Dec. 29, 1925. 1,568,024

H. K. SPENCER

MAGNETIC HOLDING DEVICE

Filed Jan. 29, 1921

Fig. 1.

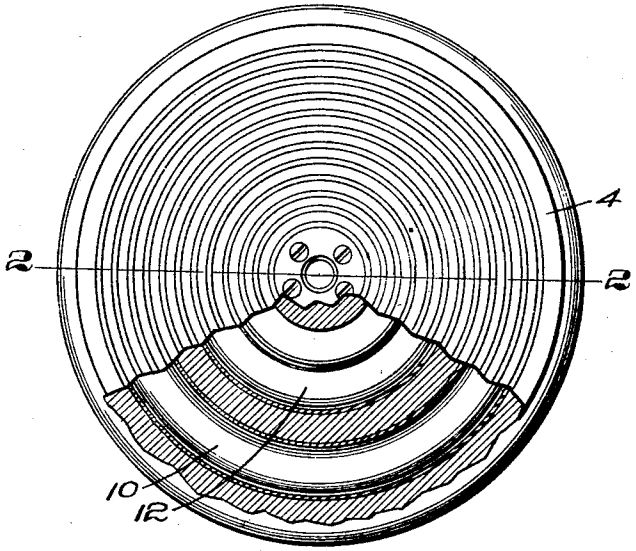


Fig. 2.

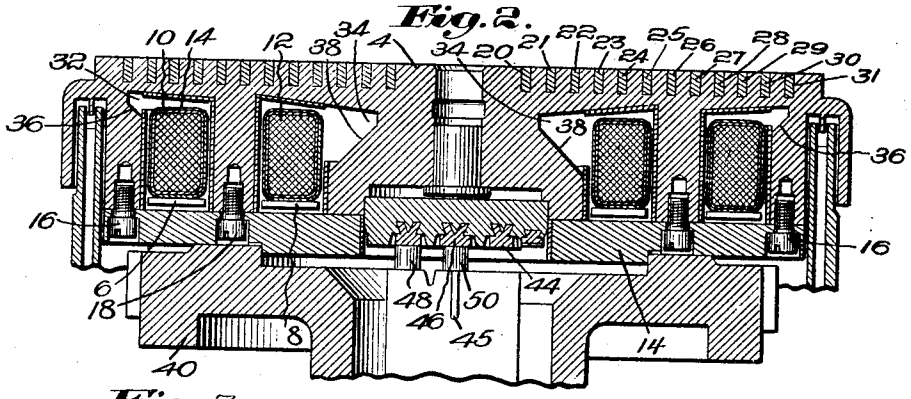
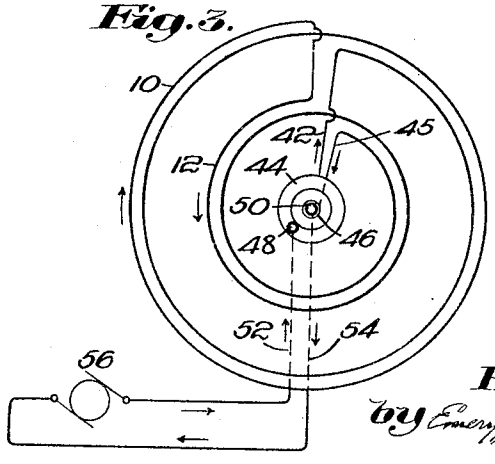


Fig. 3.



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Patented Dec. 29, 1925. 1,568,024

UNITED STATES PATENT OFFICE.

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MAGNETIC HOLDING DEVICE.

Application filed January 29, 1921. Serial No. 440,945.

To all whom it may concern:

Be it known that I, HENRY K. SPENCER, a citizen of the United States, and a resident of Watertown, in the county of Middlesex and State of Massachusetts, have invented an Improvement in Magnetic Holding Devices, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to magnetic holding devices, and is more especially, though not exclusively, concerned with devices of the type disclosed in U. S. Letters Patent 1,125,198, issued to me January 19, 1915.

My invention will be best understood by reference to the following description when taken in connection with the accompanying drawings of one illustrative embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawings:

Figure 1 is a plan, partly in section, of a magnetic holding device exemplifying my invention;

Fig. 2 is a sectional view on an enlarged scale on line 2—2 of Fig. 1; and

Fig. 3 is a wiring diagram illustrating one way of connecting up the coils to a source of current.

