Feb. 6, 1951

R. L. BROWN

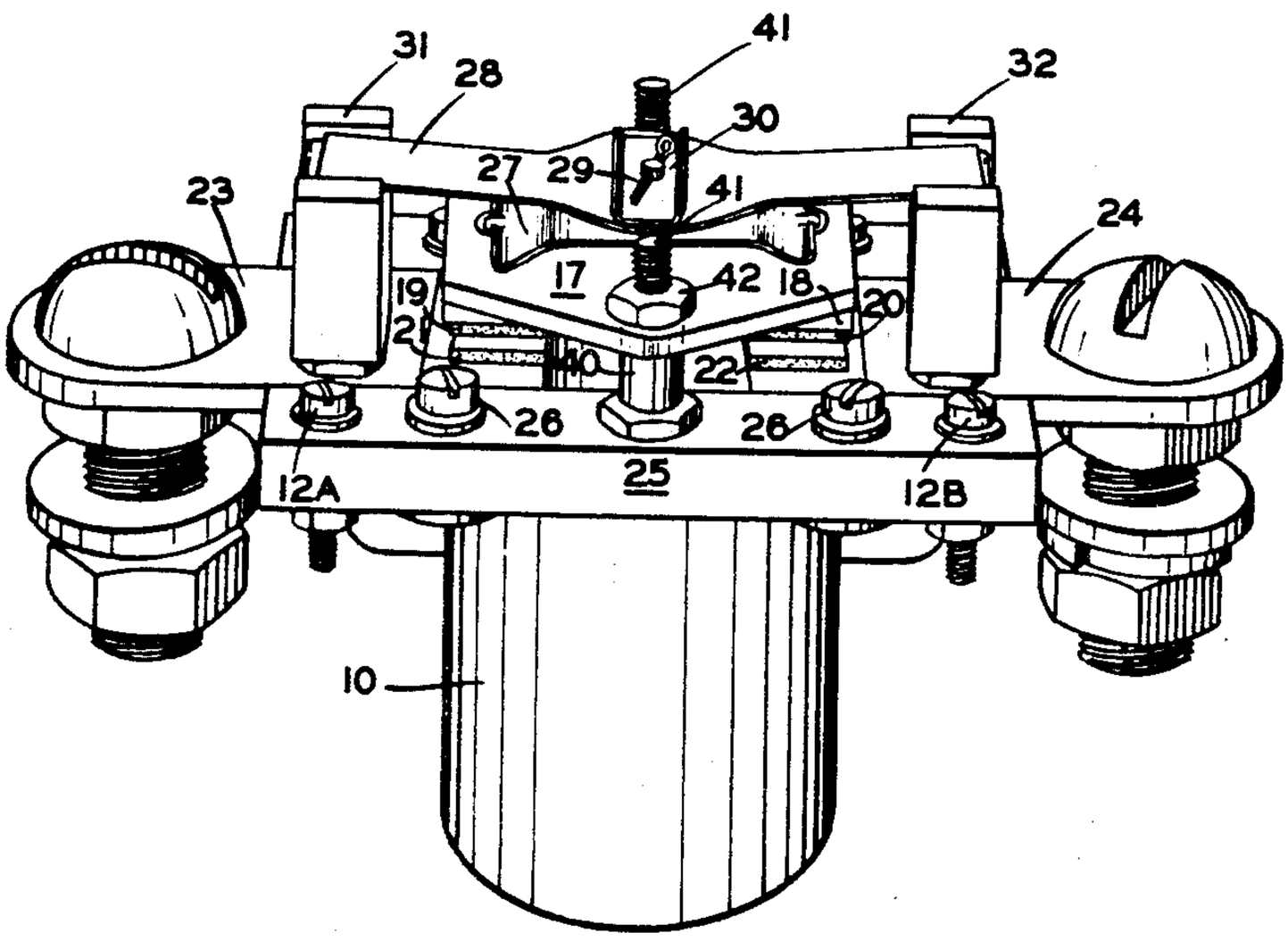
2,540,185

ELECTROMAGNETIC RELAY

Filed Oct. 15, 1947

