Jan. 5, 1971 TETSUO MORI ET AL 3,553,729

ELECTROMAGNETIC RELAY HAVING ADJUSTABLE BIASING MEANS TO PREVENT CHATTERING OF THE SWITCH CONTACTS

Filed Sept. 25, 1969 7 Sheets-Sheet 1

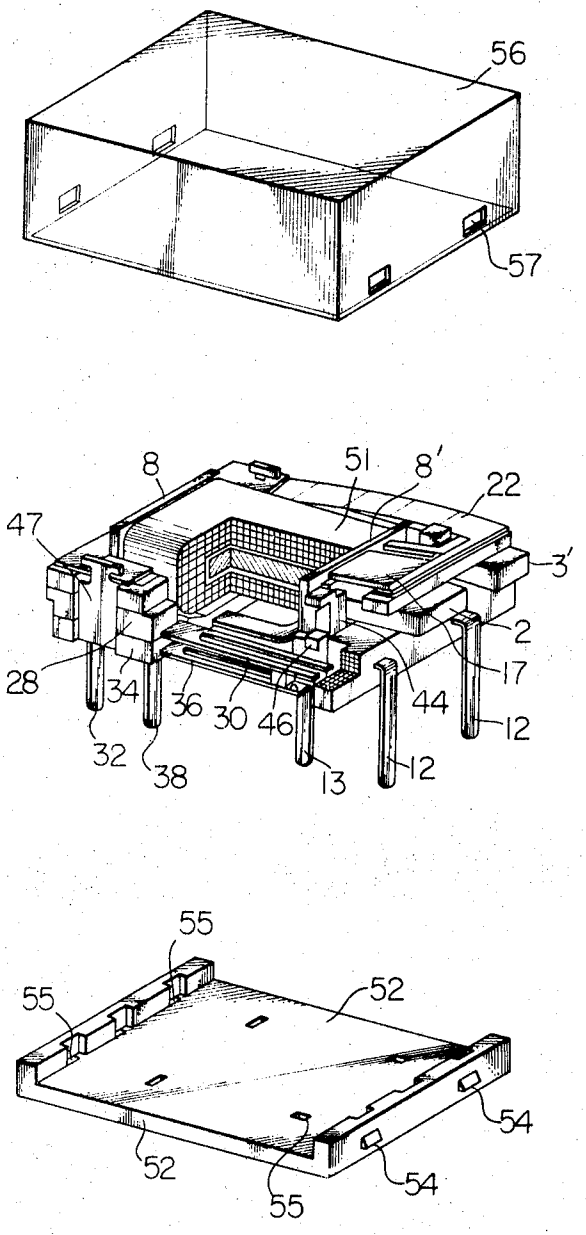

Fig. 1

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Fig. 2

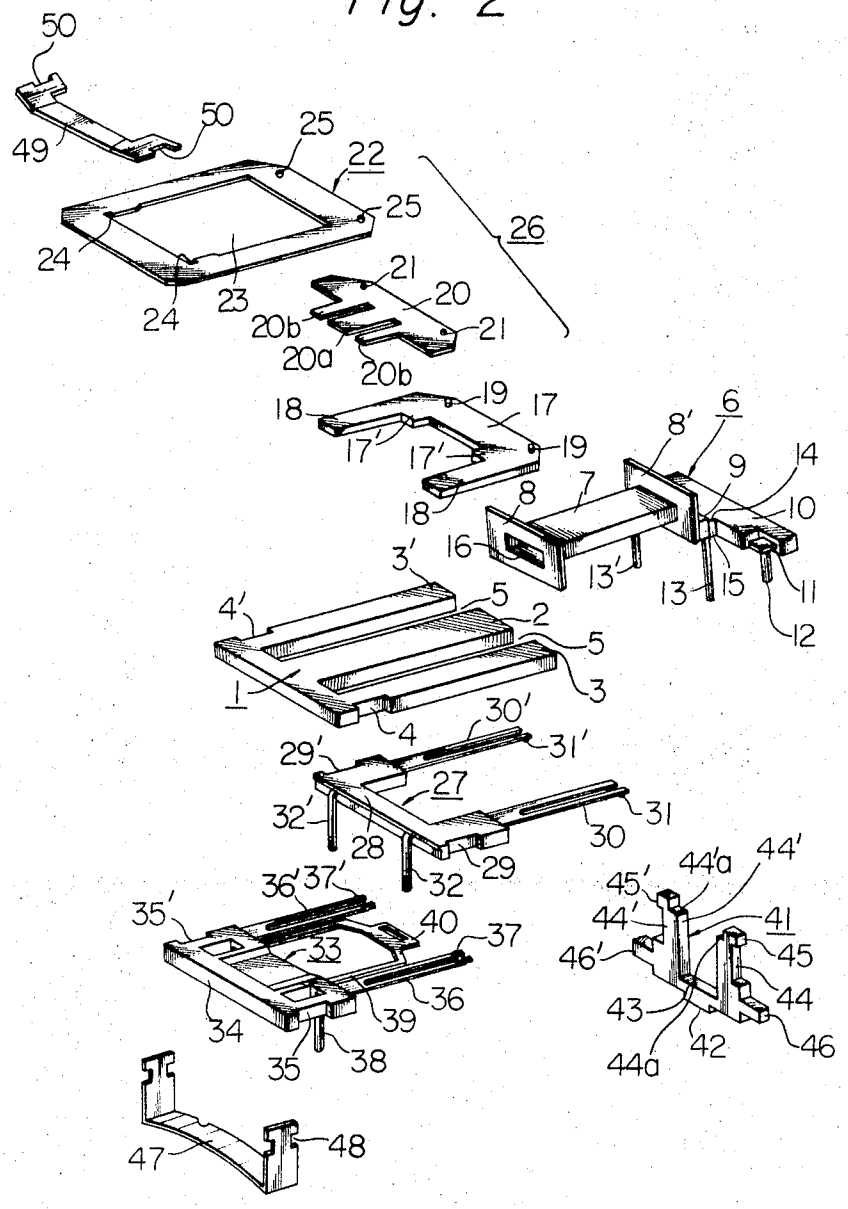

