Nov. 24, 1925. 1,562,773

L. JOHNSON

MANIPULATOR

Filed April 19, 1923 6 Sheets-Sheet 1

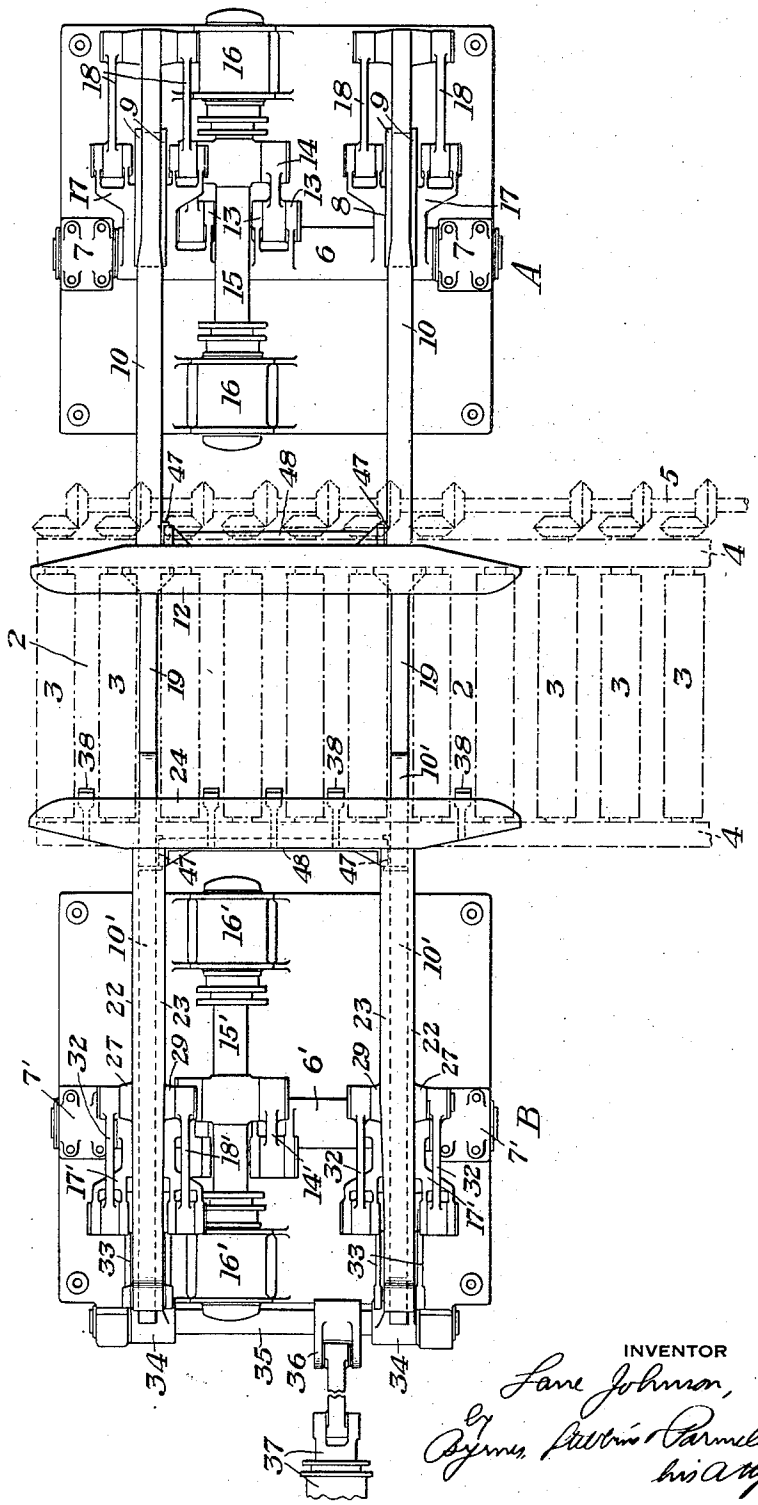


Fig. 1.

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MANIPULATOR

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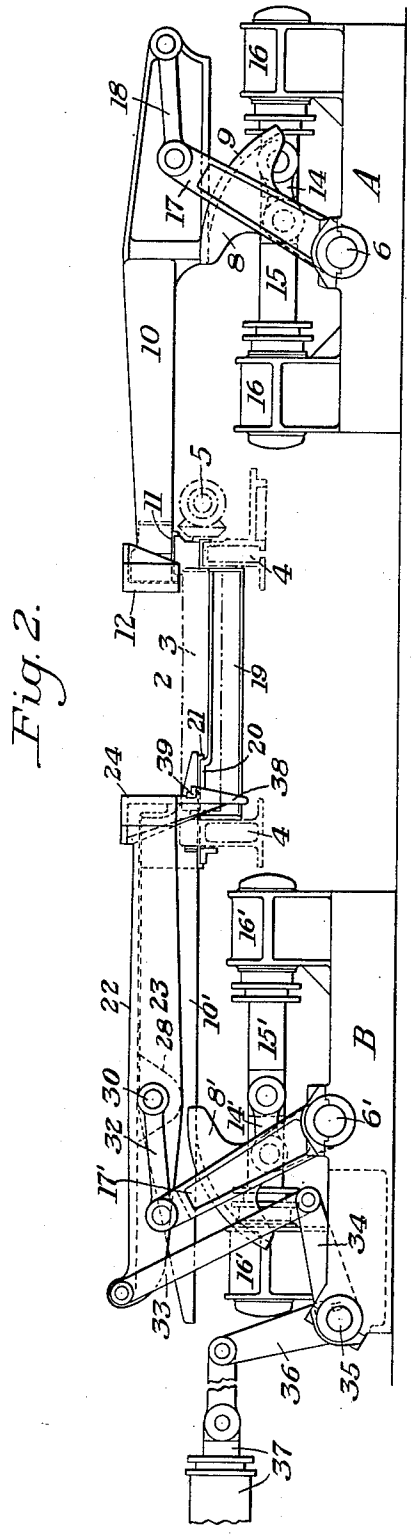


