July 22, 1952 A. K. NOWAK 2,603,988

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Filed May 27, 1946 5 Sheets-Sheet 1

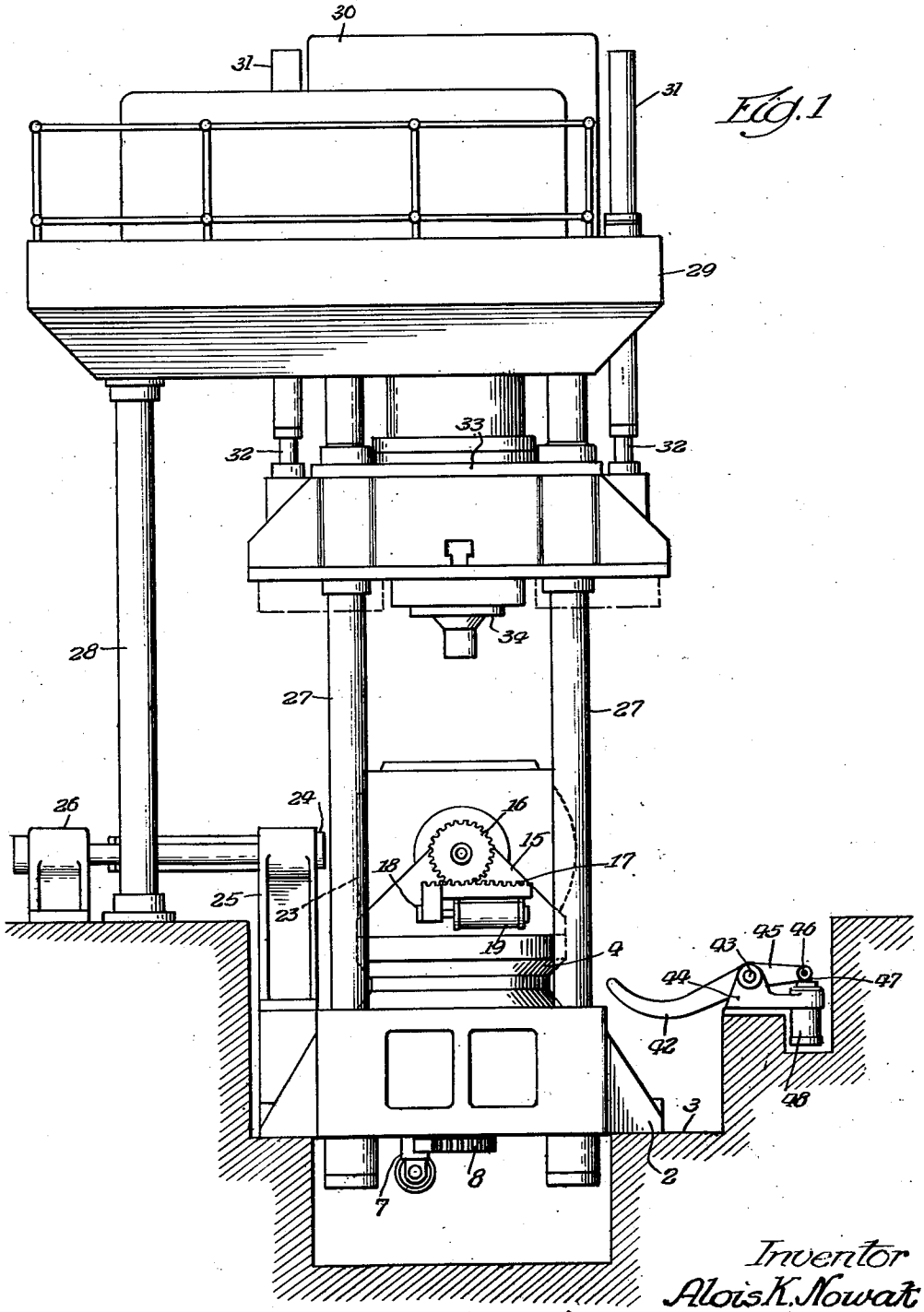


