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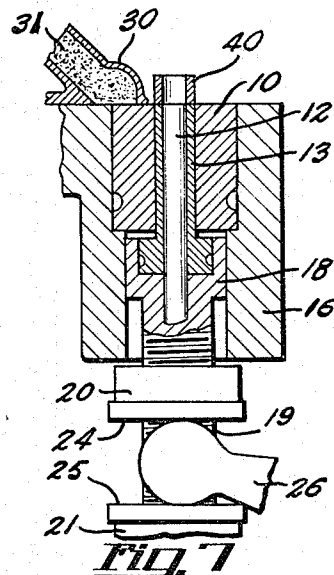
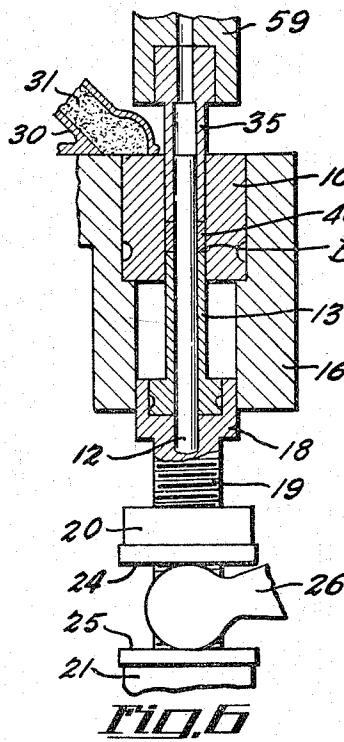
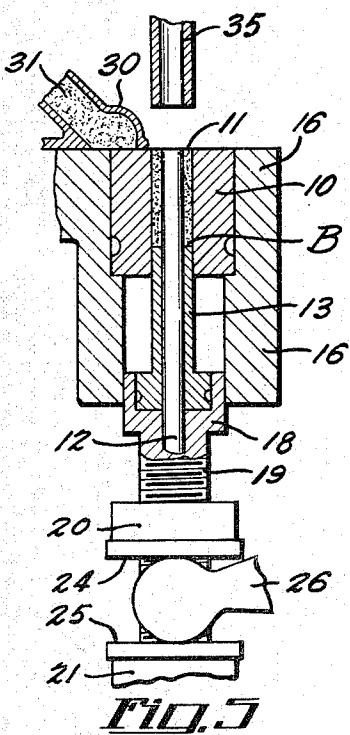
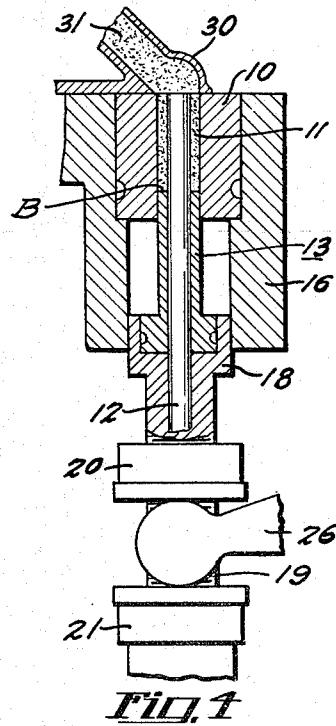
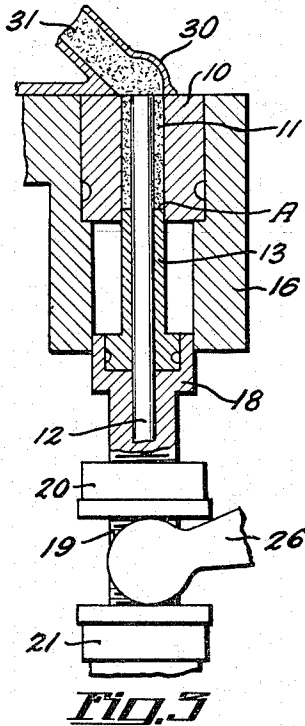
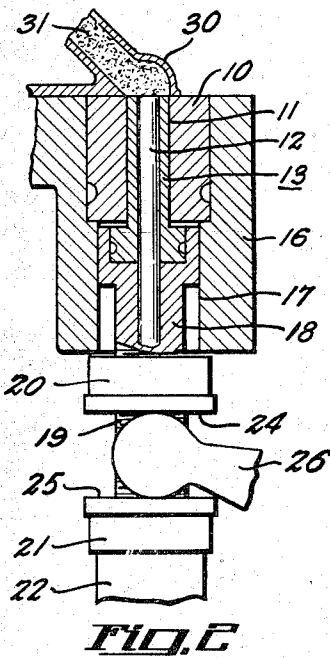
J. H. DAVIS ET AL

