

Sept. 30, 1969

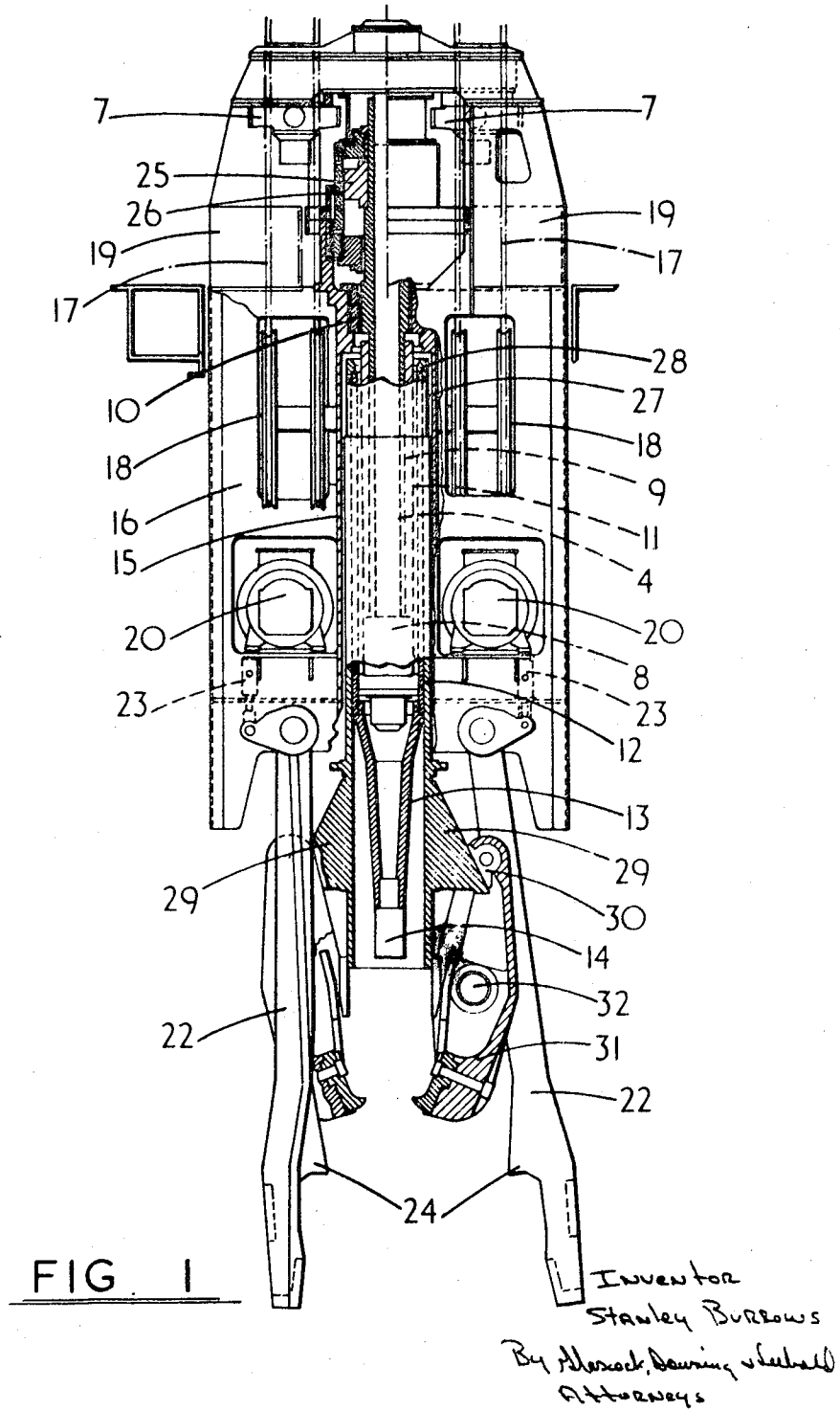
S. BURROWS

3,469,722

APPARATUS FOR REMOVING INGOTS FROM MOULDS

Filed Nov. 24, 1967

3 Sheets-Sheet 1



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J. CRIGNON ETAL

3,469,721

APPARATUS FOR VERTICAL EXTRACTION OF MATERIAL