Fig. 2.

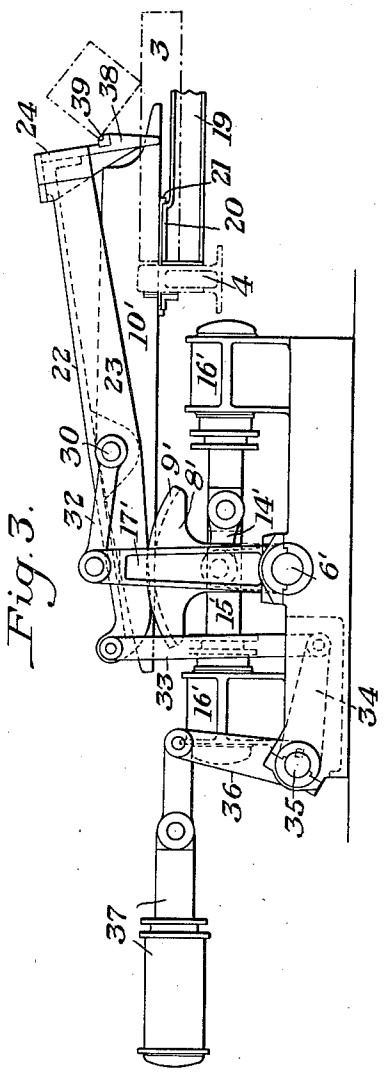


Fig. 3.

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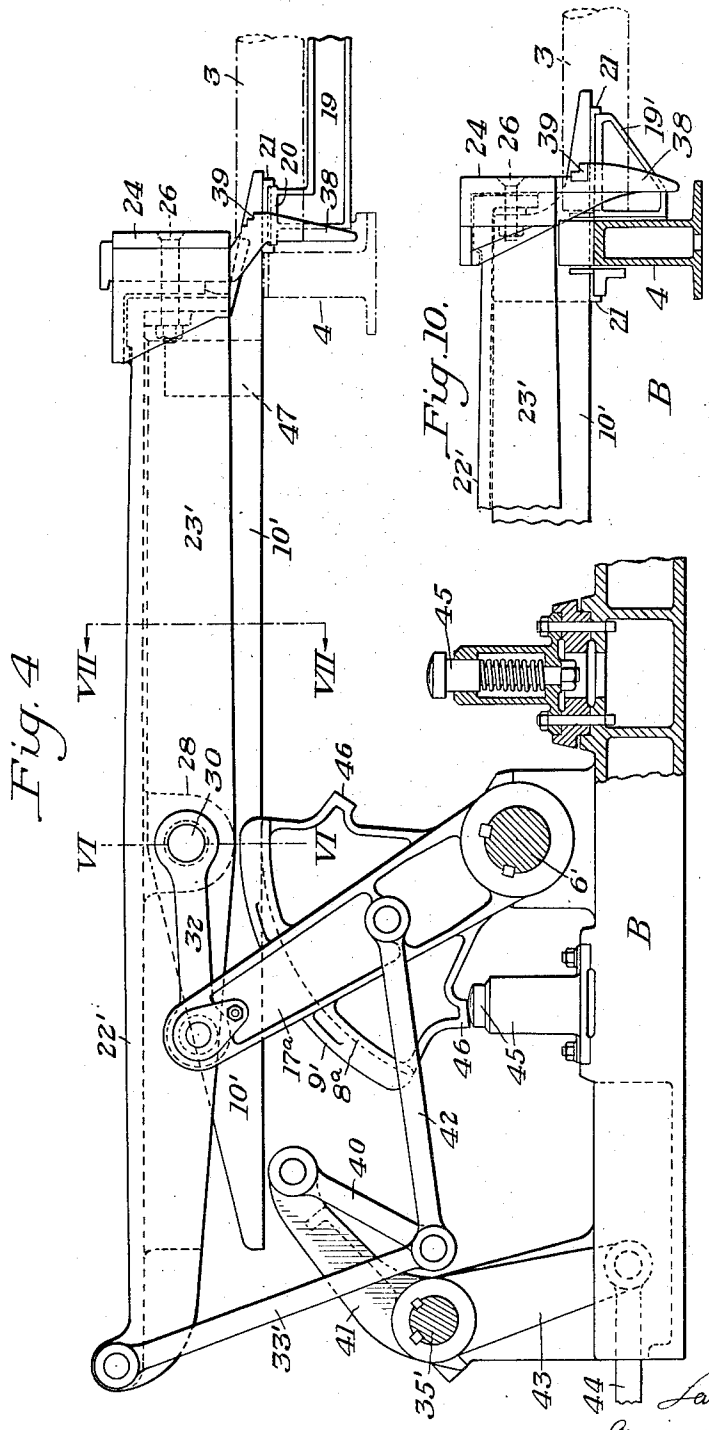
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Nov. 24, 1925. 1,562,773

