

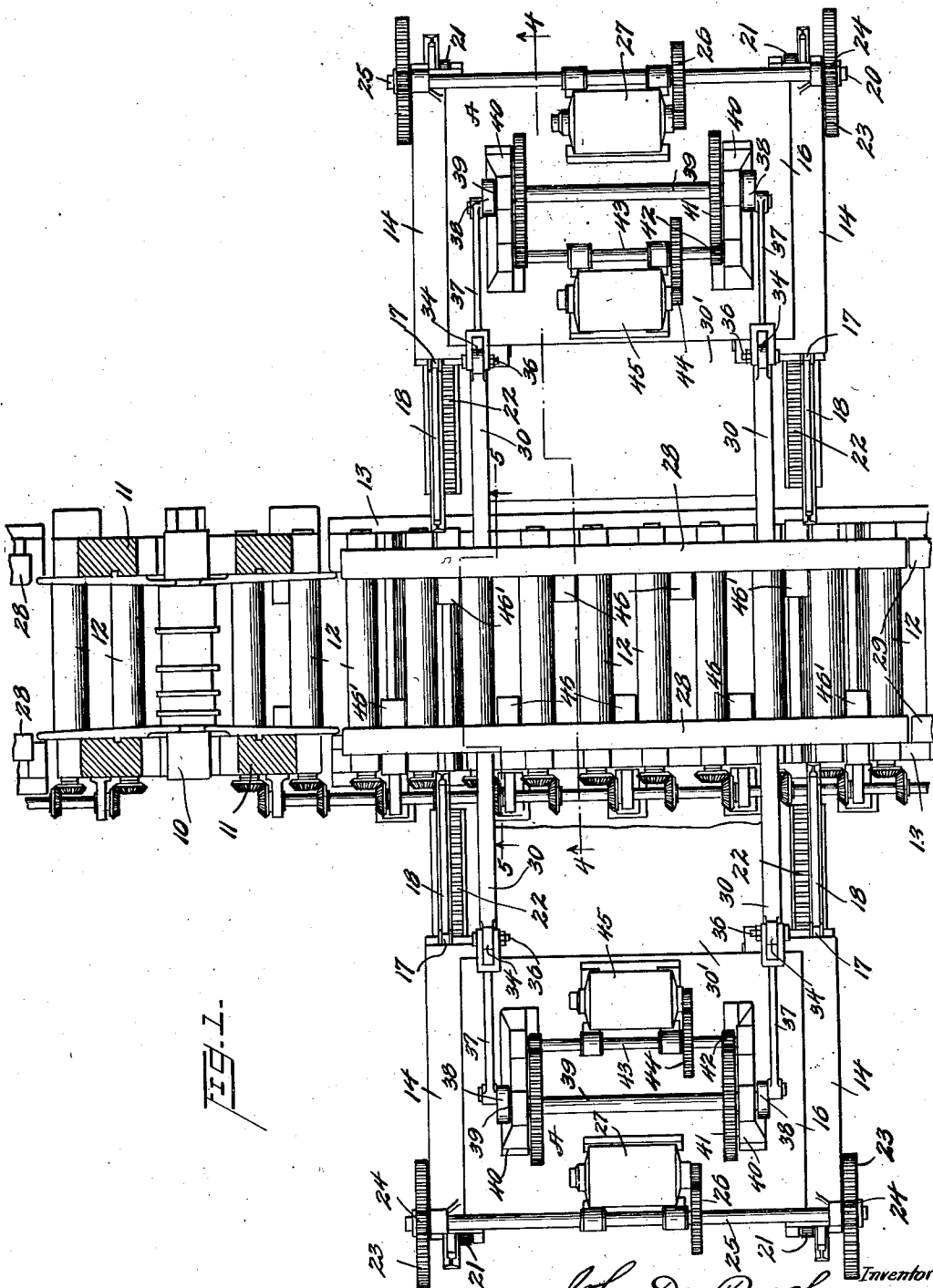
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J. D. PUGH

1,828,619

MANIPULATOR FOR INGOTS, BLOOMS, AND THE LIKE

Filed Sept. 16, 1926 7 Sheets-Sheet 1



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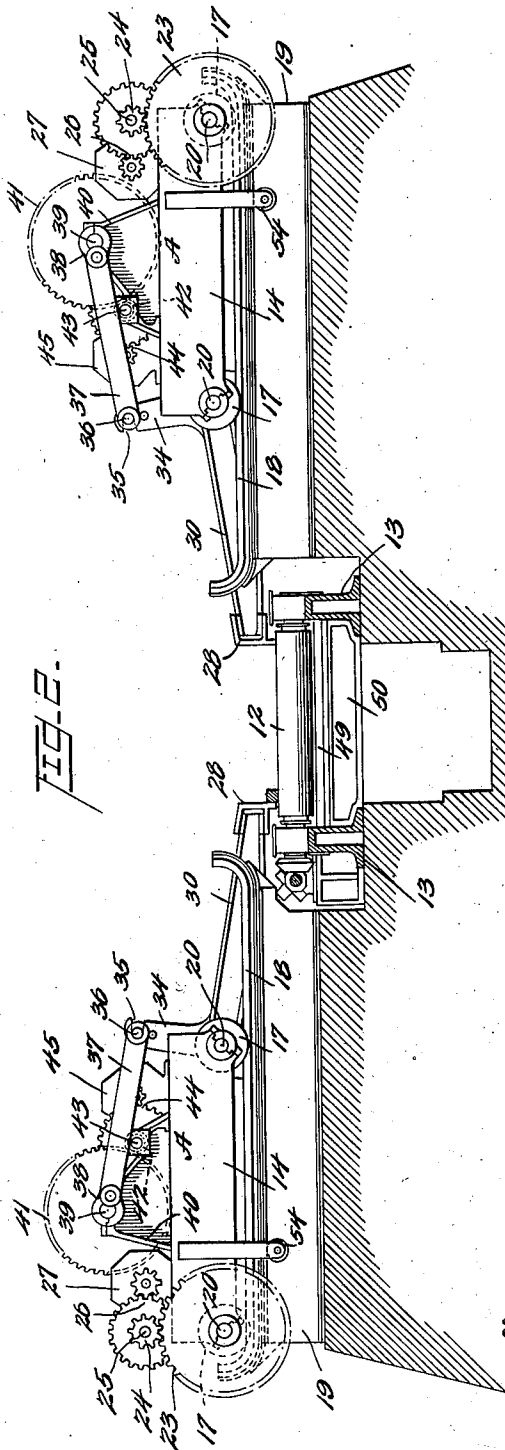
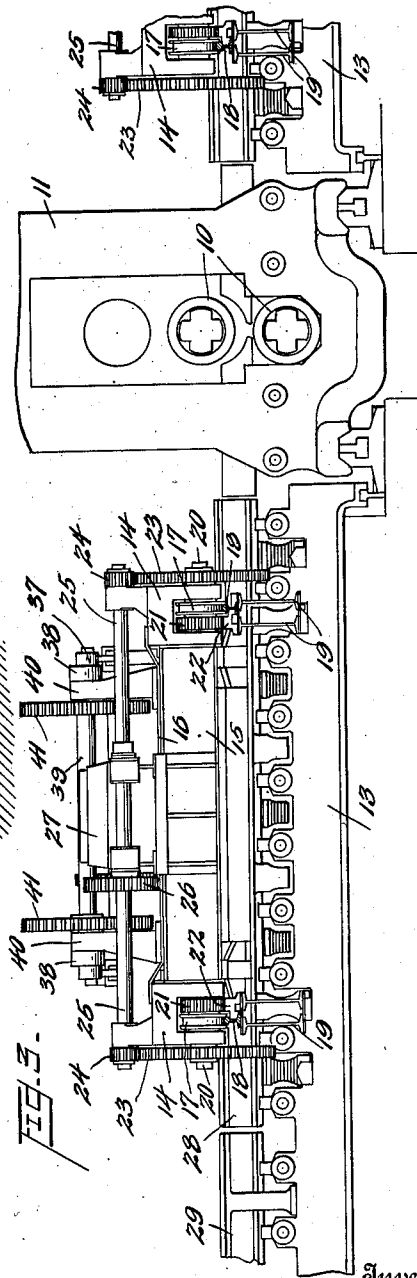
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MANIPULATOR FOR INGOTS, BLOOMS, AND THE LIKE