Filed Aug. 22, 1967

4 Sheets-Sheet 3

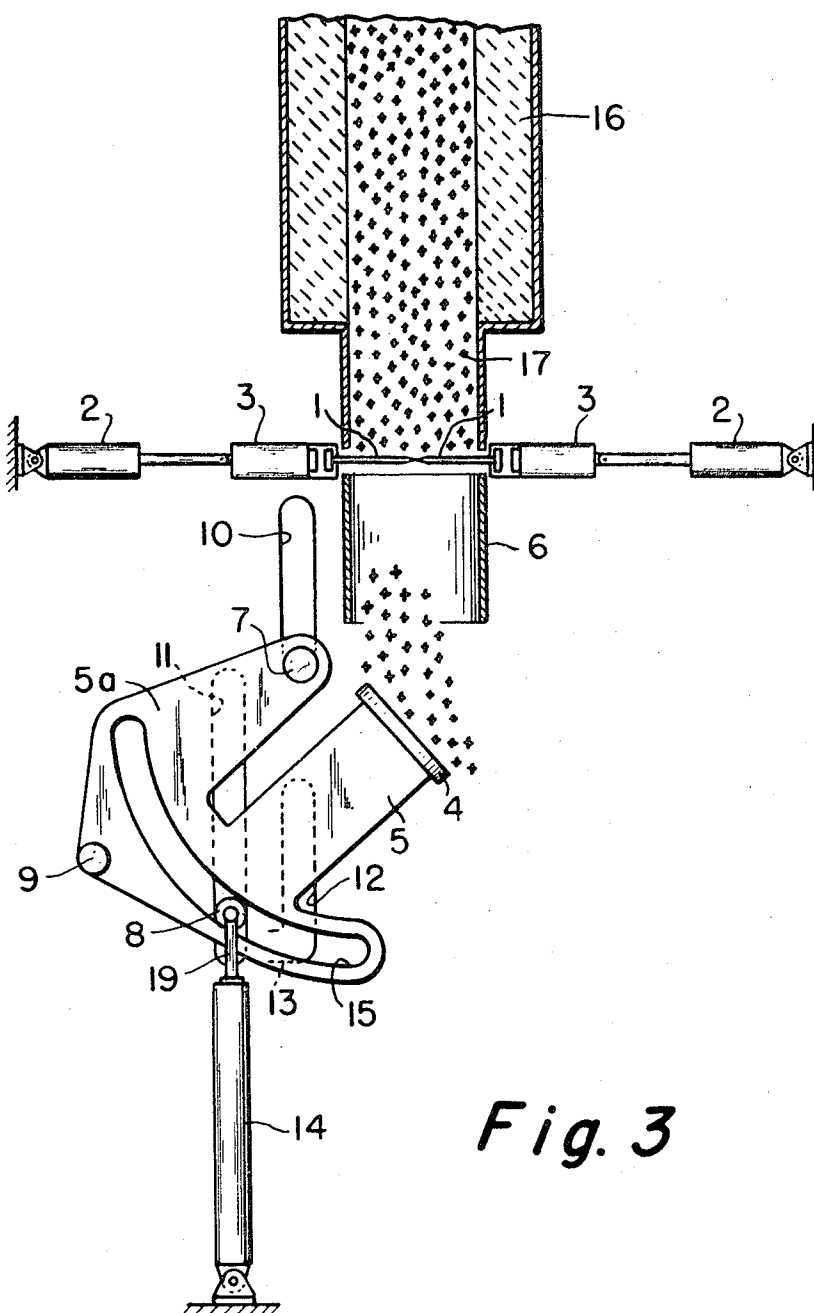


Fig. 3

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APPARATUS FOR VERTICAL EXTRACTION OF MATERIAL

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4 Sheets-Sheet 4

