

Oct. 27, 1942.

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2,300,302

APPARATUS FOR FORMING CASTINGS FROM POWDERED METALS

Original Filed June 4, 1940 2 Sheets-Sheet 1

Fig. 1.

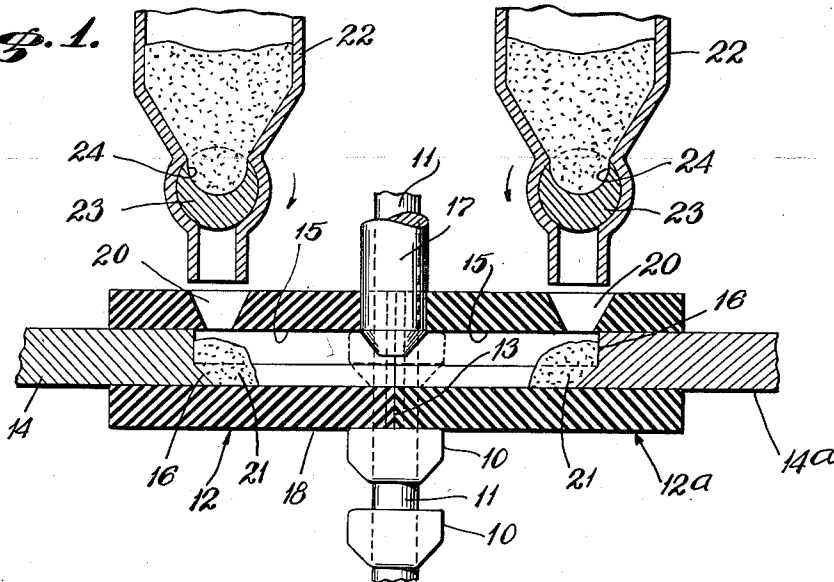


Fig. 2.

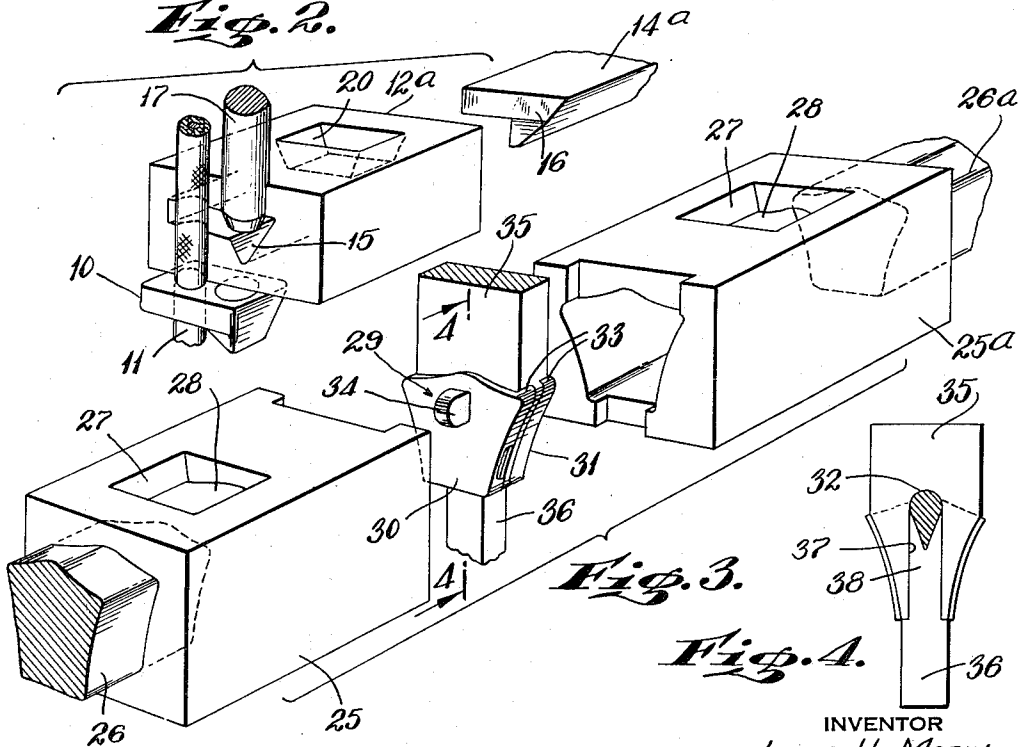


Fig. 3.

