Jan. 1, 1963 W. H. PRIESEMUTH 3,071,664

SOLENOID RELAY WITH PNEUMATIC STROKE RETARDATION

Filed Sept. 9, 1957 2 Sheets-Sheet 1

Fig. 1

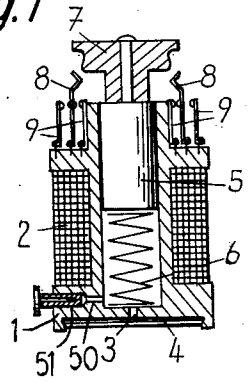


Fig. 3

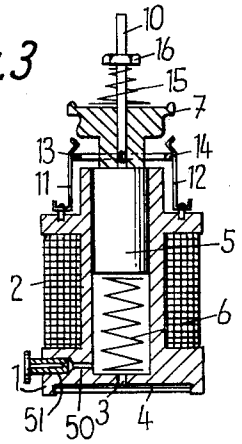


Fig. 2

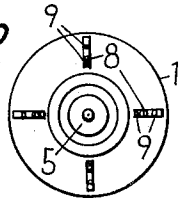


Fig. 4

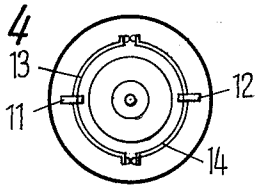
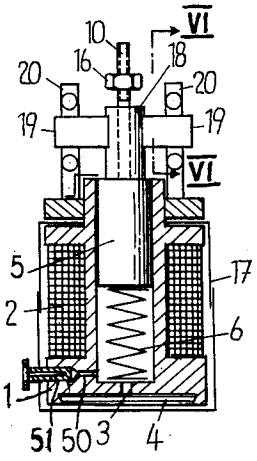


Fig. 5



INVENTOR:
WOLFGANG H. PRIESEMUTH
by Mestern & Frey
Armand E. Mestern

Jan. 1, 1963 W. H. PRIESEMUTH 3,071,664

SOLENOID RELAY WITH PNEUMATIC STROKE RETARDATION

Filed Sept. 9, 1957 2 Sheets-Sheet 2

Fig. 6

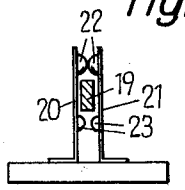


Fig. 7

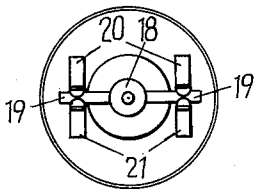


Fig. 9

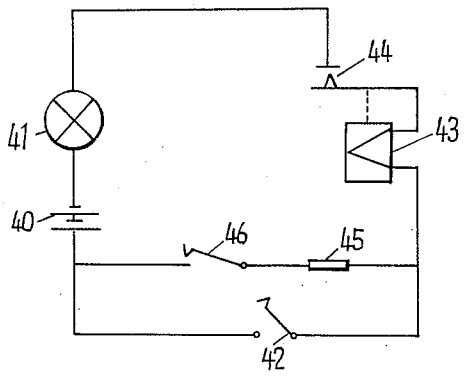


Fig. 8

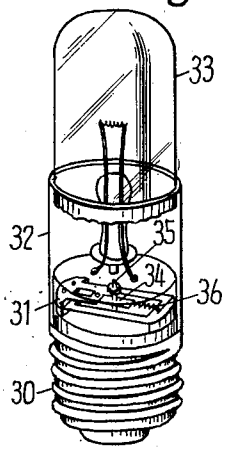
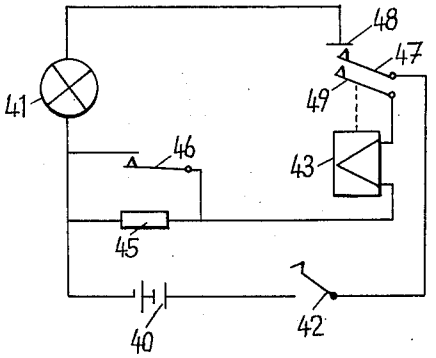


