March 4, 1930. O. S. FIELD 1,749,331

POLAR NEUTRAL RELAY

Filed Sept. 12, 1928 6 Sheets-Sheet 1

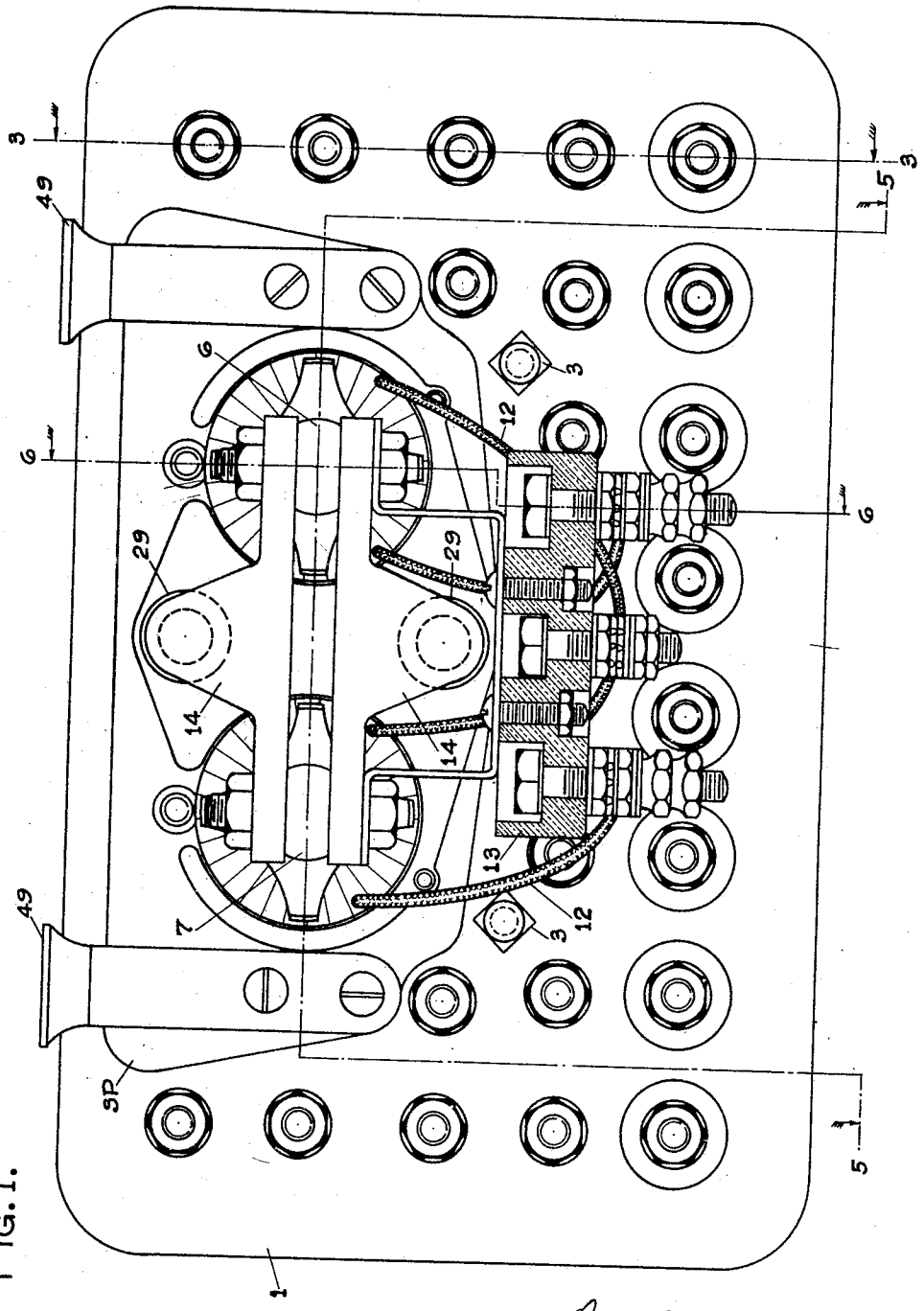

FIG. 1.

