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## (54) Switchable electromagnetic pulse relay.

(57) Switchable electromagnetic pulse relay consisting of a base (14) having fixed contacts (8) and movable contacts (10), the latter being alternately moved by a ratchet gear acting on a pusher rod (64) which in turn acts on a gear (72) whose lateral surfaces each carry two cams (80 and 82) which transmit movement to the above-mentioned movable contacts.

The movement to the pusher rod is transmitted by a movable armature (62) attracted or released by a field coil (40).

Two plug-in blades (6) establish the electric contact between the movable contacts (10) and the stationary contacts (8) and the outer circuit.

This electromagnetic pulse relay is particularly suitable for industrial use due to the particular shape and structure of its components and for the versatility of use offered.

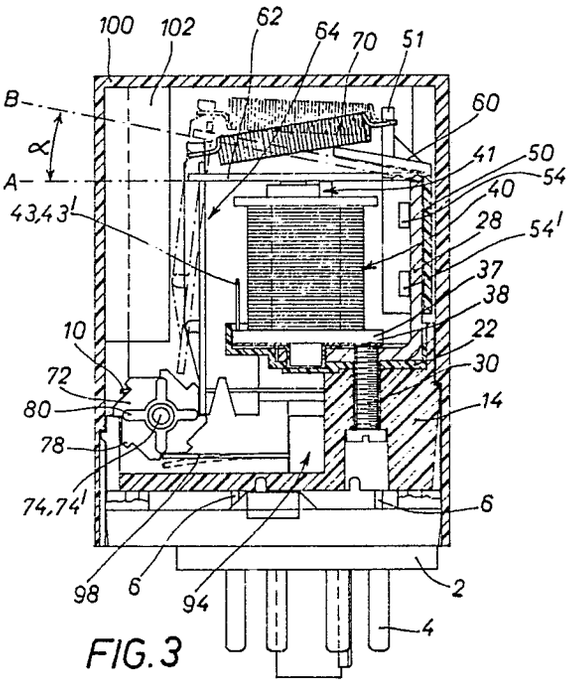


FIG.3

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# "Switchable electromagnetic pulse relay"

The present invention relates to a switchable electromagnetic pulse relay.

Electromagnetic pulse relays are known which are normally used on lighting plants for civil constructions and which have some inconveniences that make them unsuitable for industrial applications in which the currents to be interrupted are always of considerable intensity and moreover there are numerous and frequent actuations in the course of relatively short times.

Further, a considerable reliability of operation is required of the relay together with a sturdy construction so as to ensure a constant continuity to the production process in which they are used.

The pulse relays for civil applications have some inconveniences which, although partly justified by the need to contain the cost to be competitive on the market, as mentioned previously, make them unsuitable for use in industrial applications.

Such inconveniences normally consist in an under-dimensioning of the component elements of the magnetic circuit so as to cause heavy self-heating in case of locking of the movable components of the magnetic circuit in the attracted position even for periods that are not excessively long, and in a low power of breaking the arc forming in the moment of opening of the contacts, so as to considerably limit their maximum amperometric power.

Such a minimum distance between the contacts is determined by the need to contain as much as possible the dimensions of the relay and thus of its components for the reasons pointed out previously.

Further, as there is a minimum insulation between the elements under tension and the elements of the magnetic circuit, no efficient safety and continuity of operation is ensured when several of the inconveniences of the type mentioned above occur simultaneously.

A further inconvenience consists in that said pulse relays for civil use are substantially used as circuit breakers, i.e. serve to alternately break and restore a feed phase of the user according to the pulses of actuation.

Where a switchable circuit is required to be made, obviously one must resort to the use of several pulse relays, thus causing an increase of cost of the plant.

It is therefore an object of the present invention to provide a pulse relay which reduces the inconveniences of the known relays, is particularly suitable for industrial use, i.e. use requiring frequent actuations in relatively short periods of time, and finally permits a simplified mounting system which, although it meets the safety requirements prescribed by international standards, can be made in a convenient manner with regard to cost and labour of preparation.

A further and important object to be achieved by the present invention consists in providing a relay suitable to obtain switching of the circuit in which it is inserted.

