Aug. 2, 1938. G. FREDRICKSON 2,125,628

MAGNETIZER

Original Filed Dec. 22, 1933 4 Sheets-Sheet 1

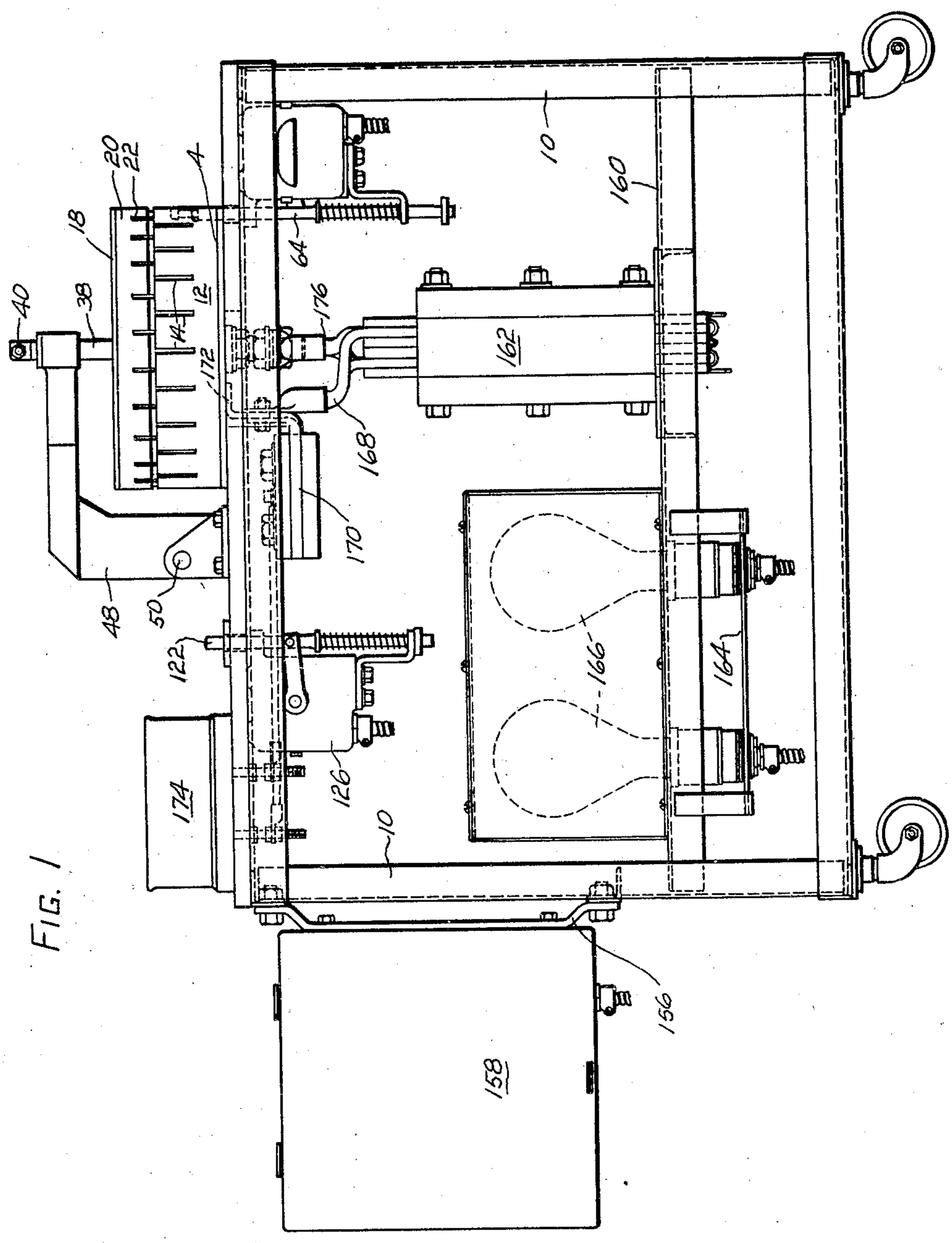


FIG. 1

INVENTOR:
GUSTAV FREDRICKSON,
BY Fales & Thurston
HIS ATTORNEY.