Fig. 1

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FIG. 2

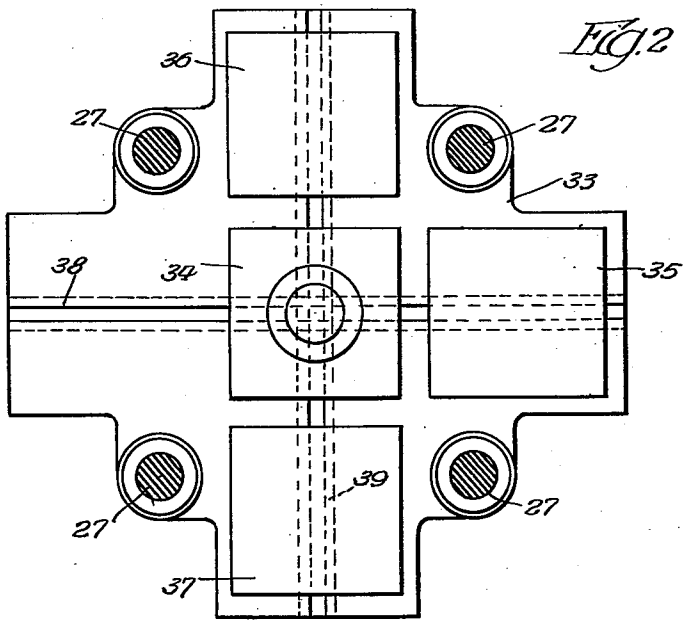
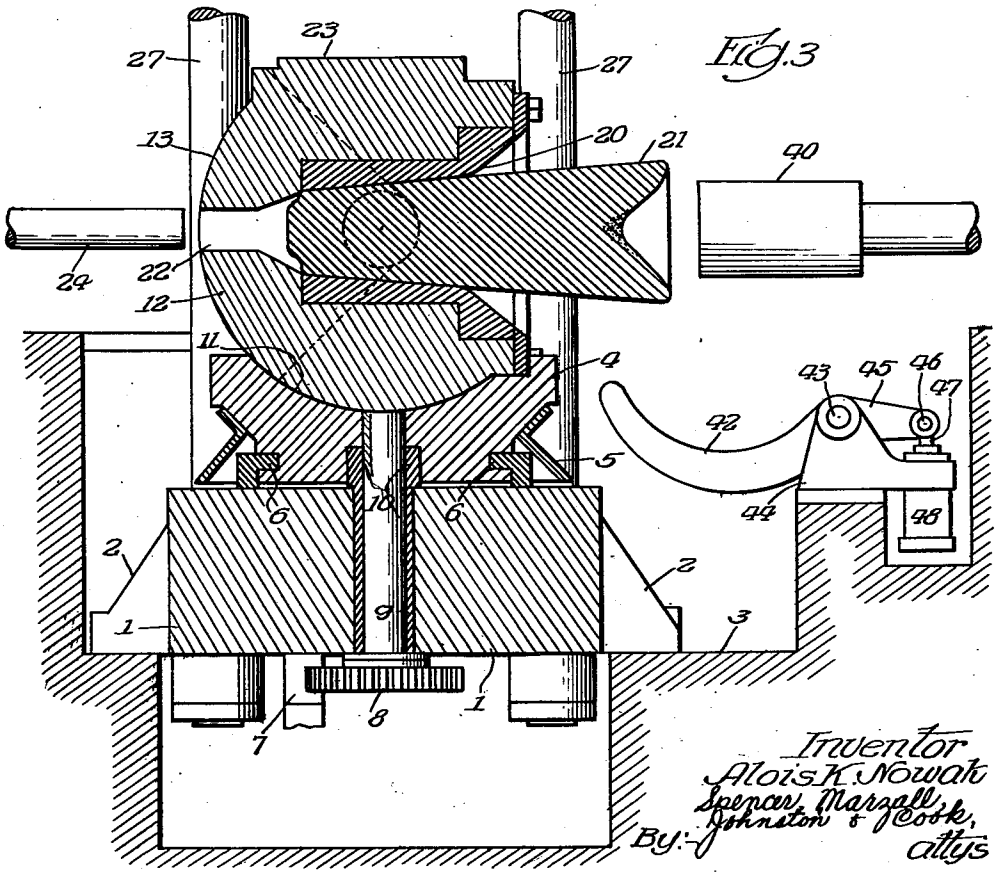


