

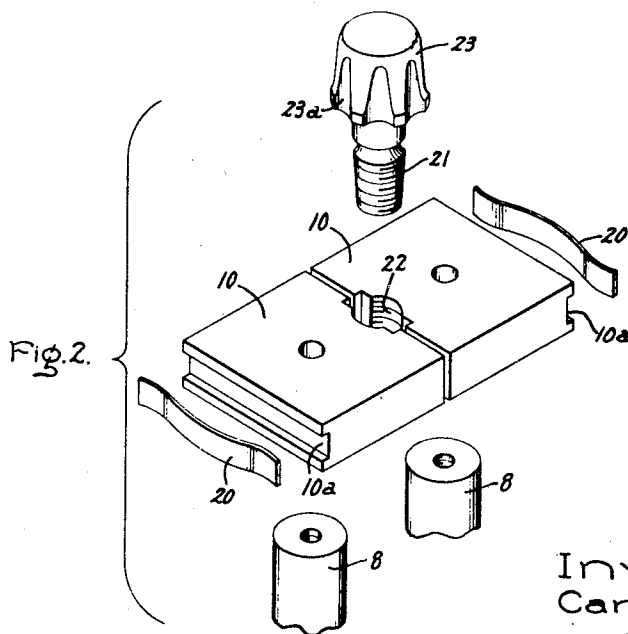
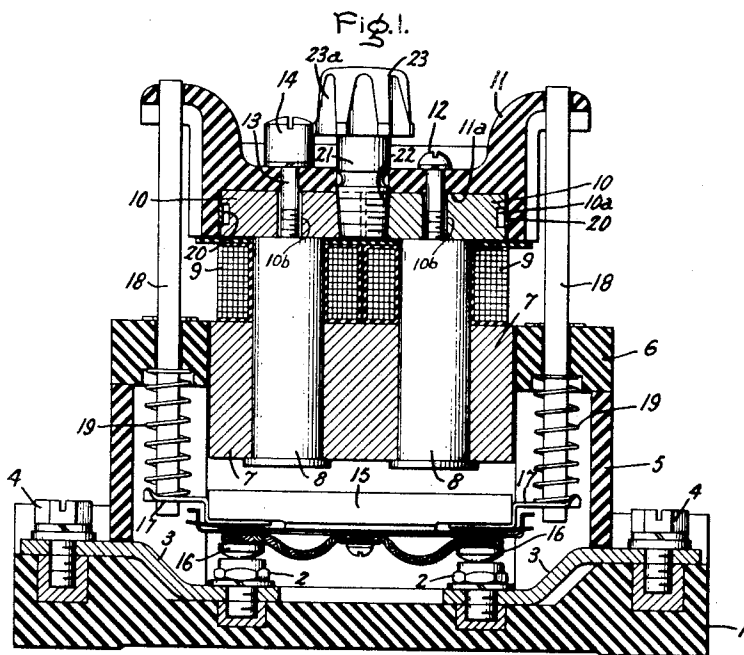
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MAGNETIC STRUCTURE

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MAGNETIC STRUCTURE

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My invention relates to magnetic structures, and more particularly to electromagnets of the variable reluctance type.

It is a general object of my invention to provide new and novel means, readily adjustable, for controllably varying the reluctance of a magnetic structure.

It is a more specific object of my invention to provide a magnetizable structure of variable reluctance which is simple and inexpensive to manufacture and durable and reliable in operation.

My invention is particularly applicable to magnetizable structures for electromagnetic control devices, such as relays and the like. My new and improved structure finds a particular application in connection with electromagnetic time delay relays wherein the reluctance variation adjustment may be utilized to control the time element of the relay.

My invention itself will be more fully understood and its various objects and advantages further appreciated by referring now to the following detailed specification taken in conjunction with the accompanying drawing, in which Fig. 1 is a cross sectional side view of an electromagnetic time delay relay illustrating one embodiment of my invention; and Fig. 2 is an exploded perspective view of a portion of the magnetizable frame of the relay at Fig. 1, showing in detail the means for varying the magnetic reluctance of that portion of the frame.

