

May 13, 1952

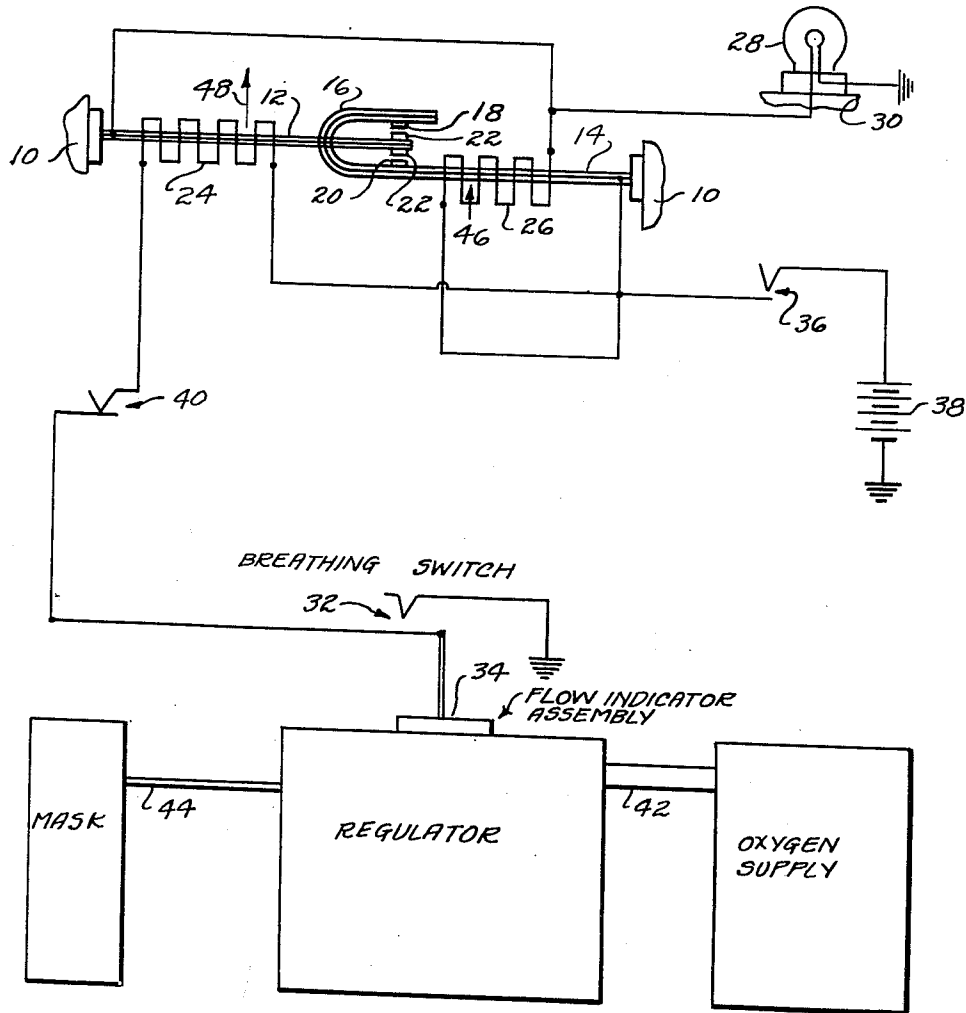
J. R. JOHNSON, JR
OXYGEN BREATHING SYSTEM

2,596,152

Filed March 30, 1951

2 SHEETS—SHEET 1

Fig. 1.



