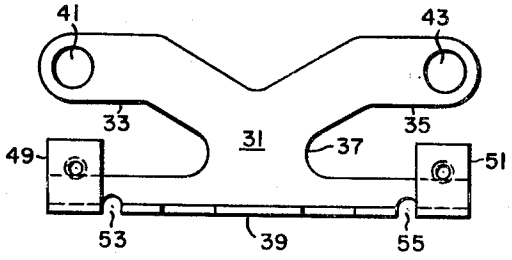


Fig. 8.

Fig. 7.

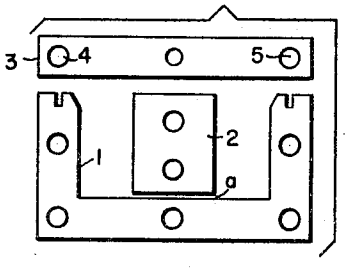
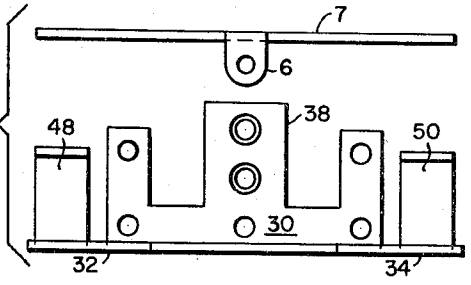


Fig. 5.



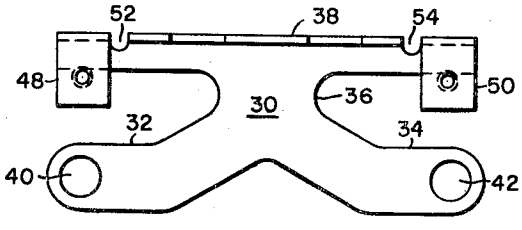


Fig. 6.

United States Patent Office 3,005,889 Patented Oct. 24, 1961

3,005,889

ELECTROMAGNETIC DEVICES

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Filed Oct. 28, 1958, Ser. No. 770,107
10 Claims. (Cl. 200—87)

This invention relates, generally, to electromagnetic devices and, more particularly, to electromagnetic relays and contactors of particular utility in alternating-current service.

It is sometimes very desirable to construct a laminated magnetic circuit for an alternating-current relay so that the laminations are mounted firmly on a base and to have a small permanent air gap in the magnetic circuit, and it is always necessary to provide mounting legs for the magnetic circuit and parts forming the complete relay, and it is, of course, necessary to provide means for attaching an arc box when the magnetic circuit is a component of a relay or contactor. Further, it is important that the laminations are firmly held and not distorted by the mounting to make the magnetic circuit noisy in service, and that all these aims are accomplished by the simplest and most reliable structure.

Not only is the structure and mounting of the magnetic circuit important but the disposition and structure of the arc box and the structure of the stationary and movable contacts are very important.

One broad object of this invention is the provision of a simpler, less expensive, and more reliable and noise-free contactor for alternating-current service than contactors heretofore known for the same type of service.

It is an object of this invention to provide an inexpensive and novel means for a relay for accomplishing all the purposes mentioned with only one tooled part.

It is a more specific object of this invention to provide a noiseless magnetic circuit for a relay, or contactor, having a selected permanent air gap in the circuit.

The objects recited are merely illustrative. Other objects and advantages will become more apparent from a study of the following specification and the accompanying drawings, in which:

FIGURE 1 is an end view of a relay incorporating the invention;

FIG. 2 is a transverse sectional view, on section line II—II of FIG. 4, of the relay shown in FIG. 1 with the parts shown in the unactuated position;

FIG. 3 is a view, similar to FIG. 2 but with parts broken away, showing the relay in its actuated position;

FIG. 4 is a side view of the relay with certain parts broken away to illustrate the biasing structure for the movable portions of the relay;

FIG. 5 is a detail showing, viewed from the side, of the mounting element for the movable laminated armature and of the structure for holding the stationary portion of the laminated magnetic circuit;

FIG. 6 is a plan view of one of the elements for mounting the stationary part of the magnetic circuit;

FIG. 7 is a side view showing the relative disposition of the laminated elements of the complete magnetic circuit; and

FIG. 8 is a plan view of an element similar to the element shown in FIG. 6.

