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## PRESS FOR POWDERED METALS

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This invention relates to presses adapted particularly for the production of briquettes or so-called green compacts consisting of powdered metal.

Presses of the kind adapted to produce compacts from powdered metal operate with unusually high pressure, such being as high as 20 tons per square inch or above in many instances. The attainment of high pressures of this order has produced short life for many of the parts of the press, particularly where loose powder is trapped between portions of the press that slide one relative to the other in defining a mold cavity for the powdered metal and in exerting the required amount of pressure on the powdered metal in the mold cavity. One of the primary objects of the present invention is to enable operating pressure of high order to be achieved in a press of the foregoing kind while prolonging the life and reducing substantially the wear of certain parts in the press.

Another problem that has been encountered in operation of presses of the foregoing kind has been the tendency for the powdered material to be squeezed from the mold cavity during the time that rams in the press are operative to compact the powdered material. In the art this has been referred to as "blow by," and another object of the present invention is to associate with the ram and the mold cavity in which the ram operates a pressure member working in opposition to the ram, which opposing pressure member does not enter the mold cavity but merely closes off the mold cavity at one end thereby substantially lessening "blow by." Other objects are specifically to afford clearance between the operating ram and the walls of the press while at the same time enabling the mold cavity at one end to be closed off by the head of the ram; to construct the ram so that the pressure at the face thereof which is to compact the powdered metal in the mold cavity is considerably higher than the base of the ram where the operating pressure is applied; and to accurately relate parts of the press that move one relative to the other in defining a mold cavity so that the resultant cavity is adapted to produce compacts of accurate dimension and withstand the operating pressure.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawing which, by way of illustration, shows a preferred embodiment of the present invention and the principles thereof and what I now consider to be the best mode in which I have contemplated applying those principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Fig. 1 is a sectional view of a press constructed in accordance with the present invention; and

Fig. 2 is a top plan of the press shown in Fig. 1 but with the upper pressure member removed.

The present invention is illustrated in the drawing as

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embodied in a press 10 comprising an upper stationary head 11 provided on the lower face thereof with an annular pressure shoe or ring 12 constituting one of the rams of the press, this ram in effect working in opposition to the movable ram of the press as will be described below.

Below the head 11 is a main operating piston 15 adapted to be operated by hydraulic pressure in a manner well understood in the art to establish a working pressure in the press, and to this end the upper or the operating end of the piston 15 is formed with a plurality of circumferentially spaced apart, upwardly projecting mounting bosses 16, there being three such bosses, 16-1, 16-2 and 16-3 as shown in Fig. 2. The bosses 16 are equally spaced, and the spacing therebetween affords radial grooves 17 at the head of the piston 15 which open in to a central recess or mounting socket 18, Fig. 1.

A force transmitting plate 20, Fig. 2, is mounted freely on the upper end of the piston 15, and this plate is adapted to be operated independently of the piston 15 as will be mentioned. The plate 20 includes an outer circumferential ring 20A, Fig. 1, and a plurality of radial arms 22 which extend inwardly from the outer ring 20A to a central post or hub 23, Fig. 1. Thus, there are three arms 22 as shown in Fig. 2, and these arms are adapted to fit in the grooves 17, and the hub 23 is adapted to fit in the socket 18 of the piston 15 as shown in the drawing.

The plate 20 is associated with the piston 15 so that the segmental recesses 22R thereof between the arms 22 are aligned and coextensive with the three segmental bosses 16-1, 16-2, and 16-3 as shown in Fig. 2. Reposed on the bosses 16 are shoes 25, there being three such shoes 25-1, 25-2, and 25-3. The shoes 25 at the outer edges thereof are formed with outwardly projecting flanges 25F, and these are secured to the respective bosses 16 by bolts 26 to thereby fix the shoes 25 to the piston 15 for movement therewith.

The upper faces of the shoes 25 are disposed in a common plane. A relatively heavy annular ram 30 is supported by the shoes 25 as shown in Fig. 1, and is bolted thereto by bolts 32 so as to be moved with the piston 15 and the shoes 25. The upper end or head of the ram 30 is flanged at 33 about the outer diameter thereof and is likewise flanged at 34 about the inner diameter thereof for a purpose to be explained below.

In the present instance, the press 10 is adapted to produce powdered metal briquettes in the form of clutch facings that are subsequently to be sintered. Thus, the portion of the ram 30 including the annular flanges 33 and 34 corresponds to the dimensions of the powdered metal ring that is to be produced in the mold cavity of the press 10, but it will be recognized that the press of the present invention can be modified to produce solid disks or plates of powdered metal where these are desired. Such would be manifest in the elimination of the core 35 to be described below, and substitution of a solid ram rather than the ring-like ram 30.

Therefore, to enable the desired annular cavity to be produced in a way to be described, a core 35, Fig. 2, is provided having an outer diameter corresponding to that of the flange 34 of the ram 30. The core 35 includes an upper end portion 35U and a lower end portion 35L, Fig. 1, these being respectively formed complementary to the head and base of the ram 30 as will be described in more detail hereinafter, and the core 35 is secured to the hub 23 of the plate 20 by a bolt 35B.

