Dec. 17, 1968

H. RICHTER ET AL.

APPARATUS FOR COMPACTING PERMANENT MAGNET POWDERS INTO PRESSINGS

Filed March 14, 1966

4 Sheets-Sheet 3

Fig. 3a

Fig. 3b

Inventors

Hermann Richter
Karl Heinz Butten
Richard Donhoff

By Cashman, Darby, Cashman

Attorneys
APPARATUS FOR COMPACTING PERMANENT MAGNET POWDERS INTO PRESSINGS

Henning Richter, Dortmund, Karl Heinz Böttner, Dortmund-Wambel, and Gerhard Bintzek, Dortmund-Brandel, Germany, assignors to Deutsche Edelstahlwerke Aktiengesellschaft

Filed Mar. 14, 1966, Ser. No. 533,899

Claims priority, application Germany, Mar. 30, 1965,

D 46,932

3 Claims. (Cl. 18—16.5)

For the production of magnet bodies made of barium or strontium ferrite with a preferred direction of magnetisation, the conventional procedure consists in mixing strontium carbonate and Fe₂O₃ powder in the proportion of about 1:4, sintering the mixture at a suitable temperature for the purpose of forming the mixed ferrite crystal, crushing and finally milling the ferrite material to a fineness under 5μ. This fine-ground ferrite powder is then magnetically oriented in presses by the application of a magnetic field, pressed to the desired magnet shape and finally sintered to completion.

The present invention relates to the pressing of the powder in a magnetic field. As known, the ferrite powder is filled into dies either in the dry form or in the form of a wet slurry and pressed whilst exposed to a magnetic field in the direction in which the magnet is to be preferentially orientated. When pressing a liquid magnetic material the liquid is withdrawn from the slurry during this process. The direction of the magnetic field may be parallel to or across the pressing direction, permitting the preferential direction of magnetisation of the discs, rings or like to be either axial or parallel to a diameter.

It has also been proposed, besides orientating the powder, to use the magnetic field for magnetically sucking the dry powder or slurry into the cavity of the die by making use of the inhomogeneity of the magnetic field. When this is done orientation in the crosswise direction cannot be performed directly after magnetically drawing the powder into the die in pressing direction because the magnetic field between the pole shoes of diametrically disposed magnetic coils would have to be located above the magnet coil required for creating the suction, would naturally interfere with the suction field and it would therefore be impossible to suck the ferrite powder magnetically into the die.

It is the object of the present invention to provide an apparatus in which the drawbacks of conventional arrangements are overcome and in which cross magnetisation can be performed even if the powder is magnetically sucked into the die. According to the invention the problem is solved by providing a die and a magnet coil which are relatively axially displaceable for drawing the powder into the die and a pair of magnetic coils for generating the field for diametrically orientating the powder, with pole shoes movable in the radial direction, i.e., normal to the axis of the pressing tool. This form of construction permits the latter pair of pole shoes to be withdrawn from the zone of the magnetic suction field whilst the powder is being drawn into the die, so that this process is not interfered with. Conveniently, the pole shoes are arranged to be movable into contiguous adjacency with a die which is made of a nonmagnetisable material and to this end they are axially movable inside the magnet coils which embrace them. Alternatively, the magnetic field for diametrically orientating the powder may, if desired, be generated by permanent magnets.

The manner in which the proposed arrangement functions is illustratively shown in more or less schematic form in the drawings. In the drawings, Fig. 1a is a sectional elevation showing the apparatus ready for drawing the material into the die, Fig. 2a is a sectional elevation showing the die as having risen from the position shown in Fig. 1a and the material drawn thereinto; Fig. 3a is a similar elevation showing the pole shoes in a position for producing the transverse magnetisation; and Fig. 4a illustrates the pressing operation after transverse magnetisation. The figures whose numbers are provided with index a are all axial sections, whereas those provided with index b are the corresponding plan views.

Figs. 1a/1b show the pressing tool in the position it occupies before the filling operation begins. The punch 1 which consists of or the head portion of which is of a nonmagnetisable material is in its normal position of rest. In this position the bottom punch 2 and the upper edge of the suction coil 4 may be brought flush with the upper edge of the nonmagnetisable die 3. The feeding shoe 6 containing the charge of ferrite powder is directly above the centre of the die. The pole shoes 5, 5' of the diametrically orienting pair of coils 7, 7' are retracted from the die sufficiently to be out of contact with the suction coil 4 and not to interfere with the suction field. In the position of the pressing tool illustrated in Fig. 1a, the field coil 4 for generating the suction is energised whilst the die rises, the coil 4 and the lower punch 2 remaining stationary in its position. Because of this relative motion the suction coil will become disposed away from the upper edge of the die and draws in the powder.

Fig. 2a shows the filling process completed. The die has been filled with powder and the magnetic field of coil 4 is therefore switched off.

In Fig. 3a the feeding shoe has been removed. Suitable devices which for the sake of greater clarity are not shown in the drawing now advance the pole shoes 5, 5' through or with the coils 7, 7' into position for applying the field for diametrically orientating the ferrite powder inside the cavity of the die. In this position the pole shoes are substantially in direct contact with the die. Consequently the field which arises when the coils are energised is particularly intense.

Figs. 4a and b show the manner in which the powder, after orientation in the direction normal to pressing direction, is compressed.

It will therefore be seen that the proposed arrangement, by using suitably shaped dies, which may be dished, annular or bar-shaped, and which may be difficult to fill when the wall sections of the pressings are thin, is capable of conveniently pressing the magnet bodies in continuous production by drawing the powder into the die in a conventional manner by magnetic suction and nevertheless magnetically orientating the pressings in the diametral direction, i.e. across the pressing direction. The arrangement is principally envisaged for use in the processing of ferrite powder. However, in principle the arrangement would be as readily applicable to the processing of other powdered permanent magnet materials.

What we claim is:

1. Apparatus for compacting permanent magnet powders into pressed magnetised diametrically across the pressing direction in a die into which the powder is introduced by magnetic suction, comprising the die and a magnet coil which are relatively movable in the axial direction of the die for drawing the powder into the die...
and a pair of magnet coils with poleshoes moveable crosswise of the pressing direction at the level of the pressing inside the die.

2. Apparatus according to claim 1, in which the said poleshoes of the magnet coils for generating the cross field are axially movable into contact with the die.

3. Apparatus according to claim 2, in which the poleshoes are advanceable in stationary coils around them.

References Cited

2,999,271 9/1961 Falk et al. ———— 18—16.5 X
3,189,667 6/1965 Büttner et al.
3,234,598 2/1966 Quinn ———— 18—16
3,274,303 9/1966 Müller ———— 18—16.5 X

J. HOWARD FLINT, Jr., Primary Examiner.
U.S. Cl. X.R.