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Fig. 3

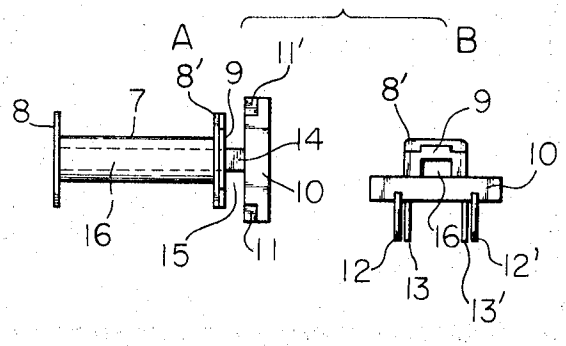

Fig. 4A

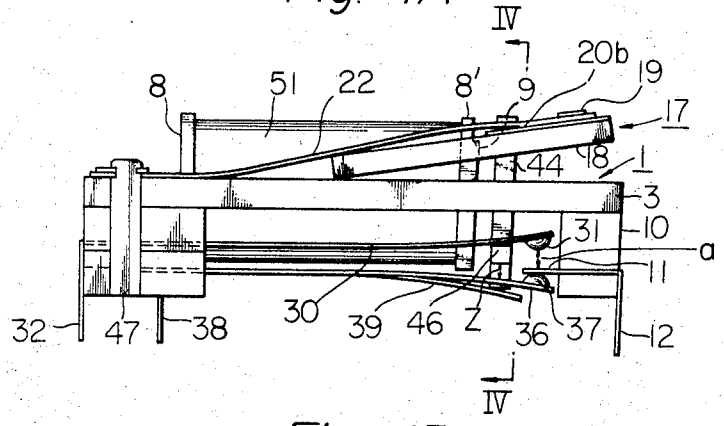

Fig. 4B

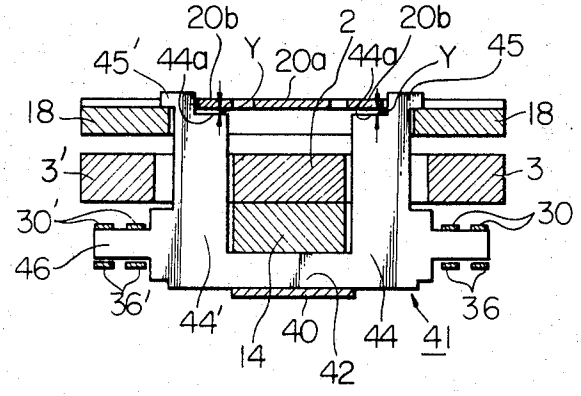

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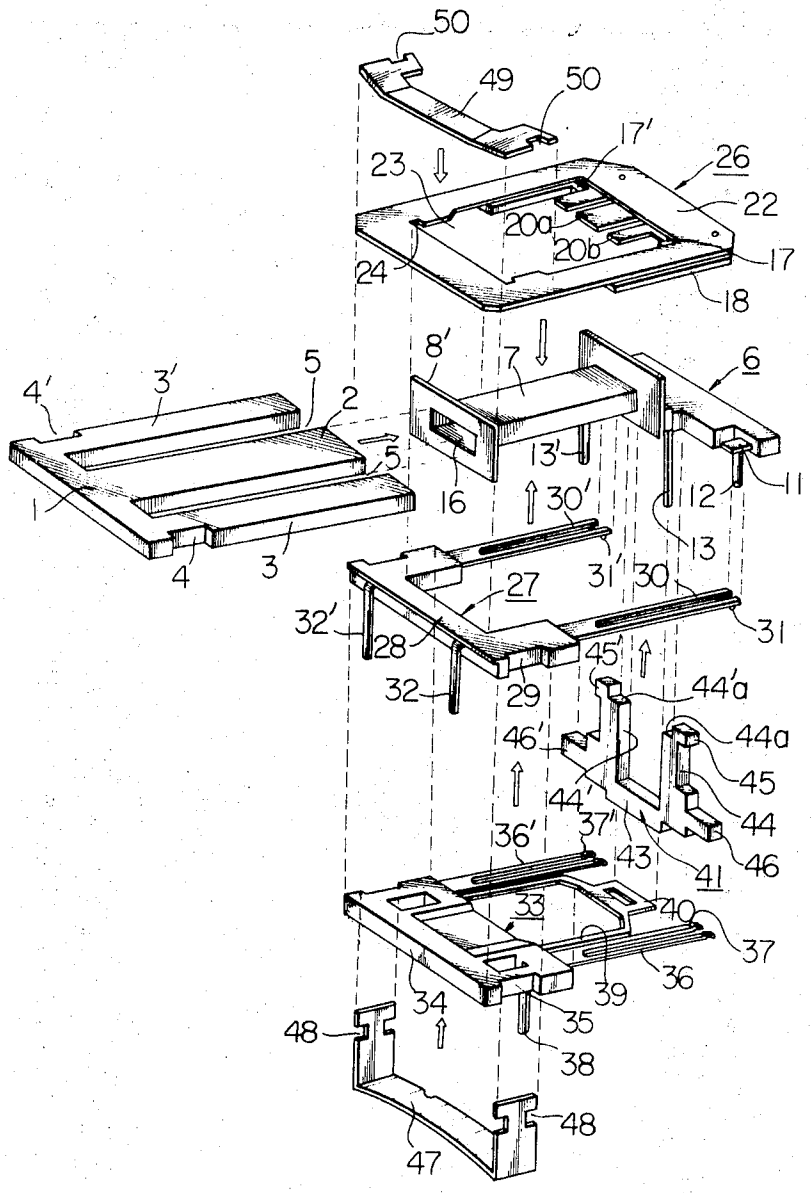
Fig. 5



