

April 14, 1959

N. K. E. BERGLUND

2,882,459

POLARISED RELAY

Filed June 4, 1954

5 Sheets-Sheet 1

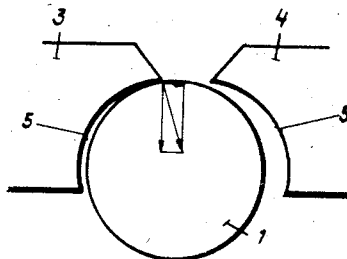


Fig. 1

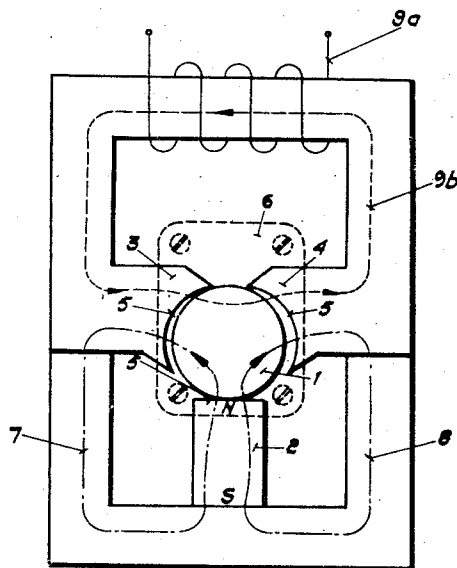


Fig. 2.

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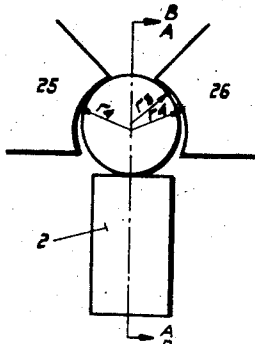


Fig. 5a.

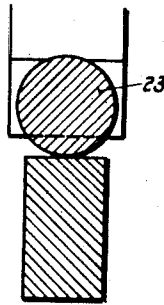


Fig. 5b.

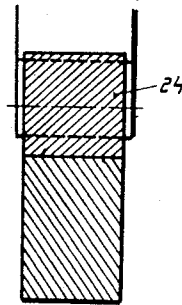


Fig. 5c.

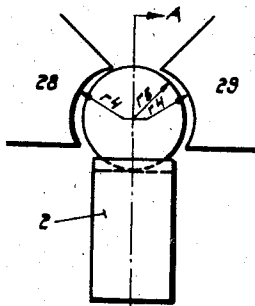


Fig. 6a

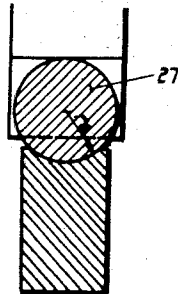


Fig. 6b

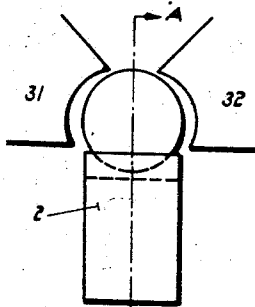


Fig. 7a

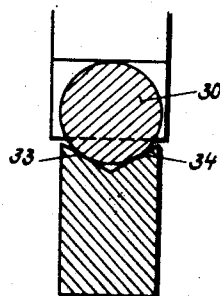


Fig. 7b.

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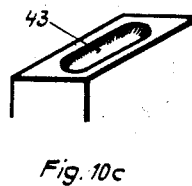
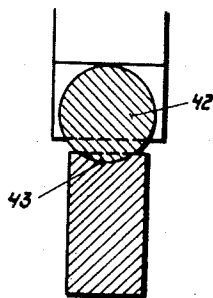
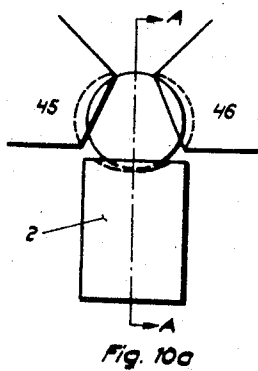
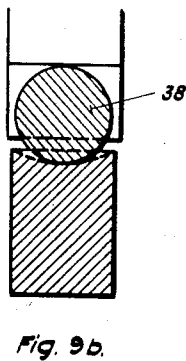
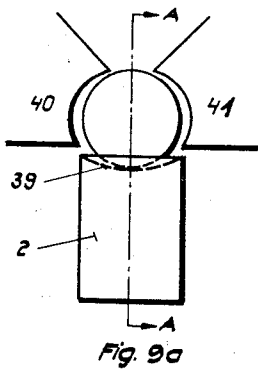
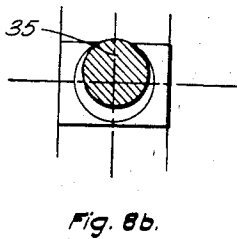
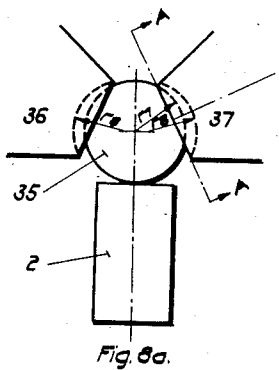