Aug. 2, 1938. G. FREDRICKSON 2,125,628

MAGNETIZER

Original Filed Dec. 22, 1933 4 Sheets-Sheet 2

FIG. 2

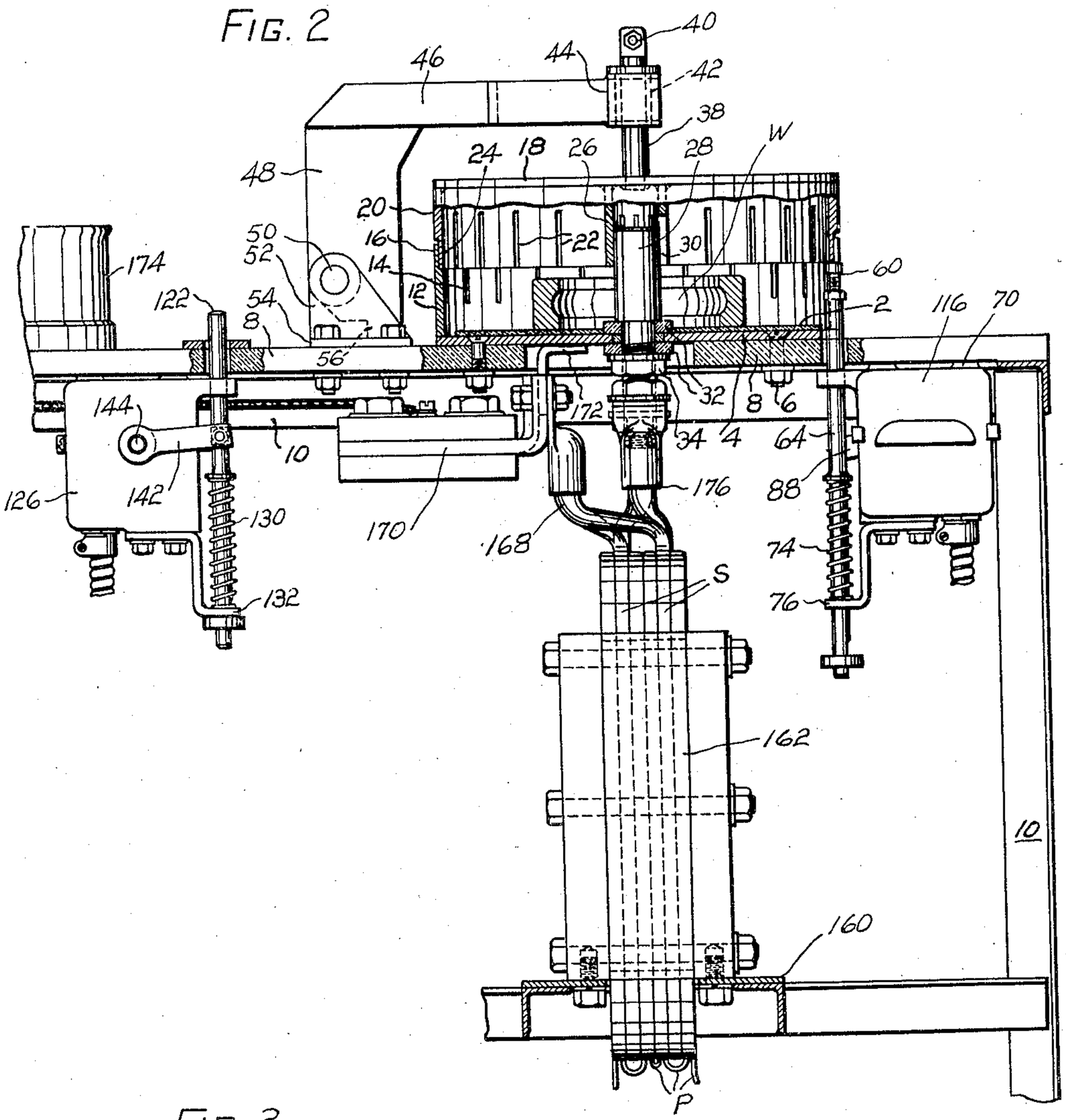
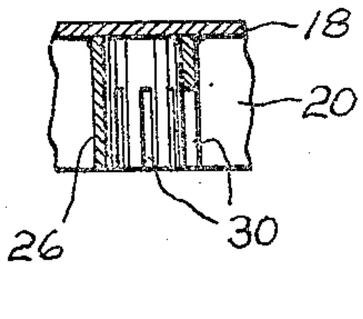


FIG. 3



INVENTOR:
GUSTAV FREDRICKSON,
BY Jales G. Moore
HIS ATTORNEY.

