Nov. 2, 1954 B. C. WELLS ET AL 2,693,553

ELECTROMAGNET RESPONSE ADJUSTMENT

Filed March 26, 1953 2 Sheets-Sheet 1

Fig. 1.

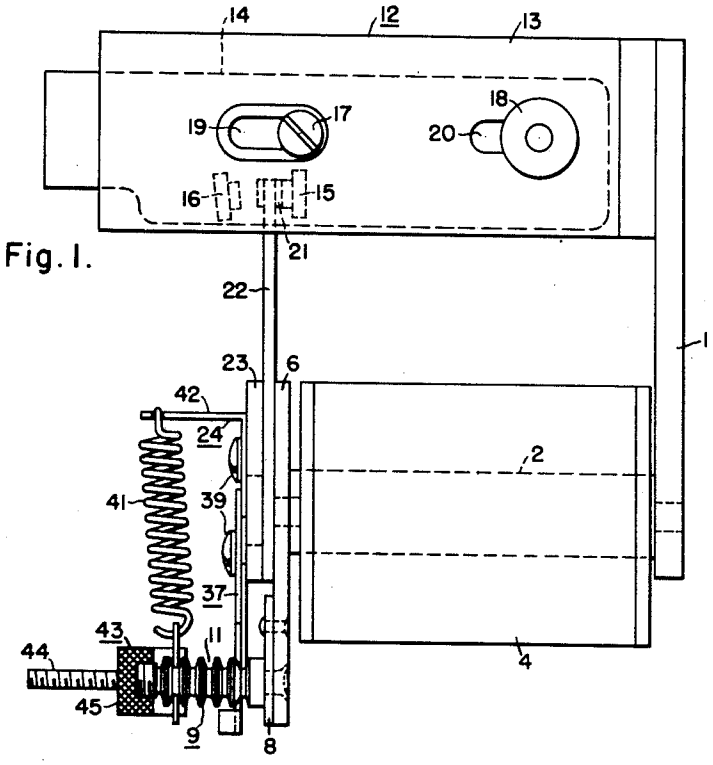
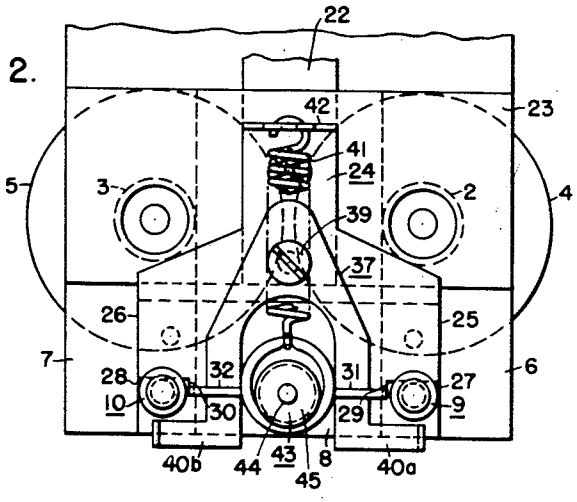


Fig. 2.



WITNESSES:

Robert A. Baird

E. F. Oberheim

INVENTORS
Bruce C. Wells &
Birney S. Layson.

BY Paul C. Friedemann

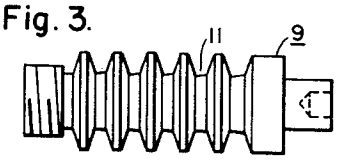
ATTORNEY

Nov. 2, 1954 B. C. WELLS ET AL 2,693,553

ELECTROMAGNET RESPONSE ADJUSTMENT

Filed March 26, 1953 2 Sheets-Sheet 2

Fig. 3.



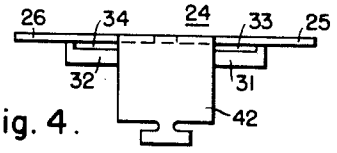


Fig. 4.

Fig. 5.