Fig. 10



INVENTOR:
WOLFGANG H. PRIESEMUTH
by Mestern & Frey
Armand E. Mestern

United States Patent Office 3,071,664 Patented Jan. 1, 1963

3,071,664

SOLENOID RELAY WITH PNEUMATIC STROKE RETARDATION

Wolfgang Herbert Priesemuth, Danzigerstr. 35, Itzehoe, Holstein, Germany

Filed Sept. 9, 1957, Ser. No. 682,846
Claims priority, application Germany Sept. 10, 1956
5 Claims. (Cl. 200—97)

The invention relates to a solenoid relay with pneumatic stroke retardation. In particular, it relates to the embodiment of such relays as blinker relays and their use in blinker circuits.

Time-delay relays are known per se. It is likewise known that the reciprocating motion of the plunger may be retarded in both directions by means of a pneumatic element.

However, known relays are of comparatively complicated construction, and moreover consume a comparatively large amount of current.

The object of the invention is to devise such a relay that will admit of a simple structure and consequently be of highly economical manufacture, such simple structure at the same time affording trouble-free operation in long continuous service.

For this purpose, according to the invention, a solenoid relay is so arranged that the plunger, electromagnetically attractable against spring action, operates against a yielding air cushion upon its return.

According to a preferred embodiment, the body of the energizing coil is fashioned as an air cylinder for a piston-like plunger, and the cylinder is further provided with a valve for unimpeded sudden air escape and a preferably controllable aperture for throttled flow. The plunger is then drawn in solely under spring load, the free escape of air permitting no pneumatic restraint, so that this step requires no additional current.

Retraction follows under the action of the spring against the air cushion, now closed, the adjustable throttled outlet being used to obtain the desired return delay.

A relay of this type will serve a great variety of applications, and is extremely simple and reliable compared to known types of relays.

A further preferred embodiment consists in building such a relay in the form of a self-interrupter. For this purpose, according to the invention, the plunger is provided with a contact slide actuable with play within the stroke, and the coil body is provided with a contact system for the energizing circuit to cooperate with the contact slide, in such manner that the contact slide is held back within its play by the contact system during the initial stroke, while in the rest of the stroke the contact slide engages the contact system, opening the energizing circuit, and is thenceforth held by it during the return of the plunger, using up the play. During the rest of the return stroke of the plunger, the contact slide is withdrawn from the contact system again, thus in turn closing the energizing circuit and recommencing the cycle of operations.

Such a solenoid relay with self-interrupter is extraordinarily simple to manufacture and nevertheless very reliable in operation. It can therefore be used to advantage in blinker circuits as well as for many other similar purposes.

The invention further relates to a modification of the relay for use in blinker circuits in conjunction with incandescent lamps, and also to a combination with the latter.

For this purpose, a solenoid relay of the kind described is so constructed that the free end of a leaf spring on the coil body oscillates laterally in the direction of motion of the piston between two terminal points thereof and is held in one of its two positions by a snap spring.

In addition, the oscillating leaf spring is provided with

pairs of contacts for the energizing coil and for a light-bulb circuit, contacting in the snap position at the beginning of the sucking stroke.

According to one embodiment, these pairs of contacts are so adjusted to each other that contact for the light-bulb circuit occurs during the return stroke in advance of contact closure of the excitation circuit.

By this arrangement, it is possible to build satisfactory and dependable blinker circuits by means of incandescent lamps. Both the relay and the lamp carry current for only an extremely short time, so that there is very low consumption. Owing to the brief closure of current, it is also possible to use lamps with low service voltage, so as to produce a stronger flash effect.

A very important advantage, however, consists in that this relay system can easily be installed in the base of an incandescent lamp. By appropriate circuiting, this produces an incandescent lamp with relay as a self-contained unit, the ordinary contacts of the lamp serving also as current leads. Such a blinker light bulb may then simply be screwed into a socket in a lighting circuit, and will produce a blinking light when switched on.