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MANIPULATOR

Filed April 19, 1923 6 Sheets-Sheet 3



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Nov. 24, 1925. 1,562,773

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Filed April 19, 1923 6 Sheets-Sheet 4

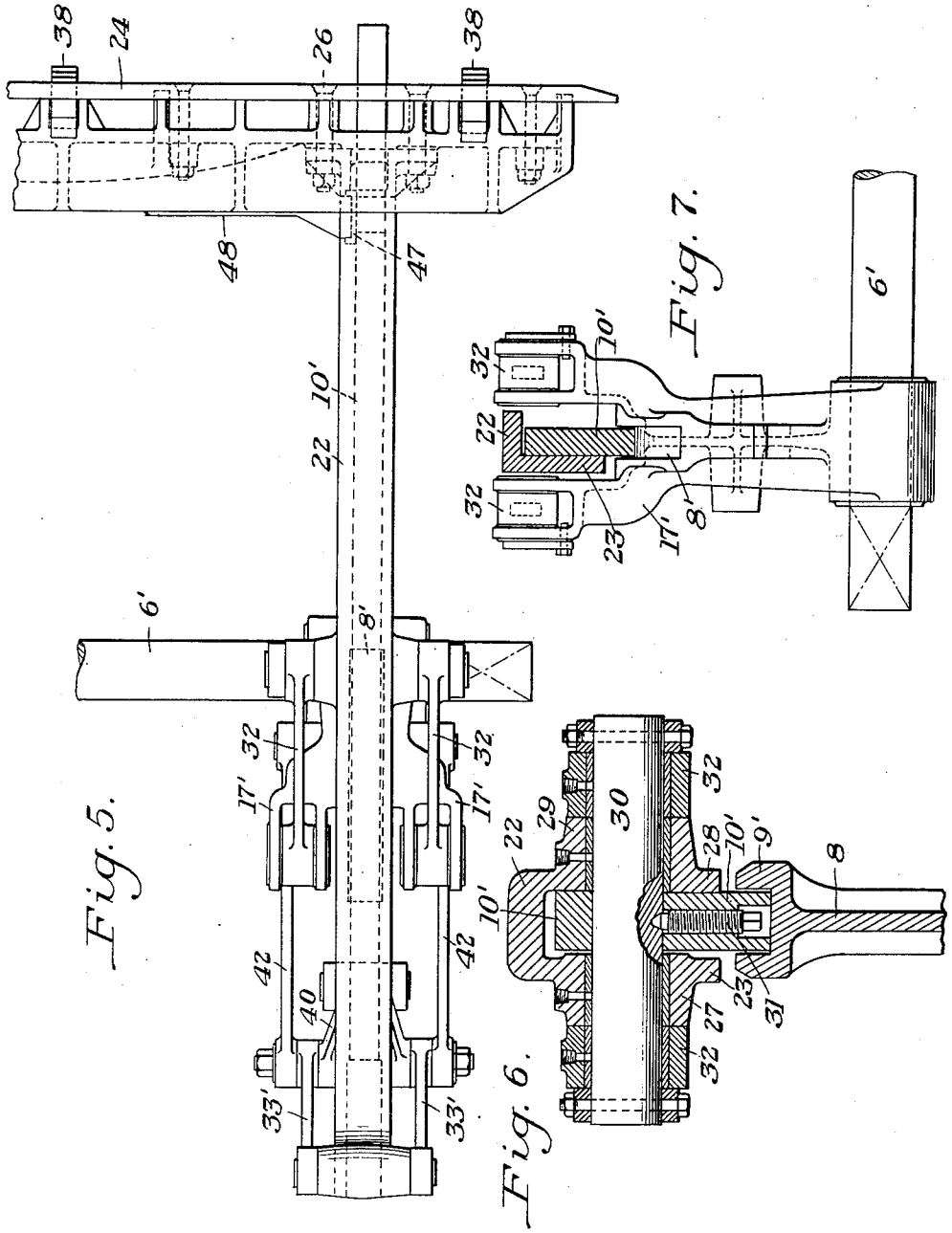


Fig. 5.

Fig. 7.

Fig. 6.

