July 1, 1958 J. W. WURGLER 2,841,668

OVERSPEED RELAY

Filed July 20, 1956

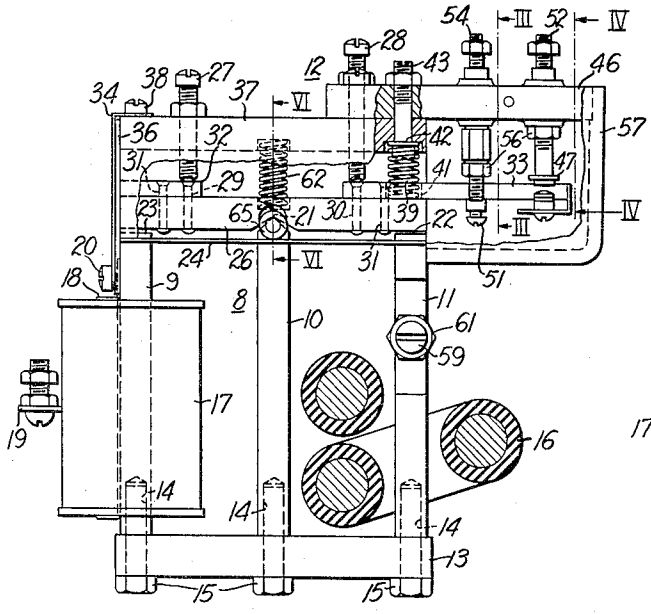


Fig. 1

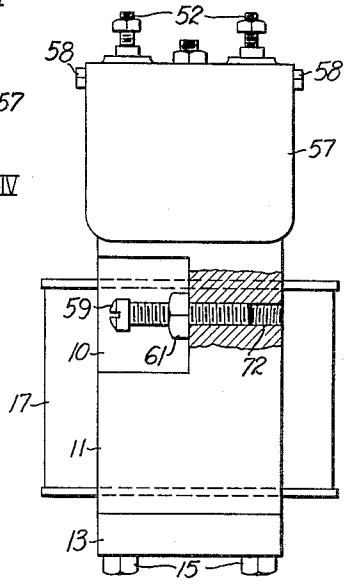


Fig. 2

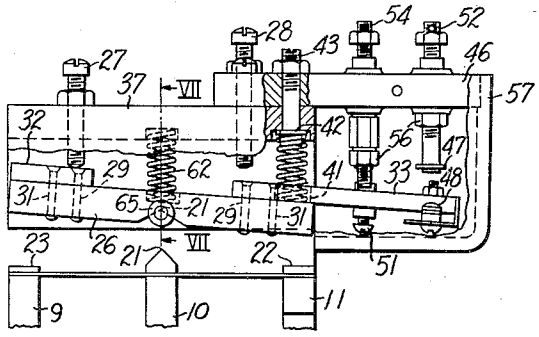


Fig. 5

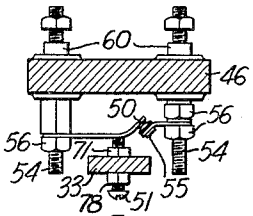


Fig. 3

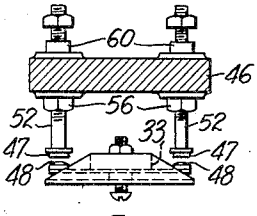


Fig. 4

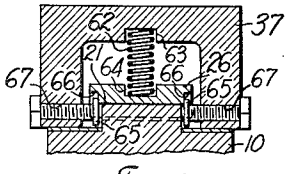


Fig. 6

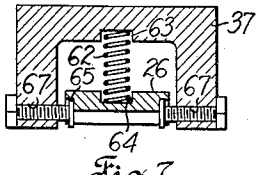


Fig. 7

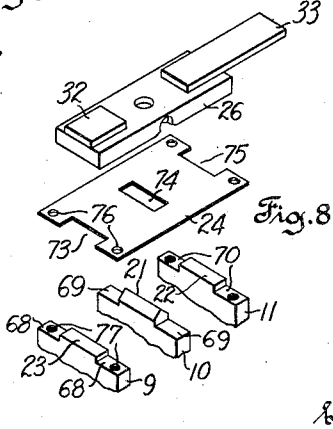


Fig. 8

Inventor
John W. Wurgler
by Joseph E. Kerwin
Attorney

United States Patent Office

2,841,668

Patented July 1, 1958

2,841,668

OVERSPEED RELAY

John W. Wurgler, Wauwatosa, Wis., assignor to Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Application July 20, 1956, Serial No. 599,107

