March 20, 1962 D. J. NORTON 3,026,456

TRACTIVE ARMATURE RELAYS

Original Filed Oct. 7, 1957 2 Sheets-Sheet 1

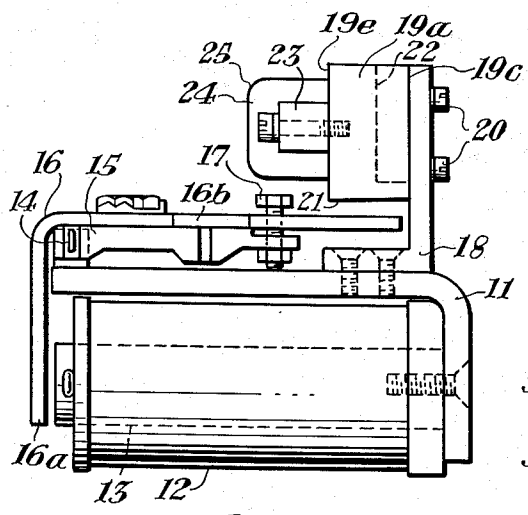


Fig. 1a.

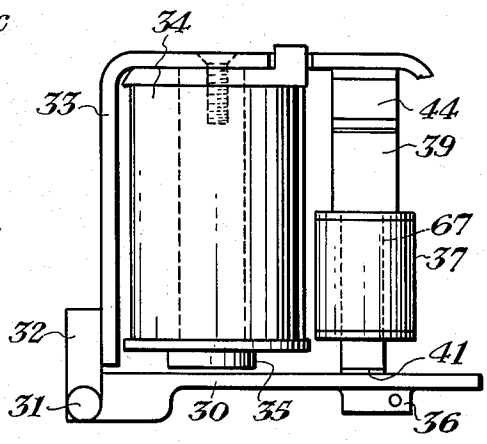


Fig. 2a.

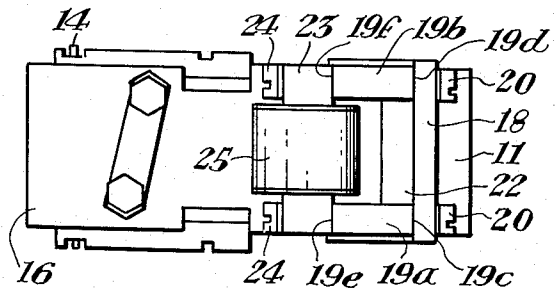


Fig. 1b.

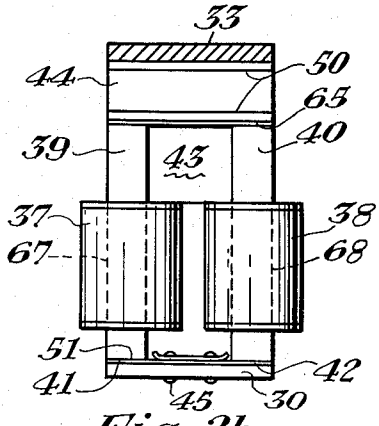


Fig. 2b.

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TRACTIVE ARMATURE RELAYS

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2 Sheets-Sheet 2

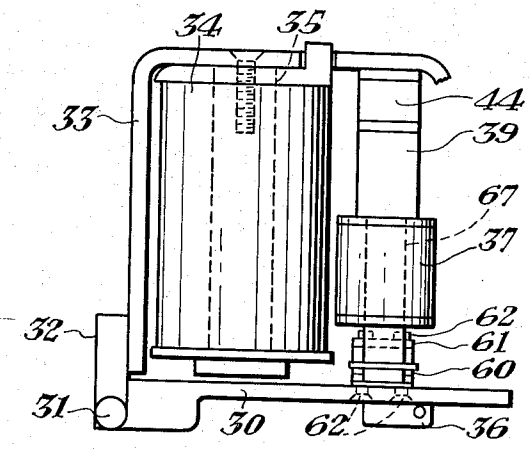


Fig. 3a.

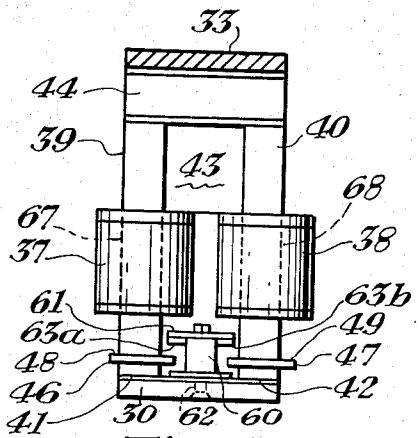


Fig. 3b.

