

March 21, 1944.

P. TROMBETTA

2,344,751

ELECTROMAGNET

Filed Aug. 26, 1940

2 Sheets-Sheet 1

FIG. 1.

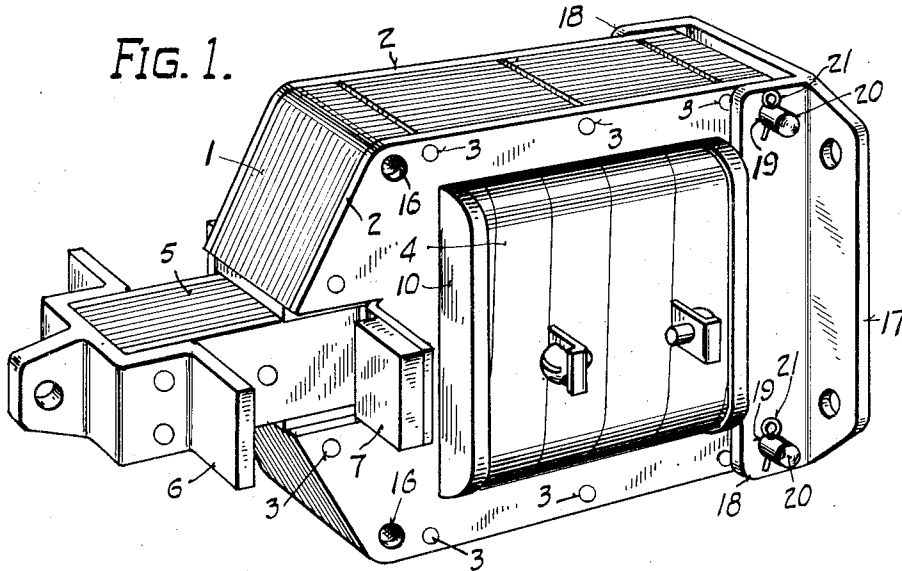
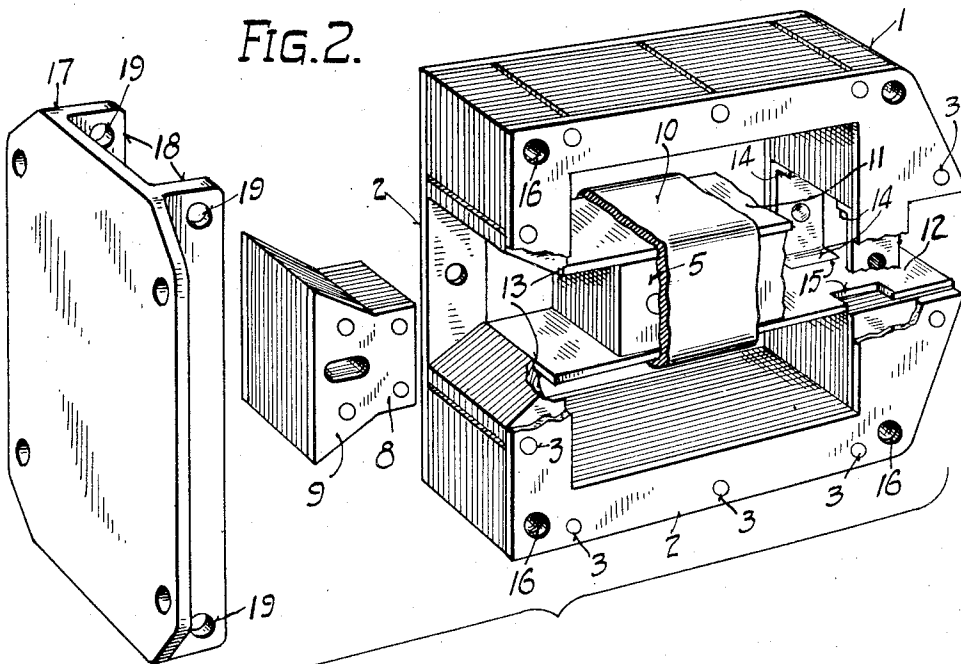


FIG. 2.