The above and other object of the invention, which will become apparent from the following description, are achieved by the invention by a switchable electromagnetic pulse relay, comprising a plug support, a field coil wound on a reel support, a ferromagnetic core constituted by a plurality of blades carrying at one end a phase shifting coil, and by a frame for fixing said field coil, characterized in that it further comprises a base of synthetic material and of parallelepiped shape, in said base there being an intermediate plane surface arranged between a lower plane surface and an upper plane surface; a support bracket in said base and adjacent said upper surface; a metal armature attractable by said field coil and having one end pivotally mounted in the interior of a lateral support and the opposite end coupled to a pusher rod forming part of a ratchet gear mechanism and subjected to the action of a return spring; movable contacts arranged in said base and actuated by a ratchet wheel of said ratchet gear, said ratchet wheel carrying on its side surfaces a pair of cams for transmitting movement to said movable contacts; a stop pawl for said ratchet wheel; fixed contacts corresponding to said movable contacts and arranged on the above-mentioned intermediate surface; a protective cover carrying inwardly a rib for movement and positioning of said rod; said fixed contacts and said movable contacts being connected electrically to an equal number of blades for connection to the outer circuit.

A preferred embodiment of the invention, given by way of a non-limitative example, will now be described with reference to the accompanying drawings, in which:

Fig. 1 is a side elevational view of the switchable pulse relay with the components shown in an exploded form;

Fig. 2 is a top plan view, partially in section, of a pulse relay according to the invention;

Fig. 3 is a side view, partially in a section taken along the line III-III of Fig. 2, of a pulse relay according to the invention; further, in said Fig. 3 the ratchet gear is shown in two different phases of actuation;

Fig. 4 is a front view, partially in section, of a pulse relay according to the invention;

Fig. 5 is a front view of a ratchet wheel of the ratchet gear of a pulse relay according to the invention;

Fig. 6 is a side view of the ratchet wheel of Fig. 5;

Fig. 7 is a rear view, corresponding to that shown in Fig. 6, of the ratchet wheel of Fig. 5;

Fig. 8 is a top plan view of the base of the pulse relay according to the invention;

Fig. 9 is a side view of the base of the pulse relay according to the invention;

Fig. 10 is a bottom view of the base of the pulse relay according to the invention;

Fig. 11 is a forward front view of the side support of the pulse relay according to the invention;

Fig. 12 is a side view of the side support of the pulse relay according to the invention;

Fig. 13 is a rear view of the side support of the pulse relay according to the invention;

Fig. 14 is a plan view of a movable contact of the pulse relay according to the invention;

Fig. 15 is a side view of the movable contact of the pulse relay according to the invention;

Fig. 16 is a side view of the pusher rod of the pulse according to the invention;

Fig. 17 is a front view of the pusher rod of the pulse relay according to the invention.

In the embodiment illustrated in Figs. 1, 2 3 and 4, the present invention is constituted by a plug support 2 carrying a plurality of hollow plugs 4 for insertion in a relay support socket (not shown).

Inserted in and subsequently welded to the interior of said hollow plugs 4 is a plurality of blades 6 which in turn are connected to fixed contacts 8 and movable contacts 10 by rivets 12 so as to establish a reciprocal electric continuity among said components, forming the inner electric switch circuit, and an outer circuit.

A base 14 shown in Fig. 1 and in three successive views 8, 9, 10 is heat moulded in one piece of synthetic material and comprises a lower plane surface 16 for support and interlocking engagement in appropriate seats arranged in the edges of the plug support 2, and an intermediate plane surface 18 forming a step relative to an upper plane surface 20.

A bracket support 22 is inserted in the interior of the base 14 and finds support and abutment in two longitudinal projections 24, 24′ arranged on the sides 26, 26′ of said base. Inserted in the interior of the above-mentioned bracket 22 is a metal frame bent in the form of an L and both are firmly secured to the base by a screw 30 passing therethrough and screwed down into a threaded hole 32 provided on the horizontal leg 31 of said square frame 28.

Further, a square hole 33 is formed in the horizontal leg 31 adjacent the hole 32 and tabs 34 are inserted, one on each side, in this hole, the tabs 34 being made by cutting from a square hole and outward bending form a metal washer 36 which together with a further washer 38 of insulating material, arranged thereabove, forms an excellent system for eliminating the residual magnetism tending to keep attracted the iron components of the magnetic circuit after the energizing impulse.

Both washers 36 and 38 are retained on the horizontal leg 31 of the frame 28 by a field coil 40 of cylindrical shape, arranged with its axis vertically and thus in a position perpendicularly to the base plane 16 of the support 14.