FIG. 3



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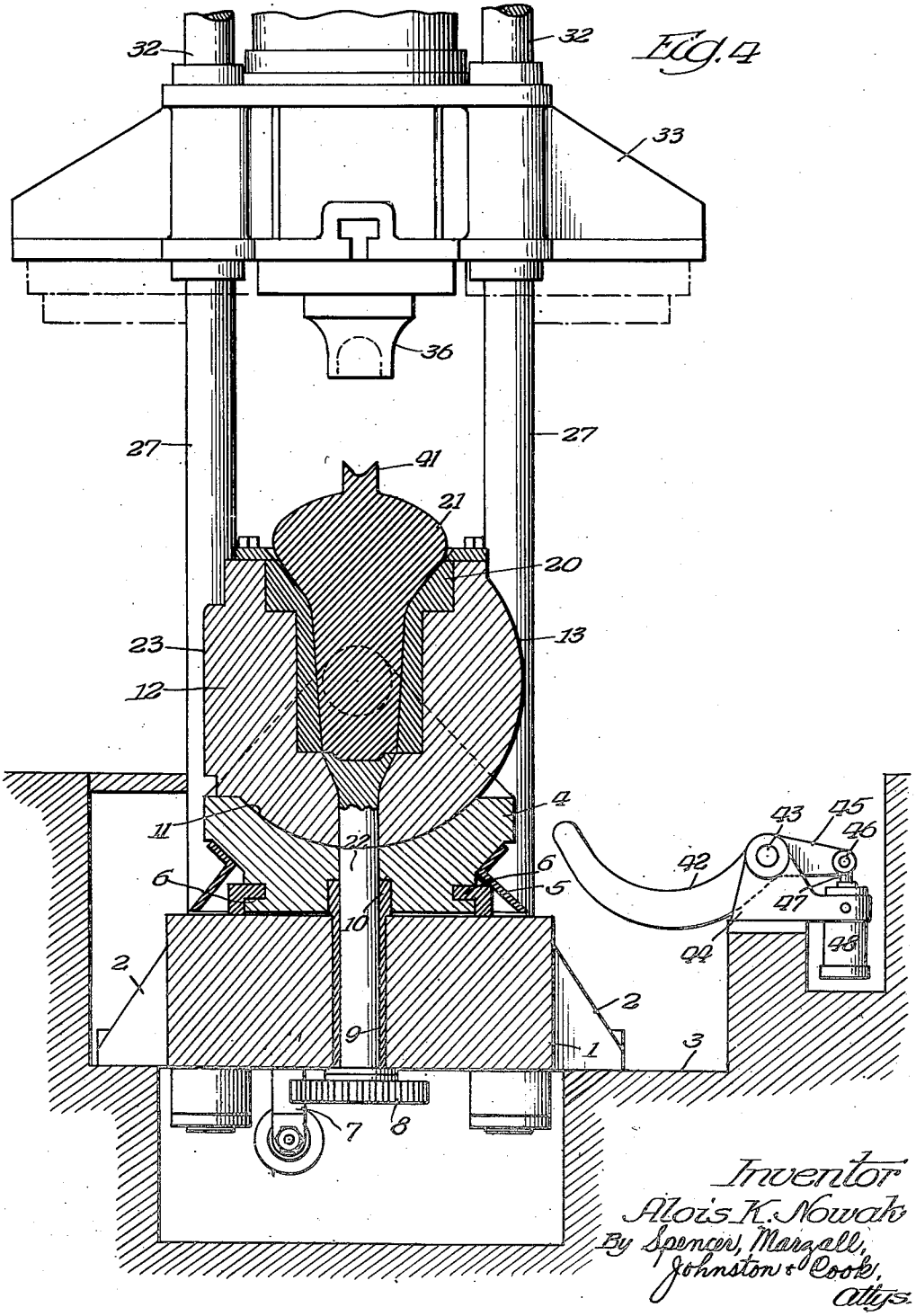


