May 31, 1966 H. VOORMAN, JR 3,254,178

HOT WIRE CONTROLLED SWINGING VANE CURRENT INTERMITTER OR RELAY

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Fig. 1.

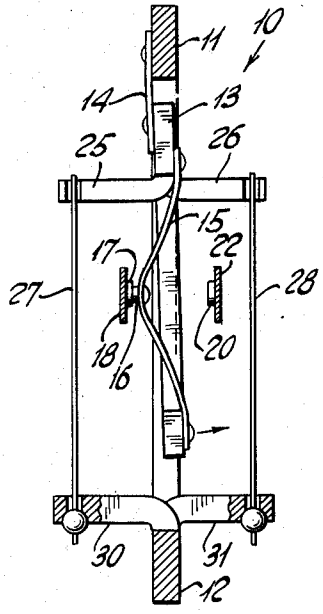


Fig. 2.

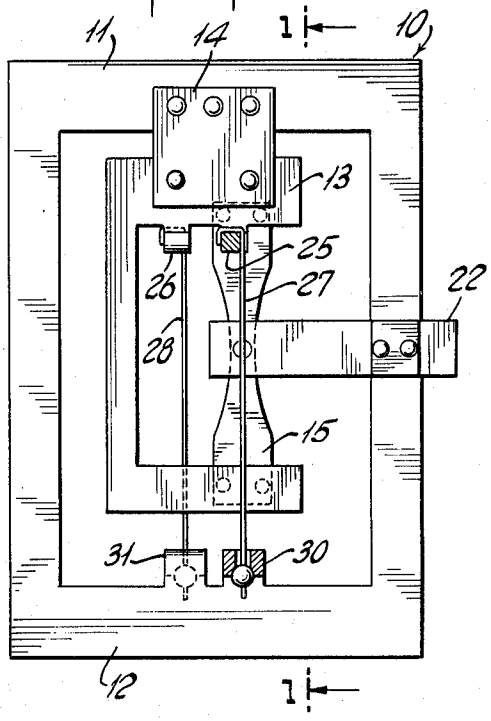


Fig. 4.

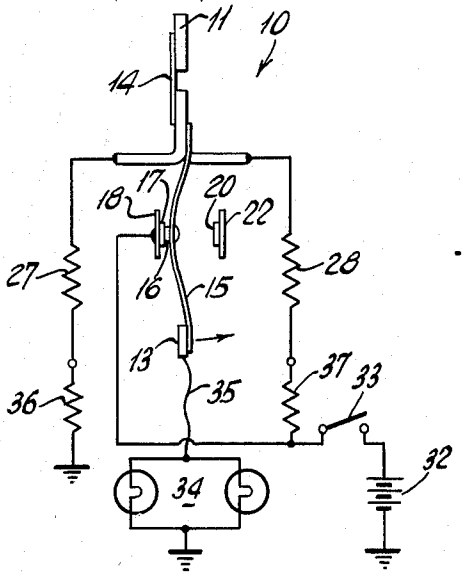
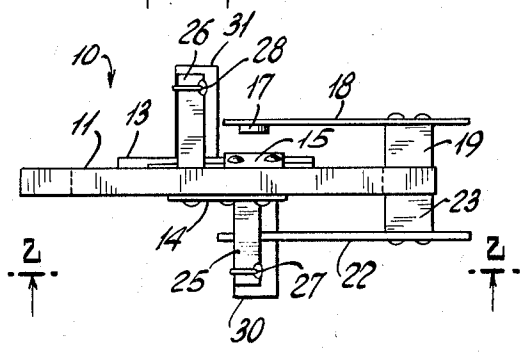


Fig. 3.



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Fig. 5.