The field coil 40 is constituted by a reel 37 of synthetic material and rectangular cross section, carrying a winding 39 with the ends thereof welded to two terminals 43, 43′ inserted in and secured to the reel 37.

A plurality of blades 42 passing through the interior of the coil 40 forms the magnetic core 41, the lower end 44 of which is inserted in the hole 33 of the frame 28 whereas the upper end 46 is embraced by a phase shifting coil 48 adapted to eliminate vibrations and thus the hum during the energizing pulse.

A lateral support 50 shown in several views in Figs. 11, 12 and 13 is slidably inserted on a vertical leg 52 of the frame 28 and is secured thereto between a pair of upper and lower lugs 54 and 54′, respectively, provided on the side walls 56 and 56′ and an outer surface 58 of said lateral support 50. The movement of the latter is stopped in the vicinity of a roof 60 provided to cover said support 50, but leaving sufficient space for the insertion of one end of a swinging armature 62, so as to constitute a seat for pivotal mounting of said armature 62.

The angular displacement of the armature 62, indicated by the letter $\alpha$ in Fig. 3, is obtained by its oscillation between a horizontal plane of attraction A of the magnetic core 41 and an inclined stopping plane B corresponding to the roof 60 of the lateral support 50.

The opposite end of the armature 62 is coupled to a pusher rod 64 shown in several views in Figs. 16 and 17 and constituted by a bar 65 of synthetic material having in its centre a longitudinal rib 66 traversed by a short transverse rib 68.

Anchored between the upper end of said rod 64 and a projection 51 of the lateral support 50 is an elastic element or spring 70 which reacts to the force of attraction of the electromagnet formed by the field coil 40 and the core 41, this force being

exerted on the armature 62, said reaction removing the armature from said core 41 at the end of the energizing pulse.

On the contrary, when the armature 62 is attracted by the magnetic core 41, the pusher rod 64 is translated towards a ratchet wheel 72 shown in several views in Figs. 6, 7 and 8, and by engaging a tooth 78 of the ratchet wheel makes the latter perform an angular rotation $\beta$ of 45°.

At the end of the pulse, the rod lifted by the armature 62 engages the next tooth, ready to carry out another rotation.

The ratchet wheel 72 carries two pivots 74 and 74' which project laterally therefrom and are forcedly inserted in two semicircular seats 76 and 76' arranged on the intermediate surface 18 of the base 14.

As these seats 76 and 76' slightly narrow beyond the median line, they provide a retaining system for the two pivots 74 and 74' inserted therein.

The ratchet wheel 72 has a particular shape.

It is constituted by a central toothed wheel for the ratchet gear movement, as shown in Fig. 5, and by two cams 80 and 82 arranged on both the side surfaces of said ratchet wheel 72 and which during rotation alternately shift elastic blades 84 of the movable contacts 10 (shown in Figs. 14 and 15).

The elastic blades 84 of the movable contact 10 carry adjacent a contact stud 86 a small lateral extension 88, as shown in Fig. 14, which by engaging the respective cam causes a reciprocating movement of approach or removal of said movable contact 10 towards or away from the fixed contacts 8.

The fixed contact is likewise constituted by a blade 90 and a contact stud 92.

A pawl 94 inserted in an appropriate recess 95 of the base 14 indicated in Fig. 8 is constituted by a square body 96 and an elastic member 98 projecting from said body 96 and which successively engages the teeth 78 of the ratchet wheel 72 to lock it at each angular rotation $\beta$ and thus prevent said ratchet wheel to rotate in a direction opposed to the direction of pushing during the phase of lifting of the rod 64.

A further characteristic of the relay according to the invention is constituted by the particular configuration of the cover 100 shown in section in Fig. 3.

A rib 102 arranged in the interior of the cover 100, after insertion of the relay engages the corresponding longitudinal rib 66 on the pusher rod 64, keeping the latter in a position suitable for engaging the teeth 78 of the ratchet wheel 72.

Due to the effect of the pulse, the armature 62 is attracted towards the coil 40 against the action of the spring 70 and causes the translation of the pusher rod 64. The latter, by acting on the teeth 78 of the ratchet wheel 72, causes rotation thereof.

As the side surfaces of the ratchet wheel are formed with cams 80 and 82, each single angular rotation causes a reciprocating movement of approach or removal of the movable contacts 10 towards or from the fixed contacts 8.

At the end of the pulse, the armature 62 and pusher rod 64 coupled thereto, return to the rest position due to the effect of the spring 70.

