Aug. 30, 1966 J. A. DOHERTY 3,269,564

INGOT TURNING MACHINE

Filed June 30, 1964 3 Sheets-Sheet 1

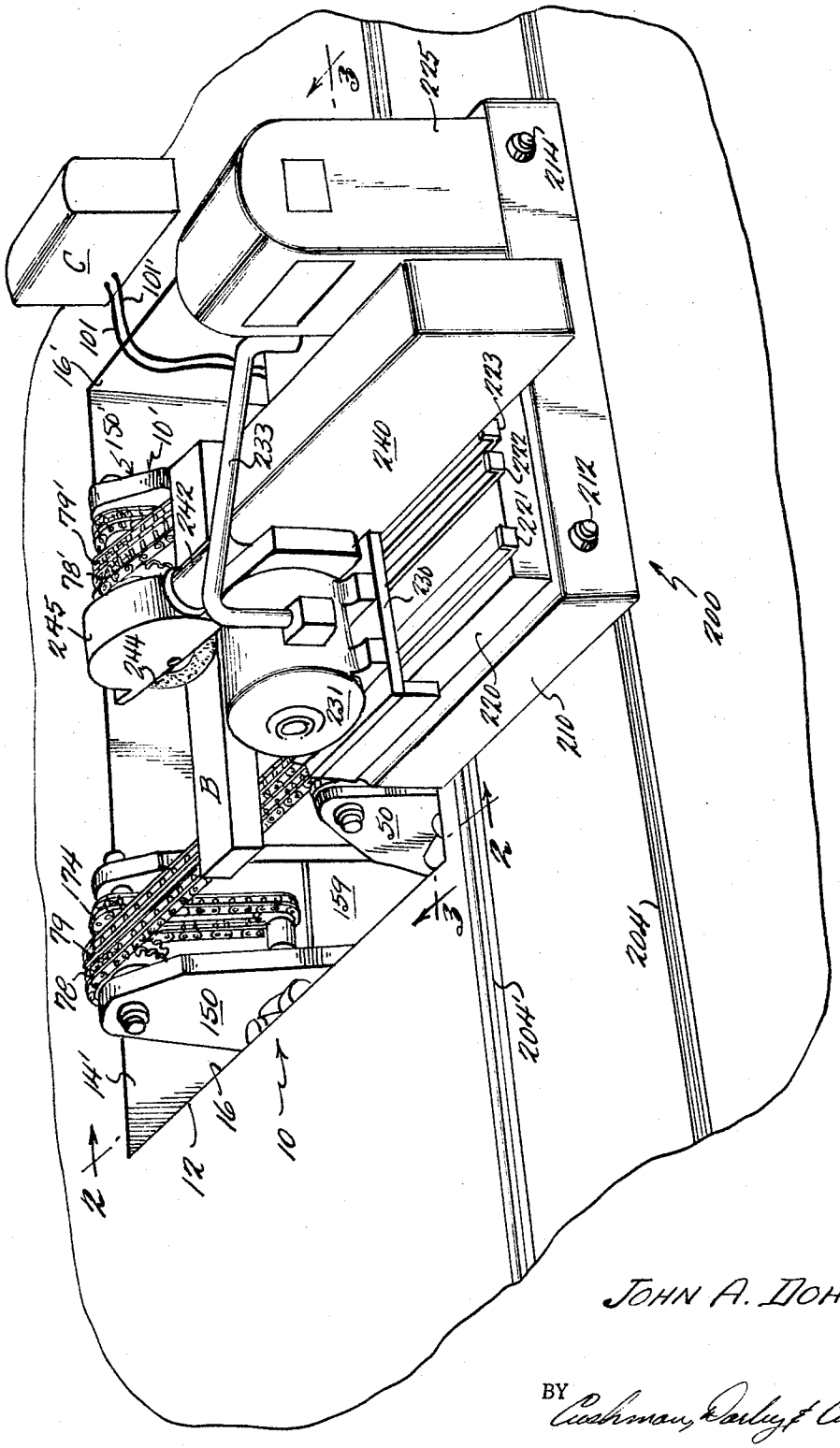


Fig. 1