Referring now to the drawing, the electromagnetic time delay relay which I have shown for the purpose of illustrating one embodiment of my invention comprises a base 1 formed of a suitable molded plastic insulating material and having mounted thereon a pair of fixed contacts 2. The contacts 2 are connected by electric conducting strap 3 to a pair of terminal connectors 4 disposed on opposite ends of the base 1. Carried also upon the base 1 is a housing 5 formed of insulating material and provided with a cover plate 6 of insulating material. The housing 5 and the cover 6 may suitably be connected to the base 1 by a plurality of bolts (not shown) passing through the cover 6 and threaded into tapped inserts (not shown) in the base 1. The insulating cover 6 is provided with a large rectangular aperture within which is mounted a block 7 of electric conducting material. The block 7 is fixedly connected to the insulating cover 6 by bolts or the like (not shown), and is provided with a pair of cylindrical apertures in parallel spaced relation. Within the apertures in the electric conducting block 7 are positioned

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a pair of magnetizable core members 8. The magnetizable core members 8 project above the conducting block 7 and are surrounded at their upper ends by a pair of energizing windings or coils 9.

A generally U-shaped frame for the relay is completed by magnetically linking the upper ends of the core members 8 through a pair of magnetizable blocks 10 disposed in end-to-end relation. The magnetizable blocks 10 are seated for sliding movement within a rectangular recess 11a in an upper housing or head 11 formed of molded plastic insulating material. The molded plastic head 11 and the magnetizable blocks 10 are rigidly connected to the relay core by bolts 12 and 13, each such bolt passing through the head 11 and a hole 13b in each of the blocks 10 into axial threaded engagement with one of the core members 8. The hole 13b in each of blocks 10 through which either bolt 12 or bolt 13 passes is of a size sufficient to permit the respective block to move relative to its holding bolt when said bolt is loosened. The connecting bolt 13 is provided with an enlarged cylindrical head 14 for a purpose which will be more fully described hereinafter.

The relay shown at Fig. 2 includes also a bar armature 15 formed of magnetizable material and carrying a pair of electrically connected movable bridging contacts 16 arranged for cooperation with the fixed contacts 2. At opposite ends of the armature 15 are a pair of brackets 17 fixed to the armature and carrying a pair of upright guide rods 18. Each rod 18 is mounted for sliding movement through a pair of aligned apertures in the insulating cover 6 and the insulating head member 11. A pair of helical biasing compression springs 19 are disposed on the rods 18 between the insulating cover 6 and the armature bracket 17. The springs 19 retain the armature 15 normally in a dropped out position with the contacts 2 and 16 in engagement.

Referring now more particularly to Fig. 2, the magnetizable blocks 10 forming the upper connecting portion of the U-shaped relay frame between the upper ends of the coil cores 8 are of flat rectangular shape and are disposed in end-to-end relation within the rectangular recess 11a (Fig. 1) in the lower side of the insulating head 11. The rectangular recess 11a is longer than the total length of the abutting blocks 10, thereby to provide for sliding movement and separation of the blocks at their contiguous end surfaces. The blocks 10 are transversely slotted across their opposite end surfaces, as at 10a, and

in these slots are positioned a pair of arched leaf springs 20. The leaf springs 20 are thus interposed between opposite ends of the blocks 10 and ends of the rectangular recess 11a, thereby to bias the magnetizable blocks 10 into end-to-end abutting engagement.

In order to force the magnetizable blocks 10 apart and to retain the blocks in variable spaced apart relation against their bias, I provide a tapered bolt 21 formed of non-magnetizable material, such as brass or the like. The tapered bolt 21 is threaded into a tapped and tapered elliptical hole 22 formed partially in each of the magnetizable blocks 10. The tapped hole 22 is formed by oppositely conically recessing and threading the blocks 10 along a center line which lies parallel to and equally spaced from the contiguous end surfaces of the blocks when the blocks are held at or slightly beyond their position of maximum separation. This tapping operation is conveniently carried out by interposing between the blocks a shim having a thickness equal to or slightly greater than the distance of maximum separation of the blocks, and then tapping a tapered hole having its center line at the center of the shim. Such a shim may be of the order of 5 to 7 mills in thickness. The bolt 21 thus serves as an adjustable wedge, engaging the blocks 10 along only the recessed or tapped portion of their contiguous surfaces, and arranged either to permit abutting engagement of the blocks or to retain the blocks in spaced apart relation against their bias. The extent to which the blocks are spaced apart is determined by the extent to which the tapered bolt 21 is screwed down into the tapped and tapered hole 22. The spacing between the blocks determines the magnetic reluctance of the relay frame.