8 Claims. (Cl. 200—87)

This invention relates in general to improvements in electromagnetic relays and more particularly to the through conductor relays of the differential type.

In contrast to the usual coil found on an electromagnetic relay the through conductor type of relay uses a bus bar or a cable to induce a magnetic flux in the relay core. As these conductors are large and unwieldly the usual procedure is to assemble the relay about the bus bar or cable once the latter is in position. In the case of a protective relay it may not be possible to create the condition required to actuate the relay once the relay is assembled around the conductor and in place without overloading the other equipment. There is need, therefore, for a reliable electromagnetic relay which may be adjusted, disassembled and reassembled without affecting the adjustment of the operating point.

Although relays have been built which remain in adjustment through disassembly and reassembly, for example, a relay described by U. S. Patent 2,558,640, they have the shortcomings of being difficult to adjust and are susceptible to fouling of the contacts and pivot point due to oil and dust in the atmosphere surrounding the relay.

It is therefore an object of this invention to provide a through conductor differential relay which is easy to adjust and has its moving parts protected from foreign matter in the atmosphere.

Another object of this invention is to provide an electromagnetic differential relay which is capable of a wide range of operation without changing any air gap or spring adjustment.

It is still another object of this invention to provide an electromagnetic differential relay which may be adjusted over a wide range of operation without a loss of sensitivity.

Other objects and advantages will be apparent from a consideration of the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a side elevation, partly in section, of a through conductor differential relay embodying the invention;

Fig. 2 is an end view of the relay shown in Fig. 1 with a section cut away to better show the reluctance adjusting screw;

Fig. 3 is a cross sectional view of the normally closed contact taken along line III—III of Fig. 1;

Fig. 4 is a cross sectional view of the normally open contact taken along line IV—IV of Fig. 1;

Fig. 5 is a view in side elevation of the armature and contact assembly showing the position of the armature after removal from the relay core;

Fig. 6 is a cross sectional view of the armature bridge assembly taken along line VI—VI of Fig. 1;

Fig. 7 is a cross sectional view of the armature bridge assembly taken along line VII—VII of Fig. 5; and

Fig. 8 is an exploded view of the relay core, the lower dust cover and the armature.

Referring more particularly to the drawings by characters of reference, the preferred embodiment of the invention illustrated in Figs. 1 to 8 comprises a generally E-shaped magnetic core **8** having three legs **9**, **10** and **11**. A base member **13** of magnetic material is affixed to the core legs by means of bolts **15** passing into tapped holes **14** in the core legs. The coil **17** with terminals **19** is mounted on leg **9** of the electromagnet core with a clamp **18** held by screw **20**. The end of core leg **10** tapers to a knife edge **21**. Core leg **9** is shorter than core leg **10** and has an end pole piece **23** opposite base member **13**. Core leg **11**, which is shorter than core leg **10**, has an end pole piece **22** opposite base member **13**.

An armature **26** of magnetic material pivots on knife edge **21**. Rivets **29** and **31** hold the counterweight **32** against armature **26**. The contact support arm **33** is affixed to the armature with similar rivets **30** and **31**. The position of armature **26** relative to core leg **11** is adjusted by armature stop adjustment screw **27** bearing against hardened steel rivet **29** passing through armature **26** and counterweight **32**. Armature retaining members **65** position the armature on the knife edge **21**. These members are adjustable so that the gap between them may be widened to permit insertion of the armature. The actuated position of armature **26** relative to core leg **9** is adjusted by armature stop adjustment screw **28** bearing against hardened steel rivet **30** passing through armature **26** and contact support arm **33**.