In this way, blinker circuits can be provided with great ease, simply in the form of an ordinary lighting circuit.

Blinker lights of this kind are used for signaling purpose, particularly in traffic signals, for the marking of construction sites and the like.

By the use of blinker relays of the present type, it becomes a single matter to install such warning blinker lights. A special factor is the source of current, whether in the form of dry cells or in the form of storage batteries, since in the first place a long-term service dependability and in the second place a certain minimum length of service are necessary. Also, it is essential for such warning blinker lights to have an independent source of current, as in this case batteries, so that they can be used anywhere and at any time.

Warning blinker lights using dry batteries can be installed quite successfully with such a self-interrupter relay, a size and type simple to operate and economical to manufacture.

But such warning blinker lights using dry batteries as source of current have another important disadvantage, namely that their preparedness for service is uncertain for a time. When new batteries are used, it is known that the requisite service life, in fact a multiple thereof, is available. When the batteries are exhausted, the interrupter relay fails to function, so that this circumstance can also be identified. In the use of warning blinker lights, however, it is necessary to be able to tell whether serviceability is assured for a certain length of time to come, which is to say that these should be a means of testing the lights at certain intervals. Permanent readiness for service cannot even be secured by regular change of batteries, because consumption in service is not directly apparent. Besides, even when not used, dry batteries have extreme storage sensitivity.

Now the present invention further relates to an improvement in warning blinker lights for overcoming these disadvantages, by providing simple means of checking future service life at any time. For this purpose, the circuit of interrupter relay, blinker light and battery, is provided with an auxiliary connectable resistance. This resistance may for example be in parallel with the switch, and briefly connected by means of a pushbutton. The resistance may, alternatively, be directly in series with the circuit and bypassed by a pushbutton switch which can be briefly opened, so as to be short-circuited in normal position of the pushbutton. In either case, therefore, the resistance is introduced into the circuit by means of a pushbutton. The value of the resistance should further be such, in relation to the operating resistances of the light and relay

coil, as well as to the service voltage of the battery as it discharges, that when a certain degree of discharge is reached, or in other words when the service voltage of the battery drops to a predetermined value, the relay coil fails to respond to the current in the circuit with the resistance connected. Preferably, the condition of discharge of the battery, and the corresponding undervoltage, should be chosen such as to ensure that the battery is good for a certain minimum additional period of time. For example, it may be required that such warning blinker lights be ready for fifteen hours continuous service. Then it is readily possible to determine a resistance value such that this requirement is met in terms of the other factors.

When the test key connecting the auxiliary resistance is actuated, the blinker light will be found to operate normally within a certain discharge interval. When discharge has progressed to a certain point, the relay will fail to respond, and the blinker light will be lit continuously while the test key is being actuated. This will mean that the blinker light with batteries as is will not last for the required period of service and that the batteries must be charged.

But if the light blinks while the test key is being actuated, the blinker light will operate for the required minimum period of time. These simple means therefore permit a permanent check-up on the blinker light, as required under existing regulations for use in traffic.

The device according to the invention will now be more fully described with reference to the accompanying drawings, but it should be understood that these are given by way of illustration and not of limitation and that many changes in the details may be made without departing from the spirit of the invention.

In the drawings:

FIG. 1 schematically shows a vertical section of a solenoid relay with plunger piston;

FIG. 2 shows a cross section of the same, through the plane of contact.

FIG. 3 shows a vertical section of a solenoid relay with self-interrupter.

FIG. 4 shows a cross-section of the relay of FIG. 3, through the plane of contact;

FIGS. 5 to 7 are views similar to FIGS. 3 and 4 showing another embodiment of a solenoid relay;

FIG. 8 shows a solenoid relay combined with an incandescent lamp.