Filed Sept. 16, 1926 7 Sheets-Sheet 2



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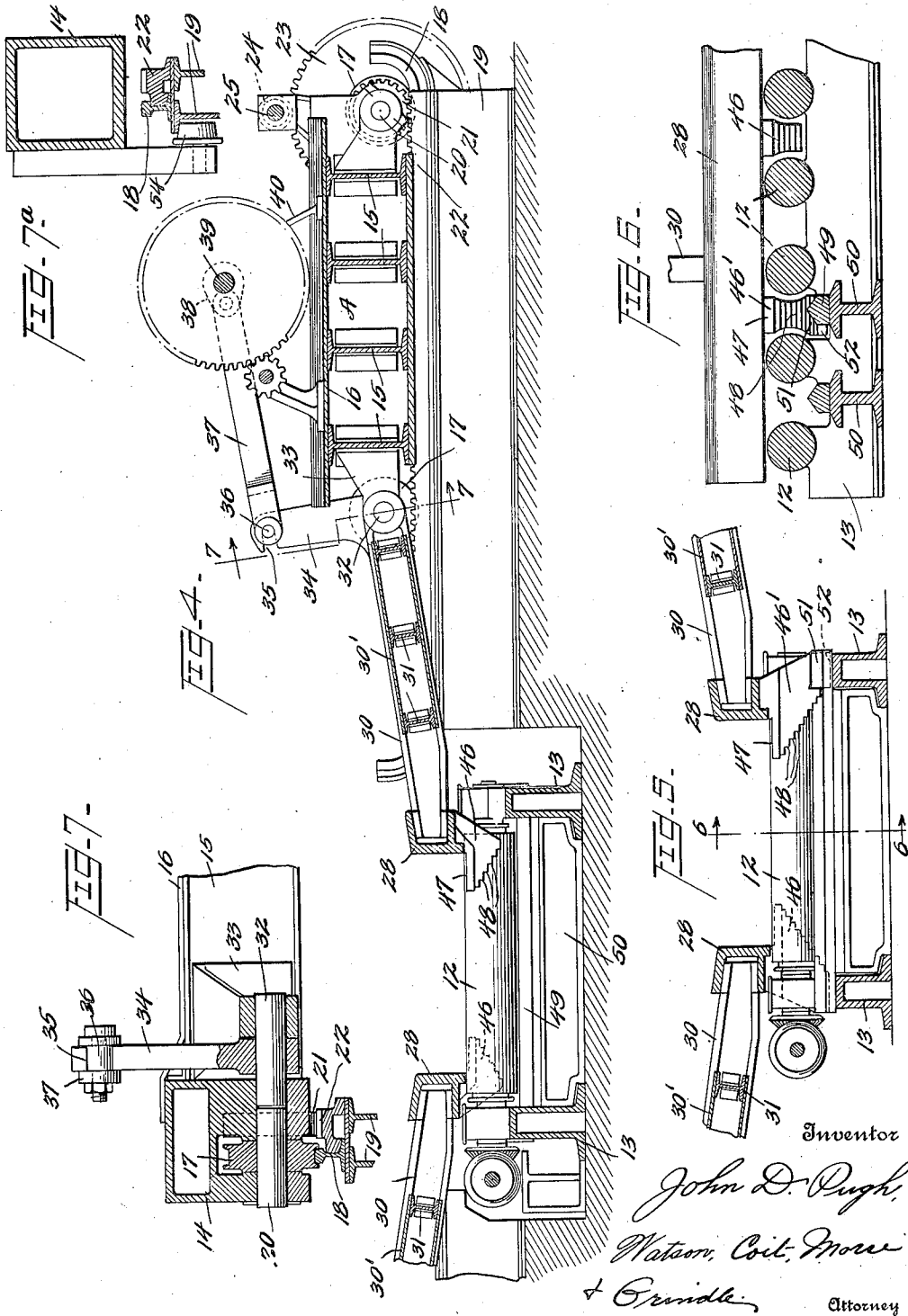
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MANIPULATOR FOR INGOTS, BLOOMS, AND THE LIKE