INVENTOR.
JOHN R. JOHNSON JR.
BY *Wade Root* AND
Frederick W. Coe
ATTORNEYS

May 13, 1952

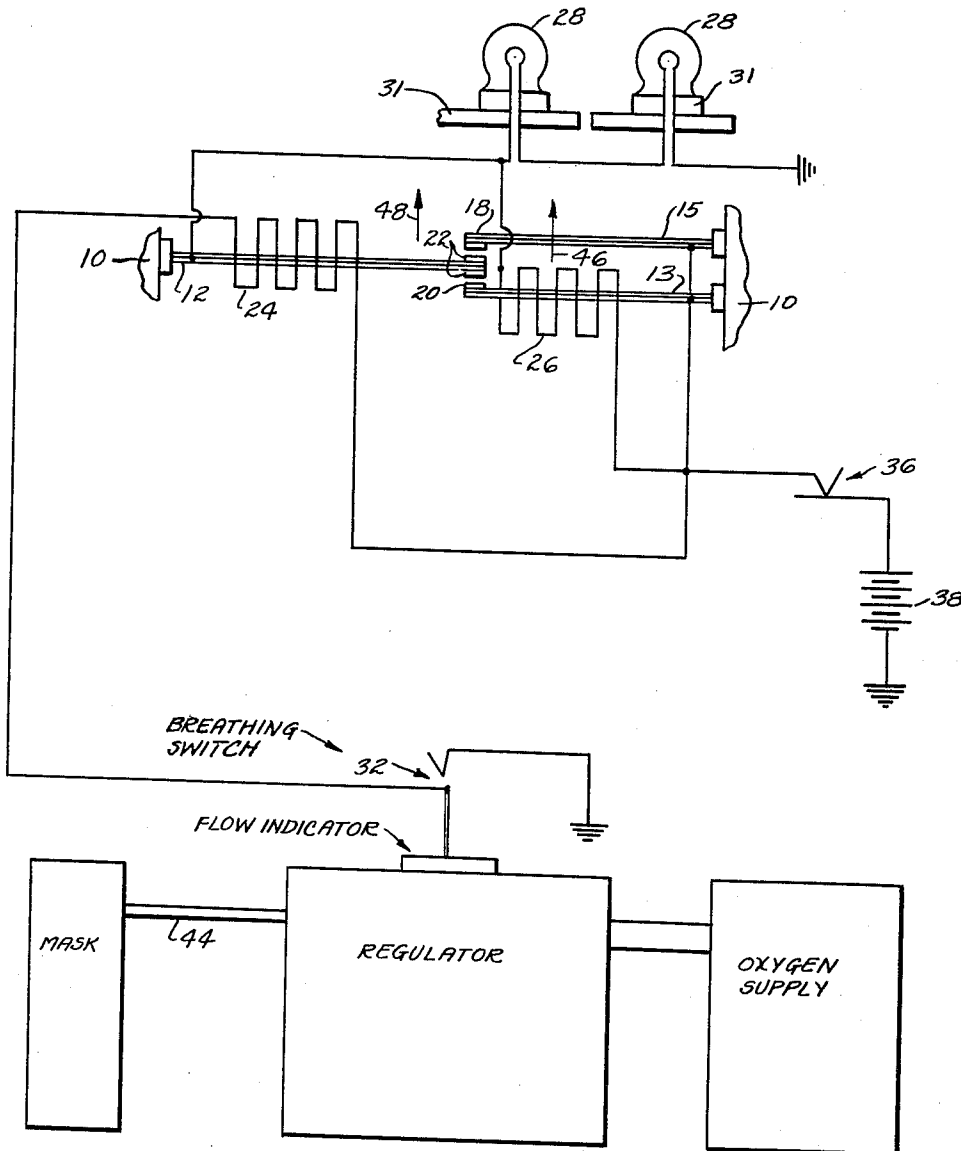
J. R. JOHNSON, JR
OXYGEN BREATHING SYSTEM

2,596,152

Filed March 30, 1951

2 SHEETS—SHEET 2

FIG. 2.



INVENTOR.
JOHN R. JOHNSON JR.

BY *Wade L. Lundy* AND
Frederick W. Cottonman
ATTORNEYS

UNITED STATES PATENT OFFICE

2,596,152

OXYGEN BREATHING SYSTEM

John R. Johnson, Jr., Frankfort, Ky.

Application March 30, 1951, Serial No. 218,506

7 Claims. (Cl. 177—311)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

1

The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to me of any royalty thereon.

This invention relates to oxygen breathing systems and especially to a signaling device which becomes automatically operative to warn a pilot or a crew member of a lack of oxygen being supplied him.