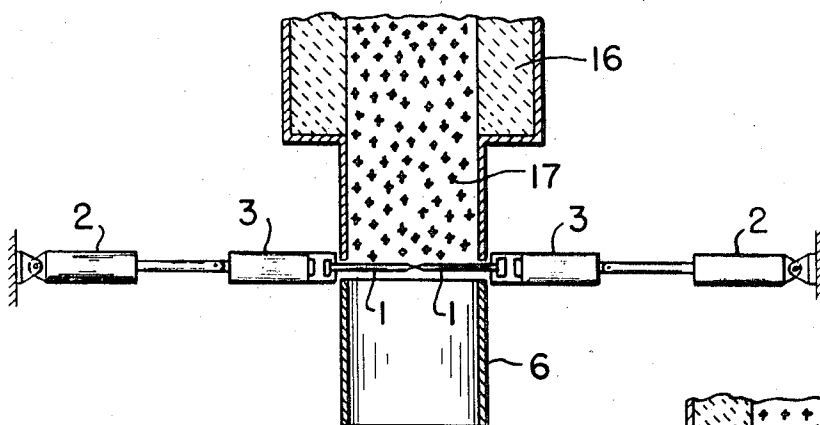


Fig. 4

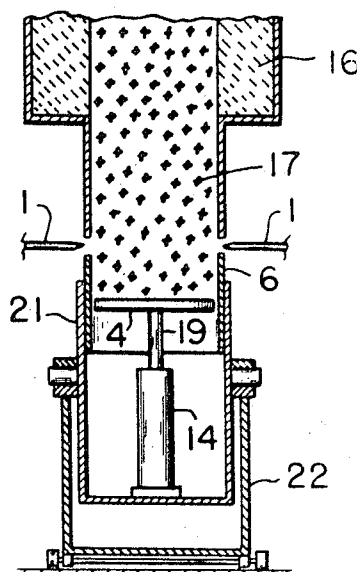


Fig. 5

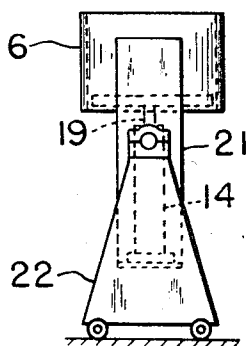


Fig. 6

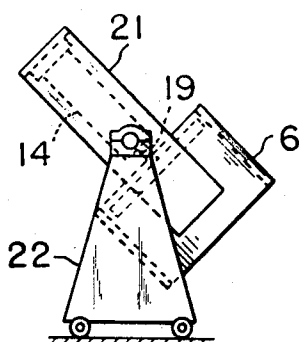


Fig. 7

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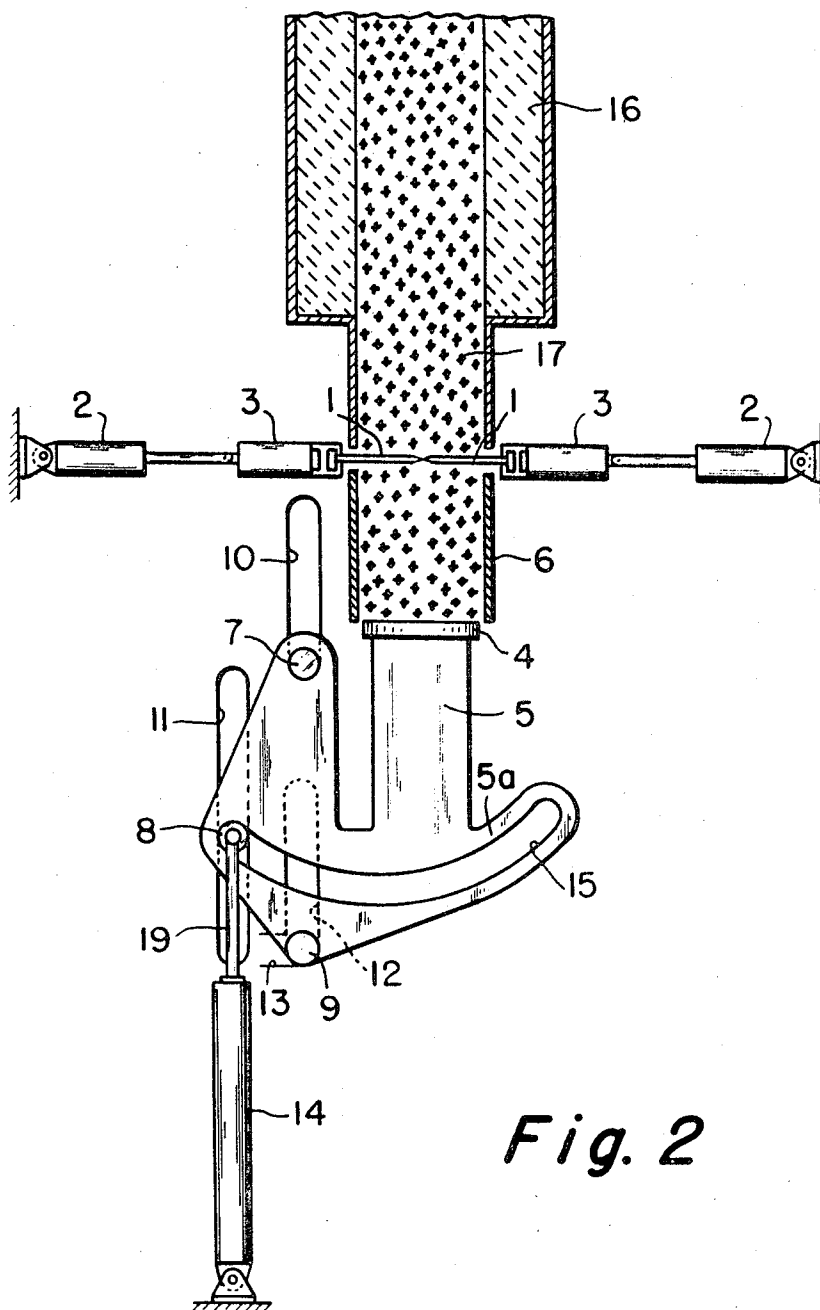