2,127,994

METHOD OF BRIQUETTING FINELY DIVIDED MATERIAL

Filed Dec. 3, 1934

2 Sheets-Sheet 2



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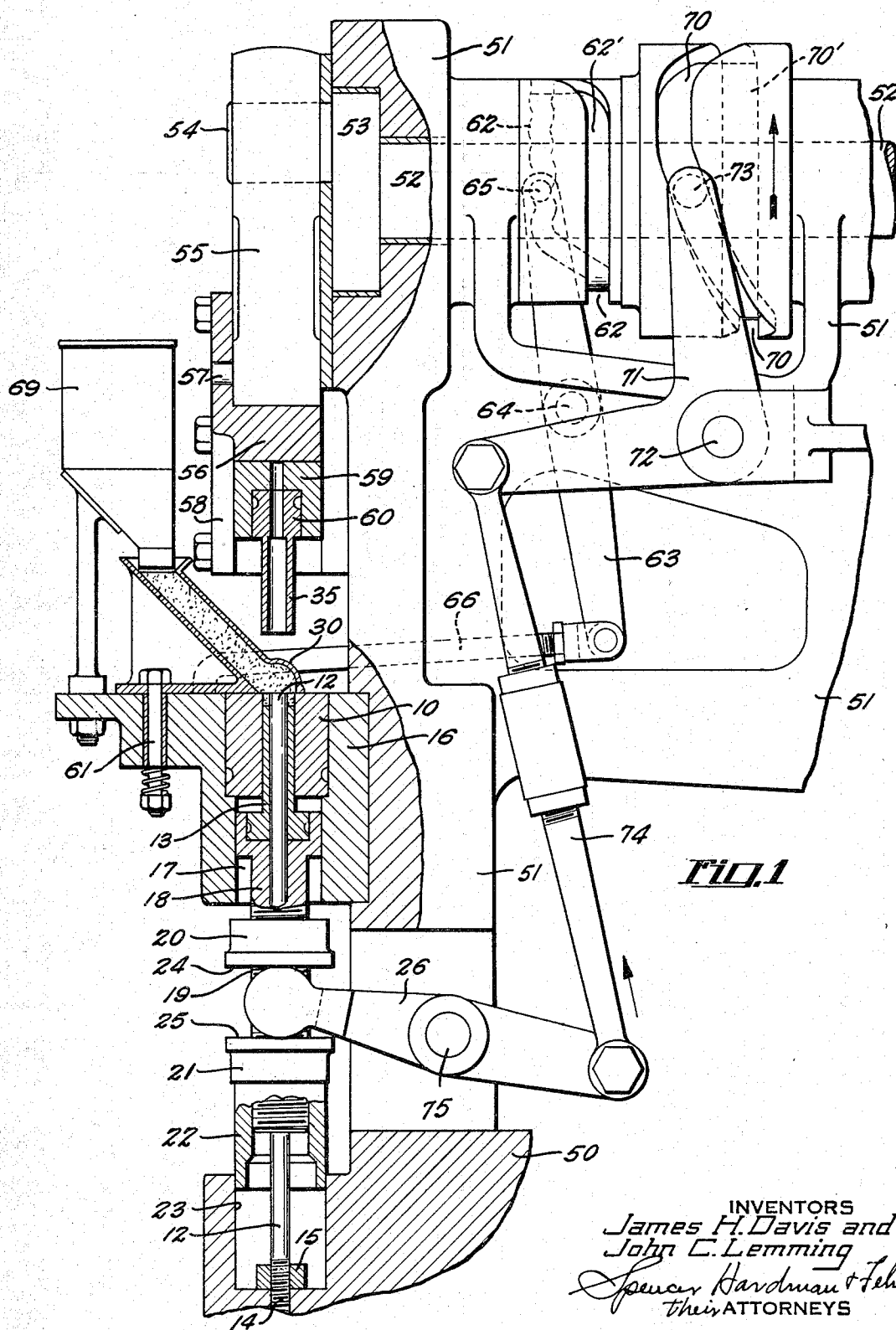
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METHOD OF BRIQUETTING FINELY DIVIDED MATERIAL

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2 Sheets-Sheet 1



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UNITED STATES PATENT OFFICE

2,127,994

METHOD OF BRIQUETTING FINELY DIVIDED MATERIAL

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Application December 3, 1934, Serial No. 755,666

5 Claims. (Cl. 18—55)

This invention relates to an improved method of briquetting bushings or other bodies from powdered or plastic materials capable of being briquetted by pressure.