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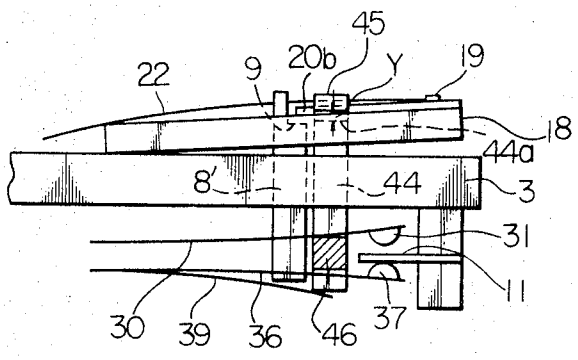

Fig. 6A

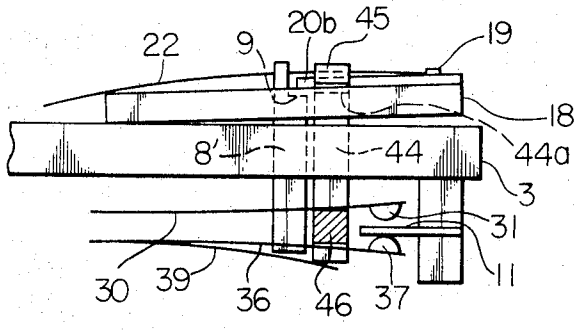

Fig. 6B

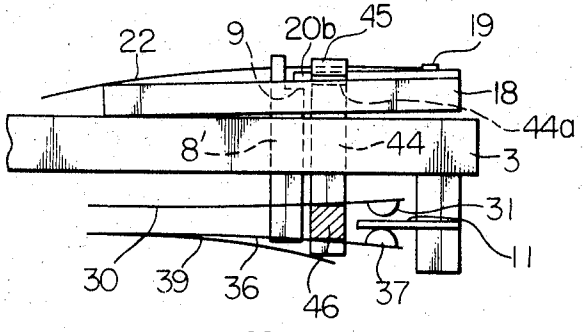

Fig. 6C

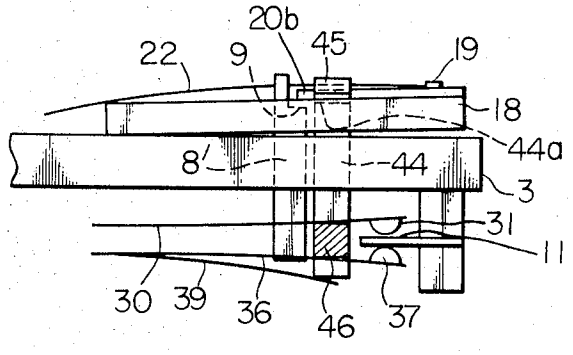

Fig. 6D

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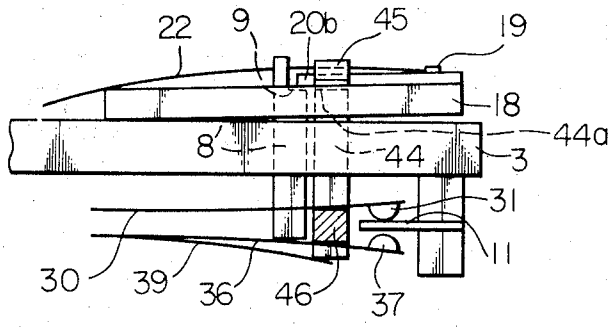