Aug. 2, 1938. G. FREDRICKSON 2,125,628

MAGNETIZER

Original Filed Dec. 22, 1933 4 Sheets-Sheet 3

FIG. 4

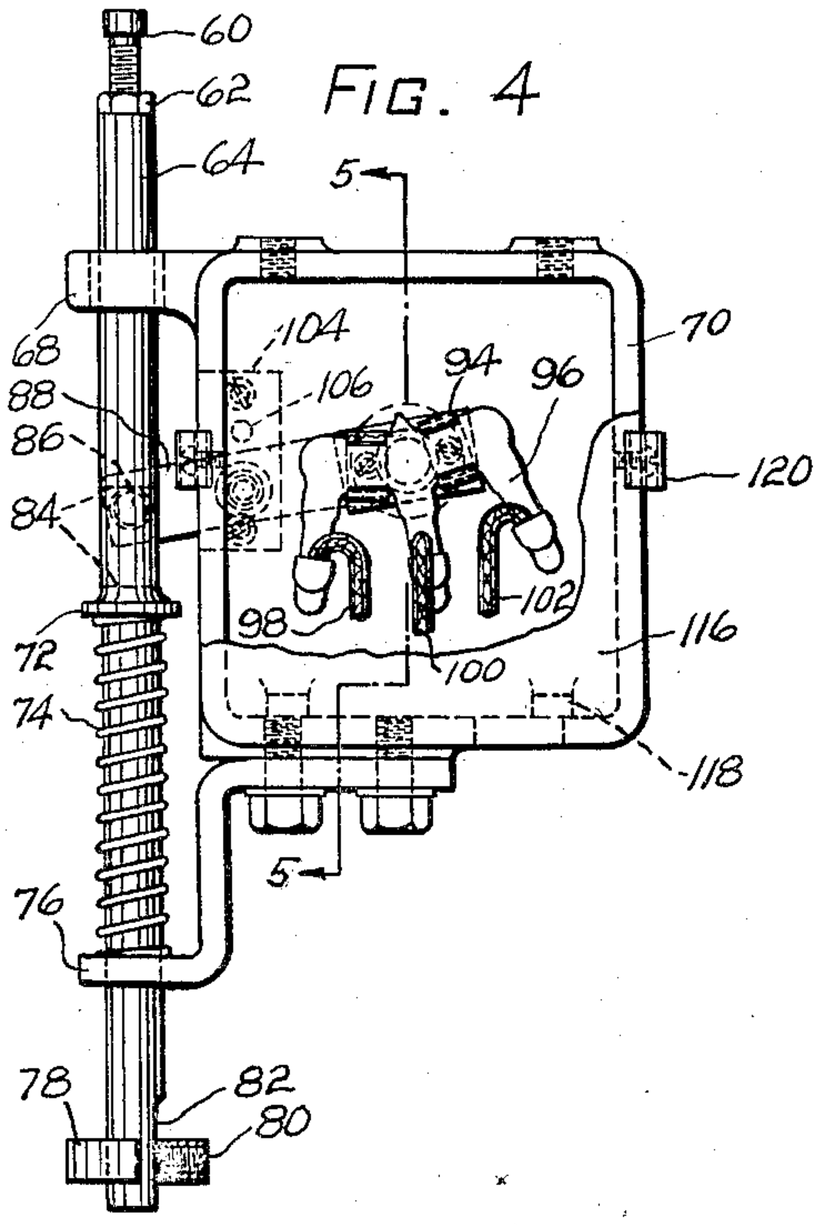


FIG. 5

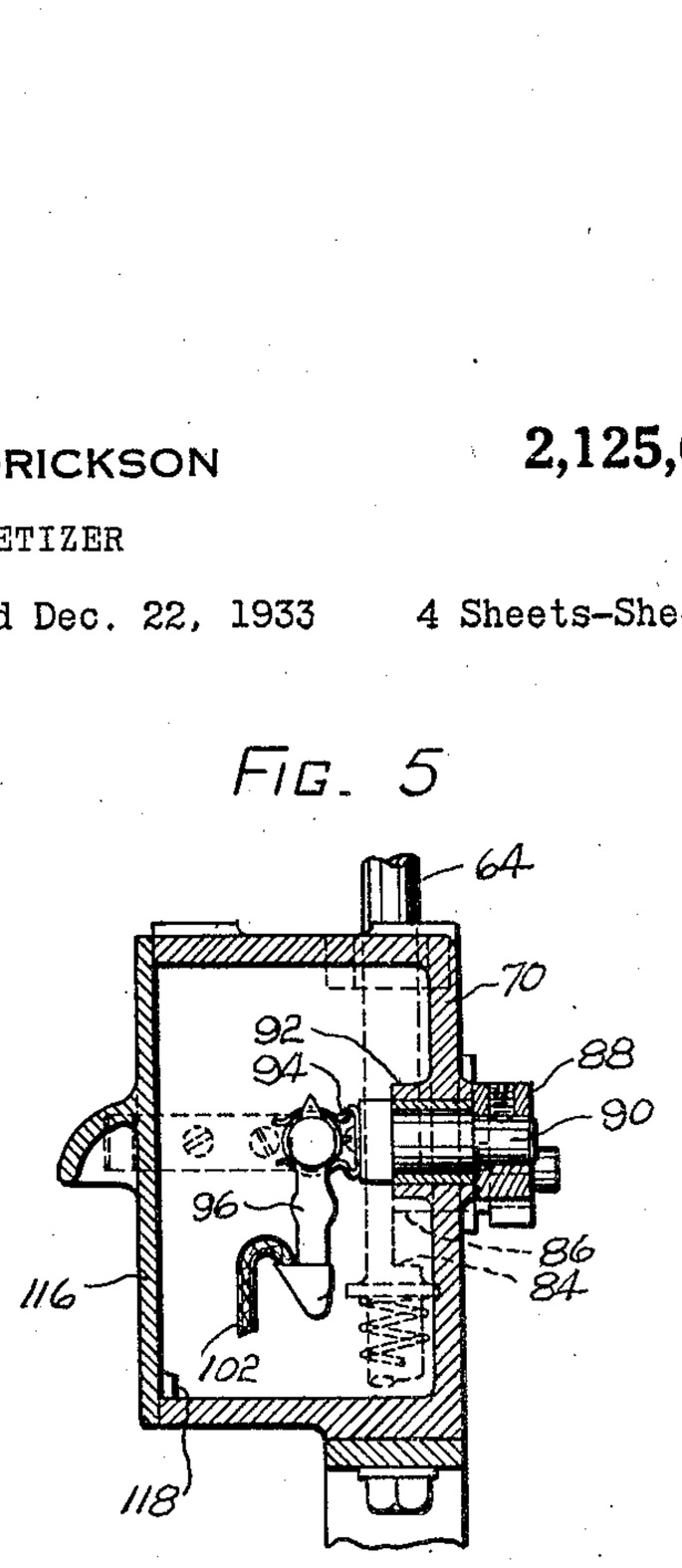


FIG. 6

