May 20, 1958 L. M. ATKINS 2,835,758

EXPLOSIVE TIME DELAY SWITCH

Filed Dec. 18, 1956 2 Sheets-Sheet 1

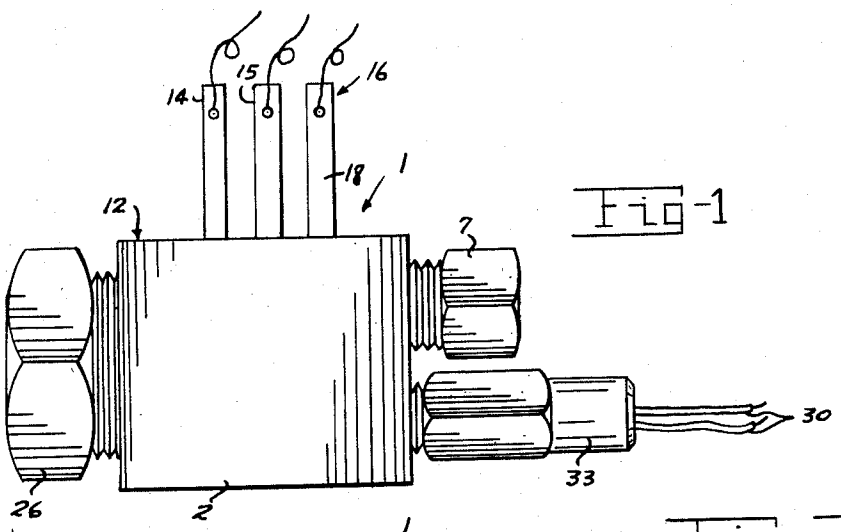


Fig-1

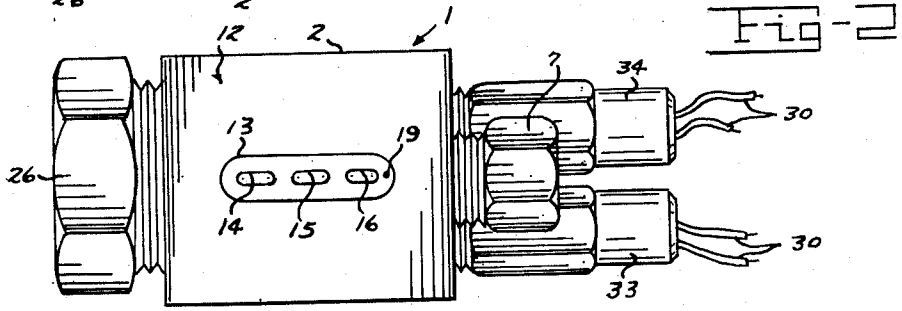


Fig-2

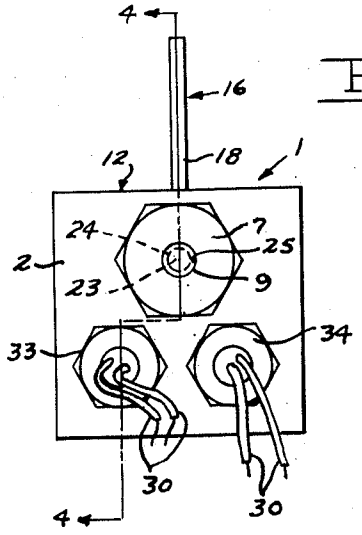


Fig-3

Fig-5

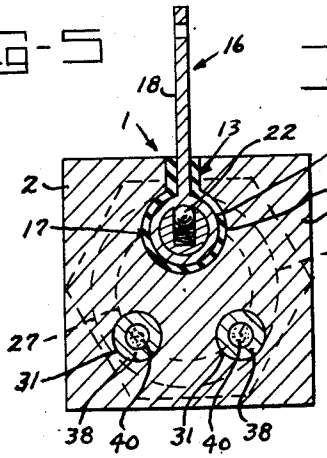
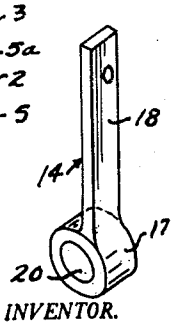