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INGOT TURNING MACHINE

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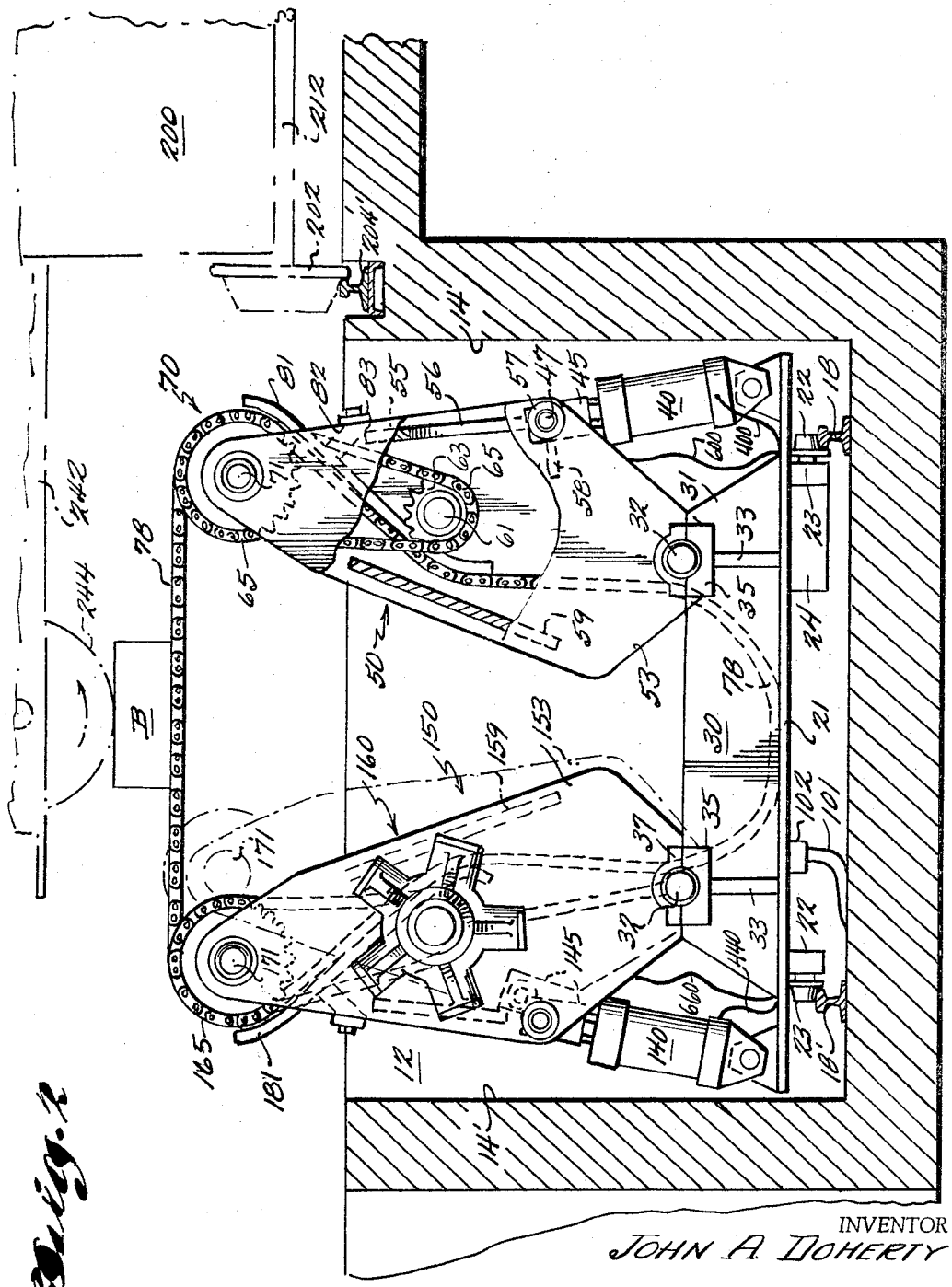