3 Sheets-Sheet 1

Fig. 1



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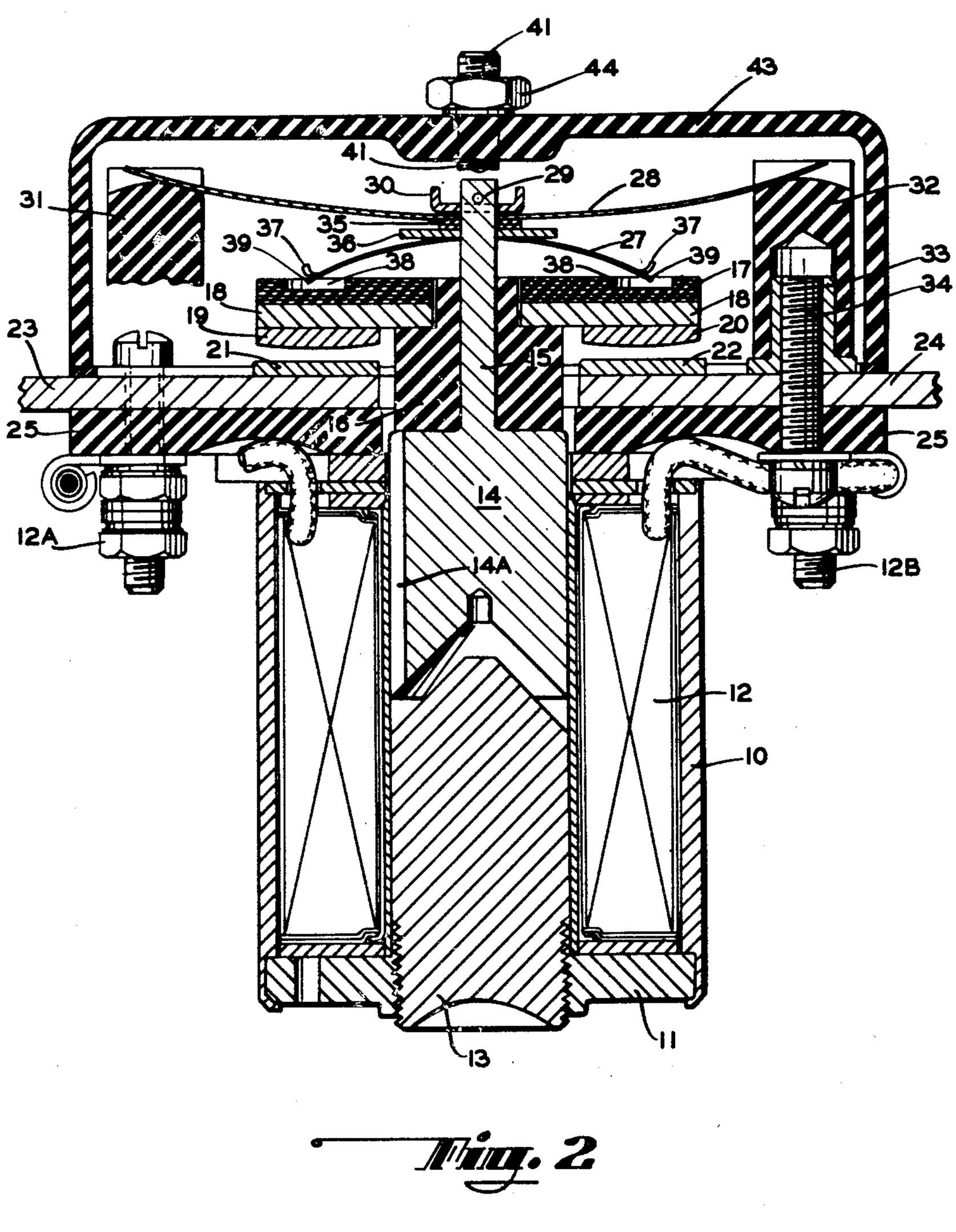