Fig. 10b

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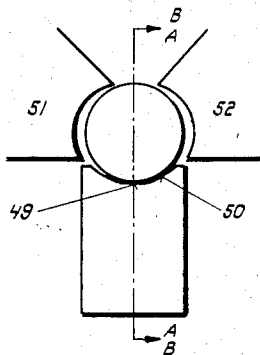


Fig. 11a.

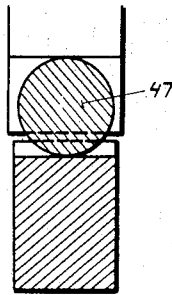


Fig. 11b.

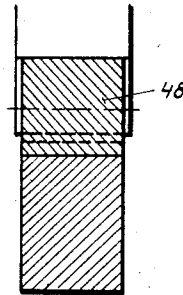


Fig. 11c.

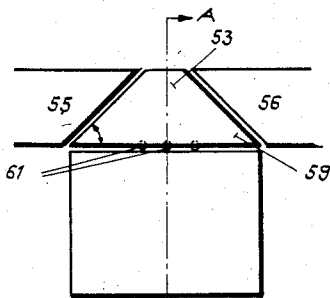


Fig. 12a.

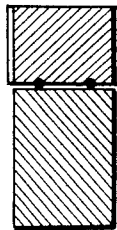


Fig. 12b.

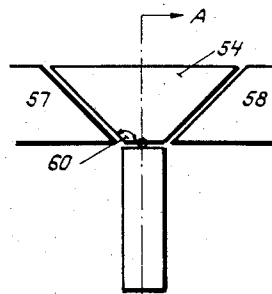


Fig. 12c.

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POLARISED RELAY

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18 Claims. (Cl. 317—196)

This invention relates to polarised relays, e.g. for telegraphy, telephony and signalling purposes.

Polarised relays of previously known design are so arranged that the rebounding force during movement of the armature is acting mainly in the direction of movement of said armature. The armature is, moreover, often in any way resiliently anchored so that the springing force acts in the same direction as the rebounding force of the armature. The contact points between the armature and the pole screws in the outgoing current path are furthermore always the same in known relays.

In relays according to the present invention the armature consists of a freely carried body, e.g. in the form of a sphere, a cylinder or having another convenient shape. The shape of the surfaces facing the armature of the pole pieces is such that they are more or less adapted to the shape of the armature, whereby further only part of the rebounding force acts in the direction of movement of the armature (wedge action). Another advantage inherent in an armature of this type is that the contact points between the armature and the pole pieces in the outgoing current path—at least as regards the armature—are not always the same, these points being distributed over the whole or mainly the whole surface and at the pole piece contacts over a comparatively large surface or along a line. Appearance of injurious burns on the contact surfaces is hereby rendered more difficult.

By way of example, embodiments of the invention will be described more in detail in connection with the relays illustrated on the accompanying drawings, wherein

Figs. 1 and 2 are diagrammatical views of an embodiment of a relay having spherical or cylindrical armature;

Fig. 3 is a view of a relay which is provided with a cylindrical armature and is intended for performing mechanical work, said relay being shown from above or in side view;

Fig. 3a is a section taken on line A—A of Fig. 3;

Figs. 4a, 4b, 4c are views of a relay having a spherical or cylindrical armature, seen from above or in side view (Fig. 4a), in section AA (spherical armature, Fig. 4b) and in section BB (cylindrical armature, Fig. 4c);

Figs. 5a, 5b, 5c illustrate a relay having a spherical or cylindrical armature, seen from above (Fig. 5a) in section AA (spherical, Fig. 5b) and in section BB (cylindrical, Fig. 5c), respectively, and having concave cylindrical shaped recesses in the pole pieces;

Figs. 6a and 6b are views of a relay having a spherical armature, which latter when moving is rolling in a concave cylinder shaped recess in the permanent magnet, seen from above (Fig. 6a) and in section AA (Fig. 6b), respectively;

