F. L. SIMMONS.

BIPOLAR MAGNETIC CHUCK.

APPLICATION FILED SEPT. 11, 1917.

1,415,723. Patented May 9, 1922.

2 SHEETS—SHEET 1.

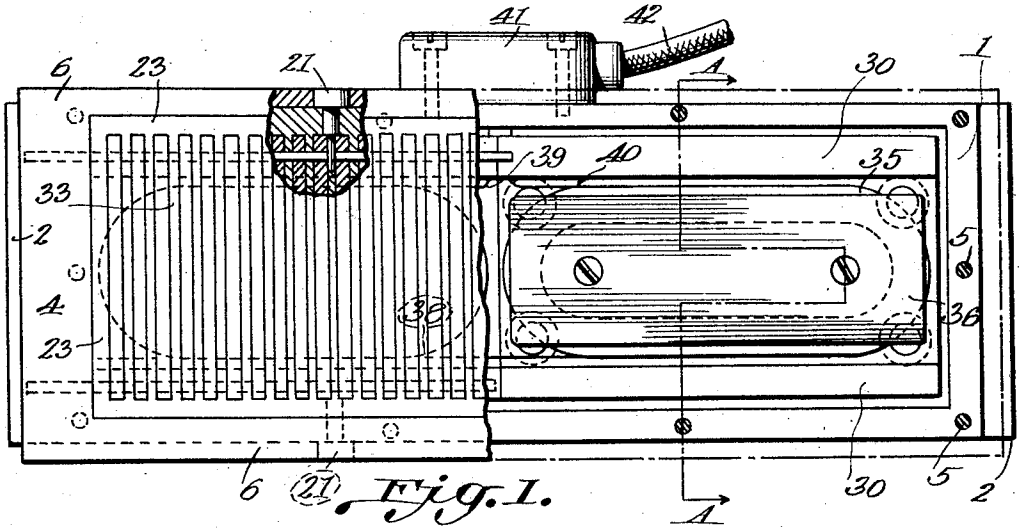



Fig. 1.

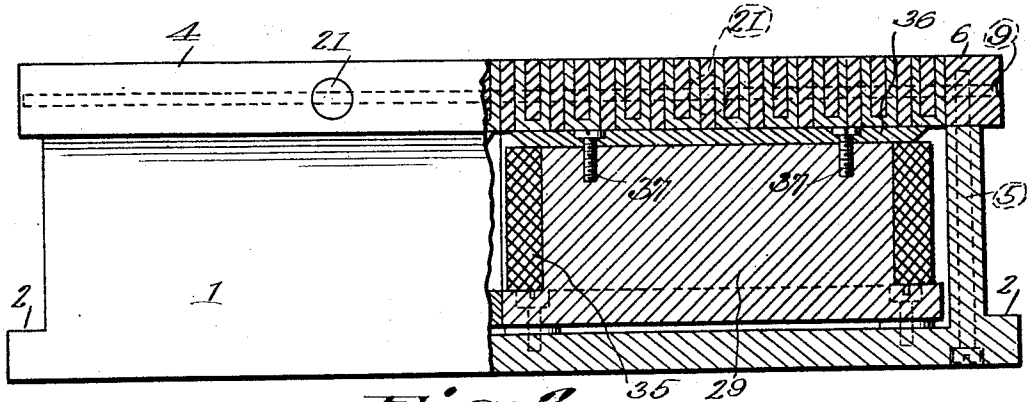



Fig. 2.

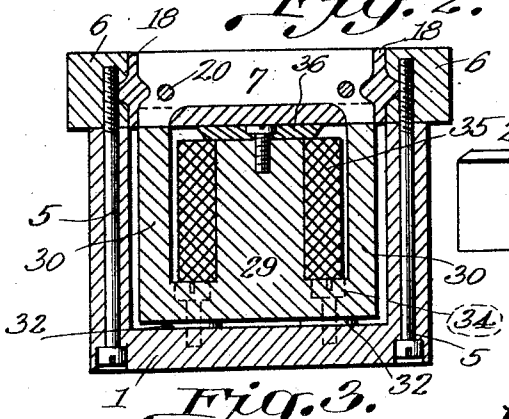



Fig. 3.

