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3,199,288

EXPLOSIVELY ACTUATED PISTON DRIVER

Filed March 20, 1963

FIG. 1.

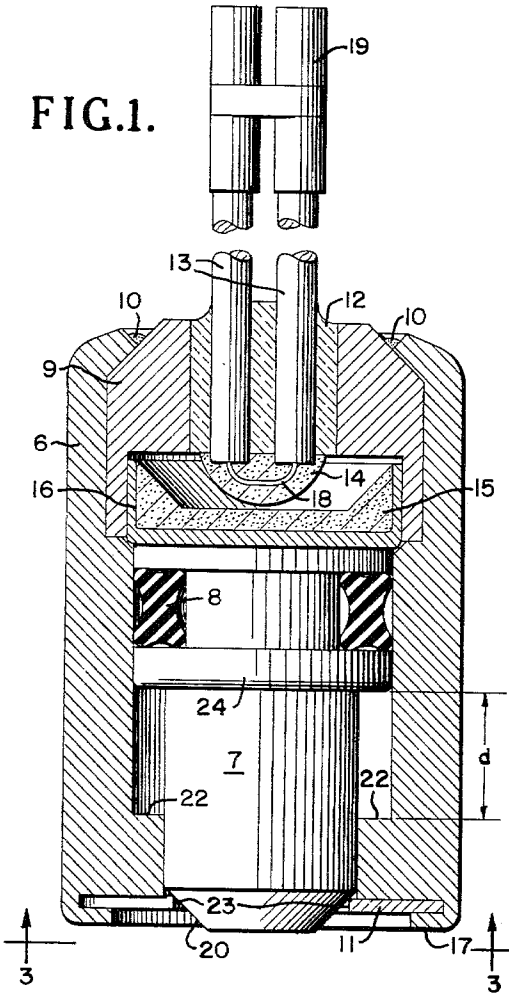


FIG. 2.

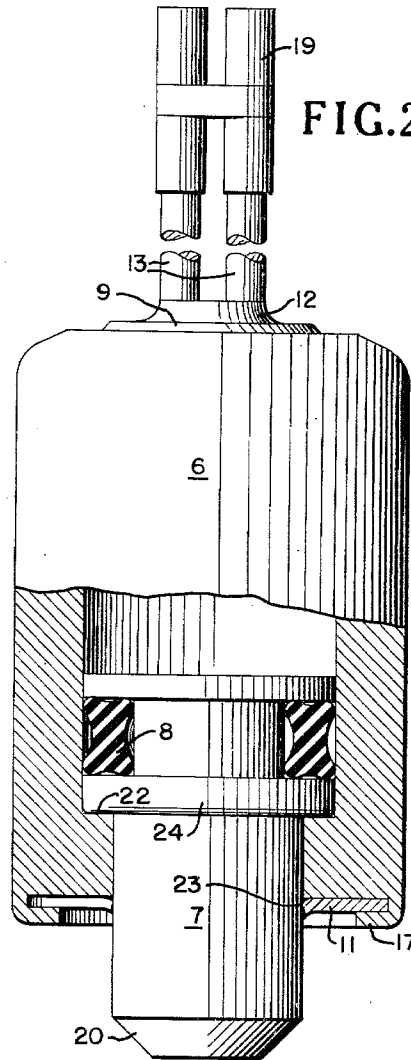


FIG. 3.

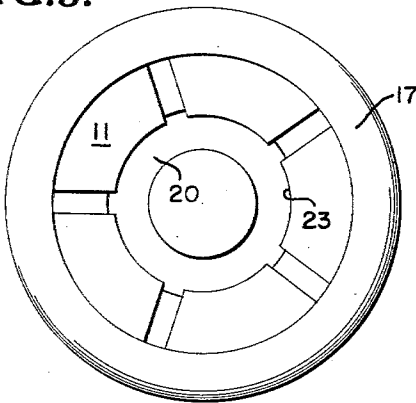
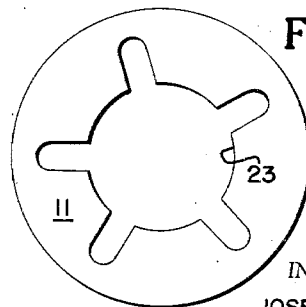


FIG. 4.



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**EXPLOSIVELY ACTUATED PISTON DRIVER**

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6 Claims. (Cl. 60—26.1)

(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 generally to explosively actuated devices used to drive mechanical loads, to operate relays, latches, solenoids, and the like and more particularly to an explosively actuated piston employed in one shot applications.

In the field of explosively actuated piston drivers used for one shot applications, it has been the general practice to rely upon a combination of gas pressure within the piston housing assembly and friction between the piston and the housing assembly in which it is slideably engaged to maintain the piston firmly in its fired position relative to the housing after firing the piston by actuation of the explosive. Reliance upon such an inherent locking means has not proved entirely satisfactory to prevent the piston from returning to its unfired position for certain applications where the piston must support a substantial mechanical load for indefinite periods of time.

The general purpose of this invention is to provide an explosively actuated piston driver which embraces all the advantages of similarly employed prior art drivers and possesses none of the aforescribed disadvantages. To attain this, the present invention employs a unique locking feature to restrain linear travel of the piston after firing which comprises a unique spring locking feature which is compressed upon the actuation of the piston and grips the piston with tiny flat arcuate fingers to thereby prevent its return to an unfired position even after the explosive gas pressure has bled off.

