

Aug. 19, 1941.

P. H. ESTES

2,252,761

RELAY

Filed May 6, 1938

2 Sheets-Sheet 1

FIG. 3

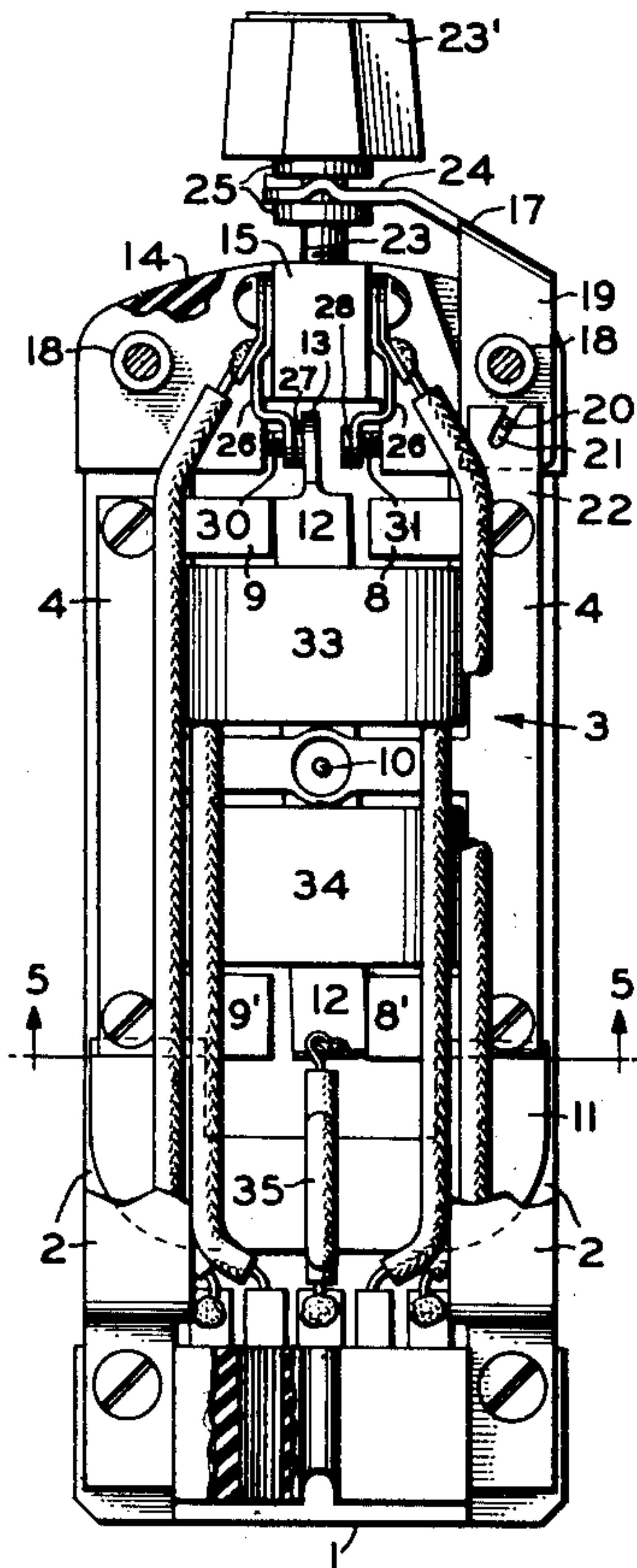


FIG. 2