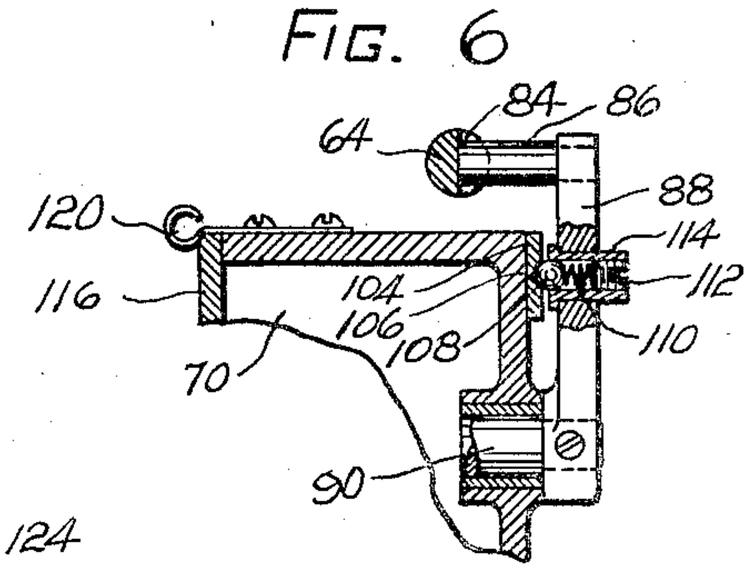


FIG. 7

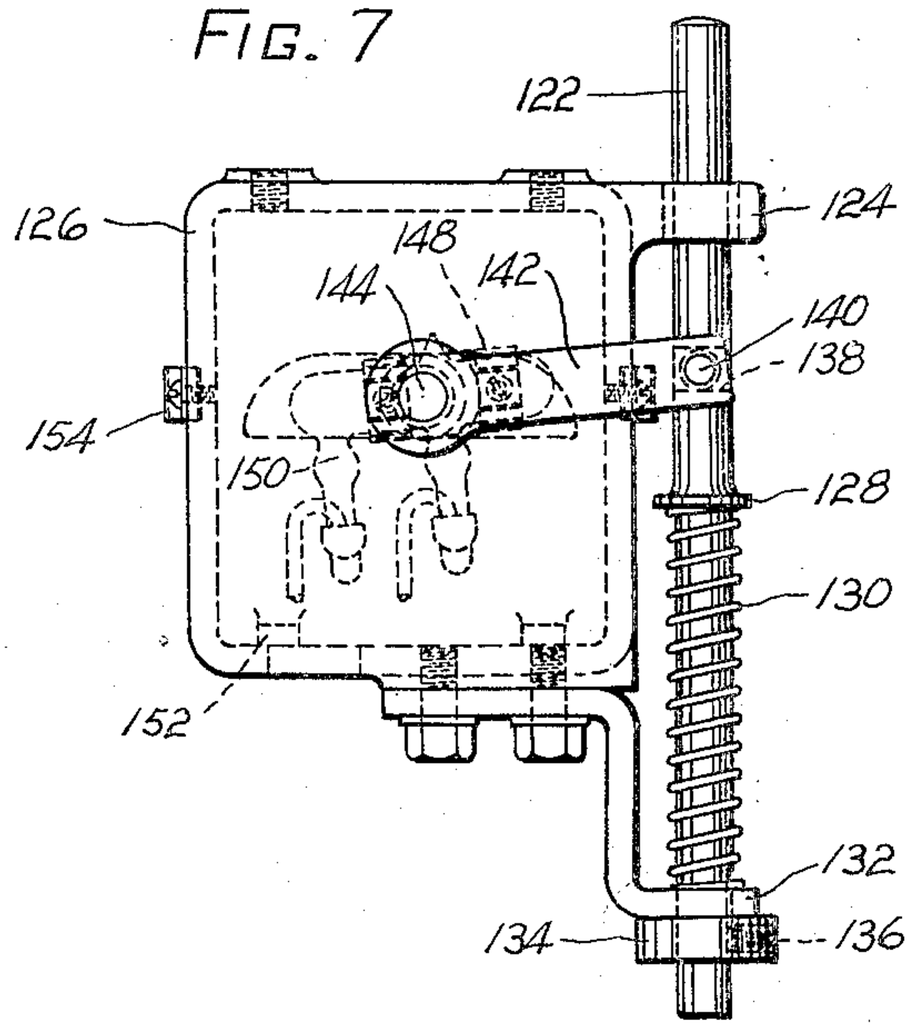
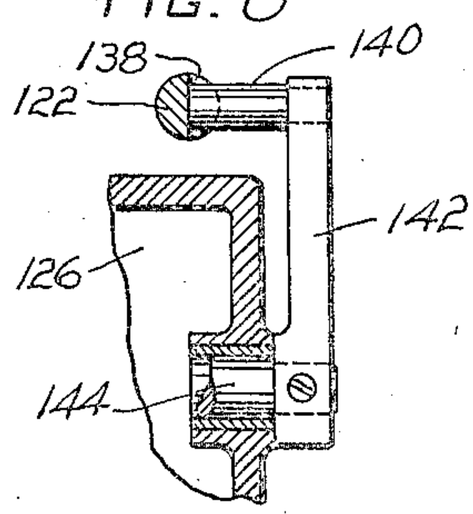


FIG. 8



INVENTOR:
GUSTAV FREDRICKSON,
BY Gales & Morris
HIS ATTORNEY.