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POLAR NEUTRAL RELAY

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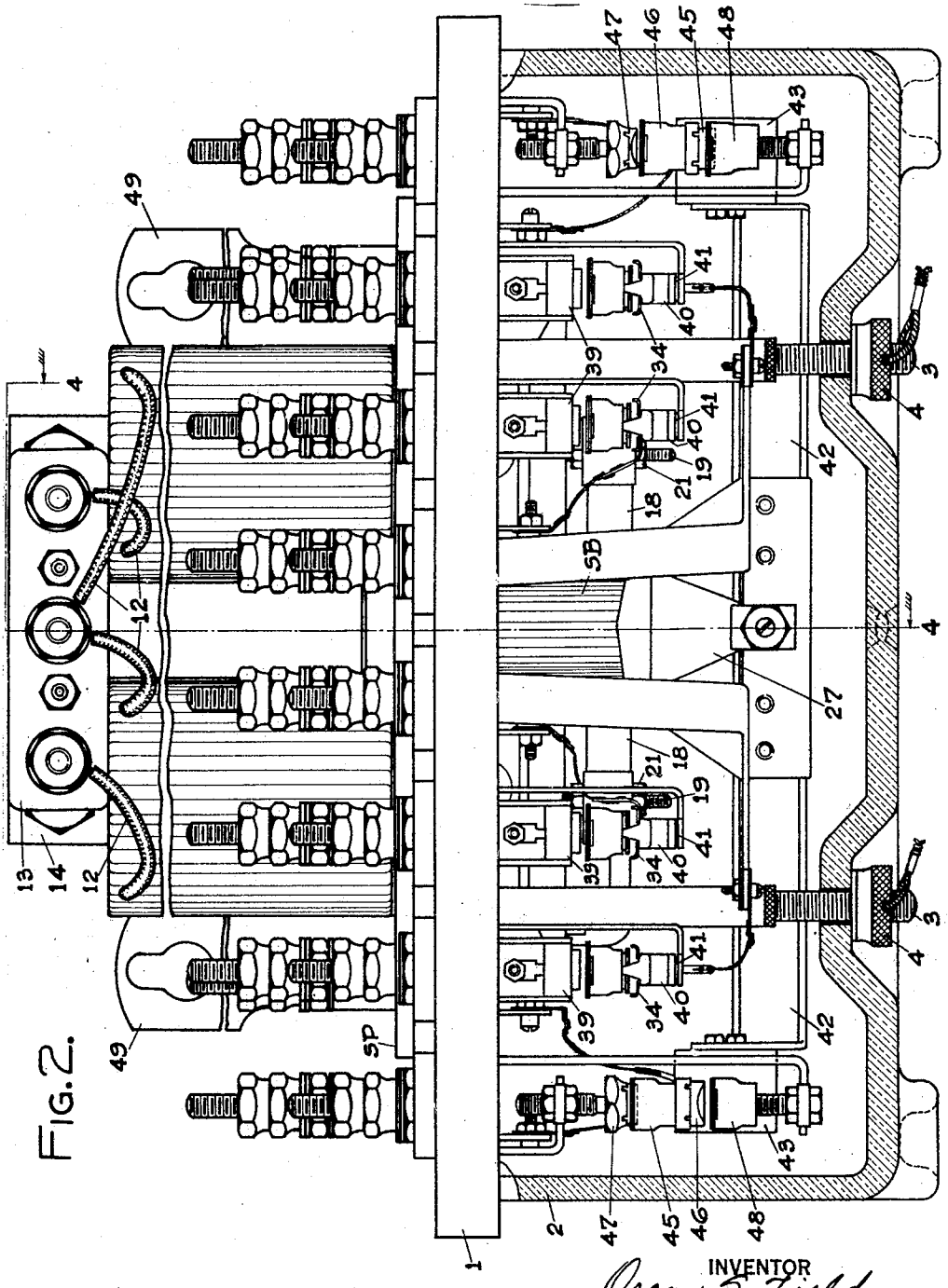

FIG. 2.