Fig. 2

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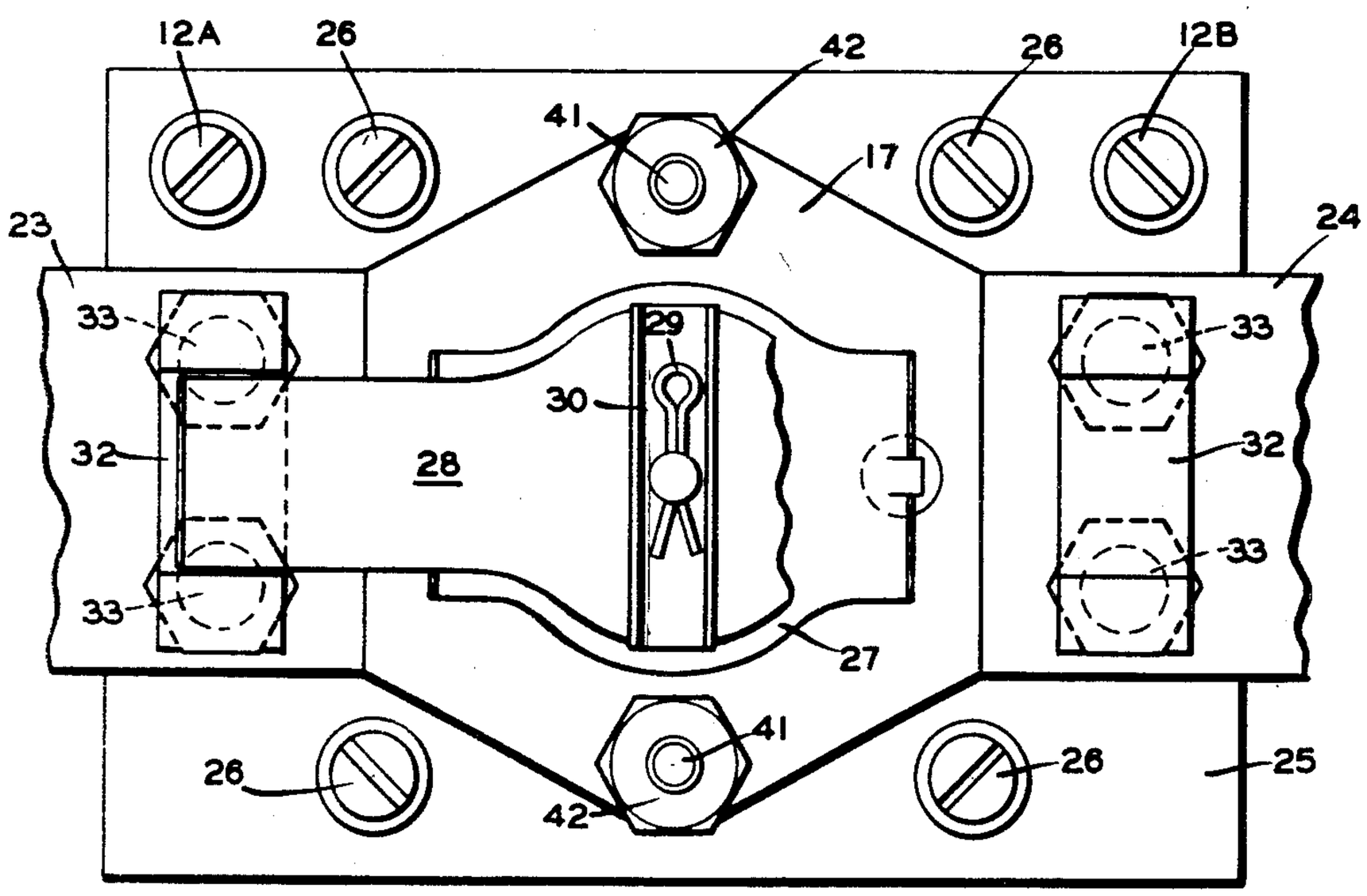