Filed Sept. 16, 1926 7 Sheets-Sheet 3



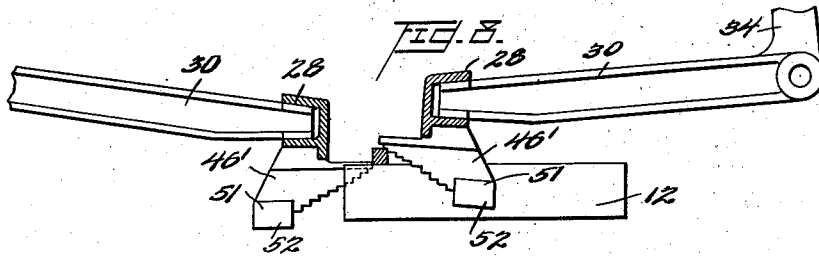
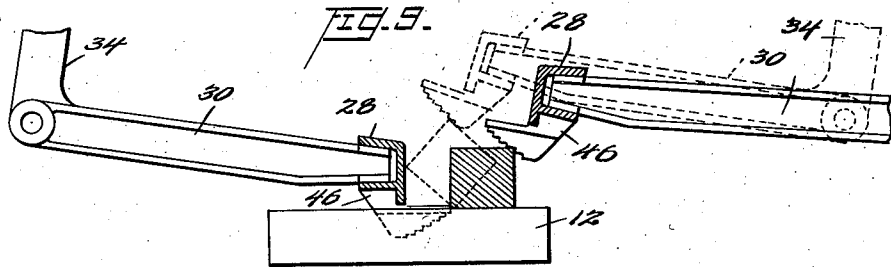
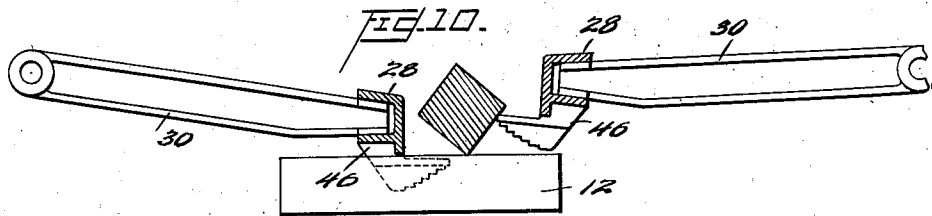
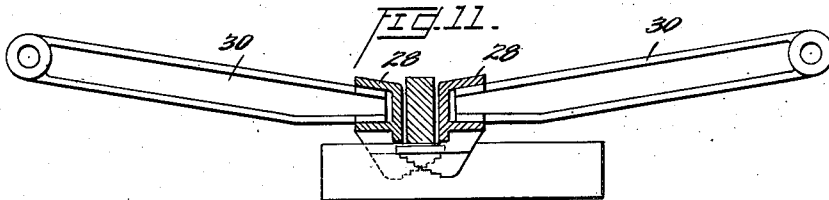
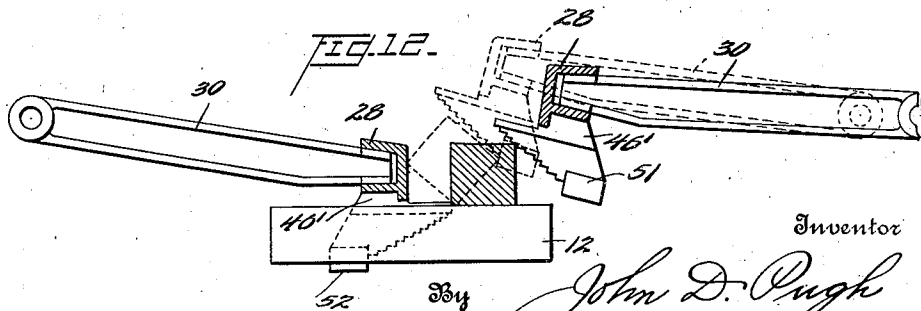
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MANIPULATOR FOR INGOTS, BLOOMS, AND THE LIKE

Filed Sept. 16, 1926 7 Sheets-Sheet 4



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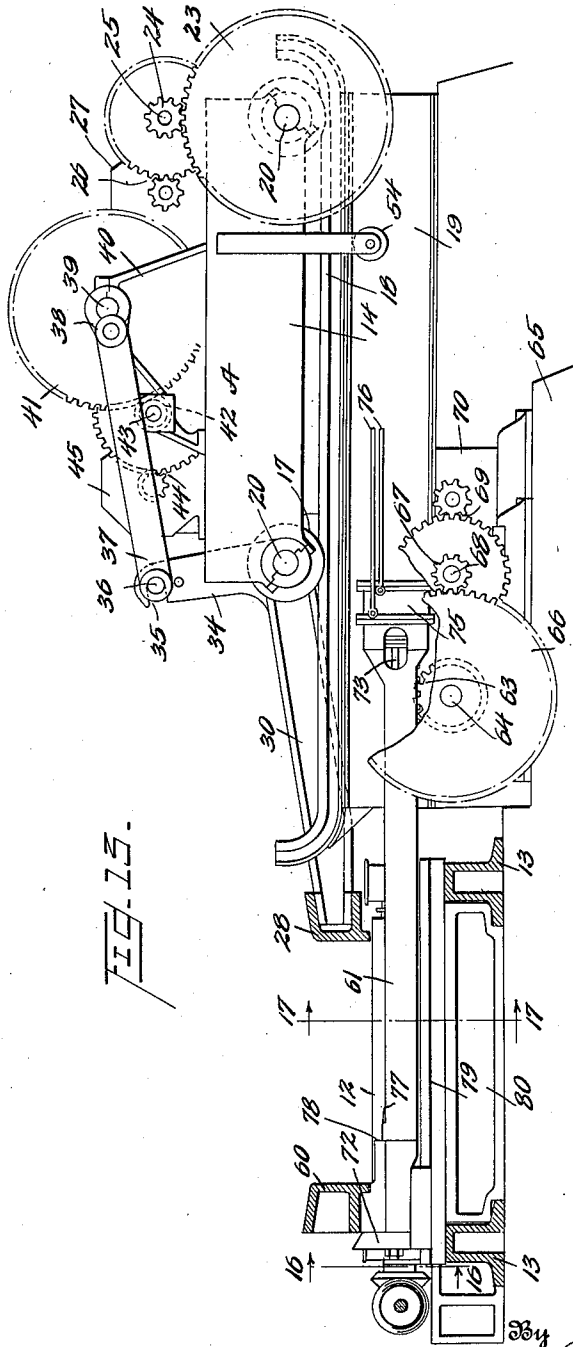
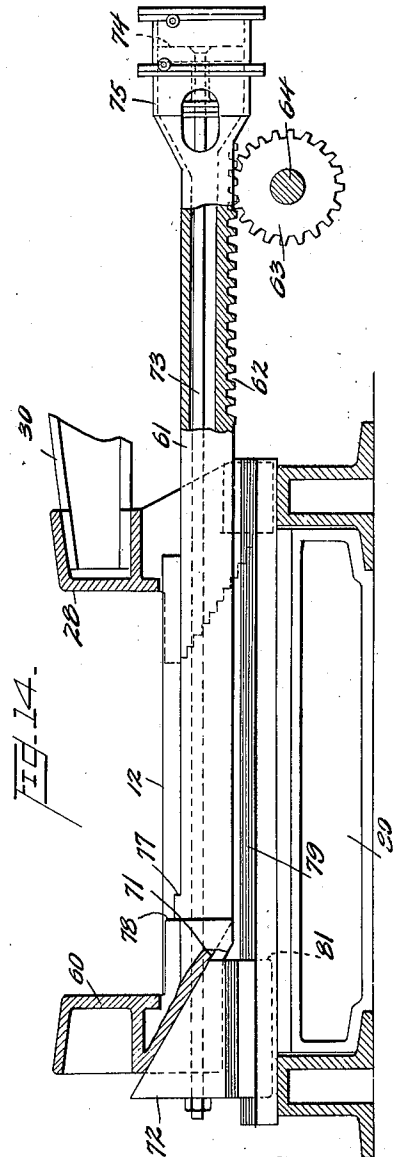
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MANIPULATOR FOR INGOTS, BLOOMS, AND THE LIKE