As already mentioned, the advantages of the present invention mainly consist in the great capacity of electric interruption exerted in the contacts by their considerable opening caused by the particular shape of the cams acting thereon, and by the minimum effort required by the mechanical equipment for being actuated, and thus by a decidedly reduced power consumption. The considerable sturdiness of the base and its particular configuration, with the interposition of the bracket support provide a clear electric insulation between the electric control circuit and the switch circuit such as to amply meet the requirements set by international standards.

As said before, particularly advantageous is the shape of the base because of the multiple solutions that it permits. Among other things, by the simple elimination of the contact blades, it permits the insertion of suitable terminals in appropriate lateral recesses so as to obtain a reduction of the dimensions of the relay and amplify its possibilities of use.

Another evident advantage of the present invention consists in the simplicity of passing from a switching function to that of interruption. In this case it will be sufficient to simply remove a contact controlled by the cam 82 while all the other components may remain unchanged in their particular array.

Obviously the invention is not limited to the specific embodiment that has been described and illustrated, but comprises all the modifications and variations adapted to achieve the same objects, such as, for example, the insertion of wire terminals in the connection blades for automobile use, thus adapting the pulse relay to the automobile industry, or connecting the blades directly to printed circuits and thus adapting the relay to the electronics industry.

## Claims

1. Switchable electromagnetic pulse relay comprising a plug support (2), a field coil (40) wound on a reel support (37), a ferromagnetic core (41) constituted by a plurality of blades (42) carrying at one end a phase shifting coil (48), and by a frame

(28) for fixing said field coil (40), characterized in that it further comprises a base (14) of synthetic material and of parallelepiped shape, in said base there being an intermediate plane surface (18) arranged between a lower plane surface (16) and an upper plane surface (20); a support bracket (22) inserted in said base (14) adjacent said upper plane surface (20); a metal armature (62) attractable by said field coil (40) and having one end pivotally mounted in the interior of a lateral support (50) and the opposite end coupled to a pusher rod (64) forming part of a ratchet gear mechanism and subjected to the action of a return spring (70); movable contacts (10) arranged in said base and actuated by a ratchet wheel (72) of said ratchet gear, said ratchet wheel carrying on its side surfaces a pair of cams (80, 82) for transmitting movement to said movable contacts (10); a stop pawl (94) for said ratchet wheel (72); fixed contacts (8) corresponding to said movable contacts (10) and arranged on the above-mentioned intermediate surface, a protective cover (100) carrying inwardly a rib (102) for movement and positioning of said rod (64); said fixed contacts (8) and said movable contacts (10) being connected electrically by rivets (12) to an equal number of blades (6) for connection to the outer circuit.

2. Switchable electromagnetic pulse relay according to claim 1, characterized in that the bracket support (22) is supported on two longitudinal projections (24 and 24') arranged in the interior of the base (14) on the sides (26, 26').

3. Switchable electromagnetic pulse relay according to claim 1, characterized in that said frame (28) is connected to the bracket support (22) by a screw (30) passing through the base (14) and screwed into a threaded hole (32) in said frame (28).

4. Switchable electromagnetic pulse relay according to the preceding claims, characterized in that the elimination of the residual magnetism is obtained by the interposition of a washer (38) of insulating material and a metal washer (36) between the frame (28) and the field coil (40).

5. Switchable electromagnetic pulse relay according to claim 4, characterized in that inserted in the square hole (33) of the frame (28) are tabs (34) cut out and bent over from a corresponding square hole made in said metal washer (36).

6. Switchable electromagnetic pulse relay according to the preceding claims, characterized in that said pawl (94) is constituted by a body (96) and an elastic member (98) projecting from said body (96).

7. Electromagnetic pulse relay according to the preceding claims, characterized in that the fixed contacts (8) are constituted by a blade (90) carrying at one end a contact stud (92).

8. Electromagnetic pulse relay according to the preceding claims, characterized in that the movable contacts 10 are constituted by an elastic blade (84) carrying at one end a contact stud (86).

9. Electromagnetic pulse relay according to claim 8, characterized in that the movement of the movable contacts (10) away from and towards the fixed contacts (8) is produced by the rotation of the cams (80 and 82) which alternately engage a lateral extension (88) on the elastic blades (84) of said movable contacts (10).

10. Electromagnetic pulse relay according to the preceding claims, characterized in that the pusher rod (64) is constituted by a bar (65) carrying forwardly two reinforcement ribs (66 and 68), a longitudinal and a transverse one, respectively.

