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[54] **METHOD AND APPARATUS FOR CENTRELESS MAGNETIC ABRASIVE POLISHING**

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[52] **U.S. Cl.** ..... **51/88;** 51/103 TF; 51/206 P; 51/292; 51/328

[51] **Int. Cl.²** .. **B24B 5/22;** B24D 3/00; B24D 17/00

[58] **Field of Search** ..... 51/74 R, 79, 80 R, 80 A, 51/82 R, 83 R, 88, 89, 103 R, 103 TF, 292, 328, 317–319, 206 P

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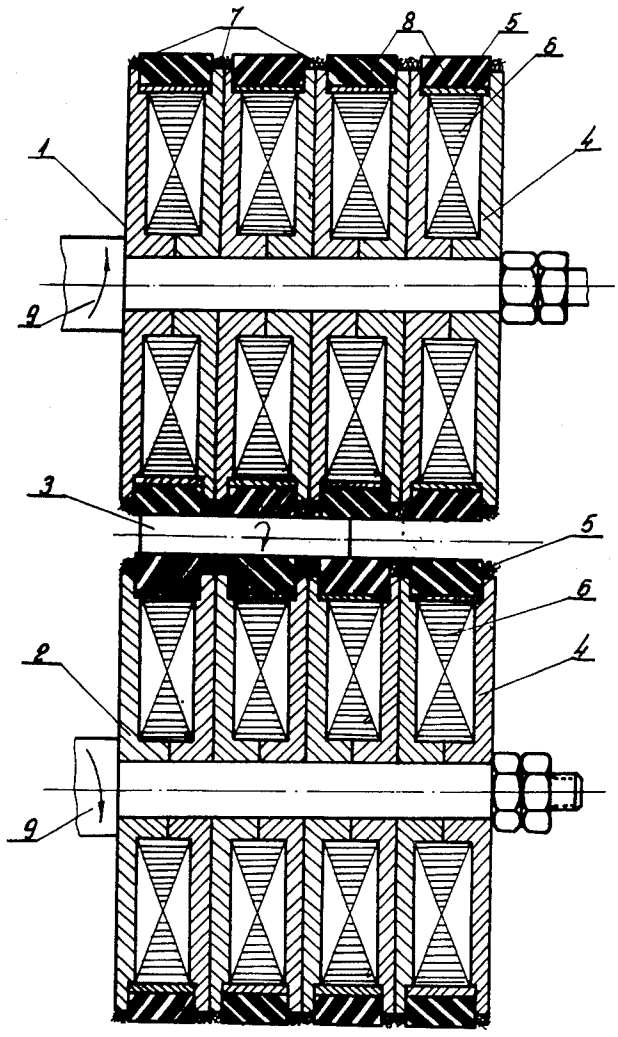
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[57] **ABSTRACT**

A method and apparatus for the centreless polishing of a workpiece is provided. Two cylindrical rolls are positioned with respect to each other such that their axes are not parallel and the axis of the workpiece is above the plane of the axes of the rolls. A guide is provided to support the workpiece. At least one of the rolls includes at least one electromagnet formed by a coil and a pair of disks. A guide ring is positioned around the coil in the space between the disks. A ferromagnetic powder is held on the disks which form the poles of the electromagnet and this powder is the abrasive which polishes the workpiece as the rolls rotate.