The invention essentially comprises a simple, compact and efficient signaling mechanism which may be contained in a conventional oxygen regulator, and be pneumatically actuated by the breathing of the user through mechanism in the flow indicator assembly of the regulator, and which will give prompt and adequate warning of a lack of oxygen being delivered to his mask. The device is easily installed and readily adaptable to all current oxygen regulators. It is contained in a case which is only 1 5/8" long by 1 1/8" diameter, whereby space may be found for the device within the regulator itself.

Inasmuch as the flow indicator assembly of the regulator may include the "on" and "off" switch operable by flow through the regulator, this switch may be employed to open or close the circuit of the signaling device.

In the drawings which illustrate several embodiments of subject invention:

Fig. 1 is a schematic view of an embodiment of the invention showing the bi-metal switch contact strips, the heating coils, the wiring, and the contacts.

Fig. 2 is a schematic view of an improved version of the invention shown in Fig. 1.

The mechanism which is the subject of this invention consists of a body 10 which contains two bimetal strips 12 and 14, strip 12 being straight and strip 14 being of fishhook contour 16 at the free end. The outer ends of strips 12 and 14 are insulatedly attached to the body 10.

Silver contacts 18 and 20 are electrically connected to the hook end 16 of the bimetal strip 14. Silver contacts 22 are electrically connected to the free end of the straight strip 12. Resistance wire heating coils 24 and 26 surround bimetal strips 12 and 14, respectively. A signal light 28 is connected into the circuit as shown. Signal light 28 is preferably not carried on or in the body 10 but is mounted on a control panel 30 in the pilot's compartment. Additional lights 28 (not shown) may be provided, one for each crew member, and should be connected in series so that the system may not be put into operation

2

unless the pilot and all crew members have their lights turned on.

A pneumatically actuated breathing switch 32, which, for clearness, in Figs. 1 and 2, is shown outside the flow indicator assembly, is, in actual practice, contained within and made a part of said assembly. Switch 32 is shown open. It is pneumatically actuated to open or closed position by the breathing pulsations of the user. A manually actuatable master switch 36 is provided to disconnect the device from the power source 38. Switch 36 is shown as part of the circuit diagram Figs. 1 and 2, although in practice it is contained within the regulator. A manually actuatable switch 40 is provided for clearing the circuit after the device has operated.

The operation of the switch mechanism shown in Fig. 1 is as follows:

When the master switch 36 is closed, as shown, and breathing begins, current will flow from the current source 38 through the heating coils 24 and 26. As the breathing switch 32 opens and closes the current in the heating coil 24 will be relatively strong but pulsating, while the current in the heating coil 26 is relatively weak but steady, thereby providing a steady but relatively dim light in lamp 28. The resistance of heating coils 24 and 26 is so proportioned that bimetal strips 12 and 14 warp in the direction of the arrows 46 and 48 substantially equal amounts and in consequence the contact 20 does not engage the contact 22 at this time, i. e., the stronger but pulsating current in coil 24 balances the weaker but steady current in coil 26 in warping their respective bimetals substantially equal amounts in the direction of the arrows 48 and 46.

If now, from any cause, the device malfunctions so that the breathing switch 32 remains open for a longer period than it does in normal breathing, there will be no current flowing through heating coil 24 whereby the bimetal strip 12 returns to its straight condition while the current through the heating coil 26 will warp the bimetal strip 14 upward bringing contact 20 into engagement with contact 22.

When the contact 20 engages the contact 22, the current flows from the source 38 through bimetal strips 14 and 12 and through the lamp 28 thereby shorting out the heating coil 26. No current is now passing through either heating coil 24 or 26, whereby the bimetal strip 12 maintains its straight outline, while the warped part of bimetal strip 14 straightens and withdraws contact 20 from contact 22 which again forces current to flow through the heating coil 26. This

3

cycle is repeated as long as the breathing switch 32 is open by reason of the malfunctioning of its operating means, whereby the lamp 23 is fairly bright but blinking.