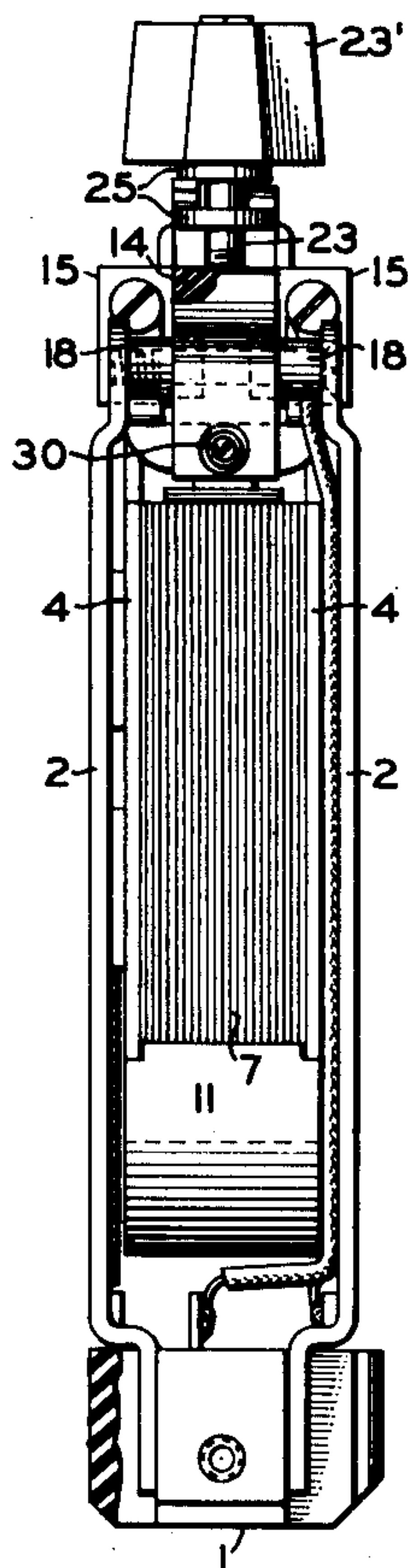


FIG. 1

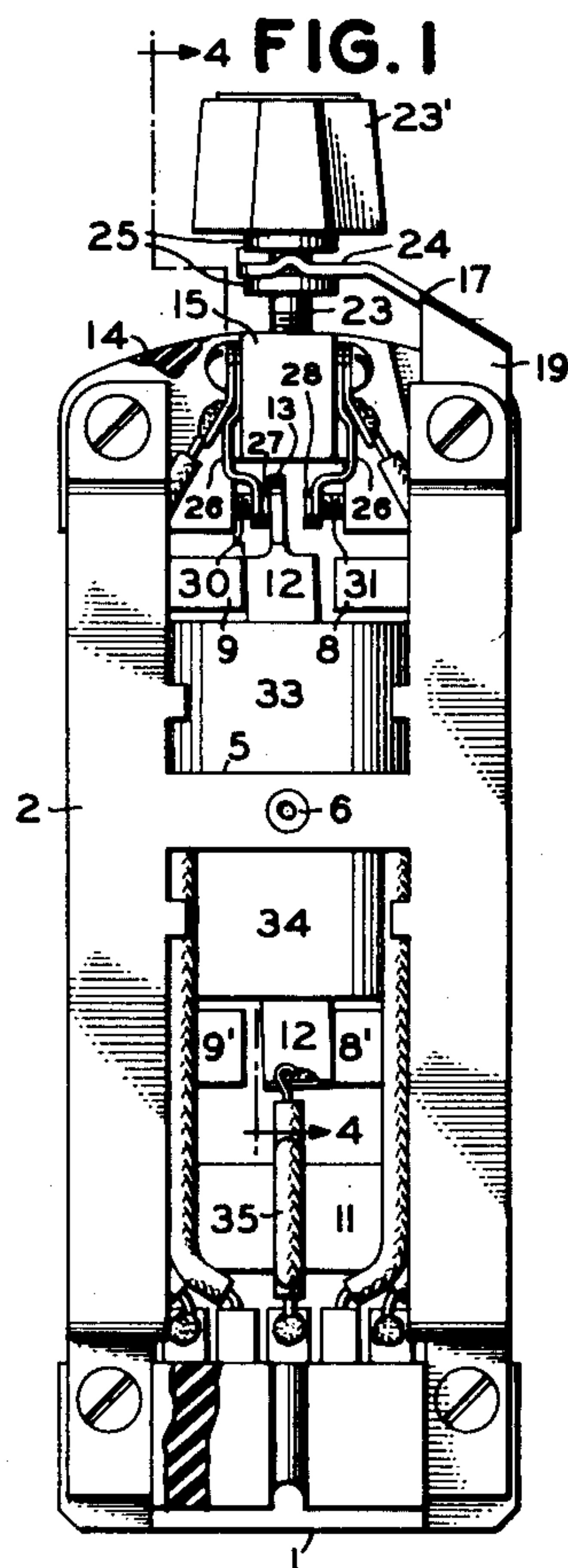


FIG. 4

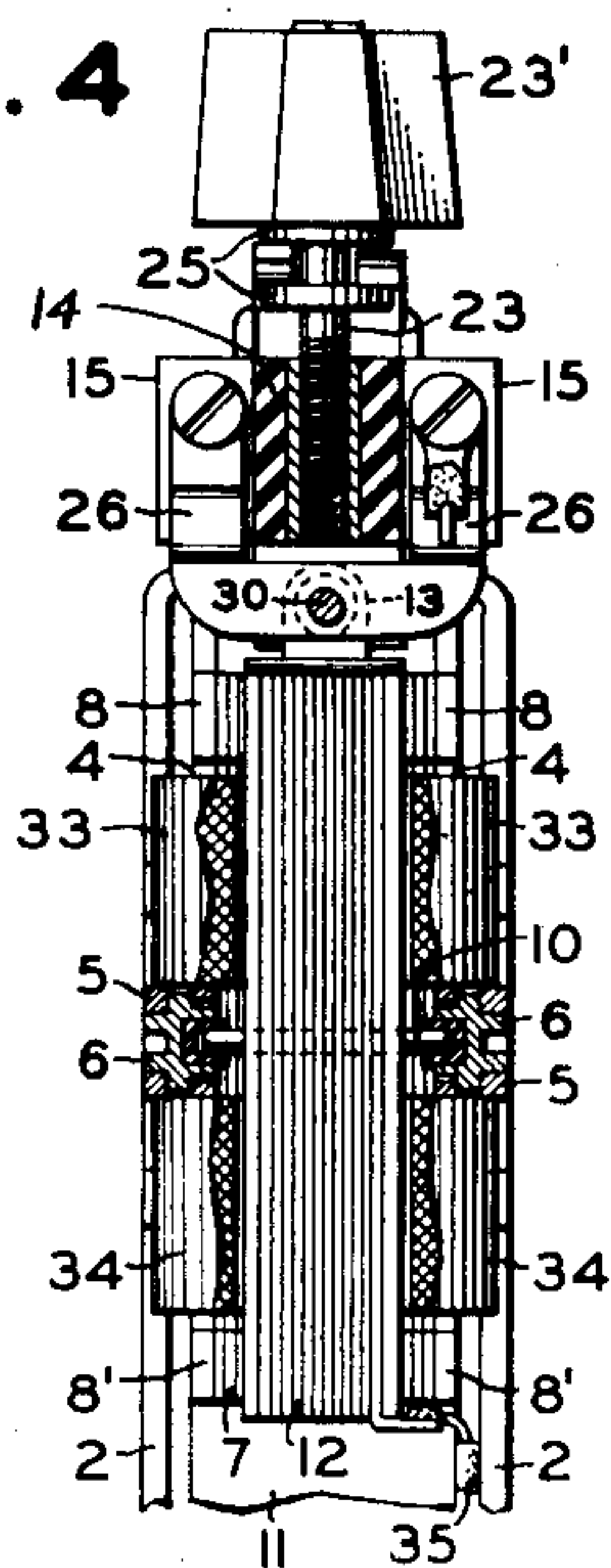