In the relay herein disclosed, the stationary part of the magnetic circuit comprises a plurality of stacked laminations, 1 and 2, which, in assembled relation as best shown in FIG. 7, form an E-shaped core structure.

It is an important improvement to provide the magnetic circuit with a permanent air gap, and it is an important requirement that the E-shaped core structure, after being assembled on the supporting plates on the relay

base, be in nowise thereafter affected by any distorting stresses. Any such stresses cause the laminations to shift and in consequence the relay becomes either noisy, or unreliable in operation, but most of the time becomes both noisy and unreliable in operation.

To accomplish the simplification, reliability of operation, and noise elimination, the supporting structure for the relay includes two identically shaped interchangeable supporting structures or parts 30 and 31. The description will suffice if mainly directed to one structure as structure, or part, 30, which consists of a frame of a sheet of tough blanked, pierced and bent brass. The sheet metal need not be brass but may be any other non-magnetic metal as for example, wrought copper or stainless steel.

The part 30 has the elongated horizontal flexible legs 32 and 34 secured to the main portion of part 30 by the narrow strip 36. This narrow strip 36 is flexible yet of sufficient strength to hold the relay to a base, or panel, without transmitting any distorting stresses to the E-shaped mount 38 for holding the laminations 1 and 2 of the E-shaped magnetic core. The outer ends of the legs are provided with openings 40 and 42, for respectively receiving grommets 44 and 46 of rubber, neoprene, nylon, or other rubber-like material. The grommets also aid in preventing transmittal of distorting forces to the mount 38.

The part 30 is also provided with the U-shaped brackets 48 and 50. These brackets have their distorting stresses isolated from the part 38 by the flexible narrows 52 and 54.

The elements 33, 35, 37, 39, 41, 43, 49, 51, 53 and 55 on part 31 in FIG. 8 correspond to parts 32, 34, 36, 38, 40, 42, 48, 50, 52 and 54 on part 30 in FIG. 6. The insulating member 11 is mounted on the horizontal legs of the brackets 48 and 50 of part 30 and 49 and 51 of part 31 by suitable bolts that hold the brackets and insulating member 11 rigidly with respect to each other. Any bending and distortion in view of the narrows 52 and 54, and 53 and 55 such mounting may cause is not transmitted to the E-shaped mounts 38 and 39.

These mounts 38 and 39 are provided with rivet holes to so index with the rivet hole in the laminations 2 that these laminations, when the rivets are in place, support the laminations so as to leave a permanent air gap at *a*. The gap is filled with suitable sheets of paper, Mylar, or other similar material of the desired thickness, which may be from .001 to .007 of an inch.

Dimensions of the parts depend, of course, on the size of the relay, or contactor. An actual first commercial embodiment of this invention, and upon which the drawings are based, was a relay actually about half the size indicated by the drawings and the thickness of the sheet metal used for the parts 30 and 31 was in the range of from .031 to .047 of an inch.

In the assembly procedure, the U-shaped laminations 1 are first riveted to the outer legs of the E-shaped mounts on parts 30 and 31. Then, by means of a fixture, or jig, the laminations 2 are riveted to the center legs of the E-shaped mounts on parts 30 and 31 over a paper, or Mylar, material of the desired thickness to provide the permanent air gap *a*.

The ends of the E-shaped core are then machined to smooth plane surfaces all falling in the same plane, and the core has an air gap of known dimension. The assembly is finished by screwing on the block 11 with suitable screws. Any strain from the tightening of the screws relieves itself at the narrows and in the brackets rather than twisting the lamination stacking, and the mounting feet will take up any distortion due to an uneven mounting panel.