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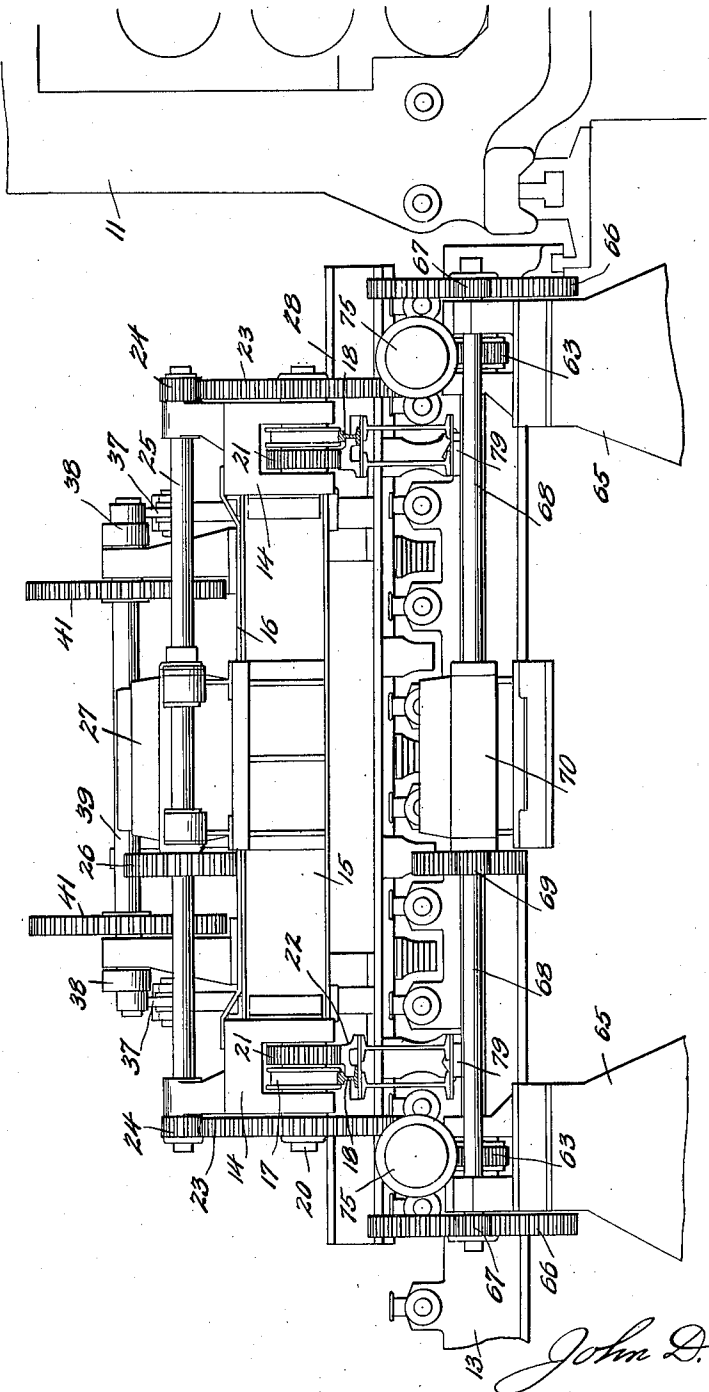
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MANIPULATOR FOR INGOTS, BLOOMS, AND THE LIKE

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FIG. 15.



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MANIPULATOR FOR INGOTS, BLOOMS, AND THE LIKE

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FIG. 16.

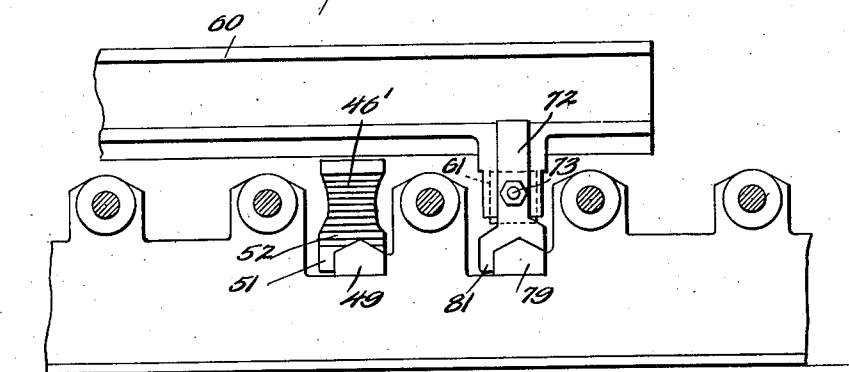
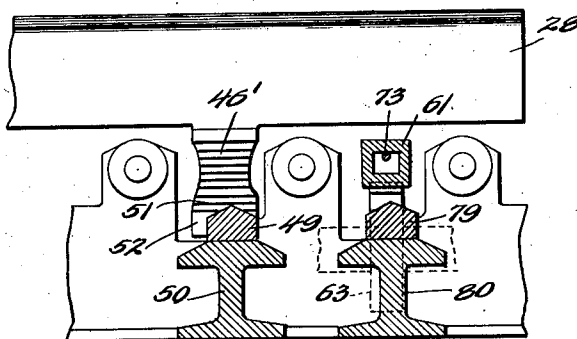


FIG. 17.



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MANIPULATOR FOR INGOTS, BLOOMS AND THE LIKE

Application filed September 16, 1926. Serial No. 135,913.

The present invention relates to manipulators associated with rolling mills for manipulating ingots, blooms or bars on the rolling mill tables.

5 Various types of manipulators for this purpose have heretofore been designed or suggested, one generally accepted early type consisting of two opposed hydraulic rams, one on each side of the mill table, with tumbling heads of various kinds on the ends of the rams adjacent to the table. In some cases the bar or bloom etc. was tumbled or overturned by the impact of the rams thereon approaching each other; in other cases mechanically operated auxiliary tilting fingers were placed on the heads of the rams and by means of which the manipulation of the work was accomplished.