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TRACTIVE ARMATURE RELAYS

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Original application Oct. 7, 1957, Ser. No. 688,715, now Patent No. 2,928,029, dated Mar. 8, 1960. Divided and this application Nov. 27, 1959, Ser. No. 855,562
1 Claim. (Cl. 317—187)

The present invention relates to tractive armature relays of a type, often known as "latched" relays, in which a latch arrangement acts, when the armature has been picked up to the energized position due to energization of the operating coil of the relay, to maintain or hold up the armature in that position upon deenergization of the operating coil unless and until the latch arrangement is rendered ineffective, whereupon the armature is free to assume the released position.

This application is a division of my copending application for Letters Patent of the United States, Serial No. 688,715, filed on October 7, 1957, and now Patent No. 2,928,029, entitled Tractive Armature Relays. Application Serial No. 688,715 is a continuation-in-part of application Serial No. 635,656, filed on January 23, 1957, entitled Magnetic Latch for Plug-In Relays, now abandoned.

Heretofore, in a certain class of relays known as a two-position magnetic stick relay, it has been proposed to interpose a permanent magnet between the cores of two separate operating coils associated with a single armature. The permanent magnet sets up a magnetic flux in the magnetic circuit including the cores and the armature, and to pick up the armature to the energized position this magnetic flux is strengthened by electromagnetic flux set up by energization of the operating coils with current of the appropriate polarity. The reduction of the air gap between the cores and the armature by picking up of the latter to the energized position enables the permanent magnet to hold the armature in that position on subsequent deenergization of the operating coils and consequent removal of the strengthening electro-magnetic flux. A disadvantage of the above type of relays is that in order to permit the return of the armature to the released position, it is necessary to energize the operating coils with current of opposite polarity to set up in the magnetic circuit an electro-magnetic flux which opposes the magnetic flux due to the permanent magnet to thereby neutralize the holding force.

According to the present invention the above disadvantage is eliminated by providing, in a tractive armature relay, a latch arrangement comprising a permanent magnet mounted in fixed relationship to the relay frame and arranged to exert on the armature, in its energized position, an attractive force sufficient to hold the armature in that position, and an electromagnetic release coil or trip coil which is additional to the operating coil or coils of the relay and which is energizable to produce a magnetic force opposing the said attractive force to an extent sufficient to allow release of the armature.

More particularly, according to the present invention, a tractive armature relay is shown comprising a first magnetic circuit extending in part through the armature and including a core having an operating coil thereon. A second magnetic circuit is provided also extending in part through the armature, the remaining extent of the second circuit being at least in part separate from the first circuit and including a permanent magnet with a shunt path therefor. In the second circuit a core is provided having thereon a release coil additional to the operating coil. The permanent magnet is effective, on the picking up of the armature to the energized position by energization of the

operating coil, to hold the armature in that position on deenergization of the operating coil, and the release coil is energizable to allow release of the armature. It will be evident that the action of the latch arrangement in holding up and releasing the armature is independent of energization of the operating coil of the relay.

In one arrangement of the relay according to the present invention, a permanent magnet extends between a pair of spaced pole piece members of magnetizable material, which pole piece members are spanned by a further member of magnetizable material to establish the shunt path for the permanent magnet. A release coil may be wound either on the last-mentioned member, or may be wound as a single coil, or as separate coils on one or both of the pairs of spaced pole piece members. In the former case the redistribution of flux resulting from energization of the release coil has the effect of boosting the permanent magnet and therefore there can be no tendency to demagnetize the permanent magnet. In the latter case the effect is opposite but by using a permanent magnet having a high resistance to demagnetization and by proportioning the members of the magnetic circuit in accordance with well-known principles, demagnetization of the permanent magnet may be avoided.

The invention will be further described, by way of example, with reference to the accompanying drawings in which like reference characters refer to like elements throughout, and, in which:

FIG. 1*a* shows, in elevation view, one form of a latch arrangement in accordance with the present invention as applied to a small size relay of the plug-in type; only those parts of the relay concerned with the operation and mounting of the latch arrangement being shown in the figure;

FIG. 1*b* is a plan view of FIG. 1*a*;

FIG. 2*a* shows diagrammatically an elevation view of another form of latch arrangement in accordance with the present invention;

FIG. 2*b* shows an end view of FIG. 2*a*, as seen from the right-hand side thereof;

FIGS. 3*a* and 3*b* are views corresponding respectively to FIGS. 2*a* and 2*b*, of a modification of the arrangement of FIGS. 2*a* and 2*b*, adapted to subject the armature to a holding force in the released position as well as in the energized position.