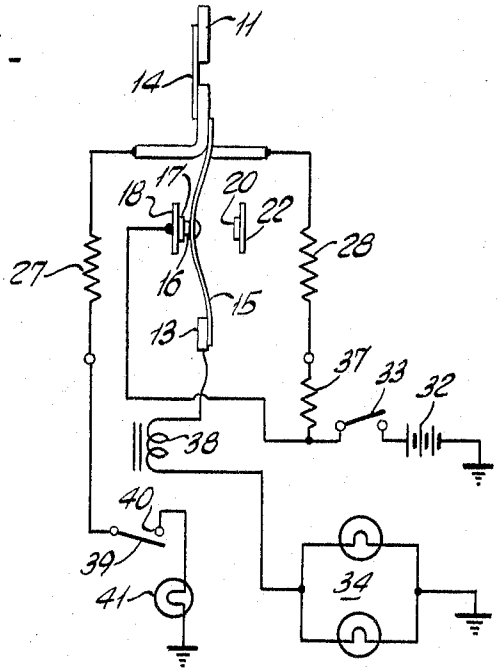
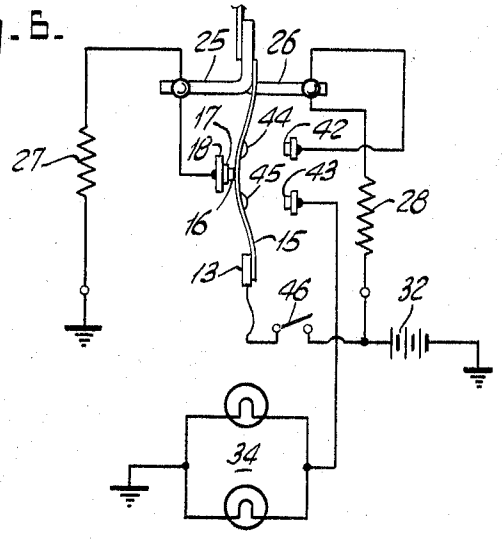


Fig. 6.



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HOT WIRE CONTROLLED SWINGING VANE CURRENT INTERMITTER OR RELAY

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3 Claims. (Cl. 200—113)

This invention relates to snap action devices of the hot wire type and comprises a novel type of flasher and thermal relay. It has particular reference to a switch means which is self-operating and which is substantially independent of the voltage of the electrical supply.

The present thermal switch described herein is intended primarily for flasher use on automotive turn signals but by slight change in structure or circuit it can be used in many other applications. One of the difficulties in all flasher switches in use today resides in the fact that their rate of flashing varies with the applied voltage of the battery. This results in flashing signal lamps which vary greatly in their flashing speed depending upon the condition of the battery and the vehicle generator. The present invention employs two pull wires for operating a rockable member on which is secured a flexible vane. The construction and the circuit arrangements are such that the action depends upon the rate of cooling of the pull wires instead of their rate of heating and for this reason a more constant rate of operation is insured.

The invention comprises a thermal switch which is mounted on a base frame including upper and lower cross pieces. A rockable member is supported between the cross pieces on a flexible hinge for rockable movement. The rockable member carries a thin vane of spring metal which is secured at both ends and is bowed out of the plane of the member. Two heat expansible pull wires are employed to rock the member and snap the vane. Electrical contacts are secured to one or both sides of the vane and cooperating stationary contacts are secured to the base for contact therewith. The operating circuits include the resistance wires, a source of potential, and the contacts opened and closed by the movement of the flexible vane. The pull wires are attached to the rockable member adjacent the pivoted end thereof to provide relatively large contact travel for relatively small change in length of controlling wires.

For a better understanding of the present invention, and of specific embodiments thereof, reference is made to the following description taken in connection with the accompanying drawings.

FIG. 1 is a side view, with parts in section, showing the new switch.

FIG. 2 is a front view of the switch.

FIG. 3 is a top view of the switch of FIGS. 1 and 2.

FIG. 4 is a circuit diagram of connections showing use of the switch of FIGS. 1 to 3 as a flasher.

FIG. 5 is a diagram similar to FIG. 4 but showing a modified circuit including a positive pilot.