On the other hand, the device may malfunction with the breathing switch in the closed position for a longer period than it remains closed during normal operation. In such a situation the current will flow through the heating coil 24 and warp the bimetal strip 12 upward and will flow through the heating coil 26 and warp the bimetal strip 14 upward. Due to the fact that, in this case, the flow is continuous in coil 24 and not intermittent as in normal operation, the heating of coil 24 will be greater than in normal operation and the resultant deflection of the strip 12 will exceed the deflection of the strip 14 by an amount sufficient to engage contact 22 with the contact 18. When this occurs the heating coil 26 is shorted out and the light 28 is connected directly across the current source 38 through the contacts 18 and 22 thus giving a continuous bright warning light.

Now since the breathing switch 32 is closed, the current will flow through the heating coil 24 whereby the bimetal 12 will be warped in the direction of the arrow 48, and since the coil 26 will be shorted out, the bimetal strip 14 will attempt to assume its straight position but cannot do so because the contact 18 will be resting on the contact 22.

In order to now permit the device to return to normal, i. e., to permit the bimetals 12 and 14 to straighten and separate the contacts 18 and 22 as seen in Fig. 1, the coil 24 must be shorted out, and this may be done by manually holding the breathing switch 32 open for a sufficient time to allow the coil 24 to cool or, what is preferable, by providing the additional switch 40 which may be opened and left open until the coil 24 cools and restores the device to normal.

The main fault in the device shown in Fig. 1 is the requirement of a separately operable manual switch to clear the circuit after pressure breathing, the condition whereunder a malfunctioning switch 32 would remain in the closed position, has been in effect.

Some of the advantages of the foregoing system as shown in Fig. 1 are

- (1) It alleviates, in part, the confusion of periodic interphone oxygen checks although these are still recommended at convenient intervals.
- (2) The steady dim light of the system establishes confidence that the system is operating.
- (3) The system is simple, compact and requires very little technical maintenance.
- (4) The system is simple to construct and install.

The disadvantages above pointed out are completely cured in the modifications shown in Fig. 2.

Referring more particularly to Fig. 2, the body 10 contains three bimetal strips 12, 13 and 15, all normally straight when the device is not operating. The outer ends of strips 12, 13 and 15 are insulatedly attached to the inside of the casing 10.

Silver contacts 18, 20 and 22 are carried on and in electrical communication with the free ends of the bimetal strips 15, 13 and 12, respectively. Resistance wire heating coils 24 and 26 surround bimetal strips 12 and 13, respectively. Associated with each signaling device, Fig. 2, are two signal lamps 28 connected in the circuit in series as shown.

Normally the two signal lights 28 are located one at the crew position and one on a central

4

control panel in the pilot's compartment. The several lights on the central control panel had preferably be connected in series on the grounded side of the lamp so that the system may not be put into operation unless all of the crew members and the pilot have their light circuits closed.

The lamps on the panel actually have individual sources of current since each is connected only in series with the individual lamp at the screw position regulator involved.

The pneumatically actuated breathing switch 32 is contained within and is a part of the flow indicator assembly as it is in the structure shown in Fig. 1. Like the device of Fig. 1 it is pneumatically actuated to open and close in response to the breathing of the user. A manual master switch 36 is provided to disconnect the device from the power source 38. In practice the switch 36 is carried by the regulator. The switch 40, necessary to the exemplification of Fig. 1 is not required in the modification, Fig. 2.

The operation of the modification shown in Fig. 2 is substantially as follows:

When the master switch 36 is closed as shown and normal breathing begins, current will flow from the current source 38 through the heating coils 24 and 26 as it does in the exemplification shown in Fig. 1, i. e., through the coil 24 via the breathing switch 32 when it is open, and through the coil 26 by way of the lamp 28. Since the breathing switch 32 opens and closes with the breathing, the current in the heating coil 24 will pulsate, while the current in the heating coil 26 which is independent of the breathing switch 32 is steady thereby providing a steady light in the lamps 28.