10 With the growth in size and weight of mills and ingots a demand arose for more powerful and speedy manipulators, which caused the practical abandonment of the relatively sluggish hydraulically operated manipulators and the adoption of electrically driven ones. The general type of modern manipulator is electrically operated. The short rams of early days have been replaced by movable side guards some twenty feet long having fingers depending between the table rollers, and these side guards are moved transversely and vertically by means of arms, links, gears and racks, electrically driven to produce the desired motion of the guards and their fingers. The motors and supports for this mechanism are all fixed on heavy bed plates and foundations adjacent to the table. With this design the movable side guards are generally suspended from the outer ends of heavy arms overhanging the table, and these arms must be of sufficient length to permit their supported mechanism to have free swing without interference with the mill table. Moreover the mechanism must be properly braced against the shock of the ingot or bar jarring the side guard as it emerges from the mill. As a natural result of such sturdy construction, manipulators of the past have generally been extremely heavy and quite expensive to manufacture and operate.

The principal object of the present invention is to simplify the design of and to produce an improved manipulator of very materially less weight than those heretofore employed, without any sacrifice of strength. For carrying out this object I provide a manipulator in which the movable side guard with its depending fingers is mounted on a carriage or trolley traversable on tracks towards and from the mill table, and I mount on said trolley the gearing and operating motors, preferably electric, for producing the desired vertical movements of the side guard and for driving the trolley on its track. In the preferred form of the invention, each manipulator comprises two opposed trolleys, one mounted on each side of the mill table. With this design each movable side guard and its operating mechanism is movable bodily as a unit towards and from the table in a plane closely adjacent the level of the table, and hence the necessity for long heavy arms supporting the side guard is eliminated. Moreover this design makes it feasible to reduce the weight of the manipulator in other respects as will hereinafter become apparent. Another important advantage of the present design resides in the fact that the manipulator units, that is the trolleys with their attached side guards and operating mechanism, can be lifted as a whole by a crane and transported to any point desired. This renders the units readily interchangeable and facilitates repairs.

Another object of the invention is to produce a manipulator capable of turning ingots, blooms or bars positively through an angle of substantially 90°, if necessary, about its longitudinal axis. This capability of the present invention constitutes an important advantage over the manipulators of pre-existing types particularly with reference to the tumbling of small bars, which are generally crooked and therefore require to be positively turned through a large angle before gravity will complete their turning movement. In the use of prior manipulators it has frequently been necessary to supplement the action of the manipulator by the manual efforts of one or more men with long spanners

to grip the bar and complete the turning thereof. With the manipulator of the present invention bars can easily be turned positively through substantially a ninety degree angle, and hence the turning of small bars presents no difficulty.

Another object of the invention is to provide a manipulator capable of turning bars about their longitudinal axes in either direction of rotation, clock-wise or counter-clock-wise.

A further object is to provide a manipulator which can be operated to straighten crooked bars, or to support and carry bars of slab-like form in a vertical position and thus direct such bars to the proper pass of the mill.

Other objects and advantages of the invention will be pointed out hereinafter and the novel features of the manipulator will be set forth in the claims.

Referring to the accompanying drawings in which one embodiment of the invention is illustrated:

Figure 1 is a plan view of a typical two-high rolling mill and table with manipulators embodying the invention associated therewith;

Figure 2 is a transverse section through the mill table showing the manipulator in side elevation;

Figure 3 is a side elevation of the mill showing the manipulator in end elevation;

Figures 4 and 5 are sectional views taken respectively on lines 4—4 and 5—5 of Fig. 1; Figure 6 is a section on line 6—6 of Fig. 5; Figure 7 is a section on line 7—7 of Fig. 4; Figure 7^a is a detail view;

Figures 8, 9, 10, 11 and 12 are diagrammatic views illustrating different operations performed by the manipulator;

Figure 13 shows a modification of the invention in which the manipulator is supported and operated by mechanism mounted at one side only of the mill table, the view being a sectional elevation looking at one side of the manipulator;

Figure 14 is a fragmentary view similar to Fig. 13, but showing the parts on a larger scale and in section;

Figure 15 is a side elevation of the mill showing this modified form of the manipulator in rear end elevation; and

Figures 16 and 17 are sectional details taken on lines 16—16 and 17—17 of Fig. 13. In the form of the invention illustrated by Figs. 1 to 12, a manipulator is mounted at each side of the mill rolls, each manipulator consisting of two opposed units supported on opposite sides of the mill table.

The mill rolls 10 are mounted in housings 11, and the table rolls 12 are mounted in girders 13 extending on both sides of the housings 11, in the usual manner. The opposed manipulator units each comprise a trolley indicated in general by the letter A.

The frame of the trolley may be formed of side castings 14 and transverse bars 15 of structural steel rigidly connecting the castings, a suitable floor plate 16 being secured to the tops of the castings and bars to support the driving motors and gearing.

The trolleys are traversable at will towards and from the mill table by mechanism driven preferably by electric motors, although it is obviously within the scope of the invention to use motors of other character. Each trolley is supported by four grooved wheels 17 mounted at the corners of the trolley frame and resting on rails 18 secured to the tops of girders 19 which are fixed to a suitable foundation. Wheels 17 are fixed on short shafts 20 (see Fig. 7), which are journaled in the side castings 14. Also fixed on the shafts 20, at the outer end of the unit A and at the inner sides of the grooved wheels, are toothed wheels 21, which mesh with racks 22 secured to the girders on the inside of rails 18. At the rear or outer corners of the trolley frame the short shafts 20 project beyond the sides of castings 14 and have fixed to their projecting ends toothed wheels 23 which are driven by pinions 24 on a shaft 25 driven through a reduction gear 26 by an electric motor 27.

The manipulator fingers depend from movable side guards 28 which are movable towards each other from positions in alignment with the fixed side guards 29. The movable side guards 28 are carried by arms 30 suitably braced by transverse angle bars 31 and pivoted at 32 to brackets 33 rigid with the inner one of the structural steel bars 15. A cover plate 30' may be provided extending between arms 30 over the brace bars 31. Integral with arms 30 are upwardly extending arms 34 formed at their upper ends with open slots, or hooks, 35, engaged in which are pins 36 secured in the bifurcated ends of links 37, the other ends of said links being pivoted to cranks 38 on the outer ends of shaft 39. Shaft 39 extends across between cranks 38 and is mounted in bearings 40 supported on floor plate 16. Mounted on shaft 39 between bearings 40 are gear wheels 41 that mesh with pinions 42 on a shaft 43 driven through a reduction gear 44 by an electric motor 45. Motor 45 will operate through gears to revolve cranks 38 raising and lowering side guards 28 by means of connecting links and arms just described. The raising motion is positive and the return lowering motion as cranks 38 revolve is accomplished by gravity, owing to hooks 35 being open at one side. This opening of the hooks permits the automatic raising of side guards 28 independent of cranks 38 in a manner later to be described.

