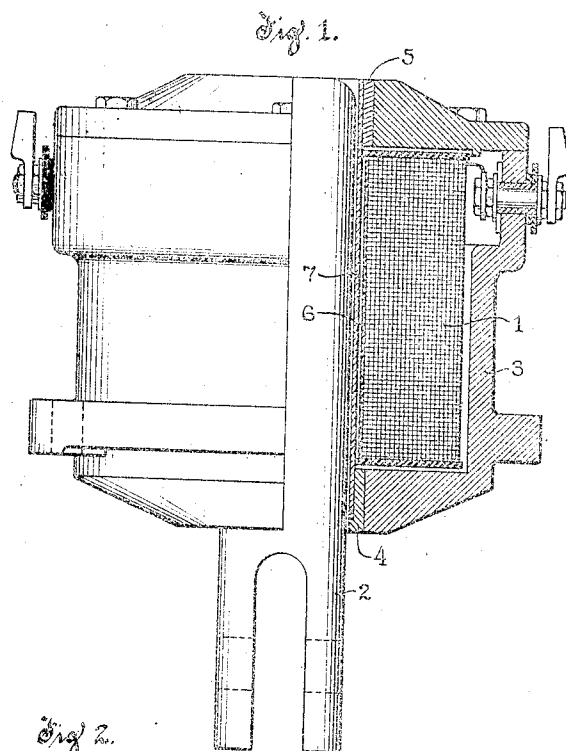
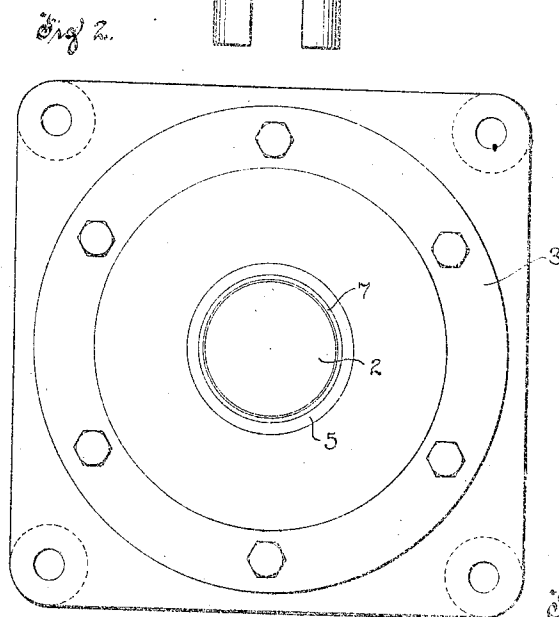


B. E. FERNOW, JR.
SOLENOID.
APPLICATION FILED APR. 18, 1914.

1,199,975.

Patented Oct. 3, 1916.



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SOLENOID.

1,199,975.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, BERNHARD E. FERNOW, JR., a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Solenoids, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

This invention relates to improvements in solenoids.

In solenoids it is customary to provide the plungers thereof with a limited amount of lateral play to insure their free reciprocation. Such lateral play, however, has caused the plungers to be subjected to magnetic side pull, especially where the solenoids are not provided with magnetic plugs. This, in turn, has resulted in wear on the plunger and its guide and also in a tendency of the plunger to stick when the solenoid is deprived of current. Both of these results are obviously objectionable and this invention has among its objects to so remedy the aforesaid conditions as to render any wear on the parts or sticking of the plunger negligible.

Figure 1 of the accompanying drawing, which shows a preferred embodiment of the invention, is a side view of the solenoid, partially in section, with the plunger in attracted position; and Fig. 2 is a plan view thereof.

The solenoid illustrated comprises, in general, a winding 1, a plunger 2 movable therein and having a limited lateral play and a magnetic frame 3 for the winding. At the ends of the frame 3 through which the magnetic flux passes to the plunger in a direction at right angles to the latter, there is provided an area of reluctance of a relative value hereinafter set forth. This reluctance is preferably in the form of two non-magnetic bushings 4 and 5 seated in opposite ends of the frame to surround the plunger.

Referring more specifically to the drawing, the winding 1 is coiled on a spool 6, which latter is as thin as consistent with its requisite stability in order that the maximum space within the frame may be utilized for the winding and that the turns thereof may lie closely adjacent the plunger. A thin tubular sleeve 7, constituting

a guide for the plunger, fits within the spool 6 and extends through the frame. The internal diameter of this sleeve 7 is slightly greater than the diameter of the plunger 2 to insure the aforesaid free movement of the latter.

In operation, the plunger commonly shifts off center so that the air-gap around the plunger is materially greater on one side than the other. As above mentioned, this difference in reluctance at opposite sides of the plunger has heretofore caused a considerable side pull to be exerted on the plunger with consequent wear on the parts and delayed release of the plunger.

The bushings 4 and 5, preferably of brass, are of such dimensions that the reluctance thereof is relatively great with respect to the reluctance of the maximum air-gap about the plunger due to lateral play thereof in the sleeve 7. In other words, the reluctance of the air-gap between the plunger and the magnetic frame is relatively small with respect to the total reluctance comprising the air-gap, the sleeve, and a bushing, between these parts. The magnetic attraction on all sides of the plunger is thus approximately equalized since the reluctance thereabout is substantially uniform, and accordingly wear between the plunger and its guide is minimized. The bushings 4 and 5 also serve to intercept the magnetic lines of force when the winding 1 is deprived of current and nullify the effect of any residual magnetism in the frame 3 thereby effecting a quick release of the plunger. It should be noted, however, that the effect of the bushings is practically negligible during initial attraction of the plunger.

What I claim as new and desire to secure by Letters Patent is:—

1. In a solenoid, in combination, a winding, a magnetic frame therefor, a plunger movable in said winding to overlap the ends of said frame, a tubular guide for said plunger affording limited lateral play to the latter for insuring its free movement, and a non-magnetic bushing at each of the overlapped ends of said frame, the reluctance of the maximum rectilinear air-gap resulting from the play of said plunger adjacent said overlapped ends being relatively small with respect to the reluctance of said bushings.

2. In a solenoid, in combination, a sleeve,
a winding thereabout, a magnetic frame in-
closing said winding and sleeve, and a
plunger extending through said frame and
movable in said sleeve with a limited lat-
eral play, said frame having a reluctance
in the path of maximum flux greater than
the reluctance of said sleeve adjacent said
winding and of a value relatively great
with respect to the reluctance of the maxi-

mum air gap resulting from the lateral
play of said plunger adjacent said frame.

In witness whereof, I have hereunto sub-
scribed my name in the presence of two
witnesses.

BERNHARD E. FERNOW, JR.

Witnesses:

S. F. WATSON,

TEHLA BAST.