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Nov. 24, 1925. 1,562,773

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MANIPULATOR

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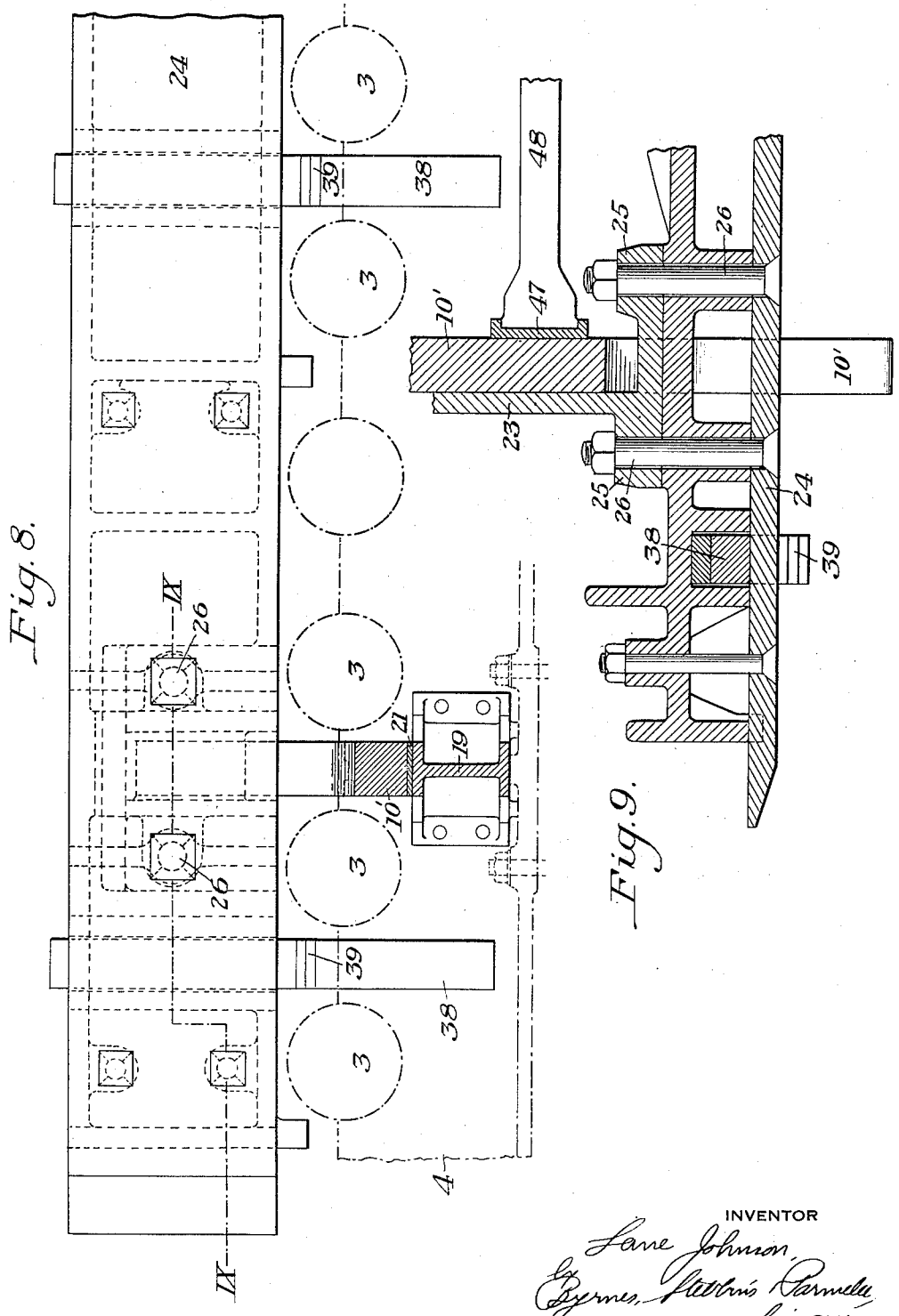


Fig. 8.

Fig. 9.