Any desired number of manipulator fingers may be provided. As shown on Fig. 1, the movable side guard 28 at the right is provided with four fingers, two inner fingers

46 and two outer fingers 46', while the side guard at the left is provided with five fingers, two outer fingers 46' and three intermediate fingers 46. The fingers depend from the side guards in the spaces between the table rollers 12, and the fingers on one guard are staggered with respect to those on the other guard, so that the guards can be moved into very close proximity to each other, for a purpose hereinafter explained. Each finger comprises a broad and generally flat top face 47 which in the normal position of the guard is slightly below the top level of the table rollers and projects out a sufficient distance to extend substantially under the largest bars on the table to be manipulated. The underneath portions of the fingers are raked back at an acute angle, preferably about 30°, to the plane of faces 47, Fig. 5, and are formed with corrugations, or steps, 48, adapted to engage the upper corners of the bars, in a manner pointed out more in detail hereinafter.

Means are provided to support and guide the side bars and fingers in addition to their support on the trolley. This means, as shown more particularly in Figs. 5 and 6, comprises guides 49 secured to the tops of rails 50 which extend transversely between the table girders 13, the tops of the table girders being depressed, or cut away, at these points to permit the guides to extend through and overhang the girders. As shown, there is a pair of guides 49 for each side guard, and the two outer manipulator fingers 46' on each guard are formed with shoes 51 which slide on the guides. The top surfaces of the guides are sloped to prevent lodgment of dirt and scale on the sliding surfaces. The shoes are formed with flanges 52 which engage the front sides of the guides and thus resist any displacement of the fingers that might otherwise be produced by thrusts of the bars as they emerge from the mill. These guides serve to support the side guards in their traversing movements and in coaction with the flanges on the fingers relieve the arms 30 and their supports from shocks and strains produced by the bars coming from the mill striking the side guards or fingers.

It is here pointed out that the trolley with its attached side guard may be lifted as a unit by a crane and transported to any point desired, for repair or for use in any emergency at another place. This renders the units of the manipulators readily interchangeable and facilitates repairs.

The electrical connections and controlling switches for the motors have not been illustrated, as the invention is not concerned with such details, and their provision is well within the skill of the electrical engineer. Current may be conveyed to the trolleys by a third rail, trolley wire, or by means of a

flexible cable and reel, and the controlling mechanism may be located at a central position where other operations of the mill are controlled.

Referring now to the diagrammatic views, Figs. 8 to 12, for a description of the operation of the manipulator above described:

Figs. 8 and 9 indicate a method of rotating a square bar through an angle of 90°. In Fig. 8 the bar operated on is of relatively small cross sectional area. To manipulate this bar, the left hand fingers are raised slightly above the level of the table rolls by operation of motor 45 and are then traversed by operation of the trolley through motor 27 to a position such that they engage the lower left hand corner of the bar. The right hand fingers are then brought to such position that their underneath stepped surfaces engage the upper right hand corner of the bar. The bar may then be turned in a counter-clockwise direction by moving either set of fingers towards the other set, or by simultaneously moving both sets. If the bar should be straight and uniform, after being turned through an angle somewhat exceeding 45° it will flop over by gravity through the remainder of the ninety degree angle. Small bars, however, are usually more or less crooked, so that their center of gravity is not well defined with reference to the supported corner, and hence they require to be positively turned sometimes through substantially the entire angle of 90°. In the use of pre-existing types of manipulators it was frequently necessary when operating on small bars to employ manual labor to supplement the turning action of the manipulator. With the manipulator of the present invention small crooked bars can be tumbled with facility as the bars can be positively turned through the entire ninety degree angle if necessary. Large bars can of course be turned according to the same method of procedure, as indicated by Fig. 9. It will be noted from the dotted line position of the finger and arm 30, in this view, that as the bar turns from its full line position the corner in engagement with the right hand finger describes an ascending arc. The one-way or hook connection of arms 34 with links 37 permits this movement automatically.

Fig. 10 indicates how the manipulator can be used to turn bars by lifting up on one corner of the bar until the center of gravity passes on the other side of the supported corner, whereupon the bar turns through the remainder of the ninety degree angle by gravity. While this method of tumbling is effective with bars of large cross section, it cannot, as heretofore pointed out, be relied upon in the case of small bars.

Fig. 11 shows how the manipulator can be used to straighten bars or to move slab-like bars transversely of the table or vertically

so as to position them to enter the proper pass of the mill. As heretofore pointed out, the manipulator fingers on one side are out of transverse alignment with the fingers on the other side, to permit the side guards 28 to be moved into close proximity. Thus a bar, even though small, may be straightened by squeezing it between the opposed faces of the guards. This squeezing operation is performed by motors 27, which are of sufficient power for this purpose, the rack and pinion gearing of the trolleys permitting the motors to exert full power without tending to produce slippage of the trolley wheels on their tracks. The weight of the trolley may be sufficient to maintain its stability under the thrusts set up in this squeezing operation. The stability, however, may be increased by additionally weighting the trolleys or may be positively insured by means such as hooks 54 pendent from the trolley engaging under the flanges of girders 19 (see Fig. 7^a). To support and lift a bar of slab-like form, such as shown in Fig. 11, the guard rails are brought to the positions shown, so that the horizontal flat faces of the fingers underlie the bar and the faces of the guard rails are in close proximity to the sides of the bar. The bar may then be moved transversely of the table by operating the trolleys in the same direction or may be lifted by operating the arms 30, the bar being securely supported in a vertical position during such movements.

Fig. 12 indicates an additional function for the shoes 51 on the two outer fingers 46'. In turning a bar as indicated, the stepped under side of the right hand fingers are placed in engagement with the upper right hand corner of the bar at such a point that when the bar has been rotated to the dotted line position, the shoes will engage the lower right hand corner and so positively complete the turning movement.

Obviously, a manipulator of the above described construction can be operated to turn bars clockwise instead of counter-clockwise, as described.

In some cases it may be desirable to have the operating mechanism of the manipulator all on one side of the table rather than on both sides. Figs. 13 to 17 illustrate a modification of the invention wherein the operating mechanism is on one side of the table only. In this modification, the movable side guard 28 at the right is carried by arms 30 mounted on a trolley A and operated by electric motors carried by the trolley, in exactly the same way as in the form already described. The movable side guard 60 at the left, however, is operated by mechanism associated with the trolley at the right, so that all the operating mechanism is located on the right hand side of the table.