Fig. 6E

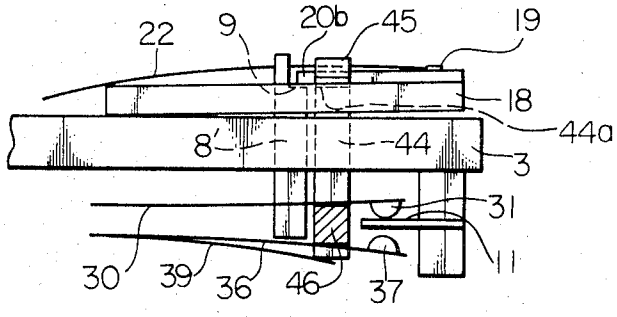

Fig. 6F

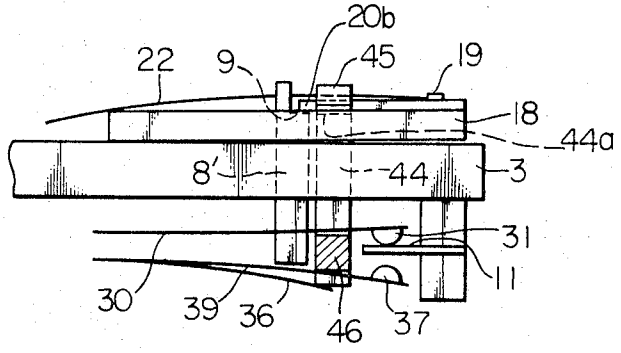

Fig. 6G

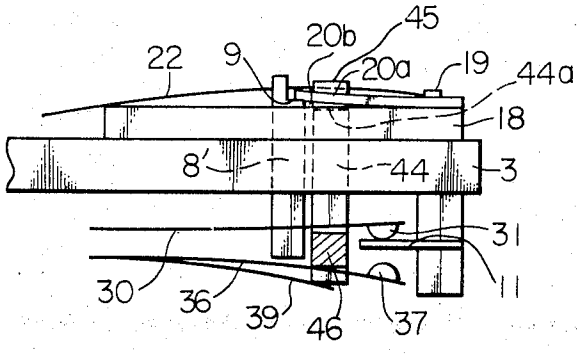

Fig. 6H

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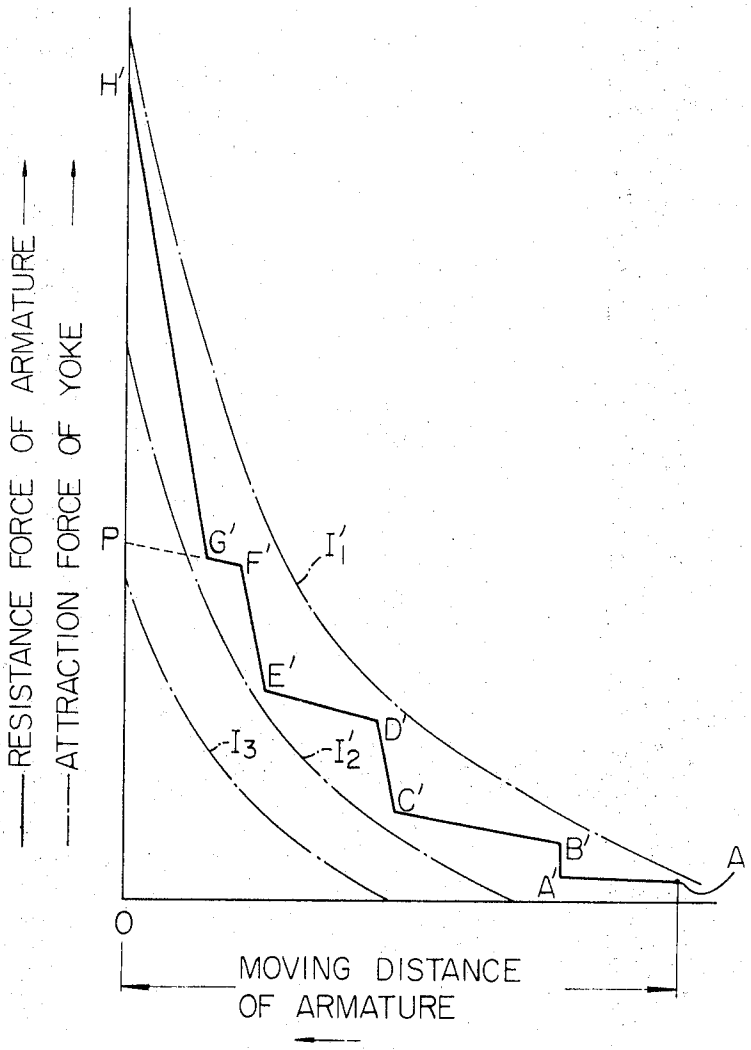
Fig. 7



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United States Patent Office

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ELECTROMAGNETIC RELAY HAVING ADJUSTABLE BIASING MEANS TO PREVENT CHATTERING OF THE SWITCH CONTACTS

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Claims priority, application Japan, Sept. 27, 1968, 43/70,449; Sept. 30, 1968 (utility model), 43/85,097; Jan. 13, 1969, 44/2,547; Mar. 10 1969 (utility model), 44/21,499; Mar. 19, 1969 (utility model), 44/24,540

Int. Cl. H01h 3/60

U.S. Cl. 335—192

6 Claims

ABSTRACT OF THE DISCLOSURE

A chattering-less electric relay, of which movable contacts are switched over in accordance with downward attraction and upward deattraction of an armature to a yoke through a card normally biased upwardly. The armature includes an adjustable biasing means to urge the card downwardly when the armature is being attracted and to urge the armature itself upwardly at both last stage of the attraction and initial stage of the deattraction. There is provided a small gap between the card and the biasing means during deattraction of the armature.

This invention relates to improvements in relays.

Conventional relays have in general the below enumerated defects in their structures.

First of all, particularly in a relay having an electromagnetic structure of a type in which the attraction becomes strong particularly at the final end point of the attracting operation of the armature, a nonmagnetic material has been inserted between the armature and yoke to prevent the returning characteristic from being deteriorated by such excess attraction. Therefore, the ampere turn of the electromagnet for operating the same load has been larger than in the case of using no nonmagnetic material and this has been a loss. In the present invention, by providing an adjusting spring which can additionally apply to the armature a returning force which becomes available just before the moment when the armature completely engage the yoke, the opening value between the armature and yoke is made to be freely adjusted and, yet, the attraction of the yoke is made to be secured at its maximum value, so that the above discussed problem will be effectively solved.