An object of the present invention is the provision of a unique piston locking feature in combination with an explosively actuated piston driver which prevents linear travel of the piston to its unfired condition once the driver has been actuated.

Another object is to provide a piston locking mechanism in combination with an explosively actuated piston driver which enables the piston to be locked in any intermediate position between the unfired position and the fully extended position of the piston.

A further object of the invention is to provide a piston locking feature in combination with an explosively actuated piston driver which can be easily mounted within the driver housing assembly and requires substantially no increase in the housing size over housings used in similar prior art piston drivers due to the inclusion of said locking feature.

Still another object is to provide in combination with an explosively actuated piston driver a unique spring lock which is easy to manufacture and which requires no expansion or compression thereof before actuation of the piston.

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 in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIG. 1 shows an elevation view partly in section of

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the explosively actuated piston driver in an unfired condition;

FIG. 2 illustrates an elevation view partly in section of the piston driver after actuation thereof by energization of the explosive;

FIG. 3 is a plan view of the piston driver taken along lines 3—3 of FIG. 1; and

FIG. 4 is a plan view of the spring lock.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1 in its unfired position an explosive piston driver having a housing 6 and a piston 7 slideably engaging the housing. An explosive actuator assembly housing 9 is mounted at one end of said piston housing 6 and has its base charge assembly including base charge cup 16 in juxtaposition with said piston 7 for imparting mechanical movement to the piston 7 when the base charge 15 is ignited. The actuator assembly housing 9 further includes a pair of lead-out pins 13 firmly disposed within a glass bead insulation material 12 and centrally positioned within said actuator assembly housing 9. An ignition composition 14 is disposed within the upper portion of the base charge assembly and in intimate contact with the bridge wire 18. The bridge wire joins the pair of lead-out pins 13 which are adapted to supply electrical energy to said bridge wire 18 when the explosive piston driver is to be actuated.

A flange 24 integral with the piston 7 carries the seal 8 along the outer periphery of piston 7, and the seal 8 is coated with a sealing compound prior to installation adjacent said piston 7 and said housing 6. A spring lock 11 is mounted in one end of the housing 6 and concentric with the piston 7. The exact nature of spring lock 11 will become more fully apparent with reference to the plan view of FIG. 4 which clearly illustrates the shape of the spring lock 11. The spring lock 11 is mounted within the lower portion of piston housing 6 in an annular cavity formed therein when one end of the housing 17 is crimped around said spring lock 11. In the unfired condition of the driver, the inner annular surface of the spring lock 11 has its edges in abutting relation with a tapered portion 20 of the piston 7. Upon firing of the driver these inner edges of the spring lock 11 grip the piston 7 as the piston by its driving force flexes the spring lock fingers outward of the piston housing 6.

In operation, an electrical signal through bridge wire 18 will ignite the ignition composition 14 which, for example, may comprise a mixture containing potassium chlorate and lead mononitroresorcinate. The explosive base charge 15 likewise may comprise a mixture containing potassium chlorate and lead mononitroresorcinate and will explode to drive the piston 7 relative to housing 6 immediately subsequent to the firing of the ignition spot 14. The piston 7 will travel a distance  $d$  relative to piston housing 6 until the flange portion 24 thereof reaches the inner stop 22 of the piston housing 6 to terminate the linear travel of the piston 7 relative to the housing 6. In addition to the high pressure gases which drive the piston forward and the friction between the piston 7 and the housing 6 which serve to prevent the return of piston 7 to its unfired condition, the spring lock 11 will lock the piston in any intermediate position of the piston travel along distance  $d$  of FIG. 1. Various thicknesses of the spring lock material may be used, and any number of fingers 23 may be employed to obtain the desired locking requirements. With the assurance of piston lock even after gas pressure has bled off, the device may be employed either to provide a constant support to various mechanical loads or to provide a temporary jolt to fire

a primer or stab detonator or to perforate or break containers.

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.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent of the United States is:

1. In a piston driver and actuator assembly which includes a piston slidably engaging a housing and having explosive charge means adjacent one end of said piston for driving said piston relative to said housing upon energization thereof the improvement comprising

spring means mounted within said housing and abutting a tapered portion of the other end of said piston before firing, said spring means being flexible outward from said housing and compressible normal to the axis of said piston due to the relative movement between said tapered portion and said spring means upon firing of said piston for gripping said piston whereby said piston will not return to its unfired condition.

2. The combination of claim 1 wherein said spring means is formed by a disc having an annular opening therein, said disc being concentric with said piston.

3. The combination of claim 2 wherein said opening is defined by an annular surface of spaced arcuate sections of said disc being separated from each other for permitting flexible deformation of said arcuate sections upon firing of said piston.

4. A piston driver and actuator assembly comprising a housing, piston means slideably engaging said housing,

actuator means adjacent one end of said piston for driving said piston relative to said housing,

said means mounted within said housing having one edge thereof engaging a tapered portion of one end of said piston before firing,

said spring being compressed by said piston when said piston is driven by said actuator means causing relative movement between said spring means and said tapered portion whereby said piston when fired is prevented from returning to its unfired position by the locking action of said spring.

5. The combination of claim 4 wherein said spring means is formed by a disc having an annular opening therein, said disc being concentric with said piston.

6. The combination of claim 5 wherein said opening has an inner annular surface of spaced arcuate sections permitting deformation of said spring upon firing of said piston.

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