FIG. 7

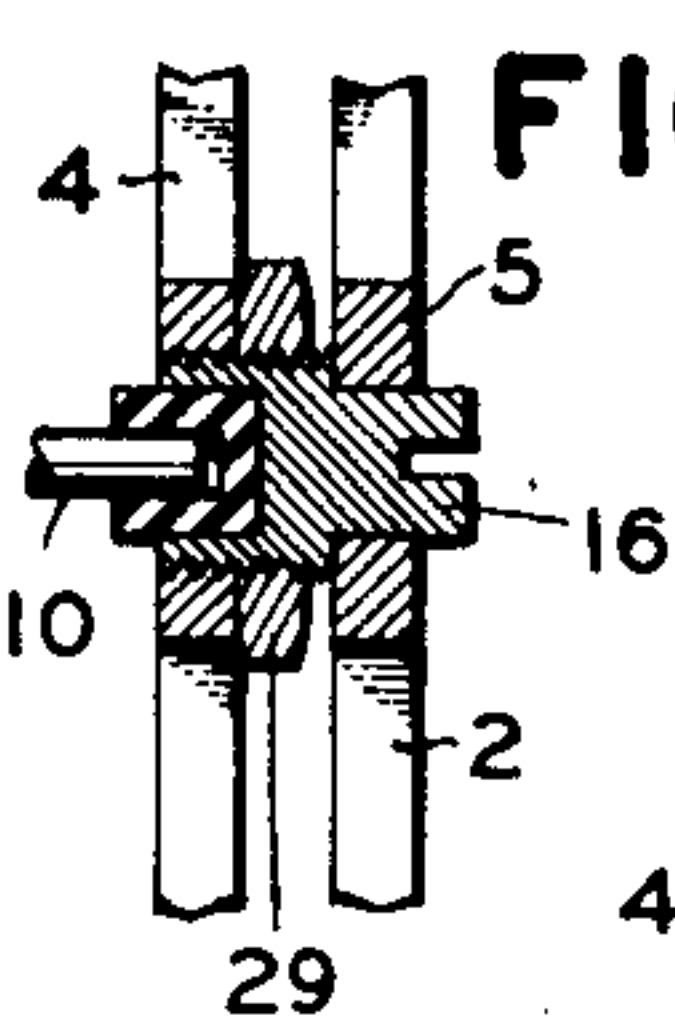


FIG. 5

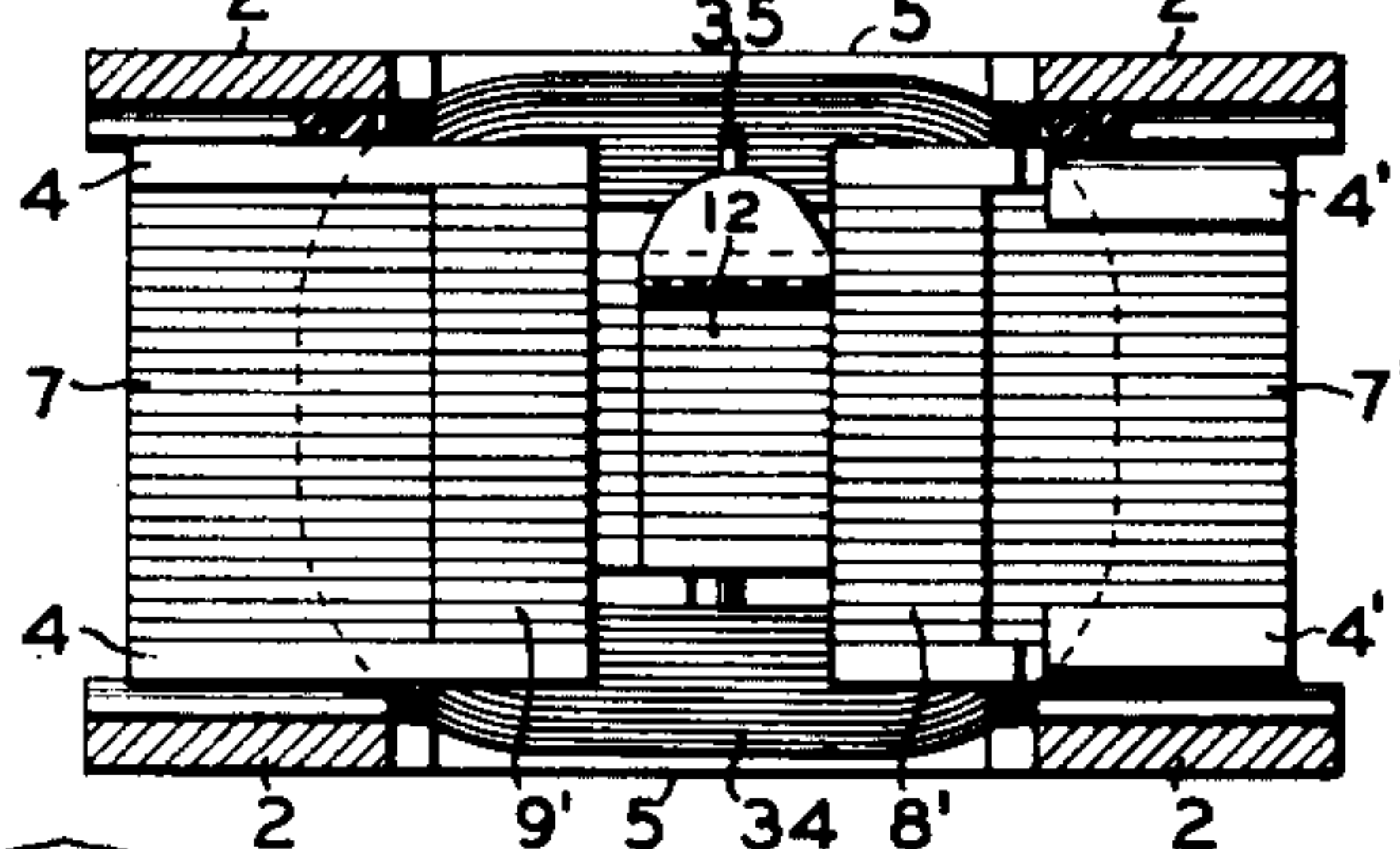
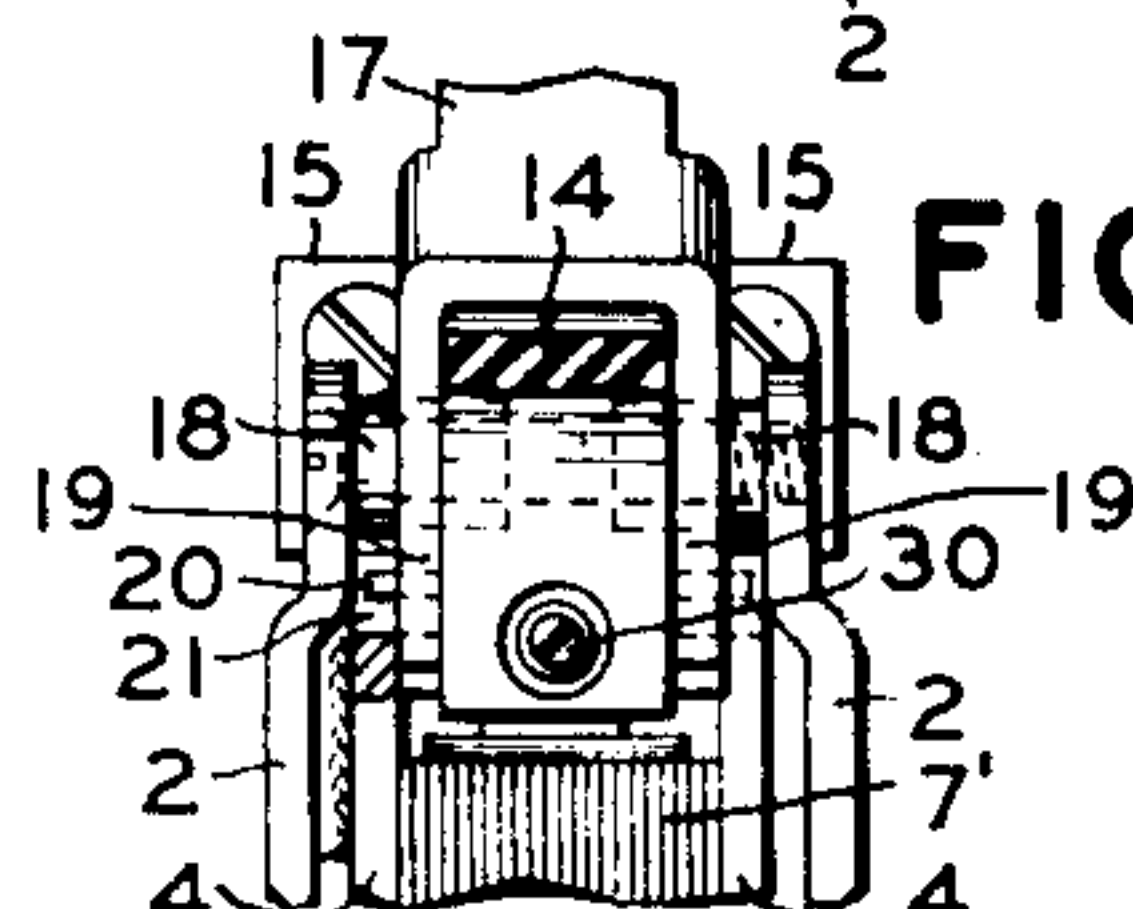