FIG. 9 shows a circuit digram of a warning blinker light with incandescent lamp and relay in series; and

FIG. 10 shows a similar circuit digram with the relay and lamp arrangement connected in parallel.

In FIG. 1, a core or coil body **1** with a cylindrical bore forming an elongated chamber of substantially uniform cross-section, carries an energizing winding **2**. At the base of the cylinder there is an aperture **3** covered by a valve disc **4**. The valve disc **4** may consist of a yielding material such as rubber, or of a thin sheet of metal held against the coil body by its own elasticity or by means of a separate spring, and covering the aperture **3** in the manner of a check valve. The aperture is so arranged as to permit free escape of air, while entry of air is prevented. In the cylindrical bore, the piston-like plunger **5** moves in axial direction against a spring **6** and forms an armature. A contact head **7** is fixedly mounted on the plunger **5**. Active contacts **8** and **9** mounted on the coil body are engaged by the contact head **7** in indrawn position.

As soon as the energizing circuit is closed, the plunger **5** is attracted under the load of the biasing spring **6**, the air escaping from the cylinder unimpeded by the unidirectional valve **4** through the valve aperture **3**. This process takes place substantially without retardation and without load due to air compression. When the energizing circuit is opened and the plunger **5** returns under the action of the spring, the valve aperture will be closed, so that accordingly a delay occurs. For throttle entry of air, a smaller auxiliary aperture **50**, preferably with an adjusting screw **51**, may be provided. Alternatively, throttled admission of air for the return may be achieved by suitable conformation of the piston plunger and the cylinder with a certain amount of clearance.

The solenoid relay with self-interrupter according to FIG. 3 is essentially similar to that of FIG. 1, with the difference that rod **10** is secured to the piston-like plunger **5** and extends outwardly of the solenoid and the contact head **7** displaceable thereon with a certain amount of play. The contact head **7** slides on the piston rod and is retained with play by an abutment or nut **16**. The contact system here consists of two contact springs **11** and **12** arranged diametrally opposite each other on the sides of the coil body and pressing against each other by means of lateral arms **13** and **14**, thus making the contact connection for the energizing circuit. When the plunger **5** is attracted, the contact head **7** will rest on the ends of springs **11** and **12** and be held by them within its displacement travel, namely for most of the instroke, whereafter during the rest of the stroke the contact head **7** is forced in between the pair of springs **11** and **12**, separating the contact arms **13** and **14**. The actuating circuit is opened and the piston begins to return. During this return, the contact head **7** is at first retained by springs **11** and **12** within its play, until in terminal position it will be released during the remaining return stroke, so that the arms **13** and **14** make contact again. The actuating circuit is again closed, and the cycle repeats itself.

Between the contact head **7** and the nut **16** limiting its play, it may be desirable to provide another spring **15** to avoid flutter of the sliding contact head. The play may be variously adjusted by setting the nut **16**. This results in a corresponding adjustment of delay, as does the aforesaid regulation of air admission. Both means of adjustment may be provided, or only one of them.

The embodiment according to FIGS. 5 to 7 is essentially similar to that of FIGS. 3 and 4. The coil body has been enclosed in an iron casing **17**. The contact head **18** is again held displaceable with play on the piston rod **10** by means of the nut **16**. The contact head **18** bears two lateral arms **19**, preferably of non-conductive material, cooperating with two pairs of lengthwise springs **20** and **21** mounted on the coil body. The pairs of lengthwise springs **20** and **21** bear contacts **22** which touch in normal position, closing the actuating circuit. In addition, stops **23**, preferably rounded or beveled, are provided, to stop arms **19** during displacement within the play. The same cycle of operations takes place as above.