Fig. 3

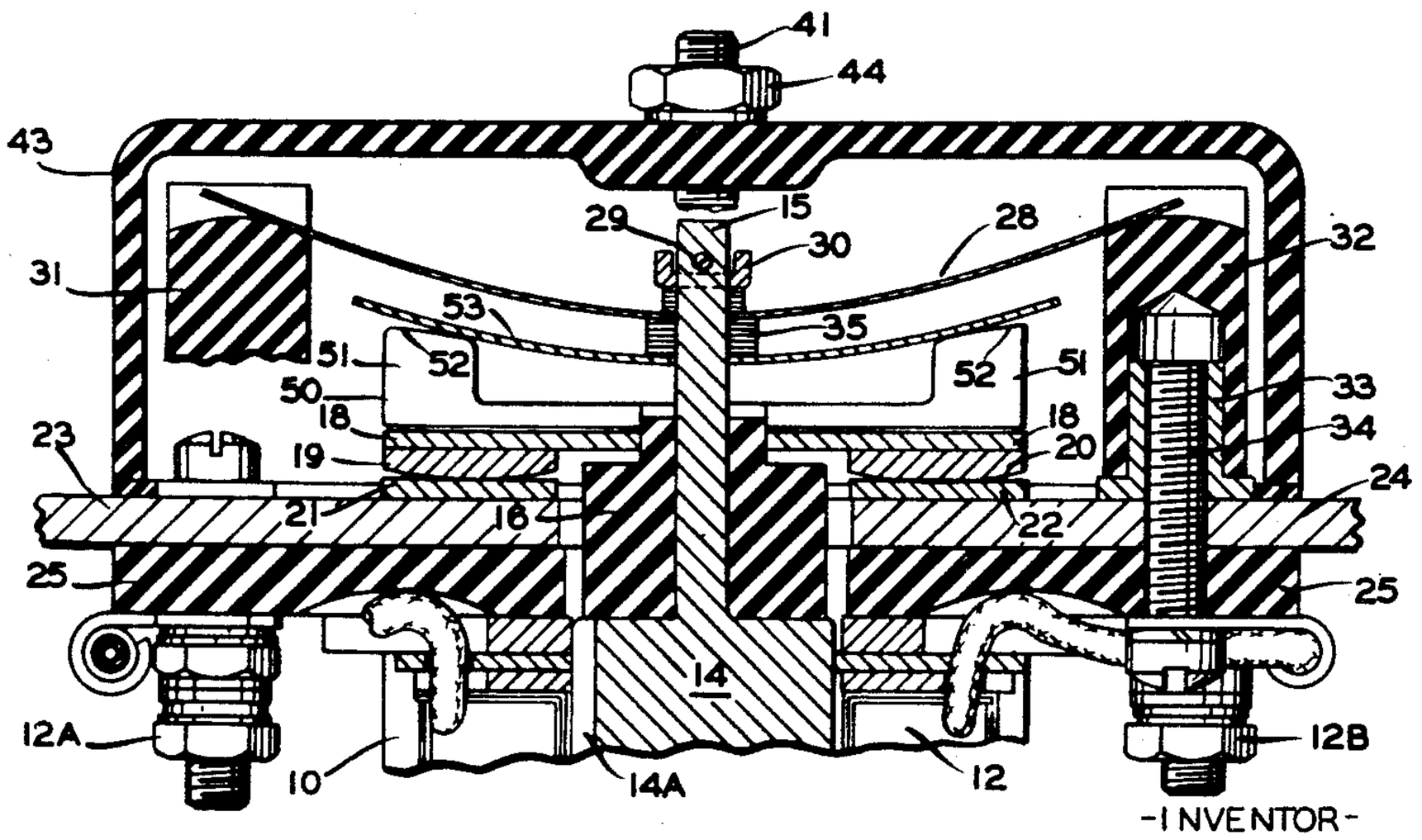

Fig. 4

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UNITED STATES PATENT OFFICE

2,540,185

ELECTROMAGNETIC RELAY

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2 Claims. (Cl. 200—111)

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The present invention relates to relay switches and more particularly to a relay switch in which the several parts are arranged so as to permit quick and easy assembly and disassembly, ease of inspection and the spring arranged so as to be insulated from the heat generated in the winding of the relay and at the relay contacts.

An object of the invention is to provide a relay switch having a pair of mounting bolts whereby the solenoid actuated plunger, the spring assembly and the cover cap of the relay may be conveniently assembled and disassembled.

Another object of the invention is to provide a novel switch assembly including a pair of bolts upon which is slidably mounted a plastic heat insulating shield having affixed thereto a switch element resiliently supported through a novel leaf spring arrangement.

Another object of the invention is to provide a novel relay switch in which there is provided a leaf spring supported at opposite ends and having suspended therefrom the heat insulating shield, switch and relay plunger.

Another object of the invention is to provide a second leaf spring bearing at opposite ends upon the switch shield and permitting movement of the solenoid relative to the shield and switch upon the switch closing the relay switch to assure good contact between the switch elements.

Another object of the invention is to provide a simple fastening means for operatively connecting the leaf springs, switch mounting and solenoid.

Another object of the invention is to provide a novel relay having a flat type leaf spring suitably shaped and cooperating with supports arranged so as to cause the effective length of the spring to decrease as it is deflected (pressure applied), thus causing its resisting force to increase at greater than a linear rate so as to permit a greater final force to be applied to the contacts with no increase in size, supply power or efficiency of actuating solenoid and thereby utilize more of the available work of a given actuating solenoid by making the pressure versus deflection curve of the spring conform more closely to the pull curve of the solenoid.