Fig. 4.

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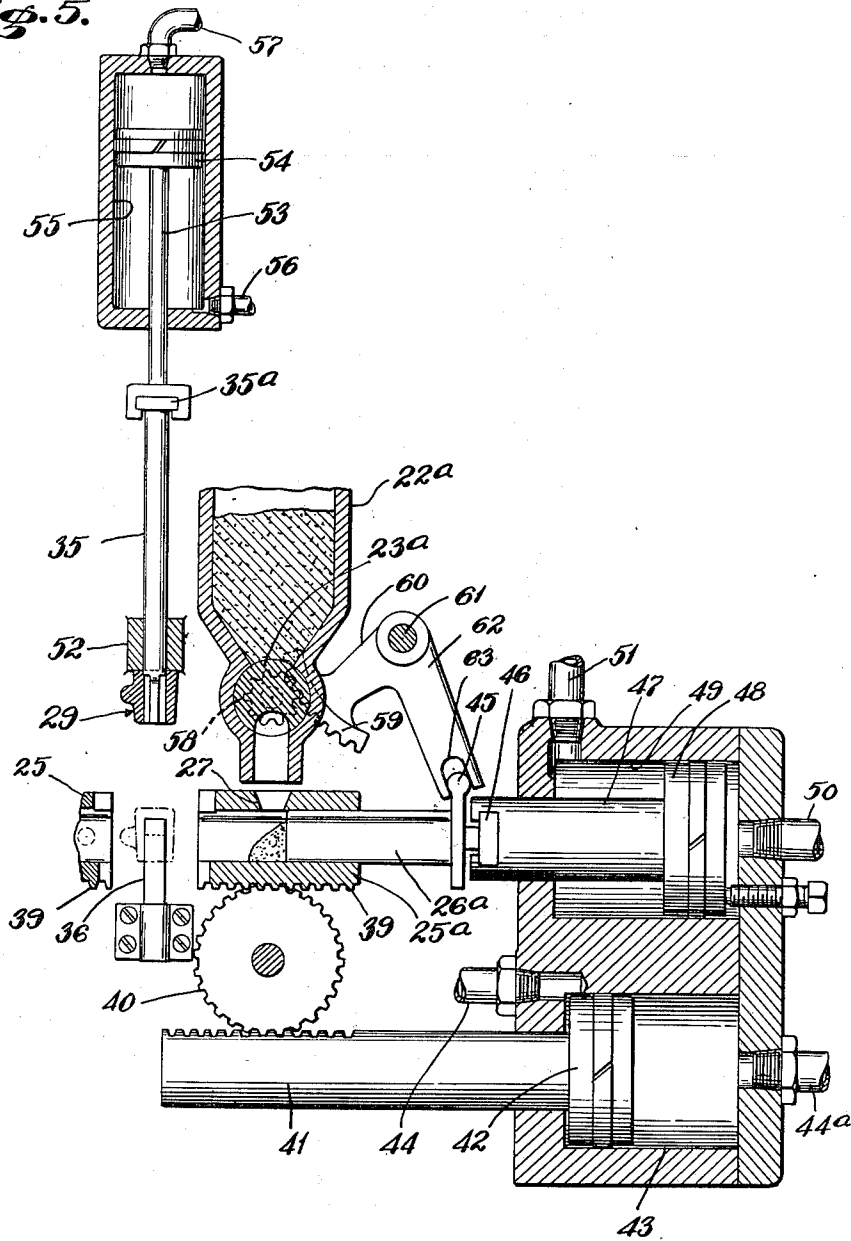
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Fig. 5.



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APPARATUS FOR FORMING CASTINGS
FROM POWDERED METALS

Louis H. Morin, Bronx, N. Y., assignor, by mesne assignments, of one-half to said Louis H. Morin and one-half to Davis Marinsky, Bronx, N. Y.