5 An object of the invention is to provide an improved method of filling the briquetting die cavity with the material charge so as to ensure a more uniform filling of the die cavity in all cases, and to prevent entrapment of air within the material in the cavity during filling thereof.

10 Porous metal bushings are now commonly made by first briquetting under high pressure finely divided metal powders and graphite or other non-metallic material into the form desired and then sintering the briquetted form at such temperature and for such a time as will cause the metal powders used in any particular case to partially fuse or alloy together so as to provide the desired strength. Patent #1,642,348, September 13, 15 1927, to H. M. Williams et al., gives an example of the briquetting materials which may readily be used with the method of this invention and also more fully describes the sintering step which may be used in making self-lubricating porous metal bushings or porous metal bodies of any shape. This present invention relates only to the briquetting step in this complete process.

20 In filling such briquetting dies with such powdered materials it is very important that the cavity be uniformly filled with the same compactness of the loose charge throughout the extent of the cavity in order to provide uniform density of the body after the briquetting operation. It is also highly important that no air be entrapped below or within the fine powder charge while it is being poured or otherwise filled into the die cavity since obviously any trapped air within the charge will destroy the uniformity in density of the final briquetted article. In other words, 40 the material charge for each filling of the die cavity is measured by the volume of the cavity and hence the cavity must be filled with a uniform compactness of the loose material at each filling operation in order to get the same degree of compression at each stroke of the briquetting plunger and to get the same weight of material in each briquetted article.

50 These difficulties encountered in properly filling small die cavities with loose powdered materials such as described above have heretofore been recognized and various means have been suggested for overcoming such difficulties. The patent to Short No. 1,839,056, December 29, 1931, discloses one method and apparatus for solving 55 these same difficulties. This present invention

solves this same problem but in a much more simple and effective manner.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is in part a side elevation and in part a vertical section through a briquetting press 10 made according to this invention.

Figs. 2 to 7 are views illustrating various successive positions of certain operating parts.

Fig. 2 illustrates the die parts at the beginning of the filling operation with the lower plunger 15 completely filling the die cavity at the instant of starting its down stroke.

Fig. 3 illustrates the lower plunger at its lowermost position, that is, somewhat lower than its position during the briquetting stroke of the 20 upper plunger.

Fig. 4 illustrates the lower plunger moved up somewhat from its position shown in Fig. 3, and having thereby ejected a portion of the powder charge back into the filling shoe which still remains in position above the die cavity. 25

Fig. 5 illustrates the filling shoe swung out of position to clear the descending upper briquetting plunger.

Fig. 6 illustrates the position of the die parts 30 when the powder charge has been fully compressed into the briquetted bushing between the upper and lower plungers.

Fig. 7 illustrates the completed ejection of the briquetted bushing by the up movement of the 35 lower plunger which is then in position to begin the next filling operation, as shown in Fig. 2.

Similar reference characters refer to similar parts throughout the several views.

10 designates the stationary die having the 40 open-end die cavity 11 therein. 12 is a central stationary core or pilot rod which terminates flush with the top surface of die 10 and which extends entirely through the tubular lower plunger 13 and its operating mechanism and is anchored in the base of the machine by the screw threads 14 and lock nut 15 (see Fig. 1). 16 is a heavy stationary table which supports the die 10 and is provided with a bore 17 which serves as a guide for the reciprocating head 18 to which 50 plunger 13 is fixed. Head 18 has a long screw-threaded shank 19 upon which are threaded two large nuts 20 and 21 in fixed spaced relation. The lower nut 21 has a depending skirt 22 which is suitably guided in its vertical reciprocation 55

by the guide bearing 23 which is a stationary part of the machine (see Fig. 1). The opposed faces 24 and 25 of the spaced nuts 20 and 21 respectively form cam surfaces which are engaged by the rounded end of bifurcated lever 26, which upon being actuated as hereinafter described will vertically reciprocate the large screw 19 and hence also the lower plunger 13.