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Nov. 24, 1925. 1,562,773

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MANIPULATOR

Filed April 19, 1923 6 Sheets-Sheet 6

Fig. 11

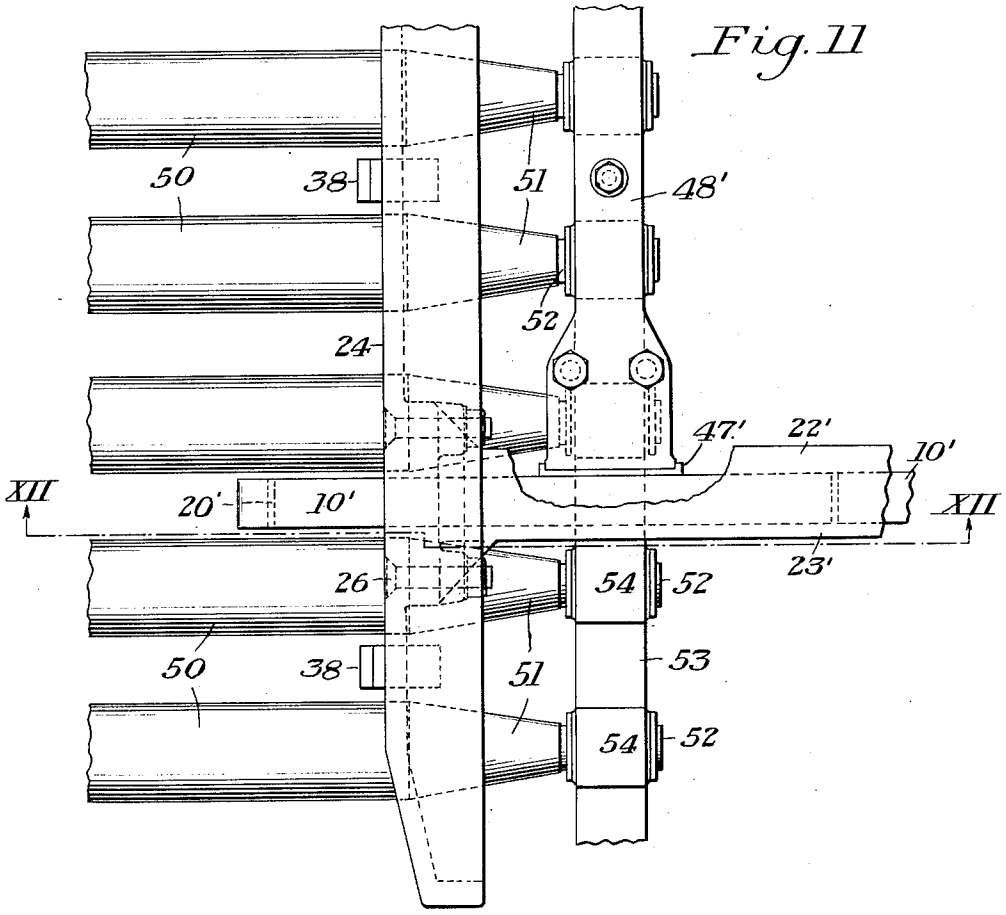
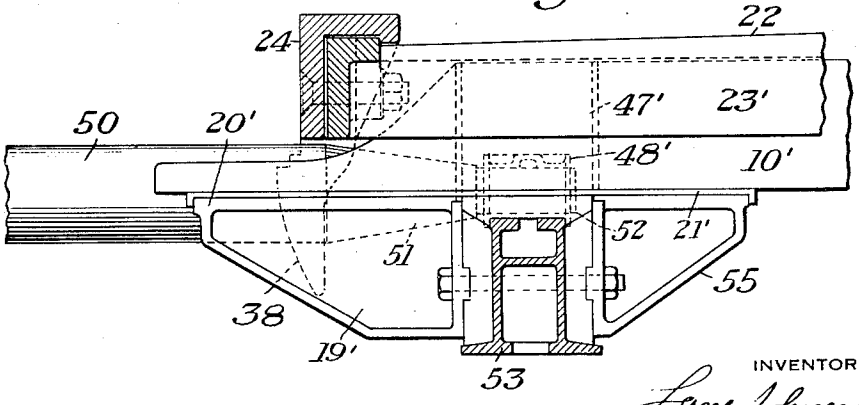


Fig. 12.



INVENTOR

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Patented Nov. 24, 1925. 1,562,773

UNITED STATES PATENT OFFICE.

LANE JOHNSON, OF INGRAM, PENNSYLVANIA, ASSIGNOR TO UNITED ENGINEERING AND FOUNDRY COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

MANIPULATOR.

Application filed April 19, 1923. Serial No. 633,138.

To all whom it may concern:

Be it known that I, LANE JOHNSON, a citizen of the United States, residing at Ingram, county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Manipulators, of which the following is a full, clear, and exact description.

The present invention relates broadly to metal working, and more particularly to manipulators adapted for use with rolling mills for turning an ingot or billet being rolled through 90 degrees between successive roll passes.

It is necessary that a manipulator for use with rolling mills be capable of moving the billet, the term billet being hereinafter used generically as including within its definition any material being rolled, transversely of the roll table and also of rotatng it through 90 degrees. For this purpose, it has heretofore been proposed to provide constructions with operating parts located below and in line with the roll table. These have proven objectionable in use due to the burning out, pitting and the like caused by the hot scale and dirt, as well as the inaccessibility. In order to overcome these objections, manipulators have been constructed so as to position the supports and operating mechanism above and laterally of the line of delivery of the billets. Due to the overhang necessitated by such a position of the supports, it has been found essential with manipulators of this later type to have the parts thereof extremely heavy, not only to carry their own weight, but also part of the weight of the billet being manipulated. This unnecessarily increases the cost, both of manufacture and installation, as well as the continued cost of operation.

By the present invention, there are combined the advantages of both of the types of manipulators referred to, in that a light construction protected from slag, dirt and the like is made possible.

In the accompanying drawings, there are shown for purposes of illustration only, certain preferred embodiments of this invention, it being understood that the drawings do not define the limits of the invention, as changes may obviously be made in the construction and operation without departing from the spirit of the invention or scope of my broader claims.

In the drawings,

Figure 1 is a top plan view of a manipulator embodying the present invention, the roll table being illustrated in chain lines,

Figure 2 is a side elevation of the construction illustrated in Figure 1,

Figure 3 is a side elevation of one form of manipulator illustrating the operation thereof for effecting turning movement of a billet,

Figure 4 is a view corresponding to Figure 2, illustrating a slightly modified form of the invention,

Figure 5 is a top plan view of the construction illustrated in Figure 4,

Figure 6 is a vertical detail sectional view, on an enlarged scale, on the line VI—VI of Figure 4,

Figure 7 is a vertical detail sectional view, on an enlarged scale, on the line VII—VII of Figure 4, looking in the direction of the arrows,

Figure 8 is a front elevation, with certain of the parts shown in section, of a portion of one of the side guards and its associated parts,

Figure 9 is a horizontal sectional view on the line IX—IX of Figure 8,

Figure 10 is a side elevation illustrating a slightly modified form of roll table construction;

Figure 11 is a top plan view of a slightly modified form of installation, and

Figure 12 is a transverse sectional view on the line XII—XII of Figure 11.

