May 23, 1961

F. I. ELLIN ET AL

2,985,857

VARIABLE TRANSFORMER

Filed Oct. 27, 1958

2 Sheets-Sheet 1

Fig. 1.

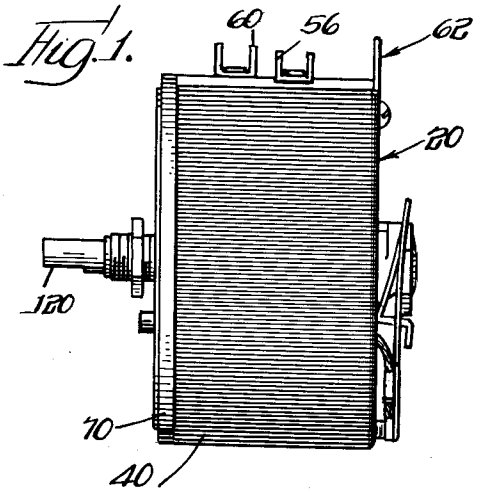


Fig. 2.

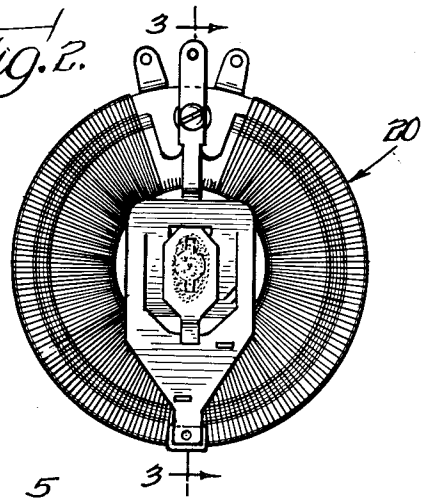
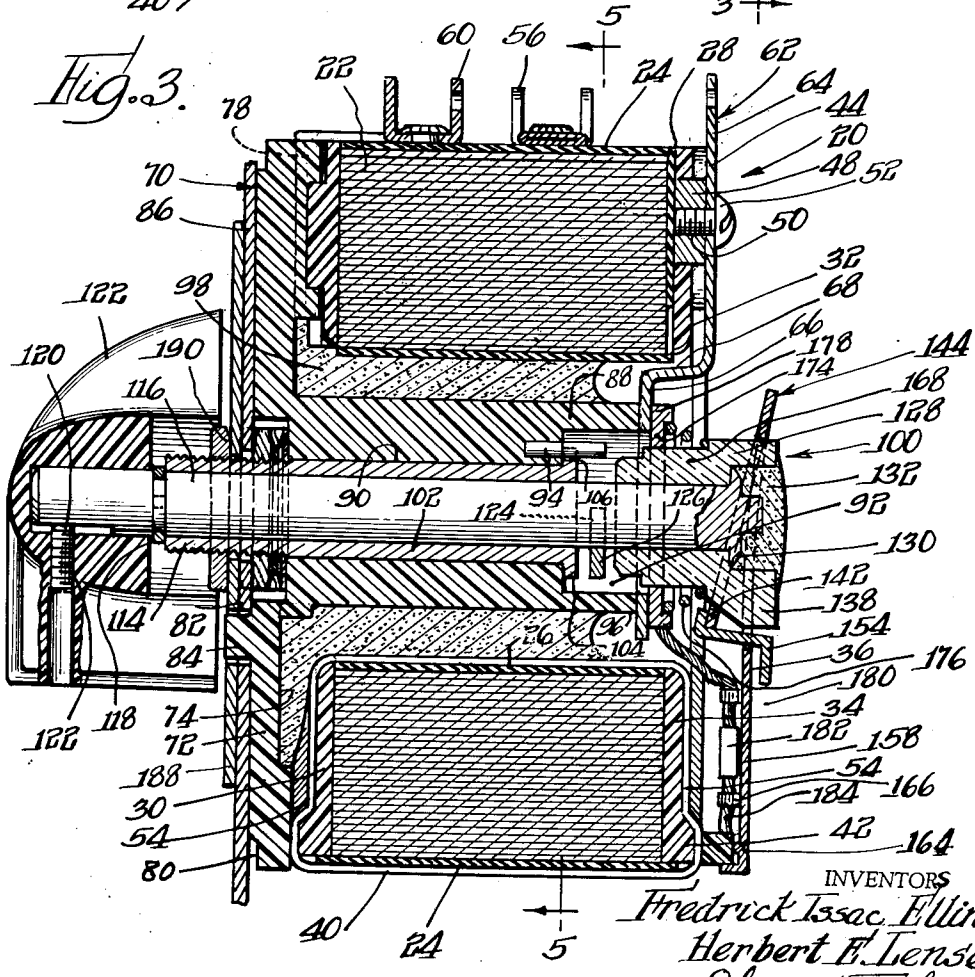


