

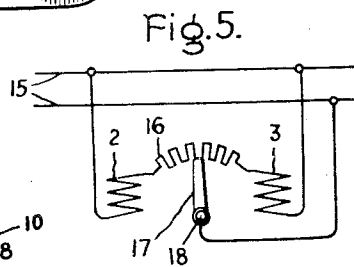
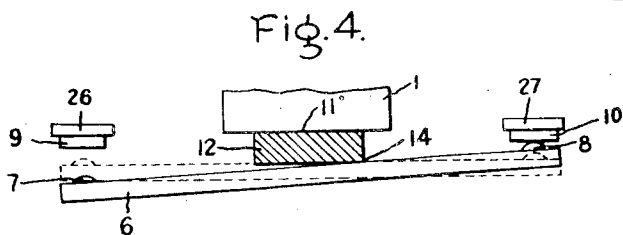
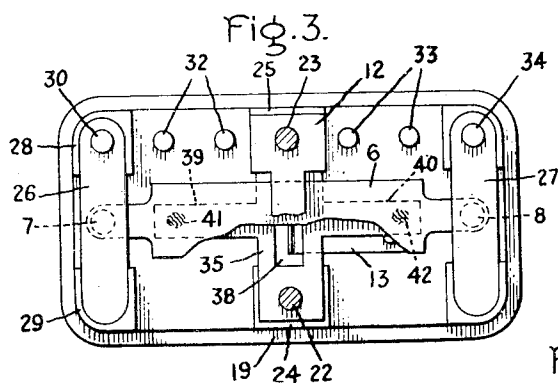
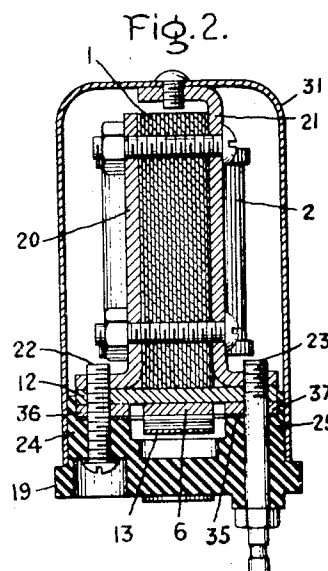
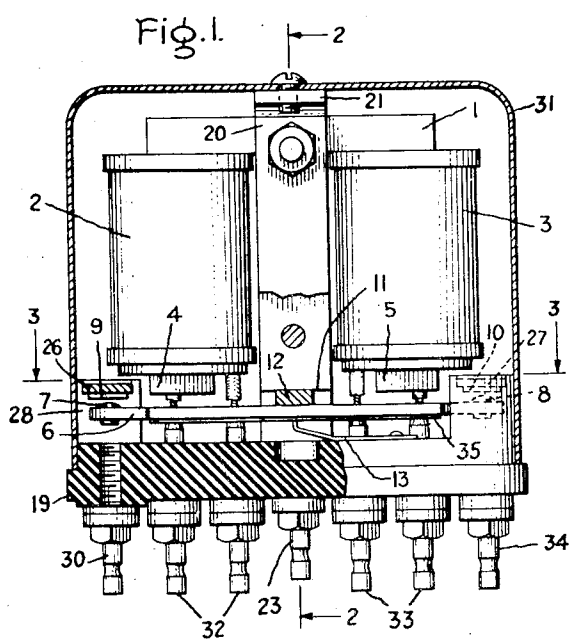
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2,436,224

DIFFERENTIAL ELECTROMAGNET HAVING SNAP ACTION

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DIFFERENTIAL ELECTROMAGNET HAVING
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My invention relates to differential control devices, more particularly to double coil electromagnetic differential relays, and has for its object a simple and reliable device having snap operation from one position to another.

My invention has particular application to differential relays provided with two coils and with an armature pivotally movable from one position to another in response to the differential energization of the coils.

In carrying out my invention in one form, I provide a three-legged core with a coil mounted on each of the two outside legs and an armature extending across the three legs and spring pressed against a flat face provided on the middle leg. Thus, when the coils are energized, the armature is held by magnetic attraction against the middle leg and upon a predetermined differential energization of the coils is moved with a snap action in each direction to an attracted position, and upon a decrease in the differential to a predetermined value the armature is moved to a neutral position or mid-position.

For a more complete understanding of my invention, reference should be had to the accompanying drawing in which Fig. 1 is a side elevation view partly in section of a differential relay embodying my invention; Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1 looking in the direction of the arrows; Fig. 3 is a sectional view taken along the line 3—3 of Fig. 1 looking in the direction of the arrows; Fig. 4 is an enlarged simplified view showing features of operation of the device; while Fig. 5 is a simplified wiring diagram showing typical electric connections for the two coils.

