June 16, 1959 O. J. SAHOLT 2,891,120

PRESSURE ACTUATED SWITCH

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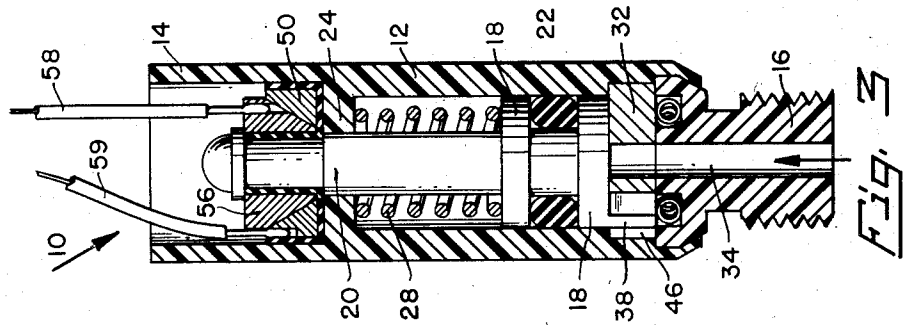


Fig. 3

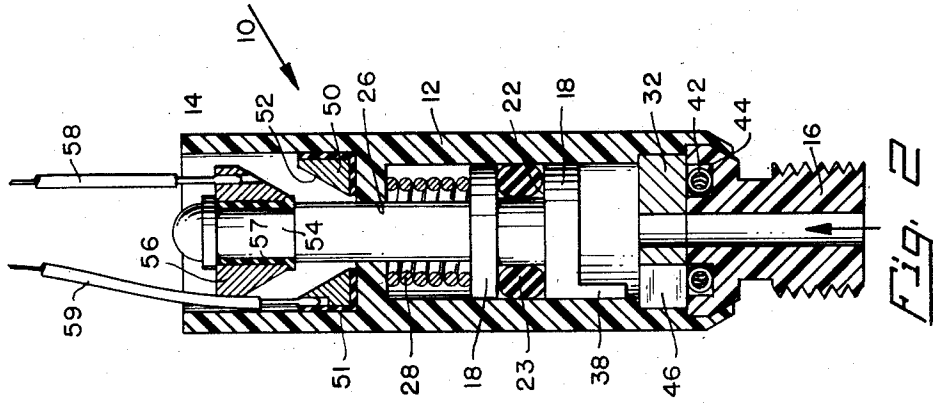


Fig. 2

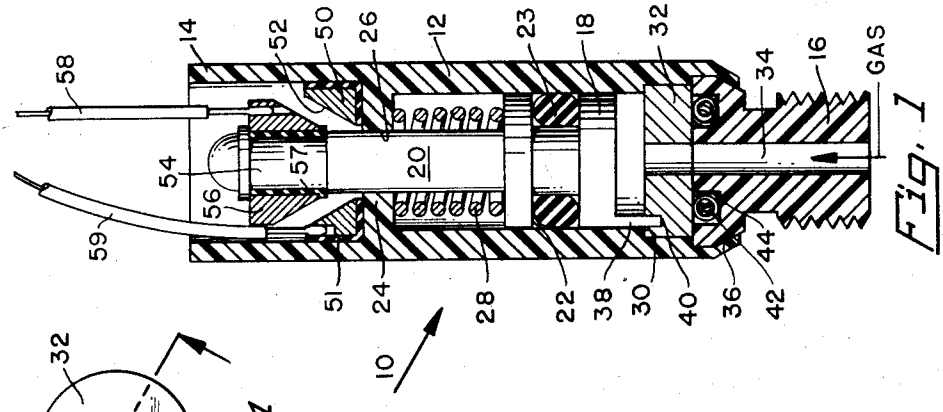


Fig. 1

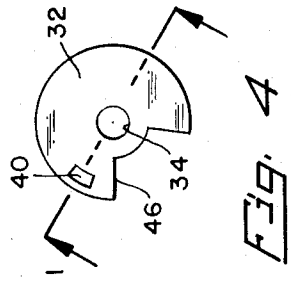


Fig. 4

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PRESSURE ACTUATED SWITCH

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7 Claims. (Cl. 200—82)

(Granted under Title 35, U.S. Code (1952), sec. 266)

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

The present invention relates to electrical switches and particularly to a miniature gas pressure actuated switch for closing an electrical circuit.

The pressure actuated switch of the present invention is a safety device for arming a rocket sustainer motor ignition circuit, or the like, such that the rocket booster motor must have ignited and then ceased to burn before the sustainer motor ignition circuit becomes electrically armed. The device comprises an electrical contact on the end of a spring biased gas operated piston which is prevented from closing by a pin on the piston bearing against and locking a torsionally spring loaded rotor. Prior types of gas pressure actuated switches are either in an open or a closed position before being actuated and then close or open, respectively, upon being actuated by gas pressure, and revert to their original position after the actuating gas pressure is reduced; thus, the prior art switches are open-closed-open or closed-open-closed type switches. The switch of the present invention is initially in a cocked open position. When it is pressure actuated the switch is uncocked, but remains in an open position. Only when the pressure drops does the switch move to a closed position; thus, the present switch is an open-open-closed type switch, unlike any prior switch.