In FIG. 8, a solenoid relay **31** is installed in a conventional base **30** for an incandescent bulb. The bulb **33** is sealed in the usual manner into an extension **32** of the base. The relay **31**, as may be seen in the figure, has an oscillating leaf spring **34** laterally attached to the coil body, an aperture in which movably accommodates the piston **35** with play. A snap spring **36** holds the leaf spring **34** in either extreme position. At the instroke of piston **35**, the snap spring is forced into the other position near the end of the travel, whereas during the retarded return stroke the same thing happens in the opposite direction owing to a projection on the piston rod.

Pairs of contacts, not detailed, on the leaf spring **34**, close in the top snap position. The pair of contacts of the light circuit may be actuated in advance. The light circuit and coil circuit may be in series or in parallel, and the previously closed light circuit may be switched off or short-circuited at the point of actuating contact.

This blinker light may of course be fitted with any base matching that of a given incandescent lamp, and may be substituted for the latter when a blinking light is desired. This greatly simplifies the installation of signal systems of all kinds.

In the circuit diagram of FIG. 9, **40** is a battery forming a circuit with incandescent lamp **41**, switch **42** and relay **43**, which circuit is interrupted by relay contact **44**.

When switch 42 is turned on, both relay 43 and lamp 41 receive current, whereupon lamp 41 lights and is at once shut off by actuating of relay 43. After a delay period, relay 43 goes on again, and the cycle repeats itself.

In parallel with the main switch 42, there is a line with resistance 45 and test key 46. When test key 46 is actuated, the blinker light can be operated via resistance 45 with switch 42 open, and the condition of battery charge can be observed by the result. The resistance 45 is so chosen that in case a predetermined minimum capacity of the battery has been reached, the relay will fail to act and interrupt, so that the light will burn steady. So long as the capacity of the battery is greater than this, the light will blink.

The circuit of FIG. 10 differs in that the circuit of the battery and main switch 42 branches via the movable intermediate contact 47 of the relay, alternatively via fixed contact 48 to light 41 or via movable contact 49 to the relay coil 43. The mode of operation is essentially the same, since when the relay responds the movable contacts 47 and 49 interrupt both the coil circuit of the relay and the light circuit.

The load resistance 45 is in the coil circuit as before, but normally by-passed by the test key 46. For testing, depression of the test key 46 puts the resistance 45 into the coil circuit, so that a blinking light or a steady light will be obtained according to the condition of discharge of the battery. The principle is the same in both cases, namely that depending on the lowered service voltage of the battery as it discharges, the current required for the relay coil to respond will be present above a certain residual charge capacity, while below that point the relay will fail to respond and the light will burn steady.

What I claim is:

1. A solenoid relay comprising a core formed with an elongated chamber of substantially uniform transverse cross-section, a piston reciprocable in axial direction within said chamber and forming an armature, a coil surrounding said core for electromagnetically displacing said piston axially upon energization of said coil, biasing means bearing on said piston and effective in a direction opposite to that of the electromagnetic displacement of said piston to displace said piston in said opposite direction upon de-energization of said coil, unidirectionally effective valve means in said core operable upon displacement of said piston in one of said directions for substantially freely permitting the passage of a fluid out of said chamber, adjustable throttle means on said core effective upon displacement of said piston in the other of said directions for throttling the flow of said fluid into said chamber, contact means secured to said core, a contact-actuating member engageable with said contact means and slidably mounted on said piston for axial displacement relative thereto between two limiting positions, and respective abutments on said piston entraining said contact-actuating member in each of said limiting positions for operating said contact means, said contact means and said member being provided with complementary means for releasably retaining said member intermediate said limiting positions.