6 Claims, 4 Drawing Figures



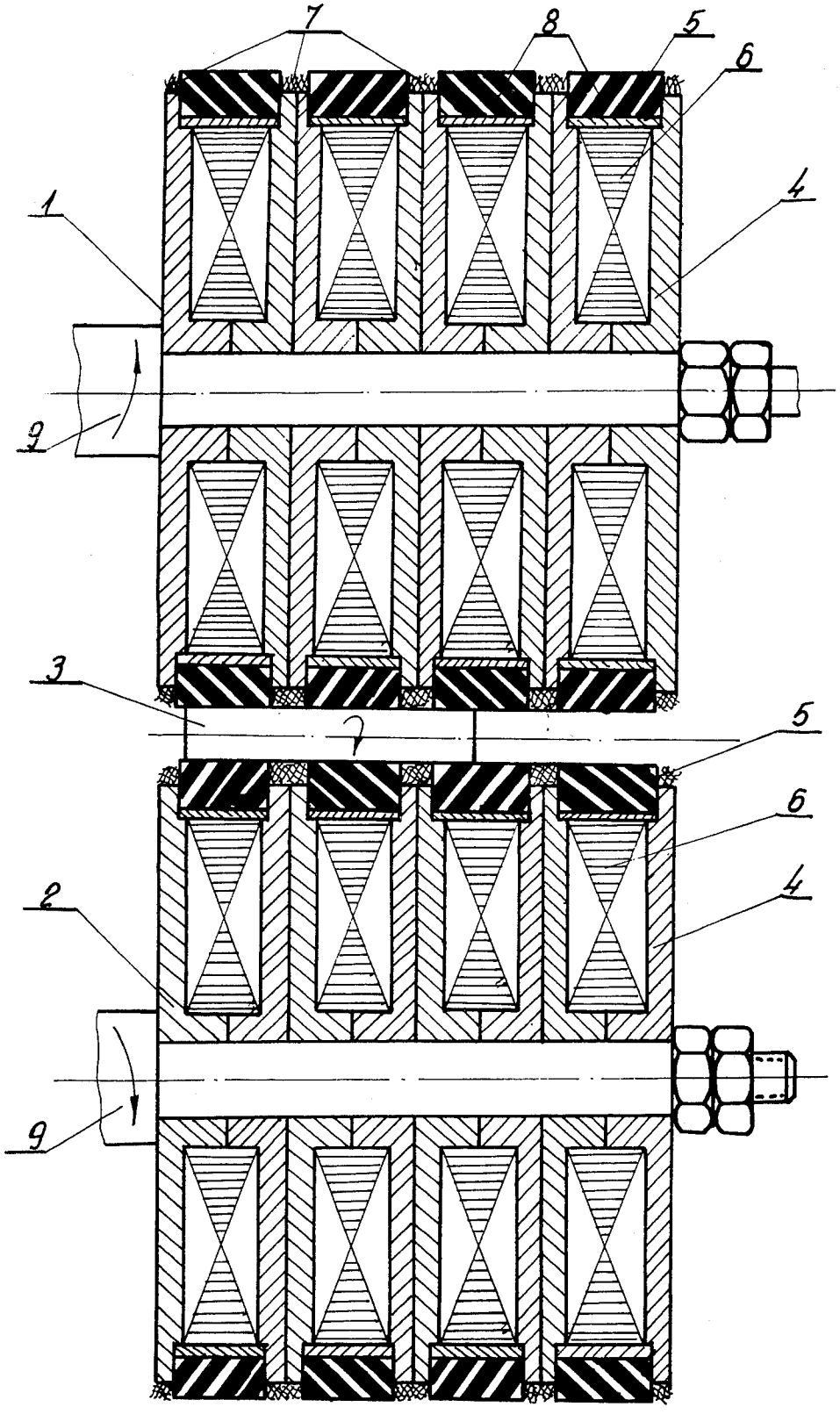


Fig. 1

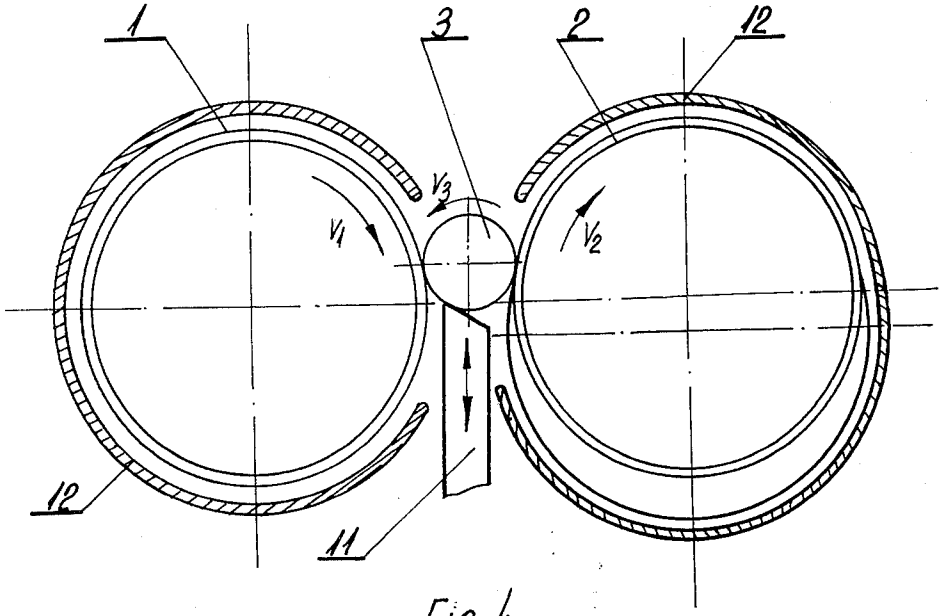


Fig. 4

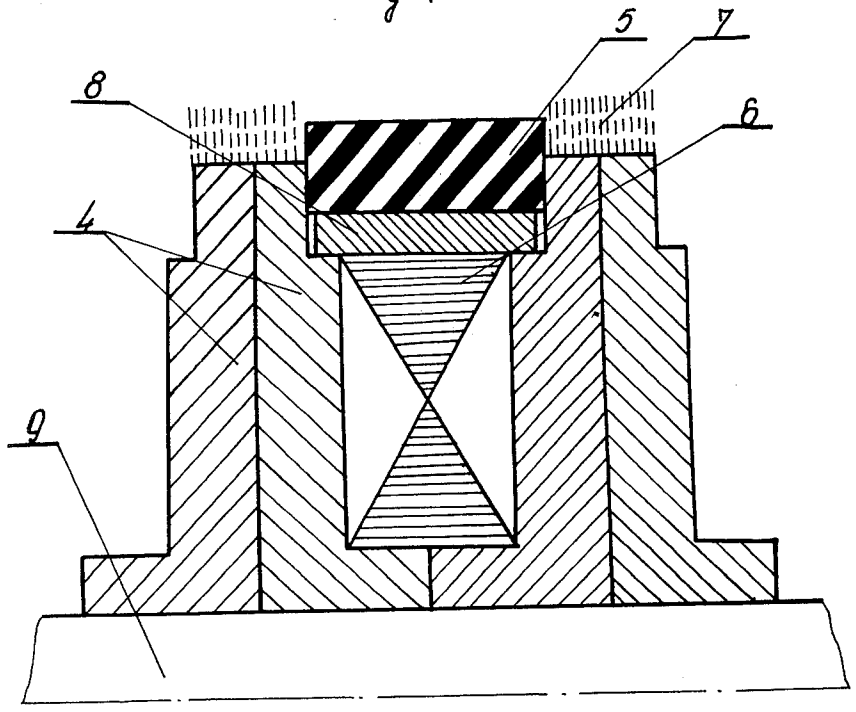


Fig. 2

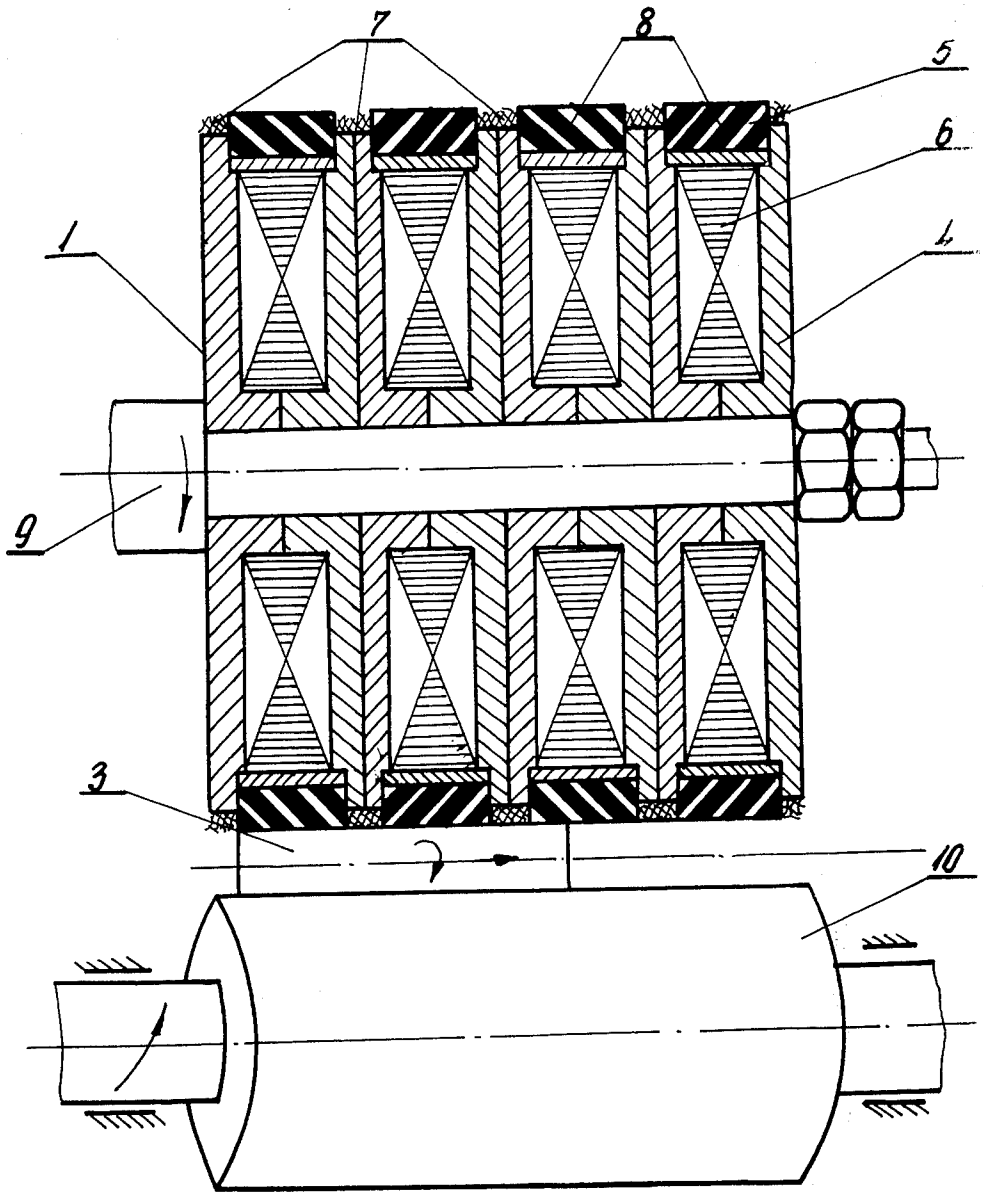


Fig. 3

METHOD AND APPARATUS FOR CENTRELESS MAGNETIC ABRASIVE POLISHING

BACKGROUND OF THE INVENTION

This invention relates to a method and apparatus for centreless magnetic abrasive polishing of external rotational surfaces by means of rotating electromagnetic heads with ferromagnetic powder thereon.

A method for magnetic abrasive polishing between centres of external rotational surfaces is known, in which a forced combined motion, is imparted to the workpiece. The motion comprises a rotation around the longitudinal axis and oscillations around the longitudinal axis of the workpiece. Poles of a magnetic field are positioned at a determined distance (the working gap), on both sides of the workpiece. A ferromagnetic powder, used for the polishing, is introduced into the working gap. A disadvantage of this method is the need of considerable time to change the workpieces, as well as the relatively complex kinematics of the machine.

SUMMARY OF THE INVENTION

It is therefore a general object of the present invention to avoid the aforementioned disadvantages by providing a method and apparatus for centreless magnetic abrasive polishing, based on the known schemes for centreless grinding.

