Sept. 24, 1935. B. SACHS 2,015,462

MACHINE FOR HOT FORGING, PRESS AND DIE CASTING OF METALS

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FIG. 1

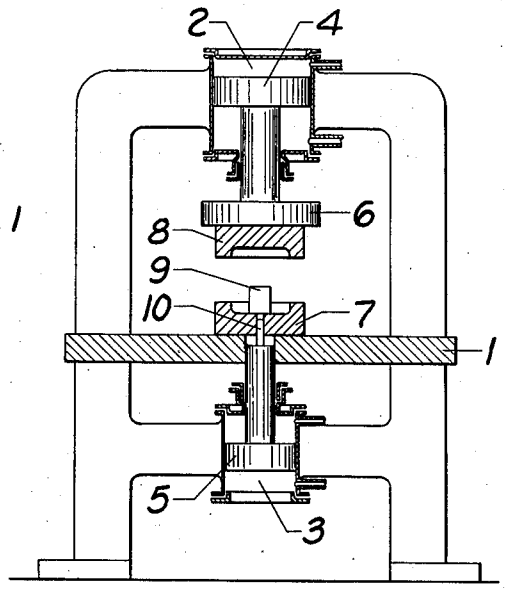


FIG. 2

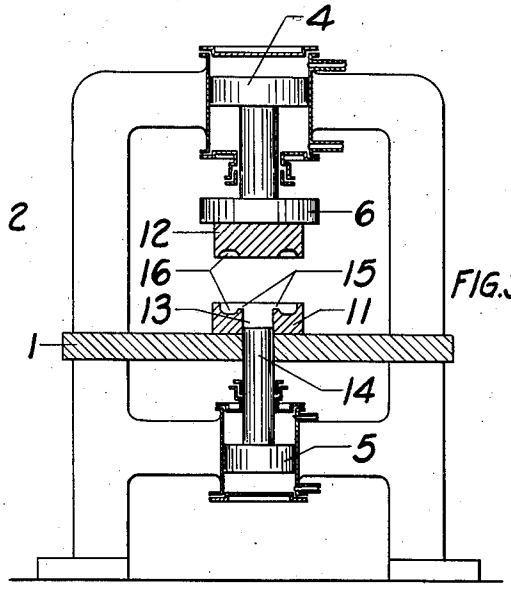
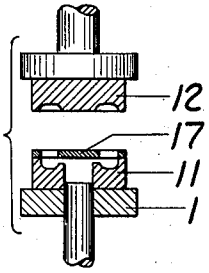