Referring to FIGS. 1*a* and 1*b*, a heelpiece **11** of the relay frame supports the operating coil **12** wound about a core **13**. Pivotally mounted on the horizontally extending portion of the heelpiece by means of a split bearing pin **14** is an armature carrier **15** to which is fixed an L-shaped armature **16** having a dependent limb **16***a* cooperating with the core **13**, and a limb **16***b* extending substantially parallel to and spaced from the horizontally extending portion of the heelpiece **11**. The armature **16** is connected mechanically, by means which are not shown, with the movable contact or contacts of the relay. The armature **16** is balanced to gravitate to the released position shown in the drawing, the released position being determined by engagement of an adjustable set screw **17** with the heelpiece **11**. By means of the latch arrangement now to be described, the armature may also be retained in the energized position determined by engagement of the dependent limb **16***a* thereof with the core **13**, even though the operating coil **12** is deenergized.

The latch arrangement is assembled as an independent unit on a bracket **18** of nonmagnetizable material, which when secured to the heelpiece **11** supports the latch arrangement above the free end of the limb **16***b* of the armature. The arrangement comprises two spaced apart pole pieces **19***a*, **19***b* secured by screws **20** to the bracket **18** to project therefrom in parallel relationship. The lower ends of the pole pieces present pole faces **21** cut at the angle assumed by the cooperating surface of the limb **16***b*

when the armature is in the energized position so that a uniform air gap pertains between the faces and the armature when the latter is in the energized position. Sides 19*c*, 19*d* of the pole pieces 19*a* and 19*b*, respectively, abut the bracket 18. A permanently magnetized bar 22 is interposed between the pole pieces 19*a* and 19*b* with its oppositely polarized ends or poles in contact therewith; the bar 22 being fixed therebetween by bonding with a suitable substance and terminating short of the pole faces 21. Adjacent the other pair of sides 19*e*, 19*f* of the pole pieces 19*a* and 19*b*, respectively, there is a core piece 23 spanning the pole pieces; this core piece 23 being fixed to the pole pieces by screws 24 which act as a shunt path for the permanent magnet 22. The core piece 23 carries, over a middle portion thereof, a release or trip coil 25. The core piece 23 may be in direct contact with the pole pieces 19*a* and 19*b* as shown, or alternatively, shims of a nonmagnetizable material may be interposed between the pole pieces and the core piece to adjust the reluctance of the magnetic circuit through the latter. The electrical connections to the trip coil 25 are separate from those to the operating coil 12 of the relay so that these two coils can be energized independently.

When the armature 16 is in the released position, the air gap between it and the pole faces 21 is such that the attractive force of the permanent magnet 22 is insufficient to lift it. However, when the armature 16 assumes the energized position, the air gap is diminished to such an extent that the flux due to the permanent magnet 22 which now passes through the armature is sufficient to hold it in the energiezd position when the operating coil 12 is deenergized. The trip coil 25 is so adapted that when energized it produces a magnetic flux strengthening that already present in the core piece 23 due to the permanent magnet 22; and, since the core piece is in a magnetic circuit parallel to the circuit through the armature 16, the flux produced by the coil 25 reduces the flux in the armature circuit to such an extent that the armature is allowed to return to the released position. Thus when once the operating coil 12 has been energized to lift the armature 16 to the energized position, the armature is "latched" or is held in that position when the operating coil is subsequently deenergized unless and until the trip coil 25 is energized. Momentary energization of the trip coil 25 will, of course, suffice to allow release of the armature 16. To avoid energization of the trip coil for longer than is necessary it may be supplied through a front contact, not shown, of the relay.

It will be evident that in this case there is no tendency for the trip coil 25 to demagnetize the permanent magnet 22. Preferably, however, the permanent magnet 22 is made of a material such as that sold under the trade name "Alcomax III," which will maintain a fairly constant flux output with varying magnetomotive force. Otherwise energization of the trip coil 25 is likely to cause an increase in the flux of the permanent magnet 22 and the trip coil would be required to supply additional magnetomotive force to counteract the effect on the armature 16 of such an increase of flux.

While in the drawing, the latch arrangement is shown applied to a relay in which the armature 16 is returned to the released position by gravity, it is equally applicable where the return force is supplied by a spring biasing the armature towards the release position.

Referring to FIGS. 2*a* and 2*b*, the latch arrangement shown therein is modified firstly to suit a different construction and disposition of the main components of the relay, the armature 30 being in this case in the form of a flat plate which is pivotally mounted at one end 31 to a fixture 32 on the heelpiece 33. The operating coil 34 and its core 35 are supported by the heelpiece on an axis perpendicular to the general plane of the armature 30 and there is provided on the armature a lug 36 to which

is attached an arm (not shown) in turn connected to the movable contact or contacts of the relay.