Fig. 2 shows plunger 13 at its top position where it completely fills the die cavity 11. The vibrating filling shoe 30 is shown swung into registering position with cavity 11 and the loose powdered material 31 in shoe 30 is immediately in contact with the top end of plunger 13. Hence when plunger 13 descends, the powdered material 31 falls by gravity and by suction into the cavity 11 and fills same, keeping up with the descending plunger 13. Thus it is clear that no vacant air space will be formed between the entering charge of material and the top end of plunger 13 tending to cause the loose material to bridge across the narrow cross section of the cavity and prevent non-uniform filling thereof. Since the entire upper end of cavity 11 is covered by the material in shoe 30 the finely divided material itself is drawn into the cavity 11 partly by suction since there is no ready access of outside air into cavity 11 as plunger 13 descends. Plunger 13 continues its descent to the point "A" (shown in Fig. 3) which is beyond its low position indicated by point "B" in Figs. 4, 5 and 6 which measures the volume of loose powdered material which is to be briquetted into the bushing. Plunger 13 is then raised by lever 26 from point "A" to point "B", and in so doing a portion of the material in cavity 11 is ejected back into shoe 30 which remains in registration for this purpose, as shown in Fig. 4. It has been found that such over-descent and partial return movement of the lower plunger 13 provides a more uniform filling of the cavity with the powder charge, that is, the weight of the powder charge measured off by the volume of the die cavity is made more exact and the same for each successive filling operation.

Fig. 5 illustrates the filling shoe swung laterally out of registration with cavity 11, thus leaving the cavity filled with material exactly flush with its top. The upper tubular punch 35 now descends and highly compacts the powder charge in the annular cavity 11 and forms the briquetted bushing 40 (see Fig. 6). The stationary central core 12 enters the central opening in punch 35 with a close sliding fit and thus serves as a pilot for both the upper punch 35 and the lower plunger 13 and maintains these in exact alignment regardless of a slight wear and consequent more loose fit on the cylindrical wall of the die cavity 11 which may occur due to the abrasive action of the powder charge thereon. After bushing 40 is fully compacted as shown in Fig. 6 the upper punch 35 is withdrawn and the lower plunger 13 is raised by lever 26 to eject the bushing 40 flush with the top of die 10 and core rod 12, as shown in Fig. 7. Plunger 13 remains in this raised position while shoe 30 swings across the top surface of table 16 again into registration with cavity 11 for the next filling operation. Shoe 30 thus sweeps bushing 40 laterally out of position to one side where it may drop into a chute or be carried off by any other suitable means as desired. The parts will now be again in the position shown in Fig. 2 and ready for the next filling operation.

One form of machine for supporting and actuating the parts as described above will now be described. This machine (see Fig. 1) includes a

base 50 which supports a main frame 51, providing suitable bearings for a power driven main shaft 52 having a crank arm 53 and crank pin 54. A connecting rod 55 connects crank pin 54 to the vertically reciprocating crosshead 56 through the crosshead pin 57. Crosshead 56 is guided in its vertical reciprocation by suitable stationary guides 58 supported upon main frame 51. The lower end of crosshead 56 has fixed thereto a socket member 59 which receives the enlarged head 60 of the tubular punch 35. Thus punch 35 is continuously reciprocated by the power shaft 52. The other moving parts heretofore described are all driven by the power shaft 52 by suitable cam means and hence may be readily suitably timed with the movement of punch 35 and with each other.

The filling shoe 30 is pivoted at pivot pin 61 and is actuated to swing laterally and to oscillate with a shaking motion about the pivot pin 61 by the rotating cam groove 62 on drive shaft 52. The lever 63 has a fixed pivot at 64, a cam follower 65 riding in the cam groove 62, and a moving link 66 connecting its lower end to the filling shoe 30, whereby said shoe will be brought into registration with the die cavity 11 at the proper time for filling same and then be given a series of rapid small oscillations or shakes in order to insure a continuous even discharge of the loose powdered material into cavity 11 as the lower plunger 13 descends. During the time cam follower 65 is riding in the straight portion 62' of cam groove 62 the filling shoe 30 is in its out of the way position shown in Figs. 5, 6 and 7. The loose powdered material is put in the stationary hopper 69 and flows by gravity therefrom into the movable filling shoe 30 and maintains same filled with material at all times.