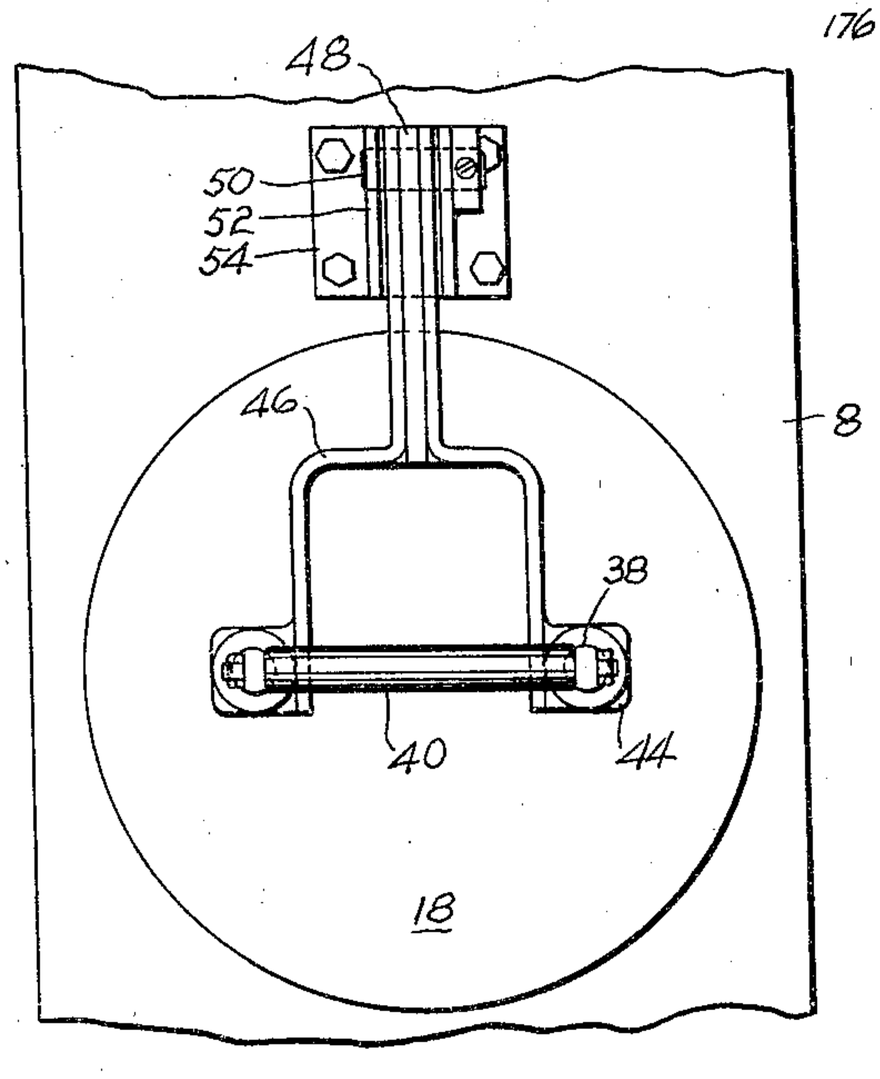
Aug. 2, 1938. G. FREDRICKSON 2,125,628

MAGNETIZER

Original Filed Dec. 22, 1933 4 Sheets-Sheet 4

FIG. 10

FIG. 9



INVENTOR:
GUSTAV FREDRICKSON,
BY Jules S. Thorne
HIS ATTORNEY.

Patented Aug. 2, 1938 2,125,628

UNITED STATES PATENT OFFICE

2,125,628

MAGNETIZER

Gustav Fredrickson, Forestville, Conn., assignor, by mesne assignments, to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application December 22, 1933, Serial No. 703,595
Renewed September 18, 1935

14 Claims. (Cl. 175—21)

This invention relates to magnetizers and comprises all of the features of novelty herein disclosed. An object of the invention is to produce a magnetizer which is especially adapted for magnetizing ring-shaped articles or the like. Another object is to provide a readily portable magnetizer using an ordinary commercial direct current circuit, thus dispensing with expensive motor generator sets, converters, etc. Another object is to provide a magnetizer employing a surge generator which reverses its magnetic flux and so increases the amount of the magnetic charge imparted to the work. Another object is to produce a magnetizer having a toroidal work receptacle which is formed in separable sections to receive a ring to be magnetized. Still another object is to produce an improved method of magnetizing articles.

To these ends and also to improve generally upon devices of this character, the invention consists in the various matters hereinafter described and claimed. In its broader aspects, the invention is not necessarily limited to the specific construction selected for illustrative purposes in the accompanying drawings in which

Fig. 1 is a front elevation of the apparatus.

Fig. 2 is a similar and enlarged view of a portion of the apparatus, some parts being in section.

Fig. 3 is a sectional view of a portion of the cover.

Fig. 4 is a front view of a two-way switch.

Fig. 5 is a vertical sectional view on line 5—5 of Fig. 4.

Fig. 6 is a horizontal sectional view of parts of Fig. 5.

Fig. 7 is a front view of a switch.

Fig. 8 is a horizontal sectional view of parts of Fig. 7.

Fig. 9 is a plan view of a detail.

Fig. 10 is a diagram.