Secured to the movable side guard 60 near the ends thereof are a pair of hollow parallel

beams 61 which extend from said guard between the table rollers 12 below the top level thereof and have formed on their under sides racks 62 which rest on and mesh with pinions 63 secured to short shaft 64 mounted in bearings on a foundation 65. Fixed to shafts 64 are large gears 66 meshing with pinions 67 on the ends of a shaft 68, which is driven through gears 69 by an electric motor 70. Formed in the outer ends of beams 61 are vertical slots having inclined top walls 71, and fitting these slots are slides 72 having inclined top surfaces corresponding to the inclined walls 71. Rods 73, extending through the hollow beams 61, are secured at one end to slides 72 and at their other ends to pistons 74 working in cylinders 75 which are rigid with beams 61. Fluid pressure is adapted to be admitted to either side of piston 74 and exhausted from the other side through flexible hose 76. Beams 61 are formed with shoulders 77 and 78 for engaging the lower left hand corners of small and large bars respectively. Slides 72 are formed to fit and slide on guides 79 secured on the tops of rails 80 and are formed with flanges 81 engaging the front sides of guides 79 to resist lateral displacement, in a manner similar to the support of fingers 46' on guides 49.

The operation of this modification may be briefly described as follows: Through the operation of the racks and pinions 62, 63, by electric motor 70, the movable side guard 60 is brought from the position shown in Figs. 13 and 14 to such position that the shoulders 77 are adapted to engage the lower left hand corner of the bar, if the latter is small or to such position that the shoulders 78 are adapted to engage the corner of the bar, if the latter is large. Fluid pressure is then admitted to cylinders 75 on the left hand side of pistons 74, whereupon the pistons, rods 73 and slides 72 move to the right. The movement of slides 72 to the right acts through their inclined surfaces to lift the beams 61 and guard rail 60 to position the shoulder 77 or 78, as the case may be, adjacent to the lower left hand corner of the bar. The trolley A is then operated to bring the guard rail 28 and its pendent fingers into position such that the stepped under surfaces of the fingers engage the upper right hand corner of the bar, whereupon further movement of either guard rail toward the other will operate to turn the bar in the same manner as previously described with reference to Figs. 8, 9 and 12. Instead of forming bars 61 with two shoulders 77 and 78 for small and large bars, respectively, a single deep shoulder could be provided and the lift of bars 61 made greater for large bars than for small bars by providing different strokes of the motor. The arrangement shown, however, is deemed preferable, as complications of the motor mecha-

nism required to produce different strokes of the pistons are avoided.

Obviously this modified form of manipulator can tumble bars only in one direction, that is counter-clockwise, as shown in the drawings. It can manipulate bars as indicated in Fig. 10, and it can straighten crooked bars and guide and support narrow slab-like bars, as indicated in Fig. 11. To straighten bars by squeezing them against the opposed faces of side guards 28 and 60 and to guide and support narrow slab-like bars, the guard 60 is traversed by the operation of the racks and pinions 62, 63, without being lifted by the operation of slides 72.

While two embodiments of the invention have been described with great particularity, any intention to limit the invention in its broader aspects to the details of construction shown and described should not be inferred. Many substantial changes well within the scope of the claims will readily occur to those skilled in the art.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A manipulator unit for rolling mills comprising a trolley mounted on tracks at the side of the mill table, a side guard with depending fingers mounted on said trolley for vertical movements, means for moving the trolley on its track and operating said side guard.

2. A manipulator unit for rolling mills comprising a trolley mounted on tracks at the side of the mill table, a side guard mounted on said trolley for vertical movements, a rack parallel with the track, a pinion on the trolley meshing with said rack, an electric motor on the trolley geared to said pinion, and a second electric motor on the trolley for independently operating said guard rail.

3. A manipulator unit for rolling mills comprising a trolley mounted on tracks at the side of the mill table, arms pivoted on said trolley, a side guard attached to the outer ends of said arms, a rack parallel with the track, a pinion on the trolley engaging said rack, a motor on the trolley driving said pinion, and independently operable means on the trolley for moving said arms about their pivots.

4. A manipulator for rolling mills comprising two trolleys mounted respectively on tracks at opposite sides of the mill table, an arm pivoted on each trolley, opposed side guards with depending fingers rigidly attached to the outer ends of said arms so as to be bodily movable vertically therewith, and means for operating said arms about their pivots and for driving the trolleys.

5. A manipulator for rolling mills comprising two trolleys mounted respectively on tracks at opposite sides of the mill table, opposed side guards mounted respectively on

said trolleys for vertical movements, and means mounted on the trolleys for operating said side guards and for driving the trolleys.

6. A manipulator for rolling mills comprising two trolleys mounted respectively on tracks at opposite sides of the mill table, opposed side guards mounted respectively on said trolleys for vertical movements, racks parallel with the tracks, pinions on the trolleys engaging said racks, electric motors on the trolleys driving said pinions, and other electric motors on the trolleys for independently operating said side guards.

7. A manipulator for rolling mills comprising, in combination, two trolleys mounted on tracks at opposite sides of the mill table, opposed side guards having depending fingers mounted respectively on said trolleys for vertical movements, means carried by each trolley for operating its side guard and for independently driving the trolley on its track, said depending fingers positioned to operate between the table rolls, and the fingers on one guard being staggered with respect to the fingers on the other guard whereby the guards may be moved into close proximity and are thereby adapted to squeeze an interposed bar to straighten the same.

8. A manipulator for rolling mills comprising, in combination, two trolleys mounted on tracks at opposite sides of the mill table, opposed side guards with depending fingers mounted respectively on said trolleys for vertical movements, means carried by each trolley for operating its side guard and for independently driving the trolley on its track, said depending fingers having substantially flat top faces extending out from the respective side guard sufficiently to project well beneath the bars to be manipulated, said fingers being positioned to operate between the table rolls and the fingers on one guard being staggered with respect to the fingers on the other guard, whereby the guards are adapted to be moved into close proximity to engage and move bars of slab-like form.

9. A manipulator for rolling mills comprising, in combination, two trolleys mounted on tracks at opposite sides of the mill table, opposed side guards with depending fingers mounted respectively on said trolleys for vertical movements, means carried by each trolley for operating its side guard and for independently driving the trolley on its track, said fingers having substantially flat top faces extending out from the respective side guard sufficiently to project well beneath the bars to be manipulated and having underneath portions inclined backwardly at an acute angle to the plane of said faces and formed with notches, whereby a bar may be turned in either direction by engaging a lower corner of the bar with the fingers on one guard rail and engaging the opposite upper corner of the bar with the notched under-

neath portions of the fingers on the other rail.