In carrying out my invention in one form, I provide a three-legged core 1 having coils 2 and 3 mounted on the two outside legs 4 and 5. Extending across the three legs is a flat bar shaped armature 6 having on its opposite ends movable electric switch contacts 7 and 8 which cooperate with stationary contacts 9 and 10.

For the purpose of giving the armature 6 a snap action in moving pivotally from the unattracted neutral position or mid-position shown in the drawing toward one or the other of the outside core legs 4 and 5, I provide a flat bearing surface for the armature on the middle core leg 11. This flat bearing surface is defined by a bar 12 made of magnetic material which extends across the end of the middle core leg 11 in a direction perpendicular with the plane of the three-legged core. The armature 6 has a middle portion provided with a flat surface in engage-

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ment with the lower flat side or surface of the bar 12 and is biased by a spring strip 13 to that position, as seen in Fig. 1, the movable end of the spring strip 13 engaging the armature at the center of the armature.

As shown in Fig. 1, the armature 6 as held by the spring 13 against the flat lower side of the bar 12 is at each end in equally spaced relation with the ends of the core legs 4 and 5, this position of the armature being an intermediate unattracted position. During the operation of the device, it is contemplated that the coils 2 and 3 will both be energized and operation of the armature by magnetic attraction toward one or the other of the pole faces formed by the ends of the legs 4 and 5 will be obtained by increasing relatively the excitation of the coil toward which the armature is to be attracted.

When the two coils are energized, it will be observed that the middle portion of the armature is pulled by magnetic attraction against the flat face of the bar 12, which magnetic force, in addition to the force applied by the spring 13, opposes pivotal movement of the armature toward either one of the core legs 4 and 5. This magnetic attractive force is effective in giving the armature a snap action. Thus, the net magnetic force applied to one end of the armature 6 is increased by increasing relatively the energization of the particular coil 2 or 3 until finally the magnetic holding force of the middle leg and the force of the spring are overcome. However, when the armature 6 starts to move and is pulled away from the bar 12, the magnetic force between the bar and the armature decreases very rapidly while magnetic force applied to the end of the bar moving toward its attracted position increases rapidly thus providing a snap action in the movement of the armature.

As seen in Fig. 4, the armature has been moved counterclockwise by the coil 3 to an attracted position with respect to the core leg 5 with the contact 8 in engagement with the contact 10. It will be observed that when the armature starts to move, it pivots about one or the other of the spaced-apart knife-edge bearings formed by the lower edges of the bar 12. As shown, in moving counterclockwise, the armature pivots on the right-hand lower edge 14.

Another feature of the device is that when the differential excitation is decreased to a predetermined value the armature is snapped by the spring back to the mid-position or unattracted position shown in the drawing without snapping through the neutral position to the other at-

tracted position. Thus, a definite neutral position is provided by the flat bar 12.

The magnetic attraction between the bar 12 and the armature is not indispensable to snap action. The coils may be connected so as to give little if any flux in the middle leg or the middle leg could be non-magnetic for some applications.

In Fig. 5, I have shown simplified electric connections for the control of the coils 2 and 3. One terminal of each of the coils 2 and 3 is connected to the same side of a direct current supply source 15, while the other two terminals of the coils are connected to each other through a control resistance 16. The connection of the coils are such that the magnetic flux flows in the same direction in the two outer legs with respect to the middle leg, i. e. toward or away from the respective ends of the armature. A movable contact arm 17 cooperating with this resistance is connected to the other side of the supply source 15. This contact arm is suitably turned, as by a shaft 18 driven from a control device or instrument, whereby the relative energizations of the coils are changed. When the contact arm 17 is in its central position on the resistance 16, as shown in Fig. 5, the currents in the two coils are equal to each other and the armature then stands in its normal unattracted position, as shown in Fig. 1. The relay may be used to control, for example, an electric motor or operating device to move an object in accordance with the movement applied to the shaft 18.

Referring to details of construction of the device, a base member 19 is provided made of electrically insulating material, such as a molded plastic material. The core 1 is secured to this base by means of two straps 20 and 21 secured by bolts on opposite sides of the middle core leg and having their lower ends bent outward and secured by the screws 22 and 23 to projections 24 and 25 on the upper surface of the support 19. The bar 12 is positioned between the lower ends of the straps 20 and 21 and the projection so as to be secured in place by the screws 22 and 23.

The stationary contacts 9 and 10 are mounted on spring strips 26 and 27 made of electrically conducting material, one end of each of the strips being secured by a suitable screw to a projection on the upper side of the support 19. With particular reference to the strip 26, a depression is provided in each of the two abutments or projections 28 and 29 for opposite ends of the strip, the upper end as viewed in Fig. 3 being secured by a screw 30.

