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[54] **DRIVE MECHANISM FOR ELECTRICAL SWITCHES**

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[51] **Int. Cl.** **H01h 39/00**

[58] **Field of Search** ..... 335/1; 200/82 R, 200/82 B, 61.08, 62

[56] **References Cited**

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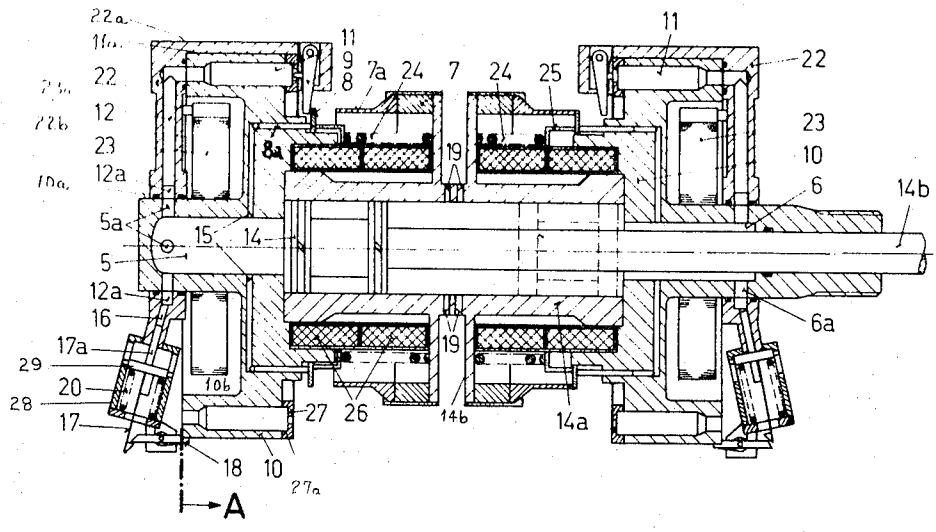
[57] **ABSTRACT**

A double-acting drive mechanism for actuating the contacts of an electrical switch between open and closed position includes a cylinder having a double-acting piston therein and a piston rod extending through one end of the cylinder for connection to the contact actuating mechanism of the switch. Each end of the cylinder is closed by a stationary member having a flanged portion provided with one or more circular rows of cartridge chambers serving as a magazine and which communicate with the corresponding end of the cylinder, and a latch-releasable spring-driven rotary member carrying a firing pin is mounted on each end closure member for the cylinder for rotation in a step-by-step manner around the row of cartridge chambers so as to fire the cartridges in succession.