11. Electromagnetic pulse relay according to the preceding claim, characterized in that said ratchet wheel (72) has two pivots (74, 74') which project therefrom and are inserted in an equal number of semicircular seats (76, 76') of said base (14).

12. Electromagnetic pulse relay according to the preceding claims, characterized in that the retention of the pivots (74, 74') in the above-mentioned semicircular seats (76, 76') is ensured by a restriction of said semicircular seats beyond their median line.

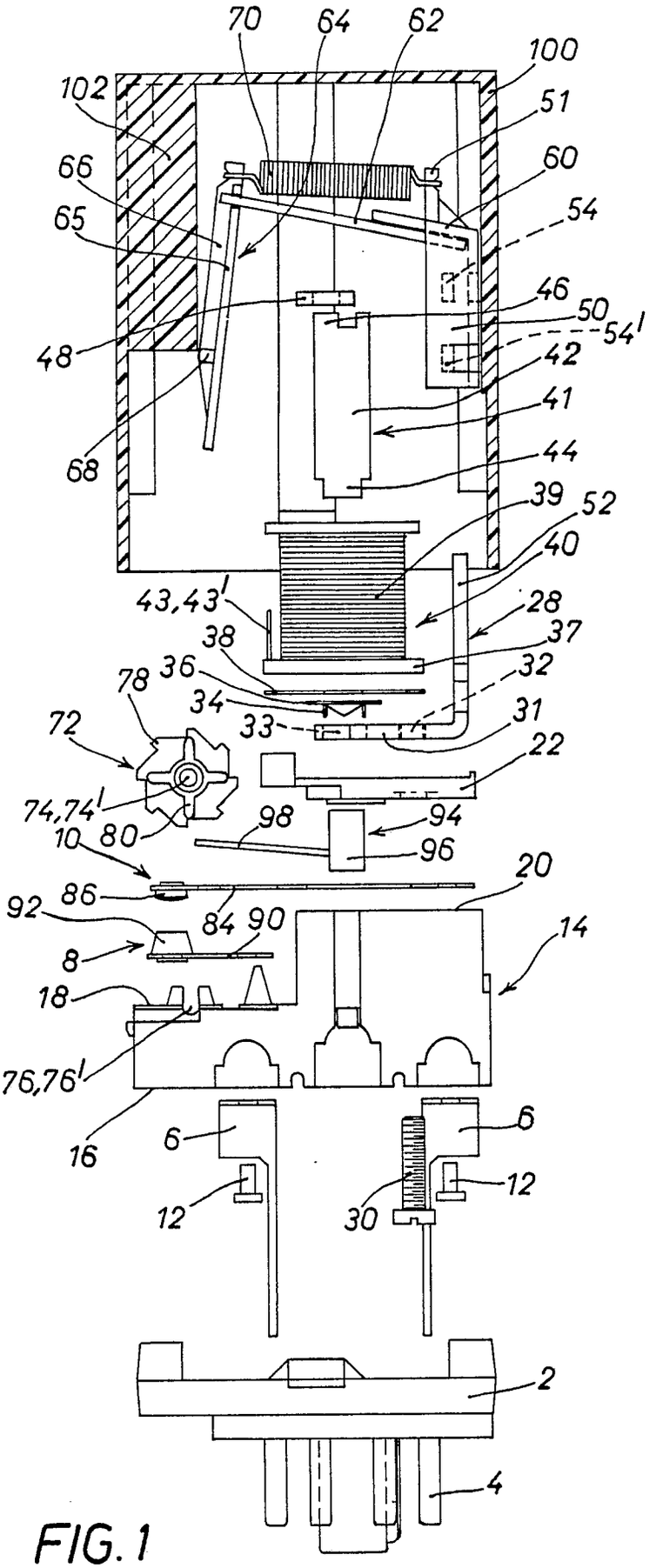
70
64
62
100
102
51
66
60
65
54
46
50
54'
48
42
41
68
44
39
52
40
43,43'
28
38
37
36
32
34
33
31
78
72
22
74,74'
98
94
80
10
96
20
86
92
84
90
14
8
18
76,76'
16
6
6
12
12
30
2
4