The movable armature 3 also comprises a plurality of

stacked laminations riveted into a rigid structure by the rivets 4 and 5. The armature 3 is pivotally mounted at bearing dogs 6 on the armature supporting bar 7.

The armature supporting bar 7 is rigidly secured to the one-piece insulating block, or member 8, by means of a bolt 9 at one end of the bar 7 and similar bolt 9' at the other end of the bar 7. FIG. 4 at the right shows the details of one of the bolts, as bolt 9. The bolt 9 has a head 10 at the bottom, and fits loosely through an opening at the right-hand end of the one-piece stationary insulating member 11. The bolt is provided with a shoulder 12 upon which the bar 7 rests, and the top of the bolt 9 is axially threaded, as shown, to receive the screw 13. The upper end of bolt 9 is peened over, as shown, to rigidly hold bar 7 on the insulating member 8.

In order to bias the insulating member 8 upwardly to a fixed position and thus bias the contact bars 14 so that they do not bridge the stationary contact members SC, a biasing spring S is placed about bolt 9 and a similar biasing spring S' is disposed about bolt 9'. These springs are compressed springs and firmly hold the bolt heads 10 and 10' of the bolts 9 and 9' in the position shown in FIGS. 1 and 4.

An actuating coil C for the armature 3 is disposed about the center leg of the E-shaped magnet. When this coil C is energized, the armature is drawn into the position shown in FIG. 3, the springs S and S' are compressed more, and the movable contact bars 14 make a bridging connection with the associated stationary contacts SC.

A movable contact bar 14 having a contact at each end rests in each recess and each is biased against the bottom of the recess by the respective springs 15. The springs fit without material side friction into recesses disposed in the respective downward projections 16 on the retaining bar 17 of insulating material. Screws 13 and 13' hold bar 17 in fixed relation to insulating member 8. The springs 15 need no special retaining means other than a very small amount of vaseline applied at the top.

The insulating member 11 has the five outwardly projecting vanes 18 forming eight arc boxes, one for each pair of stationary and movable contacts.

The stationary insulating member 11 is provided with like rectangular projections P at each side for receiving the stationary main contacts. The stationary main contacts are all alike and are generally U-shaped with one leg 19 longer than the other. The leg 19 is provided with a teat 20 fitting into a recess 21. It is thus apparent that by slipping the stationary contact SC onto the projection P until the teat 20 snaps into the recess 21, that the stationary contact SC is secured to the projection P independent of the screw S. The stationary contact is provided with the apertured tail T for connecting auxiliary circuits with the relay. It is, of course, apparent that all the stationary contacts are alike and interchangeable.

From the foregoing disclosure, it is apparent that this invention provides a sturdy, reliable, inexpensive and quiet relay.

Since changes and modifications may be made in the structure disclosed without departing from the scope of this invention, it is intended that all the foregoing disclosed subject matter be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In an electromagnetic contactor, in combination, an E-shaped magnetic core, said core including a plurality of U-shaped stacked laminations of magnetic material forming the bottom and two outer legs of the E-shaped core, and a plurality of generally rectangularly shaped laminations of magnetic material stacked to form the middle leg of the E-shaped core, a pair of identically shaped supporting frames of suitable non-magnetic sheet metal for the E-shaped core, each frame including a flat mount generally E-shaped, said stacked laminations being secured between the mounts of the frames to form a rigid E-shaped core structure, said generally rectangularly shaped laminations being so secured between the mounts to form a permanent air gap at the bottom of the middle leg of the E-shaped core, a sheet of non-magnetic non-conducting material disposed in the air gap, each of said mounts having a generally rectangular portion bent at right angles to the mount to give additional rigidity to the mounts, an extension at each end of the portion, a generally U-shaped bracket on each extension, said extension having a narrowed connection between the brackets and the portion, whereby any distorting forces on the brackets do not, by reason of the resiliency of sheet metal, transmit distorting stresses to the mounts, a pair of spaced legs for each mount falling substantially in the plane of the used portion, the two legs associated with each mount being connected to the portion at its middle by a narrow resilient connection, whereby distorting stresses on the legs are not transmitted to the mounts.