9 Claims, 4 Drawing Figures



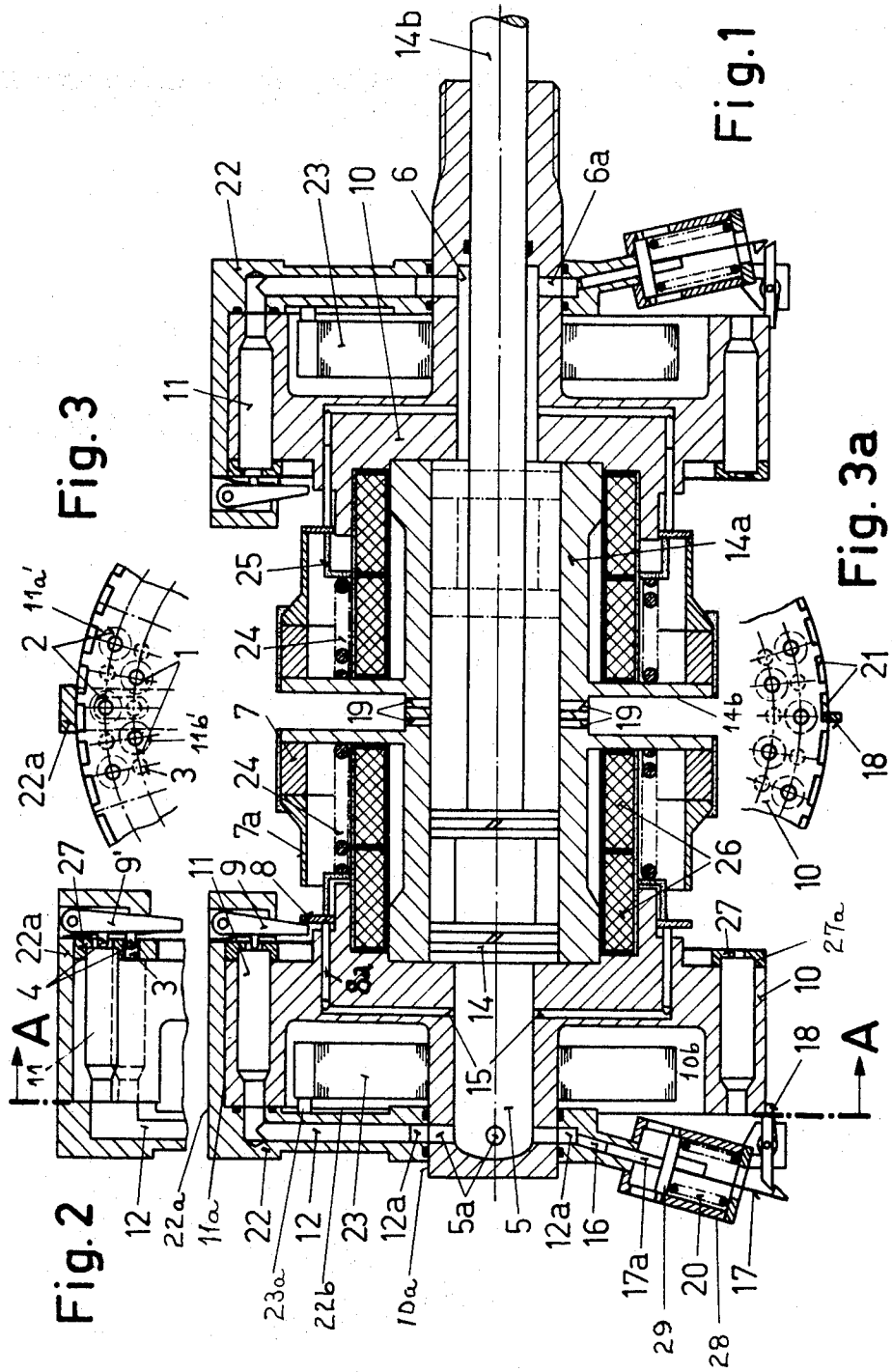


Fig. 1

Fig. 3

Fig. 3a

Fig. 2

DRIVE MECHANISM FOR ELECTRICAL SWITCHES

The present invention relates to an improved drive for electric switches where a driving piston is driven in both directions by the ignition of an explosive by use of cartridges which are filled with substances that will develop explosive gases, said cartridges being placed in at least one magazine.

A drive for electric switches is known where a piston is impinged upon alternatingly in both directions by ignited detonating gas, the ignition being accomplished by spark plugs (German Patent 1,287,677). Also known is a pressure gas switch where the cut-off is accomplished by arc quenching, and the drive by the ignition of cartridges filled with explosives which are replenished by a magazine clip, similar to a self-loading rifle (German Patent 568,887). The switching-on is accomplished here by spring force. Finally, there is known in view of the German published patent specification DT/AS 1,118,316 a switch drive where in the switch-on direction a piston is moved by the ignition of cartridges in an explosion chamber, whereby the cartridges are delivered by means of a guide-slide magazine.

The primary object of the present invention is to provide a more simple solution where the transfer of cartridges by moving magazines is avoided but still providing a relatively large quantity of cartridges. The drive proposed by the invention is characterized by the features that both ends of a cylinder which holds the driving piston, are closed off by flanged end members designed to form a stationary cartridge magazine, whereby the flanged end members are provided with a part that is rotatable by spring force, and which after the ignition of one cartridge can always be made ready to provide the next cartridge by the transitory release of the spring-activated turning device, the release being controlled by the explosive gas, and that the rotatable part is provided with a striker pin and a duct which guides the explosive gases to the drive area.