Second, the conventional relays have also in general a defect that, as the part for regulating the position of an element referred to as "card" at the time when the card is not excited and the part for mounting fixed contacts have been arranged so as to be separated from each other, any errors in the allowance for movement of the card and in contact gap could easily become so large due to accumulated errors between the card length, yoke thickness, fixed contact position and armature hinge position that a complicated adjustment has had to be made by applying a plastic deformation to each element.

According to the present invention, as the regulating surface of the above mentioned card and the fixed contact are combined in the same block, such errors of the card allowance and contact gap can be limited to be minimum.

Third, in the conventional relays, as the armature and card have been directly connected with each other, any possible vibration of the armature of a large mass when it returns to its position in non-excitation state could be transmitted directly to the card and, thus, the chattering

between the contacts by the vibration of the card has been unavoidable.

According to the present invention, a clearance or a "play" is provided between the position in which the armature pushes the card and the position in which the armature is prevented by the card from moving upward, so that no such direct influence of the vibration of armature on the contacts will be caused to occur.

Further, as a spring bent substantially in the form of Z has been adopted in the conventional relays for hinging spring for the armature, the downward biasing force applied to the hinge part of the armature on the yoke has been substantially constant and weak during the attracting operation of the armature, so that not only the magnetic resistance at the hinged point has been made high, but also errors in angle or position of armature could have been easily involved due to required bending works for the spring.

According to the present invention, a flat type spring is adopted for the hinge spring and, thus, the force applied to the hinged part of the armature can be increased as the attracting action by the yoke progresses, no bending work of the spring is required, and such position errors of the armature can be entirely eliminated.

Yet further, as stopper means for upward rotation of the armature in conventional relays have been provided in a part separate from the card, component parts have been inherently increased in number.

On the other hand, in the present invention, the stopper means is formed integrally as a part of the card, so that the number of component part is decreased without affecting any of effects or functions of those components.

The present invention has been suggested to eliminate the above mentioned defects of the conventional relays.

A main object of the present invention is therefore, to provide a relay which is remarkably easy to be adjusted.

Another object of the present invention is to provide a relay which prevents effectively any chattering of movable contacts from occurring.

A further object of the present invention is to provide a relay in which a contact gap and card allowance are regulated by controllably regulating the card position and, therefore, it is not required to give any plastic deformation to a terminal plate

Another object of the present invention is to provide a relay whose return characteristics are improved.

FIG. 1 is a partly sectioned perspective view of a relay of the present invention with a cover and base plate as removed.

FIG. 2 is a perspective view of the relay as disassembled of the present invention as shown in FIG. 1.

FIG. 3 shows a frame for coil and fixed contacts in the relay of FIGS. 1 and 2, FIG. 3A being a plan view and FIG. 3B being a front elevation.

FIG. 4A is a side view of the relay as assembled of the present invention and FIG. 4B is a sectioned view taken along line IV—IV in FIG. 4A.

FIG. 5 is an explanatory view showing a method of assembling the respective components in FIG. 2.

FIGS. 6A through 6H show a sequence of an operational travel of the armature and sequential opening and closing states of contacts according to the present invention.

FIG. 7 shows diagrammatically the relationship of the operational travel of the armature to the attraction force of yoke and the resistance force of the armature.

Referring first to FIGS. 1 to 5, 1 is an E type yoke of a magnetic material provided with a central leg 2, side legs 3 and 3' and slots 4 and 4' outside said side legs 3 and 3', respectively. 5 is a gap between said central leg 2 and respective side legs 3 and 3'.

6 is a frame made of a molded synthetic resin, for carrying coil winding and fixed contacts. 7 is a bobbin section of the frame, 8 and 8' are flanges, 9 is a stopper provided outside the flange 8', 10 is a terminal section provided with fixed contacts 11 and 11' at respective ends, each of which being aligned with the other on a horizontal line, i.e., in a parallel relation to the bobbin axis. 12 is a terminal for the respective fixed contacts, 13 is a terminal for each end of the coil. A gap 15 is provided on each side of a connecting part 14 between the inside of the terminal plate 10 and the flange 8'. 16 is a hollow chamber which is made in the bobbin 7 and in which the central leg 2 of the yoke 1 is to be inserted.

17 is a U-shaped armature of a magnetic material having a leg 18 on each side. A dowel pin 19 is provided in each corner of said armature on its upper surface.

20 is an adjusting plate provided with a central spring part 20*a* on one side, a side spring part 20*b* on each side of said central spring part 20*a* as separated from each other, and hole 21 in each corner for receiving said dowel pin 19.

22 is a flat plate type hinging spring for the armature 17, provided with a window 23 in the center. A slot 24 is made on each side of said window. 25 is a hole made in the corner for receiving the dowel pin 19 of the armature.

The holes 21 of the adjusting plate 20 are fitted to the dowel pins 19 of the armature 17, the holes 25 of the hinging spring 22 are fitted further thereon, and the upper part of each dowel pin is clampingly deformed so as to integrally combine the armature 17, adjusting plate 20 and hinging spring 22 so that an armature block 26 will be formed.

27 is a first movable contact block. 28 is a U-shaped block body made of a synthetic resin and provided with slots 29 and 29' on respective sides. 30 and 30' are a set of first movable contact springs molded integrally with said block body 28 in a parallel relation to each other, provided with downwardly directed contacts 31 and 31', respectively, at their tips, and branched respectively into two with a groove in the longitudinal direction. 32 and 32' are terminals of said movable contact springs 30 and 30', respectively, and are pulled out of the block body 28 on the other side of the movable contact springs.