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FIG. 3.

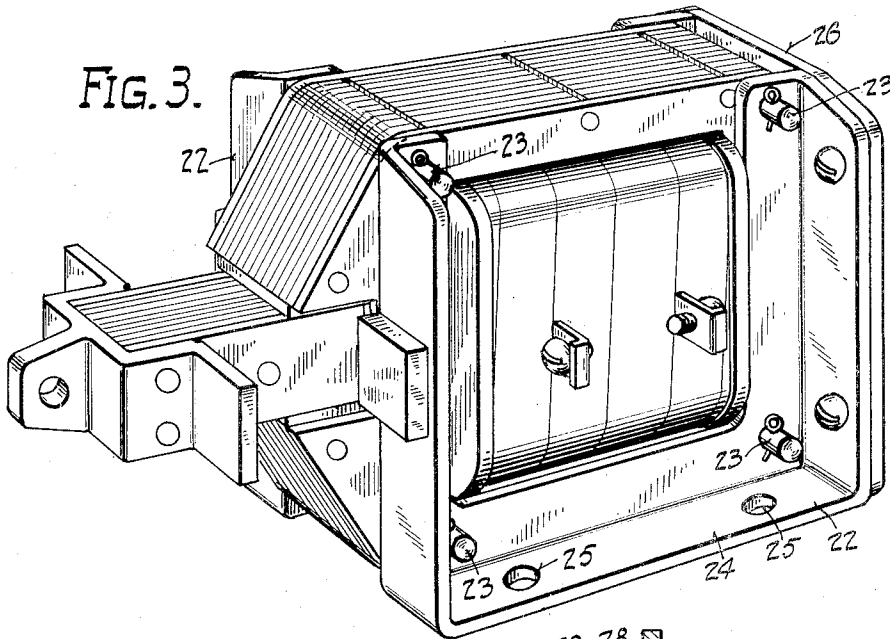


FIG. 4.

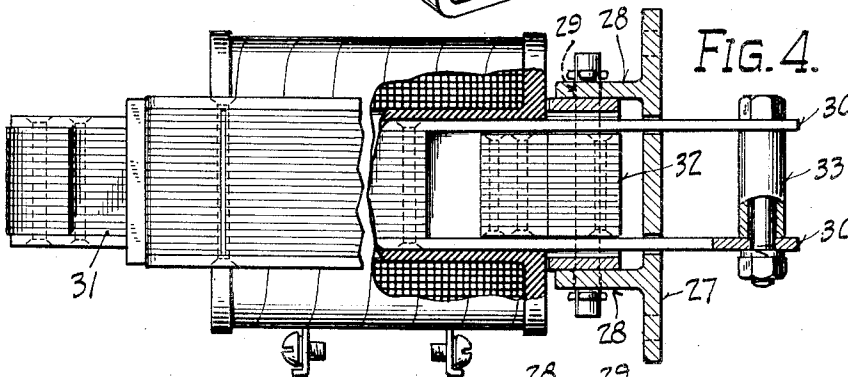
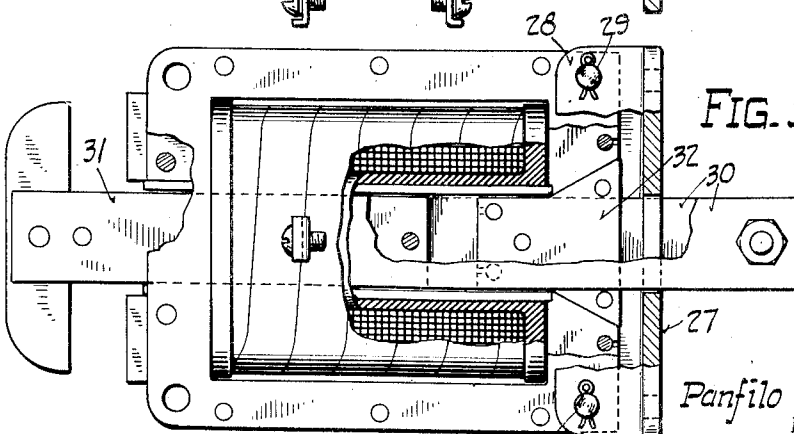


FIG. 5.