The resistances in the heating coils 24 and 26 are so proportioned that a relatively strong but pulsating current passing through the heating coil 24 has about the same effect in warping the bimetal strip 12 as a relatively weaker but steady current, passing through the heating coil 26, has in warping the bimetal strip 13. Bimetal strips 12 and 13 therefore warp substantially equal amounts in the direction of the arrows 48 and 46, respectively, whereby contacts 20 and 22 remain spaced apart substantially as they are when their bimetal strips are straight. Nor is the maximum upward flexing of the bimetal strip 12 sufficient at this time to engage the contact 22 with the contact 18. The lamp 28 therefore burns steady but dim as long as the device is functioning properly, i. e., as long as the breathing switch 32 pulsates and does not tarry too long either in the open or in the closed position.

If for any reason the device now is damaged by enemy fire or if for any other reason it malfunctions, so that the breathing switch 32 remains open for a longer period than it does in normal breathing, there will be no current flowing through heating coil 24 whereby the bimetal strip 12 remains straight while the current through heating coil 26 will warp the bimetal strip 13 in the direction of the arrow 46 thereby bringing contact 20 into engagement with contact 22.

The current will now flow from the source 38 through bimetal strips 13 and 12 and through the lamps 28 thereby shorting out the heating coil 26. With the breathing switch 32 open and the heating coil 26 shorted out, no current will pass through either coil 24 or 26 but will pass through bimetal strips 13 and 12 and through the lamp, burning it brightly.

With no current flowing in heating coil 26 the bimetal strip 13 cools rapidly so that, in a matter

5

6

of seconds, the warped bimetal strip 13 straightens and withdraws its contact 20 from the contact 22 thus breaking the circuit through the bimetal strips 12 and 13 and restoring the circuit through the heating coil 26. This cycle, i. e. the "alternately blinking first bright then dim cycle" is repeated whenever the breathing switch 32 remains open as shown for a period longer than in normal breathing.

On the other hand the device may malfunction with the breathing switch 32 in the closed position for a longer period than it remains closed during normal breathing. In that case the current will flow continuously through the heating coil 24 and warp the bimetal strip 12 in the direction of the arrow 48, and at the same time current will flow through the heating coil 26 and warp the bimetal strip 13 in the same direction as the strip 12 whereby the contacts 20 and 22 remain apart. The bimetal strip 15, however, does not have a heating coil surrounding it and therefore remains straight, so that while the contacts 20 and 22 remain apart, the contact 22 will engage the contact 18.

Current now flows through bimetal strips 15 and 12 and through the lamp 28, giving a continuous bright warning signal.

Whether the warning pertains to demand breathing or to pressure breathing, the system automatically returns to normal operation immediately after the trouble causing the warning is corrected and normal breathing is resumed. This is one of the most valuable features of the modification shown in Fig. 2 over the structure shown in Fig. 1.

I claim:

1. An oxygen want warning device which comprises, a switch body, two spaced apart bimetal strips having one end insulatedly supported by said body, a third bimetal strip having one end insulatedly supported by said body and the free end extending between the free ends of the said two spaced apart bimetal strips, spaced apart contact points carried on the free ends of said bimetal strips, a heating coil adjacent one of the said two spaced apart bimetal strips, a second heating coil adjacent the said third bimetal strip, an electric warning lamp, a source of electric current supply, and conductors for electrically connecting the said source of current supply to one end of the first mentioned heating coil; for electrically connecting the other end of the first mentioned heating coil to said lamp; for electrically connecting the said source of current supply to one end of the second mentioned heating coil; for electrically connecting the other end of the said second mentioned heating coil to one end of the flow indicator contacts of an oxygen regulator; for electrically connecting the said source of current supply to the said two spaced apart bimetal strips, and for electrically connecting the said third bimetal strip to the said lamp.

2. An oxygen want warning device which comprises, a switch body, two spaced apart bimetal strips each having one end insulatedly supported by said body, a third bimetal strip having one end insulatedly supported by said body and the free end extending between the free ends of the said two spaced apart bimetal strips, contact means on the free ends of said bimetal strips positioned upon engagement to bring the first or second bimetal strip into electrical communication with the third bimetal strip, a heating coil surrounding one of the said two spaced apart

bimetal strips, a second heating coil surrounding the said third bimetal strip, an electric warning lamp, a source of electric current supply, and conductors for electrically connecting the said source of current supply to one end of the first mentioned heating coil; for electrically connecting the other end of the first mentioned heating coil to said lamp; for electrically connecting the said source of current supply to one end of the second mentioned heating coil; for electrically connecting the other end of the said second mentioned heating coil to one end of the flow indicator contacts of an oxygen regulator; for electrically connecting the said source of current supply to the said two spaced apart bimetal strips, and for electrically connecting the said third bimetal strip to the said lamp.