A dust cover **34** of any suitable nonmagnetic material has a felt seal **36** which bears against the bridging support channel **37** and is held in position against the bridging support channel and core leg **9** by any suitable means such as screws **38** passing through holes in cover **34**, holes **76** in cover **24**, into tapped holes **77** in core leg **9**, and screw **20** passing through a slot in cover **34** into core leg **9**. Screws **38** also serve to hold the armature support bridge against the core leg **9**. Similar screws passing through the armature support bridge into core leg **11** are not visible on the drawing. A dust cover **24** of any suitable nonmagnetic material such as brass is held in position against recessed shoulders **68**, **69** and **70** of legs **9**, **10** and **11** by bridging support channel **37**. This cover abuts the lower surfaces of armature bridge **37** and walls of the core legs **9**, **10** and **11**, thereby preventing the entry of foreign matter into the armature and contact assembly. A bias spring **39** compressed between recess **41** in the armature contact support arm and shoulder **42** of spring adjustment screw **43** serves to bias the armature toward core leg **11** and away from core leg **9**; in other words, the spring **39** biases the armature in a clockwise direction.

The function of the armature pivot spring **62** and armature retaining members **65** may be better understood by reference to Figs. 6 and 7.

Fig. 6 illustrates the position of the armature **26** relative to armature retaining members **65** when the relay is assembled. Armature pivot spring **62** biases the armature against knife edge **21**. Spring **62** is retained in position against the armature by means of a recess **63** in the bridging support channel at one end and by recess **64** in the armature at the opposite end. Armature retaining members **65** passing through tapped holes **67** in the armature support bridge restrain the armature from movement in a direction parallel to the pivotal axis.

Fig. 7 illustrates the relative positions of armature **26** and armature retaining members **65** when the armature assembly is removed from the core. Armature pivot spring **62** has moved armature **26** against armature retaining members **65** so that the shoulders **66** and members **65** are in contact and the armature is restrained from further movement away from the bridging support channel.

In Fig. 8, an exploded view of the dust cover **24**, the core **8** and armature **26**, the bridging support channel has been cut away from the armature to show the shape of dust cover **24**. The spaced openings **73**, **74** and **75** for the knife edge **21** and pole pieces **22** and **23** may be seen in this figure. When assembled, dust cover **24** rests on shoulders **68**, **69** and **70** of legs **9**, **10** and **11**. This creates a dustproof seal about the two pole pieces and the knife edge.

The normally closed contacts **50** and **55**, illustrated more specifically in Fig. 3, comprise a resilient contact **50** and a fixed contact **55** supported by threaded terminal studs **54**. An adjustment screw **51** affixed to contact support arm **33** and locked in position by lock nuts **78** and **71**, coacts with contact **50** to open the contacts **50** and **55** when the relay is in the actuated position.

The normally open contacts **47**, illustrated more specifically in Fig. 4, comprise a resilient bridging contact **48** mounted on contact support arm **33**. Fixed contacts **47** affixed to the ends of threaded terminal studs **52** coact with the bridging contact to complete an electrical circuit connected to the terminal studs **52** when the relay is in the operated position. Lock nuts **56** on terminal studs **52** and **54** coact with threaded inserts **60** molded into contact carrier **46** to hold studs **52** and **54** in a fixed position.

A transparent protecting cover **57** is held in position against the contact carrier **46** of insulating material and core leg **11** by means of removable screws **58**.

A nonmagnetic counterweight **32** affixed to armature **26** at the opposite end of contact support arm **33** by means of rivets **29** and **31** serves to balance the armature on the knife edge point **21** and offsets the effect of the weight of the contact support arm and the movable contact at the opposite end of the armature. Since the armature is balanced it is essentially shockproof in operation.