Fig. 3.



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2 Sheets-Sheet 2

Fig. 4.

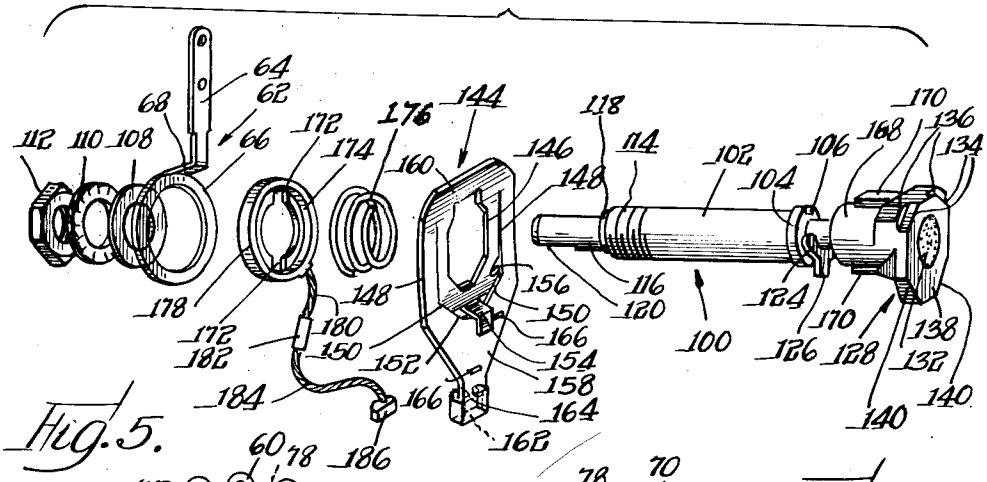


Fig. 5.

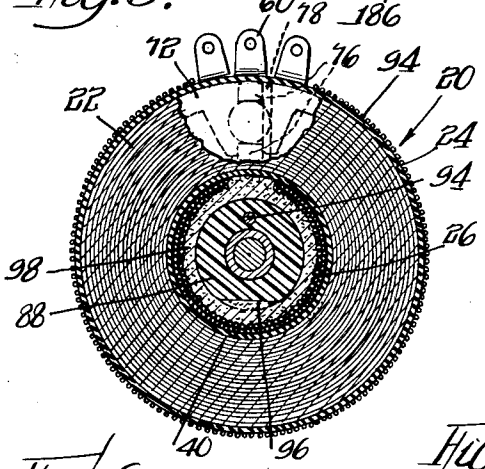


Fig. 7.

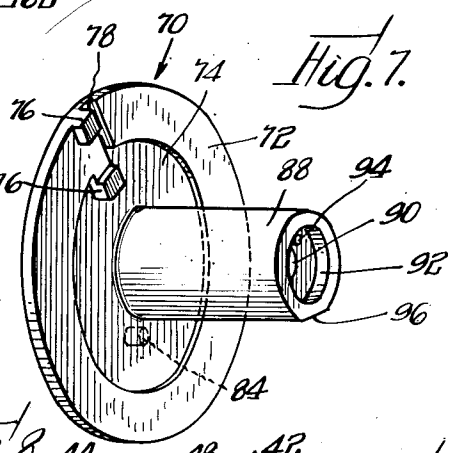


Fig. 6.

