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METHOD OF PRODUCING COMPRESSED PARTS FOR PERMANENT MAGNETS

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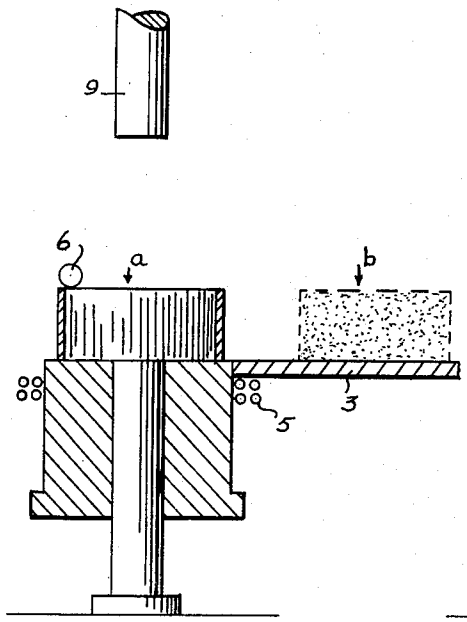


Fig. 1.

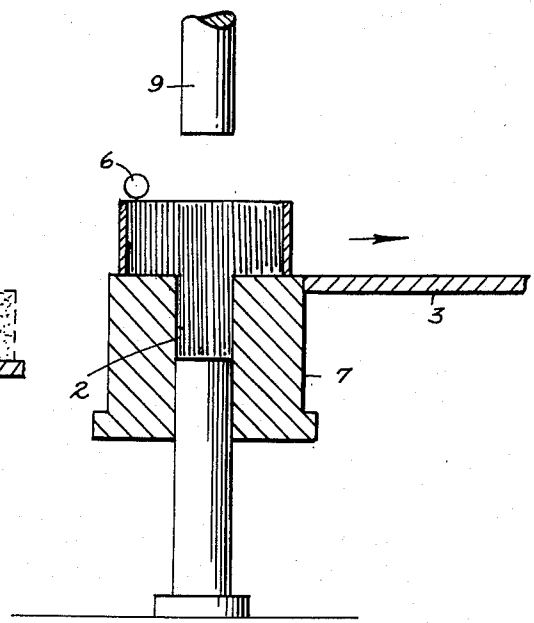
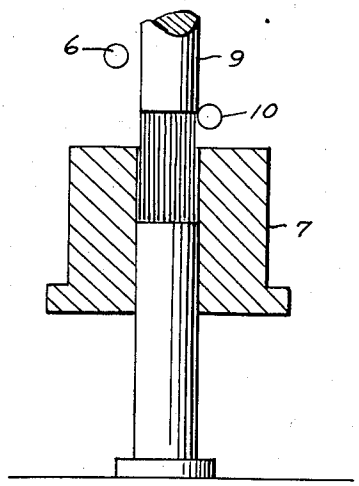


Fig. 2.

Fig. 3.



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METHOD OF PRODUCING COMPRESSED PARTS FOR PERMANENT MAGNETS

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The present invention relates to a method of producing compressed parts for permanent magnets.

A known method of producing permanent magnets consists in filling suitable powders or mixtures of powders into dies, pressing them therein into coherent shapes and then sintering them. This method is employed inter alia for producing magnets based on barium ferrite.

The initial powder is filled into the die in weighed quantities either by hand or automatically by means of a filling shoe. It is always desirable to make use of a filling shoe because this permits the process to be performed fully automatically. However, for using a filling shoe the prerequisite is the use of a flowing powder because a reliably uniform fill will not otherwise be assured when the shoe moves over the die. If the powder refuses to flow or if it does not readily flow, and this always applies in the case of ultrafine powders of the kind required for producing anisotropic magnets of barium ferrite, then a filling shoe fails to discharge equal powder fills into the die or to distribute the powder sufficiently evenly inside the die. Hitherto the only alternative therefore consisted in performing the tedious and time-wasting task of filling accurately weighed charges of powder into the die by hand and in then distributing it evenly inside the die, likewise by hand. A disadvantage which makes itself particularly felt is the disproportionately large size of the filling space, i.e. the abnormally great depth of fill which is required because of the low bulk weight of the powder.