Fig. 2

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APPARATUS FOR REMOVING INGOTS FROM MOULDS

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3 Sheets-Sheet 2

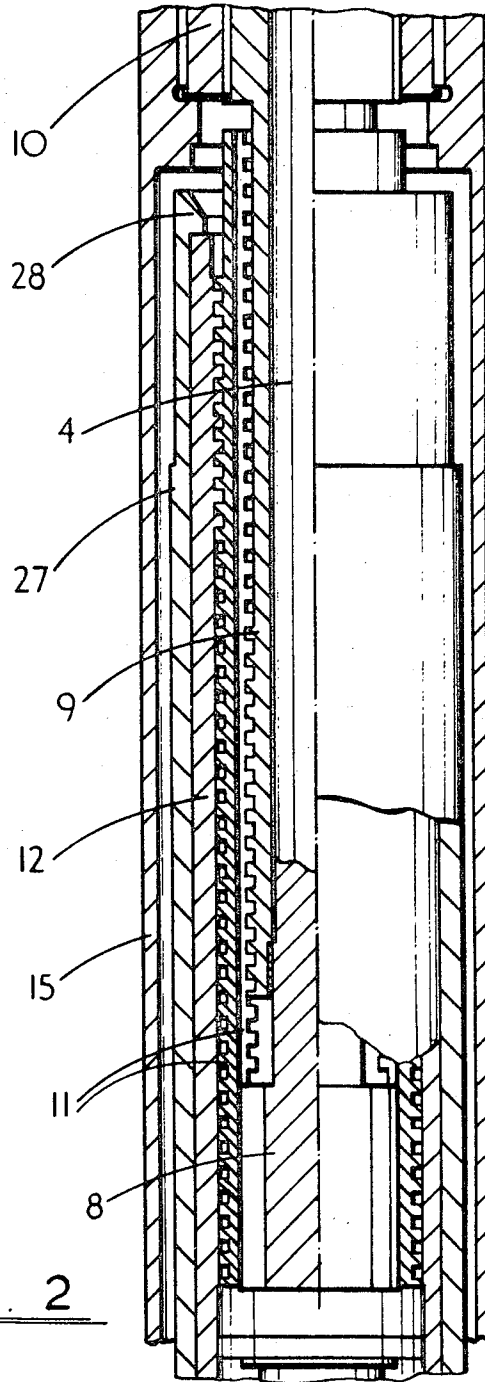


