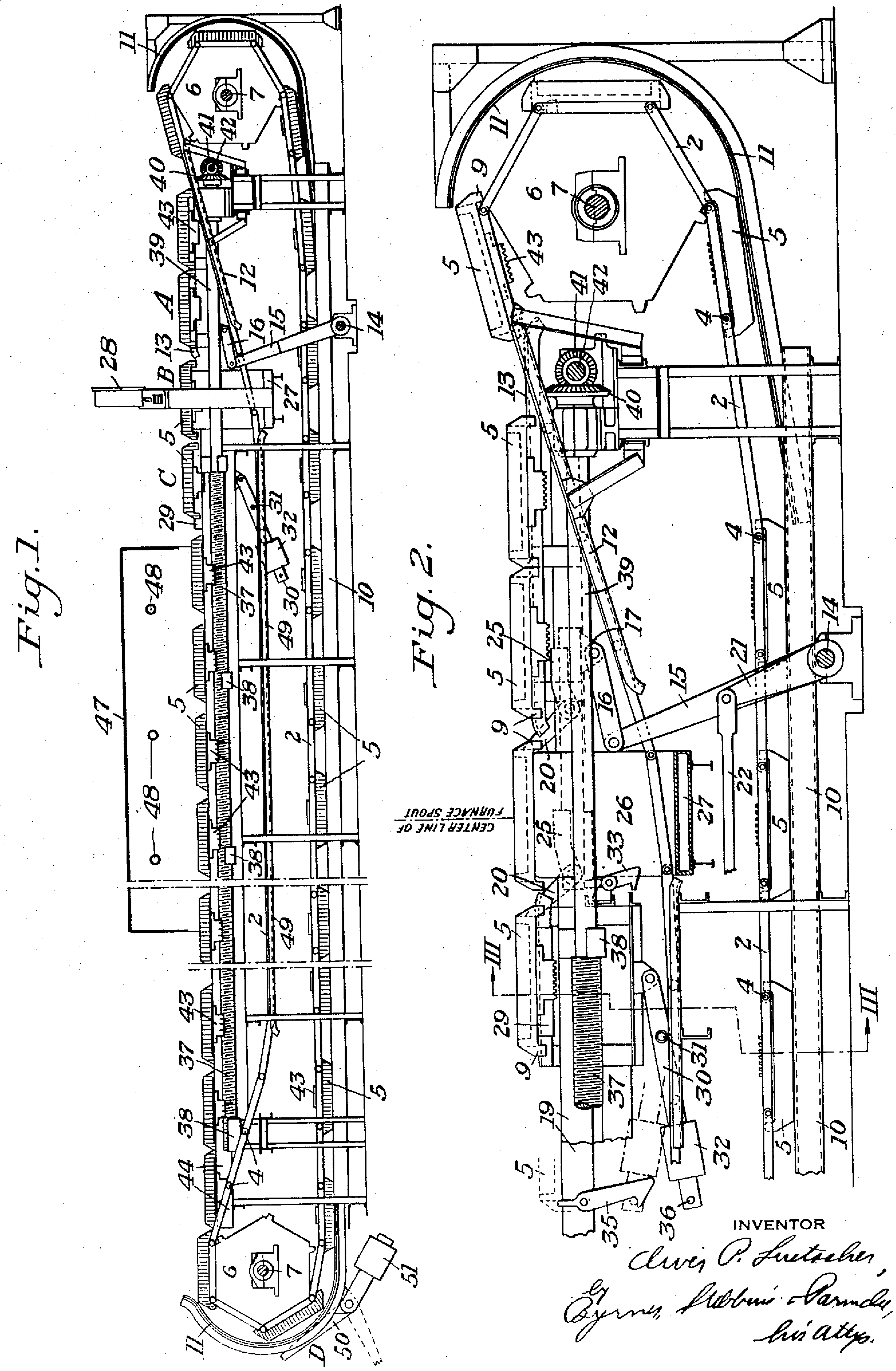
Nov. 18, 1924. 1,516,049

O. P. LUETSCHER

APPARATUS FOR CASTING

Filed May 5, 1923 5 Sheets-Sheet 1