Fig. 4

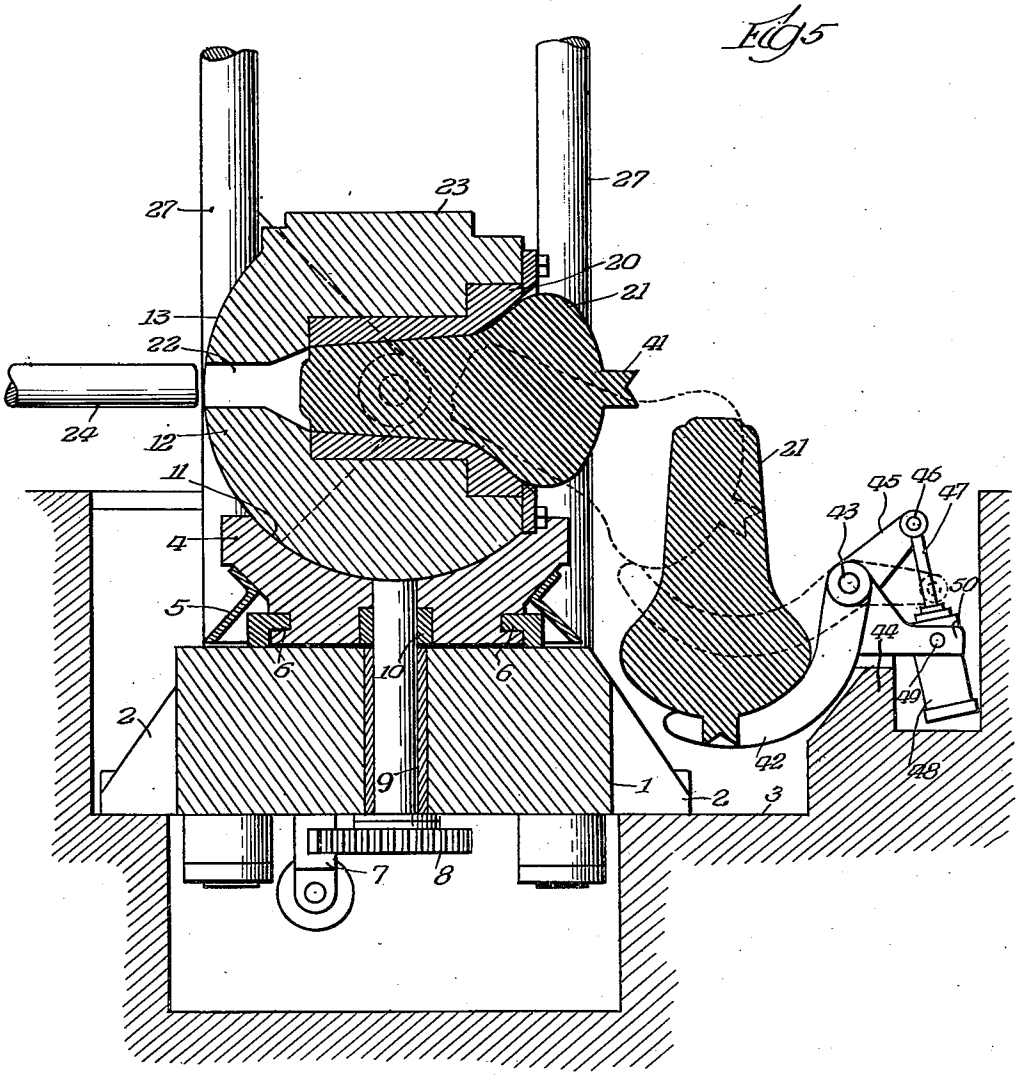
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Fig 5