FIG. 2

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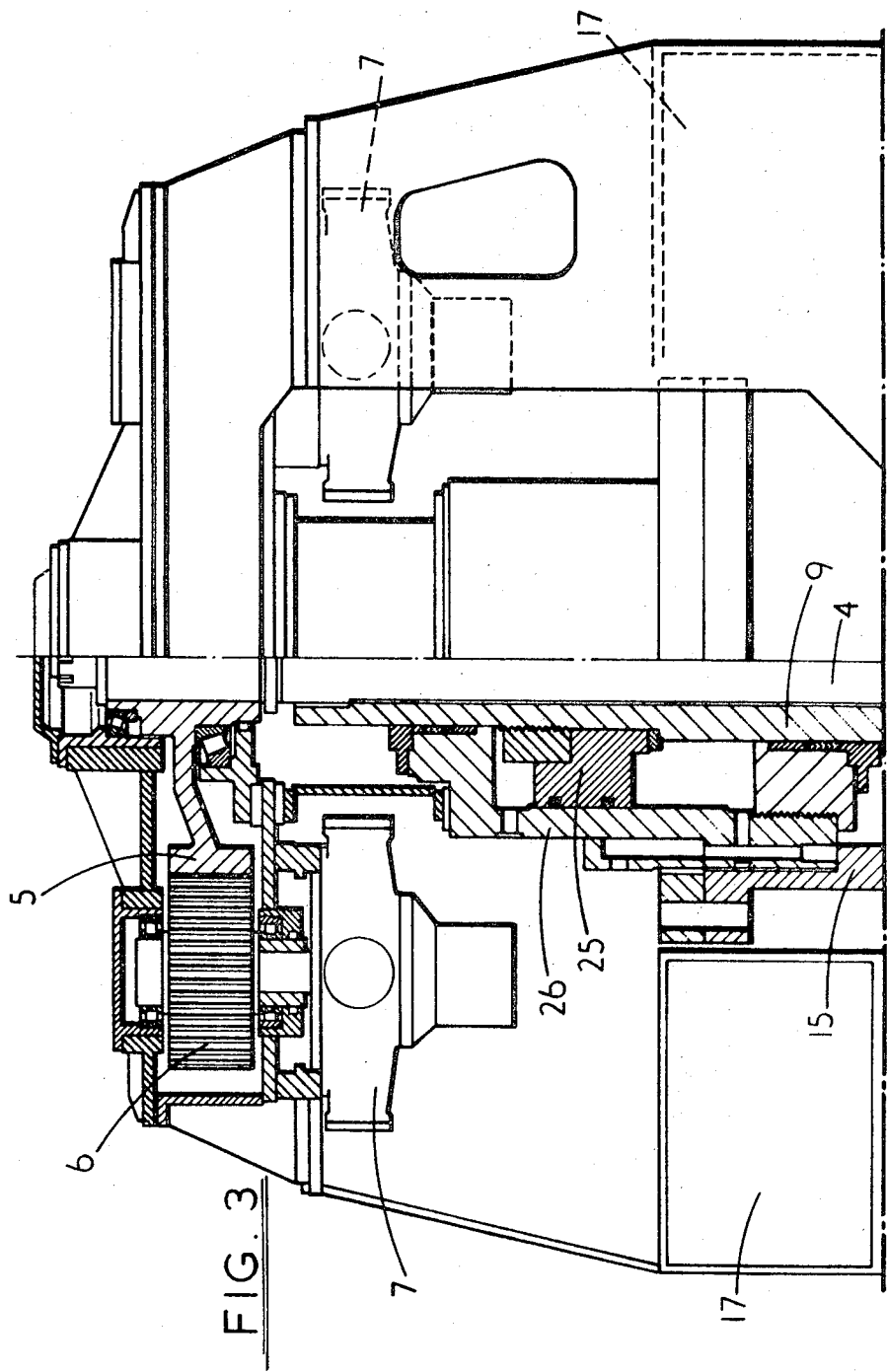
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APPARATUS FOR REMOVING INGOTS FROM MOULDS