FIG. 1

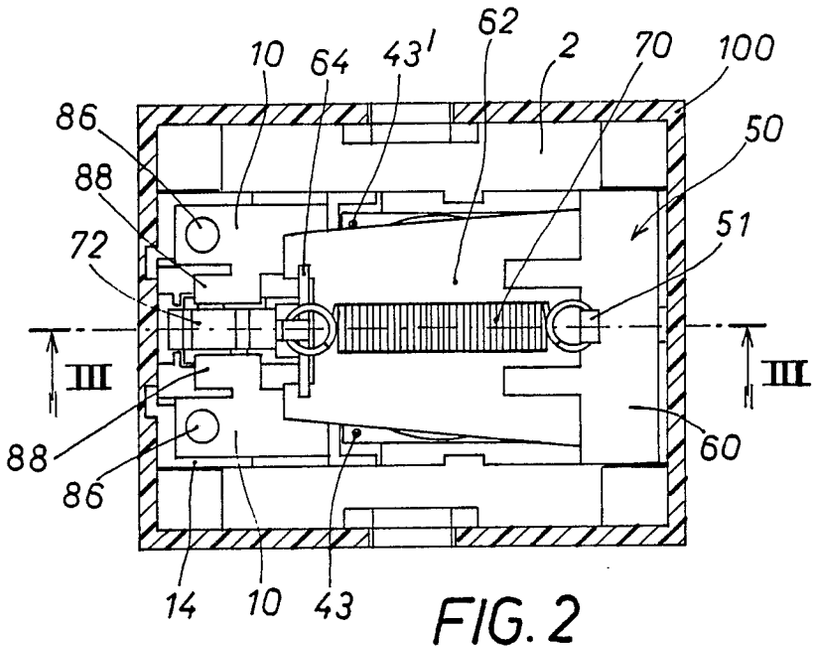
10
64
43'
62
2
70
100
86
88
72
50
51
III
III
88
86
60
14
10
43

FIG. 2

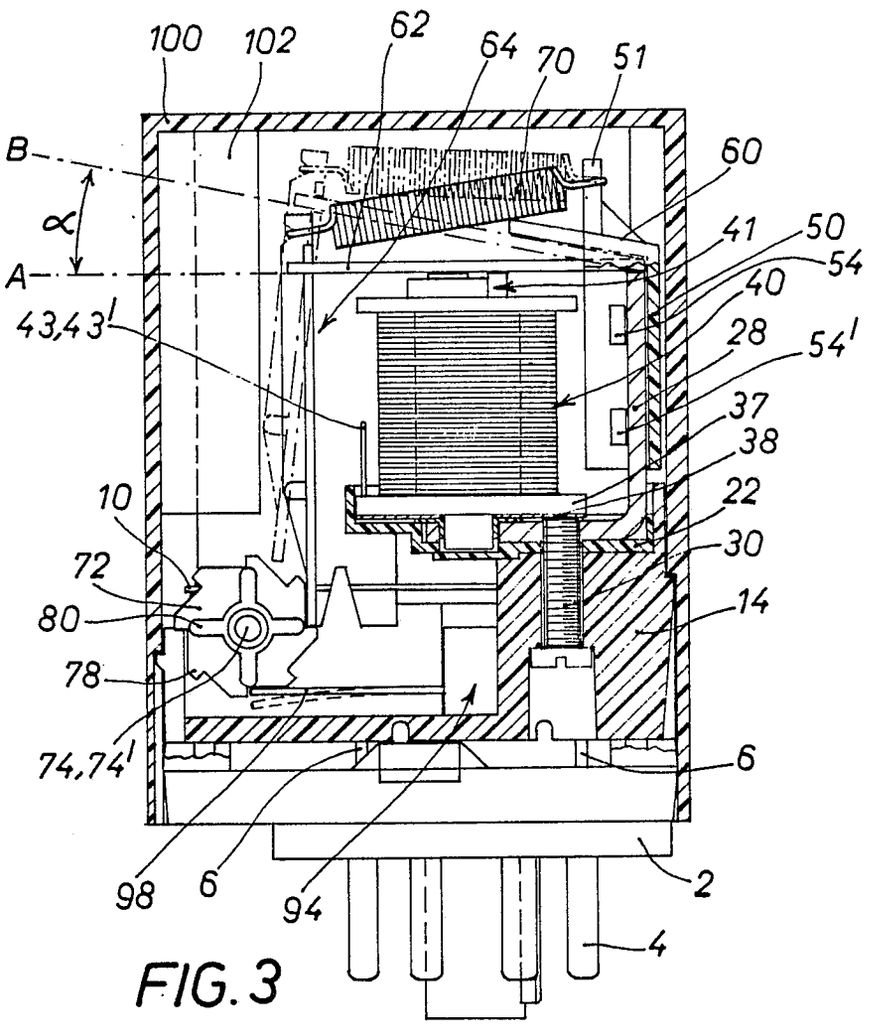
100
102
62
64
70
51
B
α
A
60
41
50
54
40
43,43'
28
54'
37
38
10
22
72
30
80
14
78
74,74'
6
98
6
94
2
4