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POLAR NEUTRAL RELAY

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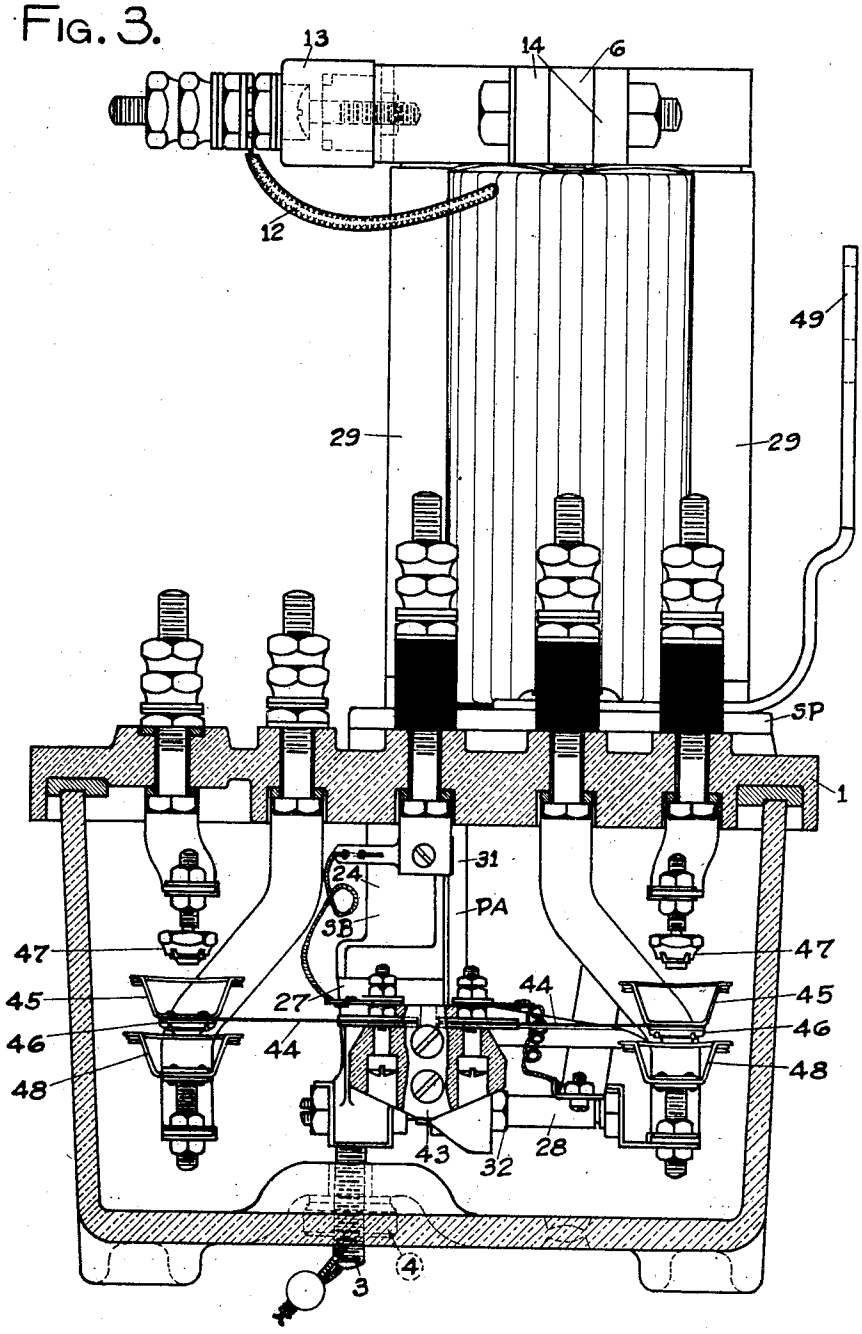
FIG. 3.



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POLAR NEUTRAL RELAY

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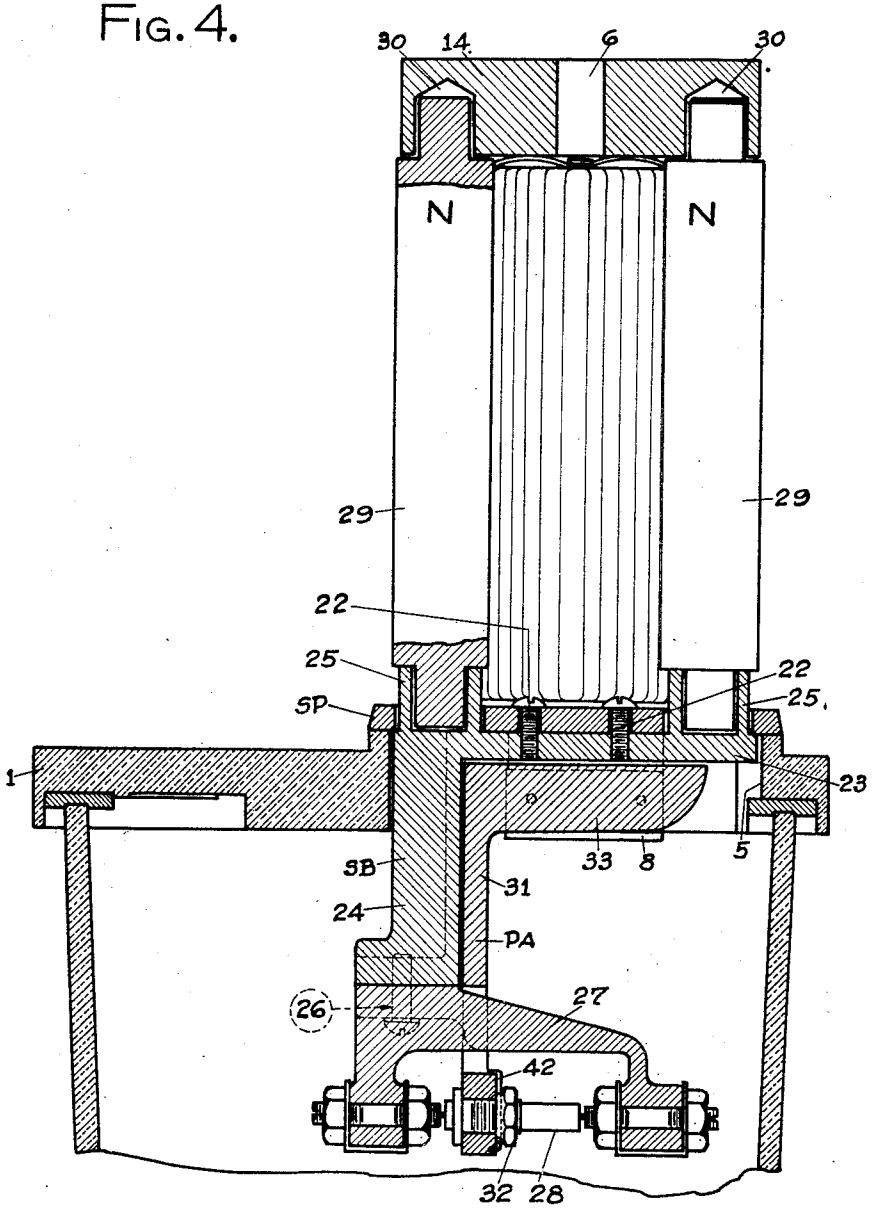
FIG. 4.