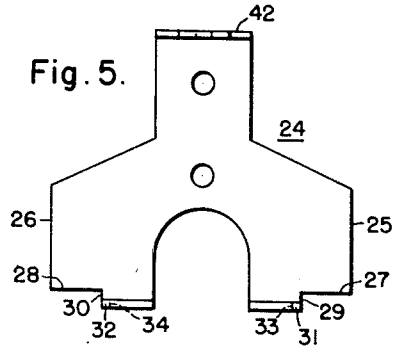
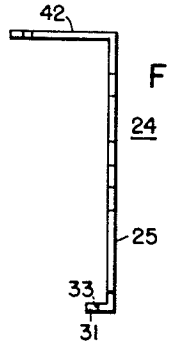


Fig. 6.



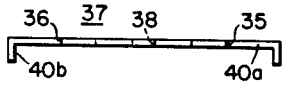


Fig. 7.

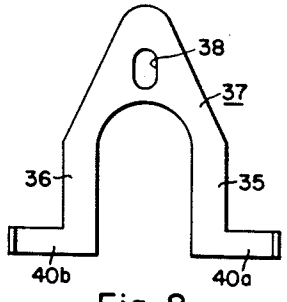


Fig. 8.

WITNESSES:

Robert C. Baird

E. F. Oberheim

INVENTORS
Bruce C. Wells &
Birney S. Layson.

BY Paul E. Frickmann
ATTORNEY

United States Patent Office

2,693,553

Patented Nov. 2, 1954

2,693,553

ELECTROMAGNET RESPONSE ADJUSTMENT

Bruce C. Wells, Buffalo, and Birney S. Layson, West Falls, N. Y., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application March 26, 1953, Serial No. 344,791

10 Claims. (Cl. 317—176)

This invention relates generally to electro-magnetically operated switches and more in particular, to a switch in this category which is adjustable over a relatively wide operating range.

One of the more common methods of changing the sensitivity of an electromagnetically operated switch in order to change its rating has been to move the contact assembly in such a direction as to change the air gap between the armature and the core of the electromagnet assembly. By so doing the flux density required for pick-up is varied and consequently the rating of the switch is varied. This method limits the maximum air gap which is obtainable due to physical limitations from the size of the switch. In other arrangements provision has been made for minor adjustments in air gap by shifting the bearing point of the armature assembly and it is in part to such a feature that the present invention is directed.

One object of this invention is to provide an electromagnetically operated switch in which provision is made for providing selective operation over a wide range of sensitivities.

Further to the preceding object it is a more specific object of this invention to achieve a wide operating range by displacement of the armature bearing.

Still more specifically, it is an object of this invention to achieve a wide operating range for an electromagnetically operated switch by adjusting both the stationary contacts and the armature bearing point to effect displacement of the armature with respect to the core.

It is also an object of this invention to provide an electromagnetically operating switch having a wide operating range which is simple with respect to operational requirements and positive in operation.

In a more specific sense, it is an object of this invention to provide a simple frictionless and inexpensive adjustable bearing for sensitive relays.

The foregoing statements are merely illustrative of the various aims and objects of this invention. Other objects and advantages will become apparent from a study of the following specification when considered in conjunction with the accompanying drawings; in which,

Figure 1 is a side elevational view of an electromagnetic operating switch embodying the principles of this invention,

Fig. 2 is a fragmentary front elevational view of the switch of Fig. 1, and

Figs. 3 through 8 illustrate certain details of the switch assembly shown in Figs. 1 and 2.

The switch assembly shown in Figs. 1 and 2 is of the electromagnetic type and is assembled upon a main back plate **1** which is adapted for mounting upon a suitable panel not shown. This back plate is preferably of magnetic material and forms part of a U-shaped magnet circuit in which the legs are defined by respective cores **2** and **3** having respective coils **4** and **5** thereon. The cores **2** and **3** project perpendicularly from the back plate **1** in spaced parallel relation so as to clear the coil portions disposed therebetween as better seen in Fig. 2. Respective pole plates **6** and **7** are secured to the ends of the respective cores. Between the lower ends of the pole plates **6** and **7** a hinge pin support plate **8** is secured. This plate is of non-magnetic material and has secured thereto respective hinge pins **9** and **10**. As best seen in Fig. 1 these hinge pins are provided with longitudinally spaced circumferential grooves **11**. The axes of the

respective hinge pins are substantially normal to the planes of the respective pole plates.