The gist of the method and apparatus, according to the invention, is in magnetic abrasive polishing between centres by passing the processed workpieces between two electromagnetic heads or between an electromagnetic head and a guiding body, comprising two or more disks. Between these disks there are conductor windings covered on the outside by a supporting ring and a wrapping band, protruding over the outer surface of the disks, and the gaps thus formed are filled with ferromagnetic powder. While the disks rotate in one direction at different speeds around their longitudinal axes, the angle between the axes can be changed.

A basic advantage of the disclosed method and apparatus is the continuity of the working process and a reduction of the time required for placing and removing the workpiece, and thus an increase in productivity. Further advantages of the method are the simplicity and conveniency of its automation, which in the general case comprises the attachment of a loading and unloading chute for the processed workpieces.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention, reference should be made to the accompanying drawings, in which there is illustrated and described a preferred embodiment of the invention. In the figures:

FIG. 1 is a diagrammatic cross-sectional view of the apparatus for the performance of the method of the invention with two electromagnetic heads;

FIG. 2 is an enlarged partial cross-sectional view of one element of the electromagnetic heads;

FIG. 3 is a version of the method with only one magnetic head; and

FIG. 4 is a general side view of the apparatus for performing the method.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the general case, two rotating electromagnetic heads 1 and 2 are needed to effect the disclosed

method for centreless magnetic abrasive polishing. These heads are suitably fastened to the shafts 9. Shown in the drawings is a possible connection and fastening of the electromagnetic heads 1 and 2 onto the shaft 9. Each electromagnetic head 1 and 2 comprises a set of disks 4, which are one or more pairs for each of the heads. The disks 4 are shaped so, that in fastening a ring-shaped cylindrical hollow space is formed between them. Electromagnetic coils 6 are disposed in the hollow space and are suitably wrapped and encapsulated to protect them from the penetration of moisture. Over the coils 6 there is a protecting ring 8, made of non-magnetic material, which protects the coils from external pressure. Pressed-on tightly over the protecting rings 8 are the guiding rings 5, made of rubber, plastics or other suitable material.