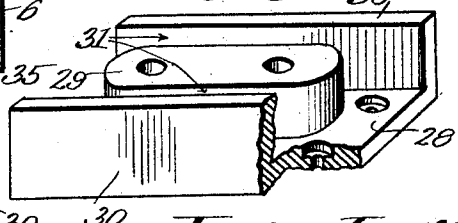



Fig. 5.

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2 SHEETS—SHEET 2.

Fig. 4.

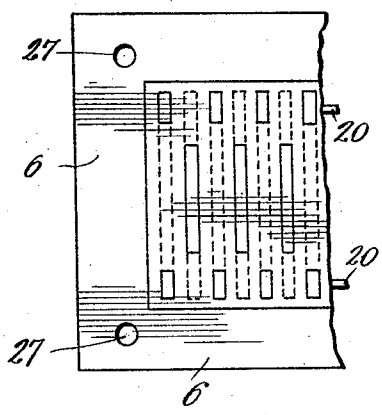



Fig. 6.

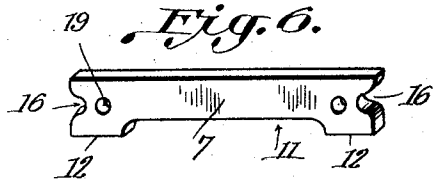



Fig. 7.

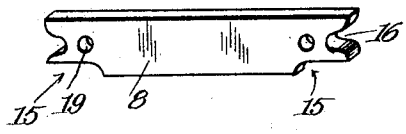



Fig. 9.

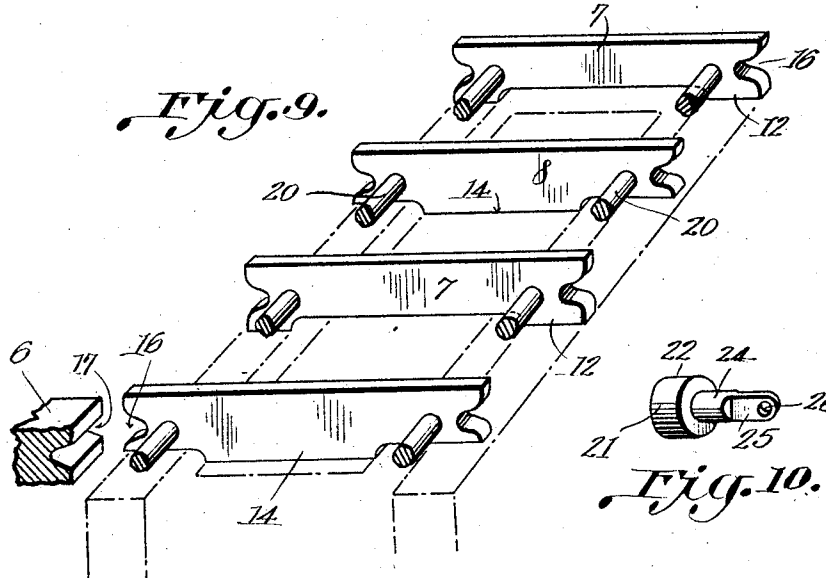






Fig. 10.

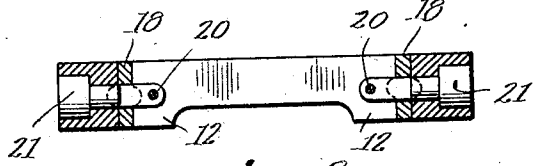



Fig. 8.

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# UNITED STATES PATENT OFFICE.

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## BIPOLAR MAGNETIC CHUCK.

1,415,723. Specification of Letters Patent. **Patented May 9, 1922.**

Application filed September 11, 1917. Serial No. 190,698.

*To all whom it may concern:*

Be it known that I, FRANK L. SIMMONS, a citizen of the United States, and a resident of the city of Woonsocket, in the county of Providence, State of Rhode Island, have invented certain new and useful Improvements in Bipolar Magnetic Chucks, of which the following is a specification.

This invention relates broadly to magnetic chucks and more particularly to a magnetic chuck wherein a single field coil energizes a plurality of work face pole pieces.

The principal object of the present invention is to provide a construction in magnetic chucks of the character specified which facilitates economy in the manufacture and assembly of the chuck.