An arc box structure **12** is secured to the upper end of the back plate **1** and as seen in Fig. 1 extends outwardly over the coil assembly. This arc box structure is not illustrated in detail since per se it forms no part of this invention. However, in general this structure comprises an outer frame **13** within which is mounted an adjustable assembly **14**, illustrated in dotted outline including, respective stationary contacts **15** and **16** which are secured therein. This adjustable assembly may include the arc extinguishing portion of the assembly as a unit with the stationary contact assembly to be adjusted therewith, or the arc quenching plates may be separate fixed units and the stationary contact adjusted relative thereon as may be feasible.

Provision is made for adjusting this assembly by means of respective screws **17** and **18** which clear through slots **19** and **20** respectively in the arc box frame **13** and thread into the adjustable assembly therewithin. Screw **17** may be the locking screw and therefore may be the only screw requiring manipulation for adjustment, in which case, to shift the contact assembly longitudinally of the arc box structure, screw **17** may be loosened and the assembly moved in the desired direction.

Moving contacts **21** of the contact assembly are mounted upon a contact arm **22** which is secured to an armature plate **23**. This armature plate **23** as will be seen by reference to Fig. 2 is of substantially rectangular plan form and straddles the respective pole plates from one outer edge to the other outer edge to bridge the magnetic circuit across its outer ends. Contact arm **22** is preferably formed of a non-magnetic material.

Armature plate **23** is movably mounted in a position adjacent to and straddling respective pole plates **6** and **7** by means of an armature bearing plate generally designated **24** which is of substantially inverted Y-shaped configuration as best seen in Fig. 2. This armature bearing plate at the bottom edges of its respective legs **25** and **26** is provided with respective bearing edges **27** and **28** which ride in the bottoms of corresponding grooves **11** in the respective hinge pins **9** and **10**. In this position a definite bearing edge is formed about which pivotal movement of the armature assembly may take place. In the illustration in Fig. 1 the bearing edges **27** and **28** are respectively positioned in the grooves adjacent to the respective pole plates and the armature is shown in the position occupied when the coil is energized and the armature is attracted to the pole plates. In this position, moving contacts **21** engage the stationary contact **15**.

Provision is made to prevent lateral movement of the armature assembly with respect to the electromagnet assembly by means of shoulders **29** and **30** (Figs. 2 and 5) respectively disposed at right angles to bearing edges **27** and **28**. At the bottom ends of these respective shoulders as best seen in Fig. 2 and in the armature bearing plate details in Figs. 4, 5 and 6 a flange is formed at right angles to the plane of the bearing plate. These respective flanges are designated **31** and **32** (Fig. 4) and are of sufficient length to straddle the adjacent partition which defines the groove. Thus any tendency for lateral movement engages the flange with the mentioned partition to effectively limit the lateral shift which can take place. Slots **33** and **34** (Figs. 4 and 5) which open through the confronting edges of the respective flanges receive the legs **35** and **36** of a substantially inverted U-shaped retainer **37**, the details of which are shown in Figs. 7 and 8. This retainer is provided with a slot **38** which clears one of the screws **39** utilized to secure the armature bearing plate to the armature plate. The lower ends of the legs **35** and **36** project downwardly through the respective slots **33** and **34** and project outwardly at **40***a* and **40***b* respectively beneath the respective hinge pins. The ends of projections **40***a* and **40***b* are formed at right angles to the plate of the retainer to project in the direction of the respective axes of the hinge pins to prevent the projections from dropping into the grooves **11**. By adjusting the vertical position of retainer **37** on the armature bearing plate the clearance between the pro-

jecting ends **40***a* and **40***b* of the retainer and the respective hinge pins **9** and **10** may be set to limit vertical movement of the armature assembly as desired.

By these expedients the armature assembly is locked against appreciable vertical movement in either direction and is locked against appreciable lateral movement in either direction but is unhindered in its pivotal movement about the axis defined by the bearing edges.