FIG. 3



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FIG. 4

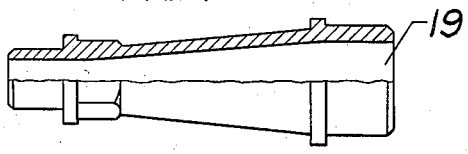


FIG. 5

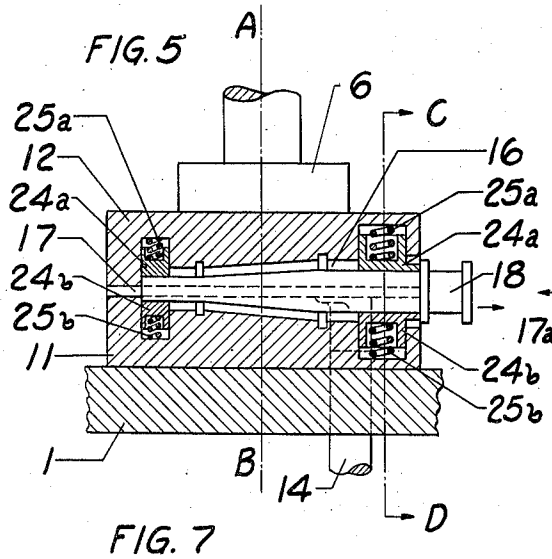


FIG. 6

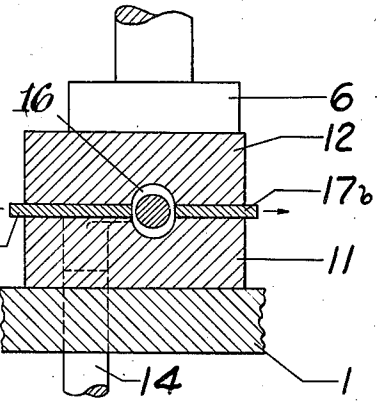


FIG. 7

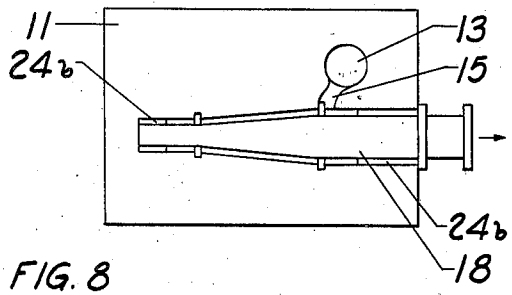


FIG. 8

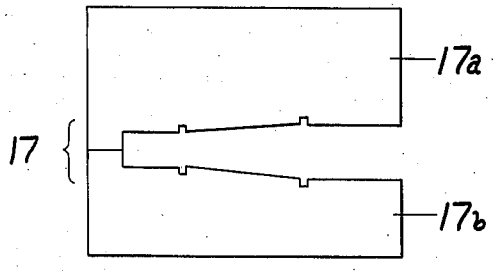
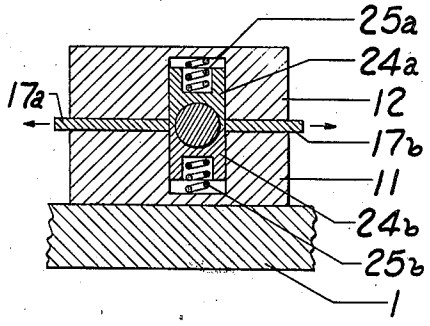


FIG. 6a



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MACHINE FOR HOT FORGING, PRESS AND DIE CASTING OF METALS

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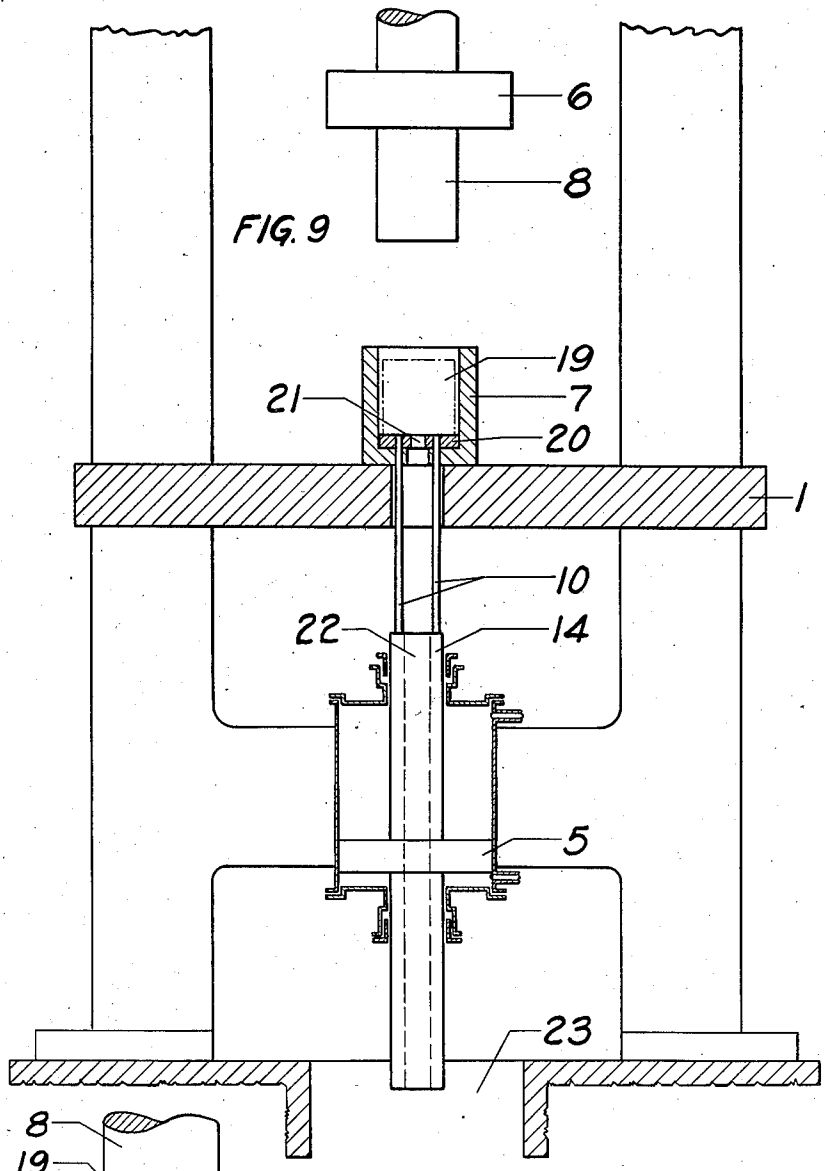