Cooperating with the core 35 to enable the desired annular cavity to be produced, there is an outer mold ring or wall 36, and the upper end of this annular wall 36 has an inside diameter corresponding to the diameter of the outer flanged portion 33 at the head of the ram 30. The mold ring 36 is secured by bolts 37 to the plate 20

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as shown in Figs. 1 and 2 so that the outer mold ring 36 moves with the core 35 and the plate 20 when the latter is actuated.

Under the present invention, the ram 30 is reduced in diameter in the portion 43 thereof immediately below the flanged head 33—34, which is to say that in the portion beyond the flanged head the ram 30 is of less width, or in this instance cross-sectional area compared to the head area 33—34. Such reduction in width affords outer and inner annular spaces 45 of substantial axial length located respectively between the opposing wall of the ram 30 and the mold ring 36 on the one hand, and those of the ram 15 and the core 35 on the other hand, as can be seen in Fig. 1. In the portion beyond the clearance space 45, the ram 30 is flanged outwardly at 47 to provide an enlarged annular base, and then is uniformly diametered at 48 at the base end to afford a lower face 50 of relatively greater area than the upper face of the ram 30 as will readily be apparent in Fig. 1. The importance of this will be mentioned below.

The inner wall of the mold wall 36 opposite the flanged portion 47 and the uniformly diametered portion 48 of the ram 30 is formed complementary thereto, but is of larger diameter so as to afford a downward progressing continuation of the outer clearance space 45. Likewise, the core 35 is formed complementary to the lower extents of the ram 30, but is of less diameter to afford a downward progressing continuation of the inner clearance space 45.

In operating the press 10, air under pressure (afforded by means not shown) is used first to elevate the plate 20, the core 35 and the outer wall 36 secured thereto sufficiently above the upper face or head of the ram 30, remaining in the position shown in Fig. 1, to afford side walls for the mold cavity of the required depth, the head of the ram 30 constituting the lower wall of this cavity. The annular mold cavity thus produced is then filled with powdered material that is to be pressed, and in actual practice the depth of the mold cavity may be but several hundredths of an inch. It will be recognized that while the plate 20 was being lifted relative to the ram 30, the association of the plate 20 with the ram 30 served to accurately guide the plate 20 to define a mold cavity of precision.

After this initial operation has been performed, hydraulic pressure (afforded by means not shown) is then effective to elevate simultaneously the piston 15 and the plate 20 so that the outer wall 36 the ram 30 and the central core or inner wall 35 of the mold cavity all advance together toward the pressure shoe 12. Again, the plate 20 is held in accurate centered relation. Eventually, the outer and inner walls, 36 and 35 respectively, of the press engage and are halted by the shoe 12, whereupon the hydraulic pressure is only effective on the ram 30, and this compresses the powder in the mold cavity to the required density to produce the powdered metal briquette.

It will be recognized from the foregoing that the particular construction of the ram 30, such including the upper or head portion and a base portion of substantially greater area, enables the efficiency of the press to be increased. Thus, if it is determined that 15 tons per square inch is the pressure required to properly densify and compact the powdered metal in the mold cavity, then the corresponding pressure per square inch to be exerted against the lower or enlarged face 50 of the ram 30 will be materially under 15 tons per square inch. In this connection, it will be observed further that the bosses 16, the shoes 25 and the base of the ram 30 are progressively of diminishing area, and it has been found that such relations materially prolong the the life of the press.

Of particular importance in the present instance are the escape passages 45 between the ram 30 and the walls 35 and 36 of the mold, such being manifest in the clear-

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ance between these parts attained by the flanges 33 and 34 at the head of the ram which close off one end, that is the lower end, of the mold cavity in opposition to the opposing member 12. Thus, where these relatively movable parts have heretofore been constructed with straight walls, there was considerable sliding contact between the ram and the mold walls, and wear became acute particularly where powdered metal escaped from the mold cavity and collected between these walls, but it will be seen that in accordance with the present invention sliding contact is restricted to those portions of the walls afforded by the members 35 and 36 immediately opposite the flange portions 33 and 34 of the ram 30. At the same time, this increases responsiveness of the press in respect of what has been termed "up" and "down" time manifest in operation of the ram 30 and the plate 20, since the area of sliding contact has been materially decreased and any powdered metal escaping from the mold cavity drops by gravity down through the passages 45.

Another of the important advantages of the press of the present invention is that the pressure shoe 12 does not enter the mold cavity, but rather merely closes off one end of the mold cavity, inasmuch as it will be seen in Fig. 1 that the outer diameter of the ring 12 extends about one-eighth inch beyond the outer flange 33 of the ram 30. Likewise, the ring 12 is formed with an inner diameter that extends about one-eighth inch inwardly of the outer circumferential edge of the core 35. By thus holding the over-lap close rather than of some extent, substantial sealing pressures are established about the outer ring 36 and the core 35 preventing "blow-by" of the powder during closing of the mold. If the shoe 12 were larger such sealing pressure would be distributed over a greater area about the core 35 and the ring 36, reducing the sealing effect and increasing the likelihood of high spots that interfere with the attainment of an effective seal.