The armature may be biased to a given deenergized position by means of a tension spring **41** which is engaged between a spring support **42** at the upper end of the armature bearing plate and an adjustable nut assembly **43** at its lower end. This adjustable nut assembly comprises a threaded screw **44** which is anchored in and projects outwardly from the hinge pin support plate **8**. In this position the screw **44** substantially parallels the spring support **42**. Thus the nut **45** which threads over the screw **44** travels a path which is substantially perpendicular to the plane of armature bearing plate **37**. The arrangement is such that the spring tension by adjustment of nut **45** along the screw **44** remains substantially unchanged, but the moment arm, to which the spring force is applied to the armature assembly is varied by such adjustment of the nut. As a consequence, the biasing torque acting on the armature is varied with such adjustment and may be made any suitable value within the physical limits of the adjustment feature.

For the position of the armature bearing in the hinge pin grooves illustrated in Fig. 1 maximum sensitivity of the relay is obtained. The rating of this relay may now be changed by selectively positioning the bearing edges of the armature bearing plate in corresponding grooves of the respective hinge pins along the length of the hinge pins. In one practical embodiment of this invention this adjustment is made in one-eighth increments which is determined by the spacing between the grooves. If the armature bearing plate is moved from the position indicated to the next adjacent grooves of the hinge pins, it will be appreciated that armature plate **23** will be moved away from the pole plates **6** and **7** respectively. Thus the air gaps between the armature plate and the respective pole plates are increased in dimension and more flux will be required to attract the armature to the core for this particular setting. As a consequence by this simple adjustment alone the rating of the relay may be increased; that is, the sensitivity is decreased. At the same time if necessary the stationary contact assembly may be positioned by means of the adjustable feature provided in the arc box structure. By so doing the position of the stationary contact with respect to the moving contact remains unchanged. A feature such as this may be found desirable in order to maintain the engaged positions of the contacts the same for any setting of the armature bearing plate bearing edges in the grooves alone.

The adjustment of the armature bearing plate along the hinge pins is accomplished by the simple expedient of loosening the screw **39** which secures the retainer to the armature assembly at which time the retainer drops downwardly to the limit of movement afforded by the slot **38**. In this position the flanged ends of the retainer clear the bottoms of the respective hinge pins in sufficient amount to permit lifting the bearing edges of the armature bearing plate over the separating partition into the next adjacent groove or to any of the grooves along the hinge pins as may be desired. When the armature bearing plate is properly positioned along the respective hinge pins, the retainer is then moved back to the position illustrated and the screw **39** is again tightened to secure the retainer in the desired position.

The hinge pins are of circular cross section primarily as a matter of manufacturing convenience since these items may be turned out on a screw machine which measurably expedites manufacture. However, from an operating point of view, it will be appreciated that the grooves **11** need not be circumferential as shown, nor does the hinge pin need to be of circular cross sectional configuration but may be of any desired cross section. The grooves **11** need only be in the upper edge of the hinge pin to receive the respective bearing edges of the armature bearing plate. Similarly the specific adjustment feature for adjusting the stationary contacts in correspondence with repositioning of the bearing edges of the armature bearing plate may assume a wide variety of designs. That being illustrated is only one of numerous simple ways of accomplishing this adjustment.

As will be seen from Fig. 3 which is an enlarged detail of the hinge pin, the bottom surfaces of the grooves **11** are sloped and do not parallel the axis of the hinge pin. By so doing, the bearing edges of the armature bearing plate are urged to the lowermost corner of the respective grooves. Thus the bearing point is well defined and travel of the bearing edge longitudinally along the bottom of the groove is eliminated. The threaded ends of the hinge pins afford a connection for a small shunt which carries the current around rather than through the bearing. Inasmuch as this detail, per se, forms no part of the present invention, it has not been illustrated in the interest of simplicity.

From the foregoing description and the illustrations in the drawing, it will be appreciated that a simple yet effective adjustment for varying the rating of the relay is provided by means of this invention. It will be appreciated, however, by those skilled in the art that this invention is susceptible of modification in its details without departing from the principles and scope of the teachings hereof. Consequently, it is intended that the foregoing disclosure and the illustrations of the drawings shall be considered as illustrative of the principles herein involved and are not to be interpreted in a limiting sense.