FIG. 9

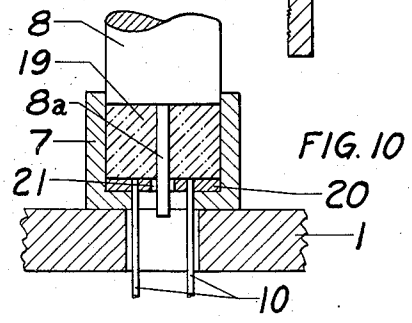


FIG. 10

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UNITED STATES PATENT OFFICE

2,015,462

MACHINE FOR HOT-FORGING, PRESS AND DIE-CASTING OF METALS

Bruno Sachs, Vienna, Austria, assignor to Nathan Forgings and Machining Corporation, New York, N. Y., a corporation of New York

Application November 2, 1934, Serial No. 751,120
In Austria, July 28, 1933

6 Claims. (Cl. 29—33)

In the hot-forging method metal parts are produced by means of friction spindle, eccentric, hydraulic or other presses and sometimes by means of drop or other hammers in such manner that sections of metal bars heated to forging temperature and sometimes bars cast in sand or in dies or in some other manner, are plastically formed in two, three or multiple part dies, which in their closed position represent a hollow mould corresponding to the shape of the article to be produced. All machines utilized for hot-forging are provided with a plate adapted to receive the fixed part of the die and are fitted with a movable reciprocating member to which is secured the other (movable) part of the die, said reciprocating member communicating the energy necessary for the plastic formation of the inserted bar during the forging process.

In the die-casting method metal parts are produced by introducing molten metal with a high velocity produced by pressure exerted upon the molten metal in a die usually made of steel and constructed of two parts, said die being held closed during the die-casting process. All machines utilized for the production of die-cast articles are provided with a plate adapted to receive the fixed half of the die and with a movable member whereto is secured the second half (or movable half) of the die, said movable member being adapted to lower the movable half of the die upon the fixed half and to press same upon the fixed half with a certain pressure, the so-called closing pressure, in the operative position. Connected to the fixed half of the die and communicating therewith through a nozzle applied thereto in a pressure tight manner or through a passage there is, as a rule, a container or chamber containing the molten metal on which the aforesaid pressure acts at the moment of operation, whereby the molten metal is forced through the nozzle or passage into the steel die at great velocity. The pressure is produced either by compressed air acting directly upon the molten metal or by a plunger, which in turn is actuated either by compressed air, or hydraulically, or mechanically or by hand. The aforesaid closing pressure must be able to stand up against the hydraulic shock of the metal rushing into the die, as well as against the inertia forces of the masses exerting or transmitting the casting pressure (resulting from suddenly stopping of plungers, rods, and so forth).

The present invention relates to a machine which makes it possible to produce metal parts according to the hot-forging process as well as the die-casting and press-casting process by the mounting of suitable dies or moulds. Figs. 1 to 3 illustrate an embodiment of the invention.

Fig. 4 shows a nozzle which may be produced by the combined process.

Fig. 5 is a vertical sectional view of the complete die used in the production of the nozzle.

Fig. 6 is a section taken along the line A—B of Fig. 5.

Fig. 6a is a section taken on the line C—D of Fig. 5.

Fig. 7 is a plan view of the lower part of the die, and Fig. 8 is a plan view of the spacing plate interposed between upper and lower parts of the die.

Fig. 9 is a view, partly in section, showing the arrangement for producing rods, and Fig. 10 is a detail view, partly in section.

In Fig. 1 the plate or table of the machine indicated at 1 is rigidly connected to cylinders 2 and 3 by means of a frame or columns. In the cylinders, which are closed at both ends in a pressure tight manner, reciprocate the hydraulically driven pistons 4 and 5. At its lower end the piston 4 carries a plate like member 6. If hot-forged parts are to be produced the fixed half 7 of a hot-forging die is secured to the table 1 and the movable half 8 to the plate like member 6 and the heated bar 9 is placed in position. The movement of the piston 4 performs in this case the pure operative movement and the piston 5 conveniently actuates the ejector 10 for ejecting the forged part from the lower half 7 of the die.

If die-cast parts are to be produced the fixed half 11 (Fig. 2) of a die is secured to the table 1 and the movable half of the die 12 to the plate 6. The fixed half of the die is provided with a cylindrical bore 13 passing right through same, wherein is movably disposed a piston rod 14 secured to the piston 5. The bore 13 communicates through a passage 15 with the hollow of the die proper indicated at 16 (for the article to be produced). Molten metal is introduced into the hollow space 13 the bottom of which is closed by the piston rod 14, thereupon the piston 4 lowers the movable half of the form 12 on to the half 11 and holds the half 12 on to the half 11 with the closing pressure. Pressure is then exerted upon the piston 5 from below, this causing the piston rod 14 to shoot upwards thereby forcing the molten metal through the passage 15 into the hollow mould 16.