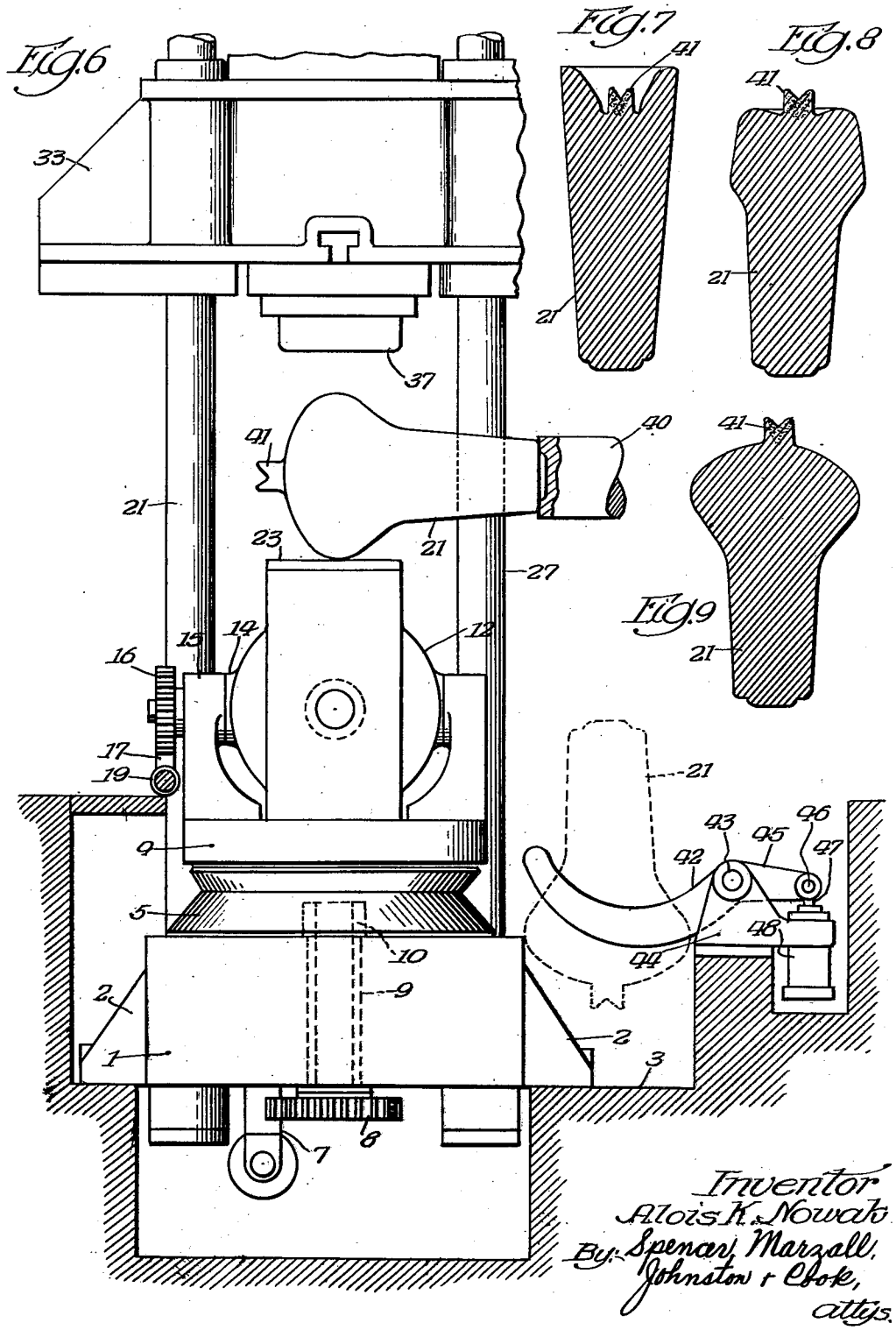


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UNITED STATES PATENT OFFICE

2,603,988

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Application May 27, 1946, Serial No. 672,536

2 Claims. (Cl. 78—60)

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This invention relates to an apparatus and method for extruding, forming and reducing ingots for the purpose of isolating the unsound metal thereof containing the segregated impurities.

It is well known that after an ingot has been poured and commences to cool, the solidification thereof causes a shrinkage of the metal resulting in a cavity being formed centrally of the ingot and at one end thereof, which cavity is known as the "piping." As the ingot congeals the impurities therein will be segregated in an area immediately below the piping.

Removing the unsound metal of the ingot containing the segregated impurities by cutting off the entire end of the ingot just below the segregate has been a common practice. This method disposed of the unsound metal, but it also resulted in the discard of a considerable amount of sound metal which could be used only for remelting, thereby wasting a considerable proportion of the good metal in the ingot. Isolating this unsound metal from the remainder of the ingot resulting in a considerable saving has been proposed in recent years.

My invention is directed to an improvement upon the method of isolating the unsound metal, and provides for an apparatus to carry out the various steps necessary in the extrusion, forming and reducing of the ingot to completely isolate the unsound metal thereof from the sound metal.

It is, therefore, one of the principal objects of my invention to provide a machine which automatically will perform a series of operations on an ingot necessary to isolate the unsound metal thereof.

Another object of the invention is to provide a machine which will receive and hold an ingot while various operations are being performed upon it to isolate the unsound metal thereof, and then will eject the ingot after these various operations have been performed.

A further object of the invention is to provide a machine having a plurality of different dies adapted to be pressed against the end of the ingot having the piping therein to thereby isolate the unsound metal.

Still another object of the invention is to provide a machine for receiving an ingot in one position thereof, and which will move the ingot into a position to be operated upon by a plurality of dies necessary to isolate the unsound metal thereof.

A still further object of the invention is to

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provide a machine which has an automatically operated press containing a plurality of dies, each adapted to be moved into operative position successively thereby to perform successive operations on the ingot.

Still another and more specific object of the invention is to provide a die block for receiving the ingot, the block being capable of being rotated about a horizontal axis as well as about a vertical axis to position properly the ingot for convenient manipulation and operation thereon.