We claim as our invention:

1. Electromagnetically operated switch apparatus comprising a core, a magnetizing coil mounted on said core, an armature assembly including an armature member and an armature bearing plate secured to said armature member, said bearing plate having a pair of spaced bearing edges, a pair of correspondingly spaced hinge pins receiving said bearing edges thereagainst, each hinge pin having a plurality of axially spaced circumferential grooves, said grooves being axially spaced in a direction away from one end of said core and each being adapted to receive one of the respective bearing edges, said armature bearing plate pivotally supporting said armature in proximity to said one end of said core, the air gap between the armature member and the core being adjustable by selective positioning of the respective bearing edges in the grooves of the respective hinge pins.

2. Electromagnetically operated switch apparatus comprising a core, a magnetizing coil mounted on said core, an armature assembly including an armature member and an armature bearing plate secured to said armature member, said bearing plate having a pair of spaced bearing edges, a pair of correspondingly spaced hinge pins receiving said bearing edges thereagainst, each hinge pin having a plurality of axially spaced circumferential grooves, said grooves being axially spaced in a direction away from one end of said core and each being adapted to receive one of the respective bearing edges, said armature bearing plate pivotally supporting said armature in proximity to said one end of said core, the air gap between the armature member and the core being adjustable by selective positioning of the respective bearing edges in the grooves of the respective hinge pins, and resilient means engaging said armature assembly and biasing said assembly away from said core.

3. Electromagnetically operated switch apparatus comprising, a core, a magnetizing coil mounted on the core, an armature assembly including an armature member and an armature bearing plate secured to said armature member, said bearing plate having a pair of spaced bearing edges, a pair of correspondingly spaced hinge pins receiving said bearing edges thereagainst, each hinge pin having a plurality of axially spaced laterally disposed grooves, said grooves being axially spaced in a direction away from one end of said core, and each being adapted to receive one of the respective bearing edges, said armature bearing plate pivotally supporting said armature member in proximity to said one end of said core, the air gap between the armature member and the core being adjustable by selective positioning of the respective bearing edges in the grooves of the respective hinge pins.

4. Electromagnetically operated switch apparatus comprising, a core, a magnetizing coil mounted on the core, an armature assembly including an armature member and an armature bearing plate secured to said armature member, said bearing plate having a pair of spaced bearing edges, a pair of correspondingly spaced hinge pins receiving said bearing edges thereagainst, each hinge pin having a plurality of axially spaced laterally disposed grooves, the

axis of each hinge pin substantially paralleling the axis of said core, each hinge pin being adapted to receive in the grooves thereof one of the respective bearing edges, said armature bearing plate pivotally supporting said armature member in proximity to one end of said core, the air gap between the armature member and said one end of the core being adjustable by selective positioning of the respective bearing edges in the grooves of the respective hinge pins.

5. Electromagnetically operated switch apparatus comprising, a U-shaped core, a pair of magnetizing coils, one coil on each leg of the U-shaped core, an armature assembly including an armature member of a length to straddle the ends of said legs and an armature bearing plate secured to said armature member, said armature bearing plate having a pair of spaced bearing edges, a pair of correspondingly spaced hinge pins having a plurality of axially spaced laterally disposed grooves, the axis of each hinge pin paralleling the respective axes of said legs, each hinge pin being adapted to receive in the grooves thereof one of the respective bearing edges, said armature bearing plate pivotally supporting said armature member in proximity to and straddling the ends of said legs, the air gaps between said armature member and the ends of said legs being adjustable by selective positioning of said respective bearing edges in the grooves of said respective hinge pins.