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POLAR NEUTRAL RELAY

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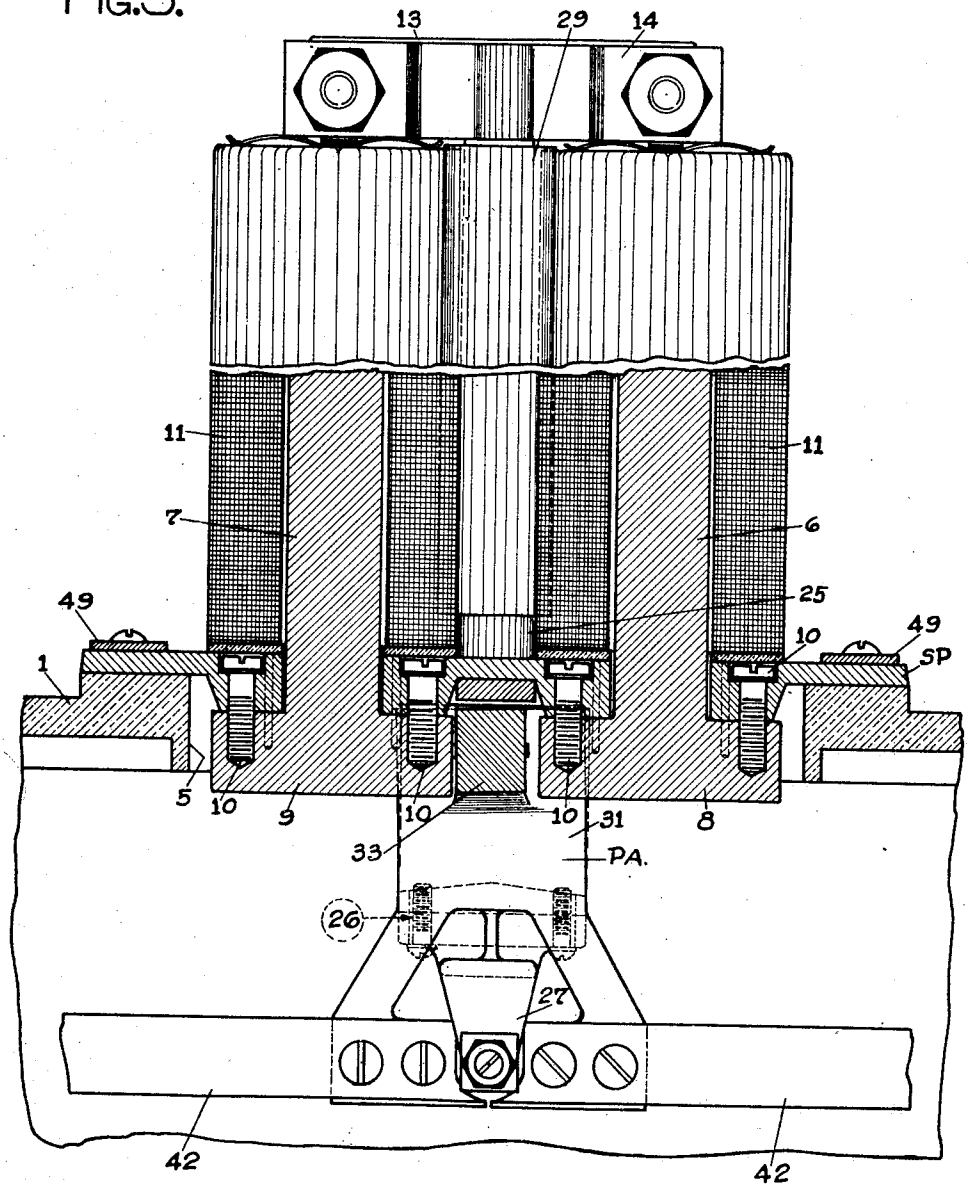
FIG. 5.