A further object of the present invention is to provide a magnetic chuck of the character specified wherein substantially the entire work face of the chuck is rigidly supported against torsion and pressure stresses thereby providing a chuck of great resisting power.

Another object of the present invention is to provide a chuck of the character specified with the work face comprising a plurality of pole pieces adapted to be stamped from sheet metal and arranged in the face plate in alternate series and with the back of the face plate substantially parallel to the work face thereof.

A still further object of the present invention is to provide a magnetic chuck with the work face composed of individual pole pieces separated one from the other by non-magnetic material and surrounded by a supporting frame also separated from the pole pieces by non-magnetic material with reinforcing members extending through the pole pieces and secured to both the ends and the sides of the face plate frame.

A further and equally important object of the present invention is to construct a magnetic chuck comprising a supporting casing, an energizing unit spaced apart from said casing and separated therefrom by non-magnetic material, and a face plate comprising a work face portion and a frame portion with the work face portion in direct contact with the energizing member and the frame portion in contact with the supporting frame, but separated from the work face portion by non-magnetic material.

A still further object of the present invention is to provide a magnetic chuck of the character specified wherein an energizing unit comprises an elongated unitary coil carrying post located between a pair of parallel side members whereby a cross-section of the members is similar to the letter E placed on its back, and with the posts in direct magnetic contact with one series of work face pole pieces and the parallel members in direct magnetic contact with the other series of work surface pole pieces.

Other and further objects of the present invention will in part be obvious and will in part be pointed out hereinafter in the specification following by reference to the accompanying drawings wherein like parts are designated by like characters throughout the several figures thereof.

Figure 1 is a plan view showing a portion of the face plate broken away to illustrate the relation of the interior parts to the face plate.

Figure 2 is an elevational view with a portion of the chuck shown in section.

Figure 3 is a cross-section taken on line A—A Figure 1.

Figure 4 is a detail view of the underside of the face plate showing the portions of the work face pole pieces adapted to contact with the energizing unit.

Figure 5 is a detail perspective view of one of the energizing units with the coil removed.

Figure 6 illustrates a work face pole piece adapted to contact with the parallel members and bridge the coil carrying post, prior to its assembly in the face plate.

Figure 7 illustrates a work face pole piece adapted to contact with the coil carrying post and bridge the parallel side members, prior to its assembly in the work face.

Figure 8 illustrates the construction whereby the longitudinal reinforcing rods are tied to the surface plate frame.

Figure 9 illustrates the work face pole pieces and the manner in which these pole pieces contact with an energizing unit. This

view also illustrates the relation of the longitudinal reinforcing rods to the individual pole piece members.

Figure 10 is a detail view of one of the tie members for connecting the reinforcing rods to the work face frame.

Heretofore in the art of magnetic chucks it has been proposed to utilize a single coil to energize a plurality of portions of a face plate but such portions have comprised elongations and configurations of single pole pieces so that the body of the chuck connecting with one individual member comprised a portion of the magnetic circuit and the coil carrying core connecting with the other of the configurations comprised the remainder of the same magnetic circuit. Chucks of this character are very expensive to manufacture and since the housing or body of the chuck comprises a part of the magnetic circuit the efficiency of such chucks is impaired when they are mounted on the iron or steel beds of machine tools as is customary in the normal use of magnetic chucks. Furthermore, in chucks of this character it is difficult to produce a sufficient number of poles on the work face to enable such chucks to be efficiently used in handling small pieces of work.