Figs. 7a and 7b are views of a relay having a spherical armature, which when moving is rolling in a generally V-shaped channel in the permanent magnet, seen respectively from above or in side view (Fig. 7a) and in section AA (Fig. 7b);

Figs. 8a and 8b are views of a relay having a spherical armature and wherein the pole pieces form part of a

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spherical contact surface, seen from above (Fig. 8a) and in section AA (Fig. 8b), respectively;

Figs. 9a and 9b are views of a relay having a spherical armature and wherein the permanent magnet forms part of a spherical contact surface, seen from above (Fig. 9a) and in section AA (Fig. 9b), respectively;

Figs. 10a and 10b illustrate a relay having a spherical armature and wherein both the pole pieces and the permanent magnet form part-spherical contact surfaces, seen from above (Fig. 10a) and in section AA (Fig. 10b);

Figs. 11a, 11b and 11c are views of a relay having a spherical and a cylindrical armature, respectively, seen from above (Fig. 11a) in section AA (spherical, Fig. 11b) and in section BB (cylindrical, Fig. 11c) and with the recesses in the pole pieces concave, and the permanent magnet recesses partly concave and partly plane;

Figs. 12a, 12b and 12c are views of a relay having an armature, which has plane face with two parallel and two relatively sloping surfaces and pole pieces having corresponding surfaces as seen from above (Fig. 12a or 12c) and in section AA (Fig. 12b).

In Figs. 1 and 2 numeral 1 refers to an armature arranged as a freely carried body, which in this case consists of a sphere of magnetic material. Numeral 2 indicates a permanent magnet of conventional shape, 3 and 4 are pole pieces which latter on their contact surfaces 5 with the armature body 1 are concave with the same or essentially the same radius of curvature as the armature sphere.

The upper surface of the permanent magnet shown in Fig. 2 as well as the surface facing the armature of the pole pieces 3, 4 are coated with contact material which on at least two of the three surfaces is isolated from its supporting parts. The armature 1 is prevented from falling out from its position during transport by means of lateral pieces 6 preferably made of a transparent material.

The relay operates in the following manner:

If the permanent magnet 2 is given the polarity according to Fig. 2 the permanent flux is closed through one of the flux paths 7, 8 shown in the figure. With the direction shown in the figure of a control flux 9b generated by a control coil 9a the permanent flux 8 will thereby co-operate with the control flux (on the right-hand side of the figure). The flux 7 and the flux 9b will, however, be opposed to each other (on the left-hand side of the figure) whereby the spherical armature 1 is moved over to the right.

Besides the above mentioned spherical shape of the armature (which latter can be a solid ball or a spherical shell) the armature may be formed as a solid cylinder or as a cylinder tube, a prism of trapeziform section or another body adapted to be freely supported between pole pieces of suitable form.

Another embodiment of a relay in accordance with the present invention is shown in Fig. 3 and is provided with a cylindrical armature body 13 mounted between a permanent magnet 14 and pole pieces 15 and 16, respectively. The contact surfaces of the pole pieces with the armature are concavely cylindrical.

The armature body 13 is penetrated by a central shaft 17, which by means of a fork piece 18 is capable of transmitting the mechanical work performed by the armature 13 to any suitable mechanism. The transmission takes place in time to the variations of the control flux through the control coil winding and the variations of the resulting control flux, respectively.

In Figs. 4a to 4c two embodiments are shown having a spherical armature body 19 (Figs. 4a, 4b) and a cylindrical armature body 20 (Figs. 4a, 4c), respectively. The sphere 19 may be solid or a hollow shell. The cylinder 20 may also be solid or a hollow tube. The radius of

curvature of the armature body 19 and 20, respectively, is designated r_1 , the radius of curvature of the contact surfaces of the pole pieces 21, 22 against the body is designated r_2 . The radii r_1 and r_2 may be equal.

In Figs. 5a to 5c two embodiments are shown having a spherical armature body 23 (Figs. 5a, 5b) and a cylindrical armature body 24 (Figs. 5a, 5c). The radius of curvature of the sphere 23 or the cylinder 24 is designated r_3 and the radius of curvature of the pole pieces 25 and 26 is designated r_4 . Radius r_4 is in this case somewhat greater than radius r_3 . The centre of last mentioned radius is so located with respect to the centre of the armature body that the contact point between the armature and the pole pieces is located on the surface directed from the permanent magnet of the armature.