A reluctance adjustment screw **59** of magnetic material passing into tapped hole **72** in core leg **11** varies the reluctance of the magnetic circuits of which leg **11** is a part. Core leg **11** is restricted in area at the point to obtain the desired flux density for proper range of adjustment with screw **59**. Lock nut **61** provides a means of holding adjustment screw **59** in position and prevents vibration from changing the adjustment.

In adjusting a through current relay used as a protective device it is essential that the operating point of the relay be determined with accuracy and be easily changed to give the desired protection. The ease and simplicity of adjustment of this relay will be apparent from the following description of the method of adjustment.

The armature assembly **12** must be first removed from the core to permit insertion of a turn of conductor **16** into the passage between legs **10** and **11**. Screws **38** and screws passing through bridging support channel **37** into core leg **11** are removed and screw **20** loosened slightly to permit cover **34** to be withdrawn. Assembly **12** may now be removed from core **8**, permitting dust cover **24** to be lifted from the core legs and the conductor to be inserted. Depending on the current to be measured and the size of the conductor, one or more turns about leg **11** may be used.

The unit is then reassembled with the conductor in place, leaving off dust cover **34**. Contact cover **57** is now removed by withdrawing screws **58** from the contact support **46**. The two air gaps are now accessible to enable a feeler gauge to be inserted.

A simple mechanical adjustment of the air gap is the next step in establishing the operating point of the relay at the desired level. In a conventional differential relay using two air gaps it is necessary to carefully vary the air gaps and the bias spring tension but with a relay embodying this invention it is necessary only to adjust the air gap to specific values which are already known to obtain the desired operating point. The adjusting screw **27** and its associated lock nut provide a simple means

of setting the pickup air gap between core leg **11** and armature **26**. A feeler gauge is inserted into the gap between armature **26** and the pole piece **22**. The air gap adjusting screw is then varied until the proper separation is obtained. The lock nut is tightened to prevent the adjustment from changing. As may be seen from Fig. 1, the bias spring **39** holds the armature against the air gap adjustment **27** due to the pivoting action of the armature about the knife edge **21**.

When the relay is used solely as a protective device the air gap between the pole piece **23** and armature **26** in the actuated position is not critical since it does not enter into the operating cycle of the relay.

However, since it may be desirable to use the relay in situations where the drop out value is important, this gap may be easily set to a predetermined value by means of feeler gauges and an adjustment screw **28**, much as the working air gap was established by the adjustment of air gap screw **27**. Adjusting screws **27** and **28** bear against hardened steel rivets **29** and **30** passing through the armature to prevent changing the air gap due to wear. In addition to presenting a wear resisting surface, the rivets serve to hold the contact support arm and counterweight against the relay armature.

Where extreme accuracy in determining the operating point of the relay is desired, it is desirable to preset the tension of the resilient contact **50** of the normally closed contact assembly, since screw **51** engaging resilient member **50** produces a force resisting the counterclockwise movement of the armature much as does the bias spring **39**. This completes all the mechanical adjustments on the armature assembly with the exception of an adjustment of the bias spring.

A source of variable potential is now connected to the relay coil **17** at terminals **19**. The potential is varied until a direct current of a predetermined known value is passing through the coil. With no current flowing in conductor **16**, the compression in spring **39** is varied by means of adjusting screw **43** until the armature is attracted to pole piece **23** and pulled away from pole piece **22**. The potential applied to the coil **17** is dependent upon the pull in curve desired for the relay but will be standard for any given type of relay. A direct current is now passed through the bus bar or heavy conductor, passing through the opening defined by legs **10** and **11** and base **13**. When the desired value of current is passing through the conductor the reluctance adjustment screw **59** is gradually withdrawn from the tapped hole in leg **11**. At a point where the reluctance of the magnetic circuit including the air gap between pole piece **22** and armature **26** has increased sufficiently to reduce the attraction between the armature **26** and pole piece **22**, the attractive force exerted on the armature across the air gap between pole piece **23** and armature **26**, in a counterclockwise direction, becomes sufficient to overcome the additive force of the bias spring **39**, the contact tension and the magnetic attraction of pole piece **22**. Adjustment of the relay is now complete and lock nut **61** is tightened on adjustment screw **59** to insure that the adjustment will not change. This adjustment may be performed in a laboratory where complete and accurate measuring facilities are easily obtained, permitting quick and easy adjustment of the relay.