At its upper end the bar 21 is bent over laterally to form a support for an enclosing cover 31. Also mounted on the support 19 are electric terminals 32 for the coil 2 and terminals 33 for the coil 3. Terminals are also provided on the heads of the screw 30 and the screw 34 securing the strip 27. Also, the head of the screw 23 is provided with a terminal whereby an electric connection can be made with the armature 6 and the movable contacts 7 and 8.

Another feature of my invention is that the differential current required for operation of the armature increases with the sum of the currents in the coils. In other words, with high current values in the coils, a greater differential current is required for operation of the armature. This is because the increased total current gives increased magnetic holding effect between the bar 12 and the armature.

Referring to Fig. 3, a spring sheet member 35

is provided below the armature for securing the armature in the relative position shown in the drawing. This member 35 is stamped from a sheet of thin spring material, such as phosphor bronze. It is provided with a central portion of substantially the same over-all outline as the bar 12 with an aperture at each end through which the clamping screws 22 and 23 extend. Metal spacer members 36 and 37 having the same thickness as the armature are provided between the member 35 and the bar 12. Also, in this central transverse portion an aperture 38 is provided through which extends the end of the spring 13 into engagement with the armature. The spring 13 is secured at its opposite end to the base member 19 as by suitable rivets.

The spring member 35 also has two portions 39 and 40 extending lengthwise with respect to the armature and having their ends secured as by spot welded connections 41 and 42 to the armature. Thus, it will be observed that the spring member 35 secures the armature against movement in its own plane, although the member is made of thin flexible material and, therefore, does not offer any appreciable spring opposition to pivotal movement of the armature.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A differential control device comprising a magnet core provided with at least two legs, a coil on each of said core legs, a support between said core legs provided with spaced-apart knife-edge bearings, an armature extending across the ends of said core legs, a spring biasing said armature against said bearings in an intermediate unattracted position with each end of said armature in spaced unattracted relation with the end of the adjacent core leg, and electric circuit connections for energizing said coils differentially thereby to produce snap pivotal movement of said armature on one or the other of said core legs, upon predetermined differential energization of said coil, said spring being constructed and arranged to secure said armature in said intermediate unattracted position when said differential energization is reduced thereby to produce reverse snap movement of said armature away from one of said core legs.

2. A differential control device comprising an E-shaped magnet core, a coil on each of the two outside legs of said core, spaced-apart knife-edge bearings on the end of the middle core leg, an armature extending across the ends of said core legs, a spring biasing said armature against said knife-edge bearings with each end of said armature in spaced unattracted relation with the end of the adjacent outside core leg, electric circuit connections for energizing said coils substantially equally whereby said armature is held magnetically against said bearings, and means for varying the energization of said coil differentially thereby to produce snap movement of said armature on one or the other of said bearings toward one or the other of said outside core legs, said spring and the magnetic force between said armature and said middle core leg being arranged to secure said armature against said bearings

when said differential energization is reduced to produce reverse snap movement of said armature away from one of said outside legs.

3. A differential control device comprising an E-shaped magnet core, a coil on each of the two outside legs of said core, said middle core leg being provided with a flat surface on its end, an armature provided with a central flat surface extending across said core legs, a spring biasing said armature against said middle core leg with said flat surfaces in engagement with each other and with each end of said armature in spaced unattracted relation with the end of the adjacent outside core leg, electric circuit connections for energizing said coils substantially equally whereby said armature is held magnetically against the middle core leg, and means for varying the energization of said coil differentially thereby to produce snap pivotal movement of said armature on one edge of said middle core leg toward one or the other of said outside core legs, said spring and the magnetic force of the middle core leg being arranged to secure said armature with said flat surfaces in engagement with each other when said differential energization is reduced to produce reverse snap pivotal movement of said armature away from one of said outside core legs.

4. A differential control device comprising an E-shaped magnet core, a coil on each of the two outside legs of said core, a bar on the end of the middle core leg provided with a flat surface, an armature provided with a central flat surface extending across said core legs, a spring biasing said

armature against said bar with said flat surfaces in engagement with each other and with each end of said armature in spaced unattracted relation with the end of the adjacent outside core leg, electric circuit connections for energizing said coils substantially equally whereby said armature is held magnetically against said bar, and means for varying the energization of said coil differentially thereby to produce snap movement of said armature on one edge or the other of said bar toward one or the other of said outside core legs, said spring and the magnetic force of said middle core leg being arranged to secure said armature in an intermediate position against said bar when said differential energization is reduced a predetermined amount to produce snap movement away from one of said outside core legs.

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