33 is a second movable contact block. 34 is a main block body made of a synthetic resin substantially in a rectangular shape and provided with slots 35 and 35' on respective sides. 36 and 36' are second movable contact springs molded integrally with said block body 34 so as to be parallel with each other, provided with upwardly directed contacts 37 and 37', respectively, at their tips, and each branched likely into two with a groove in the longitudinal direction. 38 is a terminal for each of said movable contact springs and is pulled out of the block body 34 on the other side of the movable contact spring. 39 is a return spring molded to the block body 34 between said second movable contact springs 36 and 36'. The top 40 of said spring has an action of pressing the bottom 42 of a card 41.

41 is a card made of a synthetic resin as an electric insulating material, substantially in the form of U, which is provided with upstanding arms 44 and 44' at right angles with respect to base portion 43 on respective sides of it. The arms 44 and 44' are provided with upper projections 45 and 45' on respective sides in the upper parts. As described later, these projections 45 and 45' are to engage with stepped parts 17' in the inside corners of the armature 17. Further, lower projections 46 and 46' are provided on respective sides of the base 43. 47 is a U-shaped clamping metal piece having a notch 48 on each side of each upstanding side plate. 49 is a retaining plate provided at each end with an notch 50 to engage with the notch 48 of the clamping metal piece 47.

51 is a coil wound around the bobbin 7. The coil is connected at both ends to the coil terminals 13 and 13'.

52 is a base plate or a bid provided with a projection 54 on each side wall 53. 55 is a set of holes through which the coil terminal, fixed contact terminals and first and second movable contact terminals are led out. 56 is a case for covering the relay and provided on the side wall with a window 57 with which the projection 54 of the lid 52 fits.

A manner in which the respective components of the relay of the present invention are to be assembled shall now be explained.

Referring to FIG. 5, the central leg 2 of the yoke 1 is inserted into the hollow chamber 16 of the bobbin 7 (in which the coil 51 is shown in chain lines here) formed integrally with the frame 6. Then, the armature block 26 is mounted on the above mentioned combination of the frame and yoke so that the flange 8 will fit on the slot 24 provided in the window 23 of the hinging spring 22. The first movable contact block 27 is then fitted to the lower surface of the frame 6, so that the upper surface of the block body 28 will be in contact with the lower surface of the armature 1, the end surface of the flange 8' of the bobbin 7 will be in contact with the inside of the U-shaped block body 28 and the movable contact spring 30 will be located on the upper side on the upper side of the fixed contact 11.

Then the arms 44 and 44' of the card 41 are inserted into the gaps 5 between the central leg 2 and side legs 3 and 3' of the yoke 1 so that the upper projections 45 and 45' provided on the arms 44 and 44', respectively, will engage with the stepped parts 17' of the armature 17.

The second movable contact block 33 is then brought into contact with the lower surface of the first movable contact block 27, so that the top 40 of the return spring 39 will press he bottom 42 of the card 41 and the lower projections 46 and 46' of the card 41 will be held between the first movable contact springs 30 and 30' and the second movable contact spirngs 36 and 36'.

The upstanding side plates of the clamping metal piece 47 are fitted into the slots 4 and 4' of the yoke 1, through slots 29 and 29' of the first movable contact block 27 and slots 35 and 35' of the second movable contact block 33, and then the notches 50 of the retaining plate 49 mounted on the upper surface of the armature block 26 are fitted into the notches 48 so that thus assembled combination will be tightly clamped as jointed together.

In the above mentioned assembled state, the bottom 42 of the card will be pushed up by the top of the return spring 39 (the resiliency of the return spring 39 will press the card upward overcoming the resiliency of the first movable contact springs 30 and 30'), and upper surface of the base portion 43 of the card 41 will be butted against lower surface of the connecting part 14 of the frame 6, that is, upward motion of the card 41 is to be limited by the lower surface of the connecting part 14 of the frame 6. The armature 17 will be engaged with the upper projections 45 and 45' on the card 41 in the corners 17' so that the armature 17 will be prevented from being floated up by the hinge spring 22. In this state, the first movable contact springs 30 and 30' will be pushed up by the upper surfaces of the lower projections 46 and 46' of the card 41 so that the contacts 31 and 31' will be separated from the fixed contacts 11 and 11', respectively. On the other hand, the second movable contact springs 36 and 36' will be resiliently directed upward by their own resiliency, so that the contacts 37 and 37' will be normally in contact with the fixed contacts 11 and 11', respectively.

As a gap Y is provided between the lower surface of the side spring part 20*b* of the adjusting plate 20 combined integrally with the armature 17 and the upper surface 44*a* of the arm 44 of the card 41, the second movable contact will be prevented from chattering (see FIG. 4B).

That is, if the coil 51 is magnetically excited and the armature 17 is attracted by the yoke 1, along with the initiated downward travel of the armature, the adjusting plate 20 formed integrally with it will also go down, the side spring parts 20*b* will engage and push the upper sur-

faces **44***a* and **44***a'* of the arm **44** downward. Consequently, the card **41** will be pushed down and the second movable contact springs **36** and **36'** will be in turn pushed down by the lower surfaces of the lower projections **46** and **46'**, respectively, of the card, so that the contacts **37** and **37'** will be separated from the fixed contacts **11** and **11'**, respectively, while the contacts **31** and **31'** will come into contact with the fixed contacts **11** and **11'**, respectively. However, as there is provided such gap Y as is described above, even if the exciting current of the coil **51** is reduced and the armature rises quickly, collides with the upper projections **45** and **45'** of the card **41** and repeats small vibrations, such small vibrations of the armature will not be transmitted to the surfaces of **44***a* and **44***a'* of the card **41** through the adjusting plate and, therefore, the movable contacts will not cause any chattering to occur.