Thus, it was heretofore the practice for a pressure member such as 12 to enter the mold cavity to cooperate with a ram as 30 in compacting the powdered metal. Such design in particular resulted in powdered metal within the mold cavity actually being squeezed upwardly out of the mold cavity along the outer side wall due of course to the fact that it was heretofore necessary to provide some clearance for a pressure member as 12 designed to operate within the mold cavity.

Moreover, this accounted for a great deal of wear at the corners of the outer ring and inner core, where used. As such wear increased, the edges of the powdered metal compact became more and more imperfect, and the parts had to be replaced after a relatively short life.

After full pressure of a predetermined amount has been applied to the powdered metal within the mold cavity as above described, the press is then opened by releasing the hydraulic pressure that operated simultaneously the piston 15 and the transmitting plate 20, although there are circumstances where it may be desirable to first strip the outer wall 36 while maintaining full hydraulic pressure to hold the opposed faces of the completed briquette between the corresponding opposed faces of the pressure ring 12 and the operating ram 30.

Hence, while I have illustrated and described the preferred embodiment of my invention, it is to be understood that this is capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. In a press of the kind described for pressing powdered metals, a movable ram having a head constituting one wall of a mold cavity in which the material to be pressed is adapted to be placed, the base of said ram

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being of substantially larger cross-sectional area as compared to the head of the ram, means affording an outer side wall for the mold cavity about said ram and relative to which said ram is adapted to move, said wall means being carried by a transmitting plate, the head of said ram being defined by an enlargement adapted to slidably engage said outer wall in affording said mold cavity and the portion of said ram beyond said enlargement being of reduced width to afford substantial clearance between said outer wall and such portion of the ram, a movable piston on which said ram is mounted for movement therewith, said piston having recesses therein and said plate having arms mounted in said recesses and being movable independently of said piston to move said wall means independently of said ram, and means affording a pressure member cooperating with said ram and the means affording said outer wall to close off said mold cavity, said pressure member being adapted to span said mold cavity without entering the mold cavity.

2. In a press of the kind described for pressing powdered metals, a movable ram having a head constituting an end wall of a mold cavity in which the material to be pressed is adapted to be placed, the end of said ram opposite the head being of substantially larger cross-sectional area as compared to the head of the ram, a piston for driving said ram with a predetermined pressure at the enlarged end thereof, means affording an outer side wall about said ram and relative to which said ram is adapted to move, a transmitting plate for said outer wall and movable independently of said ram to elevate said outer wall to afford a side wall for said mold cavity, said plate including radial arms mounted freely in complemental radial recesses formed in said piston, a flange about the head of said ram adapted to slidably engage said outer wall and the portion of said ram beyond said flange being of reduced width to afford substantial clearance between said outer wall and such portion of the ram, and means affording a pressure member cooperating with said ram and the means affording said outer wall to close off the end of said mold cavity opposite said ram, said pressure member being adapted to span said mold cavity without entering the mold cavity.

3. In a press of the kind described for pressing powdered metals, a movable ram having a head constituting one wall of a mold cavity in which the material to be pressed is adapted to be placed, the base of said ram being of substantially larger cross-sectional area as compared to the head of the ram, means affording an outer side wall for the mold cavity about said ram and rela-

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tive to which said ram is adapted to move, said wall means being carried by a transmitting plate member, the head of said ram being defined by an enlargement adapted to slidably engage said outer wall in affording said mold cavity and the portion of said ram beyond said enlargement being of reduced width to afford substantial clearance between said outer wall and such portion of the ram, a movable piston member on which said ram is mounted for movement therewith, one of said members having recesses therein and the other of said members having arms mounted in said recesses, said plate member being movable independently of said piston member to move said wall means independently of said ram, and means affording a pressure member cooperating with said ram and the means affording said outer wall to close off said mold cavity without entering the mold cavity.

4. In a press of the kind described for pressing powdered metals, a movable ram having a head constituting an end wall of a mold cavity in which the material to be pressed is adapted to be placed, the end of said ram opposite the head being of substantially larger cross-sectional area as compared to the head of the ram, a piston member for driving said ram with a predetermined pressure at the enlarged end thereof, means affording an outer side wall about said ram and relative to which said ram is adapted to move, a transmitting plate member for said outer wall and movable independently of said ram to elevate said outer wall to afford a side wall for said mold cavity, one of said members being provided with radial arms and the other of said members being provided with radial recesses substantially complemental to said arms and said arms being mounted in said recesses, a flange about the head of said ram adapted to slidably engage said outer wall and the portion of said ram beyond said flange being of reduced width to afford substantial clearance between said outer wall and such portion of the ram, and means affording a pressure member cooperating with said ram and the means affording said outer wall to close off the end of said mold cavity opposite said ram, said pressure member being adapted to span said mold cavity without entering the mold cavity.

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