It is necessary that both lateral surfaces (i.e. the faces) of the disks are machined to a high grade of smoothness and that they are perpendicular with regard to their central hole. The aim of this is to avoid any play between the disks 4 during assembly, since the play is undesirable for magnetic cores.

The electromagnetic coils 6 are assembled in such a way, that their direction of winding is changed alternating in each successive coil. For example, if the left disk 4 is the north pole of the electromagnet, then the right disk will be the south pole, and in the next group this polarity is reversed and so on. The guiding rings 5 protrude over the outer cylindrical surface of the disks 4 (for example with 1 to 2 mm), and as a result there is formed between each pair of adjacent guide rings 5 a cylindrical working gap, which is filled with a suitable ferromagnetic powder. The workpiece 3 is placed between the electromagnetic heads 1 and 2 so that its axis is above the axes of the electromagnetic heads. The workpiece 3 is supported from below by the knife-shaped guide 11, which can also be a freely rotating roll. To provide an axial motion of the workpiece 3, one of the electromagnetic heads (head 2, for example) has its axis set at a determined angle with respect to the axis of the other electromagnetic head 1. The processed workpiece is pressed and guided by the guiding rings 5 and receives its own rotation V_3, which is different from the rotational velocity of the electromagnetic heads 1 and 2. Both electromagnetic heads 1 and 2 rotate at different speeds V_1 and V_2 and therefore a relative difference in the speeds is obtained, which determine the speed of cutting. The processing itself is carried out only in the sections between the guiding rings 5, where there is the ferromagnetic powder 7.

In this scheme of operation the ferromagnetic particles of the powder 7 are pressed by the electromagnet to the processed surface and as a result of the differences in the speeds the processing is carried out.

It is also necessary that, in the case of this scheme of operation, the opposite working gaps have a different polarity.

It is necessary to deliver in the area of processing a suitable cutting fluid, which is carried out in a known way and is not shown in the drawing. It is also possible, that each of the electromagnetic heads 1 and 2 be enveloped by a cylindrical protective cover 12. The latter must be at a considerably greater distance from the electromagnetic head than the working gap. If the protective cover 12 is made of a ferromagnetic material, a screening of the magnetic field is achieved which reduces its scattering. Moreover, the protective cover 12

does not permit any spilling of the ferromagnetic powder 7 or any splashing of the cutting fluid.

FIG. 3 shows another embodiment of the method and apparatus for centreless magnetic abrasive polishing according to the invention. The processing is carried out by only one single electromagnetic head 1, while the workpiece 3 is guided from the opposite side by a guiding roll 10. The surface of the latter can be shaped in a known way in order to provide the possibility to process workpieces of special shape, such as tapered or barrel-shaped rollers for roller bearings. In this case a spiral-shaped feeding chute is provided with a suitably shaped bottom.

The aforedescribed examples illustrate only in principle the application of the disclosed method for centreless magnetic abrasive polishing without limiting the scope of the invention in other possible design versions.

What we claim is:

1. An apparatus for the centreless polishing of a workpiece said apparatus comprising two cylindrical roll means and a guide means for supporting said workpiece wherein said roll means are positioned with respect to each other such that their axes are not parallel and the axis of said workpiece is above the plane formed by the axes of said roll means, and wherein at least one of said roll means comprises at least one electromagnetic means, at least two guide rings with a working gap therebetween and a ferromagnetic powder in said working gap said ferromagnetic powder being held therein by said electromagnetic means.

2. The apparatus of claim 1 wherein said electromagnetic means comprises a pair of disks and an electromagnetic coil therebetween wherein said guide rings surround said electromagnetic coil and the circumferential surface of said disks form said working gap and the poles of said electromagnetic means.

3. The apparatus of claim 2 including a protective ring positioned between said electromagnetic coil and said guide ring.

4. The apparatus of claim 1 wherein said at least one roll means comprises two roll means.

5. The apparatus of claim 1 wherein said at least one roll means comprises one roll means and the other of said two roll means comprises a guide roll.

6. The apparatus of claim 1 further including a protective cover means surrounding a substantial portion of said roll means.

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