The above and other objects and features of the invention will appear more fully hereinafter from a consideration of the following description taken in connection with the accompanying drawings wherein two embodiments of the invention are illustrated by way of example.

In the drawings:

Figure 1 is a perspective view of the relay switch with cover removed.

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Figure 2 is a sectional view of the relay switch of Figure 1 with the cover in place.

Figure 3 is a top plan view of the relay switch of Figure 1 with the cover removed and certain parts broken away to better illustrate the structure thereof.

Figure 4 is a fragmentary sectional view of a modified form of the invention.

Referring to the drawings of Figures 1 and 2, numeral 10 indicates a cup shaped shell or casing member having a bottom closure plate 11 and positioned therein an electromagnet 12 connected by suitable conductors to terminals 12A and 12B. A pole piece 13 is screw threadedly mounted in the closure plate 11 and projects into the electromagnet 12. The pole piece 13 cooperates with a plunger 14 formed of a magnetic material and slidably mounted in the electromagnet 12. The plunger 14 has a channel 14A for opening the underside thereof to atmosphere.

The plunger 14 has suitably fixed thereto a rod 15 which projects through a plastic non-electrical conducting member 16. Mounted on the insulating member 16 is a heat insulating shield 17 formed of a suitable non-electrical conducting plastic material.

Affixed to the plastic shield 17 is an electrical switch bar 18 formed of a suitable conducting metal such as copper or silver and having mounted thereon switch contacts 19 and 20. The contacts 19 and 20 are arranged to cooperate with switch contacts 21 and 22 formed on conductor bars 23 and 24 respectively. The conductor bars 23 and 24 are mounted in a non-conducting electrical insulating plate 25. The plate 25 is suitably fastened to the casing member 10 by bolts 26 shown in Figure 1.

The rod 15, as shown in Figure 2, projects through leaf spring members 27 and 28 and is affixed at its upper free end by a cotter pin 29 which, as shown in Figures 1 and 3, bears upon a plate 30 biased upwardly by leaf spring 28. Opposite ends of the leaf spring 28 are supported by members 31 and 32 formed of suitable non-electrical conducting material. The supporting members 31 and 32 fit over suitable pegs 33. The pegs 33 are screw threadedly engaged by bolts 34 which fasten the conductor bars 23 and 24 to the insulator plate 25, as shown in Figure 2.

It will be seen then that the leaf spring 28 assumes a dished shape and opposes downward movement of the plunger 14. Between leaf spring 28 and leaf spring 27 there are provided washers 35 and a plate 36. The plate 36 bears upon the inverted dish shaped leaf spring 27. End portions 37 of the leaf spring 27 bear upon

the plastic heat insulator shield 17. Recesses 38 are formed in the shield 17 for receiving portions 39 of the leaf spring 27 to position the leaf spring 27 on the shield 17.

The leaf spring 27 resiliently opposes movement of the plunger 14 relative to the shield 17 and switch contactor 18. Thus upon downward movement of the plunger 14 under force of the electromagnet 12, the leaf spring 28 is first depressed and then upon contacts 19 and 20 engaging contacts 21 and 22 further downward movement of the plunger 14 further depresses leaf spring 28 and then depresses the leaf spring 27 so as to move the contacts 19 and 20 into intimate engagement with the contacts 21 and 22 respectively under force of the spring 27.

When the control switch of the electromagnet 12 is opened by the operator, the magnetic flux of the solenoid drops almost instantly to zero, and leaf springs 27 and 28 instantly and forcibly thrust the contact assembly 18 away from the terminal contacts 21 and 22 in spite of any burning together of the surfaces thereof which may have taken place, and so rapidly that any appreciable amount of arcing is prevented.

As shown in Figures 1 and 3 the heat shield 17 is slidably mounted on a pair of posts 40 having screw threaded portions 41 engageable by nuts 42 which limit the upward movement of the shield 17 under force of spring 28. The screw threaded portions 41 are further arranged to project through suitable openings formed in a cover cap 43 as shown in Figure 2. The cover cap 43 protects the switch assembly and is secured in position by suitable fastening nuts 44 screw threadedly engaged on the portions 41.

It will be seen from the foregoing that the switch mechanism may be readily disassembled by removing the nuts 44 and cover cap 43, whereupon the spring assembly, heat shield 17, contacts 19 and 20, and solenoid 14 may be disassembled by the removal of the nuts 42. To further disassemble the leaf springs 27 and 28 and plunger 14 from the shield 17 it is necessary only to remove the cotter pin 29.