Further, as there is provided a clearance Z, which is referred to as the card allowance between the lower surface of the lower projection **46** of the card **41** and the second movable contact spring **36** in the state that the coil is not excited, even if a wear is produced between the contact **37** and contact **11**, the contact will totally not fail.

Further, as the tips of the armature **20** will be engaged with the upper projections **45** and **45'** of the card **41** while the armature is released, there can be omitted any excess trouble of providing the yoke **1** or coil bobbin **7** with stoppers for restricting upward release of the tips of the armature.

The flat type hinging spring **22** provides to the armature always an angular moment for keeping the gap between the armature and yoke with inward tips of armature legs **18** as a fulcrum, since the spring is fixed to base part of the yoke by means of the clamping member **47** at its end opposite to the other end where the same is jointed with the armature, as previously referred to. Consequently, said tips of legs **18** acting as a fulcrm of the armature, that is, the hinge part of the armature, is always pressed to the yoke with a certain constant resiliency of the spring while the yoke is not excited. Once the yoke is excited, on the other hand, said end jointed with the armature of the spring will be also drawn downward. Since this downward movement of the spring at the jointed side with the armature will also result in an additional downward pressure against the hinge part of the armature, the engagement of the hinge part with the yoke will be increased to be stronger than that of the time when the yoke is not excited, so that possible magnetic resistance at the hinge part will be reduced.

FIG. 7 shows the relations between the stroke (moving distance) of the tip of the armature **17** with respect to the yoke **1** and the attraction of the yoke **1** for the armature **17** when electric currents of different intensities are made to flow to the exciting coil **51**. If the curves I_1', I_2' and I_3' represent respectively the attractions when currents I_1, I_2 and I_3 are made to flow to the exciting coil and the intensities of the currents are $I_1 > I_2 > I_3$, the larger the intensity of the current, the farther the attraction curve from the original point O.

A bent line A–A'–B'–C'–D'–E'–F'–G'–H' represents a sequence of force of the armature specifically at its free end held by the spring **22**, with which force the armature is normally biased to separate away from the yoke as varied due to the returning forces of various springs (such as the hinge spring, contact springs, return spring and adjusting springs **20***b*), that is, the resistance force of the armature against the above mentioned attraction. Further, the bent line A–A'–B'–C'–D'–E'–F'–P, partly shown with a dotted line between G'–P, represents the resistance force of the armature in the case where no return spring **40** is provided.

Turning now to FIGS. 6A to 6H and with reference to FIG. 7, the sequence of operating states of the relay according to the present invention shall now be explained in detail.

In the position shown in FIG. 6A, the resistance force of the armature corresponds only to the force of the hinge spring **22**, the latter of which increases as the armature moves to the point A' shown in FIG. 7.

Then, as shown in FIG. 6B, when the exciting coil is excited, the side spring parts **20***b* of the adjusting plate **20** will respectively contact the upper surfaces **44***a* and **44***a'* of the arms of the card **41** and, at this moment, the push-up force of the difference between the push-up force of the return spring **39** and push-down force of the first movable contact springs **30** and **30'** will be applied to the armature and thereby the resistance force of the armature will increase from A' to B' as shown in FIG. 7.

Until the point C' in FIG. 7, the push-up force of the return spring **39** will further increase, as the descending card **41** increasingly pushes down the spring **39**, the push-down force of the first movable contact springs **30** and **30'** will be further decreased and, therefore, the resistance force of the armature will gradually increase.

FIG. 6C shows the moment at which, with the card **41** thus descended, the lower projections **46** and **46'**, shown as hatched for easy observation, contact the upper surfaces of the second movable contact springs **36** and **36'**, respectively. That is, the line section B'–C' represents the distance corresponding to the card allowance Z. The resistance force of the armature increases from B' to C' as shown in FIG. 7.

FIG. 6D shows a state, up to which the card **41** has been further attracted down toward the yoke, that the contact pressure of the second movable contact springs **36** and **36'** reduces to be zero and the second movable contacts **37** and **37'** are just about to leave the fixed contacts **11** and **11'**, respectively.

FIG. 6E shows the next state in which the card **41** has been further descended and the first contacts **31** and **31'** have just come into contact with the fixed contacts **11** and **11'**, respectively. That is, the contact pressure of the first movable contact **31** and **31'** on the fixed contact is zero at this instance. Up to this state, the resistance force of the armature increases from D' to E' as shown in FIG. 7, due to, in this case, the spring force by the second movable springs **36** and **36'** will be added to the resistance force of the armature.

Then, with the further movement of the card **41** along with the yoke being attracted, the contacting pressure of the first movable contact springs **30** and **30'** with fixed contacts **11**, **11'** will increase and, at the same time, the force of the first movable contact springs **30**, **30'** to push down the card **41** will reduce so as to be zero. This state is shown in FIG. 6F. Once the downward force of the spring **30**, **30'** becomes zero, then the upward force of the second contact springs **36**, **36'** is fully enabled. Thus, the resistance force of the armature increases rapidly from E' to F' as shown in FIG. 7. In this particular case, the central spring part **20***a* of the adjusting plate **20** is in a state just before contacting the top of the stopper **9** provided on the coil bobbin. The spring force of the second movable contact springs **36** and **36'** is further gradually increased as the card **41** further descends and, thus, the resistance force of the armature will gradually increase from F' to G' in FIG. 7.