FIG. 6



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FIG. 8

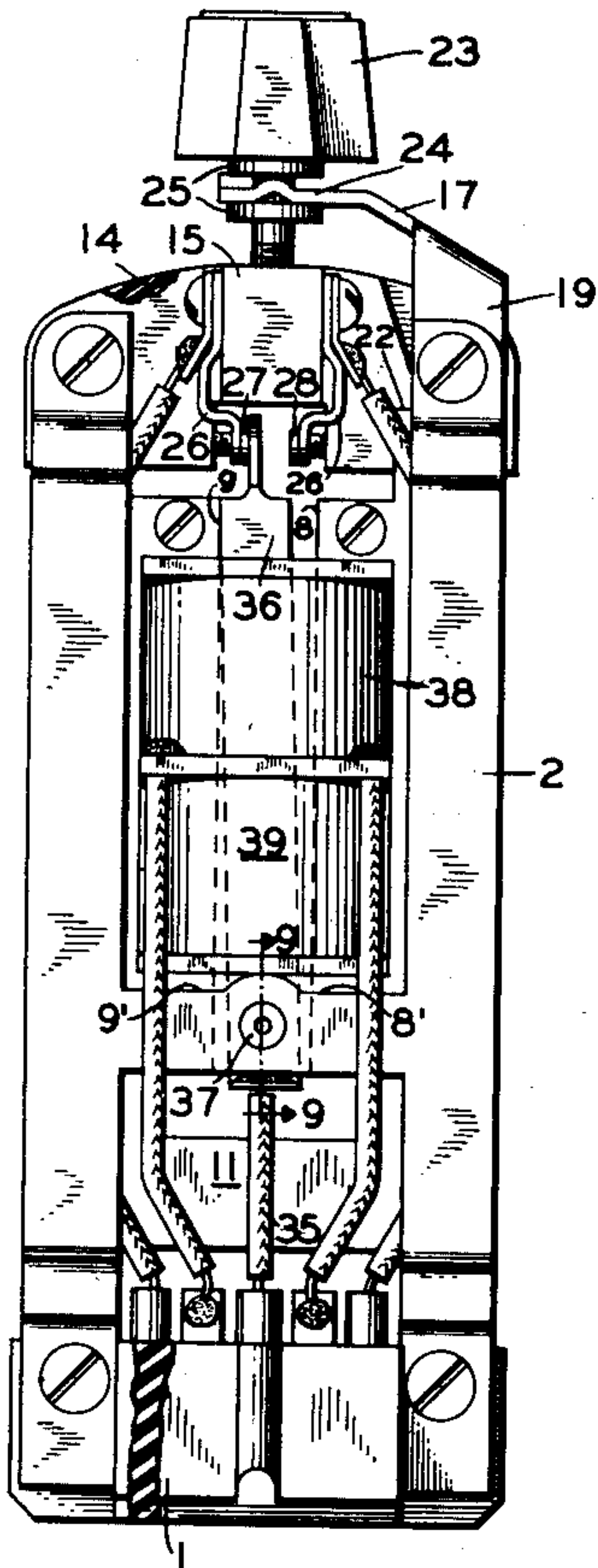


FIG. 9

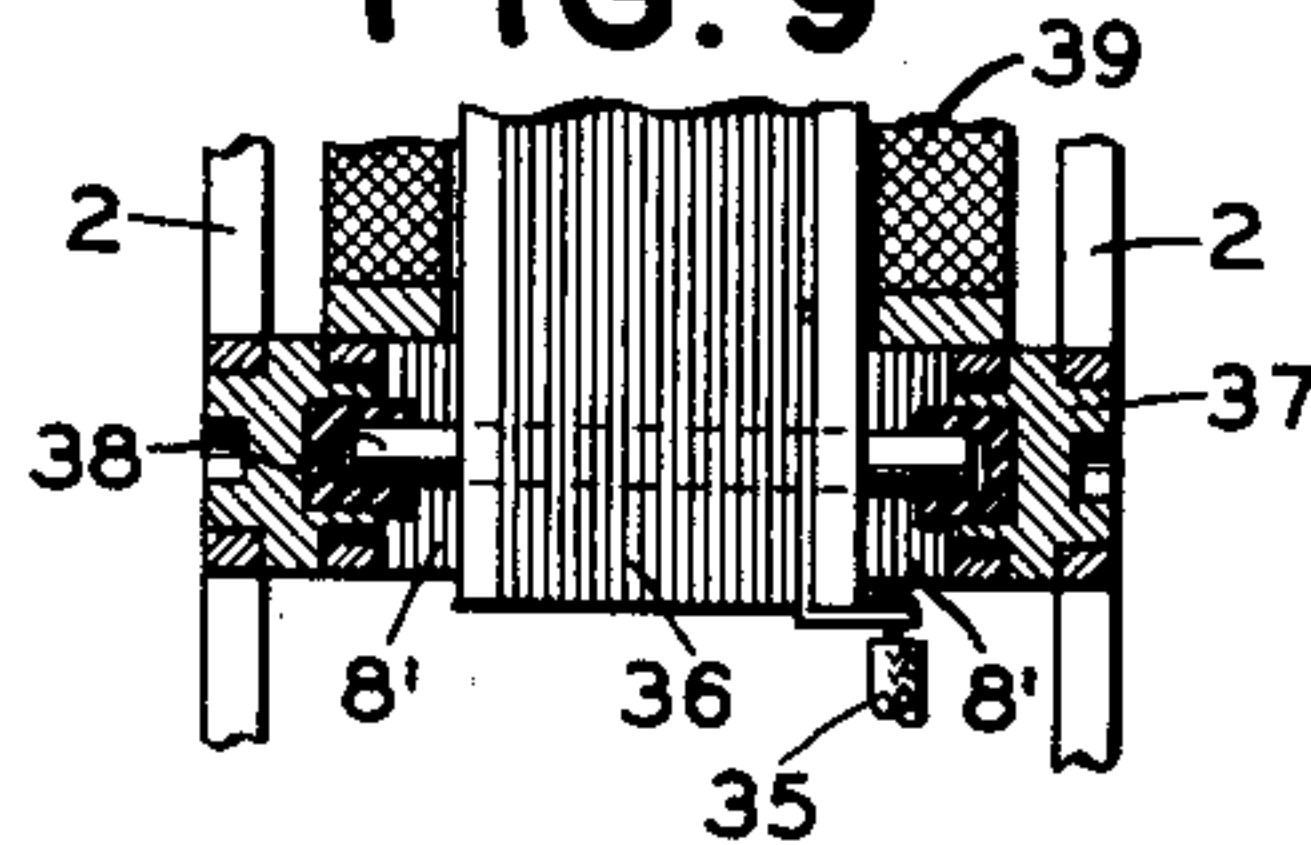


FIG. 10

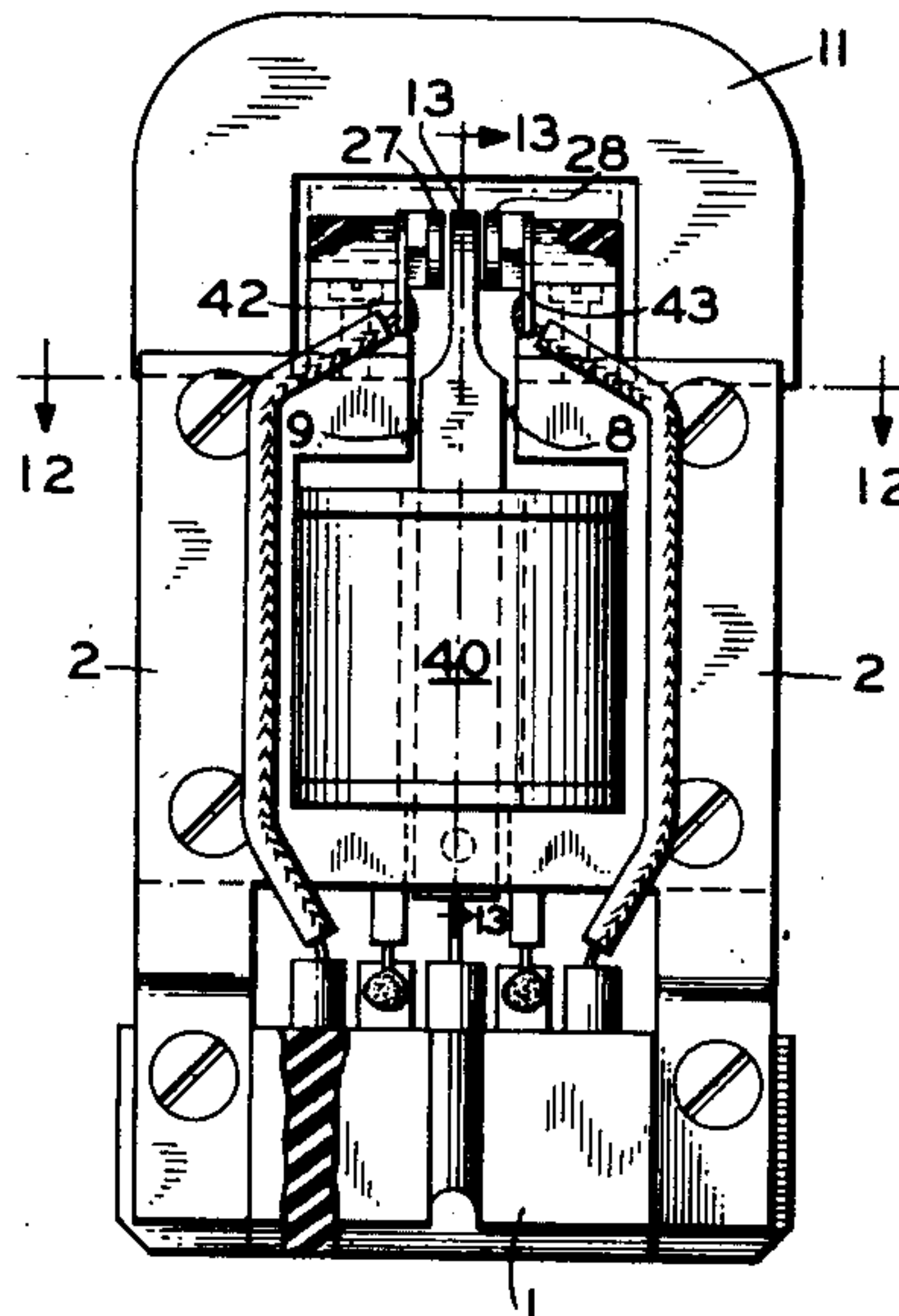


FIG. 11

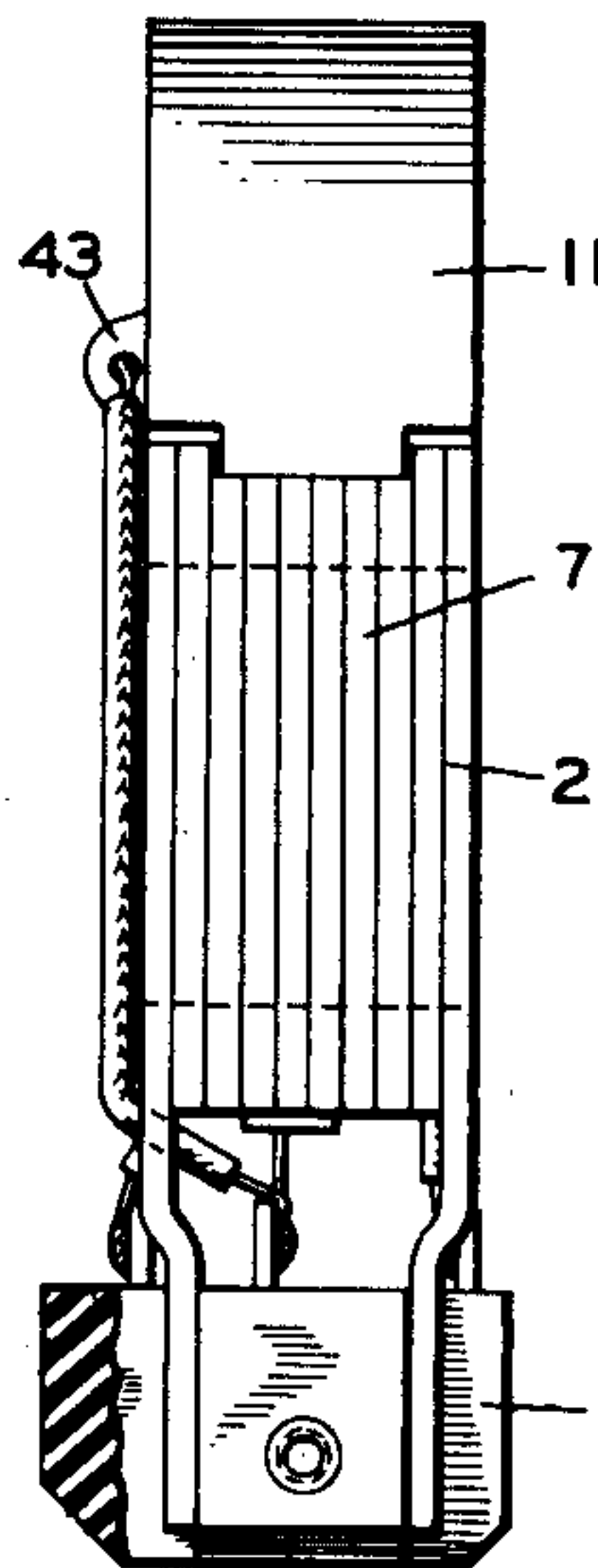


FIG. 13

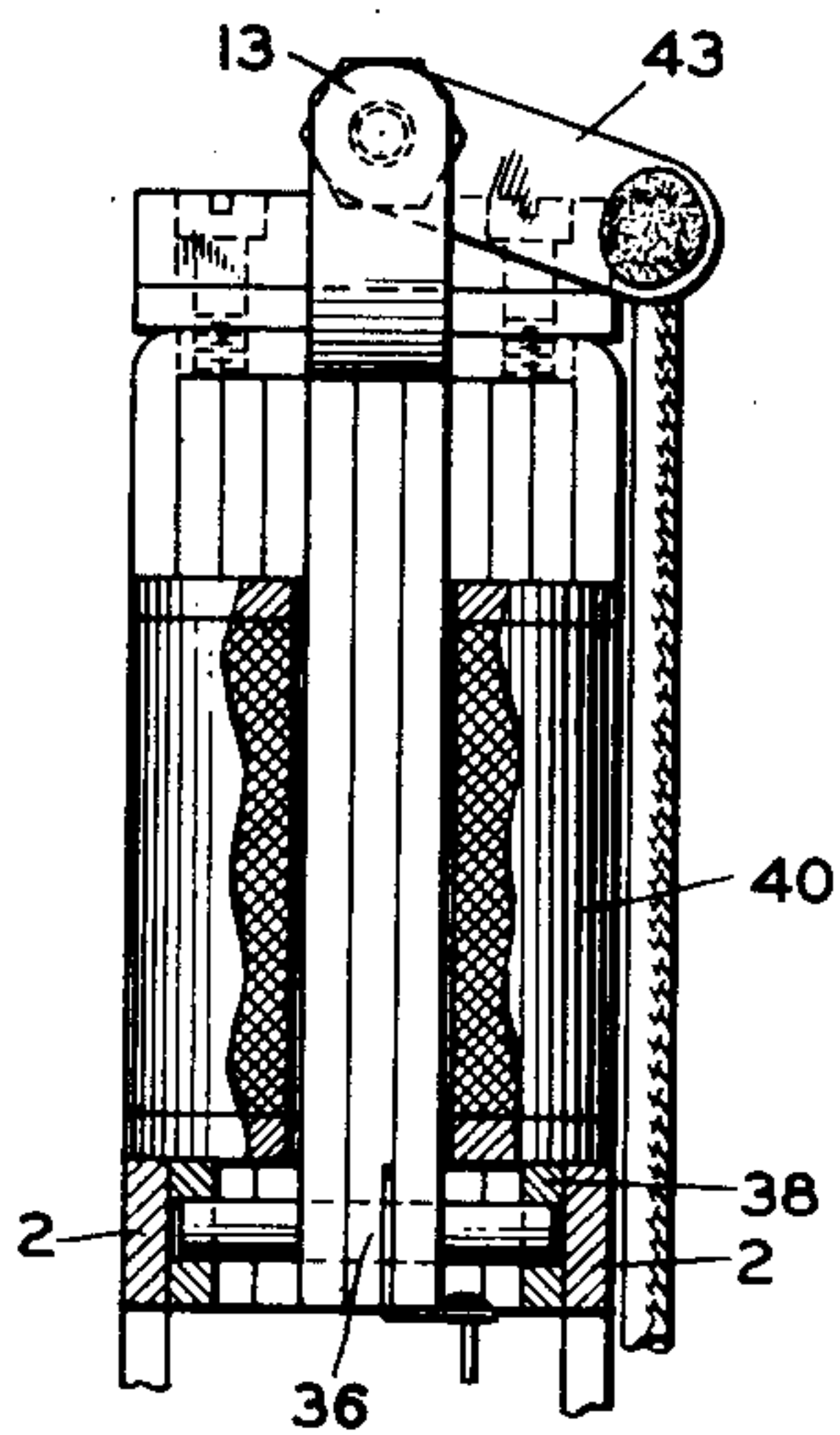
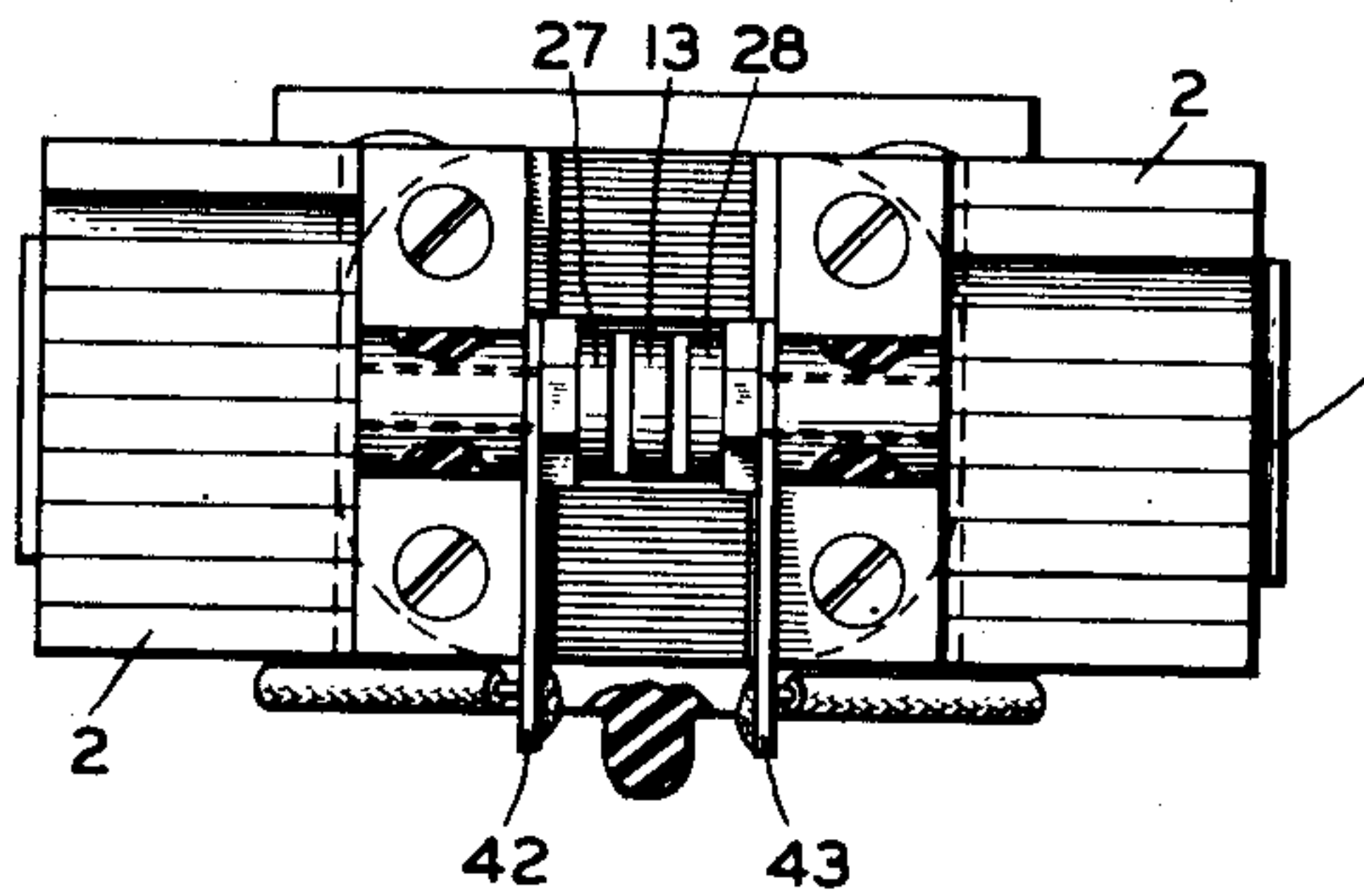


FIG. 12



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2,252,761

RELAY

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Application May 6, 1938, Serial No. 206,383

13 Claims. (Cl. 200—93)

This invention relates to relays and more particularly electromagnetic relays adapted for use in telegraph systems in conjunction with other telegraph apparatus. In the relays shown by the prior art it is found that three losses occur, those due to travel time of the contacts, those due to bouncing of one contact on another and distortion losses due to eddy currents and hysteresis. It is desirable to eliminate these losses in order to increase the speed of operation of relays, particularly relays which are used in connection with teletypewriter operation. In this sort of operation it is desirable to use the relay in circuits wherein 60 to 100 cycle currents occur. In the relays of the prior art the above mentioned losses prevent such high speed operation.

The primary object of the present invention is to provide a relay which has relatively high armature torque whereby to decrease contact travel time and to substantially eliminate contact bounce.

Another object is to provide a relay of compact construction to thereby enable its use in teletypewriters.

A further object is to provide a relay having the magnetic parts thereof made from a material such as to minimize distortion losses.

A still further object is to provide novel adjusting means and supporting means for relay contacts.

A still further object of this invention is to provide novel means for accurately adjusting the position of the pole pieces with respect to the contacts to thereby determine the relative length of the transmitted signals.

The foregoing and more specific objects will appear from the following complete disclosure of the invention. Referring to the drawings:

Fig. 1 is a front elevational view of the relay constructed in accordance with the invention.

Fig. 2 is a side elevation of Fig. 1.