FIG. 3

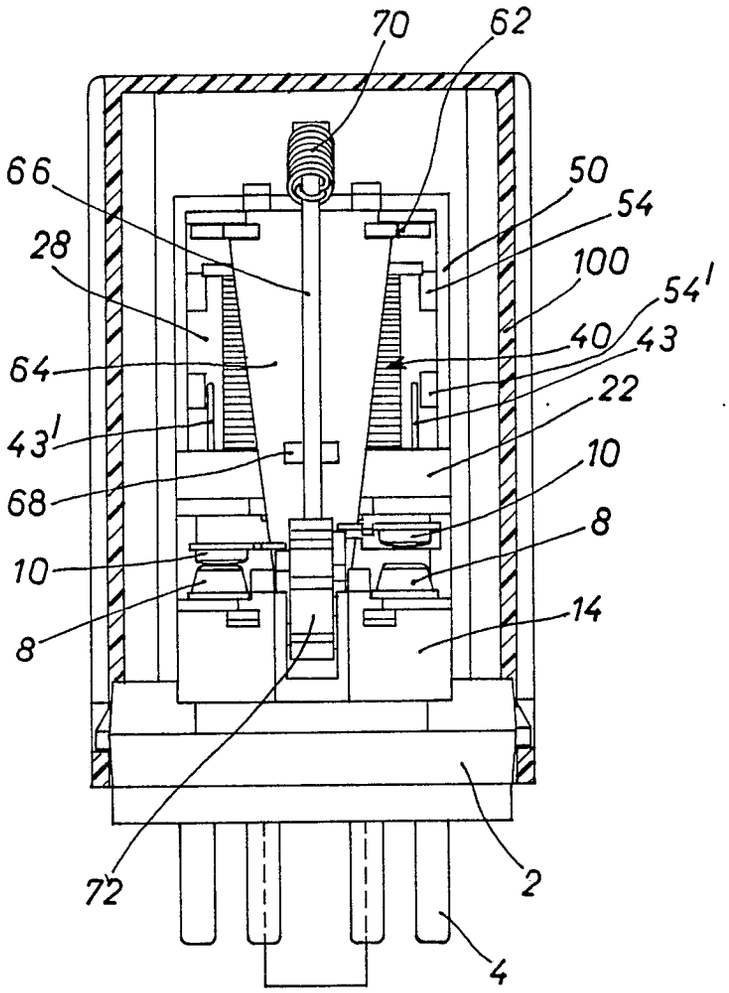


FIG. 4

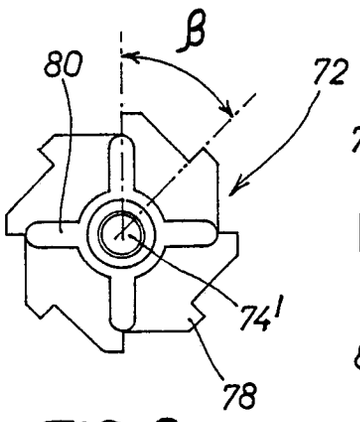


FIG. 6

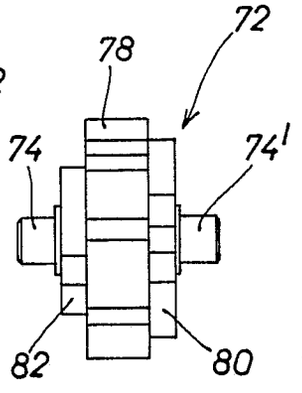


FIG. 5

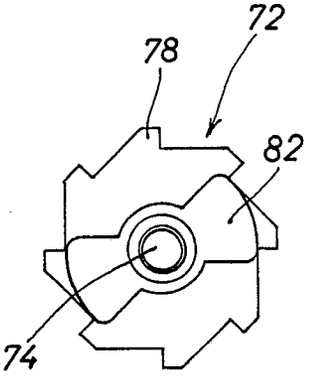


FIG. 7

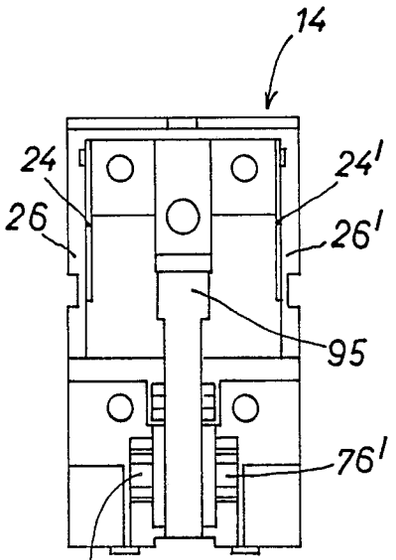


FIG. 8

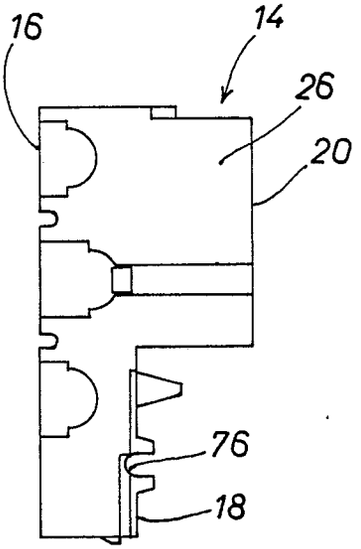


FIG. 9

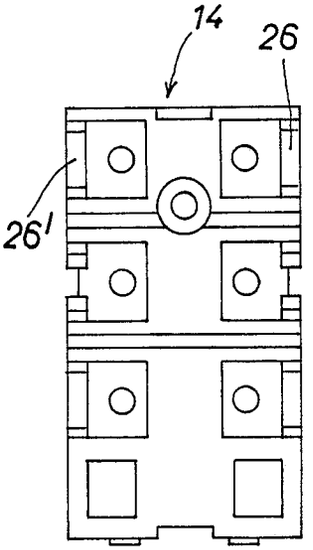


FIG. 10