In order to lock the non-magnetizable bolt 21 in position and thus fix the adjustment of the magnetizable blocks 10, the bolt 21 is provided with a control knob or head 23 which is suitably formed of a molded plastic insulating material and arranged for interlocking engagement with the bolt head 14. The knob 23 is of larger diameter than the bolt 21 and is provided around its periphery with a plurality of flutes 23a, preferably cylindrical and having a radius of curvature corresponding to the radius of curvature of the bolt head 14 (Fig. 1). The bolt 21 and the bolt 13 carrying the head 14 are so positioned that when the bolt 13 is screwed down tightly, the enlarged head 14 fits into one of the flutes 23a and locks the bolt 21 against turning.

In operation, it will be understood that drop-out of the relay is delayed for an appreciable time interval by the jacket 7 of electric conducting material surrounding the lower portions of the coil cores 8. The precise length of the drop-out interval is controllable by varying the reluctance of the magnetic circuit of the relay. This reluctance variation is accomplished by adjustably positioning the magnetizable blocks 10 by means of the non-magnetizable tapered bolt 21.

When it is desired to change the reluctance of the relay frame, the bolt 13 is first withdrawn until the enlarged head 14 is clear of engagement with the control knob 23. Loosening of the bolt 13 releases the clamping pressure upon one of the blocks 10 and allows sliding movement of this one block. The bolt 12 is then loosened to permit movement of the other block 10. Next, the control knob 23 and the bolt 21 are turned to position the blocks 10 as desired. The

bolts 12 and 13 are then tightened to clamp the block 10 in position, the head 14 and the bolt 13 simultaneously locking the tapered bolt 21 in position.

It will, of course, be understood that a limited amount of reluctance adjustment may be carried out without loosening the bolt 12. In this case, only one of the blocks 10 is movable within the head 11, so that reluctance variation may be effected only within the limits of movement of the one block 10. Indeed, if desired, the spring 20 in the block 10 which is clamped by the bolt 12 may be omitted and the bolt 12 left tight in clamping position at all times. In this mode of operation it is desirable, in order to permit a maximum of adjusting movement, that the block 10 clamped by the bolt 12 be clamped in its position of maximum retraction, that is, against the end of the recess 11a.

While I have shown and described only a preferred embodiment of my invention by way of illustration, it is evident that many modifications will occur to those skilled in the art, and I therefore intend in the appended claims to cover all 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. In a magnetic structure of variable magnetic reluctance, a non-magnetizable base, a pair of relatively movable magnetizable members slidably mounted on said base, spring means interposed between each of said members and said base to bias said members into abutting engagement along a pair of contiguous surfaces, said members being conically tapped along a center line lying parallel to and equally spaced from said surfaces when said members are spaced apart, thereby jointly to provide a tapered bolt-receiving aperture, and a tapered bolt of non-magnetizable material positioned in said aperture and arranged to separate said members against their bias, thereby to control the reluctance of said structure.

2. In a magnetic structure of variable magnetic reluctance, a non-magnetizable base having a rectangular recess therein, a pair of blocks of magnetizable material mounted for relative movement in said recess, spring means interposed between at least one of said blocks and said base at one end of said recess to bias said blocks into abutting end-to-end relation, said blocks being conically tapped along a center line lying parallel to and equally spaced from the abutting end surfaces of said blocks when said blocks are spaced apart, thereby to provide a tapered bolt-receiving aperture, and a tapered bolt of non-magnetizable material threaded into said aperture and adjustably positionable to permit engagement of said blocks or to retain said blocks in variable spaced apart relation.

3. In a magnetic structure of variable magnetic reluctance, a base, a pair of relatively movable magnetizable members slidably mounted upon said base, spring means engaging said base and said members and arranged to bias said members into abutting engagement along a pair of contiguous surfaces, said members being conically tapped along a center line lying parallel to and equally spaced from said surfaces when said members are spaced apart thereby jointly to provide a tapered bolt-receiving aperture, and a tapered threaded bolt of non-magnetizable material positioned in said aperture in engagement with said magnetizable members and arranged

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to separate said members against their bias,
thereby to control the reluctance of said struc-
ture.

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The following references are of record in the
file of this patent:

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