A work-piece W, herein shown as a ring to be magnetized, is supported upon an insulating pad 2 engaging a circular plate 4 which is secured by screw bolts 6 to an insulating bench top 8. All of the mechanism to be described is supported by a suitable framework 10 having casters for ready portability. The plate 4 has a circular side wall 12 which is made springy by a series of slots 14. The upper inner portion of the side wall is provided with an annular recess or shoulder leaving a thin upwardly projecting flange 16. The receptacle formed by the plate 4 and the side wall 12 has a cover plate 18 which is provided with a circular side wall 20 having slots 22 to make it springy. Near the bottom, the side wall 20 has an exterior recess or shoulder leaving a downwardly projecting flange 24 arranged to yieldingly engage the flange 16 and thus make good electrical contact.

A suitable centering means or pilot is provided for the cover and this comprises a sleeve 26 arranged to surround the upper end of a core or plug 28. The sleeve is conveniently secured to the cover plate 18 as by welding (see Fig. 3) and is slotted as indicated at 30 to make it springy. The core or plug 28 has a reduced portion carrying a set of insulating washers 32, the two outermost washers being largest and being clamped to the plate 4 by a nut 34. A pair of lifting bars 38 are secured to the cover plate 18 and have flattened extensions connected by a handle 40. The bars are slidable manually in bearings 42 in bosses 44 carried by bracket arms 46, and such sliding allows the cover to be shifted vertically into or out of electrical contact with the work receptacle. The centering sleeve 26 will engage the plug or core 28 before the flanges 16 and 24 enter one another, thus insuring a line-up of the flanges prior to actual contact.

In order to be able to insert the work in its receptacle, with the plug 28 inside the work, the cover is capable of swinging laterally out of the way and the swinging is also made use of to operate switches. The bracket arms 46 are mounted on an upright arm 48 which is pivoted by a pin 50 between lugs 52 on a bracket 54 which is bolted to the bench top 8. The arm 48 has one portion cut away for clearance in swinging and is provided with a stop plug 56 which engages the bracket 54 to position the cover in alignment with the receptacle. When the cover is swung to the left in Fig. 1 to its inoperative position, the arm 48 opens a spring-pressed switch as will later appear.

When the cover 18 slides up or down with the bars 38, its flange 24 operates a spring-pressed two-way switch by contact with a screw 60 which is adjustably secured by a lock nut 62 in a tapped opening of a slide rod 64. The rod 64 slides in a lug 68 carried by a switch housing 70 and is provided with a collar 72 engaging a coil spring 74 which abuts against a guide bracket 76 on the switch housing. Upward movement of the rod is adjustably limited by a stop collar 78 fastened in adjusted position by a set screw 80 engaging a flat 82 on the rod. The rod has, at the rear, a vertically elongated notch having its end walls 84 straddling a pin 86 on a switch operating arm 88, the lost motion at the

notch postponing the action of the switch until near the end of the movement of the rod in each direction. This provides a chance for the flanges 16 and 24 to make ample contact in the interval or to separate without arcing. The switch arm 88 is secured to a rock shaft 90 journalled in a boss 92 of the switch housing. A spring clip 94 on a collar at the end of the shaft detachably supports a two-way switch 96 which is preferably a mercury switch as indicated. In the position indicated in Fig. 4, wires 98 and 100 have electrical connection through the mercury in two legs of the switch. When the rod 64 rises and tilts the switch clockwise, wires 100 and 102 will be in electrical connection.

To hold the switch arm in either of its two positions but not positively, thus to insure postponement of the movement of the switch arm until the lost motion of the rod 64 is taken up at the pin 86, a spring-pressed detent is provided. (See Fig. 6.) This comprises a plate 104 secured to the switch housing and provided with a pair of shallow cavities 106 for co-operation with a ball 108 urged towards the cavities by a light coil spring 110. The spring abuts against a plug 112 threaded in a bushing 114 carried by the switch arm 88. The switch housing is closed at the front by a removable door 116 having locating lugs 118 to rest on the bottom of the housing, spring clips 120 on the housing snapping over the sides of the door.

As above stated, a spring-pressed switch is opened when the work receptacle cover 18 is swung over to the left in Fig. 2. The switch is preferably a one-way mercury switch and its operating means is similar to that for the two-way switch 96. A switch operating rod 122, (Figs. 2, 7 and 8), in the path of the swinging arm 48, is slidable in a bearing lug 124 on a switch housing 126 and has a collar 128 abutting against a coil spring 130. The coil spring abuts against a guide bracket 132 and urges the rod upwardly to close the switch. Upward movement is adjustably limited by a stop collar 134 clamped in adjusted position on the rod by a set screw 136. The rod has a notch 138 receiving a pin 140 projecting from a switch arm 142 which is secured to a rock shaft 144 journalled in a boss of the switch housing 126. A spring clip 148 detachably holds a mercury switch 150 to the rock shaft. A detachable door which closes the rear of the housing is supported by lugs 152 and held closed by spring clips 154, these parts corresponding to those for the other switch housing. The switch is moved to closed position by the spring 130 whenever the work-receptacle cover is closed over the work and the switch is opened when such cover is swung back.