The present invention comprises an electric chuck wherein the foregoing difficulties are overcome by providing a construction composed of three primary units, namely, a supporting member that comprises the shell or housing; an energizing unit; and a face plate. The face plate has a work holding field composed of a plurality of individualized pole piece members that may be formed by stamping from sheet metal. This face plate when finished presents two flat parallel surfaces, one being the work face and the other being the back. The supporting member, or in the present case the housing, comprises simply an open topped rectangular box of material sufficiently strong to support the other members of the chuck and preferably comprises a cast-iron box of the character specified. The energizing unit preferably comprises a member cast from special magnet mild steel and having an upstanding coil carrying elongated member separated by parallel valleys or grooves from upstanding parallel side members. This construction enables the grooves to be rough finished by running an emery wheel through them thereby smoothing the sides of the coil carrying member to facilitate attachment of the coil thereto. A top plate is mounted on the coil carrying post and overhangs the same to make a wider platform for contacting with certain of the work face pole pieces, and also to securely retain the energizing coil in position. The energizing unit is secured to the supporting frame or shell by brass or other non-magnetic machine screws and is separated therefrom by brass or other non-magnetic washers so that the magnetic unit does not come into direct magnetic contact with the supporting frame or shell. When the magnetic unit is assembled within the supporting frame the upper surfaces of the shell and the unit are machined or ground to a common plane surface. The face plate is then secured in position over the housing or unit by suitable frame screws and the requisite parts are in intimate magnetic contact without the necessity of expensive hand fitting.

A more detailed description of the construction will now be given by referring particularly to the drawings. The supporting frame is illustrated as comprising a rectangular box 1 which is provided with ledges 2 on each end thereof to permit the chuck to be clamped to the bed of a machine tool, such as a planer, shaper, grinder, etc. The supporting box 1 is shown as comprising a unitary structure which is capable of being hermetically sealed, though an open supporting member might be used since the function of the box is purely a support, as will be hereinafter explained. A face plate 4 is adapted to be secured to the supporting frame by means of face plate screws 5 that extend through openings in the side walls of the supporting frame.

The face plate 4 is comprised of a face plate frame 6 and a series of work face pole pieces 7 and 8 that are separated from the work face frame and from each other by non-magnetic material and are further supported and interlocked by non-magnetic reinforcing rods 20 and tie members 21. The work face pole pieces 7 have the center under portion thereof cut-away as at 11 and are provided with feet 12 on each end of the member and on opposite sides of the cut-away portion 11. The work face pole pieces 8 are provided with a foot 14 in the middle under portion thereof and are cut-away at the ends, as at 15. All of the pole pieces are provided with notches 16 in the ends, which notches are adapted to be opposite to the grooves 17 in the side members of the work face frame 6 whereby when non-magnetic material, such as the Babbitt metal 18, is melted and poured to fill the spaces between the frame and pole pieces and between the individual pole pieces, an interlocking arrangement is provided between the pole pieces and the frame whereby these pieces are securely mounted therein. In order to strengthen the face plate construction each pole piece is provided with openings 19 through which brass or other non-magnetic reinforcing rods 20 are adapted to be extended prior to the pouring in of the Babbitt. In order to make a watertight compact face plate the various layers or ribs of Babbitt metal around the poles

are hammered or peened thereby expanding the Babbitt metal laterally and forcing it into very intimate contact with the work face frame and the pole pieces. To prevent any spreading of the frame during this operation tie members 21 are provided to extend through the side member of the face plate frame 6 and engage with the reinforcing rods 20. These tie members comprise lugs of non-magnetic material, such as brass, provided with heads 22 from which extend cylindrical bodies 24 that carry the blades 25 through which are the openings 26 adapted to accommodate the reinforcing rods. Since the Babbitt metal is flowed in to substantially fill all the crevices and voids in the face plate and around the poles, the face plate may be machined and ground on both the front and back thereof and the work face or front of the face plate comprises a grid-like formation of non-magnetic material in which the poles 7 and 8 alternate, and the back of the face plate comprises a double row of feet 12 from the poles 7 between which is located a single row of wide feet 14 from the poles 8. The grid-like formation of non-magnetic material is so constructed that the portion 23 between the face plate frame 6 and the poles is substantially twice the width of the portion 33 between the poles 7 and 8. Where the thickness of the poles is one-eighth of an inch the portion of babbitt 23 between the frame and the poles is also one-eighth of an inch thick, and the cross-bars 33 between the poles are one-sixteenth of an inch thick while the cut-away portions 11 and 15 in the poles 7 and 8 are substantially one-quarter of an inch thick. By this construction it will be noted that the magnetic field is concentrated on the work face. The foregoing dimensions may be varied in accordance with the requirements and dimensions of the chuck being made so long as the distance between the individual work face pole pieces is maintained proportionately less than other adjacent polarized portions of the device. The underside or back of the face plate is provided with screw openings 27 for receiving the ends of the face plate screws 5. The energizing devices for the present chuck are formed in units and comprise a member 28 provided in its middle portion with an elongated coil carrying post 29 on each side of which extend parallel side members 30 with a groove or spaces 31 between the parallel side members and the coil carrying post. This construction facilitates manufacture by making it easy to reach the coil carrying post for finishing the sides thereof. The member, or members as the case may be, 28 are separated on all sides from the supporting frame 1 and are mounted upon brass or other non-magnetic washers 32 through which pass the stub screws 34 that secure the members 28 to the casing 1. After the coil 35 is placed in position on the coil carrying post 29 the top plate 36 is secured to the post 29 by means of screws 37. Since the face plate has been surfaced upon its under side it will be noted that by surfacing the upper portions of the side walls of the frame the parallel members 30, and the top plate 36, the face plate will engage all of these portions when the face plate is secured in position. This arrangement also facilitates manufacture and obviates necessity of hand fitting of these parts. It will be noted by reference to Figure 3 that the feet 12 and the pole pieces 7 are in direct contact with the parallel side members 30 and that the foot 14 in the pole pieces 8 is in direct contact with the top plate 36 whereby when the coil 35 is energized the pole pieces 7 will be of one polarity and the pole pieces 8 of the other polarity with the face plate frame and the supporting frame or shell unpolarized.