Fig-6



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EXPLOSIVE TIME DELAY SWITCH

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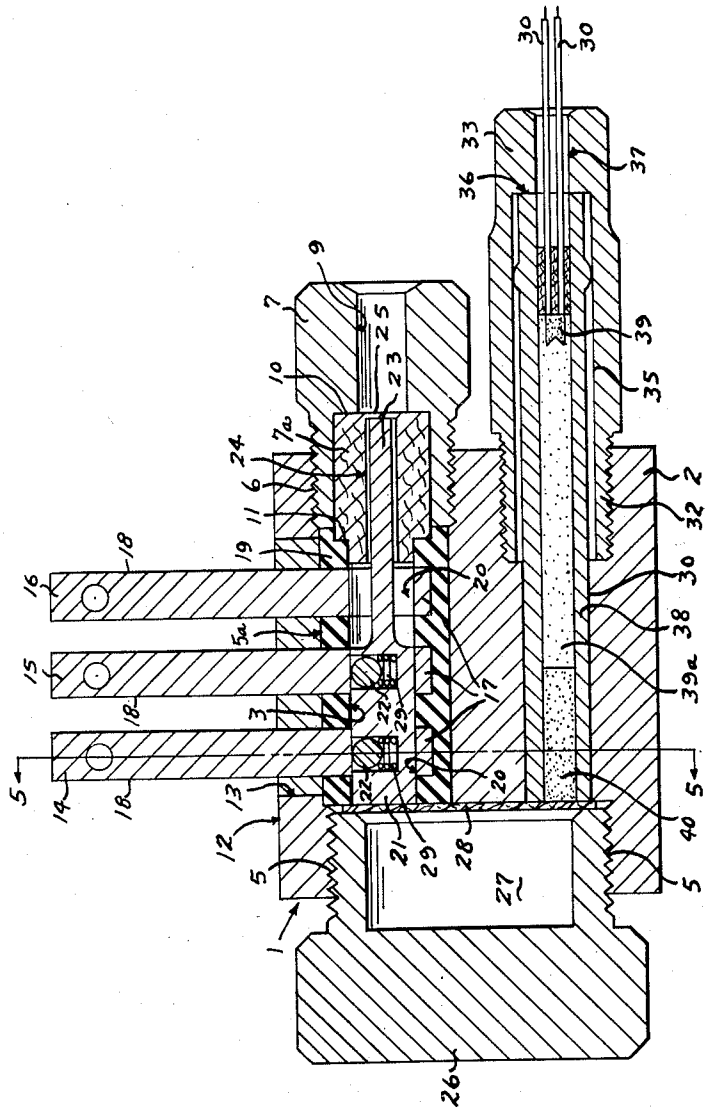

Fig 4

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EXPLOSIVE TIME DELAY SWITCH

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Application December 18, 1956, Serial No. 629,206

10 Claims. (Cl. 200—61.08)

This invention relates to electrical switches and more particularly to an electrical explosive time delay switch having for an object the provision of a switch which is simple in construction, inexpensive to manufacture, positive in operation, and sealed against outside atmosphere, moisture, etc.

A further object is the provision of a switch having an electrical primer, a time delay powder train to be ignited thereby and an explosive charge to be ignited by the powder train for operating the switch.

A further object includes the provision of an explosive time delay electrical switch which includes an air cushion chamber between the explosive charge and the switch device which is sealed out of communication with the switch actuating plunger by a diaphragm or partition device which is adapted to be ruptured by the explosive charge to establish communication between the air cushion chamber and the piston actuated switch device.

A further object includes the provision of a blow-out plug in the path of the switch piston for normally retaining the switch actuated piston in one of its two switch positions until actuated by pressure from the air cushion chamber, initiated by an explosive charge.

A further object is the provision of a two-way explosive time delay electrical switch device including a piston-type circuit closing switch member movable axially in opposite directions for establishing two different electrical circuits and includes rupturable abutment sealing means for holding the piston in circuit closing relation in one of said circuits, and a time delay explosive device for pressurizing said piston type circuit closing member to move the same to rupture said abutment means and move said piston to open the first circuit and close the second circuit.

A further object includes rupturable sealing means between the explosive charge and the piston and between the piston and the atmosphere.

A further object includes an air cushion chamber between the explosive charge and the second mentioned rupturable sealing means for isolating the piston initially from the explosive charge.

A further object includes convenient means for removing and replacing said rupturable sealing means after the explosive charge has been detonated and the rupturable sealing means has been ruptured.

A further object includes an indicator carried by the piston to indicate when the switch has been actuated.

Other objects and advantages will become apparent from the following description and accompanying drawings in which like reference characters refer to like parts in the several figures.

Drawings

Figure 1 is a side elevation of my improved explosive switch device.

Figure 2 is a top plan view.

Figure 3 is an end of my switch device.

Figure 4 is a vertical longitudinal sectional view taken about on the plane indicated by line 4—4 in Figure 3.

Figure 5 is a transverse sectional view about on the plane indicated by line 5—5 in Figure 4; and

Figure 6 is a detail perspective view of one of the contact bars.