A further object of the invention is to provide novel means to aid the manipulating mechanism for handling the ingot so that the efficiency of the mechanism can be increased considerably.

Still another object of the invention is to provide an improved process for isolating the unsound metal of ingots, the apparatus herein disclosed being adapted to carry out such process.

Numerous other objects and advantages of the invention will be apparent by reference to the following description in conjunction with the accompanying drawings in which:

Fig. 1 is a side elevational view of the apparatus embodying my invention;

Fig. 2 is an under plan view of the press slide containing the various dies therein;

Fig. 3 is a fragmentary enlarged vertical sectional view through the lower part of the machine showing the die block with an ingot which has just been charged therein;

Fig. 4 is a side elevational view of the machine with the lower part thereof in vertical section, showing the die block and ingot after rotation about the horizontal axis thereof to position the ingot vertically, the ingot being shown after having been operated on by the final upsetting die;

Fig. 5 is a vertical sectional view through the die block and ingot therein, showing the manner of ejecting the ingot from the die block;

Fig. 6 is a side elevational view of the machine showing the ingot in position on the anvil portion of the die block and about to be operated upon by the forging die;

Fig. 7 is a vertical sectional view through the ingot as it appears immediately after being operated upon by the extruding die;

Fig. 8 is a vertical sectional view through the ingot as it appears immediately after being operated upon by the first upsetting die, and

Fig. 9 is a vertical sectional view through the ingot as it appears immediately after being operated upon by the final upsetting die.

My invention provides for the use of a die block having a recess therein to receive an ingot to be

operated upon. The ingot is charged into the recess in a horizontal position, after which the die block is rotated about a horizontal axis to position the ingot vertically. The press slide which is adapted to move downwardly and press against the upper end of the ingot, has a plurality of dies therein which may be moved successively into operative position over the ingot. The first operation is the extruding die which produces a cleavage between the unsound portion thereof and the metal surrounding it. The other dies for upsetting the surrounding metal are then brought into position and pressed against the upper end of the ingot. The die block is then returned to its original position, and the ingot ejected, whereupon suitable handling mechanism transfers the ingot to the anvil portion of the die block, at which time the forging die acts to reduce the ingot to substantially its original shape with the isolated unsound portion extending outwardly beyond the end thereof. I also provide means for rotating the die block about a vertical axis so that a subsequent ingot can be charged thereinto while the previous ingot is being acted upon by the forging die.

Referring now more particularly to the drawings, I prefer to so position the machine that the die block is substantially at the floor line, the mechanism below the die block extending downwardly into a pit. The supporting base 1 of the machine is provided with a plurality of supporting blocks 2, which are adapted to rest on shoulders 3 in the pit. The upper side of the base 1 supports a turn-table 4, which has a bracing or supporting member 5 extending downwardly and outwardly intermediate the upper and lower sides thereof. An annular rib 6 is mounted on the upper side of the base 1 and has a horizontal and inwardly extending portion which is adapted to be received within an annular groove in the turn-table, and acts as a guide when the turn-table is rotated.

The turn-table is rotated by means of a rack 7 and gear 8 which may be actuated hydraulically or by any other desired means. The gear 8 has secured thereto a vertically extending tubular member 9 having a collar 10 attached thereto, or integral therewith, and this member 9 is supported by the upper side of the base 1. The tubular member 9 and collar 10 provide a vertical elongated opening through the turn-table and base, the purpose of which will be more fully explained hereinafter. The collar 10 may be secured in any suitable manner to the turn-table 4 so that actuation of the rack 7 and gear 8 will impart a rotary movement to the turn-table.

The upper surface of the turn-table 4 is concave, substantially as shown at 11 in Figs. 3, 4 and 5, in order to receive the die block 12, which has an outer spherical portion 13. It will be noted that this spherical surface extends substantially halfway around the die block so that when it is rotated about its horizontal axis, this surface 13 will ride in the concave surface 11 of the die block.

The mounting of the die block 12 for rotation about its horizontal axis may be more clearly seen by reference to Figs. 1 and 6, where the die block is shown as being provided with trunnions 14 extending outwardly at each side thereof, and journalled in bearing 15 supported on the upper side of the turn-table 4. One of the trunnions 14 has a gear 16 secured to its outer end, the gear 16 being adapted to be rotated by a rack 17. While any suitable means may be provided to actuate and reciprocate the rack 17, I have shown in Fig. 1, the rack as being secured to a piston rod 18, movable within a cylinder 19 which may be actuated by hydraulic means. It will be clear that reciprocation of the rack 17 will rotate the die block 12 about its horizontal axis through the gear 16.