Where it is desired to make a chuck of a length greater than that of a single energizing unit, as is illustrated in Figures 1 and 2, the energizing units are simply arranged end to end in series and the other portions of the chuck are extended accordingly. The electrical connections of the parts are in accordance with the usual practice in the electrical arts and comprise the connecting wire 38 whereby the pair of coils 35 are electrically connected, and the terminal wires 39 and 40, which lead to an outlet box 41 that is connected with a suitable electric cable 42 which may be attached to a direct current line of suitable voltage.

From the foregoing it will be noted that this construction provides a magnetic chuck having a finely divided field particularly adaptable for holding small as well as large pieces; that the chuck is economical to manufacture and since the work face is supported on substantially its entire back surface, as well as being reinforced lengthwise and crosswise, it is adapted to withstand very heavy stresses and strains; and further the construction is such that the effective magnetic holding power produced is high for the amount of current consumed so that the chuck is economical in use as well as to manufacture.

Realizing that my invention may be embodied in structures other than the specific construction herein disclosed, I desire that such disclosure shall be understood as illustrative and not to be considered in the limiting sense.

Having thus described my invention what I claim is:

1. In a device of the character described, in combination, a supporting member comprising a hollow rectangular box, a face plate provided with opposite parallel sur-

faces, pole pieces within said face plate and comprising a series of faces on the top of said face plate, and three series of faces on the back of said surface plate, reinforcing rods extending through said pole pieces, a face plate frame to which said reinforcing rods are secured, tie members securing the sides of said frame to said reinforcing rods, and electro-magnetic means for magnetizing said pole pieces.

2. In a device of the character described, in combination, a supporting member, an energizing unit mounted within said supporting member, the core of said energizing unit being substantially E-shaped in cross-section, an energizing coil carried upon the central member of said core, and a face plate mounted over said energizing unit, said face plate comprising a plurality of pole pieces with certain of said pole pieces in magnetic connection with the end members of said core and other of said pole pieces in magnetic connection with the central member of said core whereby when said unit is energized the pole pieces in connection with the central member become one magnetic pole and the pole pieces in connection with the end members become the other magnetic pole.

3. A face plate for magnetic chucks comprising a frame, a plurality of spaced apart pole pieces within said frame, reinforcing members extending longitudinally of said frame and adapted to support said pole pieces, tie devices connecting said reinforcing members with the side pieces of said frame whereby said face plate is reinforced both laterally and longitudinally.

4. A face plate for a magnetic chuck comprising a frame, a plurality of pole pieces within said frame, non-magnetic material separating said pole pieces one from another and from said frame, reinforcing rods extending through said pole pieces and said non-magnetic material, said pole pieces and said frame being provided with recesses to receive said non-magnetic material whereby the said non-magnetic material comprises an interlocking member between said pole pieces and said frame.