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## UNITED STATES PATENT OFFICE

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## ELECTROMAGNET

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Application August 26, 1940, Serial No. 354,307

3 Claims. (Cl. 175-341)

This invention relates to electromagnets.

The application constitutes a continuation in part of an application Serial No. 738,571, filed August 6, 1934, for Electromagnetic apparatus, and is related to applicant's co-pending application Serial No. 353,196, filed August 19, 1940, now Patent No. 2,311,890, for Electromagnetically operated systems.

The principal object of the invention is to provide an electromagnet of the solenoid type of simple construction and which can be assembled complete and then removably attached to a base or support as a unit.

Another object is to provide a solenoid mounting which will more effectively hold and support the solenoid and prevent injury to it.

Another object is to provide a solenoid having a receding pole piece and in which the pole piece will be maintained in alignment with the armature.

Other objects will be clear from the description of certain embodiments of the invention illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a perspective view of a pull type electromagnet;

Fig. 2 is a perspective of the magnet without the winding and showing the solenoid construction with parts in section and the support and pole piece ready for attachment;

Fig. 3 is a perspective view of a solenoid having a mounting for securing the same to a support at different angles;

Fig. 4 is a top plan view of a push type solenoid with a modified form of base and with parts in section; and

Fig. 5 is a side elevation of the solenoid illustrated in Fig. 4 with parts in section.

In most solenoid construction heretofore the frame of the solenoid consisted of a plurality of laminations of magnetically permeable iron and the supporting angle irons were riveted directly and permanently to the frame and became the side plates for the frame. This meant that in case the solenoid had to be removed for repair or replacement the alignment and work of mounting was lost. Furthermore, the stress on the mounting was transferred directly to the laminations of the solenoid frame and tended to cause loosening and ultimate separation of the same.

The solenoid of the present invention, illustrated in Figs. 1 and 2 has its laminations 1 secured together between two continuous side plates 2 by suitable rivets 3 located where least affected by the magnetic flux. The frame of laminations

is substantially rectangular and surrounds the winding 4.

The laminations 1 are cut away at one end to provide an opening for receiving a plunger or armature 5 which extends axially of the winding and has a head 6 disposed to engage an abutment 7 on the frame to limit the movement of the plunger in the working stroke.

The other end of the laminations 1 is cut away to provide an opening for accommodating a movable pole piece 8 disposed to recede when struck by the armature. The pole piece 8 comprises a plurality of laminations riveted together and having a total thickness slightly less than the total thickness of laminations 1, so that the pole piece will move freely between the side plates 2. The pole piece has a head 9 of wedge shape to fit into a complementary facing on the laminations 1 and provide tight contact throughout the area of the meeting surfaces.

The winding of the solenoid has a central tubular spool 10 of sufficient inside diameter to accommodate the plunger 5 and the inner end of the pole piece 8. The winding is held in place in the frame by two small strips 11 and 12 of suitable non-magnetic wear resisting material inserted through the open end of the frame, axially of the winding, and held in notches 13 in the laminations 1 inside the side plates 2 at one end, and by flanges 14 secured to plates 2 and extending into notches 15 in the strips at the other end. The strips 11 and 12 serve as guides for the plunger 5.

The laminations 1 and side plates 2 have a transverse hole 16 at each corner to receive the attaching pin. In mounting the solenoid a base plate 17 of angular construction is provided with two parallel flanges 18 spaced apart to receive the frame of the solenoid. Each flange 18 has a plurality of holes 19 disposed to align with holes 16 in the frame of the solenoid.