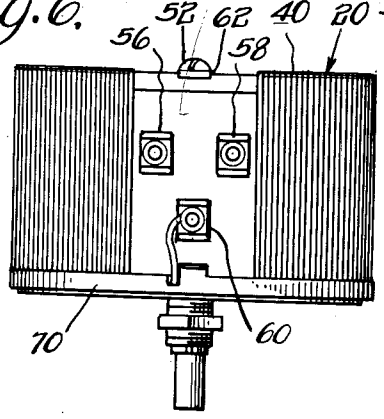


Fig. 8.

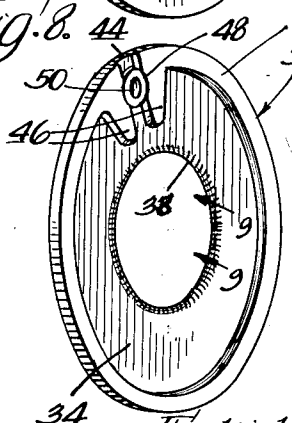
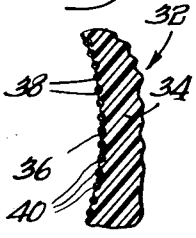


Fig. 9.



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United States Patent Office 2,985,857 Patented May 23, 1961

2,985,857

VARIABLE TRANSFORMER

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Filed Oct. 27, 1958, Ser. No. 769,696

7 Claims. (Cl. 336—148)

This invention is concerned with a transformer, more particularly a variable transformer of the single winding or auto transformer type.

Variable transformers of the type disclosed herein are known in the art and generally include a winding energized with a predetermined alternating current voltage. A sliding tap connected to an output terminal then picks off a voltage anywhere from zero on up to the predetermined energizing voltage, or even slightly higher if connections are properly made. Such transformers are widely used in laboratory test equipment, in power supplies, in filament controls, in speed control of motors, and in other installations. In many instances the size requirements of such transformers are severely restricted by the space available. This, in turn, limits the output current that can be drawn.

It is an object of this invention to provide a variable transformer having a higher output rating for an equivalent size than any heretofore commercially available.

It is a further object of this invention to provide a variable transformer which is simple and economical to manufacture.

It is another object of this invention to provide a variable transformer which is rugged, positive in operation, and yet of simple construction.

Other and further objects and advantages of the present invention will be apparent from the following description when taken in connection with the accompanying drawings wherein:

Fig. 1 is a side view of the transformer;

Fig. 2 is a rear end view thereof as taken from the right of Fig. 1;

Fig. 3 is a longitudinal sectional view as taken along the line 3—3 in Fig. 2;

Fig. 4 is an exploded perspective view of the shaft assembly;

Fig. 5 is a cross-sectional view as taken substantially along the line 5—5 in Fig. 3;

Fig. 6 is a plan view of the transformer base;

Fig. 7 is a perspective view of the transformer base;

Fig. 8 is a perspective view of an end cap utilized in conjunction with the base; and

Fig. 9 is a detail sectional view of a part of the end cap as taken substantially along the line 9—9 in Fig. 8.

Referring now in greater particularity to the drawings, there will be seen a variable transformer generally indicated by the numeral 20. The transformer includes the usual magnetic core 22 comprising a spirally wound strip of transformer steel. Insulating material 24 is provided about the outer circumference of the core, and similar insulating material 26 is provided about the inner circumference. A certain amount of insulating paper also is applied to one end of the core as indicated at 28. A front end cap 30 and a rear end cap 32 are cemented to the ends of the core. The two end caps are substantially identical, and the rear end cap 32 is shown in perspective in Fig. 8. The end caps are molded of phenolic plastic or the like, and with reference to Fig. 8 it will be

seen that the rear end cap includes a flat ring-like body section 34 having a central aperture 36. As may be seen further with reference to Fig. 9, it will be apparent that the edge of the aperture 36 is bevelled and is provided with serrations 38 for positioning the transformer winding 40 thereon. The rear end cap is provided with a thickened rim 42. The rim is interrupted at 44, and a pair of spaced apart projections 46 extends substantially radially inwardly on each side of the interruption. In the case of the rear end plate, a brass terminal 48 having a central threaded aperture 50 is molded in place between the projections 46 and a short distance in from similar shaped projection of plastic being provided in the circumference of the cap. The front end cap is identical with the rear end cap, but lacks the insert 48, a place thereof. The threaded aperture 50 in the insert 48 extends completely through the insert, and the insulating section 28, which conveniently may be cemented to the rear end cap rather than to the core, is provided to prevent a mounting screw 52 from engaging the core.

