June 23, 1942. J. BING ET AL 2,287,286

MAGNETIC CHUCK

Filed July 27, 1939

Fig. 1

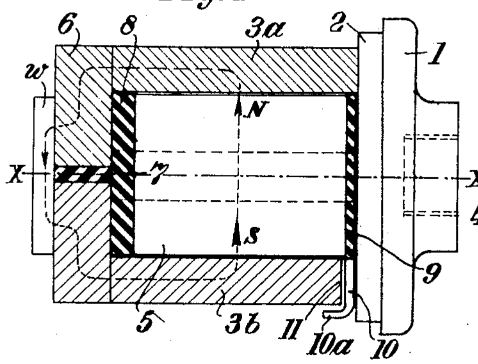


Fig. 2

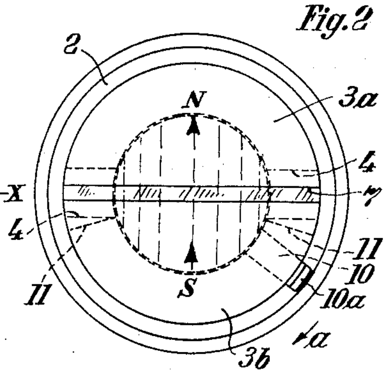


Fig. 3

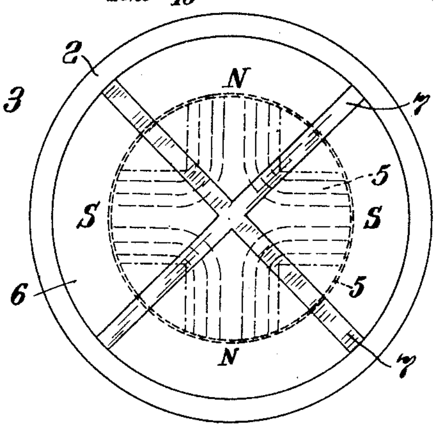


Fig. 4

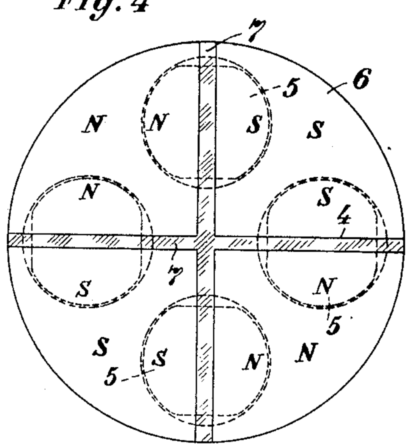
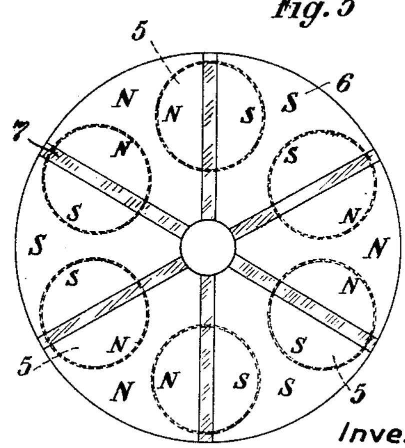


Fig. 5



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MAGNETIC CHUCK

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5 Claims. (Cl. 175—367)

The present invention relates to magnetic chucks and more particularly pertains to the magnetic circuits of such devices.

Chucks for magnetically gripping work pieces for the purpose of subjecting them to a grinding or other treatment have already been proposed, wherein the magnetic action is obtained with the aid of permanent magnets in place of the electro-magnets previously employed. The present invention relates to circular clamping chucks of the type such as are used for clamping work pieces which, during their treatment, are subjected to rotation, and making use of one or more permanent magnets.

The invention resides more particularly in a magnetic chuck, in which there are provided one or more rotatable permanent magnets, the axes of rotation of which are parallel to the axis of rotation of the chuck and which are magnetised transversely to their axes of rotation. Each magnet is surrounded by two soft iron parts, which establish the magnetic connection with a divided pole plate, which is disposed at right angles to the axis of rotation of the permanent magnet or magnets.

The invention is illustrated by way of example in the accompanying drawing, in which

Figs. 1 and 2 illustrate a small chuck according to the invention in vertical axial section and in front view respectively.

Figs. 3, 4 and 5 are front views of modifications of the chuck according to the invention.

In the embodiment according to Figs. 1 and 2 there is secured to a boss 1, which in the conventional manner is screwed on to the spindle of a turning or grinding lathe, a plate 2 consisting of a non-magnetic material such as brass. To the plate 2 there are attached two hollow-cylindrical sectors *3a* and *3b*, which are concentric to the axis of rotation X—X of the boss 1 and are separated from each other by two diametrically opposite intermediate spaces 4 which are preferably filled with a non-magnetic material such as "Bakelite" and extend over the entire length of the sectors. In the hollow cylindrical space thus formed there is fitted with slight clearance a cylindrical permanent magnet 5, in such a way that it can rotate therein. The magnet body, which consists of a material of particularly great coercive force, is so magnetised that, as indicated in Fig. 2, the lines of force are disposed substantially transversely to the axis of the particular cylinder and parallel to an axial plane of the cylinder. To the free ends of the soft iron sectors *3a* and *3b* there is secured a circular pole plate 6, in such a way that the transmission of the magnetic lines of force is facilitated as much as possible. The pole plate 6 is divided into two halves by means of a diametrically disposed gap or fissure 7 located in the plane of the intermediate spaces 4. This gap or fissure is preferably filled with a non-magnetic material such as "Bakelite".