Fig. 2

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INGOT TURNING MACHINE

Filed June 30, 1964 3 Sheets-Sheet 3

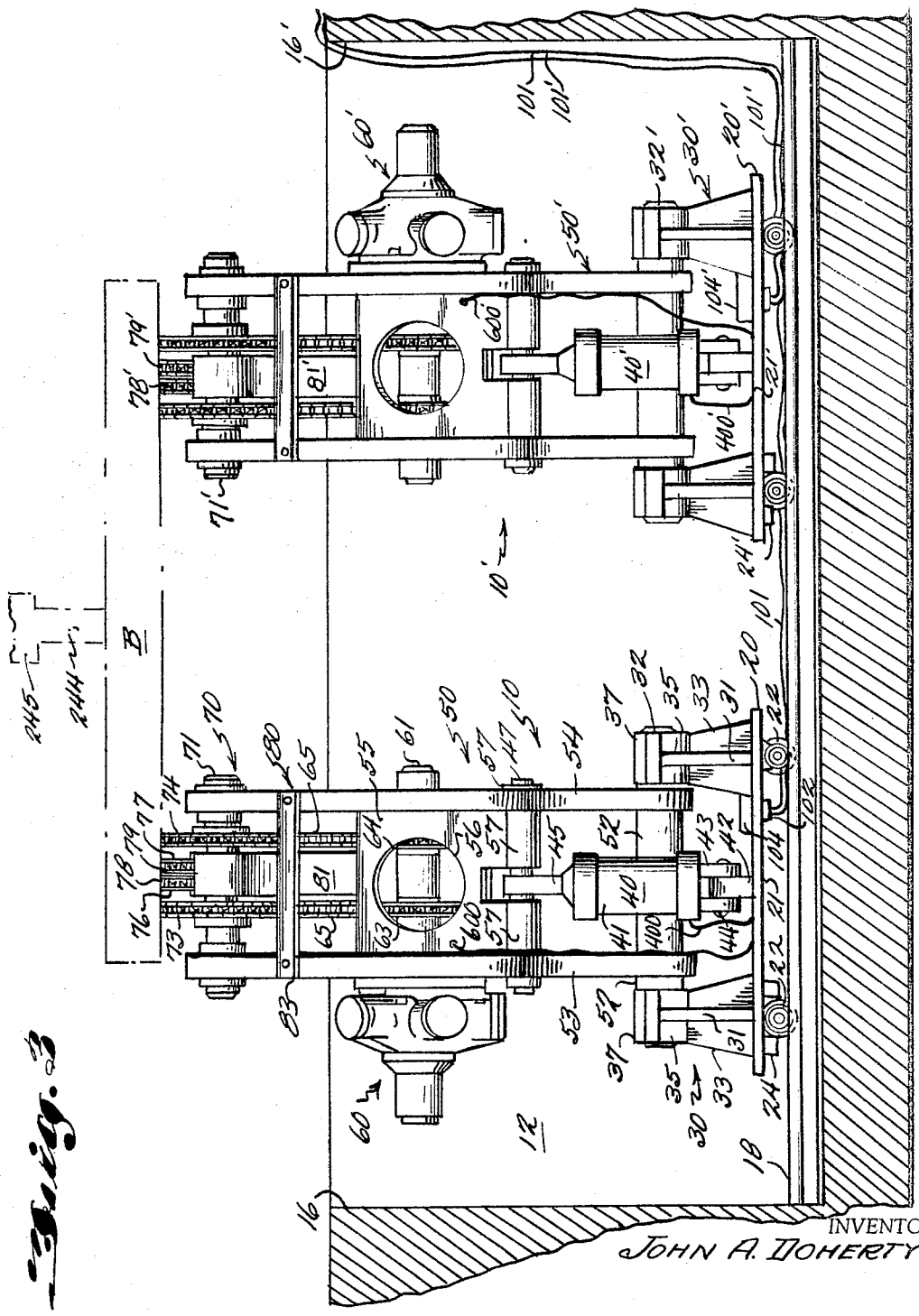


Fig. 2

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United States Patent Office 3,269,564
Patented August 30, 1966

3,269,564

INGOT TURNING MACHINE

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Filed June 30, 1964, Ser. No. 379,188
20 Claims. (Cl. 214—1)

The present invention relates to improvements in the turning and handling of ingots, slabs, and other ponderous objects encountered in heavy industries. More particularly, the present invention relates to an improved remote controlled ingot turning machine that will permit ease and precision of control in the rotation and placement of ingots, slabs, and the like, as desired by the operator. As used herein, the terms ingot and slab are each intended to be generic to slabs, ingots, bars, billets and the like objects formed from iron, steel, stainless steel and ferrous and nonferrous metals, that may require handling and rotating during the performance of grinding, burning, cutting, rolling and other shaping and finishing operations.

Ingot and slab turning machines are well-known in heavy industry and principally in large iron and steel mills where these machines almost necessarily seem to comprise large, very complicated and expensive equipment, a fact which makes these machines objectionable to the smaller metal fabricator from the standpoint of high initial cost and extensive maintenance requirements. These known machines have also not been entirely satisfactory in use, due to a difficulty in control which, like the expense and complication of these machines, has been considered in the art to be an inherent but necessary detriment, due to the large and ponderous size of the materials usually handled thereby. Thus, it is commonly accepted in the art that the control and placement of ingots and slabs by means of the known machines is largely dependent upon the skill of a highly trained operator, coupled with some good fortune as the equipment employed, principally employing mechanical linkages, has normally not possessed sufficiently sensitive features to permit the complete control desired. This problem is more acute with the smaller fabricators, particularly in the finished metal industries, where careful placement of slabs and bars is desired to quickly and economically obtain desired results in terms of a good finish, etc., while avoiding injury and damage due to lack of precision and control. Moreover, the known machines are best adapted only for the repetitious operations in big mills which can absorb the cost of such machines by their continuous use, often preventing the smaller metal fabricating companies from using these machines because of cost, and necessitating almost completely manual operations.

In a small fabricating yard, for example, a substantially rectangular shaped slab, which may be obtained from a larger mill as an individual order, is usually placed on a stationary support or table in a relatively crude, manual fashion. This is usually accomplished by lifting one edge of the slab with a crane or lift truck in order to tumble the slab into a horizontal position, to expose an unfinished face for a horizontal scarfing or grinding operation, while edge surfaces must often be ground in an awkward, vertical position. As each operation is finished on the exposed face and edges of the slab, the crane or lift truck operator, guided by hand signals from a foreman and workmen, must then attempt to tumble and turn it again to place another unfinished face in the upright horizontal position. Adjustments in positioning can then be attempted by pushing the slabs with brute force, and by shoring or shimming up low and precariously balanced portions with wooden beams, wedges and sledgehammers. This tumbling and dropping of the slab is not only far from accurate, but is also obviously dangerous to men and machines. After this tedious operation is completed for all horizontal and edge surfaces of the slab, if the slab has not been unnecessarily marred by tumbling and falling during these operations, it is then tediously lifted from the support and taken to another manufacturing step. In a small mill, the support and area in which this operation is performed may then not be used again for several hours or days or even longer, until a similar operation is necessary, such that the presently known large and expensive ingot and slab turning machines obviously could not be economically employed.

The art is thus desirous of an ingot or slab turning machine which will provide precise and highly refined control and yet be sufficiently easy to operate to permit use by persons of ordinary skill. Desirably, the machine satisfying these needs must be economical, both from a standpoint of initial cost and from economy of operation, to permit use by the smaller fabricators. Additionally, the art is desirous of a movable ingot turning machine that can be utilized for various operations in a plurality of locations by fabricators not having completely continuous production as in the large mills. Further, it would also be desirable to provide an ingot turning machine that could be used by large mills in continuous production and could be adapted for movement from job to job, such as where a replacement machine is readily needed in the case of breakdown.