Instead of a hydraulic drive the pistons 4 and 5 may be actuated by compressed air, steam or mechanically.

The axis of the machine need not to be vertical, it may be horizontal or inclined in space. Furthermore, it is not at all necessary for the two cylinders to have a common axis, the cylinders or the axis of movement may be relatively displaced in parallel relationship, or they may be disposed at right angles or may have any desired relative inclination.

With such a machine it is also possible to give a metal part to be manufactured its approximate shape by the die-casting process and to subject the metal shape thus produced by die-casting immediately after it has obtained its shape to a subsequent or finishing forging operation. For this purpose all that is required is to superpose on the lower part 11 of the die for example a plate 17 (Fig. 3) which has an aperture corresponding to section of the shape to be produced at the dividing plane of the die. This results in the die-cast article being thicker to the extent of the thickness of the interposed plate. The interposed plate is removed immediately after the die-casting operation and the movable half 12 of the form is pressed against the fixed half, whereby the superfluous material is caused to flow away and forms the forging flash.

This aspect of the operation of the machine will now be described in greater detail.

The lower part 11 of the die, wherein is made a cavity corresponding to the outer configuration of the lower half of the nozzle, is rigidly connected to the table 1. The upper part 12 of the die, wherein is made a cavity corresponding to the outer configuration of the upper half of the nozzle, is rigidly connected to the plate like member 6 of one of the movable members. The plate 17 comprises two parts 17*a* and 17*b* which are movable in the direction of the arrows (Figs. 6 and 8). 18 indicates the core movable in the direction of the arrow (Figs. 5 and 7) which is necessary for forming the hollow interior 19 of the nozzle (Fig. 4). The sliding pieces 24*a* and 24*b*, which surround the core 18, are slidably fitted in the upper and the lower parts of the die respectively. The springs 25*a* and 25*b* press these sliding pieces 24*a* and 24*b* against the core 18 and permit the relative movement of the core 18 to the upper and lower parts of the die during the forging operation. 14 illustrates, as in Fig. 2, the rod connected to the second movable member, said rod being slidably fitted in the cylindrical bore 13 of the lower part of the die.

The operation is as follows: At the beginning of the cycle of operation the reciprocating member 6 and therewith the upper part of the die 12 is in raised position and the half plates 17*a* and 17*b* are removed from the lower part, so that this is freely exposed. Into the hollow space 13 closed below by the rod 14 liquid metal is poured for example by means of a scoop or ladle from a melting furnace disposed by the side of the machine. The two half plates 17*a* and 17*b* are then placed in position on the lower half of the die and the member 6 is lowered with the uppper part 12 of the die and is pressed upon the lower half 11 of the die with the closing pressure. (This moment in the cycle of operations corresponds to the position of the closed die illustrated in Figs. 5, 6 and 6*a*). The rod 14 is then moved upwards and the liquid metal is forced through the passage 15 into the hollow space 16 of the die. This hollow space is formed by the hollow spaces in the upper and lower part of the die, by the lateral bounding faces of the half plates 17*a* and 17*b*, as well as by part of the core 18. The next step is the upward movement of the member 6 with the upper part 12 of the die and removal of the half plates 17*a* and 17*b* by pulling them away in the direction of the arrows (Figs. 6 and 8). The member 6 with the upper part 12 of the die is then lowered and pressed upon the work in the lower part 11. The work is already solidified but is still incandescent. The superfluous material is thereby caused to flow away and forms the forging flash, the work thereby obtaining its final shape. The member 6 is then raised with the upper part 12 of the die and the core 18 is pulled out in the direction of the arrow (Figs. 5 and 7). In the course of the further upward movement of the plunger 14 the pressed work is ejected from the lower part 11 of the die. In this condition the forging flash and the piece of metal remaining in the filling plug still form part of the work, and these may be subsequently removed in the usual manner by hand or machining.

