Sept. 8, 1942. W. F. OLIVER 2,295,047

SOLENOID

Filed Aug. 7, 1940

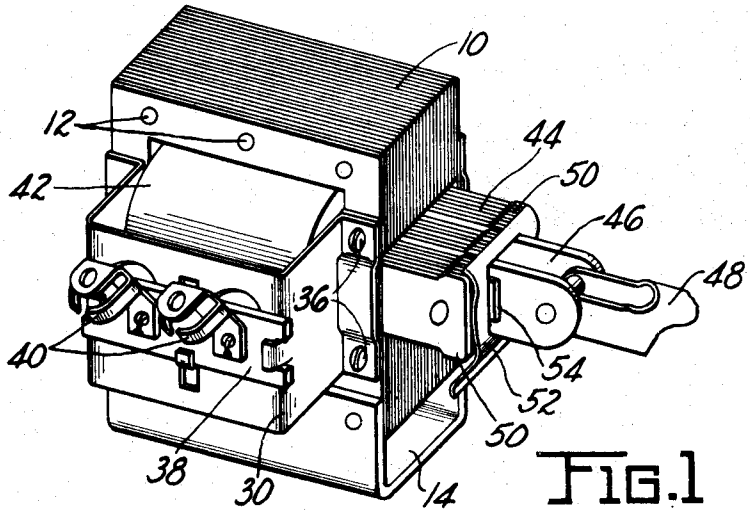



FIG. 1

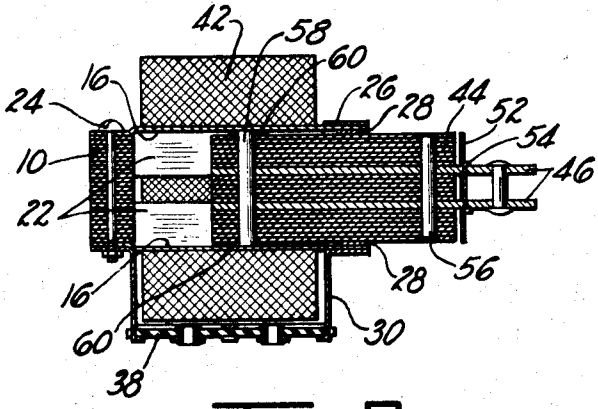



FIG. 2

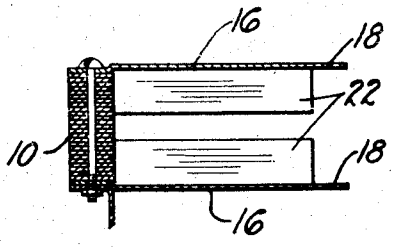



FIG. 3

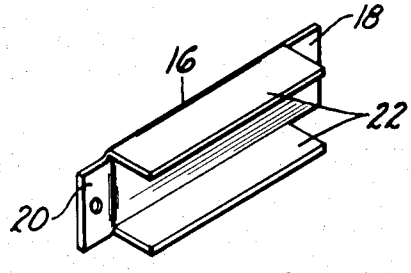



FIG. 4

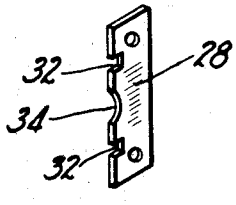



FIG. 5

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# UNITED STATES PATENT OFFICE

2,295,047

## SOLENOID

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Application August 7, 1940, Serial No. 351,725

1 Claim. (Cl. 175—341)

This invention relates to solenoids and more particularly to solenoids having movable plungers adapted to operate a mechanism to be controlled.

One of the objects of the invention is to provide a solenoid which is extremely simple and inexpensive to produce but which is rugged and reliable.

Another object of the invention is to provide a solenoid in which the plunger is guided by relatively small surfaces spaced along its length so as to reduce the friction drag. This construction enables the small guiding surfaces to be accurately controlled so that the solenoid will be guided properly in its movements with a minimum of friction.

Another object of the invention is to provide a solenoid in which cooperating parts on the plunger and the frame interengage to stop movement of the plunger outwardly of the frame. According to one important feature of the invention such interengaging parts serve not only to stop the plunger, but also form the guiding surfaces for guiding the plunger movement.

The above and other objects, advantages and novel features of the invention will appear from the following description when read in connection with the accompanying drawing, in which:

Figure 1 is a perspective view of a solenoid embodying the invention;

Figure 2 is a horizontal section through the solenoid and plunger of Figure 1;

Figure 3 is a partial view similar to Figure 2 with parts omitted;

Figure 4 is a perspective view of a guide plate; and

Figure 5 is a perspective view of a stop plate.