2. In an electromagnetic contactor, in combination, an E-shaped magnetic core, said core including a plurality of U-shaped stacked laminations of magneic material forming the bottom and two outer legs of the E-shaped core, and a plurality of generally rectangularly shaped laminations of magnetic material stacked to form the middle leg of the E-shaped core, a pair of identically shaped supporting frames of suitable non-magnetic sheet metal for the E-shaped core, each frame including a flat mount generally E-shaped, said stacked laminations being secured between the mounts of the frames to form a rigid E-shaped core structure, each of said mounts having a generally rectangular portion bent at right angles to the mount to give additional rigidity to the mounts, an extension at each end of the portion, a generally U-shaped bracket on each extension, said extension having a narrowed connection between the brackets and the portion, whereby any distorting forces on the brackets do not, by reason of the resiliency of sheet metal, transmit distorting stresses to the mounts, a pair of spaced legs for each mount falling substanially in the plane of the used portion, the two legs associated with each mount being connected to the portion at its middle by a narrow resilient connection, whereby distorting stresses on the legs are not, by reason of the resiliency of sheet metal, transmitted to the mounts.

3. In an electromagnetic contactor, in combination, an E-shaped magnetic core consisting of a plurality of stacked laminations of magnetic metal, contact housing elements, a pair of identically shaped sheet metal supporting frames for the E-shaped core, each frame including a flat generally E-shaped mount, said stacked laminations being secured between the mounts of the frames to form a rigid E-shaped core structure, each of said mounts having a portion bent at right angles to the mount to add rigidity to the mounts, an extension at each end of the portion upon which said contact housing elements are to be mounted, a narrowed, and thus somewhat resilient, connection between the end of the portion and the extensions, a pair of legs on each frame, each pair of said legs being connected by means of a narrow, and thus somewhat resilient, connection to the middle of said portion.

4. In an electromagnetic contactor, in combination, contact housing elements of the contactor, an E-shaped magnetic core, said core consisting of a plurality of U-shaped stacked laminations of magnetic material forming the two outer legs of the E-shaped core, and a plurality of stacked lamination of magnetic material forming the middle leg of the E-shaped core, a pair of identically shaped sheet metal supporting frames for the E-shaped core, each frame including a plate shaped to generally match the shape of the laminations, said stacked laminations being secured between the mounts of the frames to form a rigid E-shaped core structure, each of said frames having a portion bent at right angles to the mounts to add rigidity to the mounts, an extension connected by a narrow, and thus somewhat resilient, strip of material at each end of the portion, said extension being designed to

rigidly support contact housing elements of the contactor, a pair of legs on each frame, each pair of legs associated with a particular frame being connected to the middle of the said portion by a narrow, and thus somewhat resilient, strip of material.

5. In an electromagnetic contactor, in combination, contact housing elements of the contactors, an E-shaped magnetic core, said core consisting of a plurality of U-shaped stacked laminations of magnetic material forming the two outer legs of the E-shaped core, and a plurality of stacked laminations of magnetic material forming the middle leg of the E-shaped core, a pair of identically shaped sheet metal supporting frames for the E-shaped core, each frame including a plate shaped to generally match the shape of the laminations, said stacked laminations being secured between the mounts of the frames to form a rigid E-shaped core structure, the laminations forming the middle leg of the E-shaped core being so secured between the mounts to form a permanent air gap of a selected dimension at the bottom of the middle leg of the E-shaped core, each of said frames having a portion bent at right angles to the mounts to add rigidity to the mounts, an extension connected by a narrow, and thus somewhat resilient, strip of material at each end of the portion, said extension being designed to support contact housing elements of the contactor, a pair of legs on each frame, each pair of legs associated with a frame being connected to the middle of the said portion by a narrow and thus somewhat resilient, strip of material.