5. A face plate for magnetic chucks comprising a frame, a plurality of pole pieces, non-magnetic material separating said pole pieces one from another and from said frame, the non-magnetic material separating the pole pieces from the frame being substantially twice the thickness of the non-magnetic material separating one pole piece from another whereby the magnetic lines of force are concentrated over said pole pieces.

6. A face plate for a magnetic chuck comprising a face plate frame, a plurality of pole pieces within said face plate frame, said pole pieces comprising flat elongated members arranged in series, certain of said pole pieces having the under middle portion undercut to provide feet at the ends of the pole pieces and certain other of said pole pieces being undercut at the ends thereof to provide a foot in the middle of such pole pieces, and non-magnetic material separating said pole pieces from said frame and separating one pole piece from another.

7. In a magnetic chuck, an energizing unit comprising a core of E-shaped cross section, and an energizing coil carried by the central member, the side members extending above said central member, a coil retaining plate carried by the central member with the surface thereof co-planer with the surfaces of the side members.

8. In a magnetic chuck, an energizing unit comprising a core of E-shaped cross-section, the central member being of a less length than the side members, said side members being substantially parallel and with the space between the ends of said members being open, a coil mounted upon said central member with the longitudinal dimension of said coil less than the longitudinal dimensions of said side members whereby energizing units of the character specified may be arranged end to end in a suitable casing with the ends of the side members substantially in contact.

9. An energizing unit for a magnetic chuck comprising a core piece having an upstanding coil carrying post, side members separated by longitudinal grooves from said post, a coil on said post, and a coil retaining plate carried by said post, certain of the edges of said plate being substantially parallel to said side members with the top surface of said plate co-planer with the top surfaces of the side members.

10. A magnetic chuck comprising in combination a housing, electro-magnetic energizing means within said housing, a plurality of sheet metal face plate pole pieces mounted edgewise over said electro-magnetic energizing means with the upper surfaces of said pole pieces being substantially parallel, and the under parts of said pole pieces having undercut portions, and depending means having contact with said electro-magnetic energizing means whereby certain of said pole pieces may be energized to comprise one magnetic pole and others of said pole pieces may comprise the opposite magnetic pole, and non-magnetic material filling the spaces between said pole pieces.

11. In a device of the character described, in combination, a non-magnetized supporting member, energizing means mounted within and separated from said supporting member, said energizing means comprising parallel pole pieces of alternate magnetic polarity, a face plate carried by said supporting member, and a plurality of pole pieces within said face plate and extending

crosswise thereof, said pole pieces being in alternate contact with the poles in the energizing means and positioned so that adjacent pole pieces are oppositely polarized when said energizing means is operative.

12. In a magnetic chuck, a face plate comprising a substantially rectangular frame member, a plurality of pole pieces therein, non-magnetic material separating said pole pieces from said frame member and from each other, said pole pieces being constructed to present a single series of work faces on the face of said plate and a plurality of series of faces on the back of said plate, the back of said plate being substantially parallel to the face thereof.

13. A magnetic chuck comprising a face plate having a field portion of flat metal poles and a frame surrounding said poles, a shell supporting said frame, parallel supporting members extending beneath the ends of said pole pieces, and a central supporting member extending beneath the central portion of said pole pieces whereby substantially the entire face plate is completely supported.

14. A magnetic chuck face composed of two sets of strips of equal length, disposed parallel and in alternating relation, magnetizing means extending transversely of said strips and in contact with those of one set only, and other magnetizing means extending transversely of said strips and in contact with those of the other set only.

15. A magnetic chuck comprising a shell, magnetizing means supported on the bottom of said shell and insulated therefrom, a frame superposed on said shell, and pole pieces carried by and insulated from said frame, and adapted to be energized by said magnetizing means.

16. In a magnetic chuck, a face plate comprising a plurality of sets of pole pieces, and an electromagnetic support for said pole pieces, one set of pole pieces being supported in the middle by said electromagnetic support and the other set of pole pieces being supported at the ends by said electromagnetic support.

17. A magnetic chuck comprising a work face formed of a plurality of sets of face plate pole pieces, and electromagnetic means which when energized is capable of energizing said pole pieces, one set of pole pieces being energized at the middle thereof and the other set of pole pieces being energized at the ends thereof when said electromagnetic means is energized.

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