Following cementing of the end caps to the core, the wire 40 is wound thereon substantially from the outside of one of the projections 46 to the outside of the other projection, the wire extending through the central apertures 36 of the end caps and through the bore of the core, and being wrapped around the outside and ends of the core. The serrations 38 position the wire at the inner location, controlling piling up of the wire turns upon one another. The turns are naturally spaced farther apart where they pass over the outer circumference of the core and end caps, and there is no problem of piling up of the wire turns when the inner portions thereof are positioned as noted heretofore. The wire is pressed in against the plates 34 of the end caps as is indicated at 54, and is held in place as by the application of a varnish or the like. The wire in the position where it passes over the thickened rim 42 of the rear end cap 32 is ground down flat to remove the enamel therefrom, and to provide a flat sliding surface for a tap subsequently to be described.

Three terminals 56, 58 and 60 are affixed to the insulation 24 in accordance with conventional practices, being spaced from the ends of the winding 40. The opposite ends of the winding are connected to the terminals 56 and 58 for energization of the entire winding. The terminal 60 is connected to a tap on the winding adjacent one end thereof, and the input voltage can be connected to the terminal 60 rather than to the terminal 56, thereby providing a maximum output voltage somewhat higher than the input voltage. The output voltage is taken from the terminal 58 and from a terminal or center lead 62 secured to the rear end cap by the screw 52. The center lead 62, as may be seen in Figs. 3 and 4 includes a strap-like section 64 extending radially along the back of the rear end cap, and extending radially outwardly therefrom. The center lead 62 further includes an integral ring section 66 connected by an offset 68 to the strap section 64. The ring section 66 is positioned axially inward from the end of the core 22 as will be apparent in Fig. 3.

The transformer further includes a molded base 70 of phenolic or the like plastic. The base, as best may be seen in Figs. 3 and 7, includes a generally flat front disc 72 having a central recessed portion 74. The base is provided on its rear or inner surface with a pair of radially spaced lugs 76 adapted to be received in the space between the projections 46 of the front end cap, and on radially opposite sides of the plastic plug therein for positioning the base and the front end cap relative to one another. The rear face of the base plate is provided with a radial slot or groove 78 adjacent the lugs

76 to provide space for a wire leading from the winding 40 to the terminal 60.

The front face of the base is provided with a peripheral recess 80, and with a central recess 82. A projecting pin or plug 84 extends axially from the front of the face for non-rotatable association of the transformer with a mounting plate 86 or the like.

The base 70 further includes a cylinder extending rearwardly from the plate 72 and identified by the numeral 88. The cylinder is provided with a central bore 90 which is countersunk at the rear end at 92. A metal pin 94 extends axially into the countersink 92. The exterior of the cylinder is provided with a chordal flat 96 extending from one end to the other thereof. The chordal flat 96 is of considerable importance, as is brought forth immediately hereinafter.

As may be seen in Figs. 3 and 5 the base 70 is assembled with the core 22 and associated parts by inserting the cylinder 88 through the bore of the core. It will be noted that the bore is somewhat larger than the diameter of the cylinder, and a heat conducting insulating material 98 is inserted in this space, and flows partially into the space adjacent the base plate 72. Upon hardening the resin holds the parts firmly together. The bond is waterproof as will be appreciated. The flat 96 is of importance in keying the base to the resin, and hence to the core and associated parts. It is of further importance in that the space between the inner coil winding and the cylinder must be kept reasonably small in order to provide a sufficient amount of steel in the transformer, and this makes flowing of the resin into place rather difficult. The flat provides an enlarged passageway insuring that the resin will pass through the space and up against the back of the base plate. It will be observed that the cylinder terminates short of the rear end cap 32, and abuts the ring section 66.

The transformer further includes a shaft assembly 100 best seen in Figs. 3 and 4. The shaft assembly includes a mounting sleeve 102 extending through the bore 90 in the cylinder 88 and having at one end a radially projecting flange 104 having a notch 106 therein for receiving the pin 94 to prevent rotation of the sleeve relative to the base. A flat washer 108, a toothed lock washer 110, and a nut 112 are received on the outer threaded end 114 of the sleeve 102, all being recessed in the central recess at the front of the base plate 72.