It is an object of the invention, therefore, to provide an open-open-closed pressure actuated switch.

Another object of the invention is to provide a new and improved miniature gas pressure operated electrical switch.

A further object of the invention is to provide a normally open switch having a gas operated piston therein with means for preventing closing of the switch until after being pressure actuated and the actuating pressure is removed.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a cross-sectional longitudinal view of the pressure actuated switch of the present invention in its normal cocked and open position, prior to being actuated;

Fig. 2 is a cross-sectional view of the switch in its uncocked and open position while pressure is being applied against the spring loaded piston;

Fig. 3 is a cross-sectional view of the switch in its uncocked and closed position after the actuating pressure is removed from the piston;

Fig. 4 is a plan view of the rotor disc in the switch.

Referring now to the drawings, like numerals refer to like parts in each of the figures, and substantially all parts are circular in cross-section taken normal to the longitudinal axis of the views shown.

The entire switch assembly **10** is comprised of a minimum number of parts and is simple to operate. A housing cylinder **12** having an open end **14** and being closed at its opposite end with a base member **16** houses the entire operating or moving parts of the switch, as shown in Figs. 1, 2 and 3. A piston having a head portion **18** and a shaft portion **20** fits within housing cylinder **12**. The diameter of head portion **18** is slightly less than the inner diameter of the housing cylinder, allowing the piston to slide therein. Head portion **18** of the piston has a circumferential groove **22** thereabout containing an O-ring **23** which slides against the inner surface of the housing cylinder to provide a gas seal for preventing gas from leaking past the piston head **18**. An inwardly extending flange **24** is provided in the housing cylinder; the opening **26** formed thereby is slightly greater than the piston shaft **20**, allowing the shaft to ride freely therein. Shaft **20** and aperture **26** are such as to prevent relative rotation thereof. A biasing spring **28** fits about piston shaft **20** and bears against flange **24** and the rear side of piston head **18** tending to move the piston in the direction of base member **16**. The inner diameter of housing cylinder **12** at the closed end thereof is slightly enlarged to provide a seat **30** for holding rotor disc **32** which is free to rotate therein. Base member **16** holds rotor **32** in place and completely closes the end of housing cylinder **12** except for a passage **34** through the base member. Base member **16** may be mounted on the end of housing cylinder **12** by means of a crimp **36**, as shown, or by any other suitable means. Passage **34** also extends through rotor **32** allowing gas under pressure, from an outside source not shown, to pass through the base member and rotor and enter the closed end of the cylinder housing. This gas pressure exerts a force on piston head **18** tending to move it in a direction against the force of biasing spring **28**.

Piston head **18** has a pin-like protrusion **38** on the forward side thereof which fits into a cavity **40** on the surface of rotor **32** facing the piston head for holding the switch cocked in an open position. Protrusion or pin **38** is free to be lifted out of cavity **40** when the piston is moved back compressing biasing spring **28**. Rotor **32** is torsionally spring loaded for rotation by means of a spring **42** which fits within a groove **44** on the inner surface of base member **16**. The rotor is allowed to rotate a limited amount, 45° for example, when cocking pin **38** is removed from cavity **40**. Rotor **32** also has a notch section **46** cut out of the side of the disc, as shown in Fig. 4, allowing a space for pin **38** to drop into after the rotor has moved and the gas pressure is removed.

On the opposite side of flange **24** from biasing spring **28** is a lower electrical switch contact **50** having substantially the same diameter as the inner diameter of housing cylinder **12**. A layer of insulating material **51** may be provided between contact **50** and housing **12**. Lower contact **50** has an aperture **52** therethrough whose cross-section is that of a frustum of a cone; the smallest diameter of aperture **52** being equal to the diameter of aperture **26** formed by flange **24** so that piston shaft **20** will slide freely therein. End **54** of the piston, the opposite end from the piston head is slightly smaller in diameter than the main portion of piston shaft **20**; it has mounted thereon the upper electrical switch contact **56**, which may be insulated therefrom by a layer of insulating material **57**. Upper contact **56** is in the shape of a frustum of a cone having a central aperture therethrough for mounting **54** of the piston shaft and is the same size as aperture **52** in lower contact **50**, thus providing good electrical contact when upper contact **56** is moved to seat within aperture **52** in lower contact **50**. Electrical lead wires **58** and **59** are electrically connected to upper and lower contacts **56** and **50**, respectively.

The exterior configuration of housing cylinder **12** is not critical but it is preferably made from electrical insulating materials, though any other suitable materials may be used so long as the upper and lower contacts are suitably insulated from each other when in open position. Copper is preferable for the upper and lower contact material though other suitable materials having good electrical conductivity may be used.