6. Electromagnetically operated switch apparatus comprising, a U-shaped core, a pair of magnetizing coils, one coil on each leg of the U-shaped core, an armature assembly including an armature member of a length to straddle the ends of said legs and an armature bearing plate secured to said armature member, said armature bearing plate having a pair of spaced bearing edges, a pair of correspondingly spaced hinge pins having a plurality of axially spaced laterally disposed grooves, the axis of each hinge pin paralleling the respective axes of said legs, each hinge pin being adapted to receive in the grooves thereof one of the respective bearing edges, said armature bearing plate pivotally supporting said armature member in proximity to and straddling the ends of said legs, the air gaps between said armature member and the ends of said legs being adjustable by selective positioning of said respective bearing edges in the grooves of said respective hinge pins, and resilient means engaging said armature assembly and biasing said armature member away from the ends of said legs.

7. Electromagnetically operated switch apparatus comprising, a U-shaped core, a pair of magnetizing coils, one coil on each leg of said core; a pole plate secured to the end of each leg of the core, said pole plates extending in substantially the same direction from the core, an armature assembly including an armature member and an armature bearing plate secured to the armature member, said armature member having a dimension sufficient to straddle said pole plates, said armature bearing plate having spaced bearing edges, a pair of hinge pins, said hinge pins being respectively secured to the respective pole plates in corresponding positions thereon displaced from said legs, each hinge pin having axially spaced laterally disposed grooves, said bearing edges being respectively seated in corresponding grooves of said respective hinge pins, said armature bearing plate pivotally supporting said armature member in proximity to and straddling said pole plates, the air gap between the armature member and the respective pole plates being adjustable by selectively positioning the respective bearing edges in the grooves of the respective hinge pins.

8. Electromagnetically operated switch apparatus comprising, a U-shaped core, a pair of magnetizing coils, one coil on each leg of said core; a pole plate secured to the end of each leg of the core, said pole plates extending in substantially the same direction from the core, an armature assembly including an armature member and an armature bearing plate secured to the armature member, said armature member having a dimension sufficient to straddle said pole plates, said armature bearing plate having spaced bearing edges, a pair of hinge pins, said hinge pins being respectively secured to the respective pole plates in corresponding positions thereon displaced from said legs, each hinge pin having axially spaced circumferential grooves, said bearing edges being respectively seated in corresponding grooves of said respective hinge pins, said armature bearing plate pivotally supporting said armature member in proximity to and straddling said pole plates, the air gaps between the armature member and the respective pole plates being adjustable by selectively positioning the respective bearing edges in corresponding grooves of the respective hinge pins.

9. Electromagnetically operated switch apparatus comprising, a U-shaped core, a pair of magnetizing coils, one coil on each leg of said core; a pole plate secured to the end of each leg of the core, said pole plates extending in substantially the same direction from the core, an armature assembly including an armature member and an armature bearing plate secured to the armature member, said armature member having a dimension sufficient to straddle said pole plates, said armature bearing plate having spaced bearing edges, a pair of hinge pins, said hinge pins being respectively secured to the respective pole plates in corresponding positions thereon displaced from said legs, each hinge pin having axially spaced circumferential grooves, said bearing edges being respectively seated in corresponding grooves of said respective hinge pins, said armature bearing plate pivotally supporting said armature member in proximity to and straddling said pole plates, the air gaps between the armature member and the respective pole plates being adjustable by selectively positioning the respective bearing edges in corresponding grooves of the respective hinge pins, and resilient means engaging said armature assembly and biasing said armature member away from said pole plates.

10. An electromagnetically operated switch comprising, a core, a magnetizing coil mounted on the core, an armature assembly including an armature member and an armature bearing plate secured to the armature, a pair of hinge pins disposed in spaced relation in corresponding positions laterally displaced from said core, each hinge pin having axially spaced and laterally disposed grooves, bearing edges on said armature bearing plate spaced in correspondence with the spacing of said hinge pins, said respective bearing edges occupying positions in corresponding grooves of said respective hinge pins and said armature bearing plate supporting said armature member in proximity to one end of said core, the air gap between said armature member and said core being adjustable by selectively positioning said respective bearing edges in corresponding grooves of said respective hinge pins.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
708,539	Fell	Sept. 9, 1902
1,000,314	Zundel	Aug. 8, 1911
1,226,775	Koenig	May 22, 1917
1,481,104	Lenaghan	Jan. 15, 1924