6. In an electromagnetic contactor, in combination, contact housing elements of the contactor, an E-shaped magnetic core, said core consisting of a plurality of U-shaped stacked laminations of magnetic material forming the two outer legs of the E-shaped core, and a plurality of stacked laminations of magnetic material forming the middle leg of the E-shaped core, a pair of identically shaped sheet metal supporting frames for the E-shaped core, each frame including a plate shaped to generally match the shape of the laminations, said stacked laminations being secured between the mounts of the frames to form a rigid E-shaped core structure, the laminations forming the middle leg of the E-shaped core being so secured between the mounts to form a permanent air gap of a selected dimension at the bottom of the middle leg of the E-shaped core, a sheet of non-magnetic non-conducting material disposed in the air gap, each of said frames having a portion bent at right angles to the mounts to add rigidity to the mounts, an extension connected by a narrow, and thus somewhat resilient, strip of material at each end of the portion, said extension being designed to support said contact housing elements of the contactor, a pair of legs on each frame, each pair of legs associated with a particular frame being connected to the middle of the said portion by a narrow, and thus somewhat resilient, strip of material.

7. In the mounting structure for certain elements of an electromagnetic contactor having a laminated magnetic core and housing means of insulating material, in combination, a pair of identically shaped sheet metal supporting frames for the magnetic core, each frame including a mounting plate shaped to match the shape of the sides of the core with the core being supported between the plates to form a rigid structure, each of said frames having a portion bent at an angle to the plate to add rigidity to the plate, an extension connected by a narrow strip at each end of the portion of each frame, said extensions being designed to rigidly support the said housing means, a pair of legs, one pair for each frame, each pair of legs being connected to the said portion of each frame by a narrow strip of material.

8. In an electromagnetic contactor, in combination, a support element of sheet metal for the magnetic core and the contact housing means of the contactor, said support element having a horizontal elongated flat part and a vertical elongated flat part to which the magnetic core may be rigidly secured, a pair of legs connected to the mid-region of the horizontal part by a narrow strip of material with the legs falling substantially in the plane of the horizontal part but flaring outwardly from the connection and away from each other, a U-shaped bracket, to which the housing means may be connected disposed at one end of the horizontal part, said bracket having one leg falling in the plane of the horizontal part, its other leg disposed above the horizontal part, and the bight of the U-shaped bracket falling in the plane of the vertical part, a relatively narrow connection between one end of the horizontal part and the lower leg of the U-shaped bracket, and a similar U-shaped bracket similarly connected to the other end of the horizontal part.

9. In an electromagnetic contactor, in combination, certain support elements for the magnetic core and contact housing means of the contactor, said supporting elements comprising a relatively flat sheet metal frame to which the core is attached, said frame having a portion bent at right angles of the flat frame to lend rigidity to the frame, a pair of legs for the frame, said legs being connected to the mid-region of the portion by a relatively narrow strip of material, and a pair of housing means supporting brackets, one at each end of said portion, and each being connected to the portion by a relatively narrow strip of material.

10. In an electromagnetic contactor, in combination, a magnetic core built up of a plurality of stacked laminations of magnetic material, a housing of insulating material for the contactor parts of the contactor, a pair of sheet metal supporting means for said core and housing, said supporting means comprising, a pair of like elongated frames, core securing means for firmly securing the core between said frames, a pair of projecting legs together secured to one frame by a single narrow strip of sheet metal, a second pair of similar legs similarly connected to the other frame, whereby any bending stresses to which the legs are subjected are not transmitted to the core, a pair of brackets for supporting the housing, said brackets being connected to the respective ends of the first frame each by a narrow strip of sheet metal, a second pair of brackets for supporting the housing, said second pair of brackets being connected to the respective ends of the second frame each by a narrow strip of sheet metal, and means for rigidly securing the housing to said brackets, said narrow strips of sheet metal connecting the brackets to the frames providing an isolation for the core of any stresses and movements of the brackets by reason of the rigid securing of the housing on the brackets.

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