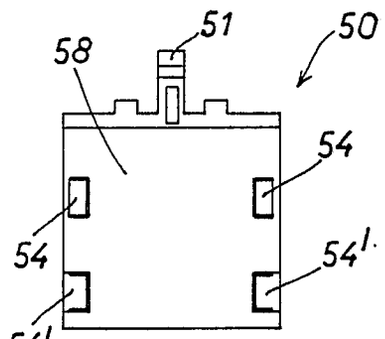


FIG. 11

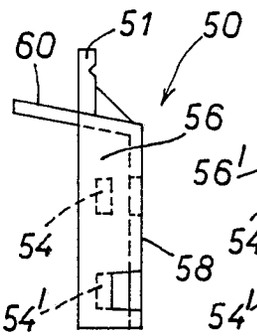


FIG. 12

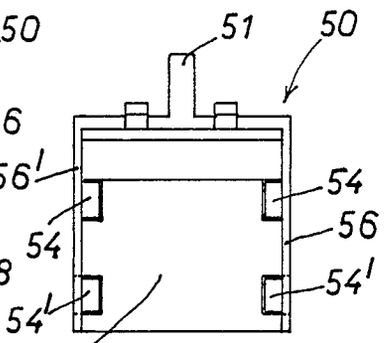


FIG. 13

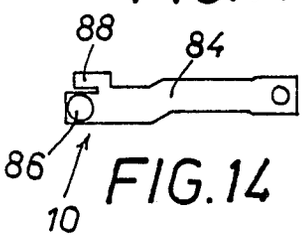


FIG. 14

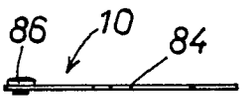


FIG. 15

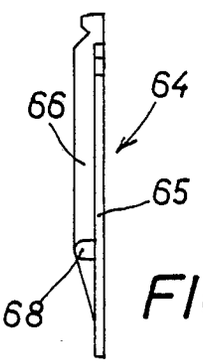


FIG. 16

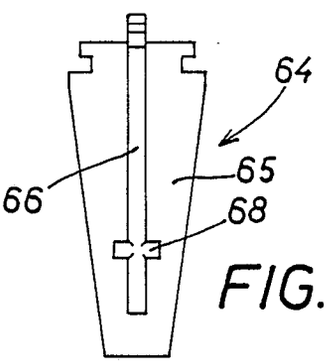


FIG. 17