The die block is provided with a recess having a liner or insert 20 adapted to be formed of any desired material suitable for withstanding wear and the high temperature of the ingot if it is placed therein while still hot, and has converging sides having a taper substantially the same as that of the ingot 21 so that the ingot may be supported tightly therein. The recess extends all the way through the die block and terminates at its opposite end in a reduced portion 22. The die block 12 is also provided at one side thereof with an anvil portion 23 which supports the ingot 21 when it is being forged back to its original shape, as will be more fully described hereinafter.

The ejector 24 is adapted to be moved through the opening 22 and against the ingot 21, after all of the operations have been performed thereon, to eject the ingot and permit a subsequent one to be charged therein.

The ejector arm 24, Fig. 1, is supported in a bearing 25, and is adapted to be reciprocated therein. The opposite end thereof is secured to actuating means 26 which, in the preferred embodiment of the invention, will be operated hydraulically, although other means such as mechanical or electrical, may be used with equal success.

A plurality of columns 27 extend upwardly from the base 1 and, together with the column 28, support a platform 29 at the top of the apparatus. A housing 30 is located on the platform within which the mechanism is located for actuating the press slide and moving it against the ingot to perform the various operations thereon. This actuating mechanism may take the form of pumps, if the apparatus is to be operated hydraulically, or may be any other suitable means if the apparatus is to be operated mechanically. In the form of the invention shown, cylinders 31 extend downwardly through the platform 29 and have pistons and piston rods 32 movable therein. The piston rods in turn support the press slide 33, which is reciprocable along the columns 27, the under side of which is shown in Fig. 2. It is desirable to first produce a cleavage by artificial means between the unsound metal containing the segregate and the surrounding sound metal, and for this purpose I provide an extruding die 34. I also provide two upsetting dies 35 and 36 to produce in succession the shapes at the upper end of the ingot, as shown in Figs. 8 and 9. If it is desired to perform a final forging operation to reduce the ingot back to substantially its original shape, I provide a forging die 37. All of these dies are located in and carried by the press slide 33, and each is movable to a central position within the press slide, so that it can perform the desired operation on the ingot. These dies are mounted on shuttle blocks which in turn are movable on tracks within the press slide. As shown in Fig. 2, the extruding die 34 and first upsetting die 35 move along the track 38, while the second upsetting die 36 and forging die 37 move along the track 39. The specific arrangement of these various dies with relation to each other is rela-

tively unimportant, since after the extruding die performs its operation, it is moved along the track 38 and the first upsetting die takes its place at the center of the press slide. Likewise, each successive die is moved to the center position so that as the press slide descends, it is pressed against the upper end of the ingot. Here again the actuating means for moving the shuttles with the dies thereon successively into position, may be either hydraulic or mechanical, as desired.

The operation of the machine thus far includes the first step of positioning the die block 12, as shown in Fig. 3, with the recess therein in a horizontal position. A manipulator 40 is adapted to charge the ingot into the recess of the die block. This manipulator may take any suitable form such as a chain hoist, a pair of tongs, or other means in common usage for the handling of ingots in steel mills.

After the ingot is in place the rack and pinion 17 and 16 are actuated to rotate the die block with the ingot therein to position the ingot substantially vertically with the area of segregated impurities at the top thereof immediately below the piping. The extruding die 34 will have been moved to the position shown in Fig. 2 in the center of the press slide and the slide moved downwardly under sufficient pressure so that the die will press against the upper end of the ingot and isolate the unsound metal thereof. The shape of the ingot at this point will be as shown in Fig. 7.

The first upsetting die 35 is then moved to the center of the press slide 33 along the track 38 as the extruding die 34 is moved out of position. The press slide is again lowered to press the upsetting die against the end of the ingot to upset the sound metal around the isolated unsound metal, and the ingot will then take the shape substantially like that shown in Fig. 8.

After the slide moves upwardly again and the first upsetting die is moved back to its original position, the second upsetting die 36 is moved to the center of the press slide and will be lowered and pressed against the end of the ingot to further upset the sound metal so that the ingot will then take substantially the same shape as that shown in Fig. 9.