Referring more particularly to Figures 1, 2, 3, 8 and 9 of the drawings, there is shown a portion of a billet delivery means, which may conveniently be in the form of a roll table 2, as is customary in the art. These roll tables usually comprise a series of rolls 3 supported at their opposite ends in table girders 4, and adapted to be driven in unison from one end through suitable gearing from a jack-shaft 5. It will be understood that

upon rotation of the jack-shaft in one direction or the other, the roll table may be caused to deliver a billet from the rolling mill to the manipulator, or from the manipulator back to the mill.

The manipulator itself may conveniently be formed of two sections A and B located respectively on opposite sides of the billet delivery means. The section A is adapted merely for effecting movement of the billet transversely of the billet delivery means, while the section B is adapted not only to produce such transverse movement, but also to effect turning of the billet through substantially 90 degrees between successive roll passes.

The manipulator section A may conveniently comprise a suitable base having extending transversely thereof a shaft 6 mounted in suitable bearings 7 at its opposite ends. Adjacent each of the bearings 7 the shaft 6 may have secured thereto vector or segmental members 8, which may or may not have their curved surfaces formed with side flanges 9. Supported entirely at their outer ends upon the members 8 are manipulator beams 10, these beams extending inwardly across one of the table girders 4 and being slidably supported thereon by a slide bearing 11. At their forward ends the manipulator beams carry a side guard 12 adapted to engage the billet for moving it transversely of the rolls 3.

For moving the manipulator beams to effect movement of the side guard 12 transversely of the billet delivery means, the shaft 6 may be formed with crank arms 13 adapted to be connected by links 14 to a piston rod 15. This piston rod may have at each end thereof a piston adapted to cooperate with a hydaulic cylinder 16, whereby the rod may be moved at will in opposite directions.

Also carried by the shaft 6 are levers 17 having their upper ends pivotally connected to links 18, which in turn are pivotally connected to the rear ends of the manipulator beams 10. With this construction, it will be apparent that as the piston rod 15 is moved to the left, as viewed in Figures 1 and 2, it will move the members 8 and the levers 17, thereby producing a longitudinal movement of the beams 10. This movement will be effective for transferring the billets to the desired point on the billet delivery means. It will be apparent that by reason of the provision of a slide bearing 11 adjacent the inner end of each of the manipulator beams, and the provision of supporting sectors adjacent the rear ends thereof, the beams themselves may be of comparatively light construction.

The manipulator section B may, in certain respects, be similar in construction to that of the section A, in that it comprises a main transversely extending shaft 6′ operated by hydraulic cylinders 16′, and carrying segmental supporting members 8′. The actuating connections for the parts of the manipulator section B referred to have been designated by the same reference characters as those heretofore used in connection with the section A, but with a prime suffixed thereto.

The manipulator beams 10′ are supported adjacent their outer ends by the segmental members 8′, in a manner similar to that already described, but at their inner ends are supported in a distinctive manner. This support for each of the manipulator beams comprises a guide 19 extending transversely of the roll table and secured at its opposite ends to the table girders 4. Only a comparatively small portion 20 of the guide is utilized as an actual supporting face. In different installations the length of the supporting face may vary in accordance with the amount of clearness provided between the side guard for the manipulator section A and its corresponding table girder, it being desirable in every instance that the supporting face be of such length that at all times it will be completely covered and protected by the inner end of the manipulator beam 10′ which cooperates therewith. This supporting face may carry a covering or plate 21 of suitable bearing material. It will be apparent that with this construction the actual supporting portion of the guide may be kept lubricated at all times, and that it will be protected from any falling scale, dirt and the like. In this manner, the objections which have heretofore existed to the use of guides and other operating mechanism between the table girders or below the table are obviated.

Carried by each of the manipulator beams 10′ is a guard arm 22 of generally angular cross section, as clearly shown in Figure 7. These guard arms are carried by the manipulator beams in such manner that the depending or vertically extending flange portions 23 overlie the outside of their respective beam. This permits a limited outward movement thereof relative to the beams under the expansion and contraction of the guard 24 carried thereby and illustrated in detail in Figures 8 and 9. As clearly shown in these figures, the inner ends of the guard arms 22 are provided with attaching lugs 25, to which the guard is secured by means of bolts 26. In continuous use, the contact of the guard with the hot billets causes the same to expand. As pointed out, this expansion is taken care of by the relative movement permitted between the guard arms and their respective beams.

For attaching the guard arms 22 to the beams which carry the same, the guard arms are provided at a point intermediate their

ends with a boss 27 on the flange 23, and on the opposite side are formed with a lug 28 having a similar boss 29. Each of the manipulator beams 10′ is drilled to receive a pin 30 which extends transversely therethrough, and through the bosses on the corresponding guard arm. This provides a pivotal connection between the guard arms and the beams. If desired, the pins 30 may be held against rotation by means of set screws 31. These pins 30 are utilized for transmitting lateral motion to the beams 10′ and guard arms 22 simultaneously by means of links 32 secured to the ends of the pins at one end, and at their opposite ends secured to the levers 17′.

