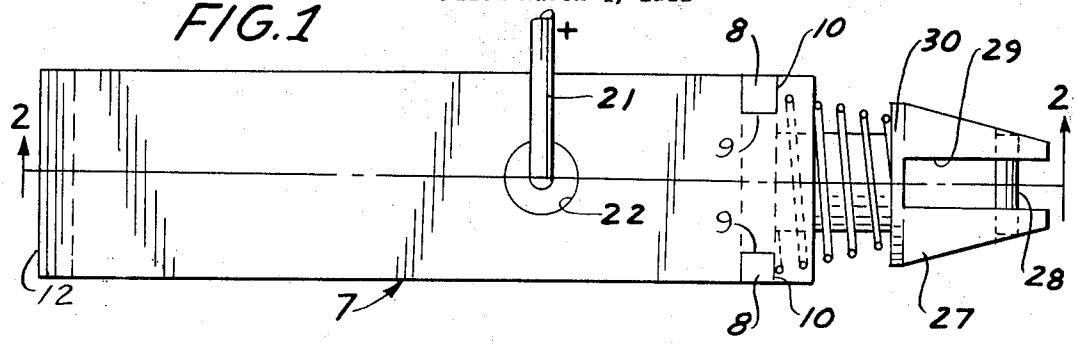
April 7, 1970 P. E. ALLEN 3,505,628

SOLENOID PLUNGER WITH LIMITED FREE TRAVEL

Filed March 4, 1968

FIG. 1



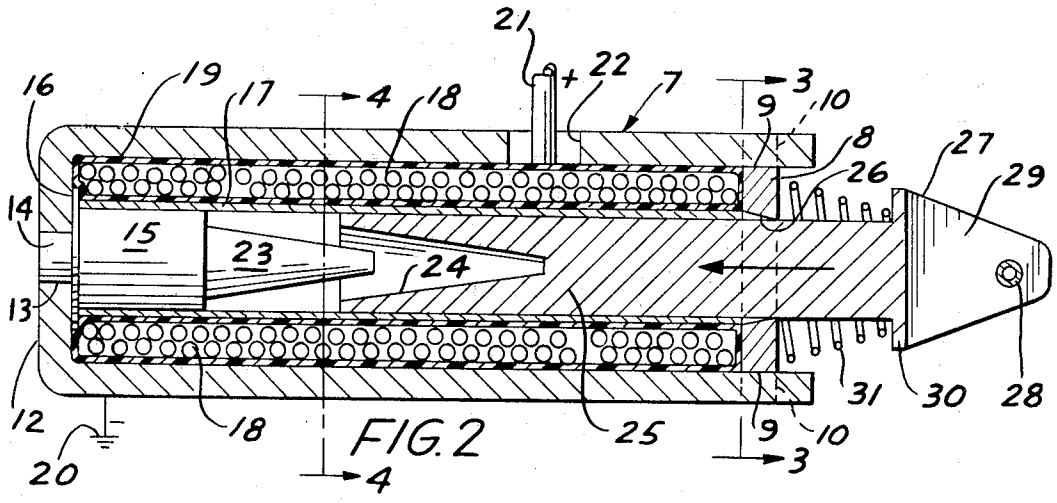


FIG. 2

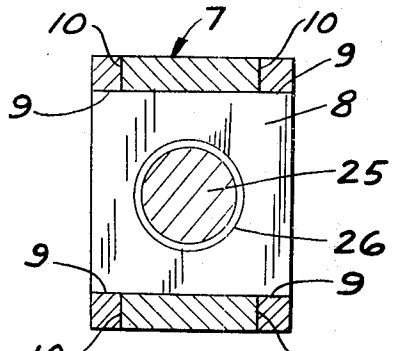


FIG. 3

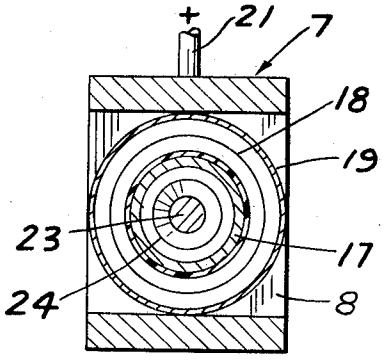


FIG. 4

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SOLENOID PLUNGER WITH LIMITED FREE TRAVEL

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U.S. Cl. 335—255 5 Claims

ABSTRACT OF THE DISCLOSURE

An improved solenoid which has a substantially high torque ratio with respect to size and weight is constructed with a U-shaped frame, having a frusto-conical core, and a plunger slidable in said frame. The plunger has a conical recess therein for receiving the frusto-conical core.

The plunger also has an enlarged head mounted exteriorly of the frame, the head having a slot for receiving a connecting linkage. The slot is traversed by a pin which provides means for anchoring the plunger to any connecting linkage, whereby there is delayed motion between the plunger head and the pin, and the connecting linkage upon actuation of the solenoid.

There is a spring concentric with the plunger and positioned between the solenoid frame and the head of the plunger to return the plunger to a position of rest after the solenoid has been actuated.

It is an object of this invention to provide a compact solenoid having a high torque ratio with respect to its weight and size, and one which is ideally suited for installation in a confined space, such as the housing of a lock, as disclosed in my copending application.

Another object of the invention is to generally improve solenoids and to provide a solenoid which is simple in construction, economical to manufacture and install in a limited space, and one which will provide maximum torque with respect to its weight and size.

Another object of the invention is to provide a solenoid which is constructed with a frame which is easily mounted within the confines of another structure, such as a lock housing, and arranged so that the lock housing, or any other carrier member, improves the flux pattern of the solenoid, and provides a flux pattern on all four sides of the solenoid, whereby to provide maximum pulling torque with a minimum of electric windings and core.