In Figs. 6a and 6b an embodiment of a relay is shown diagrammatically. Said relay has a spherical armature body 27 and concavely cylindrical contact surfaces of the pole pieces 28 and 29 against the armature. Furthermore, the contact surface of the permanent magnet 2 with the armature body has a concave cylindrical form. The radius of the armature body is designated r_5 and the radius of curvature of the concave surface of the permanent magnet is designated r_6 . The both radii r_5 and r_6 may be equal. The radius of curvature of the concave contact surfaces of pole pieces 28, 29 with the armature body is designated r_4 . It may be equal to or greater than r_5 .

In Figs. 7a and 7b a spherical armature body 30 is shown between concave contact surfaces of pole pieces 31, 32. The contact surface of the permanent magnet with the armature body is in this case shaped as a V-formed channel having two oblique plane surfaces 33, 34. The contact points between the armature body 30 and permanent magnet move during the movement of the armature along two straight lines.

In Figs. 8a and 8b the armature body is shown as a sphere 35. The contact surface of the permanent magnet is here plane but the contact surfaces of the pole pieces 36 and 37 are concave and constitute a part of a spherical surface having a radius r_8 which is equal to or greater than the radius r_7 of the armature body 35. In Fig. 8b a section along line AA in Fig. 8a is shown.

In Figs. 9a and 9b the armature body is shown as a sphere 38. The contact surface 39 of the permanent magnet here forms a part of a concave spherical surface. The contact surfaces of the pole pieces 40 and 41 are also concave.

In Figs. 10a and 10b the armature body is formed as a sphere 42. The contact surface of the permanent magnet is in this case so arranged that the armature, when moved laterally from its central position in either direction is displaced in a cylindrical channel 43, the end portions of which terminate in a part-cylindrical surface closely corresponding to the armature surface. The contact surface of the permanent magnet is shown in section AA illustrating the cylindrical central portion of the channel 43, Fig. 10b and the channel 43 is shown in perspective in Fig. 10c.

As the pole pieces 45 and 46 moreover have concave spherical contact surfaces, the armature sphere 42 in its end positions fits either to the spherical contact surface of pole piece 45 and the channel in the permanent magnet or to the spherical contact surface of pole piece 46 and the channel in the permanent magnet.

In Figs. 11a to 11c a relay is shown respectively having an armature sphere 47 (Figs. 11a, 11b) and an armature cylinder 48 (Figs. 11a, 11c). The contact surface of the permanent magnet is here plane at the central portion 49, but forms otherwise part of a cylindrical surface 50 having its axis perpendicular to the direction of movement of the armature body. During contact movement the armature body is at first rolling on a plane surface at the central portion, but in its end positions the armature fits to the cylindrical surface, where it makes contact along a line in a plane (spherical armature) or over a great

part of the cylindrical surface (cylinder formed armature). The pole pieces 51 and 52 are provided with concave cylindrical contact surfaces.

Finally Figs. 12a to 12c illustrate two examples of relays having armature bodies 53 and 54, respectively. These bodies are polyhedrons or frusto-conical. The contact surfaces of the pole pieces 55, 56 and 57, 58 respectively, are plane, concave or convex depending upon the shape of the armature and their angle of inclination with respect to the horizontal plane is substantially the same as that of the corresponding armature surface. Between the base surfaces 59 and 60, respectively, of the armature bodies and the contact surface of the permanent magnet small balls 61 are mounted in order to reduce the friction during contact movements of the armature body.

The relays according to the invention are not restricted to the embodiments respectively of the armature body and the contact surface of the pole pieces and the permanent magnet shown in Figs. 1 to 12c. On the contrary a great number of other combinations of the mentioned relay parts is possible. Thus the permanent magnet shown in Figs. 10a, 10b can be combined with pole pieces according to Figs. 9a, 9b or the pole pieces shown in Figs. 10a may be combined with a permanent magnet either according to Figs. 6a, 6b or according to Figs. 7a, 7b. Further combinations are possible within the scope of the present invention.

Naturally the armature body may have any other form as a freely supported body than those described above. It may thus be shaped as a bobbin, a revolution symmetric body having a parabola, hyperbola, part-ellipse or any other curve as its generatrix.

The surface of the permanent magnet facing the armature may also be made plane and the types of recesses for the armature described above can instead be made in a body arranged between the permanent magnet and the armature and attached to the above mentioned plane surface of the permanent magnet.