The latching arrangement is constructed considerably longer in one dimension than in the others and is supported in fixed relationship with the heelpiece 33 with the longest dimension parallel to the axis of the operating coil 34. The trip coil is divided into two separate coils 37, 38 which are wound one about each of core sections 67, 68 formed on two spaced apart pole pieces 39, 40 presenting pole faces 41, 42 toward the armature. The coils 37, 38 are connected electrically either in series or in parallel so as to be energizable simultaneously. The permanent magnet, in the form of a magnetizable bar 43, is interposed, and fixed by a bonding agent, between the pole pieces 39, 40 on the side of the coils 37, 38 remote from the armature 30. Adjacent the permanent magnet 43 a yoke 44 of magnetizable material spans the ends of the pole pieces 39 and 40. Shims 50 of nonmagnetizable material are shown interposed between the yoke 44 and the adjacent ends of the pole pieces 39, 40, and between the yoke and the heelpiece 33. A shim 51, similar to shims 50 is inserted between the pole faces 41 and 42 and the armature 30, which shim, as illustrated, is attached to the armature by rivets 45. The shim 50 between the yoke 44 and the heelpiece 33 is such as to maintain the substantial magnetic isolation of the latch arrangement necessary in the illustrated example, while the remaining shims serve to adjust the reluctances in the various portions of the magnetic circuit formed by the latch arrangement.

The latch arrangement acts to hold the armature in the energized position in exactly the same way as the arrangement according to FIGS. 1*a* and 1*b*, and, as previously, energization of the trip coils 37, 38 allows release of the armature 30. However, by virtue of the altered disposition of the trip coils 37, 38, such energization tends to produce a flux distribution which is demagnetizing in relation to the permanent magnet 43 but the yoke 44, forming a shunt path for the permanent magnet, accepts an increased amount of flux to thereby prevent the permanent magnet from being demagnetized. The permanent magnet is of a material having a high coercivity, such as that sold under the trade name "Alcomax III."

The latch arrangement in accordance with FIGS. 2*a* and 2*b* may also be modified to obtain a holddown force in the released position of the armature. This latter modification may be undertaken in a different way in order to avoid intrusion into the space below the armature 30 where contact stacks are accommodated. The modified arrangement is shown in FIGS. 3*a* and 3*b*. The pole pieces 39, 40 are provided at correspondingly situated points along their lengths, just short of the pole faces 41, 42, with collars 46, 47 of magnetizable material presenting pole faces 48, 49 directed oppositely to, and spaced apart from the pole faces 41, 42. A lightweight fixture added to the armature 30 comprises a pillar support 60 and a plate 61, both of magnetizable material, which are assembled to resemble a T. Support 60 and plate 61 are fixed to the main body of the armature by screws 62 in a position intermediate, and clear at their edges from, the pole pieces 39, 40. The portions 63*a* and 63*b* of the underside of this plate 61 which overlap the pillar support are oblique to the upper surface of the main body of the armature 30 so as to be parallel with the pole faces 48, 49 when the armature is in the released position. Portions 63*a* and 63*b* constitute secondary surfaces of the armature which cooperate with the pole faces 48, 49. When the armature 30 is in the released position defined by back stops (not shown), the air gap between the secondary surfaces 63*a* and 63*b* and the pole faces 48, 49 is such that flux due to the permanent magnet 43 passing by way of these faces through the plate 61 acts to exert on the armature 30 a force tending to hold it in the released position. This force supplements such similar acting force as may be applied by other agencies, for example, a return spring. However, on en-

ergization of the operating coil 34, the pickup force acting on the armature is sufficient to overcome the hold-down force and the armature moves to the energized position in the normal manner.

While my invention has been described with reference to a particular embodiment thereof, it will be understood that various modifications may be made by those skilled in the art without departing from the invention. The appended claim is therefore intended to cover all such modifications within the true spirit and scope of the invention.

Having thus described my invention, what I claim is:

In a tractive armature relay including a relay frame and an operating coil, a latch arrangement comprising a permanent magnet in fixed relationship with said relay frame and arranged to exert on the armature in its energized position an attractive force sufficient to hold said armature in that position, an electromagnetic release coil which is additional to the operating coil and which is energizable to produce a magnetic force opposing said attractive force exerted by said permanent magnet to an extent sufficient to allow release of said armature, said permanent magnet including two poles, a pair of pole faces associated with each of said poles, said pairs of pole faces being disposed in oppositely facing relationship on the same side of the main

body of said armature, a secondary surface fixed to said armature by a support intervening between the pole faces which secondary surface cooperates with the pole face of each pair more distant from the main body of said armature, one pole face of each pair being disposed to cooperate with said secondary surface in the deenergized position of said armature, the other pole face of each pair being disposed to cooperate with another surface of said armature in the energized position of said armature, such that in either position said armature is subject to a holding force due to said permanent magnet, the holding force effective in the energized position being overcome by energization of said release coil and the holding force effective in the released position being overcome by the force which acts on said armature when said operating coil is energized.

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