Original application June 4, 1940, Serial No. 338,672. Divided and this application April 14, 1941, Serial No. 388,403

14 Claims. (Cl. 29—1)

This invention relates to a novel and improved apparatus for forming castings from powdered metals. In the practice of what is known as "powder metallurgy," a powdered metal is usually made by an electric deposit and then the powder thus formed is molded into the desired shape under high pressure, for example 10,000 pounds per square inch, and then the article thus formed is usually subjected to a sintering temperature, for example 300–400 degrees F., which is well below the melting point of the material, thus causing the particles to flow together into a solid mass. However, certain difficulties have been experienced in the forming of articles from powdered metals, particularly where those articles are of such shape as to require the use of a core, and the apparatus of this application is intended to solve those difficulties.

For example, the apparatus described herein is particularly adaptable for use in the formation of the various parts of separable fasteners, such for example as the parts sometimes referred to as links and sliders. In the formation of those parts as well as other parts, in the past it has been known to stamp the parts out of sheet material or to cast them by die casting machines, but the apparatus which I have devised is adapted to form such small articles by so-called "powder metallurgy."

The novel features of the invention will be best understood from the following description and annexed drawings, in which certain embodiments of the invention are disclosed and in which the separate parts are designated by suitable reference characters in each of the views, and in which:

Fig. 1 is a diagrammatic sectional view illustrating the manner of inserting powdered metal into mold cavities and between relatively movable dies in forming links of a fastener stringer;

Fig. 2 is a perspective view illustrating one-half of the mold with one of the movable die parts in an exploded position;

Fig. 3 is an exploded perspective view of the mold chambers and movable die parts illustrating another adaptation of the invention with a formed casting arranged upon core members employed;

Fig. 4 is a sectional detail view substantially on the line 4—4 of Fig. 3; and

Fig. 5 is a diagrammatic view illustrating the manner of operating the dies and cores of the structure diagrammatically illustrated in Fig. 3 of the drawings.

This application constitutes a division of my

prior application Ser. No. 338,672, filed June 4, 1940.

In the accompanying drawings, I have shown certain adaptations of the invention in making two devices of the type and kind under consideration to show the general adaptation of my improved machine to the formation of intricate devices, and particularly devices which are formed upon a core or other supporting member arranged angularly to the direction of applied pressure.

In Figs. 1 and 2 of the drawings, the invention is diagrammatically illustrated as applied to the formation of links 10 at spaced intervals on a strand-like mounting member 11; it being understood however, that this strand may simply constitute the beaded edge of a stringer tape. In this construction two die or mold parts 12, 12a are shown which abut at the parting line 13. These parts are shaped primarily to form the end walls and top and bottom walls of the resulting cast links 10, whereas plunger die parts 14, 14a are movably disposed in the molds 12, 12a or the channels 15 thereof to form the side surfaces 16 of the resulting castings 10 by the inner surfaces 16 of said plunger dies. Adjacent surfaces of the molds 12, 12a are shaped to receive a core pin 17 which protrudes into the cavity formed between the parts 12, 12a, 14, 14a and the resulting cast link 10 is formed around the core 17. This core forms a recess or aperture in the upper surface of the link. The core also serves as a means for feeding the cast link to a position upon the lower surface 18 of the molds 12, 12a to space the link on the strand or member 11 composed of flexible wire or similar material which is also disposed between adjacent surfaces of the molds 12, 12a as clearly illustrated in Fig. 2 of the drawings.

It will be understood that after the cast link 10 is formed on the core 17, the plunger dies 14, 14a are separated and the molds 12, 12a are separated to permit movement of the cast link into the position in alignment with the surface 18; after which the molds 12, 12a are partially closed, the core 17 stripped from said link and returned to its normal position; after which the molds 12, 12a are again moved into closed position, in which position another spaced section of the member 11 is in position to receive the next successive casting. Adjacent the outer end portions of the molds 12, 12a are admission ports 20 which open into the chambers 15 forwardly of the ends 16 of the dies 14, 14a so that measured quantities of powdered metal as at 21 may be deposited in

front of each die 14, 14a in advance of the movement of the dies 14, 14a toward each other in forming the casting.