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POLAR NEUTRAL RELAY

Filed Sept. 12, 1928 6 Sheets-Sheet 6

FIG. 6.

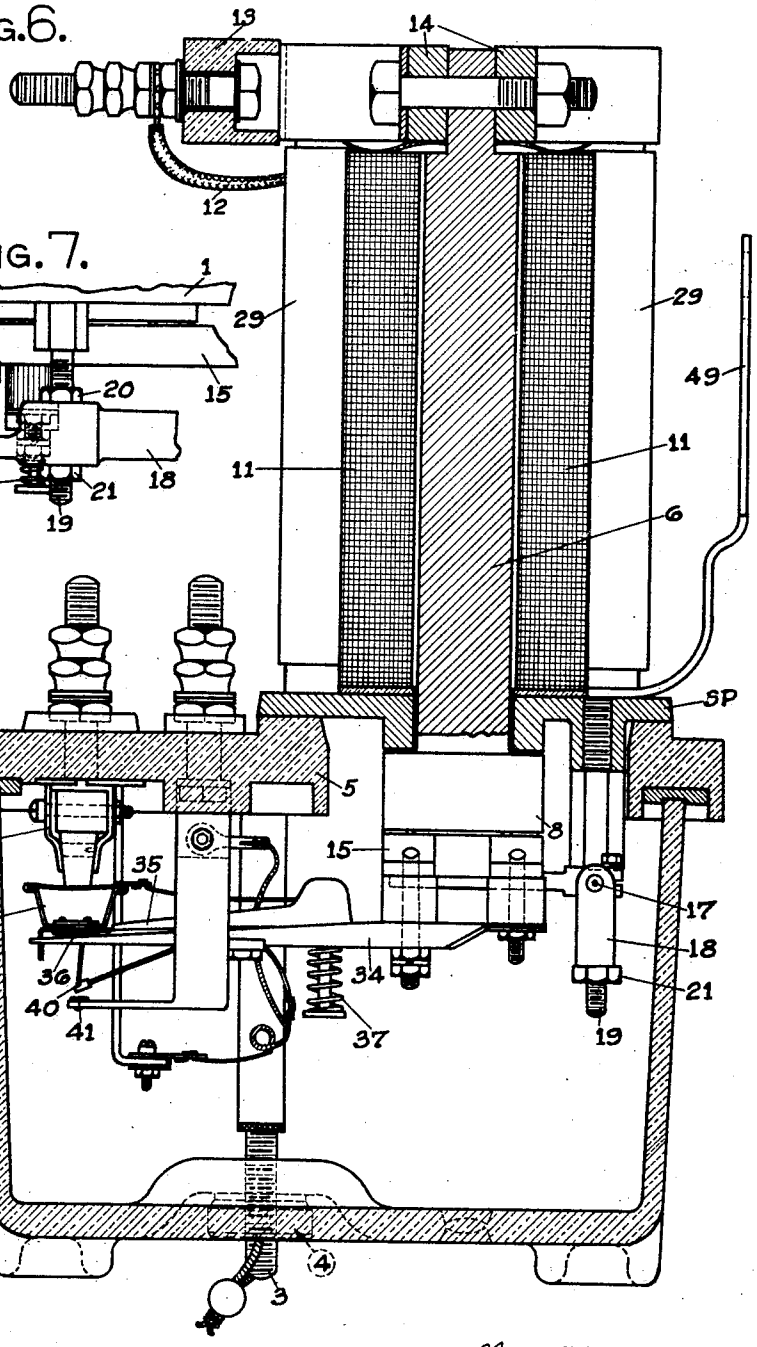

FIG. 7.

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Patented Mar. 4, 1930 1,749,331

UNITED STATES PATENT OFFICE

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POLAR NEUTRAL RELAY

Application filed September 12, 1928. Serial No. 305,408.

This invention relates in general to relays particularly adapted for railway use, and has more specific reference to a direct current relay of the polar neutral type.

Among the objects of this invention is to provide a polar magnetic structure which will be particularly efficient and dependable. This is accomplished, in general, by so proportioning and relating the cooperating moving and stationary parts of the polar magnetic structure as to reduce the air gaps in the magnetic path to a minimum, and so retain them during operation, and furthermore to provide large opposing surfaces for the flow of flux so as to keep the flux density low and the magnetic reluctance of the magnetic path small.

Further objects, purposes, and characteristic features of the invention will appear as the description progresses, reference being had to the accompanying drawings showing, solely by way of example, and in no manner in a limiting sense, one form which the invention can assume.