It is therefore a principal object of this invention to provide an improved slab support and ingot turning machine which will overcome the difficulties and disadvantages of prior art devices.

It is another object of this invention to provide a movable, reasonably small and economical but sturdy unit for supporting and turning ingots and the like.

It is still another object of this invention to provide a remote-controlled hydraulic slab and ingot turning machine which will afford extreme precision and ease in the controlling and placement of ingots and other large sized objects.

It is a further object of this invention to provide an ingot turning machine which is unique in its simplicity and very effective in its operation.

Other and further objects of this invention, together with an appreciation for the advantages thereof, will become apparent as reference is had to the following description and drawings.

Broadly stated, the objects of this invention are accomplished by providing a remote controlled and hydraulically operated ingot turning machine that is preferably carriage mounted and composed of opposed, hydraulically movable, tilting support members, hereinafter termed ingot turning housing assemblies, each such assembly being provided with a hydraulic drive assembly and ingot or slab supporting and handling chains to provide a support and handling capacity for accommodating a wide variety of slab, billet, bar or ingot shapes and lengths. Preferably, chain drives are employed to actuate the handling chains, and suitable hydraulic power units including pumps, electric motors, valves, controls, hydraulic lines and the like, are employed to provide the hydraulic fluid power for the support and turning movements which form a part of the present invention.

More particularly, the objects of the invention are accomplished by providing an ingot turning machine for rotating ingots and the like comprising at least one and preferably a pair of movably mounted carriage members, wherein each carriage member has a pair of opposed and substantially parallel mirror image ingot turning housing assemblies mounted thereon, each of said ingot turning housing assemblies is independently movably mounted in a plane substantially perpendicular to both

the plane and direction of movement of said carriage member and the ingot turning housing assemblies of each pair are movable in substantially the same plane. Desirably, each ingot turning housing assembly comprises a pair of substantially planar and substantially parallel housing members fixedly secured together, and a hydraulic cylinder or ram assembly is provided for independently moving each housing assembly. Each housing assembly carries at least one and preferably a pair of substantially continuous ingot handling chains which connect each pair of ingot turning housing assemblies, each ingot handling chain being mounted on suitable sprockets carried by each of said housing assemblies, which sprockets are situated preferably in a plane parallel to the plane of the housing members. A driving assembly is mounted on each housing assembly for driving the sprockets and chain thereon, independently of sprockets on the other housing assembly of each pair. Understandably, one of such ingot turning machines, comprising a single carriage and a pair of ingot turning housing assemblies, could be employed for handling and turning reasonably short ingots, while two such carriage mounted machines could be used in normal practice and three or more such carriage mounted machines could be utilized and connected in series for turning and handling unusually long objects such as pipes, girders and the like where it is desired to provide nonflexing support for various finishing and handling operations.

According to the invention, it is preferred that the hydraulic ram assembly for moving each housing assembly is mounted on the carriage member and movably connected to each housing assembly. To facilitate movement of the housing assembly, it is desirable that each housing assembly is mounted on its carriage member by means of a trunnion having each journal end received on a pillow block type bearing, and to facilitate movement of each carriage member, the same may be mounted on railroad-type track engaging wheels and may be powered by hydraulic or electric motors for independent movement from any other carriage member. As to the driving assembly for driving the ingot handling chains, it is preferred to employ a hydraulic motor directly connected to at least one and preferably two or a plurality of driving sprockets for receiving endless drive chains, other portions of which are received on driven sprockets directly connected to and driving the ingot handling chain mounting sprockets. Also according to the invention, each housing assembly may include a substantially S-shaped chain handling guide for facilitating movement of the ingot handling chain.

Turning now to the drawings which form an illustrative part of the present invention and are offered for purposes of explanation rather than of limiting the invention:

FIGURE 1 is a pictorial view, not necessarily to scale, showing a suitable installation employing a pair of ingot turning machines according to the invention and used in combination with a suitable grinding device;

FIGURE 2 is a side elevation taken along lines 2—2 of FIGURE 1 and partly in section to show constructional details of a single ingot turning machine according to the present invention; and

FIGURE 3 is a front elevation, taken along lines 3—3 in FIGURE 1 and partly in section to show further constructional details of the ingot turning machine of the invention, and demonstrating the suitable use thereof in pairs according to the present invention.

Turning now to FIGURES 1 to 3 of the drawings, two ingot turning machines according to this invention, as desirably used in combination, are generally indicated by the reference numerals **10** and **10'**. As shown, these machines are mounted in a suitable concrete pit **12** having end walls **14, 14'** and slide walls **16, 16'**, although it will be appreciated that the devices of the present invention need not be mounted in such a pit, but may be employed on a flat and level surface due to the use of the railroad-type wheels and rails **18** shown in FIGURES 2 and 3 which provide for movement thereof.