The foregoing, as well as other objects and advantages inherent in the invention will become more apparent from the following detailed description of a preferred embodiment thereof and from the accompanying drawings wherein:

FIG. 1 shows the improved drive in longitudinal cross-section,

FIG. 2 is also a cross-section which depicts a variation in a detail of the cartridge arrangement in FIG. 1; and

FIGS. 3 and 3*a* are sections along the cutting line A — A, with FIG. 3, 3*a* depicting the same cartridge arrangement as shown by FIG. 2.

With reference now to FIG. 1, the double acting working piston **14** is seen to be located within cylinder **14***a*. Piston **14** is provided with a piston rod **14***b*, connected to the contact mechanism of the switching apparatus — which is not shown in detail. Both ends of the piston cylinder **14***a* are closed off, each with one flanged end member **10**. Inside the flanged end members, spaces **5** and **6** are provided which can have volumes of different sizes. In the species depicted, the space **5** located at the left end of cylinder **14***a* which communicates with the left side of piston **14** is larger so that with the use of identical cartridges, the energy of thrust, acting in this direction, i.e., towards the right,

will have a lesser effect (switch-on direction). The thrust space **6** for the switch-off direction associated with the right end of cylinder **14***a* and the right side of piston **14** is kept smaller with the result that a desirable greater driving force of piston **14** and piston rod **14***b* to the left is generated. The cartridges **11** are accommodated in bores provided in the flanged end members **10**, located along a single pitch circle or along two circles **1, 2** (FIG. **3**). It will be advantageous in this connection, as shown by FIGS. **2** and **3**, to arrange the bores of the smaller pitch circle **1** so as to lie between the bores of the larger circle **2**, because in this manner a greater number of bores, and consequently a greater number of cartridges **11** can be accommodated in the flanged end members **10**.

Mounted for rotation on a cylindrical projecting part **10***a* of each of the flanged end members **10** and which is coaxial with an extension of the axis of cylinder **14***a* is a rotatable part **22** which is provided with a duct **12** which extends in a radial direction inwardly from the cartridge chamber **11***a* and terminates in a circumferentially extending passageway **12***a* which is in constant communication with the spaces **5, 6** respectively by means of one or more bores **5***a*, **6***a* through the wall of the mounting part **10***a*. The rotatable part **22** is provided with a longitudinally extending arm portion **22***a* which rotates in contact with the periphery of the flanged end member **10** and which is provided with a pivotally mounted lever **9** which, in the case of the embodiment depicted in FIG. **1**, carries a single firing pin **4** having a stroke along a path intersecting the pitch circle defining the positions of the circumferentially spaced cartridge chambers **11***a*.

In the case of the embodiment according to FIG. **2**, the corresponding lever **9'** is provided with two firing pins **4, 4** which are aligned respectively with each of the two concentric pitch circles **1** and **2** provided with the staggered circular rows of cartridge chambers **11***a'* and **11***b'* in which the cartridge **11** are fired in alternation. It will be noted that dummy holes **3** are located along each of the two pitch circles in alternation with the cartridge chambers **11***a'* and **11***b'* so that each time the firing pin lever **9'** is actuated, one firing pin serves to detonate a cartridge along one pitch circle and the other firing pin enters a dummy hole **3** on the other pitch circle.

A magnetic system is utilized for effecting actuation of the firing pin lever **9**, or **9'** at each end of the cylinder **14***a* and flanged end member **10**. As depicted in FIG. **1**, each of the two magnetic systems includes a permanent magnet **7** having an annular configuration which concentrically surrounds the cylinder **14***a* and is supported by a radially extending flange **14***b*. Each annular magnet **7** is provided with an annular pole shoe **7a** and includes an annular disc-shaped armature **8** carried by an annular support **25** which is slidable along and is guided by a cylindrical control coil **26** surrounding and supported by cylinder **14***a* so as to provide for movement of armature **8** between the lever-striking position depicted at the left end of FIG. **1** at which the cartridge **11** is fired, and a retracted position depicted at the right end of FIG. **1** against the counter-action of a helical firing spring **24** located intermediate coil **26** and magnet structure **7, 7***a* so as to lie in contact with the end of the pole shoe **7***a*. The magnetic flux produced by energization of coil **26** is counter to that produced by the permanent magnet **7** itself so that when