In the drawings:—

Fig. 1 is a top plan view, with parts shown in section, of a relay constructed in accordance with this invention.

Fig. 2 is a side elevational view, with parts shown in section of the relay of Fig. 1.

Fig. 3 is a sectional view on line 3—3 of Fig. 1, viewed in the direction of the arrows.

Fig. 4 is a sectional view, with parts omitted for clearness, on line 4—4 of Fig. 2, viewed in the direction of the arrows.

Fig. 5 is a sectional view, with parts omitted for clearness, on line 5—5 of Fig. 1, viewed in the direction of the arrows.

Fig. 6 is a sectional view, with parts omitted for clearness, on the line 6—6 of Fig. 1 viewed in the direction of the arrows.

Fig. 7 is a fragmentary view showing a detail of the neutral armature mounting.

Referring now to the drawings, the relay comprises a top plate 1 of insulating material to which is connected, in water tight relationship, a casing 2, preferably of glass or other transparent material, the two members 1 and 2 being connected together by bolts 3 and nuts 4.

Mounted over a large opening 5 in the top plate 1 is a support plate SP of non-magnetic material such as aluminum, brass or the like. Carried by the support plates SP are two cores 6 and 7 having pole pieces 8 and 9 and connected to the support plate by screws 10 or the like. On the cores 6 and 7 are coils 11 connected by lead-in wires 12 to a terminal block 13 mounted on a back strap 14 which is clamped to cores 6 and 7 to furnish a good magnetic path therebetween.

Cooperating with the pole pieces 8 and 9 is a neutral armature 15 mounted on trunnions 16 which turn in bearings 17 in a support bracket 18 which is adjustably supported from the plate SP by means of threaded studs 19 and upper and lower nuts 20 and 21, whereby the back gap between the neutral armature and its pole shoes can be readily adjusted.

Coming now to the polar magnetic structure, a support bracket SB of magnetic material is connected by screws 22 to the support plate and is right angular in form, with a horizontal arm 23 and a vertical arm 24. The horizontal arm 23 has two upstanding hollow bosses 25 which are received in openings in the support plate as shown in Fig. 4. The vertical arm 24 has connected to its lower end by screws 26, a yoke 27 of non-magnetic material, in which yoke is adjustably mounted a spindle 28.

Spaced from each other, and in a plane at right angles to the plane passing through the axes of the electromagnet cores 6 and 7, are two permanent magnets 29, with their lower ends mounted in the hollow bosses 25 of the support bracket SB and their upper ends in corresponding sockets 30 in the back strap 14.

Mounted on the spindle 28 is a polar armature PA which is right angular in shape to correspond with that of the support bracket SB. This polar armature PA has a vertical leg 31 mounted on spindle 28, as shown in Fig. 4, by a nut 32, and is positioned to have a horizontal arm 33 between the pole shoes 8 and 9 of the electro-magnets.

The above described magnetic structure furnishes a good magnetic path for both the

electromagnetic flux and the permanent magnetic flux.

The electro-magnetic flux produced by energization of the windings 11 passes downwardly through one of the cores, such as 7, across between the pole shoes 8 and 9 and the horizontal arm 33 of the polar armature PA, then up through the other core, such as 6, and across the back strap 14. Of course the direction of flow of flux is reversed, on reverse energization of the windings.

With regard to the polar magnetic structure, the permanent magnets 29 are positioned so as to each have the same polarity at the upper end, as for example north, as indicated by the reference letters N in Fig. 4. The flow of flux from each permanent magnet passes upwardly through the permanent magnet, through the back strap 14, down through one or the other of the electro-magnet cores, 6 or 7, depending on the particular direction of energization of the windings 11, through an electromagnet pole shoe, to the horizontal arm 33 of the polar armature PA, and thence back to the lower end of the permanent magnet, through the air gaps between the horizontal and vertical arms 33 and 31 of polar armature PA, and the corresponding arms 23 and 24 of support bracket SP.

By employing a support bracket with a horizontal arm 23, it is possible to use two permanent magnets 29 intsead of a single one as is generally the case. Also by having the vertical arms 31 and 24 of the polar armature and the support bracket respectively, of a broad plate like form, a very large area is provided for the passage of flux from one member to the other, with a resulting low flux density and the low magnetic reluctance in the magnetic path of the polar magnetic structure. This operates to greatly increase the efficiency and reliability of operation of the polar armature.

It is apparent from the above that the polar armature is always of one polarity, and that it will swing, with its spindle 28, to have its horizontal arm 33 in contact with one or the other of pole shoes 8 and 9, depending on the direction of flow of current in the windings 11.

The various contact fingers operated by the neutral and polar armatures, described above, and their cooperating front and back contacts, together with their connected terminal posts for lead-in wires, are all very similar to what is shown and described in detail in applicant's co-pending application Ser. No. 126,914, filed July 27, 1926, and for a more detailed discussion of these features than that appearing below, reference should be had to said application.