Disposed above each aperture 20 is a hopper 22 containing a supply of the powdered metal. Rotatably mounted in the lower discharge end portion of each hopper is a measuring and delivery member 23, the chamber or aperture 24 of which is of such size as to supply to the chambers 15 the measured quantities 21 of material required to form the complete casting. The members 23 may be of a standard size, but the dimensions of the apertures or cavities 24 therein may be varied to supply the required amount of powdered metal. In this connection it will be understood that in some instances more metal may be disposed in one end portion of the mold than in the other end portion to meet the requirements in the resulting casting. It will be understood that the illustrations in the accompanying drawings are purely diagrammatic.

In the casting operation, it will be understood that the molds 12, 12a will be held in firm engagement with each other with sufficient pressure to prevent any possible separation of these molds when pressure is applied to the powdered material. The dies 14, 14a will then be simultaneously moved toward each other under sufficient pressure upon the powdered material to form the resulting homogeneous mass or resulting casting, and the pressures exerted upon the two dies should be approximately equal, so as to avoid undue stress upon the core. Thereafter the dies 14, 14a are separated and the casting ejected in the manner previously described.

In the adaptation of the invention as seen in Figs. 3 and 4 of the drawings, mold parts 25, 25a are employed which have the same characteristics as the molds 12, 12a, whereas 26, 26a, represent the plunger dies slidably disposed within the molds 25, 25a. At 27 are shown the admission ports similar to the ports 20, through which the powdered metal is introduced into the chambers 28 of the molds 25, 25a forwardly of the plunger dies 26, 26a. The molds and the dies are so formed as to produce what is commonly referred to as the slider 29 of a separable fastener, that is to say, the member slidably engaging the links such as at 10 in coupling links of two stringers. In this connection it will be understood that the slider as seen in Fig. 3 of the drawings is on a much smaller scale than the link as shown in either of Figs. 1 and 2 of the drawings, Fig. 2 being on a smaller scale than Fig. 1. The various parts just described will be operated in the same general manner as in the arrangements shown in Figs. 1 and 2, here again care being exercised to have the two dies operated by substantially equal pressures so as to avoid breaking the core.

The slider 29 is in the form of a channeled body, that is to say, it comprises top and bottom plates 30, 31 joined at the wide or flared end in a connecting web 32, the top and bottom walls having inturned side flanges 33. One wall 30 of the slider has a bearing portion 34 forming the pivot means for a pull such as commonly employed in devices of this type and kind. The pull is not shown, but is independently formed.

In producing slider devices, two relatively movable cores 35 and 36 are employed, these cores being moved perpendicularly with respect to the horizontal movement of the dies and molds. The core 35 has a long channel portion 37 and the core 36 a long tongue portion 38 fitting the channel 37 but spaced from the base of the channel

37 to form the contour of the connecting web 32 as clearly seen in Fig. 4 of the drawings. In other words, after the casting has been formed and the dies and molds separated in the manner shown in Fig. 3, the core 35 is raised, removing the casting from the core 36, after which the casting is stripped from the core 35.

In Fig. 5 of the drawings is illustrated, diagrammatically, means for operating the dies and molds and the core 35 in order to indicate one method of carrying the invention into effect, although other means may be employed. The mechanisms diagrammatically illustrated in Fig. 5 as applied to the structure of Fig. 3 will also be applicable to the structure of Figs. 1 and 2.

In operating molds such as 25, 25a, these molds will be provided on their undersurfaces with rack teeth 39, in connection with which a gear 40 operates, the latter being rotated through a plunger rack 41 on a plunger 42 operating under hydraulic pressure in a cylinder 43 into which liquid (e. g. oil or water) under pressure is admitted as indicated at 44 in moving the mold 25a into closed position with the mold 25. It will be understood that both molds are operated in the same manner but only one cylinder and plunger is shown. At 44a is shown another liquid admission pipe for moving the plunger rack in the opposite direction in opening or separating the molds. It will of course be apparent in this connection as in the other cylinders later described that the admission ports or tubes act as exhausts in the reverse operation of the plungers in the cylinders.