10. In a manipulator for rolling mills, opposed side guards having depending fingers adapted to operate in the spaces between the table rolls, means for moving said guards towards and from each other and independent means for moving said guards vertically, said fingers having flat top surfaces extending out from the respective side guard and having underneath portions inclined backwardly at an acute angle to the plane of the respective faces and formed with notches.

11. In a manipulator for rolling mills, opposed side guards having depending fingers adapted to operate in the spaces between the table rolls, means for moving said guards towards and from each other and vertically, said fingers having backwardly inclined portions formed with notches.

12. In a manipulator for rolling mills, opposed side guards having depending fingers adapted to operate in the spaces between the table rolls, means for moving said guards towards and from each other and vertically, said fingers having flat top faces extending out from the respective side guard and the fingers on one guard being staggered with respect to the fingers on the other guard.

13. In a manipulator for rolling mills, opposed side guards having depending fingers adapted to operate in the spaces between the table rolls, means for moving said guards towards and from each other and vertically, said fingers having flat top surfaces extending out from the respective side guard and having underneath portions inclined backwardly at an acute angle to the plane of said faces and formed with notches.

14. A manipulator unit for rolling mills comprising a side guard bodily movable vertically, an arm carrying said side guard, a carriage on which said arm is pivoted, means for moving said carriage in a horizontal plane towards and from the mill table and means for operating said arm about its pivot to bodily raise or lower the side guard.

15. A manipulator unit for rolling mills comprising a side guard, an arm having said side guard rigidly secured to its outer end, a carriage on which said arm is pivoted, tracks supporting and guiding said carriage, means for moving said carriage on said tracks towards and from the mill table, and means for operating said arm about its pivot to bodily raise or lower the side guard.

16. A manipulator unit for rolling mills comprising a side guard, an arm carrying said side guard, a carriage on which said arm is pivoted, tracks supporting and guiding said carriage, means for moving said carriage on said tracks towards and from the mill table, a motor on said carriage, and gearing connecting said motor with said arm.

17. A manipulator unit for rolling mills comprising a side guard, an arm carrying

said side guard, a carriage on which said arm is pivoted, tracks supporting and guiding said carriage, a track parallel with said tracks, a pinion on the carriage engaging said track, and electric motors supported on the carriage for driving said pinion and operating said arm.

18. A manipulator unit for rolling mills, comprising a side guard, arms carrying said side guard, a carriage on which said arms are pivoted, means for moving said carriage towards and from the mill table and independent means for operating said arms about their pivots, said last named means comprising a connection adapted to positively lift the side guard and return it downward by gravity and permit the free upward movement of the side guard independent of the positive means.

19. A manipulator unit for rolling mills comprising a side guard having depending fingers, each of said fingers having a flat upper face projecting substantially at a right angle to the side guard and having an underneath portion inclined backwardly at an acute angle to the plane of said face and formed with notches for engagement with the upper corners of bars to be manipulated, arms carrying said side guard, a carriage on which said arms are pivoted, means for moving said carriage towards and from the mill table and means for operating said arms about their pivots comprising a connection adapted to positively lift the side guard and return it downward by gravity and permit the free upward movement of the side guard independent of the positive means.

20. In a manipulator for rolling mills, a side guard having depending fingers adapted to operate between the table rolls, some of said fingers terminating at their lower ends in shoes, and guide bars extending between the table girders supporting said shoes.

21. In a manipulator for rolling mills, a side guard having depending fingers adapted to operate between the table rolls, some of said fingers terminating at their lower ends in shoes, and guides extending between the table girders, said shoes adapted to slide on said guides and formed with flanges engaging the sides of said guides to resist lateral displacement by thrust of the bars as they emerge from the mill.

22. In a manipulator for rolling mills, a side guard having depending fingers adapted to operate between the table rolls, said fingers formed with backwardly inclined under surfaces provided with corrugations, some of said fingers provided with shoes, and guides supporting said shoes, said shoes having faces at an angle to said inclined surfaces adapted to engage the lower corner of a bar after the latter has been turned through a predetermined angle by engagement of the corrugated surfaces with the upper corner of the bar.

23. A manipulator for rolling mills comprising two carriages mounted respectively on tracks at opposite sides of the mill table, opposed side guards mounted respectively on said carriages for vertical movements and means for moving said carriages towards and from the mill table and for independently operating said side guards.

24. A manipulator for rolling mills comprising two carriages mounted respectively on tracks at opposite sides of the mill table, opposed side guards with depending fingers mounted respectively on said carriages, and motors supported on said carriages for driving the latter towards and from the mill table and for independently operating the side guards.

25. A manipulator for rolling mills comprising two carriages mounted respectively on tracks at opposite sides of the mill table to move towards and from the table in a horizontal plane, means for driving said carriages, opposed side guards mounted respectively on said carriages for vertical movements, and motors supported on said carriages for operating said guards.

26. A manipulator unit for rolling mills comprising a carriage mounted at the side of the mill table for movements towards and from the table, arms pivoted on said carriage and projecting towards the table, a side guard carried on the outer ends of said arms, upwardly extending arms rigid with said first mentioned arms, cranks supported on the carriage, links connecting said cranks with said upwardly extending arms, and a motor on the carriage driving said cranks.

27. A manipulator unit for rolling mills comprising a carriage mounted at the side of the mill table for movements towards and from the table, arms pivoted on said carriage and projecting towards the table, a side guard with depending fingers carried on the outer ends of said arms, an upwardly extending arm rigid with each of the first mentioned arms, a link having a lost motion connection with said upwardly extending arm, and means on the carriage for reciprocating said link.

28. A manipulator for rolling mills comprising, in combination, opposed side guards having means to engage the diagonally opposite corners of bars to be manipulated, means for moving said side guards towards and from each other and independent means for moving said guards vertically.

29. A manipulator unit for rolling mills comprising a carriage mounted at the side of the mill for horizontal movement towards and from the latter, a side guard mounted on the carriage for vertical movement, a rack parallel to the path of the carriage, a pinion on said carriage meshing with said rack, motor means on said carriage for rotating

said pinion and a second motor for operating said guard.

30. In a manipulator for rolling mills, a side guard having depending fingers adapted to operate in the spaces between the table rolls, means for moving said guard horizontally and for independently moving it vertically, said fingers having flat top surfaces extending out from the guard and having underneath work engaging portions inclined backwardly at acute angles to the top surfaces.

31. In a manipulator for rolling mills, a side guard having depending fingers adapted to operate in the spaces between the table rolls, means for moving said guard horizontally and vertically, said fingers having flat top surfaces extending out from the side guard and having underneath work engaging portions inclined backwardly at acute angles to said surfaces and formed with notches.

In testimony whereof I hereunto affix my signature.

JOHN D. PUGH.