coil 26 is not energized, the magnetic flux produced by magnet 7 is strong enough to hold armature 8 in the retracted position away from the firing pin lever 9, or 9'. However, when the flux-weakening coil 26 is energized, the force attracting armature 8 to the pole shoe 7*a* is lessened to the extent that the counterforce stored by compression of spring 24 is then sufficient to drive the support 25 and armature 8 so that the latter strikes lever 9 or 9' and causes the firing pin 4 to strike and detonate cartridge 11. The ensuing explosion gases pass through the passageways 12, 12*a* and 5*a* into the chamber space 5 and drive piston 14 and its piston rod 14*b* from the left hand, full line position at the left end of cylinder 14*a* depicted in FIG. 1 to the right hand, broken line position at the right end of cylinder 14*a*. As previously explained, piston rod 14*b* is coupled to the switch contact actuating mechanism and thus effects closing of the switch contacts.

As the pressure builds within the space 5 by the explosion gases, a portion of such gases passes outwardly through ducts 15 each of which lead from the space 5 and terminate at one end of a bore containing a tappet rod 8*a* which acts in the manner of a piston and drives against armature 8 forcing the latter to move in the opposite direction away from lever 9 against a counter force of spring 24 which is then re-compressed and reengage with pole 7*a* which then holds it in this attracted position, the release current pulse applied to the field-weakening coil 26 then having been terminated, until the next firing action takes place.

Also mounted on the rotatable part 22 is a casing 28 enclosing a compression spring 20 which exerts its force against a tappet rod 17*a* slidable within a bore 16 which communicates with the circular passageway 12*a*. Connected to tappet rod 17*a* by means of a piston-like guide member 29 slidable within casing 28 is a resilient pawl 17 engageable with and controlling the operation of a latch lever, one end of this lever 18 being engageable with the pawl and the opposite end being arranged to engage in one of a circumferential array of grooves 21 provided at the periphery of the end member 10, as shown more clearly in FIG. 3*a*.

As soon as piston 14 moves past ports 19 in the wall of cylinder 14*a*, the pressure of the explosion gases will drop at the driving side, e.g., 5, thus dropping the pressure within bore 16 and permitting the force stored within compressed spring 20 to act through the piston-like guide members 29 and shift tappet 17*a* and pawl 17 in the direction such as to cause a temporary rotation of the spring biased latch lever 18 to release it from the particular groove 21 with which it has been engaged. This shifted position of the tappet 17*a*, guide 29 and pawl 17 is depicted at the right end of FIG. 1.

A spirally coiled spring 23 is located in a recess 10*b* provided within each of the end members 10 and surrounds the cylindrical portion 10*a*. The inner end of spring 23 is anchored to the portion 10*a* and the outer end of spring 23 is provided with a driving dog 23*a* which engages a recess 22*b* provided in the rotatable part 22. The driving spring 23 is wound by rotating the part 22 about the end member 10 with the latch lever 18 disengaged.

When latch lever 18 is momentarily actuated by the shifting movement of pawl 17 so as to disengage the lever from a groove 21, the torque stored in the wound spring 23 will then cause the part 22 to rotate by one step or pitch along the pitch circle of the cartridge chambers at which instant it is then stopped by engagement of the latch lever 18 in the next adjacent groove 21. The pawl 17 and its associated structure will remain in the position depicted at the right end of FIG. 1 until the next cartridge is fired from the left end of FIG. 1, at which time, the pressure build-up within the space 5 will cause the tappet 17*a*, guide 29 and pawl 17 to be shifted back to the position depicted at the left end of FIG. 1 in readiness to once again trip the latch lever 18 as soon as piston 14 has been driven far enough into its cylinder 14*a* to expose the ports 19 to the space 5.