My improved switch device, indicated generally at **1**, comprises a casing or switch body **2**, preferably rectangular in shape, as seen in Figures 1 to 4, and formed with an upper cylindrical bore **3** therein terminating at the left hand end, as seen in Figure 4, in an enlarged annular threaded recess **5**, and at the right hand end in an enlarged threaded nylon "blowout" plug receiving cavity **6**, the right hand recess **6** threadably receiving a blowout plug holder **7** having a blowout plug receiving cavity **8** and a blowout opening or bore **9** disposed in axial alignment with the cylindrical bore **3**, but smaller in diameter forming an abutment or annular shoulder **10**. A blowout plug insert **7***a* is seated in the cavity **8**. The outer or right hand end of the bore **3** is counterbored inwardly to provide an annular shoulder **11** facing the shoulder **10** in spaced relation.

The top portion **12** of the casing **2** is formed with a slot **13** directly over the axis of the bore **3** and an enlarged cylindrical bore **5***a* is provided having a plurality of contact elements or posts **14**, **15** and **16** (a detail of one being shown in Figure 6). These are disposed in the slot **13** with the heads **17** thereof surrounding the guide bore **3** in axially spaced relation and the shanks **18** extending out through the slot opening **13**. The space between the cylindrical bore **5***a* and the contact posts **14**, **15**, and **16**, and the side walls of the slot **13** is filled with a "potting" compound **19** of insulating material and hardened to retain the contact posts **14**, **15** and **16** in proper position in the casing **2** with the centers of the heads **17** concentric to the axis of the bores **3** and **5***a*, after which the bore **3** may be reamed out to provide a cylindrical guide passage therethrough with the inner contact surfaces **20** of the heads **17** exposed.

Slidably mounted in the cylindrical bore **3** is a piston contact member **21** having a pair of spring biased contact balls **22** which are spaced apart a distance equal to the spacing of the adjacent contact surfaces **20** of the contact heads **17** of the contact bars **18**. The piston member **21** has a concentric reduced extension or stem **23** which extends freely into the bore **24** of the blowout insert plug **7***a* to the thin outer wall **25** thereof, thus forming an abutment for holding this piston in its left hand operative position as shown in Figure 4 with the contact balls **22** thereof in contacting relation with the centers of the contact surfaces **20** of the contact bars **14** and **15**.

When the piston **21** is moved to the right, referring to Figure 4, the thin wall **25** of the blowout plug insert **7***a* is ruptured and the stem portion **23** pierces the thin wall **25** and passes through the bore **9** to project slightly beyond the outer face of the plug **7** so that the same may be observed or felt manually to indicate the outer or right hand contact position of the piston contact member **21**, indicating that the two contact balls **22** have now moved into contact with the contact surfaces **20** of the two contact posts or bars **15** and **16** and out of contact with the bar **14**.

The left hand end of the bore or cylinder **3** opens into communication with the larger threaded bore **5** and a hollow closure or end plug **26** is screwed into the threaded bore **5** and has an air cushion chamber **27** formed therein. A frangible diaphragm or partition **28** is interposed or clamped between the inner end of the plug **26** and the bottom of the threaded opening or bore **5**, closing the left hand end of the cylindrical bore **3** and retaining the contact piston member **21** from left hand movement

with the contact balls 22 thereof in contact with the contact surfaces 20 of the two left hand contact bars 14 and 15.

Sufficient pressure may be applied in the air cushion chamber 27 so as to rupture the sealing diaphragm 28 and admit the pressure into the left hand end of the cylindrical bore 3, thus forcing the piston 21 to the right, causing the outer end of the stem 23 to rupture the thin wall 25. This permits the piston 21 to move to the right and shift the contact balls 22 into contact with the contact surfaces 20 of the contact bars 15 and 16. The outer end of the stem 23 moves outwardly through the bore 9 to a point beyond the outer face of the plug 7 to provide indicating means showing that the contact piston 21 has moved to the right and electrical contact between the contact bars 15 and 16 has been established. The piston 21, balls 22, and biasing springs 29 therefor are metallic for establishing good electrical contact.

The cylindrical plug which contains the cylindrical bore 3 and supports the imbedded contact bars 14, 15 and 16 is preferably of insulation material. The blowout plug insert 7*a* is preferably made of nylon and is retained in position by the screw plug member 7 and the shoulder 11 at the outer end of the insulating sleeve carrying the contact bars 14, 15 and 16.