The length of the permanent magnet 5 is less than the length of the hollow space formed by the sectors *3a* and *3b* and by the base plate 2 and the pole plate 6. In this hollow space there is provided between the front end of the magnet 5 and the pole plate 6 an intermediate plate 8 composed of a non-magnetic material such as "Bakelite", which can be secured to the pole plate 6. This intermediate plate serves to reduce the leakage lines. At the opposite end there is connected to the magnet 5 a plate 9, which also consists of a non-magnetic material such as "Bakelite" and from which there projects radially an arm 10, which passes through a slot 11 in the annular sector *3b* towards the outside and is there furnished with a handle *10a*. By means of this handle the magnet 5 can be turned. The length of the slot 11 is such as to permit rotation over one-half of the pole pitch, or in the example illustrated over 90°.

The operation is as follows: In the position of the magnet 5 shown in Fig. 2 the north pole of the magnet is situated opposite the upper sector *3a* and the south pole opposite the lower sector *3b*. A powerful magnetic field is accordingly produced in the direction indicated by the arrows in Fig. 1, so that a work piece W composed of magnetic material placed against the pole plate 6 is strongly attracted and held. If the work piece W is to be released, the magnet 5 is turned in the direction of the arrow *a* in Fig. 2, to an extent somewhat exceeding 90°.

Theoretically the field of the lines of force will have reached the zero value upon rotation to a position of 90° displaced with respect to that shown in the drawing, but owing to the residual magnetism the work piece will still remain attracted and will only be released upon a reversal of the polarity of the pole plate 6 occurring upon rotation in excess of 90°, when the signs of the poles will be reversed. The exact extent to which the magnet 5 will require to be rotated for this purpose will depend on the size and the form of the work piece and also on the magnetic properties thereof.

In the embodiment illustrated in Fig. 3 the pole plate 6 is divided, by means of two gaps or fissures disposed at right angles to one another, into four quadrants. Accordingly the magnet body is also magnetised in such a way that it possesses four poles which, taken in the peripheral direction, form alternately a north pole and a south pole. Here again the lines of force are disposed substantially transversely to the axis of the particular cylinder and also, at least in the outer parts of the cylinder, parallel to two axial planes, which intersect each other at right angles. As indicated by the dotted lines, the form of the permanent magnet need not be exactly cylindrical, it merely being essential that considerable parts of its periphery form a common cylindrical surface. Incidentally, this also applies to the magnet **5** in the embodiment according to Figs. 1 and 2, wherein the magnet **5** is preferably flattened at two diametrically opposite points. This has a favourable effect on the leakage conditions.

In the embodiment according to Fig. 4 there is also provided a pole plate which is divided into four quadrants, while Fig. 5 shows an embodiment in which the pole plate is composed of six sections. These embodiments, which differ from those in Figs. 1 to 3 principally by the use of a larger number of permanent magnets, are intended primarily for chucks of larger size.

In both cases the permanent magnets correspond in number to the number of sectors of the pole plate. The axes of the permanent magnets, however, do not coincide, as in the previous embodiments, with the axis of rotation **X—X** of the chuck, but are disposed about a cylinder which is concentric thereto, the spacing of the magnet axes being equal throughout, so that they are perfectly symmetrical with respect to the axis **X—X**.

The hollow cylindrical spaces accommodating the magnets **5** are formed by suitable axially disposed borings in a soft iron cylindrical body, which in addition is furnished in the planes formed by the gaps **7** in the pole plate with longitudinal slots, which correspond to the intermediate spaces **4** in the embodiments according to Figs. 1 and 2. Here again the slots **4** and the gaps **7** are preferably filled out with a non-magnetic material. It will be apparent that in this way circular chucks of the type illustrated in Figs. 4 and 5 can also be produced on a large scale in very simple fashion.

When using a plurality of rotatable permanent magnets of the embodiments according to Figs. 4 and 5 the rotation for the purpose of producing the non-magnetic condition of the pole plate, or in other words the reversal of the polarity, is preferably performed with the aid of a common actuating means.

The permanent-magnet chucks described above can be produced very cheaply on a large scale, even in very small sizes. They also have the advantage that upon each adjustment of the magnets they are completely balanced with respect to the axis of rotation of the chuck, which is of considerable importance for obtaining accuracy, particularly if the chucks rotate at a high speed.

Since the magnet systems pertaining to the permanent magnets are also magnetically balanced in every position of the magnets, the actuation of the magnets calls only for very small forces, which can be transmitted with simple and cheap means.