It is seen that each ingot turning machine **10** and **10'** is mounted on a suitable railroad-type carriage indicated at **20**, which may be of any desired size and in the form shown, has a flat frame member **21** and wheels **22** mounted on suitable supports **23**. The carriage members **20** may be driven for movement on the tracks **18** by means of the motor units **24** and **24'**, which may house electric or hydraulic motors to drive the wheels **22** by direct or fluid couplings. In either case, the electric line or hydraulic line supplying power to the motor units **24** and **24'** may lead from such units in a suitable manner to the control unit C. The frame member **21**, which also constitutes a trunnion base or support for the device of the present invention, has mounted thereon a trunnion support generally indicated at **30** and comprising suitable lateral members **31** and the reinforcing members **33** situated at right angles thereto. Mounted at the intersection of such lateral members and reinforcing members are trunnion pillow blocks **35** for receiving suitable journal ends of the trunnion shafts **32, 32'**, the members **35** and the ends of the shafts **32** being covered by the bearing caps **37**. As is known in the art, the bearing caps **37** may be provided with suitable lubrication points for the intermittent or continuous application of lubricant to the journal ends of the trunnion shaft and any sleeve-type trunnion bushing which may be mounted therein for bearing purposes and to facilitate lubrication. Also mounted on the trunnion base **21** of the carriage **20** is a suitable hydraulic ram assembly generally indicated at **40**. As shown, four such rams are employed, two for each carriage member **20**, each carriage member having one ram mounted on either side thereof. These rams may be of a type known in the art, such as a Tomkins-Johnson type SH–3 hydraulic cylinder. The rams **40, 40'** and **140** shown are mounted on a suitable footing **42** having a pin **44** therein for rotatably receiving the clevis member **43** which in turn supports the body **41** of the ram assembly **40**. The piston (not shown) of each ram supports a connecting rod **45** which is secured around a ram driving shaft **47** mounted within the ingot turning housing generally indicated at **50**.

It will be appreciated from reference to the drawings that the two ingot turning machines **10** and **10'** shown are similarly numbered, the left-hand machine alone being described for convenience herein by simple reference numerals, while the right-hand machine is designated by the same reference numerals but with a prime (') thereon. In each machine, as shown in FIGURE 2, the right-hand ingot turning housing is described in terms of simple reference numerals, while the left-hand ingot turning housing, which is a mirror image thereof, is denoted by the same reference numerals but with a one hundred (100) prefix. Accordingly, the description hereinafter of the machine **10** and ingot turning housing **50** will generally apply to the machine **10'** and housings **50', 150** and **150'** (FIGURE 1).

Each ingot turning housing **50** is comprised of housing side members **53** and **54**, the same being secured by the trunnion shaft receiving bushing indicated at **52** which rotatably receives the shaft **32**. As shown, bushing **52** passes from pillow block to pillow block, completely through both housing side members. Alternatively, the bushing **52** may be fabricated from several members and joined into the form shown to provide a unitary structure. The housing side members **53** and **54** are also joined together in their central portions by means of reinforcing plates **55** and **59**. As shown, the plate **55** may have an opening **56** therein to provide ready access to the hydraulic motor generally indicated at **60** and to provide an operator with some visual indication of the operation of the present invention. Connected to the lower portion of the reinforcing member **55** are two bushings **57** which pass through the housing side members or are fabricated thereto in a similar manner to the bushing **52**. As shown, the

bushings **57** receive the ram driving shaft **47**, the bushings **57** being reinforced in position by the reinforcing member **55** and the reinforcing member **58** at right angles thereto, as shown in dotted lines in FIGURE 2.

The hydraulic motor assembly generally indicated at **60** may be of a type known in the art, such as a Mark 4 Staffa hydraulic motor, which is adapted to drive a drive shaft **61**, and may be mounted in the housing side members by means of any suitable combination of bushings and bearings, which may be lubricated as is understood in the art. The drive shaft **61** has mounted thereon two drive sprockets **63** and **64** for receiving drive chains **65**, which chains, like the ingot handling chains described hereinafter, are preferably of the heavy duty roller type. The chains **65** in turn drive sprockets **73** and **74** mounted on the driven assembly generally indicated at **70** and comprising the driven shaft **71** mounted within the housing side members by suitable bushings and having sprockets **73, 74, 76** and **77** thereon. Both sprockets **63** and **64** are driven in unison by the motor **60** and as a means of accomplishing this, may be rigidly fastened to the shaft **61** by means of a suitable key and keyway slot. Similarly, the sprockets **73, 74, 76, 77** are mounted on the shaft **71** for rotation in unison as by means of a similar key and keyway, the sprockets **73** and **74** in turn directly driving the sprockets **76** and **77** which have mounted thereon the slab or supporting and handling chains **78** and **79**, supporting chains **78'** and **79'** being mounted on the right-hand ingot turning machine for supporting the opposite end of a slab B.

Although the sprockets **76** and **77** are shown immediately adjacent each other, it will be understood that the same may be provided at the ends of the shaft **71** according to an embodiment of the invention wherein a single pair of housing assemblies **50** and **150** may be used to rotate and handle short length ingots and the like. For this embodiment, the single frame member **21** could be rotatably mounted on a similar lower frame member to permit rotational movement and enhance the material handling capabilities of the present invention.