FIG. 6 is a circuit diagram of a thermal relay embodying this invention.

Referring now to FIGURES 1, 2 and 3, the switch comprises a base frame **10** which includes an upper cross piece **11** and a lower cross piece **12**. A rockable generally C-shaped member **13** has its upper arm secured to the frame by a hinge **14** which may be a flat strip of metal. A vane **15** is secured between the upper and lower arms of the member **13**. The vane is made of thin spring metal and is bowed out of the plane of the supporting member as shown in the figures. Vane **15** is provided with a centrally disposed contact **16** on the left side of the vane as viewed in FIG. 1. A cooperating contact **17** is secured to a conductive support **18**

which is mounted on an insulator **19** secured to the base frame **10**. (See FIG. 3.)

A contact or stop **20** is positioned on the opposite side of the vane from the contact **17**. Contact **20** is carried by an arm **22** mounted on the base frame **10** by means of suitable insulation **23**.

Portions **25** and **26** of member **13** are bent outwardly as shown in FIGS. 1 and 3 for anchoring resistance pull wires **27** and **28**. The lower portions of the pull wires are secured to similar bent-over portions **30** and **31** of the base frame **10**. The pull wires **27** and **28** are made of resistance material such as Nichrome and the lower end of each pull wire is insulated from the base frame by an insulating bead.

In the diagram of FIG. 4, showing the device of FIGS. 1 to 3 connected for operation as a flasher, the pull wires **27** and **28** have been shown conventionally as resistance elements. A source of potential **32**, which may be a car carried battery of nominally 12 volts, has its negative terminal grounded and its positive terminal connected through a switch **33** to fixed contact **17**. Signal lamps **34** to be flashed are connected between ground and the movable end of the member **13** through a flexible lead **35**. The lower end of pull wire **27** is connected through a ballast resistor **36** to ground and the lower end of pull wire **28** is connected through a ballast resistor **37** to contact **17**.

Before describing the operation of the circuit upon closure of switch **33**, the operation of the vane during swing of the frame **13** will be briefly described. The position of the vane **15** shown in FIGS. 1 and 4 corresponds to the maximum tension in the pull ribbon **27**. The member **13** has been swung counterclockwise and the center of the vane has engaged the stop **20** snapping the center of the vane into position where contacts **16** and **17** are in engagement. When the tension in pull wire **28** is a maximum the lower end of element **13** is swung clockwise, building up pressure between contacts **16** and **17** until the center of the vane snaps in the opposite direction to engage the stop **20**. In such position of the member **13** and vane **15** the contacts **16** and **17** are open. With the circuit connections shown in FIG. 4 it is assumed that the tension in pull ribbon **27** has been adjusted to make the normal position of the vane **15** that is shown in the drawing, namely, with the contacts **16** and **17** in engagement. If now the switch **33** is closed current flows from the source **32** through the contacts **16** and **17** and the vane to the lamps **34** of the load. The lamps are thereupon lighted. Current also flows from the source **32** through the contacts **16** and **17**, vane **15** and pull wire **27** and ballast resistance **36** to ground. Pull wire **28** and ballast resistance **37** are shunted by the vane and contacts **16** and **17**. Pull wire **27** thereupon expands due to the current therethrough with the result that the cold pull wire **28** rocks the frame **13** in a clockwise direction causing the contact **17** to exert pressure on contact **16** snapping the vane. This opens the contacts **16** and **17** and brings the center of the vane in contact with the stop **20**. The lamps **34** are thereupon dimmed because the circuit thereof includes the pull wire **28** and resistor **37**. The current through pull wire **27** and resistor **36** is substantially reduced with the result that the wire cools at the same time that the wire **28** is heating. Consequently, when the tension of the pull wire **27** reaches a predetermined value the vane will snap back to its initial position closing contacts **16** and **17** and energizing the lamps **34** to full brilliance. The cycle thereupon repeats.