Moreover it will be noted that the leaf springs 27 and 28 are protected from the heat of the electromagnet 12 and the heat at contacts 19—21 and 20—22 by the novel plastic heat insulating shield 17 which extends directly over and around the contact bar 18.

A modified form of the invention is illustrated at Figure 4 in which like numerals indicate corresponding parts to those shown in Figures 1–3.

In the modified form of the invention a plastic shield 50 is provided having projecting portions 51 with an inclined surface 52.

A leaf spring 53 is provided in place of the spring 27 and the opposite ends of the leaf spring 53 rest on the inclined surface 52 of the portions 51. An intermediate portion of the spring 53 acts through washers 35 so as to resiliently oppose downward movement of the plunger 14 relative to the shield 50.

As the plunger 14 moves downwardly under force of the electromagnet 12, the force applied to the plunger 14 by the electromagnet 12 continuously increases in excess of a linear relation as the plunger 14 approaches the pole piece 13.

The point of contact of the leaf spring 53 with the inclined surface 52 moves downwardly along the surface 52 as the spring 53 is deflected downward. Thus the spring 53 cooperates with the inclined surfaces 52 of the portions 51 so that upon the contacts 19—21 and 20—22 engaging,

further downward movement of the plunger 14 causes the effective length of the leaf spring 53 to decrease as it is deflected (pressure applied). The latter action causes the resisting force of the leaf spring 53 to increase at greater than a linear rate so as to more nearly approximate the change in force of the electromagnet 12 and thereby provide a greater final contact closing force to be applied to the contacts 19—21 and 20—22 through spring 53 with no increase in size, supply power or efficiency of the actuating electromagnet 12.

The latter arrangement thus utilizes more of the available work of a given actuating solenoid by making the pressure versus deflection curve of the spring 53 more closely approximate the pull curve of the solenoid, although the force exerted on the contacts through the spring 28 will be sufficiently less than that of the electromagnet 12 to assure the full extent of movement of the plunger 14 under varying operating conditions, as shown for example in Figure 4.

Although only two embodiments of the invention have been illustrated and described, various changes in the form and relative arrangements of the parts may be made to suit requirements.

What is claimed is:

1. A switch mechanism comprising an electromagnet, an armature operably positioned by the electromagnet, a heat insulating shield, switch elements mounted at one side of the shield, other switch elements cooperating with the first mentioned switch elements and carried by the electromagnet, a pair of posts on said armature of which at least one is of insulation for slidably mounting the shield on said electromagnet, a first leaf spring mounted at the other side of the shield, said first leaf spring supported at opposite ends by said shield, a releasable member connecting said first leaf spring to said armature and at a point intermediate the opposite ends of said first leaf spring so as to resiliently connect said armature and shield, a second leaf spring mounted at said other side of the shield, and members carried by the electromagnet to support opposite ends of the second leaf spring, said releasable member connecting said second leaf spring to said armature at a point intermediate the opposite ends of said second leaf spring to bias said armature and thereby said shield in an opposite direction from said electromagnet, and said shield tending to protect said first and second leaf springs from high temperatures at said switch elements and electromagnet.

2. A switch mechanism comprising an electromagnet, an armature operably positioned by the electromagnet, a heat insulating shield, switch elements mounted at one side of the shield, other switch elements cooperating with the first mentioned switch elements and carried by the electromagnet, a pair of posts on said armature of which at least one is of insulatiton for slidably mounting the shield on said electromagnet, portions projecting from said shield at the other side thereof and having inclined surfaces, a first leaf spring contacting said inclined surfaces at opposite ends thereof, a releasable member connecting said first leaf spring to said armature and at a point intermediate the opposite ends of said first leaf spring so as to resiliently connect said armature and shield, said first leaf spring cooperating with said inclined surfaces so as to decrease the effective length thereof upon movement of said armature relative to said shield after

closure of said second mentioned switch elements by said first mentioned switch elements, a second leaf spring at said other side of the shield, and members carried by the electromagnet to support opposite ends of the second leaf spring, said releasable member connecting said second leaf spring to said armature at a point intermediate the opposite ends of said second leaf spring to bias said armature and thereby said shield in an opposite direction from said electromagnet, and said shield tending to prevent said first and second leaf springs from being adversely affected by high temperature at said switch elements and electromagnet.

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