The lower portion of the casing 1 is provided with two laterally spaced cylindrical passages 30 and 31 disposed in spaced parallel relation to the bore 3 and open at their left hand ends into the air cushion chamber 27. The partition or rupturable diaphragm 28 closes the left hand ends of these passages 30 and 31. The right hand ends of these passages 30, 31 are counterbored and threaded at 32 to receive the primer retainer plugs 33 and 34 therein. The plugs 33 and 34 each have a primer tube receiving bore 35 therein terminating in a shoulder 36 and a concentric bore 37 of smaller diameter through the outer end.

A time delay primer tube 38 is inserted in the bores 30 and 35 and secured in place by the tightening of the primer tube plug 33 or 34, the opposite ends of the tube 38 being in engagement with the partition 28 and the shoulder 36.

The primer tube 38 comprises a cylindrical shell having an electric igniter 39 with ignition circuit leads 30 extending through the bore 37 and adapted to be connected to a suitable firing circuit (not shown). The tube 38 next contains a time delay (slow burning) powder train 39*a* and an explosive charge 40 at its inner end, next to the rupturable partition 28.

Operation

When the igniter 39 is energized through the electrical conductors 30, the slow burning powder train 39*a* is ignited. After a predetermined time delay the powder train burns so as to detonate the explosive charge 40. The pressure from the explosive charge 40 ruptures the partition 28 and is admitted into the air cushion chamber 27. The pressure buildup in the chamber 27 becomes effective on the left hand end of the contact plunger 21 pushing it to the right to cause the outer end of the stem 23 to rupture the thin wall 25, thus permitting the piston and stem 23 to move to the right. As the piston 21 moves to the right the two contact balls 22 are shifted into contact with the contact surfaces 20 of the contact bars 15 and 16.

It is proposed to use two time delay squibs in parallel to increase the safety feature of the device.

When it is desired to reset the device after use, the plug 26 is removed after which the partition 28 can be replaced and the plug 26 can now be secured by tightening the same and clamping the periphery of the partition between the plug 26 and the bottom of the air cushion chamber as seen in Figure 4.

The blowout plug holder 7 is removed and the ruptured nylon blowout plug insert 7*a* is replaced returning the contact member 21 to the left as shown in Figure 4 when the blowout plug holder 7 is tightened up.

The two primer tubes 38 are likewise replaced and the firing circuits again connected.

While only one preferred embodiment of the invention is shown and described, it will be obvious to those skilled in the art that it is susceptible to various changes and modifications without departing from the spirit and scope of the invention as defined in the accompanying claims.

I claim:

1. In an electrical switch device, a casing having a guide passage formed therein, a plurality of stationary electrical contacts exposed in the wall of said guide passage, a contact member movable axially in said passage, an electrical contact carried by said contact member for electrical contacting relation with said stationary electrical contacts when said movable contact member is moved axially in one direction in said guide passage and movable out of contacting relation with one of said stationary contacts when said movable contact member is moved axially in the opposite direction, and explosive pressure means for moving said movable contact means in one of said directions.

2. In an electrical switch device, a casing having a guide passage formed therein, a plurality of stationary electrical contacts exposed in the wall of said guide passage, a slidable contact member movable axially in said guide passage, an electrical contact carried by said slidable contact member for circuit closing contacting relation with said exposed stationary electrical contact when said slidable contact member is moved axially in one direction and movable out of said contacting relation when said slidable contact member is moved axially in the opposite direction, and explosive pressure responsive means for moving said slidable contact member to one of said positions.

3. A switch device as defined in claim 2 including rupturable means in the path of said axially shiftable electrical contact member for yieldably resisting axial movement of said shiftable electrical contact member in the last mentioned direction.

4. A switch device as defined in claim 3 including rupturable sealing means in said casing in the path of movement of said axially movable contact member in either direction, a fluid pressure supply means for rupturing said sealing means and applying pressure to one end of said axially movable contact means for moving the same toward the other rupturable sealing means, and means on said axially movable contact means for rupturing said other rupturable sealing means upon movement thereof by said pressure.

5. An electrical time delay explosive switch device comprising a casing having an insulated guide passage formed therein, a plurality of equally spaced stationary electrical contacts exposed axially along said passage, said casing having an enlarged air cushion chamber formed in one end with said guide passage opening thereinto, an electric time delay primer receiving passage formed in said casing in spaced substantially parallel relation to said guide passage with one end of said primer receiving passage opening into said air cushion chamber, an insulating rupturable partition disposed across said end of said casing between said air cushion chamber and said guide passage and said primer receiving passage, an axially movable piston contact member disposed in said guide passage with one end in juxtaposed relation to said partition, said piston contact member having a yieldable electrical contact in the outer wall thereof in contact with one of said spaced stationary electrical contacts, a blowout plug closing the other end of said axial passage, an axial stem member on said piston facing said blowout plug with the outer end of said stem in juxtaposed relation to said plug to space said piston from said blowout plug, and a time delay explosive device secured in said primer re-

ceiving passage including an explosive charge adjacent said partition, a time delay powder train next to said explosive charge, an electric primer igniter in contact with said powder train, and a primer seal for sealing said explosive time delay explosive device in said primer receiving passage.