In Fig. 5 of the drawings, one of the dies, the die 26a, is shown. This die carries at its outer end a beaded flange portion 45 and an end coupling collar 46, the latter engaging the shaft 47 of a plunger 48 arranged in a cylinder 49. The liquid is introduced into the cylinder 49 through a pipe 50 in moving the die 26 into closed position, whereas it is admitted through the pipe 51 to move the plunger in the opposite direction in opening the die.

In the present construction the core member 36 has a fixed mounting between the relatively movable molds and dies, whereas the core 35 is movable vertically and cooperates with a suitable stripper 52 in stripping the casting 29 from the core. The core 35 carries an enlarged flange 35a at its upper end coupled with the shaft 53 of a plunger 54 arranged in a cylinder 55. Liquid is admitted into the cylinder 55 through a pipe 56 in moving the core 35 upwardly and in stripping the casting as aforesaid, and is admitted through the pipe 57 for moving the core 35 downwardly into position between the dies.

In Fig. 5 of the drawings is indicated one of the two feed hoppers 22a for supplying the granular material to the mold chambers through the apertures 27, and the measuring and delivering member 23a of the hopper is rotated through a gear 58 arranged on the axis of the member 23a. This gear 58 is rotated through the medium of a gear segment 59 on a rocker arm 60 pivoted as seen at 61. The arm 60 has an angular extension 62 apertured as seen at 63 to engage the beaded flange 45, so that as the die 26a is moved into open and closed positions, the member 23a is automatically rotated to pick up and deliver measured quantities of the powdered material to the mold 25a.

The apparatus described above exemplifies a suitable means for operating the various movable parts and for applying equal and opposite pressures to the parts which move towards and

away from each other, thus making it possible to form an article of powdered metal about a core which is inserted into a mold cavity between the ends of the cavity. Of course it will be understood that in Fig. 5 I have shown an apparatus for operating the parts on one side of the parting line of the mold and that a duplicate arrangement may be used on the other side of that parting line. The admission and exhaust of air from the various cylinders may be controlled by any suitable valve mechanism, the details of which are not necessary for an understanding of the invention and so will not be illustrated or described.

Returning for a moment to the disclosures in Figs. 1 and 2 of the drawings, it will be apparent that in carrying out my method, I may substitute for the wire or member 11 another core member which would simply be shaped to form an open forked end on each link for mounting upon a strand or wire in the manner of mounting stamped metal devices of this type and kind. In other words, it is not essential that the casting be formed on and as a part of the member 11.

With both forms of construction disclosed and in both methods described, it will appear that one or more core members are arranged and movable in a plane at right angles to the direction of the applied pressure to the powdered material forming the casting. In this way the cores may be disposed on the parting line of the dies and utilized to eject the castings from the molds and also as a means for feeding and spacing the castings.

In applying the pressure to the plunger dies 14, 14a, 26, 26a, the same will be cushioned in order to compensate for slight uncomputable variances in the amount of material introduced into the dies or molds to insure perfect formation of the resulting castings.

The molds 12, 12a together with the associated dies 14, 14a may be referred to as telescopic die parts, which is also true of the molds 25, 25a and dies 26, 26a, as both die parts move in the same direction but are independently operated as will readily appear. As another alternative, the outer die parts may be said to define cylinders and the inner die parts or plungers movable in the cylinders.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an apparatus for forming powdered metal castings, a pair of molds movable toward and from each other, said molds having registering chambers forming part of a mold cavity at the parting line of said molds, a core arranged on the parting line of the molds and extending into the cavity, said core being movable along the parting line of molds at right angles to the direction of movement of the molds toward and from each other, a plunger die slidably mounted in the chamber of each mold, said dies being movable toward and from each other, opposed surfaces of the dies forming the remainder of the mold cavity, means for delivering measured quantities of powdered metal into the chamber of each mold forwardly of the plunger die when in retracted position, means moving said plunger dies toward each other into position defining the resulting mold cavity within said molds, and means supporting the molds in firm engagement with each other to form a homogeneous casting of said powdered metal on said core and of predetermined contour.