Fig. 3 is a front elevation view with parts removed from the relay.

Fig. 4 is a section of Fig. 1 on line 4—4.

Fig. 5 is a section of Fig. 3 on line 5—5.

Fig. 6 is a fragmentary end view of the upper part of Fig. 1.

Fig. 7 is a detail section showing another form of armature bearings.

Fig. 8 is a front elevation of a simpler modification of the relay shown in Fig. 1.

Fig. 9 is a section of Fig. 8 on line 9—9.

Fig. 10 is a front elevation of a still simpler modification of this invention.

Fig. 11 is side elevation of Fig. 10.

Fig. 12 is a section of Fig. 10 on line 12—12.

Fig. 13 is a section of Fig. 10 on line 13—13.

A specific example of a relay constructed in accordance with the present invention is disclosed in Figs. 1 to 6. This relay is a very compact and economical type since many of the parts are made from stampings which can be cheaply and easily manufactured. The relay comprises in general the base member 1 to which the non-magnetic frames 2 are secured, the other frame ends supporting the insulating bridge member 14. The magnet assembly 3 is pivotally mounted in bearing 6 between the base member and the bridge member on the cross members 5 of the frames 2. Armature 12 is also pivoted at its center in bearing 6. The magnet assembly comprises a permanent magnet 11 which is supported by its own attraction to laminated cores 7 and 7', the laminations of which are fastened together within frames 4. The cores 7 and 7' form the pole pieces 8, 8' and 9, 9' which provide an air gap in which the armature 12 operates. Coils 33 and 34 surround armature 12 and are fixed between the cores 7 and 7' and held in position by portions of frames 2 as shown in Fig. 1. The insulating bridge member 14 supports, laterally thereof, the U shaped springs 26 on the ears 15, the springs providing a compact arrangement which saves space and also saves the use of bulky coil springs and the like. These U shaped springs support the contacts 27 and 28 and adjustment is provided for by the screws 30 and 31 in the bridge member 14. This particular arrangement of contacts provides a means for adjustment which is positive in action and does not require rotation of the contacts 27 and 28. This is advantageous since the contacts become pitted after use and become fitted to one another with the result that rotation spoils the fitted relation and thereby cuts down the effective contact area. The bridge member 14 also supports the means for adjusting the relation between the pole pieces 8 and 9 and the contacts 27 and 28, this means comprising a lever 17 pivoted in the bridge member at 18 and having a slotted or forked extension 24 which engages an adjusting screw 23 between the collars 25 thereon as shown in Figs. 3 and 4. Screw 23 is provided with operating knob 23'. The lever is also provided with the ears 19 which extend on either side of the bridge member and engage the slots 21 in the extended portions 22 of the frames 4 by means of the bosses 20 as shown clearly in Fig. 6. Thus as the adjusting screw 23 reciprocates in and out of the

bridge member 14 the lever 17 will rotate the magnet assembly, which is supported by frames 4, in either direction around its pivot point 6 in the frame 2. The arrangement of the permanent magnet assembly saves considerable space and this is accomplished by using a high permeability magnet material for magnet 11 such as an aluminum-nickel-cobalt-iron alloy which requires comparatively less space for the same amount of flux than the ordinary tungsten-steel or cobalt-iron which has been previously used. In order to conserve space the cores 7, 7' and the armature 12 consists of laminations of 45% nickel-iron alloy which has a considerably higher permeability than Norway iron, silicon steel and similar materials heretofore used in such instruments. Thus, distortion losses such as hysteresis and eddy currents are reduced and operating force is increased to thereby decrease travel time of the armature 12 and bounce of the contact 13.

Contact bounce is also decreased and substantially eliminated as a result of the arrangement of the contacts 27 and 28 on the bridge member 14. The contacts 27 and 28 are supported on springs 26 which bear solidly on adjustment screws 30 and 31. This arrangement provides a rigid support which inherently eliminates the bounce of the armature contact on the fixed contacts. It should further be noted that the lever arrangement for adjusting the angular position of the magnet assembly will also eliminate the contact bounce since the engagement between the lever and the adjusting screw 23 is positive thereby eliminating any use of springs and their consequent inherent ability to produce contact bounce. The permanent magnet 11 is arranged to be positioned in a given relation to the cores 7 and 7' as will be evident from inspection of Fig. 5. The portions 4' of frame 4 are turned over the end of core 7' to render this core face narrower than the face of core 7 and magnet 11 is so dimensioned that one pole fits only the core face of core 7' while the other pole is wider and fits only the core face of core 7. Thus magnet 11 can only be inserted and positioned on the core faces in the proper relation to properly polarize the cores 7 and 7'.

The coils 33 and 34 are nested within the cores 7 and 7' and polarize the armature 12. The permanent magnet 11 polarizes the cores north and south respectively so that pole pieces 8 and 8' may be polarized north while pole pieces 9 and 9' may be polarized south. The coils 33 and 34 are connected to the operating potential and will polarize the armature to thereby operate the armature and move the contact 13 to its operative position with either of the fixed contacts 27 or 28 to thereby complete the operating circuit in which the relay functions and in which the armature and contacts 27 and 28 are connected. The lever 17 and its adjusting screw 23 are intended to be used for determining the value of current necessary for operating the armature.

The flux from the permanent magnet 11 passes through the laminated cores 7 and 7' causing the core ends or pole pieces 8, 9, 8' and 9' adjacent to the armature 12 to be poled north on one side of the relay and south on the other side. The air gaps between the pole pieces and the armature are initially adjusted to be of equal length. If the contacts 27 and 28 are now moved away from the armature contact 13,

or if the adjusting screw 23 is moved outwardly the armature will assume a position against one of these contacts, for instance 27 as shown in Fig. 3, thus decreasing the air gaps between the armature and the pole pieces 8' and 9 for instance and increasing the gaps between the armature and pole pieces 8 and 9'. This results in a decrease of the magnetic reluctance of the flux path between the armature and core on one side and an increase in its reluctance on its opposite side, so that a portion of the flux entering the core from the permanent magnet will pass through the armature and will cause a force tending to hold the armature against the contact 27 to which it has been moved. This force may be increased by further opening of the contact gap or by further adjustment of the screw 23. The armature may be moved from one contact to the other by passing current through the relay coils 33 and 34 in the proper direction. This accomplishes a change in the reluctance of the armature which will in turn change the armature flux and if the current in the coils is sufficiently strong, the polarity of the ends of the armature will be reversed. The coil current required to cause this reversal is determined by the amount of magnetic unbalance of the relay caused by the contact adjustment or by the adjustment of screw 23. In other words, the wider the contact gap or the air gap, the more coil current will be required to cause the armature to move. Thus the coil current is determined by adjusting the contacts 27 and 28 or the adjustment screw 23 to position the armature of the relay in the proper relation to the pole pieces 8 and 9.

Fig. 7 shows an alternative form of armature bearing which may be used in place of those shown in Figs. 1, 3, 4, or 8. It is desirable that the armature bearing should be adjustable for the purpose of reducing end play in the shaft 10 which supports the armature 12. Therefore, the bearing member 16, which supports the magnet assembly 3 in the cross-member 5, is threaded in the frame 4 so that it can be adjusted longitudinally to take up end play. Lock nut 29 holds the member 16 in the desired position.