What we claim as new and desire to secure by Letters Patent is:

1. A magnetic chuck comprising, a disc-shaped boss adapted to be supported on a machine tool, a disc-shaped plate of non-magnetic material secured to one face of said disc-shaped boss, a plurality of soft iron sectors attached to and extending axially from said non-magnetic disc-shaped plate forming a hollow cylindrical axially extending space between the sectors, said sectors being circumferentially spaced providing diametrically opposite gaps extending throughout the length of said sectors, a cylindrical-shaped permanent magnet polarized transversely of the axis thereof rotatably mounted in said cylindrical space with said sectors forming bearings for the permanent magnet, a disc-shaped pole plate having its central portion extending diametrically therethrough composed of non-magnetic material and its side portions of magnetic material, said plate being secured to and having its magnetic portions in engagement with the free ends of said sectors, the median plane of said central portion coinciding with the median plane of the diametrically opposite gaps between the sectors, means interposed between the disc-shaped pole-plate and an end of said permanent magnet magnetically insulating the pole-plate with respect to said end of the permanent magnet, and means for rotating said permanent magnet with respect to said sectors.

2. A magnetic chuck comprising, a disc-shaped boss, a disc-shaped plate of non-magnetic material carried by one face of said boss, two substantially hemi-cylindrical-shaped sectors formed of magnetic material secured to and extending axially from said disc-shaped plate forming a hollow cylindrical space therebetween extending axially from said disc-shaped plate, said sectors being circumferentially spaced providing diametrically opposite gaps extending throughout the length of said sectors, a cylindrical-shaped permanent magnet polarized transversely of the axis thereof rotatably mounted in said cylindrical space with the axis thereof in alignment with the axis of said boss and with the sectors forming bearings for said permanent magnet, a disc-shaped pole plate having its central portion extending diametrically therethrough composed of non-magnetic material and its side portions of magnetic material, said plate being secured to and having its magnetic portions in engagement with the free ends of said sectors, the median plane of said central portion coinciding with the median plane of the diametrically opposite gaps between the sectors, a disc of non-magnetic material between said disc-shaped pole-plate and an end of said permanent magnet, and means for rotating said permanent magnet with respect to said sectors.

3. A magnetic chuck comprising, a disc-shaped boss adapted to be mounted on a spindle of a machine tool, a plurality of soft iron substantially hemi-cylindrical-shaped sectors extending axially from said boss and magnetically insulated with respect thereto, said sectors forming a hollow cylindrical space therebetween extending axially with respect to said boss, said sectors being circumferentially spaced providing diametrically opposite gaps extending lengthwise of said sectors, a cylindrical-shaped permanent magnet polarized transversely of the axis thereof rotatably mounted in said cylindrical space with said sectors forming bearings for said permanent magnet, a disc-shaped pole plate having its central portion extending diametrically therethrough composed of non-magnetic mate-

rial and its side portions of magnetic material, said plate being secured to and having its magnetic portions in engagement with the free ends of said sectors, the median plane of said central portion coinciding with the median plane of the diametrically opposite gaps between the sectors, means magnetically insulating said pole-plate with respect to an adjacent end of said permanent magnet, and means for rotating said permanent magnet in said sectors.

4. A magnetic chuck comprising, a boss, a hollow cylindrical body formed mainly of magnetic material extending axially of said boss, means for securing said cylindrical body to the boss and magnetically insulating the boss with respect to said cylindrical body, said cylindrical body being formed of a plurality of soft iron sectors with the sectors having substantially hemi-cylindrical-shaped openings therein providing a plurality of cylindrical openings in said body all extending axially parallel with the axis of said boss, and non-magnetic material located in diametrically arranged gaps spacing said sectors and extending throughout the length of said body, a cylindrical-shaped permanent magnet polarized transversely of the axis thereof rotatably mounted in each of said cylindrical spaces with two of the sectors forming bearings for each permanent magnet, a disc-shaped pole plate having central portions extending diametrically therethrough composed of non-magnetic material and the remaining portions of magnetic material, said plate being secured to and having its magnetic portions in engagement with the free ends of said sectors, the median plane of each said central portion coinciding with the median plane of diametrically opposite gaps between the sectors, and means for magnetically insulating said pole-plate with respect to the ends of said permanent magnet.

5. A magnetic chuck comprising, a boss, two substantially hemi-cylindrical shaped sectors formed of magnetic material extending from said boss and magnetically insulated with respect thereto, said sectors forming a cylindrical space therebetween, said sectors being circumferentially spaced providing diametrically opposite gaps extending throughout the length of said sectors, a substantially cylindrical-shaped permanent magnet polarized transversely of the axis thereof rotatably mounted in said cylindrical space with said sectors forming bearing means for the permanent magnet, a two-part pole plate formed of magnetic material having a fissure extending therethrough magnetically separating the two parts thereof, one magnetic part of said pole plate being secured to and in engagement with a free end of one of said sectors, another magnetic part of said pole plate being secured to and in engagement with a free end of the other of said sectors, the median plane of said fissure coinciding with the median plane of the diametrically opposite gaps between said sectors, means magnetically insulating said pole plate with respect to an adjacent end of said permanent magnet, and means for rotating said permanent magnet in said sectors.

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