INVENTOR

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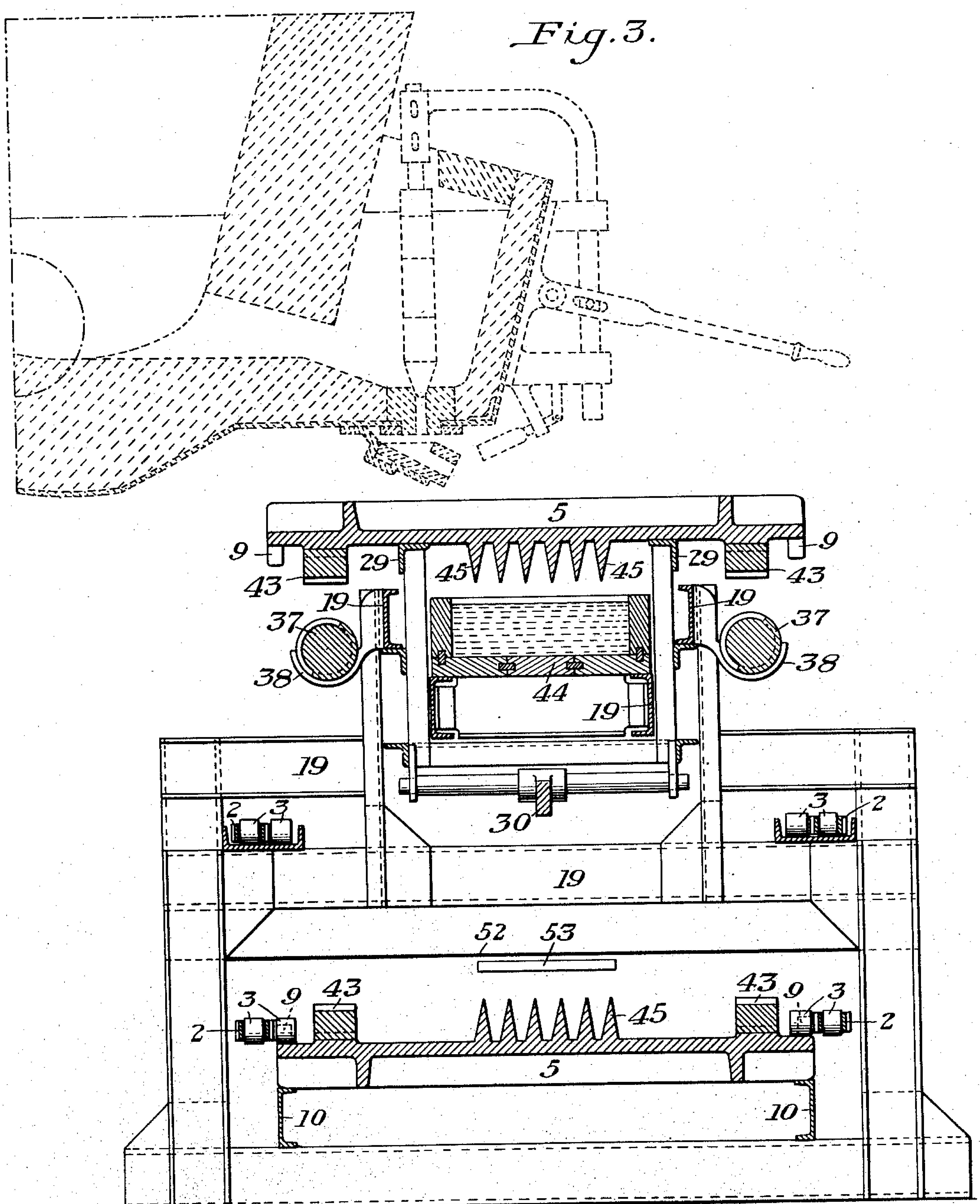
5 Sheets-Sheet 2

Fig. 3.