Referring to the drawings and to the embodiment of my invention which I have selected for exemplification, there is shown a magnetic holding device particularly intended for use as a rotary chuck, but it should be understood that the invention is susceptible of application to other forms of magnetic holding devices. In the present example the chuck is provided with a work support 4 formed of steel or other suitable magnetic material and provided with a plurality of annular chambers, herein two, designated by the numerals 6 and 8. Located in these chambers are suitable magnetizing coils 10 and 12, respectively. It should be observed that the work support presents a continuous shell without joints above the coil chambers and hence the coils are protected against the entrance of water. This is an important advantage where it is desired to flood the pieces of work with water while the work is being performed. The bottoms of the coil chambers are closed by a plate 14 formed of suitable magnetic material such as steel and secured to the work support by appropriate means, herein two sets of screws 16 and 18.

In the present example currents of equal magnitude are passed through the two coils in opposite directions, as indicated by the arrows in Fig. 3. This creates concentric alternate poles of opposite polarity, thus causing a magnetic flux to flow around each coil. In the present embodiment the work support extends from pole to pole and the magnetic circuit is complete without the inclusion of the pieces of work. The latter are attracted and held by making suitable provision for diverting a part of the magnetic flux from the metallic circuit and compelling the same to flow through the pieces of work to be held.

In the present example this is accomplished by narrowing the path of the magnetic circuit adjacent the work-supporting surface of the chuck by providing the work support with a series of closely spaced concentric grooves, which may be and preferably are filled with rings of suitable non-magnetic material, such as brass, designated 20 to 31 inclusive. It should be understood that these rings may be omitted if desired, in which case the grooves will present air gaps performing the same function as the rings. The spacing between the bottoms of these rings or grooves and the tops of the coil chambers is less than the spacing between each coil chamber and the adjacent coil chamber and less than the thickness of metal surrounding the outer coil and that which is surrounded by the inner coil.

The metal between the bottoms of the rings or grooves and the tops of the chambers presents a magnetic shunt through which a part of the magnetic flux flows, while the remainder is compelled to flow between the rings and into the pieces of work. An important feature of my present invention relates to the character of this magnetic shunt. Considering that portion of the shunt which is immediately below any given ring or groove, the cross-sectional area presented for the flow of the flux is equal to the circumference at that point multiplied by the depth of the metal, that is to say, the distance between the bottom of the ring or groove and the top of the coil chamber at that point. This being so, it is evident that

if in the case of each ring the thickness of metal below the latter were the same as that which is below every other ring, the shunt would present different cross-sections below the different rings, that is to say, a cross-section of the shunt below the outer ring would be greater than the cross-section of the shunt below the inner ring because of the difference in diameters. This being so, the holding power of the chuck would be different at each different ring.

In carrying out my present invention this undesirable result is avoided by making the cross-sectional area of the shunt substantially equal beneath all of the rings or grooves and this is conveniently accomplished by making the top of each coil chamber inclined in an upward and outward direction, as represented in Fig. 2, that is to say, when considered with reference to a radial plane, the depth of metal decreases from one ring or groove toward one which surrounds it, or in other words, the cross-section in such plane diminishes in an outward direction to compensate for the increased section in a circumferential direction due to the increase of diameter.

Another important feature of my invention is the provision of means permitting the use of a less number of coils than heretofore used considered with reference to the holding area of the work-supporting surface. In the present example, this is accomplished by widening the coil chambers, thereby to spread the magnetic circuit out over a greater number of the spaces between the rings or grooves. This can be safely done within reasonable limits and with very little magnetic leakage by widening the coil chambers at the top as shown at 32 in the chamber 6 and at 34 in the chamber 8. Preferably the side of the chamber 6 is inclined as at 36 and the side of the chamber 8 is inclined as at 38, thereby to cause the adjacent pole of the magnet to present a relatively thick cross-section. With this form there is very little magnetic leakage at the lateral undercut portions of the chambers. The described construction possesses the advantage of decreased weight and cost of manufacture of a chuck of a given size with practically the same holding power by the use of a less number of coils than has heretofore been considered necessary.

The chuck proper may be mounted in any suitable manner and herein is secured to and carried by a driving gear 40. Rotation of the gear turns the chuck about a vertical axis which is the center of the coils as well as the grooves or rings. The coils are connected, one by a lead 42 to a contact ring 44 and the other by a lead 45 to a central contact disk 46. These are connected by brushes 48 and 50 and lead wires 52 and 54 to a suitable source of current 56. The general operation of the chuck should be evident without further description.