As previously explained, the operating arrangement for the cartridge magazine structure at each end of cylinder 14*a* is alike with the possible exception that the volume of space 5 is made somewhat greater than that of space 6 so as to provide a less forceful actuation of the switch contacts to the contact-closed position as piston rod 14*b* is driven from left to right as viewed in FIG. 1. The cartridges 11 are retained within their chambers by means of an annular ring 27 provided with an annular groove or grooves 27*a* depending upon whether one or two rings of cartridges are utilized which receive and press against the ends of the cartridges. Removal of ring 27 enables the cartridge magazine structure to be re-filled simply and quickly. While the spaces 5 and 6 have essentially the same diameter and length, the differences in their respective volumes is attributable to the fact that piston rod 14b passes through the space 6 thus reducing its effective volume accordingly.

I claim:

1. In a double-acting drive mechanism for actuating the contacts of an electrical switch between their closed and open positions, the combination comprising a cylinder, a double-acting piston operable within said cylinder, a flanged end member for and closing off each end of said cylinder, the flanged portion of each said end member being provided with at least one circular row of circumferentially spaced chambers constituting a stationary magazine for receiving cartridges which upon detonation produce explosion gases for driving said piston from one end of said cylinder to the other, a piston rod extending through one of said end members and which is connectible to the switch contact actuating means, duct means establishing an explosion gas flow path between each of said cartridge chambers and the corresponding end of said cylinder, cartridge firing means including a firing pin mounted on said end member for rotation in a step-by-step manner along said row of cartridge chambers for effecting consecutive firing of the cartridges, actuating means for said firing pin, spring means for imparting a continuous torque to said rotary cartridge firing means, a latching device restraining rotation of said cartridge firing means at each cartridge chamber position, and means releasing said latching device after each cartridge is fired whereby said rotary cartridge firing means automatically steps to the next cartridge firing position.

2. A double-acting drive mechanism as defined in claim 1 for actuating the contacts of an electrical switch wherein each of said flanged end members is provided with a pair of concentric circular rows of circumferentially spaced cartridge chambers, the cartridge chambers of one row being circumferentially staggered with respect to the cartridge chambers of the other row, and wherein said cartridge firing means is

provided with a firing pin serving each row of cartridge chambers.

3. A double-acting drive mechanism as defined in claim 1 for actuating the contacts of an electrical switch wherein said releasable latching device for restraining rotation of said cartridge firing means at each cartridge chamber position includes operating means therefor actuated by the explosion gases after said piston has been driven for a predetermined distance within its cylinder.

4. A double-acting drive mechanism as defined in claim 1 for actuating the contacts of an electrical switch wherein said firing pin is mounted on a lever and wherein said actuating means for said firing pin is constituted by a magnetic assembly including a stationary annular holding magnet surrounding said cylinder, an annular armature member also surrounding said cylinder and which is mounted for movement parallel to itself between said holding magnet and a position striking said firing pin lever, and a striker spring engaging said armature member for driving the latter against said firing pin lever when released from said magnet.

5. A double-acting drive mechanism as defined in claim 4 for actuating the contacts of an electrical switch wherein said holding magnet is of the permanent type and which further includes a release coil associated therewith, said release coil when energized producing a magnetic flux counter to the magnetic flux produced by said permanent magnet and which serves to weaken the effective attractive force and release said armature member.

6. A double-acting drive mechanism as defined in claim 4 for actuating the contacts of an electrical switch and which further includes means actuated by the explosion gases for resetting said armature member into engagement with said holding magnet and simultaneously storing a force in said striker spring.

7. A double-acting drive mechanism as defined in claim 1 for actuating the contacts of an electrical switch and wherein said duct means establish a flow path for the explosion gases from said cartridge chambers to the end of said cylinder includes a passageway leading through said rotary cartridge firing means into a space provided in said end member and which communicates with the end of said cylinder.

8. A double-acting drive mechanism as defined in claim 7 for actuating the contacts of an electrical switch wherein the effective volumes of the spaces provided respectively in said end members differ from one another so as to provide correspondingly different driving forces on said piston for its opposite directions of movement.

9. A double-acting drive mechanism as defined in claim 1 for actuating the contacts of an electrical switch wherein said latching device includes a latch lever mounted on said rotary cartridge firing means, one end of said lever being engageable in each of a circular row of circumferentially spaced grooves provided in said end member, and the other end of said lever being actuatable by a pawl which in turn is actuated in response to the pressure created by the explosion gases.

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