A plurality of contact fingers 34, of like construction, is connected to the neutral armature 15, each finger comprising two main parts, 35 and 36, articulated to each other and biased apart by a spring 37. The member 35 carries a movable front contact 38 of silver mesh or the like to cooperate with a fixed front contact 39 of carbon or the like, while the member 36 carries a movable back contact 40 of coin silver, or the like, to cooperate with a fixed back contact 41 of coin silver, for example.

Fixed to move with the vertical arm 31 of the polar armature, and the connected spindle 28, are carrier bars 42 extending in opposite directions to the two ends of the relay. Each bar 42 carries an insulating block 43, to each of which are connected two contact fingers 44, each having mounted at its end a movable front contact 45 of silver mesh, and a movable back contact 46 of carbon. These contacts 45 and 46 cooperate respectively with a fixed front contact 47, of a carbon block, and a fixed back contact 48 of silver mesh.

On movement of the polar armature PA to position its horizontal arm 33 against one or the other of the pole shoes 8 or 9, contact will be made between the two sets of movable and fixed front contacts carried by one of the carrier bars 42, and between the two pairs of movable and fixed back contacts carried by the other carrier bar 42.

The various details of the contact fingers and cooperating front and back fixed and movable contact means, are all clearly shown and described in the above referred to co-pending application Ser. No. 126,914, and accordingly the above brief description of these parts is believed quite sufficient for the purposes of this specification.

Attention is also directed to co-pending application Ser. No. 155,009, filed December 15, 1926, which shows the particular means for mounting the front stationary polar contacts 47.

Due to the particular form and arrangement of the polar magnetic structure, and the cooperating electro-magnetic structure and neutral armature, the magnetic reluctance and flux density of the polar magnetic path is reduced to a minimum, which results in a much more economical and certain operation of the relay generally and more particularly of the polar contacts with which difficulties are more generally encountered than with the neutral contacts.

For supporting the relay from a wall or the like, two brackets 49 are provided, as shown in Figs. 1 and 2.

The above rather specific description of one form of the present invention is given solely by way of example, and is not intended, in any manner whatsoever, in a limiting sense. Obviously, the invention can assume many different physical forms, and is susceptible of numerous modifications, and all such forms and modifications are intended to be included in this application, as come within the scope of the appended claims.

Having described my invention, I now claim:—

1. In a relay, in combination, a pair of spaced electromagnets including spaced pole shoes, a pair of spaced permanent magnets adjacent said electromagnets, and a back yoke magnetically connecting together one end of each of said magnets.

2. In a relay, in combination, a pair of spaced electromagnets including spaced pole shoes, a pair of spaced permanent magnets adjacent said electromagnets, a back yoke magnetically connecting together one end of each of said magnets, an angular support bracket of magnetic material having a horizontal arm receiving the other ends of said permanent magnets and a depending plate like arm presenting a broad face of relatively large area, and a pivoted polar armature magnetically cooperating with said pole shoes and said angular support bracket.

3. In a relay, in combination, a pair of spaced electromagnets including spaced pole shoes, a pair of spaced permanent magnets adjacent said electromagnets, a back yoke magnetically connecting together one end of each of said magnets, an angular support bracket of magnetic material having a horizontal arm receiving the other ends of said permanent magnets and a depending plate like arm presenting a broad face of relatively large area, and a pivoted polar armature of angular form having a horizontal arm positioned to swing sidewise between said pole shoes and a depending plate like arm parallel with, and spaced by but a narrow gap from, said broad face of said depending plate like arm, whereby to afford a much better magnetic path between the permanent magnets and the electromagnets by way of said polar armature than by any path excluding said polar armature.

4. In a relay, in combination, a pair of spaced electromagnets including spaced pole shoes, a pair of spaced permanent magnets adjacent said electromagnets, a back yoke magnetically connecting together one end of each of said magnets, an angular support bracket of magnetic material having a horizontal arm receiving the other ends of said permanent magnet and a depending plate like arm presenting a broad face of relatively large area, a pivoted polar armature magnetically cooperating with said pole shoes and said support bracket, a pivot yoke fixed to the lower end of said depending arm of said support bracket, a spindle adjustably mounted in said pivot yoke, and means mounting said polar armature on said spindle.

5. In a relay, in combination, a pair of spaced electromagnets including spaced pole shoes, a pair of spaced permanent magnets adjacent said electromagnets, a back yoke magnetically connecting together one end of each of said magnets, an angular support bracket of magnetic material having a horizontal arm receiving the other ends of said permanent magnets and a depending plate like arm presenting a broad face of relatively large area, a pivoted polar armature of angular form having a horizontal arm positioned to swing sidewise between said pole shoes and a depending plate like arm parallel with, and spaced by but a narrow gap from, the broad face of said depending arm of said bracket, whereby to afford a much better magnetic path between the permanent and the electromagnets by way of said polar armature than by any path excluding said polar armature, a pivot yoke fixed to the lower end of said depending arm of said bracket, a spindle adjustably mounted in said yoke, and means mounting said polar armature on said spindle.