It is also possible to produce with such a machine metal rods and tubes by the extrusion process. Fig. 9 illustrates the arrangement for producing rods. 1 indicates the table of the machine with which the lower part 7 of the tool is rigidly connected and which contains the matrix 20. This is a round disc made of steel with an aperture 21 in the centre which corresponds to the section of the bar to be produced. 10, as in Fig. 1, are ejectors which are supported on the lower piston rod 14. The piston rod 14 has a bore 22 passing right through it. The upper part of the tool is a cylindrical bar 8 rigidly connected to the movable member 6. The operation is as follows: The billet 19 cast in sand or in a die or in any other manner and heated to pressing temperature is placed in position in the lower part 7 of the tool. When the upper part 8 of the tool is lowered the inserted billet is increased in diameter so that it fills up the lower part of the tool completely and it is forced through the opening 21 of the matrix 20, whereby a rod is produced. (In order to allow unrestricted passage of same the piston rod 14, as mentioned above, is provided with a suitable passage 22). When the pressing is finished the residue left in the lower part 7 of the tool is still in connection with the extruded rod. When the piston 5 rises this residue is lifted out of the lower part of the tool by the ejectors 10 and is cut off the extruded rod. The extruded rod is then pulled out downwardly through the aperture 23 in the bottom.

The production of tubes is similar. In addition to the cylindrical plunger bar 8 the upper part of the tool comprises a thinner plunger bar 8*a* (Fig. 10) which corresponds to the inner diameter of the tube to be produced. The billet inserted into the tool 7 is first pierced and only then is the hollow cylindrical member formed by the piercing pushed through the opening 21 of the matrix 20 over the mandrel 8*a* by the plunger 8, so that a tube is produced. The opening 21 of the matrix 20 corresponds to the outer diameter of the tube to be produced. Fig. 10 illustrates the tool with the inserted billet at the moment when the actual pressing begins.

The machine is adapted to produce shapes of all industrial metals and alloys which are workable by the hot-forging or die-casting process, lead, tin, zinc, magnesium, copper, iron, nickel, silver alloys should be specially mentioned.

The possibilities of shaping the articles to be produced depend upon the possibilities offered by the hot-forging and die-casting process.

Having now particularly described and ascer-

tained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:

1. The process of making metal articles by successive die casting and hot pressing comprising the steps of maintaining complemental dies under closing pressure with a removable spacing element between said dies, injecting molten metal into said mold members under pressure, opening said dies after the metal has solidified and while still at a temperature suitable for hot pressing, removing the spacing element, and compressing said casting by subjecting the dies to hydraulic pressure.

2. The process of making metal articles by successive die casting and hot pressing comprising the steps of die casting said article in relatively movable oversize dies, opening said dies after the metal has solidified and while still at a temperature suitable for hot pressing, reducing the size of said dies, and compressing said casting by subjecting the dies to hydraulic pressure.

3. The process of making metal articles by successive die casting and hot pressing comprising the steps of die casting said article in complemental relatively movable dies having an oversize die cavity, opening said dies after the metal has solidified and while still at a temperature suitable for hot pressing, reducing the size of said cavity to the size and shape of the desired article, and compressing said casting between said complemental dies.

4. An apparatus of the kind described comprising a frame, an upper and a lower cylinder carried thereby, a piston in each cylinder operable by hydraulic pressure, a table fixedly carried by said frame, said table having a vertical passage therethrough, the lower piston having a piston rod entering said passage, a lower mold member fixed on said table and having a passage in registry with the passage in said table, the upper piston having a piston rod projecting downwardly from said upper cylinder, a complemental upper mold member carried by said upper piston, the cavity in said mold members being formed to the shape and size of the desired article, and a removable spacing element disposed on said lower mold member serving to increase the size of the casting, whereby upon completion of the casting operation the element may be removed and the casting subjected to hot pressing by the coaction of said mold members.

5. An apparatus of the kind described comprising a frame, an upper and a lower cylinder carried thereby, a piston in each cylinder operable by hydraulic pressure, a table fixedly carried by said frame, said table having a vertical passage therethrough, the lower piston having a piston rod entering said passage, a lower mold member fixed on said table and having a passage in registry with the passage in said table, the upper piston having a piston rod projecting downwardly from said upper cylinder, a complemental upper mold member carried by said upper piston, the cavity in said mold members being formed to the shape and size of the desired article, and an element cooperating with said dies for increasing the size of said cavity during the casting operation, whereby upon completion of the casting operation the element may be removed and the casting subjected to hot pressing by the coaction of said mold members.

6. An apparatus of the kind described comprising a frame, an upper and a lower cylinder carried thereby, a piston in each cylinder operable by hydraulic pressure, a table fixedly carried by said frame, said table having a vertical passage therethrough, the lower piston having a piston rod entering said passage, a lower mold member fixed on said table and having a passage in registry with the passage in said table, the upper piston having a piston rod projecting downwardly from said upper cylinder, a complemental upper mold member carried by said upper piston, and means whereby the cavity of said mold members may be enlarged during the casting operation and reduced at the completion of the casting operation, thereby permitting the use of said dies for a hot pressing operation immediately upon completion of the casting operation.

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