The isolated portion 41 will then project upwardly from the center of the ingot as shown in Figs. 4 and 9, and may be cropped at this time if so desired. If the ingot is to be forged back to substantially its original shape for rolling or extruding into a seamless tube, the isolated metal may be left on the ingot and disposed of after the rolling operation, but if the ingot in the form shown in Fig. 9 is to be immediately formed into the final article, it may be advisable to crop the isolated metal before a further forging operation.

After the final upsetting die has performed its operation, the rack and pinion 17 and 16 will then be actuated to rotate the die block 12 so that the ingot therein will again assume a horizontal position, as shown in Fig. 5, with the anvil portion 23 of the die block also in a horizontal position at the top thereof. The ejector arm 24 will then be moved through the opening 22 and force the ingot 21 outwardly, where it will be intercepted by a supporting arm 42. This arm may be pivoted at 43 to a support 44 and have a rearwardly extending portion 45 pivotally secured at 46 to the piston rod 47 of a cylinder 48. The piston 48, which may be hydraulically operated if so desired, is rotatably mounted by means of a pivot pin 49 between rearwardly extending arms 50 of the support 44. When the supporting arms 42 receive the ingot 21, the position thereof will be like that shown in Fig. 5 where the supporting arms have been rotated downwardly and the piston rod 47 will be extended as shown. To permit this motion the cylinder 48 will pivot slightly about its pivotal point 49.

If a further forging operation is desired, the piston 48 and piston rod 47 will be actuated to rotate the supporting arms 42 in a clockwise direction and carry the ingot 21 upwardly to a position where it can be easily contacted by the manipulator 40, which will place the ingot on the anvil 23, as shown in Fig. 6. In the meantime, the forging die 37 will have been moved to the center of the press slide, which will then be lowered to bring the forging die against the bulged-out part of the ingot to thereby reduce it back to substantially its original shape.

To further increase the efficiency of the machine, I provide a similar manipulator and supporting and delivering mechanism on another side of the machine, substantially 90° away from that shown in the present figures. When this is done, the rack and pinion, 7 and 8, will be operated to rotate the turn-table 4 and the die block about a vertical axis after the ingot has been ejected therefrom. Then while the manipulator is transferring the ingot from the die block to the anvil, another ingot will be charged into the recess when the apparatus is in the position shown in Fig. 6. Then, after the final forging operation on the ingot has been completed, and the ingot removed from the anvil, the die block can be rotated about its horizontal axis to bring a succeeding ingot into position to be operated upon. This procedure will obviate the necessity of waiting until the final forging operation on an ingot has been completed before charging a succeeding ingot into the die block.

It should be noted that when the ingot is in a vertical position, as in Fig. 4, the opening 22 in the die block will be in vertical alignment with the elongated opening through the base and within the tubular member 9. As the various isolating and upsetting operations are performed on the ingot, a certain amount of crust and scale will be forced off of the ingot, which will drop downwardly into the pit through this latter opening.

The invention provides an efficient apparatus for performing isolating and upsetting operations on an ingot to separate the unsound metal thereof from the sound metal without necessitating the removal of any of the sound metal.

While the invention has been shown and described herein in the preferred embodiment thereof as being actuated hydraulically, it will be clear that other actuating means can be employed, and the general form, construction and arrangement of parts can be modified without in any way departing from the spirit or scope of the invention and without sacrificing any of the attendant advantages.

Having thus described my invention what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a machine having dies associated therewith for isolating unsound metal of an ingot, a unitary die block having a substantially semicircular outer surface and an opening therethrough, said opening terminating at one end

thereof in a reduced neck portion, whereby crust and scale from the ingot will drop therethrough during the working of the ingot, a support for said die block having the surface thereof concave to receive and support the curved outer surface of said die block, a vertically disposed opening through said support adapted to become aligned with the opening through said die block when said last named opening is vertically positioned whereby to dispose of said crust and scale, and means to rotate said die block on its support and about a horizontal axis from the horizontal ingot receiving position of the opening therethrough to a vertical position of said opening for isolating the unsound metal of the ingot therein.

2. In a machine having dies associated therewith for isolating unsound metal of an ingot, a unitary die block having a portion of the outer surface thereof convexly curved and having an opening therethrough to receive an ingot, a support for said die block having the surface thereof concave to receive and support the curved outer surface of said die block, a vertically disposed opening through said support in alignment with said first opening during the isolating of the unsound metal, and means to rotate said die block on its support about a horizontal axis.

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