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3,469,722 APPARATUS FOR REMOVING INGOTS FROM MOULDS

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U.S. Cl. 214—309

5 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for removing an ingot from a mould comprising a member arranged to be moved into engagement with an ingot whilst the mould is held fixed. The ingot-engaging member is advanced mechanically by screw-threaded means and if the force applied by the screw-threaded means is insufficient to remove the ingot, the ingot-engaging member is subsequently advanced by hydraulic means until the ingot is removed.

This invention relates to apparatus for removing ingots from moulds.

It has previously been proposed to provide a screw-type mechanism for stripping ingots from moulds. In this mechanism a vertical screw is driven by an electric motor through gearing thereby causing a ram and bull nose to descend and push out the ingot, the mould being held meanwhile by side arms which engage with projections on the sides of the mould. The advantage of the screw-type stripping mechanism is that a long travel can be accommodated.

It has also been previously proposed to employ an hydraulic stripping gear in which a descending ram is pushed downwards by a piston operating in an hydraulic cylinder to urge an ingot out of a mold. The hydraulic mechanism has an advantage over the screw-type in that it can provide a higher stripping force.

Both screw and hydraulic forms, however, have disadvantages. The screw-type has the inherent low efficiency of a screw and nut mechanism and if the gearing ratio is chosen to provide a high stripping pressure, the action will be slow even when the ingot offers low resistance to ejection from its mould. Further, the maximum stripping pressure of the screw type is limited by screw friction and the largest driving motor which can be accommodated. On the other hand the hydraulic type of gear has disadvantages in that if a long stroke is required, a long cylinder and large displacement of oil must be provided, thereby necessitating large capacity oil tanks and pumps. Also the lower end of the cylinder is liable to become heated from the hot ingots.

An object of the present invention is to obviate or mitigate the aforesaid disadvantages of both the screw-type and hydraulic stripping gears.

According to the present invention there is provided apparatus for removing an ingot from a mould comprising means for gripping the mould, screw means adapted to move an ingot-engaging member into engagement with the ingot in the mould to tend to remove it therefrom until the resistance of the ingot to displacement prevents further movement of the ingot-engaging member, and hydraulic means operable on stalling of the screw means to effect movement of the locked screw means and the ingot-engaging member as a unit so as to cause further displacement of the ingot until the ingot is removed from the mould, said screw means comprising a rotationally and axially movable internally and externally screw-threaded nut, a ram member in screw threaded engagement with

one of the threads of the nut and adapted to be moved axially on rotation of the nut, a member in screw-threaded engagement with the other thread of the nut and adapted to be moved axially on rotation of the nut, and said hydraulic means adapted to effect axial movement of the latter member whereby the member, nut and ram member can be moved axially as a unit.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIG. 1 is a longitudinal sectional view of ingot stripping apparatus,

FIG. 2 is an enlarged fragmentary section illustrating relatively movable screw-threaded components shown generally in FIG. 1 and

FIG. 3 is a detail view illustrating drive mechanism for the apparatus.