Then, as shown in FIG. 6G, the central spring part **20***a* of the adjusting plate **20** contacts the stopper **9**. In order that the armature **17** will further move down, a large force which gradually, but in a large extent, increases from G' to H' in FIG. 7 is required due to the fact that according to the present invention the spring force of the adjusting plate **20** is selected to be large.

The state in which the movement of the card has ended is shown in FIG. 6H. In this state, the central spring part **20***a* of the adjusting plate **20** is contacting the top of the stopper **9** and will bend, and the side spring parts **20***b* will be respectively in contact with the upper surfaces **44***a* and **44***a'* of the arm. (The side spring parts **20***b* are omitted in FIG. 6.) The resistance force of the armature

at this state is of the largest, which is shown in FIG. 7 as H'.

It will be noted that the gradient of the straight line G'H', that is, the resistance force from G' to H' can be freely varied by adjusting the central spring part **20***a*' of the adjusting plate **20**. Further, if the attraction curve is on the side of the original point O from the point H', the armature will return immediately after being attracted by the yoke. Therefore, the returning characteristic of the armature can be freely varied by adjusting the bending degree of the central spring part **20***a* of the adjusting plate **20**.

It will be also noted that, in the case where no such additional biasing means as the central part **20***a* of which resiliency is actuated at the last stage of the above explained sequence is provided in the relay, the returning action of the armature, when the exciting current for the yoke is interrupted, has to be initiated by the armature's resistance force P in FIG. 7 which relies mostly on the second contact spring. According to the invention, the returning action of armature can be initiated by such a large force as H' so that the return characteristics are much improved.

The position of the card in the relay is so made that the lower surface of the connecting part **14** of the frame **6** in which the fixed contacts **11** and **11'** are embedded will come into contact with the upper surface of the base of the card **41**. Thus, the relative positions of the card and fixed contacts at the time of nonexcitation can be accurately restricted and the contact gap *a* and card allowance Z can be accurately regulated. Therefore, there is no such conventional operation of regulating the contact gap *a* and card allowance Z by plastically deforming the terminal plate and the adjustment is very easy according to the present invention.

What we claim is:

1. A relay comprising a yoke of a magnetic material in an E-shape having a centre leg and side legs at both sides of said centre leg;

a frame made of electrically insulating material including a bobbin section into which said centre leg of the yoke is inserted and a terminal section formed integrally with said bobbin section through a connecting section,

said bobbin section being wound therearound an exciting coil for the yoke,

said terminal section being provided with fixed contacts and terminals therefor, and

said fixed contacts being projected at the bobbin side and on a parallel plane to that of the yoke;

a first movable contact block butted at its mounting base of an insulating material to said yoke and having a set of first movable resilient members respectively having contacts at their free ends,

said contacts being ararnged above said fixed contacts respectively;

a second movable contact block butted to the first movable contact block through its mounting base of insulating material,

said second movable contact block having a set of second movable resilient members respectively having contacts at their free ends, and

said contacts of the second movable contact block being arranged below said fixed contacts respectively, and

said second movable contact block including a returning biasing means;

a card made of an electrically insulating material in a U-shape and arranged between said bobbin section and terminal section of the frame vertically in upward and downward movable manner,

said card having a pair of upright arms on its base and a pair of lower projections respectively laterally extending at both sides of the base, and

said lower projections being positioned between said first and second movable contact resilient members opposing; and

an armature block resiliently held above said yoke by means of a hinging spring member,

said armature block being provided at its free end with an armature and an adjusting plate member;

said card being urged downwardly by means of said adjusting plate member at the time when the armature is attracted to the yoke with an excitation of the coil, thereby the contacts will be opened and closed.

2. The relay according to claim **1**, wherein said adjusting plate member having a central resilient part at the centre and a pair of side resilient parts respectively at both sides of said central resilient part as separated from each other, said side resilient parts being so arranged as to urge downwardly upper surface of said upright arms of the card as the armature is attracted by the yoke, and said central resilient part being so arranged as to engage a stopper means formed integrally with the frame immediately before complete attraction of the armature.

3. The relay according to claim **1**, wherein said side resilient part of adjusting plate member being so arranged as to have a predetermined gap between its lower surface and upper surface of said upright arms of the card during the time when no excitation of the yoke exists.

4. The relay according to claim **1**, wherein said card being made to engage at its upper surface of the base the lower surface of said connecting section of the frame so that, when no excitation of the yoke exists, respective gaps between lower surfaces of said lower projections of the card and upper surfaces of said second movable contact resilient members and between said contacts of the first movable contact resilient members and opposing fixed contacts will be restricted.

5. The relay according to claim **1**, wherein said hinging spring member of the armature block being of a flat plate type and being piled on said armature and adjusting plate member along one side of the spring member, of which pile being jointed together along outward end of the hinging spring, the other end of said hinging spring extending over the armature and being fixed to an end of the yoke so as to place the armature on the yoke, so that inward end of the armature will be movably hinged all the time onto the yoke and said jointed outward end of the armature will be separated from the yoke when the latter is not excited and will be brought into contact with the yoke when the latter is excited.

6. The relay according to claim **1**, wherein said upright arms being provided respectively with an upper sideward projection at upper end of the arms for engaging upper surface of the armature.

References Cited

UNITED STATES PATENTS

3,255,327	6/1966	Wood, Jr.	335—193
3,278,872	10/1966	Maynard	335—185
3,501,719	3/1970	Richert	335—106
3,501,722	3/1970	Zwanen	335—192

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