To control movement of the slack portions of the handling chains **78** and **79**, which as shown in FIGURE 2 drop to the bottom of the carriage **20**, there may be provided a suitable chain guide indicated at **80** and having a substantially S-shaped longitudinal member mounted by means of a support **82** onto a cross support **83** fixed at each end to one of the housing side members **53** and **54**. The upper end of the chain guide **80** may be curved slightly inward to conform to the shape of the handling chain sprockets **76** and **77**, while the lower end of the chain guide **81** may be curved in the opposite direction and downward and slightly upward to permit the slack portion of the handling chain to fall straight to the bottom of the carriage **20**. Other configurations may be utilized but the present configuration is offered for purposes of simplicity.

Remote control of the machines according to the invention may be accomplished in a number of ways known in the art, and as an illustration, the control panel for the present invention may be located at the installation indicated by the control panel at C, although control can be accomplished by connecting the hydraulic lines to the grinding machine **200** and controlled by the operator thereof. The control panel C may be connected to the machines **10** and **10'** by the trunk lines **101** and **101'** into into the receiving members **102, 104** and **102'**, and **104'** where the separate lines forming the trunk lines are separated and directed to the individual ram and driving assemblies, the hydraulic lines shown, i.e., **400, 400', 440, 600, 600'** and **660**, to each of the ram assemblies **40, 40', 140**, etc., and to each of the driving assemblies **60, 60', 160**, etc., being connected to such ram and driving assemblies by means of suitable couplings known in the art and not forming a part of this invention. It should also be understood that the placement of these lines as in the drawings, is only for illustrative purposes and not limiting on this invention. Also, continuous lubricating lines to all bearings, bushings and journals shown can form a portion of the trunk lines **101** and **101'**, if desired.

For the purpose of illustrating this invention, the same is shown in combination with a suitable railway mounted grinding machine generally indicated at **200**, although it will be appreciated that the present invention can be used with other finishing devices known in the art, such as scarfing and cutting machines, as well as forming a unit in a continuous rolling mill. The grinding machine shown may be mounted for movement on the rails **204** and **204'** by means of wheels **202** connected to shaft **212** and **214** within the carriage member **210**. Mounted on the carriage member is an upper platform **220** having guide tracks **221, 222, 223**, etc., thereon and an operator's cab indicated at **225**. The tracks **221**, etc., movably receive a motor mounting carriage **230** and a grinding wheel carriage **240**. The motor **231** on the carriage **230** may be controlled through a movable cable conduit such as the conduit **233** passing from the operator's cab over the housing **240** to the motor. The grinding wheel **244** mounted within the curved housing **245** is mounted by means of a cantilever support **242** to the housing **240**. The grinding machine, which does not form a part of this invention, and is known per se in the art, may have motors within the housing **240** for providing reciprocating movement of the cantilever arm **242** both back and forth and up and down to a certain extent. Motors are also provided for rotating the grinding wheel independently of the housing movement.

In the operation of the present invention and according to the preferred embodiment thereof wherein a pair of carriage mounted ingot turning machines are employed, a suitable sequence for carrying out a grinding operation would involve first placing an ingot or slab reasonably flat on the four ingot turning housing assemblies straddling the two double stranded pairs of ingot handling chain connecting each housing assembly pair. The placement of the slab may be by the overhead crane such that the slab is in position to afford proper clearance for the grinding machine and any final adjustment of position can be made by manipulating the chains and/or the individual housing assemblies.

Upon completion of grinding operations on the top exposed surface of the slab, the first turning operation takes place to change the relative position of the slab from horizontal to vertical, placing one longitudinal edge in a position for grinding. This operation of turning may follow a basic sequence comprising rotating the four chain drive assemblies in the same direction, away from the grinding machine, until the slab edge is clear of the ingot handling chain sprockets in the housing assembly nearest the grinding machine. When such sprockets are cleared, the two hydraulic chain drive assemblies near the side of the grinding machine are rotated away from the grinding machine to move the handling chains until the slab is lowered down into the fold of the handling chains. When the top edge of the slab has reached the desired elevation, actuation of the four hydraulic rams will move the four housing assemblies inward until the slab is centered, in line and firmly clamped, thus making the slab ready for edge grinding.

Upon completion of the edge grinding, the slab must be rotated to a position exposing the other flat surface for grinding. To do this, the basic sequence will comprise releasing the firm clamping action by actuating the hydraulic rams in reverse and spreading the four housing assemblies apart. Thereafter, the two chain drive assemblies farthest from the grinding machine should be rotated away from the grinding machine and in a lifting direction, thus lifting the lower end of the slab up and to the rear, until the top surface thereof is approximately horizontal. When the slab is in this position, rotation of the four chain drive assemblies in a rearward direction

away from the grinding machine will shift the slab to a position where it will be supported by the four housing assemblies. Upon completion of grinding operations on this second flat surface, the same procedure as above may be repeated for exposing the other edge. Then, the slab may be returned to a horizontal position, and removed by a crane and lifting tongs, or other device.