Having thus described one embodiment of my invention but without limiting myself thereto, what I claim and desire by Letters Patent to secure is:

1. A magnetic holding device comprising, in combination, a magnetic body having a work-holding face, means associated with the body for producing a magnetic flux to hold magnetic material on said work-holding face, said body providing within itself a complete circuit for the magnetic flux, a portion of the body adjacent to the work-holding face, and within the circuit, constituting a magnetic shunt, said portion having a varying thickness, said body presenting at intervals recesses separated by magnetic connections leading from said shunt portion to said face, thereby to divert a part of the magnetic flux from the magnetic circuit and to compel the same to flow through the magnetic pieces to be held while the remaining flux flows through said shunt portion.

2. A magnetic holding device comprising, in combination, a magnetic body having a work-holding face, means associated with the body for producing a magnetic flux to hold magnetic material on said work-holding face, said body providing within itself a complete circuit for the magnetic flux, a portion of the body adjacent to the work-holding face and within the circuit constituting a magnetic shunt, said shunt portion having a thickness which tapers along said work-holding face and said body having provision to divert part of the magnetic flux from the magnetic circuit and to compel the same to flow through the magnetic pieces to be held while the remaining flux flows through said shunt portion.

3. A magnetic holding device comprising, in combination, a magnetizing coil, and a magnetic body having a work-holding face, forming within itself a complete magnetic circuit for the magnetic flux from said coil, the work-holding face of said body having a plurality of recesses to reduce the effective cross-sectional area of the magnetic mass at a portion of the magnetic circuit, thereby to compel a portion of the lines of force to pass into the material held, the latter thereby forming a part of the magnetic circuit, that portion of the body within the complete circuit and adjacent to said work-holding face, providing a shunt, and tapering along said work-holding face.

4. A magnetic holding device comprising, in combination, a body of magnetic material presenting a work-holding face, a magnetic coil associated with said body, said body forming within itself a complete magnetic circuit about the cross-section of said coil, a portion of the body within said circuit lying adjacent to the work-holding face

and presenting a substantially uniform cross-section to the path of the flux.

5. A magnetic holding device comprising, in combination, a magnetizing coil in the form of a ring, and a body of magnetic material presenting a work-holding face transverse to the axis of said ring, said body presenting a chamber in which said coil is received and providing within itself a complete magnetic circuit about said chamber, the thicknesses of that portion of the body intermediate said chamber and said work-holding face at different radial distances from said axis being approximately inversely proportional to the circumferences at such points.

6. A magnetic holding device comprising, in combination, a magnetizing coil, and a body of magnetic material having a work-holding face and provided with a chamber in which said coil is received, said body presenting within itself a complete circuit for the magnetic flux, a portion of the body adjacent to the work-holding face, and within the circuit, constituting a magnetic shunt, said body presenting at intervals recesses separated by magnetic connections leading from said shunt portion to said face, thereby to divert a part of the magnetic flux from the magnetic circuit and to compel the same to flow through the magnetic pieces to be held, while the remaining flux flows through said shunt portion, the area of said face served by said recesses being substantially greater than the corresponding area of said coil, and said chamber being substantially wider than the corresponding dimension of said coil adjacent to said face, thereby to compel lines of force to flow between the recesses which are outside of said area of said coil.

7. A magnetic holding device comprising, in combination, a magnetizing coil, and a body of magnetic material having a work-holding face and provided with a chamber in which said coil is received, said body presenting within itself a complete circuit for the magnetic flux, a portion of the body adjacent to the work-holding face; and within the circuit, constituting a magnetic shunt, said body presenting at intervals recesses separated by magnetic connections leading from said shunt portion to said face, thereby to divert a part of the magnetic flux from the magnetic circuit and to compel the same to flow through the magnetic pieces to be held, while the remaining flux flows through said shunt portion, the area of said face served by said recesses being substantially greater than the corresponding area of said coil, and said chamber having a width approximating the corresponding dimension of that portion of said face which is served by said recesses, thereby to compel lines of force to flow between the recesses which are outside of said area of said coil.

8. A magnetic holding device comprising, in combination, a magnetizing coil in the form of a ring disposed about an axis, and a body of magnetic material having a work-holding face and provided with an annular chamber in which said coil is received, said body presenting within itself a complete circuit for the magnetic flux, a portion of the body adjacent to the work-holding face, and within the circuit, constituting a magnetic shunt, said body presenting annular recesses about said axis, thereby to direct a part of the magnetic flux from the magnetic circuit and to compel the same to flow through the magnetic pieces to be held, while the remaining flux flows through said shunt portion, the area of said face served by said annular recesses being substantially greater than the corresponding annular area of said coil and said annular chamber having a radial dimension greater than the corresponding dimension of said coil adjacent to said face, thereby to compel lines of force to flow between the recesses which are beyond the area of said coil.

In testimony whereof, I have signed my name to this specification.

HENRY K. SPENCER.