When the relay is desired to be installed about a bus bar or a heavy conductor, the screws securing the armature bridge assembly to the relay coil are again removed and screw **20** loosened. This frees the armature bridge assembly from the core and allows dust cover **24** to be removed and conductor **16** to be inserted into the opening between core leg **10** and core leg **11**. It will be noticed that removing the armature bridge assembly does not affect the adjustment screws for either of the air gaps, nor is it necessary to change the spring tension of spring **39** or the setting of the resilient contact **50**. Since armature pivot spring **62** exerts a downward force and the bias

spring 39 exerts a downward force, the relay tends to pivot about point of contact between air gap adjustment screw 27 and hardened steel rivet 29. Rotation about that point is limited by the armature retaining members 65 and the shoulders on the armature 26. When these shoulders engage the armature retaining screws, the armature comes to rest and is held from further movement out of the armature bridge. Screw 20 must be again loosened slightly to permit insertion of the sealing plate 34 with the felt insert 36 designed to prevent the entry of dust into the area of the pivot and contacts. Contact assembly cover 57 is replaced in position by screws 58 passing into contact support 46 effectively sealing the contact from foreign matter in the air.

Thus, the entire air gap pivot point and contact assembly is protected against the entry of foreign matter and reliable operation is easily obtained. Although the relay herein described is referred to as a through conductor differential type the invention is not limited to this application but could be used with a conventional two legged core or a relay using a plurality of coils.

What is claimed is:

1. An armature and contact assembly for an electromagnetic relay comprising a bridging support channel of nonmagnetic material, said channel adapted to be mounted on an electromagnetic relay core, a nonmagnetic dust cover closing off the bottom of said channel, an armature of magnetic material adapted to be pivotally supported within said channel, a first spring bias means urging said armature outwardly from said channel, armature retaining means on said channel, said retaining means engaging said armature to retain said armature substantially within said channel, said retaining means disengaging from said armature when said armature is pivotally supported within said channel, a second adjustable spring biasing means resisting pivotal movement of said armature, armature stop means limiting the pivotal movement of said armature, contact means disposed to be actuated in response to the pivotal movement of said armature, a plurality of enclosure means coacting with said channel and dust cover to define a chamber enclosing said armature and contact means.

2. An electromagnetic relay of the through conductor differential type comprising a three legged core of magnetic material, a first of said legs having a first pole piece, shoulders on said first leg adjacent to said first pole piece, a second of said legs having a second pole piece, shoulders on said second leg adjacent to said second pole piece, a third of said legs having a knife edge, a dust cover of nonmagnetic material, said dust cover adapted to be mounted on said shoulders of said legs, a removable bridging support channel of nonmagnetic material, detachable mounting means securing said channel to said shoulders of said core legs, said mounting means coacting with said channel to secure said dust cover to said shoulders, an armature of magnetic material, said armature adapted to be pivotally supported within said channel by said knife edge, the point of engagement of said armature and said knife edge defining a pivot point, armature retaining means on said channel, a first spring bias means urging said armature outwardly from said channel, said retaining means engaging said armature and coacting with said first bias means to limit the outward movement of said armature whereby said armature remains substantially within said channel when said channel is removed from said core, said retaining means disengaging from said armature when said armature is pivotally supported by said knife edge and said channel is mounted on said shoulders of said core legs, said first spring bias means holding said armature in pivotal engagement with said knife edge when said channel is secured to said shoulders of said core legs, an adjustable armature stop member, said stop member limiting the pivotal movement of said armature about said pivot point, a second adjustable spring bias means resisting the pivotal movement of said armature in one direction, an electrical contact support plate of insulating material affixed to said channel, electrical contact means affixed to said support plate, said contact means actuated in response to pivotal movement of said armature, a plurality of enclosure means coacting with said contact support plate, said channel, said core and said dust cover to define a chamber enclosing said armature and contact means.