As a flasher depends solely upon the cooling of a pull wire and not upon the temperature of the heated pull wire the speed of operation can be made substantially independ-

ent of the voltage of the source. Actually, unlike hot wire flashers previously known the rate of flashing of the flasher of the invention will slightly decrease with increase of voltage rather than increase as in the usual hot wire flasher. By proper choice of ballast resistors and of initial tension in the pull wires substantially constant rate of flashing over a wide range of voltage say from 11 to 15 volts can be obtained.

Where it is desired to have a positive pilot indication the circuit of FIG. 5 may be employed. In this embodiment of the invention, a relay winding **38** is connected between the movable end of the element **13** and the lamp load, and ballast resistor **36** is omitted and instead the lower end of pull wire **27** is connected to an armature **39** associated with the winding **38**. A top contact **40** engageable by armature **39** when the winding is energized is connected through a pilot lamp **41** to ground. The remainder of the circuit of FIG. 5 is the same as that of FIG. 4. With this arrangement when the lamps **34** are energized upon closure of switch **33**, winding **38** is likewise energized to pick up its armature and close the circuit for the pilot lamp through pull wire **27**. Thus, the pilot lamp **41** will flash in unison with the lamps **34** provided both lamps **34** are operative. Should one of the lamps **34** be burned out the current through the winding **38** will be insufficient to attract the armature **39**. Accordingly, the pilot lamp **41** will not be lighted and current will not flow through pull wire **27**. The flasher will then cease to operate and the positive indication thereof will be given by the absence of light from the pilot lamp **41**.

The flasher of FIGS. 1 through 3 may be readily converted to a thermal relay as will be explained in connection with the diagram of FIG. 6 to which reference may now be had. In FIG. 6 the only structural differences comprise the insulation of the upper ends of the pull wires **27** and **28** from the cross arms **25** and **26**, the provision of two fixed contacts **42** and **43** in place of the stop **20** and the mounting of two contacts **44** and **45** on the vane **15** for cooperation, respectively, with the contacts **42** and **43**. In this embodiment of the invention the source **32** is connected to the lower end of pull wire **28** and the upper end of the pull ribbon beyond the insulated mounting in the cross piece **26** is connected to contact **42**. The positive terminal of the source **32** is also connected through a switch **46** and flexible connector to the free end of the element **13**. The lamp load **34** is connected to the fixed contact **43** and contact **17** is connected through the insulation in arm **25** to the pull wire **27**. The lower end of the pull wire **27** is grounded.

With this arrangement, when switch **46** is open no current flows through any part of the circuit as the circuit of the pull wire **28** is open at contact **42**. When the switch **46** is closed current flows through the normally closed contacts **16** and **17** and pull wire **27** which thereupon expands and permits pull wire **28** to swing element **13** clockwise to close the contacts **43** and **45** and contacts **42** and **44**. The lamps **34** are thereupon lighted. In this position pull wire **28** is shunted by the vane and the closed switch **46**. Thus as pull wire **28** remains cool while pull wire **27** is cooling the device will stay in position for illuminating the lamps until and unless switch **46** is open. When the switch is opened current will again flow through the pull wire **28** to permit wire **27** to return the vane to the initial position. The time required for the vane to return to initial position after switch **46** is open will depend upon the resistance of the pull wire **28**. If the pull wire is of high resistance the load is essentially cut off as soon as switch **46** is open because the resistance of the pull wire is in series with the load. If the pull ribbon **28** is of low resistance the load current will continue to flow until the vane switches. Thus by varying the magnitudes of the resistances the unit can provide for a rapid pull in with a delayed drop out and instant reset or for a delayed pull in with a rapid drop out and instant reset or for both a delayed pull in and a delayed drop out with instant reset.