When the manipulator section B is in the desired operative position in which it is desired to turn the billet before its next passage to the rolls, it is necessary to lift the guard 24 vertically relatively to the roll table and the associated mechanism. For accomplishing this movement, each of the guard arms has pivotally secured to the outer end thereof links 33, which links at their lower ends are pivotally connected to crank arms 34 carried by a transversely extending shaft 35 mounted in the base of the manipulator. For rotating this shaft to move the crank arms downwardly, the shaft is provided intermediate its ends with a crank arm 36 connected in any desired manner to a suitable operating mechanism, such as a hydraulic cylinder and piston 37. It will be noted, from Figures 2 and 3, that the rear ends of the manipulator beams have their upper surfaces inclined downwardly from the pivot pins 30 to the outer ends thereof This provides a clearance space between the beams and the guard arms, permitting the guard arms to rock about the pins 30 into the position shown in Figure 3.

For actually engaging the billet to effect the desired turning movement thereof, the guard 24 is provided with any desired number of depending manipulator fingers 38. These fingers may be formed with shoulders 39 normally positioned below the line of delivery of the billet delivery means, but adapted upon operation of the manipulator to move upwardly into engagement with the corner of a billet and thereby turn the same.

It will be apparent that with the construction just described, the weight of the manipulator is carried partly by the supporting faces 20 at a point adjacent that at which the billet is manipulated. This materially decreases the overhang of the parts, and enables the use of a materially lighter construction. At the same time, the weight of the guard 24 is such as to tend to hold the guard arms in their lower positions during movement of the manipulator transversely of the billet delivery means. In this manner, the guard 24 is caused to move in a straight line. Any relative movement necessitated between the links 33 and the crank arms 34 during such transverse movement is automatically taken care of by a movement of the hydraulic piston within the cylinder 37 provided therefor.

In certain cases it may be desirable to use operating mechanism other than a hydraulic cylinder. In such an event, the construction illustrated more particularly in Figures 4 and 5 may be employed. In this modified construction, the essential difference consists in supporting the links 33′ from similar links 40 carried by crank arms 41 which in turn extend upwardly from the shaft 35′. The point of connection between the links 33′ and the links 40 is also connected to a third set of links 42 pivotally connected to the levers 17ª. It will be apparent that this provides a so-called parallel motion connection in which the downward movement of the lower end of the link 40 and the lateral movement thereof compensates for any tendency of the guard arm 22′ to move relatively to the manipulator beam 10′. The shaft 35′ may be operated for lifting the front end of the guard arms 22′ by a downwardly extending crank arm 43 having a connection 44 with a source of operating power, not shown. The limit of travel of the segmental member 8ª may be determined by spring buffers 45 provided for engagement with suitable stops 46 thereon. In actual practice, it has been found that the guard arms may be raised to any angular position, and the entire device moved in a direction transverse to the line of delivery of the billet delivery means without causing the guard to travel out of a predetermined straight line. It will be apparent that the detail construction shown in Figures 6 and 7 is in all material respects common to the constructions of Figures 1, 2 and 3 and Figures 4 and 5.

In order to prevent relative movement of the manipulator beams 10 and 10′ inwardly, they are adapted to cooperate with vertically extending bearing plates 47 engaging their inner sides. Extending between these plates is a strut 48 having a length such that it just engages the bearing plates 47. This insures a construction of great rigidity and definitely holds the manipulator beams against any undue inward movement.

In Figure 10 there is shown a slightly modified form of construction, in which the guides 19′ do not extend from one table girder to the other. They are entirely carried by the girder adjacent the manipulator section B with which they cooperate.

In Figures 11 and 12, the rolls 50 are illustrated as having tapered necks 51 terminating in bearing portions 52. These bearing portions throughout the major length of the table are journalled partly on the

table girders 53 and cap bearings 54. Between the manipulator beams 10', however, there is utilized a modified construction in which the strut 48' not only holds the manipulator beams against inward movement, but also constitutes cap bearings for the rolls. In this case the strut serves a double purpose, and thereby still further increases the rigidity of the manipulator.

It will be apparent that in an installation of this character the clearance between the guard 24 and the table girder is increased, thereby enabling the use of a supporting face 20' of much greater length. In order to still further increase the effective length of the face, there may be provided supplemental guides 55 located exteriorly of the table girder.

The advantages of the present invention arise from the provision of a manipulator in which a straight line motion of the side guards transversely of the billet delivery means is made possible, and in which points of support are provided adjacent opposite ends of the manipulator beams.

Still further advantages arise from the provision of a supporting means within the line of the billet delivery means and below the level thereof and so constructed that it may be continuously lubricated and protected.

Still further advantages arise from the provision of a construction in which relative movement to compensate for expansion and contraction due to temperature changes is made possible.

I claim:

1. In a manipulator, a roll table having side girders, a guide between said girders having a horizontal supporting face below the plane of delivery of the roll table and extending a substantial part only of the distance between said girders, and manipulating means slidable on said guide, substantially as described.