The shaft assembly 100 further includes a shaft 116 rotatably received in the mounting sleeve 102 and secured against movement into the sleeve by a retaining ring 118 received in a peripheral groove. The front end of the shaft further is provided with a flat 120 whereby a knob 122 is secured against rotation on the shaft. A set screw 122 is threaded through the knob into engagement with the flat 120 to hold the knob on the shaft.

Rearwardly of the sleeve 102 the shaft 116 is provided with a yoke or stop 124 welded thereon. The stop further is provided with an integral projection or tongue 126 engageable with the pin 94 to limit rotation of the shaft 116. As will be apparent, the pin and tongue so limit the rotation of the shaft that the sliding tap carried by the shaft does not pass off of the winding at either end.

Rearwardly of the yoke 124, the shaft 116 is provided with a knob or head 128 of insulating material, preferably ceramic. The end of the shaft is swaged over as at 130 in a counterbore in the head 128, and the counterbore preferably is filled with a suitable insulating cement 132. The head 128 is provided at two adjacent corners with relieved sections 134 providing shelves 136. At the opposite side, the head is provided with a projection 138 having tapered sides 140 and a wedge shaped undersurface 142.

The shaft assembly further includes a spring arm 144. The spring arm is provided with a central aperture at

146 generally complementary to the head 128, including the relieved corners 136, and the wedge-shaped undersurface 142 of the projection 138. The aperture is received over the shelves 136 and beneath the projection 138, as will be seen in Fig. 3. The spring arm is slotted along the opposite sides of the aperture as at 148, the slots angling in at 150, generally in the same shape as the aperture 146. The angled end portions 150 of the slots are connected by an opening 152 providing clearance for a generally Z-shaped limit stop 154 welded to the central body formed by the slots 148, 150, and opening 152. A notch 156 is provided in the central body adjacent one of the slots 148 to provide clearance for a wire, as will be brought out hereinafter.

An integral spring tongue 158, joined to the body, hereinafter identified by the numeral 160, adjacent the upper edge thereof (as viewed in Fig. 4) is displaced slightly from the plane of the body. Normally, the displacement is not sufficient to cause the tongue to engage the Z-shaped limit stop 154, but the limit stop prevents the tongue and body from being relatively moved a sufficient distance to destroy the resiliency of the spring arm 144. The outer end of the tongue is provided with depending tabs or flanges 162 forming a brush retainer 164. A pair of small struck out fingers 166 is provided on the tongue for securing a wire as hereinafter will be set forth.

The head 128 is provided with a shank portion 168 having a pair of diametrically located splines 170 thereon. These splines are received in a pair of notches 172 of a rotatable slip ring 174. The slip ring engages the previously mentioned ring section 66, the slip rings being resiliently held together by a coil spring 176 compresses against the slip ring and bearing against the underside of the head 128. The rear surface of the movable slip ring 174 is provided with an axially extending circumferential flange 178 for positively locating the spring 176.

A stranded wire 180 is cast or molded into the movable slip ring 174, and is joined at 182 to another stranded wire 184 cast or molded in a carbon brush 186. The brush is shaped to provide a narrow surface engaging the wire, as is known in this art. The brush is received in the brush holder 164, and the wires 180 and 184 are secured beneath the tongue 158 by the struck out fingers 166.

In addition to the parts heretofore enumerated, it will be observed that the transformer includes a dial 188 held against the mounting plate 86 by a nut 190, the dial being keyed to the transformer by the stud or projection 84.

As has been indicated heretofore, the body 160 of the spring arm 144 is received diagonally across the head 128, being disposed above the shelves 136 and beneath the tapered undersurface 142. This causes the projecting tongue 158 to hold the brush against the wire winding under spring tension. The Z-shaped stop 154 prevents the tongue from being bent backwards far enough relative to the body to prevent being "sprung."