In the foregoing description both of the flasher and of the relay the pull wires represented by the reference numerals **27** and **28** have been described as carrying current. Obviously, and particularly in the thermal relay the pull wires can be indirectly heated by means of heater elements surrounding the pull wires. In the case of the circuit of FIG. 6 for example the resistors **27** and **28** can be considered as heaters for the pull wires and if so insulation for the ends of the pull wires would not be required. Also longer time delays in the relay may be obtained by shrouding the pull wires in an indirectly heated metal tube or channel with appropriate thermal mass.

The invention has now been described with reference to two embodiments thereof. In each embodiment, unlike thermal switches heretofore employed the functioning depends upon the cooling of a pull wire and not upon the heating of the pull wire. As the structure of the invention is bi-stable the wire that is being heated can relax completely without any shift in the position of the vane, the shifting of the vane depending solely upon the temperature reached by the cooling wire as it cools. This feature of the invention is of particular value as heretofore indicated in insuring substantial constant speed of flasher operation. Another important feature of the invention is the structure whereby the pull wires act through lever arms upon the pivoted end of the rockable member. If the pull wires were connected to the free end of the rockable member they would have to expand in amounts equivalent to the movement of the free end. With the described instruction relatively a small elongation yields a large contact travel.

The following is claimed:

1. A flasher comprising a fixed support, a movable member with one end pivoted on the fixed support, a bowed vane mounted on said movable member and carrying an electrical contact on one side, a first stop means facing the bowed vane and carrying an electrical contact for engagement with the electrical contact on the bowed vane, a second stop means facing the other side of the bowed vane, a first pull means connected between the fixed support and the movable member at a point adjacent the pivoted end of the movable member to exert a force on the movable member which can be decreased by heating the first pull means with electric current and which tends to pivot the movable member away from the first pull means, a second pull means connected between the fixed support and the movable member at a point adjacent the pivoted end of the movable member to exert a force on the movable member which can be decreased by heating the second pull means with electric current and which opposes the force exerted on the movable member by the first pull means, a source of electric current connecting in series with the first and second pull means for heating the same, said contacts, when in engagement, shunting said second pull means to cause an alternate heating and cooling of the first and second pull means out of phase with each other and thereby alternately reverse the bow in the vane by alternately building up pressure between the bow and the first and second stops, and a lamp load connected in series with said electric contacts across said source of electric current so that said lamp load will flash on and off.

2. The thermal switch of claim **1** including arms extending out in opposite directions from said movable member and wherein the point where the first pull means is mounted on the movable member is one of said arms and the point where the second pull means is mounted on the other movable member is the other of said arms.

3. A thermal switch comprising a fixed support, a movable member with one end pivoted on the fixed support, an electrically conducting bowed vane mounted on said movable member and carrying a first electrical contact

on one side thereof, and second and third electrical contacts on its other side, a first stop means facing the one side of the bowed vane and carrying an electrical contact which contacts the first electrical contact on the bowed vane, a second stop means facing the other side of the bowed vane and carrying two electrically isolated electrical contacts which are respectively aligned with the second and third electrical contacts on the bowed vane, a first pull means connected between the fixed support and the movable member at a point adjacent the pivoted end of the movable member to exert a force on the movable member which can be decreased by heating the first pull means with electric current and which tends, when cold, to pivot the movable member towards the second means, a second pull means connected between the fixed support and the movable member at a point adjacent the pivoted end of the movable member to exert force on the movable member which can be decreased by heating the second pull means with electric current and which opposes the force exerted on the movable member by the first pull means, a source of electric current, circuit means including said first contact and the contact on said first stop means, for connecting said electrically conductive vane and the said first pull means across said source, said second pull means being connected between

one terminal of said source and one of said isolated contacts, a load connected between the other terminal of the source, and the other one of said isolated contacts, said circuit means including switch means for opening the heating circuit of said first pull means, whereby when said switch means is closed the force exerted by said first pull means is reduced, said movable member is moved by said second pull means to snap and bow the vane into a position to bridge said isolated contacts, shunt said second pull means, energize said load and open the circuit of said first pull means, thereby said load remaining energized until said switch means is opened.

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