Lower plunger 13 is actuated by the rotating cam groove 70 on drive shaft 52. The bell-crank lever 71 has a fixed pivot at 72 and a cam follower 73 riding in the cam groove 70. An adjustable length link 74 is pivotally connected at its upper end to bell-crank lever 71 and at its lower end to the lever 26 which has a fixed pivot at 75. Cam groove 70 is arranged to give the movement to the lower plunger 13 fully described hereinabove. During the time cam follower 73 is riding in the straight portion 70' of cam groove 70 the plunger 13 is held stationary with its upper end at point "B" shown in Figs. 4, 5 and 6, that is, during the briquetting stroke of the upper punch 35. If desired, the cam groove 70 may easily be arranged so that plunger 13 is forced up a predetermined distance from point "B" during the briquetting stroke of punch 35 and thus provide for compressing the material from both ends of die cavity 11.

In some cases, dependent upon the flowing characteristics and coarseness of the powdered material, it may be desired to postpone the filling of cavity 11 with the powder charge until after the upper end of plunger 13 has descended to point "A" (shown in Fig. 3), the remaining operations remaining the same as described above. This can readily be done simply by changing the timing of cam groove 62 so that the filling shoe 30 is swung into registration with cavity 11 only after plunger 13 has reached or nearly reached point "A". In such a modification of the filling operation, cavity 11 will obviously be filled with air when the material charge begins to enter same but if the entering material is sufficiently loose or coarse the air can escape through the material itself. However if the material is so fine

as to render such escape of the air through the material difficult it is much better to begin filling the cavity 11 with the beginning of the descent of plunger 13, as fully described above, and thus avoid entrapment of air in cavity 11 and any necessity for such air to escape through the material as it enters the die cavity.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. The steps in the method of briquetting bodies from loose powdered material comprising: filling a vertically elongated mold cavity with the loose powdered material to be briquetted by dropping the loose powder therein by the force of gravity while forming said cavity by a receding movement of the bottom wall relative to the side walls of said cavity whereby to avoid entrapment of air within the powdered material during filling of the cavity, then moving said bottom wall upwardly to eject part of the loose material from the upper end of said mold cavity, then highly compacting the powdered material remaining in said cavity by an axially moving plunger.

2. The steps in the method of briquetting bodies from loose powdered material comprising: providing an elongated upright die cavity open at both ends, moving a lower plunger upwardly to substantially fill said die cavity, then simultaneously lowering said plunger to its lowermost position and pouring the loose material into the upper end of said cavity as the cavity is being formed by the receding lower plunger, then moving said lower plunger upwardly to eject part of the loose material from the upper end of said cavity, then highly compacting the remaining material charge by a second plunger descending into the upper open end of said cavity, then ejecting the briquetted body by a subsequent upward movement of the lower plunger.

3. The steps in the method of briquetting bodies

from loose powdered material comprising: pouring by the aid of gravity the loose powdered material into the mold cavity simultaneously with the formation of said cavity by a receding bottom wall therein whereby to avoid entrapment of air at or near the bottom of the mold cavity, then ejecting a fraction of the loose powder from the cavity by a partial return movement of the movable bottom wall, then highly compacting the powder charge remaining in the cavity by an axially moving plunger.

4. The steps in the method of briquetting bodies from loose finely divided dry powdered material, comprising: providing an elongated upright mold cavity, filling the mold cavity with loose dry powdered material by pouring same by the aid of gravity into the upper end of said cavity while simultaneously and continuously increasing the vertical depth of said cavity by a receding bottom wall therein to provide a more uniform density of the loose dry material thruout the vertical depth of said cavity, then ejecting a fraction of the loose material from the upper end of said cavity by a partial return or up-movement of the bottom wall, then highly compacting the powder charge remaining in the cavity by an axially moving plunger.

5. The steps in the method of briquetting bodies from loose powdered material comprising: forming a mold cavity by relative vertical movement between the bottom and side wall portions of a mold; simultaneously pouring, with the aid of gravity, loose powdered material into said cavity as the same is formed, then ejecting a portion only of said powdered material from said cavity by reverse relative vertical movement of said mold portions, said reverse relative vertical movement being of less magnitude than the movement required to form the mold cavity, and then highly compacting the powdered material remaining in said cavity by means of a plunger axially movable relative to said mold cavity.

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