Referring to the drawings, apparatus for stripping ingots from moulds comprises a vertical drive shaft 4 having a gear wheel 5 (FIG. 3) secured to its top end whereby the shaft 4 can be driven through reduction gearing 6 by means of hydraulic motors 7. The lower end of the shaft 4 is provided with an enlarged splined head 8 (FIGS. 1 and 2). Surrounding the shaft for substantially the whole of its length, excluding the splined head, is a cylindrical sleeve 9 provided with an external screw thread adjacent its lower end as shown in FIG. 2, the sleeve 9 co-operating with a splined fixed collar 10 so as to permit movement only in an axial vertical direction. In mesh with the screw-threaded portion of the sleeve 9 is an elongated nut 11 which is screw-threaded right hand internally and left hand externally, (or vice versa), the external screw-threading being in mesh with an internally screw-threaded non-rotating outer cylinder or ram 12 which carries at its lower end a depending ram extension 13 and bull-nose 14. The internal surface of the nut 11 throughout its length is provided with grooves to receive the splines of the splined head 8 at the lower end of the drive shaft 4. In this way the nut 11 can move axially relative to the shaft 4 but cannot move rotationally relative to it. The shaft 4, nut 11 and ram 12 are surrounded by a hollow cylindrical casing 15 (FIG. 1) which is integral with a vertically sliding column 16, the column 16 in turn being carried on suspension ropes 17 which pass round rope sheaves 18 at their lower extremities and over hoisting drums (not shown) located at one side of the upper end of the apparatus to be anchored to an equalising device (not shown but of known form) at the other side. The column 16 also houses oil tanks 19 and an electric motor or motors 20 which drive hydraulic pumps (not shown) and a manifold block which contains solenoid-operated control valves. Adjacent to the lower end of the column 16 is carried a pair of pivotally mounted link tongs 22 controlled by hydraulic cylinders 23 mounted on the column 16. The link tongs 22 are arranged to engage projections or lugs on the mould whilst the bull-nose urges an ingot out of the mould, and the tongs 22 have integral projections 24 thereon.

Towards the top of the vertical drive shaft 4, the surrounding sleeve 9 passes through the central bore of an hydraulic piston 25 and is keyed thereto, the piston 25 acting within the bore of an associated cylinder 26 which is in communication with the hydraulic motors 7 via the control valves.

Surrounding the ram 12 is a block 27 which is slidable within a bore in the column 16 and which block has an annular shoulder 28 at its top end. Towards the lower end of the block 27 there are provided inclined guides 29 arranged to engage slideblocks 30 carried by extractor jaws 31 which are pivotally mounted at 32.

In operation of the apparatus, the vertical shaft 4 is located over the ingot and the mould and the link tongs

22 are operated to engage the projecting side lugs of the mould. Hydraulic fluid is then pumped to the hydraulic motors by the motor-driven pumps from the oil tanks 19 in the hollow column 16. Operation of the hydraulic control valves causes the vertical shaft 4 to rotate which in turn, through the splined head 8 at the lower end of the shaft engaging with the grooves in the nut 11, causes rotation of the nut. Rotation of the nut 11 causes the rotating ram 12 which carries the ram extension 13 and bull-nose 14 to be advanced downwardly under screw action until the bull-nose 14 contacts the ingot. If the ingot shows little or no resistance to stripping from the mould, the ram extension 13 and bull-nose 14 continue their downward travel under screw action until the ingot is stripped from the mould. If, however, the ingot shows appreciable but limited resistance to stripping, the nut 11 continues to rotate and pressure is applied to the top of the ingot until the hydraulic motors 7 attain their maximum driving torque causing them to stall. When this point is reached, the high pressure oil is diverted by automatic or manual operation of the control valves to the top of the hydraulic cylinder 26 which houses the piston 25 to which the sleeve 9 surrounding the drive shaft 4 is keyed. The piston 25 is then displaced downwards carrying with it the sleeve 9, nut 11 and screw-threaded ram 12 which act as a locked unit to transmit pressure to the ram extension 13 and bull-nose 14. In this way pressures of 1000 tons or more can be imparted to the bull-nose 14 for the full stroke of the cylinder. When the piston 25 reaches the bottom of its stroke pressure is automatically released from the top side of the piston. The hydraulic motors 7 are thus relieved from their stalled condition and since the ram 12 is still prevented from downward travel due to the bull-nose resting on the sticking ingot, the hydraulic motors 7 recommence to rotate the drive shaft 4, thereby rotating the nut 11 and causing the piston-carrying sleeve 9 to be screwed upwardly until the piston 25 is returned to the top of its stroke. At this point pressure is again automatically or manually applied to the top of the piston 25, the hydraulic motors 7 become stalled, and full hydraulic pressure is again transmitted to the ram extension 13 and bull-nose 14. The sequence of operations is repeated if necessary until the ingot is removed from its mould.