In attaching the solenoid to the base 17 the pole piece 8 is first slipped into place in the solenoid frame and the latter is then positioned between the flanges 18 with the corresponding holes 16 and 19 in alignment. Pins 20 are then inserted through the aligned holes and cotter pins 21 applied at the ends of the pins to prevent accidental removal of the pins. The plate 17 limits the receding movement of the pole piece 8.

In mounting the solenoid the base 17 is screwed or bolted in place and then the solenoid is attached to it. Any shim or adjustment in position of the base will remain fixed and in subsequent repair the solenoid can be quickly removed

without disturbing the support, so that it can be re-attached or replaced to accurate positioning and it is not necessary to shim it again.

In Fig. 3 the solenoid is fastened between two angle iron U shaped side mountings 22 by means of pins 23 similar to pins 20. In this instance there are four pins 23, one at each corner, and the outward flanges 24 of the mountings have bolt holes 25 therein on each of the two sides so that the solenoid may be mounted to a support at the rear at the bottom or at either end. A backing plate 26 at the rear end serves to secure the mountings 22 together to add rigidity to the mounting, and to hold the pole piece in place.

In Figures 4 and 5, a push type of solenoid is illustrated. In this embodiment of the invention the base plate 27 is flat and its two flanges 28 are provided with only two holes 29 for attaching to the solenoid frame. The side plates 30 of the plunger 31 extend on either side of the pole piece 32 and through slots in the base 27 to provide a pusher head 33 for operating the mechanism being controlled by the solenoid.

In this embodiment the pole piece 32 is somewhat narrower than pole piece 8 of the other embodiment since it operates inside of the side plates of the plunger. The pole piece 32 is of the same general shape as pole piece 8 and the feature of the wedge shaped head is employed. While heads of various shape may be used for the pole piece, in connection with other features of the invention, one of the features of the invention lies in the use of a pole piece of substantially the shape illustrated. By providing tapered head shoulders on the pole piece and a complementary recess in the frame the alignment of the pole piece with the armature is more accurate and the closing contact will be more uniform. The base plate in each case limits the receding movement of the pole piece and holds the latter in place.

The invention may have various embodiments within the scope of its several features.

The invention is claimed as follows:

1. In a solenoid of the class described, a frame comprising a pair of side plates, a plurality of laminations of magnetically permeable material secured between said side plates, the laminations

having an opening therethrough at one end thereof, an armature longitudinally movable in the opening and comprising a pair of side plates and a plurality of laminations secured therebetween, the frame laminations having an opening therethrough at the other end thereof having diagonally opposed faces, the side plates of the armature extending through the frame from end to end inside of the said frame side plates, and a movable pole piece disposed between the armature side plates and having a head with substantially tapered shoulders complementary to the walls of the second named opening in said laminations.

2. In a solenoid of the class described, a frame comprising a pair of side plates and a plurality of laminations of magnetically permeable material secured between said side plates and having a lateral opening to receive an energizing coil, a coil disposed in said lateral opening in said frame and having its axis parallel to the plane of the laminations, a plunger disposed for axial movement into the coil and operating through an opening in one end of the laminations, and a receding pole piece in alignment with said plunger to be engaged thereby and disposed in an opening through the opposite end of said laminations, said pole piece having a head with a tapered shoulder and said laminations presenting a complementary tapered wall for engagement by said shoulder to provide a wedging action between said pole piece and frame when the pole piece returns to closed position after recession from the impact of said plunger.

3. In a solenoid having a frame and plunger core, a movable pole piece disposed in an opening in one end of the frame in alignment with the core and to be engaged thereby, said pole piece having a head with tapered sides fitting into a tapered opening in the frame to provide for an increase of reluctance between the pole piece and the frame as the pole piece recedes under impact from the plunger core, said tapered surfaces of the pole piece and frame providing a substantially tight contact of low reluctance when the pole piece returns to a normal holding position for the solenoid after such recession.

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