The solenoid of Figure 1 comprises a C-shaped stack of laminations 10 forming a magnetic frame having an opening in one side thereof defined by opposed pole faces. The stack of laminations is held together by spaced rivets 12 and has secured to one side thereof a channel member 14 riveted to one edge of the frame and forming a mounting means for the solenoid. It will be apparent of course, that various other types of mountings might be employed in lieu of the channel member 14.

A pair of guide plates 16 are secured to the frame and extend from the sides of the opening therein to the portion of the frame directly opposite the opening. As best seen in Figure 4, the guide plates include side portions terminating in a forward relatively narrow end 18 and a rearward end 20. The portion 20 is offset inwardly as seen in Figure 2 so that the side portions of the guide plates will lie outside of the side planes of the frame. Intermediate the end portions the guide plate is formed with upper and lower flanges 22 forming a guide channel.

The rearward end of the guide plate is secured to the frame 10 by a bolt or the like 24 extending through the end portion 20 and through the laminated frame. The forward end portion of the guide plate lies between a pair of supporting plates 26 and 28 on one side of the frame and between a similar plate 28 and the forward end of a U-shaped bracket 30 on the other side of the frame. The plates 28, as seen in Figure 5, are of substantially the same width as the laminations and are provided with spaced notches 32 to receive and support the forward edges of the flanges 22. Intermediate the ends of the plate 28 is an arcuate depression 34 for a purpose to appear later. The plate 26 and the forward end of the bracket 30 are offset in their central portions to fit around the end portions 18 of the guide plates, and the plates are all secured to the frame by bolts or rivets 36 extending through the frame adjacent the opening therein.

The bracket 30 bridges from the forward side of the frame adjacent the opening to the opposite side of the frame where its rearward end is secured by the bolt 24. This bracket carries an insulating plate 38 upon which a pair of connector members 40 are mounted. A coil 42 lies within the magnetic frame 10 around the guide plates 16 and has a pair of terminals connected to the connectors 40.

A plunger indicated generally at 44 is slidable in the channel formed by the guide plates 16 through the opening in the frame 10. The plunger is formed of a stack of relatively thin laminations in the central portion thereof, two thicker laminations projecting beyond the end of the plunger at 46 and forming a connecting yoke. An operating lever 48 extends between the plate portions 46 and is pivotally connected thereto by a pin or the like.

As seen in Figure 1 the forward end of the plunger is provided with enlarged portions 50 adapted substantially to close the opening in the frame when the plunger is in its innermost position. These enlarged portions are preferably of the form more particularly described and claimed in my co-pending application, Serial No. 295,401 filed September 18, 1939. In order to break the plunger loose from the effects of residual magnetism a spring plate 52 is secured to the forward end thereof and extends laterally from one side of the plunger to engage the for-

ward end of the frame during the final inward movement of the plunger. The plate 52 has a pair of slots fitting over the portions 46 of the central laminations and is secured in place by a strip 54 extending through slots in the portions 46.

The laminated plunger is secured together by a rivet or the like 56 at its forward end terminating substantially flush with the sides of the plunger. A similar rivet 58 at the rearward end of the plunger extends through the stack of laminations and secures thereto a pair of washers 60 projecting beyond the sides of the plunger.

When the parts are assembled the outer surfaces of the washers 60 slidably engage the sides of the guide plates 16 to guide the rearward end of the plunger. At the same time the plates 28 engage the sides of the plunger to guide the forward end thereof. It will be noted that the plates 28 lie in the path of movement of the projecting washers 60 and serve as stops to prevent the plunger from moving entirely out of the magnetic frame. Depressions such as 34 in the plates 28 may be provided to permit any desired degree of forward movement of the plunger before it is stopped by engagement of the washers 60 with the plates 28.

This construction provides a solenoid which is very simple and inexpensive to manufacture and in which the plunger is both properly guided and stopped from moving outwardly of the frame to an undesired extent.

While one particular construction has been described in detail it will be understood that this is for the purposes of illustration only and is not intended as a definition of the scope of the invention, reference being had for this purpose to the appended claim.

What is claimed is:

A solenoid comprising a C-shaped magnetic frame having an opening at one side for the reception of a plunger, a magnetic plunger slidable through said opening, said plunger having lateral projections consisting of relatively large washers riveted to opposite sides of the plunger at its rearward end extending beyond the sides of the plunger, guide means for the plunger including guide plates carried by the frame and extending from a point adjacent the opening to the opposite side of the frame, said guide plates including elongated side portions forming continuous bearing surfaces in engagement with the outer surfaces of said projections and intermediate top and bottom flanges overlying the top and bottom of the plunger, the rearward ends of the side portions being offset inwardly and lying against the sides of the frame and the forward ends of the side portions lying at the sides of said opening, and plates extending across said opening at the sides of the frame and lying within the forward ends of said side portions, said last named plates slidably guiding the plunger and lying in the path of said projections to stop forward movement of the plunger.

WALLACE F. OLIVER.