Referring to Fig. 1, the portable bench frame 10 has a bracket 156 supporting a box 158 containing magnetic switches hereinafter referred to. The frame has a shelf 160 supporting a transformer 162 having a core which may be laminated or solid and a primary coil P of many turns in series linking with a secondary coil S of two turns in parallel. Also on the shelf is a clip 164 supporting a plurality of ordinary tungsten filament lamps 166. The lamps have low resistance when cold and a high resistance when hot. One of the terminals of the transformer secondary is connected by a lead wire 168 to a resistor or shunt 170 which has an electrical connection at 172 with the plate 4. An ammeter 174 is supported on the bench top and is connected to the shunt 170. The other terminal of the transformer is connected by a lead wire 176 to the lower end of the plug or core 28. The cover 18 acts like a switch in the secondary circuit of the transformer when the flanges 24 and 16 engage or disengage.

The electrical connections are shown diagrammatically in Fig. 10 wherein a main switch 178 connects the wiring system to a suitable source of power such as 110 volt, direct current. One of the line wires is connected by a branch wire 180 to terminals of electro-magnets 182 and 184, these magnets controlling magnetic switches 186 and 188 respectively. The magnetic switches have operating arms 190 interconnected by a link 192, the link having a lost-motion slot 194 engaged by a pin 196 on one of the arms. Thus both magnetic switches can be open at the same time but only one can close at a time and, whenever either is closed, the other is positively opened. Switch 186 has a pair of blades 198 and 200 to connect the power lines to the transformer primary, and switch 188 has a pair of blades 202 and 204 for the same purpose but one pair of blades directs the current through the transformer primary in a direction opposite to that of the other pair.

When a work-piece has been placed in the receptacle and the receptacle cover 18 is swung over towards closed position, the switch 150 closes by spring pressure and, as the cover slides down, such cover acts as a switch to first complete the secondary circuit and then as the cover reaches its lowest position, the two-way switch 96 is moved by the rod 64 to that position wherein it electrically connects wires 98 and 100. Thus the magnet 182 is energized to close the magnetic switch 186 and open the magnetic switch 188. This action makes switch blades 198 and 200 effective to connect one power line to one terminal of the transformer primary and to connect the other power line to the bank of tungsten filament lamps 166, the latter being grouped in parallel and connected to the remaining terminal of the transformer primary. A surge of current from the transformer secondary through the core of the work-piece and around the latter magnetizes the piece. This magnetizing action is rendered doubly effective because of what occurs to the transformer core on a precedent lifting of the cover 18, as when removing a previously treated article. As the cover 18 rises, the surfaces at 16 and 24 separate and the secondary circuit of the transformer is broken. The rod 64 follows the cover upwardly by spring pressure while the switch 96 is temporarily held by its detent but, as soon as the lost motion at the slot 84 is taken up, the switch 96 is thrown over by the force of the spring 74 and the wires 100 and 102 become electrically connected. This energizes the magnet 184, thereby closing the magnetic switch 188 and opening the magnetic switch 186. Switch blades 202 and 204 become effective to connect the power lines to the transformer primary but the direction of current surge is opposite to that subsequently obtained when the cover is closed down over the article to be magnetized.

The current used for magnetizing the work is that resulting from applying the secondary voltage of the transformer or surge generator to the work receptacle. This secondary voltage is set up in the secondary winding by the net change of magnetic flux in the transformer core. Now by causing a complete reversal of this magnetic flux in the transformer core a direct current voltage surge is generated in the secondary. This

direct current voltage surge is applied to a closed circuit through the work receptacle. The heavy direct current which flows through the work receptacle magnetizes the ring shaped work. The work receptacle is in effect a one-turn toroidal coil which can be opened to admit a ring shaped work-piece. The work becomes a core within this one-turn toroidal coil when the work receptacle is closed on the work piece.

The magnetizer is workable without reversing the magnetic flux in the transformer during magnetizing of the work piece. The net change in magnetic flux in the core of the transformer is limited in this case to the saturation flux in the transformer core. But by reversing the magnetic flux in the core of the transformer, the net change of magnetic flux is twice that obtained on repeated operations of magnetic flux in the transformer core in the same direction. The resulting currents built up through the work receptacle are about twice as great on complete reversal of transformer flux as on repetition of flux in the same direction.

The action may also be visualized as follows: The transformer core may be considered as initially in a neutral state magnetically with the north and south poles of its particles arranged helter-skelter. Upon the first surge of current, the particles have their north poles switched over to lie all in the same direction. The net or average change may be given a value of 90° or from zero to plus one. When the current is reversed, the particles are completely reversed through 180°, a change from plus one to minus one or a difference of two. In effect, the work-piece is placed as a core in a toroidal coil and a heavy direct current caused to flow through this toroidal coil of one turn. On being removed, the work-piece retains a permanent ring-shaped magnetic field useful for crack testing for instance.

When magnetizing a number of work-pieces in succession, the cover 18 and its supporting arm 48 are moved only enough to allow easy insertion of the work in the receptacle. The repeated opening and closing of the cover throws the two-way switch 96 back and forth so that the magnets 182 and 184 are alternately energized to operate their corresponding switches. Thus the current surges in the surge generator occur in opposite directions. When the last piece is magnetized, the cover is swung way back and the arm 48 strikes the rod 122 to open the switch 150 so that both magnets are de-energized and both switches 186 and 188 are open at the same time.

I claim:

1. In a device of the character described, a surge generator having a core, a primary coil, a secondary coil, means for causing a preliminary surge of current through the primary coil in one direction, means for thereafter establishing a magnetizing circuit extending through the opening in a ring shaped work-piece and around the entire circumference uniformly and including the secondary coil, and means for causing a surge of current through the primary coil in the opposite direction; substantially as described.