The switch assembly **10** of the present invention operates as follows: Upper electrical contact **56** on the end of the gas operated piston is prevented from closing and contacting lower contact **50** by rotor **32** which prevents the spring-loaded piston from going to the full down position, and is illustrated in Fig. 1. This is the normal open position of the switch and it is in this position that the switch is assembled. When gas pressure builds up in an ignited rocket booster motor, for instance, the gas pressure may be used to move the piston upward, compressing biasing spring **28** and removing pin **38** on piston head **18** from cavity **40** in rotor **32**. This allows the rotor, which is torsionally spring-loaded in its normal or initial position, to revolve approximately 45°, for example. The switch is now in the armed or open and uncocked position, as illustrated in Fig. 2. When the booster motor combustion gas pressure subsides, the biasing spring force drives the piston back down, past its original position to the fully closed position, thus closing the switch, as illustrated in Fig. 3. This gives a switching sequence which is open when there is no pressure, open when it is subjected to pressure, and closed when it returns to a no pressure condition.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A pressure actuated switch comprising a housing, a base member closing one end of said housing, a bias spring and a piston within said housing, a torsionally loaded rotor means positioned between said piston and said base member, said bias spring biasing said piston against said rotor means preventing said rotor means from rotating, a first electrical contact carried on said piston, a second electrical contact mounted on said housing and operable to be contacted by said first electrical contact, a passage into said housing for supplying gas under pressure for moving said piston, said piston initially being held by said rotor means in a position operable to keep said first and second contacts separated, movement of said piston away from said rotor means by gas pressure being operable to allow said rotor means to rotate into a position where subsequent subsidence of the gas pressure will allow said piston to move toward said base member sufficiently for said first and second contacts to come into electrical contact with each other.

2. A pressure actuated switch comprising a tubular housing, a base member closing one end of said housing, a bias spring and a piston within said housing, a torsionally spring loaded rotor means positioned in said housing between said piston and said base member, said bias spring biasing said piston against said rotor means preventing said rotor means from rotating, a first electrical contact mounted on said piston and a second electrical contact mounted on said housing, said first electrical contact operable to be moved into contact with said second electrical contact, a passage into said housing for supplying gas under pressure for moving said piston, said piston initially being held by said rotor means in a position operable to keep said first and second contacts separated, movement of said piston away from said rotor means by gas pressure being operable to allow said rotor means to rotate into a position where subsequent subsidence of the gas pressure will allow said piston to move toward said base member sufficiently for said first and second contacts to come into electrical contact with each other for completing an electrical circuit.

3. A pressure actuated switch comprising a closed housing, a bias spring and a piston within said housing, a torsionally loaded rotor means positioned between said piston and one end of said housing, said bias spring biasing said piston against said rotor means preventing said rotor from rotating, a first electrical contact mounted on said piston, a second electrical contact mounted on said housing, a passage into said housing for supplying gas under pressure for moving said piston, said piston initially being held by said rotor means in a position operable to keep said first and second contacts separated, movement of said piston by gas pressure being operable to allow said rotor means to rotate into a position where subsequent subsidence of the gas pressure will allow said piston to move toward said one end of said housing sufficiently for said first and second contacts to come into electrical contact with each other.

4. A pressure actuated switch comprising a closed housing, a bias spring and a piston within said housing, a torsionally loaded rotor positioned between said piston and one end of said housing, cooperating means on said piston and rotor which when engaged prevent said rotor from rotating, said bias spring biasing said piston against said rotor for engaging said cooperating means, a first electrical contact mounted on said piston, a second electrical contact mounted on said housing, a passage into said housing for supplying gas under pressure for moving said piston, said piston initially being held by said cooperating means on the piston and rotor in a position operable to keep said first and second contacts separated, movement of said piston by gas pressure being operable to disengage said cooperating means to allow said rotor to rotate into a position where subsequent subsidence of the gas pressure will allow said piston to move toward said one end of said housing sufficiently for said first and second contacts to come into electrical contact with each other.

5. A pressure actuated switch comprising a tubular housing, a base member closing one end of said housing, a bias spring and a piston within said housing, a torsionally spring loaded rotor positioned in said housing between said piston and said base member, cooperating means on said piston and rotor which when engaged prevent said rotor from rotating, said bias spring biasing said piston against said rotor for engaging said cooperating means, a first electrical contact mounted on said piston and a second electrical contact mounted on said housing, said first electrical contact operable to be moved into contact with said second electrical contact, a passage into said housing for supplying gas under pressure for moving said piston, said piston initially being held by the cooperating means on the piston and rotor in a position operable to keep said first and second contacts separated, movement of said piston away from said rotor by gas pressure being operable to disengage said cooperating means to allow said rotor to rotate into a position where subsequent subsidence of the gas pressure will allow said piston to move toward said base member sufficiently for said first and second contacts to come into electrical contact with each other for completing an electrical circuit.

6. A pressure actuated switch as in claim 5 wherein a gas pressure seal ring is provided about said piston to prevent gas leakage past the piston.

7. A pressure actuated switch as in claim 5 wherein said first electrical contact is in the shape of a frustum of a cone and said second electrical contact has an aperture therein in the shape of a frustum of a cone the same size as said first electrical contact, when said contacts come into electrical contact said first contact seats in the aperture in said second contact.

No references cited.