Figs. 8 and 9 show another modification of the relay shown in Fig. 1. This particular type of relay has the same adjusting features 17, 18, 20, 21, 22, 23 and 24 as those shown in Fig. 3 but in some applications a lower speed of operation is possible and, therefore, a relay of cheaper construction can be used. In this particular modification, parts similar to those of Figs. 1 to 5 are indicated by the same numerals. The armature 36 is pivoted at 38 instead of being pivoted in the center as shown in Fig. 1. This arrangement allows the operating coils 38 and 39 to be assembled in juxta-position thereby eliminating interconnecting wires and also simplifying assembly of the relays since fewer conductors are necessary. The magnet assembly is also pivoted at pivot 37.

The operation of this particular modification is similar to that of the modification in Fig. 1 and need not be further discussed.

Figs. 10, 11, 12 and 13 show an even simpler modification of this relay in that the magnet assembly and contact adjustment features are eliminated completely and the relay may be used in applications where even less speed of operation and precision is required. The armature

36 is pivoted at one end and the operating coil 40 is reduced to a single coil thereby cutting expense of manufacture. The contacts 27 and 28 having terminals 42 and 43 are rigidly mounted on the pole pieces 8 and 9 so that adjustment is made at the factory rather than during use. For compactness and convenience the permanent magnet 11 is mounted to surround the contacts 27 and 28. This particular modification has the same air gap relations between the armature and pole pieces so that bounce and travel time are reduced to a minimum for the same reasons given above in connection with the preferred modification.

All three types of relays are mounted on the same type of base which contains jacks to compel use of the relay in a particular application as described in the applicant's previous application Serial No. 173,997 filed November 11, 1937.

It will be apparent from the foregoing description of the various embodiments of this invention that I have devised a novel relay which is quick to operate, which has no contact bounce and in which the eddy current and hysteresis losses are negligible. Furthermore, novel adjustments are provided which are positive in action and help to accomplish the objects of the invention while the general construction details of the relay afford compactness and economy.

The present invention is susceptible of various modifications within the scope of the appended claims which will be obvious to those skilled in the art.

I claim:

1. In a relay, a base member, non-magnetic frames attached to said base, an insulating bridge member supported at one end of said frames, a pair of U-shaped pole pieces rotatably supported on said frames, a U-shaped permanent magnet mounted in self-supporting relation with said pole pieces and within said frames, an armature operatively supported in relation to said pole pieces, operating coils supported adjacent said pole pieces, a lever fulcrumed between said frames and at one end of said bridge member, one end of said lever being pivotally connected to said pole pieces and adapted to rotate them, the other end of said lever being notched, an adjusting screw positively engaging the notched end of said lever for actuating it and thereby rotating said pole pieces, armature and permanent magnet as a unitary structure, a pair of U-shaped springs on said bridge member, contacts on said springs, a contact on said armature arranged to coact with said contacts and adjusting screws in said bridge for positioning said springs and contacts.

2. In a circuit making and breaking device, a pair of relatively fixed contacts, a pivotally mounted magnetic motor having an armature one end of which constitutes a contact, a screw member, a lever arranged to rotate said motor and armature about its axis and adjustably fix the position of the armature, one end of said lever positively engaging said motor and the other end of said lever being positively adjustable in two directions by said screw member.

3. In a circuit making and breaking device, a frame assembly, a bridge member supported at one end of said frame, a pair of adjustable contacts supported on said bridge member, a pivotally mounted field structure and armature supported in said frame, said armature having a contact arranged to coact with said adjustable

contacts, a screw member in said bridge member, a lever fulcrumed in said bridge member and arranged to rotate said field structure with respect to said frame, one end of said lever positively engaging said field structure and the other end of said lever being positively adjustable in two directions by said screw member.

4. In an electric switch, an insulating member, a spring mounted laterally of said insulating member, a contact fixed to said spring, a movable contact for engaging the first contact and a screw means axially lined with said contact for imparting longitudinal motion to said first contact whereby the position of said contact is fixed in the direction of motion of the movable contact.

5. In a relay, a base, a frame structure supported on said base, an insulating bridge supported at one end of said frame, a pair of pole pieces pivotally supported on said frame, a self-supporting permanent magnet in operative relation to said pole pieces, an armature pivoted on said frame structure and having a pair of energizing coils in operative relation thereto, and adjusting means comprising a lever fulcrumed on said bridge member, one end of said lever positively engaging said magnet structure and means to operate said lever to rotate said magnet structure.

6. In a circuit making and breaking device, a frame structure, a bridge member supported at one end of said frame structure, a polarized magnet assembly pivotally supported on said frame structure, an armature having a contact thereon and pivotally supported in operative relation to said magnet structure, an operating coil therefor, a pair of adjustable contacts mounted on said bridge member in operative relation with said armature contact, and a lever pivoted on said bridge member and adapted to center said armature contact with respect to said adjustable contacts.

7. In a relay, a frame, a polarized magnet and an armature pivotally supported on said frame, a contact on said armature, an operating coil for biasing said armature, a pair of adjustable contacts supported on said frame in operative relation with said armature contact, lever means acting between the frame and magnet for positively positioning said armature with relation to the magnet and contacts and a screw in the frame and engaging said lever for positively adjusting the lever in either of two directions.

8. In a circuit making and breaking device, a frame structure, a pair of pole pieces fixedly supported with respect to each other and pivoted on said frame, a permanent magnet in self-supporting relation to said pole pieces, a pair of contacts supported on said frame structure, an armature supported in operative relation to said pole pieces, a contact on one end of said armature in operative relation to said pair of contacts and a lever acting between the frame and the pole pieces for adjusting the position of the armature.

9. In a circuit making and breaking device, a frame structure, a pair of pole pieces fixedly supported with respect to each other and pivoted on said frame, a permanent magnet in self-supporting relation to said pole pieces, a pair of contacts supported on said frame structure, an armature pivoted at one end thereof, in operative relation to said pole pieces, a contact supported on said armature in operative relation to said pair of

contacts and a lever for positively positioning the armature.

10. In a circuit making and breaking device, a frame structure, a pair of pole pieces fixedly supported with respect to each other and pivoted on said frame, a permanent magnet in self-supporting relation to said pole pieces, a pair of fixed contacts supported on said frame structure, an armature in operative relation to said pole pieces, a contact supported on said armature in operative relation to said pair of contacts and a lever for positioning the armature.

11. In a circuit making and breaking device, a frame structure, a pair of pole pieces pivotally supported therein, means including a coil for energizing the pole pieces, a pair of contacts supported on said frame structure, an armature pivoted in operative relation to said pole pieces, a contact supported on said armature in operative relation to said pair of contacts and means for adjusting the pressure between the contacts and the operating current in the coil comprising a lever positively engaging a frame and pole pieces and adjustable in two directions.

12. In a circuit making and breaking device, a polarized magnet assembly and an armature operated thereby, an operating coil for actuating said armature, lever means for adjusting the position of the armature and determining the value of operating current in said coil and means for positively adjusting the lever in either of two directions.

13. In a circuit making and breaking device, an insulating member, a U-shaped spring member laterally supported on said insulating member, a contact supported on said U-shaped spring and fixed with respect thereto, a reciprocable member engaging said insulating member and axially aligned with said contact for adjusting the contact against the action of said spring in a longitudinal direction whereby the longitudinal and axial position of said contact is fixed and contact bounce is prevented and a movable contact axially aligned with said reciprocable member to engage said other contact.

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