2. In a manipulator, a billet delivery means, a guide within the line of delivery of said means, said guide having a supporting face below the plane of delivery of said delivery means and of materially less length than the width of the billet delivery means, and manipulating means slidably supported on said supporting face, substantially as described.

3. In a manipulator, a billet delivery means, a guide within the line of delivery of said means, said guide having a supporting face below the plane of delivery of said delivery means and of materially less length than the width of the billet delivery means, and manipulating means slidably supported on said supporting face and completely covering the supporting face at all times, substantially as described.

4. In a manipulator, a billet delivery means, a guide within the line of delivery of said means, said guide having a supporting face below the plane of delivery of said delivery means and extending but part of the length of said guide, and manipulating means slidably supported on said face, substantially as described.

5. In a manipulator, a billet delivery means, a guide within the line of delivery of said means, said guide having a supporting face below the plane of delivery of said delivery means and extending but part of the length of said guide, and manipulating means slidably supported on said face and completely covering the face at all times, substantially as described.

6. In a manipulator, a billet delivery means, a guide within the line of delivery of said means, said guide having a supporting face materially less in length than the width of the billet delivery means, a manipulator beam movably supported on said face, means for moving said beam, a guard arm pivotally carried by said beam, and means for moving the guard arm relatively to said beam to turn a billet, substantially as described.

7. In a manipulator, a billet delivery means, guides within the line of delivery of said means and below the plane of delivery thereof, said guides having a supporting face of materially less length than the width of the billet delivery means, a beam slidably supported by each supporting face, guard arms movably carried by said beams, billet engaging means carried by said guard arms, means for simultaneously moving said beams and said guard arms, and means for moving the guard arms relatively to said beams for turning a billet, substantially as described.

8. In a manipulator, a billet delivery means, manipulator beams cooperating therewith, means supporting said beams for movement transversely of said delivery means, a cap bearing section extending continuously between said beams and preventing inward movement thereof, and manipulating means carried by said beams, substantially as described.

9. In a manipulator, a billet delivery means, manipulator beams cooperating therewith, means supporting said beams for movement transversely of said delivery means, a cap bearing section extending continuously between said beams and preventing inward movement thereof, and manipulating means carried by said beams, said manipulating means being adapted to move laterally relatively to said beams to compensate for temperature changes in the manipulator, substantially as described.

10. In a manipulator, a manipulator beam, means supporting the same for lateral movement, said beam having a portion of its

upper surface tapered downwardly, a guard arm having pivotal connection with said manipulator beam adjacent the beginning of said tapered portion, and means for moving the guard arm about said pivotal connection, substantially as described.

11. In a manipulator, a roll table having side girders, delivery rolls carried thereby, supporting means within the line of delivery of said rolls adjacent one of said table girders only and having a supporting face below the plane of delivery of said roll table, and manipulating means carried by said supporting means, substantially as described.

12. In a manipulator, a roll table having side girders, delivery rolls carried thereby, supporting means within the line of delivery of said rolls adjacent one of said table girders only and having a supporting face below the plane of delivery of said roll table, and manipulating means carried by said supporting means and completely covering and protecting the same at all times, substantially as described.

13. In a manipulator, a supporting beam, an angular guard arm pivotally connected to said beam and laterally movable relatively thereto, and means for moving at least a portion of said guard arm upwardly with respect to said beam, substantially as described.

14. In a manipulator, a roll table constituting billet delivery means, billet engaging means cooperating therewith, and means within the line of delivery of said roll table but wholly below the plane of delivery thereof and adjacent one side of the roll table only for supporting said billet engaging means, substantially as described.

15. In a manipulator, a roll table constituting billet delivery means, billet engaging means cooperating therewith, and means within the line of delivery of said roll table but wholly below the plane of delivery thereof and adjacent one side of the roll table only for supporting said billet engaging means, said last mentioned means being carried by said roll table, substantially as described.

16. In a manipulator, a roll table having side girders, a guide carried by one of said girders and having a supporting face below the line of delivery of the roll table, said guide projecting at substantially right angles from one side of the table girder, and manipulating means slidable on said guide, substantially as described.

17. In a manipulator, a billet delivery means, a guide having a supporting face below the plane of delivery of said delivery means and materially less in length than the width of the billet delivery means, said guide being carried by said delivery means, and manipulating means slidably supported on said guide, substantially as described.

18. In a manipulator, billet delivery means, manipulator beams cooperating therewith, supporting guides carried by said billet delivery means below the line of delivery thereof and adapted to be covered at all times by said manipulator beams, and a strut extending continuously between said beams and preventing inward movement thereof, substantially as described.

19. In a manipulator, a billet delivery means, a guide carried by said billet delivery means and having a supporting face below the plane of delivery thereof, a manipulator beam slidably supported by said guide and completely covering said face at all times, and manipulating means carried by said beam, substantially as described.

20. In a manipulator, a roll table having side girders, a guide between said girders having a supporting face below the plane of delivery of the roll table and extending but part of the distance between said girders, manipulating means slidable on said guide, and supporting and actuating means for said manipulating means positioned wholly at one side of said roll table.

In testimony whereof I have hereunto set my hand.

LANE JOHNSON.