Another object of the invention is the provision of a solenoid which has a frusto-conical core and a reciprocating plunger with a conical recess therein for receiving said core to effect an increasing pull on the plunger as the solenoid is actuated.

Another object of the invention is to provide a solenoid having a reciprocable plunger with an enlarged external head thereon, which head is bi-furcated and provided with a transverse pin for connecting the head to other linkage, and to provide free travel of the head after the solenoid is actuated, and before the head mechanically actuates the connecting linkage.

Another object of the invention is to provide a solenoid of the character indicated which has a spring concentrically mounted on the plunger between the solenoid frame and the head of the solenoid to return the plunger to a position of rest after actuation of the solenoid.

Another object of the invention is the provision of a solenoid which is constructed and arranged to give a hammer action to linkage which is connected to the plunger.

Another object of the invention is the provision of a solenoid having a U-shaped frame, with a core mounted

on the closed end of said frame and having an integrated flange which abuts one face of said frame and an extension which is received in a bore formed in the closed end of the frame.

Another object of the invention is to provide a solenoid having a U-shaped frame which is suitable for mounting on the interior of a lock assembly, or the like, so that there is a positive ground connection between the solenoid and the lock assembly when the latter is installed on a vehicle body, or the like.

The foregoing and other objects and advantages of the invention will become more apparent as the description proceeds, reference being made from time to time to the accompanying drawing, forming part of the within disclosure, in which drawing:

FIG. 1 is a top plan view of a device embodying the invention.

FIG. 2 is a section taken substantially on the line 2—2 of FIG. 1.

FIG. 3 is a section taken substantially on the line 3—3 of FIG. 2.

FIG. 4 is a section taken substantially on the line 4—4 of FIG. 2.

Referring now more particularly to the drawing, it will be understood that in the embodiment herein disclosed, the reference character **7** indicates, in general, the frame of the solenoid, which in this embodiment is substantially in the form of an elongated, tensioned U. The open end of the frame **7** is closed by means of an end plate **8**, which is notched as at **9** (FIG. 3), which are received in notches **10** formed in the edges of the frame **7**.

The closed end **12** of the frame has a bore **13** therein, in which is received the reduced end **14** of a core member **15**. The core member **15** has a flange **16**, which abuts the inner face of the end **12** and serves as a retainer for one end of a brass sleeve **17**, which is retained at the other end by means of the closure member **8**.

Mounted on the outside of the brass sleeve **17** are the solenoid windings **18**, which are insulated from the sleeve **17** and the frame **7** by means of a suitable insulating material **19**.

The windings **18** are grounded to the frame **7**, which in turn is grounded as at **20**. The windings **18** are electrically connected through a wire **21** to a suitable source of electrical energy, such as a storage battery, or the like.

The electrical wire **21** extends through a suitable opening **22** formed in the solenoid frame **7**.

The core **15** of the solenoid has a frusto-conical extension **23**, which is received in a conical bore **24** formed in one end of the solenoid plunger **25**, which is reciprocable in the brass sleeve **17**. This arrangement gives an increasing torque to the pull on the plunger **25** as the solenoid is actuated.

The plunger **25** extends through a suitable bore **26** formed in the end closure member **8** and its external end is provided with an enlarged head **27**, which is bi-furcated, as shown in FIG. 1.

A drive pin **28** traverses the bi-furcated head **27** so that the open area **29**, between the drive pin **28** and the base **30** of the head, serves as a delayed action facility between the plunger **25** and any linkage which is connected thereto, by the pin **28**, so that the delayed action coupled with the increasing torque exerted on the plunger **25** during the travel of the plunger **25** and the recess **24** in its reception of the truncated core **23**, there is a terrific impact force developed in the solenoid plunger **25** before the pin **28** actually exerts pulling force on the connecting linkage.

The plunger **25** is provided with a concentric compression spring **31**, which is mounted between the end closure member **8** and the base **30** of the head **29**, which after actuation of the solenoid, will return the plunger **25** to a

position of rest and to provide the next cycle with the delayed action facility, as previously explained.

It is believed that the operation of the device is obvious from the foregoing description.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. A solenoid having its winding supported in an elongated, tensioned, U-shaped frame with a removable end closure member, press fitted therein, an opening in said end closure member, a plunger reciproable in said opening, a core having at one end a short extension received in an opening in the permanently closed end of said U-shaped frame, and a flange which abuts said closed end, and stabilizes said core, said core having a substantially long frusto-conical extension at the other end, said plunger having an elongated conical bore at one end for progressively receiving the frusto-conical extension of said core, and said plunger having at the other end an enlarged bi-furcated head, of substantial mass, and a drive pin traversing said bi-furcated head in spaced relation to the base of said head, said elongated conical core, said elongated recess, said enlarged head and said spaced pin being arranged to increase the acceleration of said plunger to effect a hammer action upon receiving a load.

2. The structure of claim 1, including a spring concentrically mounted on said plunger between said enlarged head and the press fitted end closure member of said frame.

3. The structure of claim 1, in which said plunger slides in a brass sleeve, which is retained between said core flange and said removable end closure member.

4. The structure of claim 1, in which one end of the winding of said solenoid is grounded to said frame, the opposite end of said winding being extended through a bore in said frame.

5. The structure of claim 1, in which the winding of the solenoid is grounded at one end to said frame, and said frame is provided with at least two substantially long co-extensive flat faces for carrying the magnetic flux of the solenoid over an increased area.

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GEORGE HARRIS, Primary Examiner

U.S. Cl. X.R.

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