3. An electromagnetic relay of the through conductor differential type comprising a three legged core of magnetic material, a first of said legs having a first pole piece, shoulders on said first leg adjacent to said first pole piece, a second of said legs having a second pole piece, shoulders on said second leg adjacent to said second pole piece, a third of said legs having a knife edge, shoulders on said third leg adjacent to said knife edge, a dust cover of nonmagnetic material, said dust cover adapted to be mounted on said shoulders of said legs, a removable bridging support channel of nonmagnetic material, detachable mounting means securing said channel to said shoulders of said core legs, said mounting means coacting with said channel to secure said dust cover to said shoulders, an armature of magnetic material, said armature adapted to be pivotally supported within said channel by said knife edge, the point of engagement of said armature and said knife edge defining a pivot point, armature retaining means on said channel, a first spring bias means urging said armature outwardly from said channel, said retaining means engaging said armature and coacting with said first bias means to limit the outward movement of said armature whereby said armature remains substantially within said channel when said channel is removed from said core, said retaining means disengaging from said armature when said armature is pivotally supported by said knife edge and said channel is mounted on said shoulders of said core legs, said first spring bias means holding said armature in pivotal engagement with said knife edge when said channel is secured to said shoulders of said core legs, adjustable armature stop members, said stop members limiting the pivotal movement of said armature about said pivot point, a second adjustable spring bias means resisting pivotal movement of said armature in one direction, a tapped hole in said first core leg substantially reducing the cross sectional area of said leg, a screw of magnetic material inserted into said hole, the position of said screw in said hole affecting the reluctance of magnetic circuits of which said first leg is a part, an electrical contact support plate of insulating material affixed to said channel, electrical contact means affixed to said support plate, said contact means actuated in response to the pivotal movement of said armature, a plurality of enclosure means coacting with said contact support plate, said channel, said core and said dust cover to define a chamber enclosing said armature and contact means.

4. An electromagnetic relay of the through conductor differential type comprising a three legged core of magnetic material, a first of said legs having a first pole piece, shoulders on said first leg adjacent to said first pole piece, a second of said legs having a second pole piece, shoulders on said second leg adjacent to said second pole piece, a third of said legs having a knife edge, shoulders on said third leg adjacent to said knife edge, a dust cover of nonmagnetic material, said dust cover adapted to be mounted on said shoulders of said legs, a removable bridging support channel of nonmagnetic material, detachable mounting means securing said channel to said shoulders of said core legs, said mounting means coacting with said channel to secure said dust cover to said shoulders, an armature of magnetic material, said armature adapted to be pivotally supported within said channel by said knife edge, the point of engagement of said armature and said knife edge defining a pivot point, armature retaining means on said channel, a first spring bias means urging said armature outwardly from said channel, said retaining means engaging said armature and coacting with

said first bias means to limit the outward movement of said armature whereby said armature remains substantially within said channel when said channel is removed from said core, said knife edge, said armature, said retaining means, said channel and said shoulders so disposed as to effect disengagement of said armature and said retaining means when said armature is pivotally supported by said knife edge and said channel is mounted on said shoulders, said first spring bias means holding said armature in pivotal engagement with said knife edge when said channel is secured to said shoulders of said core legs, adjustable armature stop members, said stop members limiting the pivotal movement of said armature about said pivot point, a second adjustable spring bias means resisting pivotal movement of said armature in one direction, a tapped hole in said first core leg substantially reducing cross sectional area of said leg, a screw of magnetic material inserted into said hole, the position of said screw in said hole affecting the reluctance of magnetic circuits of which said first leg is a part, an electrical contact support plate of insulating material affixed to said channel, electrical contact means affixed to said support plate, said contact means actuated in response to the pivotal movement of said armature, a plurality of enclosure means coacting with said contact support plate, said channel, said core and said dust cover to define a chamber enclosing said armature and contact means.