2. A solenoid relay comprising a core formed with an elongated chamber of substantially uniform transverse cross-section, a piston reciprocable in axial direction within said chamber and forming an armature, a coil surrounding said core for electromagnetically displacing said piston axially upon energization of said coil, biasing means bearing on said piston and effective in a direction opposite to that of the electromagnetic displacement of said piston to displace said piston in said opposite direction upon de-energization of said coil, unidirectionally effective valve means in said core operable upon displacement of said piston in one of said directions for substantially freely permitting the passage of a fluid out of said chamber, adjustable throttle means on said core effective upon displacement of said piston in the other of said directions for throttling the flow of said fluid into said chamber, contact means in circuit with said coil secured to said core, a rod axially secured to said piston, an annular contact-actuating member engageable with said contact means and slidably mounted on said rod for axial displacement relative thereto between two limiting positions, and respective abutments on said rod entraining said contact-actuating member in each of said limiting positions for operating said contact means, said contact means including a detent, said member being provided with an annular peripheral groove releasably engageable by said detent for retaining said member.

3. A solenoid relay comprising a core formed with an elongated chamber of substantially uniform transverse cross-section, a piston reciprocable in axial direction within said chamber and forming an armature, a coil surrounding said core for electromagnetically displacing said piston axially upon energizaiton of said coil, biasing means bearing on said piston and effective in a direction opposite to that of the electromagnetic displacement of said piston to displace said piston in said opposite direction upon de-energization of said coil, unidirectionally effective valve means in said core operable upon displacement of said piston in one of said directions for substantially freely permitting the passage of said fluid out of said chamber, adjustable throttle means on said core effective upon displacement of said piston in the other of said directions for throttling the flow of said fluid into said chamber, contact means in circuit with said coil secured to said core, a rod axially secured to said piston, an annular contact-actuating member engageable with said contact means and slidably mounted on said rod for axial displacement relative thereto between two limiting positions, respective abutments on said rod entraining said contact-actuating member in each of said limiting positions for operating said contact means, and spring means bearing upon said rod and said member urging the latter toward one of said abutments, said contact means including a detent, said member being provided with an annular peripheral groove releasably engageable by said detent for retaining said member.

4. A solenoid relay according to claim 2 wherein one of said abutments comprises a stop member axially adjustable on said rod.

5. A solenoid relay comprising a core formed with an elongated chamber of substantially uniform transverse cross-section, a piston reciprocable in axial direction within said chamber and forming an armature, a coil surrounding said core for electromagnetically displacing said piston axially upon energization of said coil, biasing means in said chamber bearing on said piston and effective in a direction opposite to that of the electromagnetic displacement of said piston to displace said piston in said opposite direction upon de-energization of said coil, unidirectionally effective valve means at one end of said chamber operable upon displacement of said piston in one of said directions for substantially freely permitting the passage of a fluid out of said chamber, adjustable throttle means at the same end of said chamber as said valve means, said throttle means being effective upon displacement of said piston in the other of said directions for throttling the flow of said fluid into said chamber, contact means located adjacent said core, a contact-actuating member having a lost motion connection with said piston for axial displacement of the piston relative to the member between two limiting positions, and respective abutments reciprocably movable with said piston for entraining said contact-actuating member in each of said limiting positions for operating said contact means, one of said abutments being formed by a portion of the piston and the other of said abutments being formed by a member adjustably mounted on the piston.

(References on following page)

References Cited in the file of this patent

UNITED STATES PATENTS

725,259	Kitsee	Apr. 14, 1903
798,082	Sundh	Aug. 29, 1905
946,489	Clement	Jan. 11, 1910
1,452,178	Ballew	Apr. 17, 1923
1,493,259	Green	May 6, 1924
1,584,063	Wilms	May 11, 1926
1,585,988	Hesse	May 25, 1926
1,957,877	Young	May 8, 1934
2,284,481	Schwaneger	May 26, 1942
2,323,459	De Valera	July 6, 1943
2,333,604	Wallace	Nov. 2, 1943
2,432,730	Davey	Dec. 16, 1947
2,651,166	Dorfman	Jan. 29, 1948
2,716,171	Mekelburg	Aug. 23, 1955
2,764,648	Gascoine et al.	Sept. 25, 1956
2,828,382	Davidson	Mar. 25, 1958

FOREIGN PATENTS

368,678	Germany	Feb. 9, 1923
569,211	Great Britain	May 11, 1945