I claim:

1. In a polarised relay, an electromagnet including an exciting coil and a magnetisable core with two pole pieces having opposite faces, a magnetic body disposed outside the magnetic flux paths through said core, said magnetic body having pole faces on opposite ends, magnetisable core pieces joining one of the pole faces of the magnetic body in two magnetic flux paths with said pole pieces, and an armature of circular cross-section, the pole faces of said pole pieces and the other pole face of said magnetic body defining a cage for receiving and retaining therein the armature, said armature being disposed within said cage freely resting upon the respective pole face of the magnetic body and freely movable relative to the pole faces of the said pole pieces, said latter faces having a configuration closely conforming to the peripheral outline of the armature but eccentric relative thereto in the middle position of the armature upon said magnetic body, the magnetic flux lines produced by said exciting coil when energized permeating the pole pieces and the armature in a direction controlled by the polarisation of the relay and the two magnetic flux paths of said magnetic body closing through the armature and the core pieces in directions opposite to each other whereby the armature is attracted toward one of said pole pieces, corresponding to the flow direction of the flux lines through the pole pieces and engages the respective pole piece with a wedge action to impede a rebounding tendency of the armature.

2. A polarised relay according to claim 1, wherein at least two of the pole faces coacting with the armature are coated with electrically conductive material insulated from the material of the respective pole pieces and the magnetic body.

3. A polarised relay according to claim 1, wherein said armature is in form of a sphere.

4. A polarised relay according to claim 1, wherein said armature is cylindrical.

5. A polarised relay according to claim 1, wherein said armature is frusto-conical.

6. A polarised relay according to claim 1, wherein the radii of the armature and the curvature of said concave pole pieces are substantially equal.

7. A polarised relay according to claim 6, wherein the pole faces of said pole pieces are spherically concave relative to the armature, the centers of the concave pole faces and of the armature being situated in a plane parallel to the movement of the armature on said supporting magnetic body, the rotational center of the armature being midway between the centers of curvature of said two other pole pieces in a position of the armature equidistant from said concave pole faces.

8. A polarised relay according to claim 1, wherein the faces of said two pole pieces are spherically concave relative to the armature, the radii of said two concave pole pieces being greater than the radius of the armature, the centers of curvature of said two concave pole faces and of the armature being situated in the perpendicular center plane of the supporting magnetic body.

9. A polarised relay according to claim 1, wherein said magnetic body supporting the armature is a permanent magnet, the supporting surface of said magnet being a plane surface.

10. A polarised relay according to claim 1, wherein said magnetic body supporting the armature has a concave cylindrical supporting surface extending into the direction of movement of the armature between said two pole pieces, the radii of the armature and said supporting surface being substantially equal.

11. A polarised relay according to claim 1, wherein said magnetic body supporting the armature has a supporting surface including a V-shaped groove extending into the direction of movement of the armature between said two pole pieces.

12. A polarised relay according to claim 1, wherein said two pole pieces facing the armature have spherically concave faces, the radii of said concave pole faces being greater than the radius of the armature.

13. A polarised relay according to claim 1, wherein said magnetic body supporting the armature has a spherically curved supporting surface.

14. A polarised relay according to claim 1, wherein said armature is spherical, and wherein said magnetic body supporting the armature is a permanent magnet having a supporting surface formed with a guide groove for the armature extending into the direction of the movement of the armature relative to said two pole

pieces, said groove having a semi-cylindrical cross-section and ending at both ends in a sector of a spherical surface fitting the spherical outline of the armature.

15. A polarised relay according to claim 1, wherein said magnetic body supporting the armature has a supporting surface including an elongated groove extending transversely to the direction of movement of the armature between the said two pole pieces, said groove having a flat base and side-walls forming a sector of a cylindrical surface fitting the curvature of the armature.

16. A polarised relay comprising a magnetic body having a pole face, an armature of circular cross section supported upon said pole face freely movable relative thereto, a pair of pole pieces each having a pole face, said pole faces facing the peripheral outline of the armature to restrain the movement thereof on the magnetic body, and exciting coil means for generating a magnetic flux through the pole pieces and the armature to attract the latter toward one of said pole pieces depending upon the flow direction of said flux, said faces of the pole pieces having a configuration of circular curvature facing the armature but eccentric relative thereto in the position of the armature equidistant from the pole faces of the pole pieces whereby the armature when attracted to one of said pole pieces engages the same with a wedge action impeding a rebounding tendency of the armature.

17. A polarised relay according to claim 16 wherein the pole face of the magnetic body includes a V-shaped groove extending into the direction of movement of the armature between said two pole pieces.

18. A polarised relay according to claim 16, wherein the pole face of said magnetic body has a spherically curved supporting surface for the armature.

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