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Filed May 5, 1923 5 Sheets-Sheet 3

Fig. 4

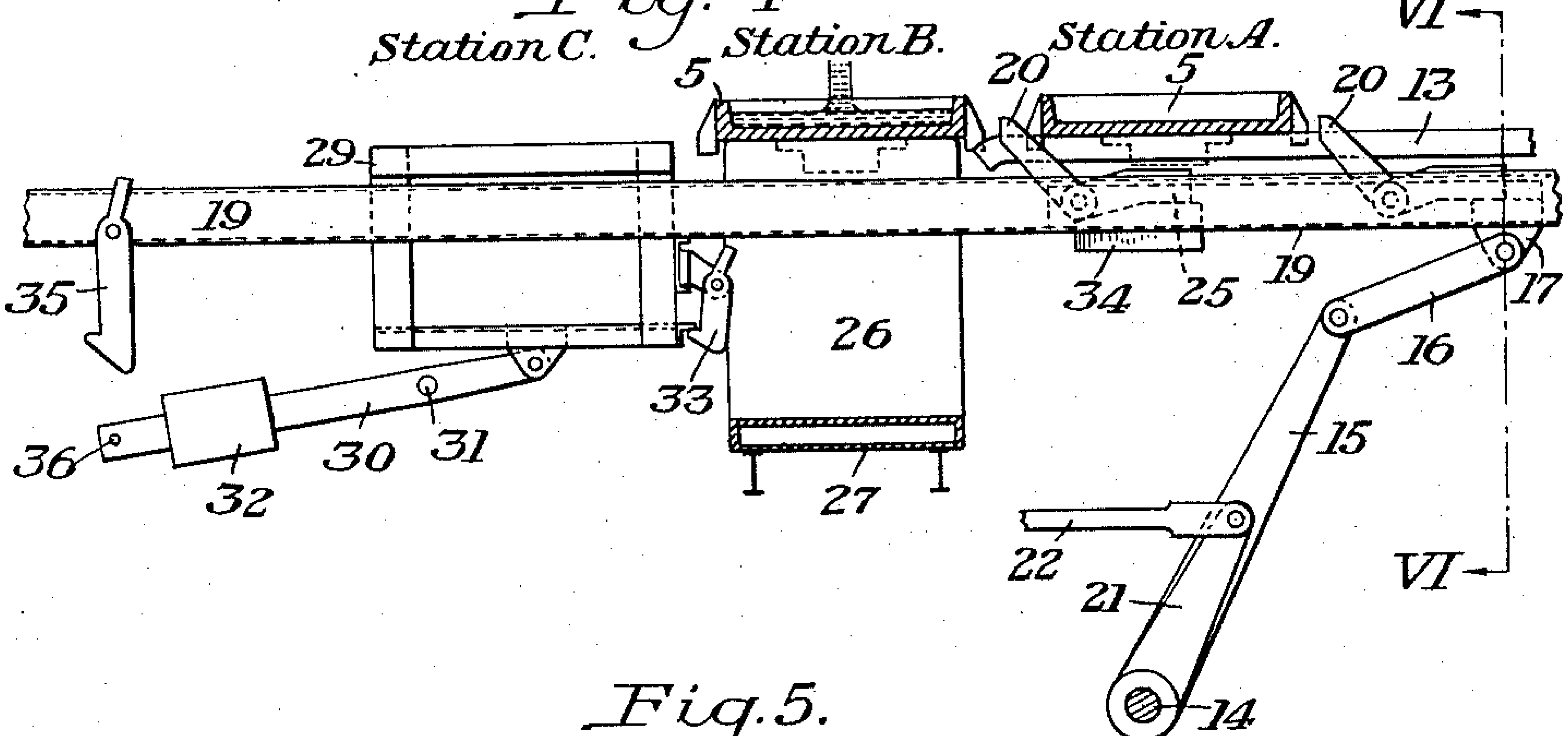


Fig. 5.