Turning again to the drawings where this basic sequence of operations is illustrated in phantom lines, an overhead crane, lift truck or the like, may place an ingot, billet, slab or bar B on the relatively taut handling chains **78**, **79**, **78'** and **79'**. If the hydraulic motors **60** are stationary, the handling chains can be made taut or slack by movement of the hydraulic cylinders **40** through suitable controls. Assuming the slab B is properly placed, the grinding machine **200** may proceed to grind the top surface of the slab. When this is completed, to rotate the slab B so that one end thereof may be turned up for grinding, the operator of the ingot turning machine will cause both hydraulic motors **60** to move the handling chains to the left, as shown in FIGURE 2, in unison so that the slab B will be moved horizontally to the left. In this position, with the bar B approximately above the housings **150**, the hydraulic motor **160** will be kept stationary while the hydraulic motors **60** and **60'** may be moved further to the left to permit the right-hand side of the slab B to drop down. As the slab B is dropping, the housings **50**, and **150** and **50'**, **150'** may be moved together to clamp the slab, while continued movement of the motors **60** and **160** will serve to position the slab B accurately in the position desired. The slab B may be more securely gripped and lowered or raised in the end up position by rotating both motors towards or away from each other. After the end up position of the slab has been ground, the former bottom side of the slab may be brought to the top by rotating the motor **160** counterclockwise as the housings **150** and **150'** are moved to the left, or as all housings may be moved apart until the handling chains are again taut, and until the former top side of the bar B, laid at all times against the right-hand portions of the slab handling chains, will be placed on the bottom. When grinding or other operations have been completed, the slab B may be simply removed by an overhead crane or other means so that the present device will be cleared to receive another slab or workpiece. If the workpiece is relatively long, the carriages **20** and **20'** may be moved apart by means of suitable motors, not shown, as they may be moved together to accommodate smaller workpieces.

It will be appreciated that the operation of the present invention is substatially free from error as the handling chains are continuous and thus may be moved completely through the machine without fear of straining the machine or of threading the chains out of their respective sprockets. Similarly, the hydraulic motors can be continuously rotated without fear of mishap as the drive chains are also continous. Each housing assembly cannot be closed too far, nor opened too wide, due to the placement of the arm assemblies and the length of stroke thereof. Very fine incremental movements are permited, due to the use of hydraulic systems throughout.

In accomplishing its objectives, the device of the present invention offers a relatively simple construction having advantages of flexibility of movement and flexibility in the fluid drive control employed, thereby permitting the operator to make almost continuous incremental changes. Although not shown, the carriages of the present invention may be provided with suitable reinforcing bars or brakes to catch the slab B should it be dropped too rapidly or should a failure occur in the hydraulic drives such that the handling chains would sag. Damage to the machine is unlikely however as in the preferred form it is constructed of sufficiently heavy gauge steel to withstand all anticipated abuse.

It should be understood that various changes and modifications may be made in the structure of the present invention without departing from the spirit thereof. For example, changes may be made in the shape of the housing assemblies and in the support structures, without affecting the operation of the present invention. Accordingly, the invention should only be limited to the extent shown by the following claims.

What is claimed is:

1. An ingot turning machine for rotating a workpiece such as an ingot or the like comprising: a movably mounted carriage member, said carriage member having a pair of upstanding opposed ingot turning housing assemblies mounted thereon, each of said housing assemblies being independently pivotally mounted about the lower end thereof for pivotal movement in a plane perpendicular to the plane and direction of movement of said carriage member, each housing assembly comprising a pair of substantially parallel housing members fixedly secured together, means for independently pivoting each housing assembly, a plurality of continuous ingot handling chains, each ingot handling chain being mounted on a suitable sprocket carried at the upper end of each of said housing assemblies such that each chain is movable on a sprocket of each housing assembly to support a portion of the workpiece between the opposed housing assemblies, and driving means mounted on each housing assembly for driving each chain handling sprocket thereon independently of the other housing assembly.

2. The machine of claim **1** wherein said means for pivotally moving each housing assembly comprises a hydraulic ram assembly mounted on the carriage member and pivotally connected to each housing assembly.

3. The machine of claim **1** wherein each housing assembly is pivotally mounted on each side by means of a trunnion received on a pillow block bearing.

4. The machine of claim **1** wherein said carriage member is mounted on track engaging wheels for independent movement.

5. The machine of claim **1** wherein said driving means comprises a hydraulic motor.

6. The machine of claim **1** wherein said driving means includes a plurality of endless chains mounted on driving sprockets, said driving chains thereby driving driven sprockets which are connected to said ingot chain handling sprockets.

7. The machine of claim **1** wherein each housing assembly includes a substantially S-shaped ingot chain handling guide.

8. An ingot turning machine for rotating ingots and the like comprising: a movably mounted carriage assembly and mounted thereon a pair of hydraulic ram assemblies and a pair of trunnion support assemblies, each of said trunnion support assemblies receiving and pivotally supporting an ingot turning housing assembly, a ram driven member mounted in each housing assembly for connection to each ram assembly, each housing assembly being provided with a driving assembly and a driven assembly, and a plurality of continuous ingot handling chains mounted on the driven assembly of each housing assembly, each ingot handling chain operatively connecting each of said housing assemblies such that a workpiece may be supported thereon for rotation between said housing assemblies, said driving assemblies including means for independently driving the driven assembly of each housing assembly to thereby drive the ingot handling chains.

9. The machine of claim **8** wherein each hydraulic ram assembly includes a hydraulic cylinder and piston mounted on the carriage assembly to effect the pivotal movement of the housing assembly associated therewith.

10. The machine of claim **8** wherein each trunnion support assembly comprises a pair of pillow block bearings, each pillow block bearing being disposed at the junction of intersecting supporting members on the carriage assembly.

11. The machine of claim 8 wherein said carriage assembly is mounted on parallel tracks and provided with track engaging wheels and a driving means for moving the carriage assembly along the tracks.