2. In an apparatus for forming powdered metal castings, a pair of molds movable toward and from each other, said molds having registering chambers forming part of a mold cavity at the parting line of said molds, a core arranged on the parting line of the molds and extending into the cavity, said core being movable along the parting line of molds at right angles to the direction of movement of the molds toward and from each other, a plunger die slidably mounted in the chamber of each mold, said dies being movable toward and from each other, opposed surfaces of the dies forming the remainder of the mold cavity, means for delivering measured quantities of powdered metal into the chamber of each mold forwardly of the plunger die when in retracted position, means moving said plunger dies toward each other into position defining the resulting mold cavity within said molds, means supporting the molds in firm engagement with each other to form a homogeneous casting of said powdered metal on said core and of predetermined contour, said first named means comprising storage hoppers for the powdered metal, and means at the discharge of said hoppers for collecting and delivering a predetermined quantity of powdered material to the chambers of the molds.

3. In an apparatus for forming powdered metal castings, a pair of molds movable toward and from each other, said molds having registering chambers forming part of a mold cavity at the parting line of said molds, a core arranged on the parting line of the molds and extending into the cavity, said core being movable along the parting line of molds at right angles to the direction of movement of the molds toward and from each other, a plunger die slidably mounted in the chamber of each mold, said dies being movable toward and from each other, opposed surfaces of the dies forming the remainder of the mold cavity, means for delivering measured quantities of powdered metal into the chamber of each mold forwardly of the plunger die when in retracted position, means moving said plunger dies toward each other into position defining the resulting mold cavity within said molds, means supporting the molds in firm engagement with each other to form a homogeneous casting of said powdered metal on said core and of predetermined contour, and said core comprising relatively movable parts within and between a portion of adjacent surfaces of which a part of the resulting casting is formed.

4. An apparatus for forming castings from powdered metal, comprising two pairs of telescopic die parts, one die part in each pair comprising a plunger die, said pairs of die parts being movable toward each other and collectively forming at the parting line thereof a mold cavity of predetermined contour, a core arranged on the parting line of the dies and extending into the mold cavity, the outer die parts having chambers with walls forming opposite sides of the cavity in which the plunger die parts are movable, and means for introducing measured quantities of powdered metal into said chambers forwardly of the plunger dies therein, whereby in the pressure movement of the plunger dies toward each other the two measured portions of powdered material will be moved toward each other to form within said mold cavity and around that part of the core arranged therein a homogeneous cast body.

5. An apparatus for forming castings from powdered metal, comprising two pairs of telescoping die parts, one die part in each pair comprising a plunger die, said pairs of die parts being movable toward each other and collectively forming at the parting line thereof a mold cavity of predetermined contour, a core arranged on the parting line of the dies and extending into the mold cavity, the outer die parts having chambers with walls forming opposite sides of the cavity in which the plunger die parts are movable, means for introducing measured quantities of powdered metal into said chamber of each of said outer die parts forwardly of the plunger dies whereby in the pressure movement of the plunger dies toward each other the two measured portions of powdered material will be moved toward each other to form within said mold cavity and around that part of the core arranged therein a homogeneous cast body, and said core being movable to eject the cast body from the die parts when they are separated.

6. In an apparatus for forming castings from powdered metal, two pairs of telescoping die parts, one die part in each pair comprising a hollow body having bores extending at opposed sides of the abutting parting line of said die parts, the other die parts in each pair comprising plunger dies of a cross section conforming to the cross section of said bores and movable in the first die parts toward each other to form at the limit of their inward movement in conjunction with the outer die parts a mold cavity of predetermined contour, the outer die parts having ports opening into the bores thereof when the plunger die parts are at the limit of their outward movement in said outer die parts, hoppers disposed over the ports of the outer die parts when in closed position, means for delivering predetermined measured quantities of powdered metal from the hoppers and delivering the same to the bores of the outer die parts through said ports forwardly of said plunger dies whereby in movement of the plunger dies toward each other under pressure, both quantities of powdered material will collectively form a homogeneous cast body within the mold cavity defined by all of said die parts.