5. An armature and contact assembly for an electromagnetic relay having an electromagnet core with a plurality of legs comprising a bridging support channel of nonmagnetic material, said channel removably mounted on said core, an armature of magnetic material pivotally positioned on a first of said core legs, an armature stop member on said channel limiting the pivotal movement of said armature, a plurality of electrical contacts, said contacts coacting to actuate an electrical circuit in response to the pivotal movement of said armature, enclosure means coacting with said channel and said core to define a chamber enclosing said armature and electrical contacts, a first adjustment spring bias means resisting the movement of said armature relative to a second of said core legs, a second spring biasing means holding said armature in pivotal engagement with said first leg, an armature retaining member on said bridge, said retaining member and said armature coacting with said second biasing means to contain said armature substantially within said bridge when said assembly is removed from said core.

6. An armature and contact assembly for an electromagnetic relay having an electromagnet core with a plurality of legs comprising a bridging support channel of nonmagnetic material, said channel removably mounted on said core, an armature of magnetic material pivotally positioned on a first of said core legs, an armature stop member on said channel limiting the pivotal movement of said armature, a plurality of electrical contacts, said contacts coacting to actuate an electrical circuit in response to the pivotal movement of said armature, enclosure means coacting with said channel and said core to define a chamber enclosing said armature and electrical contacts, a first adjustable spring bias means resisting the movement of said armature relative to a second of said core legs, a second spring biasing means holding said armature in pivotal engagement with said first leg, an armature retaining member on said bridge, said retaining member and said armature coacting with said second biasing means to contain said armature substantially within said bridge when said assembly is removed from said core, reluctance adjusting means for setting the operating point of said relay independent of adjustment of air gap between said armature and said core legs comprising a hole in said first leg substantially reducing cross sectional area of said first leg, a screw of magnetic material in said hole, position of said screw in said hole affecting the reluctance of magnetic circuits of which said first leg is a part.

7. In an electromagnetic relay of the through conductor differential type, a core of magnetic material, said core having a base and a plurality of legs, a first of said legs joined at one end to said base, said first leg having a pole piece at the other end, a second of said legs joined at one end to said base, said second leg having a pole piece at the other end, a third of said legs joined at one end to said base intermediate said first and said second legs, said third leg having a knife edge at the other end, a coil about said first leg, a coil about said second leg, an armature of magnetic material, said armature pivotally mounted on said knife edge, reluctance adjusting means comprising a member of magnetic material, said first leg having an aperture receiving said member in a variable position, the position of said member affecting the reluctance of the magnetic circuits of which said first leg is a part.

8. An electromagnetic relay of the through conductor differential type comprising a three legged core of magnetic material, a first of said legs having a first pole piece, shoulders on said first leg adjacent to said first pole piece, a second of said legs having a second pole piece, shoulders on said second leg adjacent to said second pole piece, a third of said legs having a knife edge, a coil about said second leg, a conductor passing through the opening defined by said first and third legs, a dust cover of nonmagnetic material mounted on said shoulders of said core legs, openings in said dust cover to permit the passage of said knife edge and said pole pieces when said cover is mounted on said shoulders, a bridging support channel of nonmagnetic material detachably mounted on said core, an armature of magnetic material, a groove in said armature coacting with said knife edge to form a pivotal axis about which said armature may move, an armature stop member mounted on said bridge limiting the pivotal movement of said armature, adjustable spring bias means restraining armature movement, an armature restraining member on said bridging channel engaging said armature to contain said armature within said bridge when said channel is removed from said core, electrical contact means disposed to be actuated by the pivotal movement of said armature, enclosure means coacting with said channel, said core and said dust cover to define a chamber enclosing said armature and said contacts.

References Cited in the file of this patent

UNITED STATES PATENTS

2,151,400	Williams	Mar. 21, 1939
2,454,973	Mason	Nov. 30, 1948