12. The machine of claim 8 wherein said driving assembly comprises a hydraulic motor, a drive shaft and at least one drive sprocket for receiving and driving an endless drive chain, said drive chain being adapted to drive said ingot handling chains.

13. The machine of claim 8 wherein said driven assembly includes a driven shaft, a plurality of ingot handling chain receiving sprockets mounted thereon for receiving said ingot handling chains, and at least one driven sprocket mounted thereon for driving said chain handling chains.

14. The machine of claim 8 wherein each housing assembly includes a pair of substantially parallel spaced apart mirror image housing members, front and rear transverse support members for fixedly securing said housing members together, and a chain handling guide mounted between such housing members to provide guiding control of said ingot handling chains.

15. The machine of claim 14 wherein said ram driving member comprises a shaft secured between said housing members.

16. An ingot turning machine for rotating a workpiece such as an ingot or the like comprising: a plurality of movably mounted carriage members, each carriage member having a pair of opposed, substantially mirror image ingot turning housing assemblies mounted thereon, each of said housing assemblies being independently pivotally mounted in a plane substantially perpendicular to both the plane and direction of movement of said carriage members, and means for independently pivotally moving the housing assemblies of each pair being movable toward and away from one another in substantially the same plane, each housing assembly comprising a pair of substantially planar and substantially parallel spaced apart housing members fixedly secured together, means for independently pivotally moving each housing assembly, at least one continuous ingot handling chain connecting the upper end of each pair of housing assemblies such that the upper surface of each ingot handling chain is adapted to support a portion of a workpiece disposed between each opposed pair of housing assemblies, each ingot handling chain being mounted on a suitable sprocket carried by each of said housing assemblies, each sprocket being situated in a plane parallel to the plane of said housing members, and driving means mounted on each housing assembly for driving each chain handling sprocket thereon independently of each sprocket on the other housing assembly of each pair.

17. The machine of claim 16 including a central control for controlling parallel housing assemblies in unison and for controlling the opposed housing assemblies in unison but independently of said first mentioned housing assemblies.

18. An apparatus for turning workpieces such as ingots, slabs and the like comprising: front and rear movable axially aligned supporting carriages; means for moving the supporting carriages in a horizontal plane toward and away from each other; right and left axially aligned pivotable upstanding housing assemblies mounted on each of said supporting carriages for movement toward and away from one another in the same plane; the right front housing assembly being axially aligned with the right rear housing assembly and the left front housing assembly being axially aligned with the left rear housing assembly; means mounted on said supporting carriages for independently pivoting each of said housing assemblies in a vertical plane that intersects said horizontal plane at right angles, each of said housing assemblies supporting at least one horizontally aligned chain receiving sprocket; means for independently driving the chain receiving sprocket of each housing assembly; a continuous ingot handling chain mounted on each chain receiving sprocket such that there are at least two continuous ingot handling chains with at least one continuous ingot handling chain operatively connecting the right front housing assembly chain receiving sprocket with the left front housing assembly chain receiving sprocket and at least one other continuous ingot handling chain operatively connecting the right rear housing assembly chain receiving sprocket with the left rear housing assembly chain receiving sprocket; said front and rear ingot handling chains being adapted to receive front and rear ends, respectively, of a workpiece on the top surface of the chains, such that the workpiece can be lowered by movement of each chain receiving sprocket and chain receiving sprocket means in a direction toward the opposite housing assembly on the same supporting carriage, such that reverse movement will raise the workpiece, and such that movement of the front and rear chain receiving sprockets on either the right or left sides will tend to turn the workpiece; said housing assemblies being adapted to guide and hold the workpiece during chain movement, and to cause chain movement while the chain receiving sprockets are held against rotation, by right and left-hand pivotal movement.

19. The apparatus of claim 18 wherein each housing assembly is defined by a pair of spaced apart relatively flat parallel plates connected together at a plurality of points, thereby defining a housing, said chain handling sprockets being mounted within the housing on a shaft disposed at the upper end of said plates, a journal disposed at the lower end of each of said plates, a bearing mounted on the supporting carriage for receiving each journal to thereby pivotally support each housing assembly on the respective carriage; a shaft connecting each pair of housing assembly plates towards the outside edge of the respective supporting carriage and disposed at a distance from the sprocket supporting shaft and the journal and thereby defining a bell crank configuration; said means for pivotally moving each housing assembly comprising a hydraulic cylinder and piston-rod assembly, with the hydraulic cylinder for each housing assembly pivotally mounted on the outside edge of each supporting carriage and the piston rod thereof pivotally connected to the bell crank mounted shaft to thereby control pivotal movement of each housing assembly.

20. The apparatus of claim 19 wherein there are two ingot handling chain receiving sprockets mounted for simultaneous movement on each upper shaft, with a separate continuous ingot handling chain operatively connected to each sprocket such that there are two ingot handling chains operatively associated with each supporting carriage; the means for driving the chain receiving sprockets comprising a hydraulic motor mounted on and adapted to rotate a drive shaft disposed in each housing assembly, and at least one drive sprocket and drive chain mounted thereon, said upper shaft comprising a driven shaft having at least one driven sprocket thereon for receiving the drive chain and for turning the driven shaft in response to said hydraulic motor.

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