7. An apparatus for forming castings from powdered metal, two cylinder molds, two plunger dies movable in said molds, means for moving the molds toward and from each other, means for moving the dies toward and from each other, storage means for powdered metal for independent supply to each of said cylinder molds, and means in operative engagement with the plungers for delivering measured quantities of powdered metal to each cylinder mold forwardly of the plunger dies therein prior to movement of the plunger dies toward each other.

8. An apparatus for forming castings from powdered metal, two cylinder molds, two plunger dies movable in said molds, means for moving the molds toward and from each other, means for moving the dies toward and from each other, storage means for powdered metal for independent supply to each of said cylinder molds, means in operative engagement with the plungers for picking up and delivering measured quantities of powdered metal to each cylinder mold forwardly of the plunger dies therein prior to movement of the plunger dies toward each other, a core arranged on the parting line of said cylinder molds and dies, and means moving the core

transversely of the dies to strip castings therefrom.

9. In an apparatus for forming castings, two die parts having faces adapted to abut and having aligned bores extending away from said faces, said die parts being movable to bring said faces together and to separate them, plunger dies reciprocable in said bores and having faces shaped to cooperate with the walls of said bores to form a die cavity, and means to introduce molding material into said bores in front of said faces of said plunger dies when in their retracted position, whereby when they are moved towards each other said material will be compressed by said plunger dies.

10. In an apparatus for forming castings, two die parts having faces adapted to abut and having aligned bores extending away from said faces, said die parts being movable to bring said faces together and to separate them, plunger dies reciprocable in said bores and having faces shaped to cooperate with the walls of said bores to form a die cavity, a core movable into and out of said chamber at said abutting faces, means to introduce charges of molding material between said core and the faces of said plunger dies when in retracted position, whereby when said plunger dies are moved towards each other they will compress said charges against said core and whereby said die parts may be moved away from each other to permit stripping of the casting from the core.

11. In an apparatus for forming castings from powdered metal, a mold chamber having a core extending into it through a wall thereof, plunger dies reciprocable in said chamber towards and away from said core from opposite sides thereof, means for introducing charges of powdered metal into said chamber on opposite sides of said core and between the core and the faces of said dies when in retracted position, movement of the dies towards the core compressing said charges about the core to form the casting, and movement of the dies away from the core permitting stripping of the casting from the core, the faces of the dies and the walls of the chamber defining the outer surfaces of the casting.

12. In an apparatus for forming castings, a mold chamber having a core extending into it through a wall thereof, plunger dies reciprocable in said chamber towards and away from said core from opposite sides thereof, means for introducing charges of casting material into said chamber on opposite sides of said core and between the core and the faces of said dies when in retracted position, movement of the dies towards the core compressing said charges about the core to form the casting, and movement of the dies away from the core permitting stripping of the casting from the core, the faces of the dies and the walls of the chamber defining the outer surfaces of the casting.

13. An apparatus for forming castings from powdered metal, two molds, means for moving said molds toward and from each other, a plunger die movable in each of said molds, said molds and dies collectively forming a cavity when in closed position, and means introducing powdered metal into the molds between adjacent surfaces of the dies whereby in the movement of the dies toward each other a casting will be formed of said powdered metal in said cavity.

14. An apparatus for forming castings from powdered metal, two molds, means for moving

said molds toward and from each other, a plunger die movable in each of said molds, said molds and dies collectively forming a cavity when in closed position, means introducing powdered metal into the molds between adjacent surfaces of the dies whereby in the movement of the dies toward each other a casting will be formed

of said powdered metal in said cavity, and said molds and dies having means whereby a mounting member may be supported therebetween for exposure in said cavity whereby the resulting
5 casting is formed on said mounting member.

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