6. In a relay, in combination, a support plate, two elongated spaced electromagnets mounted in said plate in a common plane, two spaced elongated permanent magnets mounted in said plate in a plane at substantially right angles to said common plane, a back strap magnetically connecting together one end of each magnet, and cooperating polar and neutral armatures.

7. In a relay, in combination, a support plate, two elongated spaced electromagnets mounted in said plate in a common plane, two spaced elongated permanent magnets mounted in said plate in a plane at substantially right angles to said common plane, a back strap magnetically connecting together one end of each magnet, spaced pole pieces on said electromagnets, a magnetic support bracket having a horizontal arm receiveing the other ends of said permanent magnets and a depending vertical arm, and a pivoted polar armature cooperating with said pole shoes and said magnetic support bracket.

8. In a relay, in combination, a support plate, two elongated spaced electromagnets mounted in said plate in a common plane, two spaced elongated permanent magnets mounted in said plate in a plane at substantially right angles to said common plane, a back strap magnetically connecting together one end of each magnet, spaced pole pieces on said electromagnets, a magnetic support bracket having a horizontal arm receiving the other ends of said permanent magnets and a depending vertical arm, and a pivoted polar armature having a horizontal arm, positioned to swing between said pole pieces and a vertical arm, said arms of said polar armature paralleling the corresponding arms of said magnetic bracket and being spaced therefrom by only a relatively narrow air gap.

9. In a relay, in combination, a support plate, two elongated spaced electromagnets mounted in said plate in a common plane, two

spaced elongated permanent magnets mounted in said plate in a plane at substantially right angles to said common plane, a back strap magnetically connecting together one end of each magnet, spaced pole pieces on said electromagnets, a magnetic support bracket having a horizontal arm receiving the other ends of said permanent magnets and a depending vertical arm, and a pivoted polar armature having a horizontal arm, positioned to swing between said pole pieces, and a vertical arm, said arms of said polar armature paralleling the corresponding arms of said magnetic bracket and being spaced therefrom by only a relatively narrow air gap, said vertical arms being of broad plate like formation, with their faces opposing, to thereby furnish a low reluctance path therebetween for permanent magnet flux.

10. In a relay, in combination, a support plate, two elongated spaced electromagnets mounted in said plate in a common plane, two spaced elongated permanent magnets mounted in said plate in a plane at substantially right angles to said common plane, a back strap magnetically connecting together one end of each magnet, spaced pole pieces on said electromagnets, a magnetic support bracket having a horizontal arm receiving the other ends of said permanent magnets and a depending vertical arm, a pivoted polar armature having a horizontal arm, positioned to swing between said pole pieces, and a vertical arm, said arms of said polar armature paralleling the corresponding arms of said magnetic bracket and being spaced therefrom by only a relatively narrow air gap, a spindle mounted on the vertical arm of said polar armature, a yoke, means adjustably mounting said spindle in said yoke, and means connecting said yoke to the lower end of said depending arm of the support bracket.

11. In a relay, in combination, a support plate, two elongated spaced electromagnets mounted in said plate in a common plane, two spaced elongated permanent magnets mounted in said plate in a plane at substantially right angles to said common plane, a back strap magnetically connecting together one end of each magnet, spaced pole pieces on said electro-magnets, a magnetic support bracket having a horizontal arm receiving the other ends of said permanent magnets and a depending vertical arm, a pivoted polar armature having a horizontal arm, positioned to swing between said pole pieces, and a vertical arm, said arms of said polar armature paralleling the corresponding arms of said magnetic bracket and being spaced therefrom by only a relatively narrow air gap, said vertical arms being of broad plate like formation, with their faces opposing, to thereby furnish a low reluctance path therebetween for permanent magnet flux, a spindle mounted in the vertical arm of said polar armature, a yoke, means adjustably mounting said spindle in said yoke, and means connecting said yoke to the lower end of said depending arm of the support bracket.

12. In a relay, in combination, spaced electromagnets having spaced pole shoes, adjacent spaced permanent magnets, a back yoke connecting together one end of each magnet, a magnetic bracket connecting together the other ends of said permanent magnets, a pivoted neutral armature positioned to contact with the faces of said pole shoes on energization of said electromagnets, and a pivoted neutral armature positioned to swing sidewise between the inner sides of said pole shoes and between said magnetic bracket and said neutral armature.

In testimony whereof I affix my signature.

OSCAR S. FIELD.