2. In a device of the character described, a surge generator having a core, a primary coil, a secondary coil, means for causing a preliminary surge of current through the primary coil in one direction, a toroidal coil of one turn comprising a circumferentially continuous wall adapted to contain a ring-shaped work-piece and a plug concentric with the wall and passing through the work-piece, the plug and the wall being connected to the secondary coil, and means for causing a surge of current through the primary coil in the opposite direction; substantially as described.

3. In a device of the character described, a surge generator having a core, a primary coil, a secondary coil, means for causing a preliminary surge of current through the primary coil in one direction, a toroidal coil formed in circumferentially continuous sections to open and receive a ring-shaped work-piece, means for bringing the sections into contact to put the toroidal coil in circuit with the secondary, and means for causing a surge of current through the primary coil in the opposite direction; substantially as described.

4. In a device of the character described, a surge generator having a core, a primary coil, and a secondary coil, a toroidal coil formed in circumferentially continuous sections to open and receive a ring-shaped work-piece, means for bringing the sections into contact to put the toroidal coil in circuit with the secondary, and means operated by movement of one of said sections for causing a surge of direct current through the primary coil to uniformly magnetize the work-piece contained in said sections; substantially as described.

5. In a device of the character described, a surge generator having a core, a primary coil, and a secondary coil, a toroidal coil formed in sections to open and receive a ring-shaped work-piece, means for bringing the sections into contact to put the toroidal coil in circuit with the secondary, and means operated by the movable section of the toroidal coil for completing a circuit through the primary coil; substantially as described.

6. In a device of the character described, a portable magnetizer comprising a frame, a surge generator having a primary coil, a secondary coil, and a core, a work receptacle for the work to be magnetized, means for placing the work receptacle in circuit with the secondary coil and, means automatically operated by said placing means for thereafter connecting the primary coil to a source of direct current; substantially as described.

7. In a device of the character described, a portable magnetizer comprising a frame, a surge generator having a primary coil, a secondary coil, and a core, means for connecting the primary coil to a source of direct current, a work receptacle adapted to open and close to place itself in and out of circuit with the secondary coil, and a switch operated by the opening and closing of the work receptacle for reversing the flow of current in the primary; substantially as described.

8. In a device of the character described, a work receptacle having a circumferentially continuous side wall of conducting material to surround a ring-like work-piece, and a core of conducting material concentric with the side wall to enter the opening in the work-piece, means for electrically connecting the core to all points in the side wall, and means for causing a surge of magnetizing current through the receptacle and the core to uniformly magnetize the work-piece; substantially as described.

9. In a device of the character described, a work receptacle comprising a base portion and a cover to contain a ring-like work-piece to be magnetized, the receptacle having a circumferentially continuous side wall of conducting material to completely surround the work-piece and a core of conducting material to enter the opening in the work-piece and form a toroidal coil

of one turn around all portions of the work-piece, means for moving the cover into or out of electrical contact with the base portion and the core, and means external to the receptacle for causing a surge of magnetizing current through the toroidal coil; substantially as described.

10. In a device of the character described, a work receptacle comprising a base portion and a cover to contain a ring-like work-piece to be magnetized, the receptacle having a circumferentially continuous side wall of conducting material to completely surround the work-piece and a solid core of conducting material to enter the opening in the work-piece and form a toroidal coil of one turn around all portions of the work-piece, means for insulating the core from the base portion, means for connecting the core and the base portion to an external source of magnetizing current, and means connected to the cover for moving it into or out of electrical contact with the base portion and the core; substantially as described.

11. In a device of the character described, a work receptacle to contain a ring-like work-piece to be magnetized, the receptacle comprising a circumferentially continuous base portion and a circumferentially continuous cover of conducting material, a solid core of conducting material passing through the base portion and the opening of the work-piece, the core being insulated from the base portion, means for connecting the core and the base portion to an external source of magnetizing current, and means for electrically connecting the core and the base portion to the cover to complete the circuit in the receptacle and thereby magnetize the work-piece therein; substantially as described.

12. In a device of the character described, a work receptacle to contain a ring-like work-piece to be magnetized, the receptacle comprising a base portion having a circumferentially continuous side wall of conducting material, a core entering the receptacle and the opening in the work-piece, a cover of conducting material having a rim to engage the side wall, guiding means between the core and the cover to center the cover with respect to the side wall, means connected to the cover for moving the cover towards the base portion to electrically connect the rim to the side wall, and means for connecting the core and the base portion to terminals of a magnetizing current; substantially as described.

13. The method of magnetizing a work-piece, which consists in causing a surge of direct current through a transformer primary in one direction, thereafter establishing a circuit from the secondary of the transformer through a conductor located in magnetizing relation to the work-piece, and causing a surge of direct current through the primary in the opposite direction while the piece remains in the same relation to the secondary; substantially as described.

14. The method of magnetizing a work-piece, which consists in connecting the primary of a transformer to a source of direct current having high voltage and low current capacity, establishing a circuit from the secondary of the transformer through a conductor located in magnetizing relation to the work-piece, and reversing the direction of current flow in the primary to build up a high direct current surge of low voltage in the magnetizing circuit; substantially as described.

GUSTAV FREDRICKSON.