6. Apparatus as claimed in claim 5 in which said blowout plug is formed with a concentric guide passage extending partly therethrough to receive said stem and formed with a thin rupturable wall at the inner end of said guide passage with said stem engaging said wall, and abutment means formed on said blowout plug in axially spaced relation to said contact piston for limiting movement of said piston toward said blowout plug when said explosive charge is detonated.

7. In a time delay explosive electrical switch device, a metallic casing having a first cylindrical bore formed therein, an enlarged threaded opening at one end of the casing in communication with said bore, a smaller threaded opening at the opposite end of said casing in communication with said bore, a slot formed in the top of said casing between the interior of said bore and the exterior of said casing, said casing having a second cylindrical bore formed therein in spaced parallel relation to the first bore with the inner end thereof disposed in communication with said enlarged threaded opening, said casing having an enlarged threaded opening formed therein at the other end of said second cylindrical bore, a primer tube having a threaded end screwed into the last mentioned threaded opening, a rupturable partition disk disposed across the bottom of first enlarged threaded opening and across the adjacent ends of said first and second cylindrical bores, a threaded blow-out plug holder screwed into said threaded opening at said opposite end of said casing, said blowout plug having a concentric blowout plug receiving opening therein and a smaller axial bore leading therefrom to the outer end of said holder, a blowout plug of nylon-like material seated in said blowout plug receiving opening formed with a concentric stem receiving bore extending partly therethrough to provide a thin abutment wall in said holder adjacent said smaller axial bore, three ring shaped contact members surrounding the axis of said first bore in spaced relation to the inner surface of said first bore and to each other, a potting insulating compound filling said first bore and said slot and surrounding said ring contact members, said insulation having a concentric cylindrical guide passage therethrough with its wall disposed in alignment with the inner surfaces of said ring contact members, a cylindrical piston contact member slidably fitting said cylindrical guide passage with one end thereof in juxtaposed abutting relation to said partition disk and its opposite end spaced from the inner end of said nylon-like blowout plug, a concentric reduced diameter stem extending axially from said piston through said stem receiving bore into substantially juxtaposed abutting relation to said thin abutment wall, said smaller diameter axial bore in said holder having a length less than the length of said guide bore in said blowout plug, said cylindrical piston contact member having a

pair of spring biased ball contact members disposed in the outer wall thereof and spaced axially in electrical contact with the inner surfaces of the two of said three contact rings which are nearest to said partition disk, a time delay explosive primer seated in said primer tube including electrical means for igniting said explosive primer, spaced electrical contact bars extending through said slot with their inner ends connected to said contact rings and a threaded plug screwed in said first enlarged threaded opening, said plug having an air cushion cavity formed therein facing said partition.

8. In a switch device, a casing having a cylinder therein, a piston axially shiftable in said cylinder, explosive means for pressuring said cylinder to move said piston axially in said cylinder in one direction, a rupturable partition member interposed between said cylinder and said explosive means, a second rupturable abutment means in the path of movement of said piston away from said partition member to resist movement of said piston in said cylinder, and cooperating electrical contact means carried by said casing and said piston in initial contact relation with each other and movable out of said electrical contact relation by movement of said piston from an initial position in said cylinder upon rupture of said partition member by pressure from said explosive means to pressurize the cylinder.

9. In a pressure operated switch device, a casing having a cylinder therein, an explosive pressure chamber formed in said casing in communication with said cylinder, a piston shiftable in said cylinder between an initial position and an axially spaced position, a rupturable diaphragm interposed between said chamber and said cylinder, an electrical circuit closing contact means between said piston and casing disposed in contacting relation when said piston is in one of said two spaced positions and shiftable out of contacting relation by movement of said piston to the other of said positions including a second rupturable abutment in the path of axial movement of said piston away from the first mentioned rupturable diaphragm, a concentric stem extension on said piston extending toward said second rupturable abutment for piercing said second rupturable abutment incident to movement of said piston toward said second rupturable abutment by explosive pressure in said cylinder on said piston.

10. Apparatus as defined in claim 9, wherein said second rupturable abutment comprises a plug of nylon-like material having an outer end wall closing the end of the cylinder remote from said rupturable diaphragm, said plug having a bore extending partly therethrough to slidably accommodate said stem extension when said piston is in an initial position adjacent said rupturable diaphragm.

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