3. An oxygen want warning device which comprises, a switch body, two spaced apart bimetal strips having one end insulatedly supported by said body, a third bimetal strip having one end insulatedly supported by said body and the free end extending between the free ends of the said two spaced apart bimetal strips, spaced apart contact points carried on the free ends of said bimetal strips, a heating coil adjacent one of the said two spaced apart bimetal strips, a second heating coil adjacent the said third bimetal strip, a plurality of electric warning lamps, connected in series, a source of electric current supply, and conductors for electrically connecting the said source of current supply to one end of the first mentioned heating coil; for electrically connecting the other end of the first mentioned heating coil to said lamp; for electrically connecting the said source of current supply to one end of the second mentioned heating coil; for electrically connecting the other end of the said second mentioned heating coil to one end of the flow indicator contacts of an oxygen regulator; for electrically connecting the said source of current supply to the said two spaced apart bimetal strips, and for electrically connecting the said third bimetal strip to one terminal of the first lamp of the series.

4. An oxygen want warning device which comprises, a switch body, two parallel spaced apart bimetal strips having one end insulatedly supported within said body, a third bimetal strip having one end insulatedly supported within said body and the free end extending between the free ends of the said two parallel spaced apart bimetal strips, spaced apart contact points electrically joined to the free ends of said bimetal strips, a heating coil wound on one of the said two parallel spaced apart bimetal strips, a second heating coil wound on the said third bimetal strip, a series of electric warning lamps, one for each breathing station, a source of electric current supply, and conductors for electrically connecting the said source of current supply to one end of the first mentioned heating coil; for electrically connecting the other end of the first mentioned heating coil to one terminal of the first of the series of said lamps; for electrically connecting the said source of current supply to one end of the second mentioned heating coil; for electrically connecting the other end of the said second mentioned heating coil to one end of the flow indicator contents of an oxygen regulator; for electrically connecting the said source of current supply to the said two spaced apart bimetal strips, and for electrically connecting the said third bimetal strip to one terminal of the first of the series of said lamps.

7

5. In an oxygen breathing device, an oxygen supply means, an oxygen regulator, an oxygen mask, conduit means connecting the oxygen supply, the regulator and the mask, in combination with a signalling device for indicating when the flow indicator of the regulator is malfunctioning, said signalling device comprising three bimetal strips each having one end insulatedly fixed and the free ends provided with spaced apart contacts, a heating coil surrounding the first bimetal strip, a second heating coil surrounding the second bimetal strip, a signal lamp, a breathing switch, a source of electric current, and electrically conductive material joining the said electric current source to the beginnings of the first and the second heating coils, and to the fixed ends of the first and the third bimetal strip, and electrically conductive material joining the fixed end of the second bimetal strip and the end of the first said heating coil to the lamp; and the end of the second said heating coil to the breathing switch.

6. In an oxygen breathing device a signalling means for indicating when the breathing through the device is not normal, said signalling means comprising three bimetal strips each having one end insulatedly fixed and the free ends spaced

8

apart, a heating coil surrounding the first bimetal strip, a second heating coil surrounding the second bimetal strip, a signal lamp, a breathing switch, a source of electric current, and electrically conductive means joining the said electric current source to the beginning of the first and the second heating coils, and to the fixed ends of the first and the third bimetal strips, and electrically conductive means joining the fixed end of the second bimetal strip and the end of the first heating coil to the lamp and the end of the second said heating coil to the breathing switch.

7. The device of claim 6 wherein the second heating coil has substantially as great heating capacity when its current is intermittent as the first heating coil has when its current is steady.

JOHN R. JOHNSON, JR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,435,181	Lindsay	Jan. 27, 1948