Attempts have already been made to transform an ultrafine non-flowing powder into one that will flow by first submitting it to a process of granulation and thereby to ensure that the fill in the die will be sufficiently accurate and also to reduce the necessary filling depth. This is however a complication and involves the introduction of additional processing steps which prolong production procedure and increase the cost.

The introduction of the granulation process into the production of anisotropic pressings consisting for instance of barium ferrite, in which production involves the maintenance of a directional magnetic field during the pressing operation, calls for especially complicated operational procedures.

For producing anisotropic pressings of for instance barium ferrite the die which is used consists of an abrasion-proof non-ferromagnetic material and is surrounded by a coil for creating the directional magnetic field, the coil being energised during the pressing operation, i.e. after the filling of the powder has been performed and whilst the pressing tool is in operation.

The problem contemplated by the inventors therefore consisted in devising a method which would permit pressings for permanent magnets consisting of ultrafine practically non-flowing powders to be produced with the help of a conventional filling shoe without requiring that the powder should first be transformed by complicated procedures into a condition in which it will flow.

With reference to Figures 1 and 2 of the accompanying drawings, the present invention solves this problem by conveying the powder to the die, as hitherto, in a filling shoe 1 but by then sucking the powder magnetically into the die cavity 2 and incidently precompacting the same. The filling shoe is a box of non-magnetic material without a bottom, the box being reciprocated in the rhythm of the working cycle of the press between positions *a* and *b* on the likewise non-magnetic plate 3 of the pressing tool. Position *b* represents the filling shoe containing the powder. After the machine has been set in operation this filling shoe moves in timed relation to the machine towards the left and reaches the position *a* over the bottom die. It then actuates the contact 6 which causes the current for creating the magnetic field to be switched on. The powder in the filling shoe receives, at this moment, the magnetic direction illustrated in the diagram. The box is filled with the powder 4 and under the effect of magnetic suction discharges the required quantity of powder into the die as the box slides over the same. The magnetic suction effect ensures that the filling space is charged with reproducibly unvarying quantities of powder in uniform distribution, irrespectively of the ability of the powder to flow.

To produce the desired magnetic suction effect the coil 5 which surrounds the die is briefly energized when the filling shoe is over the die and closes contact 6 and the die casing 7 moves upwards with the shoe to form the die cavity above stationary bottom die 8. As soon as the shoe retracts, power is conveniently cut off at once by the shoe opening the contact 6 to prevent the surplus powder which remains in the shoe and which has also been magnetized from magnetically re-entraining some of the powder already filled into the die. Figure 3 shows the top die 9 as having closed contact 10 and re-energized the coil 5 ready for the next pressing operation.

The dimensions of the shoe should be so chosen that its capacity is sufficient to hold the powder for several fills. The quantity of powder per pressing is proportioned by appropriately adjusting the filling depth of the die. The introduction of the powder into the die by magnetic suction is, as has already been mentioned, accompanied by a pre-compaction of the powder due to the action of the magnetic force. Consequently the depth of the fill can be substantially reduced by comparison with that required when filling by hand. This is an additional and by no means minor advantage offered by the method according to the invention.

If the method proposed by the present invention is to be applied to the production of anisotropic magnet pressings, for instance such as those based on barium ferrite which are pressed whilst exposed to a magnetic field, then use may be made of the equipment which for hand filling is already provided for establishing the required directional orientation when pressing.

If measures are taken to ensure that the filling shoe is automatically replenished with powder when in its initial position, then a fully automatic process for producing pressings of ultrafine powders can be established, as will be readily understood.

Naturally the powder that is to be pressed must be ferro-magnetic.

What we claim is:

1. In the method of producing pressings for permanent magnets from ultra-fine practically non-flowing powders and wherein the powder is delivered to a die from a filling shoe, the improvement which comprises temporarily creating an electro-magnetic field in the die cavity and drawing powder requisite to charge the die suddenly from the shoe into the die by magnetic suction.

2. In the method of producing pressings for permanent magnets from ultar-fine practically non-flowing powders and wherein the powder is delivered to a die from a

filling shoe, the improvement which comprises temporarily energizing a coil surrounding the die when the filling shoe is over the die and creating an electro-magnetic field and drawing powder requiste to charge the de suddenly from the shoe into the die by magnetic suction and thereby partially pre-compacting it, displacing the shoe and then re-energizing the coil and pressing the powder in the die while the re-established field prevails.

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