As will be apparent with particular reference to Fig. 3, the underside of the head 128 is substantially in the same plane as the outer, ground down surface of the wire 40 where it passes over the raised rim of the rear end plate 32. The shank 168 is actually recessed within the transformer structure and the semi-recessing of the entire head allows a greater amount of transformer steel to be used in an axial direction, for a given permissible length of the transformer from the front surface of the base plate 72 to the rear extremity of the shaft assembly, namely the outer end of the head 128. Furthermore, with the cemented construction, and particularly with the flat on the base cylinder for facilitating the flow of the resin, only a small space is needed between the core and the cylinder, thus affording a maxi-

mum of steel in a radial direction. As a result, the transformer has a higher current or power rating than similar transformers now available in commerce.

The molded or bonded construction provides for better heat transfer within the transformer. This leads to longer service life, or allows the transformer to be operated at higher ratings tending to dissipate greater heat within the transformer.

It is to be understood that the specific form of the invention as herein shown and described is exemplary only. Various changes in structure will no doubt occur to those skilled in the art, and are to be understood as forming a part of this invention insofar as they fall within the spirit and scope of the appended claims.

The invention is claimed as follows:

1. A variable transformer comprising a cylindrical core, a coil winding on said core and insulated therefrom, terminal means connected to said winding, a sliding tap engageable with said winding, terminal means connected to said tap, a one-piece molded base comprising a cylinder and an integral transverse plate of insulating material, said plate having an annular recess concentric with and on the same side thereof as said cylinder, said cylinder extending through said core with said plate proximate to one end of said core, a cementitious material interposed between and bonding together said core and said base, said cementitious material extending into said recess, and a shaft assembly extending through said base and carrying said sliding tap.

2. A variable transformer as set forth in claim 1 wherein the base cylinder is provided with a chordal flat extending substantially from end to end thereof and communicating with the plate recess, providing clearance for said cementitious material and further serving to key said base through said cementitious material to said core and winding.

3. A variable transformer as set forth in claim 1 wherein the cylinder is provided with a counterbore at the end opposite the plate, and further including a metal stop pin mounted in said counterbore and extending axially of said cylinder, said shaft assembly having a stop engageable with said stop pin to limit movement of said sliding tap.

4. A variable transformer comprising a cylindrical iron core, a pair of insulating end caps respectively disposed on the opposite ends of said core, and each comprising a ring-like plate with a central depressed area, a coil winding about said core and end caps insulated from said core and conforming to said end caps including said central depressed areas, terminal means connected to said winding, a sliding tap engageable with said winding, terminal means connected to said tap, a base comprising a cylinder and a transverse plate of insulating material, said cylinder extending through said core and end caps with said plate proximate to one of said end caps, a cementitious material interposed between and bonding together said core and said base, and a shaft assembly extending through said base and carrying said sliding tap.

5. A variable transformer as set forth in claim 4 wherein each end cap has a central aperture therein, the cap about said central aperture being provided with serrations in the nature of surface impressions forming guides positioning the turns of said winding.

6. A variable transformer as set forth in claim 4 wherein the base plate and the proximate end cap are provided with complementary keying means.

7. A variable transformer comprising a core unit including a cylindrical iron core having a coil winding thereon and insulated therefrom, terminal means connected to said winding, a sliding tap engageable with said winding on an axial end of said core unit, a base comprising a cylinder and a transverse plate of insulating material, said cylinder extending through said core unit with said plate proximate to one end of said core unit and the opposite end of said cylinder terminating within said core unit short of the end thereof opposite said base plate and adjacent the sliding tap, means fixing said base to said core unit, terminal means extending substantially radially inwardly along the end of said core unit opposite said base plate and having an offset extending in toward the terminating end of said cylinder and fixed to a slip ring abutting said end of said cylinder, and a shaft assembly extending through said base carrying said sliding tap and having means thereon connected to said sliding tap and forming a sliding contact with said ring.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,985,857 May 23, 1961

Fredrick I. Ellin et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, lines 14 and 15, strike out "the circumference of the cap. The front end cap is identical with the rear end cap, but lacks in the insert 48, a" and insert the same after "from" in line 12, same column 2.

Signed and sealed this 5th day of December 1961.

(SEAL)

Attest:

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Commissioner of Patents

USCOMM-DC

UNITED STATES PATENT OFFICE

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