The angle of thread of the screw-threaded members of the above described arrangement is so proportioned that under locked conditions little or no torque is transmitted back to the hydraulic motors 7. Also it will be seen that the screw mechanism is never subjected to heavy load whilst rotating, thus minimising wear and greatly prolonging its life.

With the screw-hydraulic ingot stripping apparatus it will be readily apparent that the screw mechanism is employed for the purpose of ejecting ingots having only a relatively small tendency to stick to their moulds and requiring a comparatively low stripping force. In actual steelworks practice, the majority of ingots fall into this category and only a small proportion are classed as "heavy stickers," requiring abnormally high forces as provided by the hydraulic action of the present invention in order to release them.

It should be noted that whilst the invention has been described for application to ingots which must be pushed downwards to free them from their moulds, it is equally applicable to ingots which must be lifted out to free them from their moulds. The two functions can be combined in one screw mechanism so that downward movement of the bull-nose pushes ingots downwards, whilst the upper movement of the screw is available for the purpose of gripping and extracting ingots upwards.

The method of extracting an ingot upwardly from the mould is described with particular reference to FIG. 1. When the ram 12 is retracted beyond the range of screw

travel assigned to the ingot-removing operation, the top end of the ram 12 comes into contact with the shoulder 28 of the block 27. Further upward travel causes the ram 12 to lift the block 27. The inclined guides 29 cause the jaws 31 to pivot about 32 until they are embedded in the ingot. At this stage the jaws are locked in their engaging position and further upward movement of the ram 12 and block 27 causes the jaws 31, block 27, ram 12, nut 11 and sleeve 9 to lift as a unit under hydraulic pressure to extract the ingot from the mould. Projections 24 on the link tongs 22 bear against the top surface of the mould and prevent it from lifting. The ingot is thus extracted and may then be lifted by the hoist gear after the link tongs 22 are opened.

Since the invention is in effect an intensifier of screw thrust or screw pull, it can be used equally well for stripping (screw in compression) or for extracting (screw in tension).

What is claimed is:

1. Apparatus for removing an ingot from a mould comprising means for gripping the mould, screw means adapted to move an ingot-engaging member into engagement with the ingot in the mould to tend to remove it therefrom until the resistance of the ingot to displacement prevents further movement of the ingot-engaging member, and hydraulic means operable on stalling of the screw means to effect movement of the locked screw means and the ingot-engaging member as a unit so as to cause further displacement of the ingot until the ingot is removed from the mould, said screw means comprising a rotationally and axially movable internally and externally screw-threaded nut, a ram member in screw-threaded engagement with one of the threads of the nut and adapted to be moved axially on rotation of the nut, a member in screw-threaded engagement with the other thread of the nut and adapted to be moved axially on rotation of the nut, and said hydraulic means adapted to effect axial movement of the latter member whereby the member, nut and ram member can be moved axially as a unit.

2. Apparatus as claimed in claim 1, in which the ram member comprises a cylindrical sleeve located externally of the nut and the hydraulically actuated member is in the form of a sleeve located internally of the nut, said sleeve having secured thereto an hydraulically movable piston.

3. Apparatus as claimed in claim 2, in which the nut is rotatable by means of a shaft extending axially within the sleeve, the shaft having a splined portion in engagement with co-operating splines on the nut.

4. Apparatus as claimed in claim 1, in which rotation of the nut is effected by means of an hydraulic motor or motors.

5. Apparatus as claimed in claim 1, in which extractor jaws are provided for engaging the ingot, the jaws being carried by a structure axially movable on axial movement of the ram member, said axial movement of the structure causing the ingot to be engaged by the jaws and subsequently causing upward extraction of the ingot from the mould.

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U.S. Cl. X.R.

164—405; 214—310; 249—66