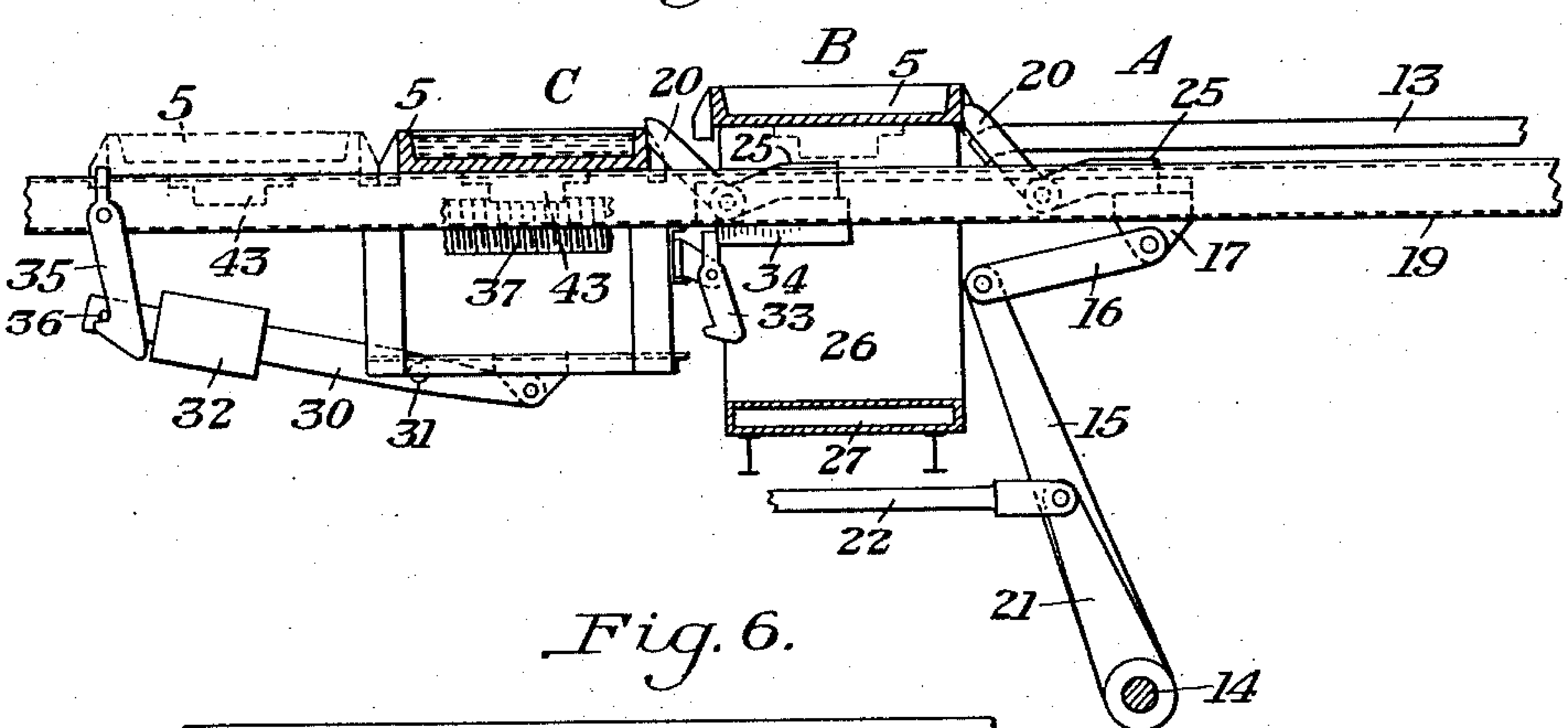
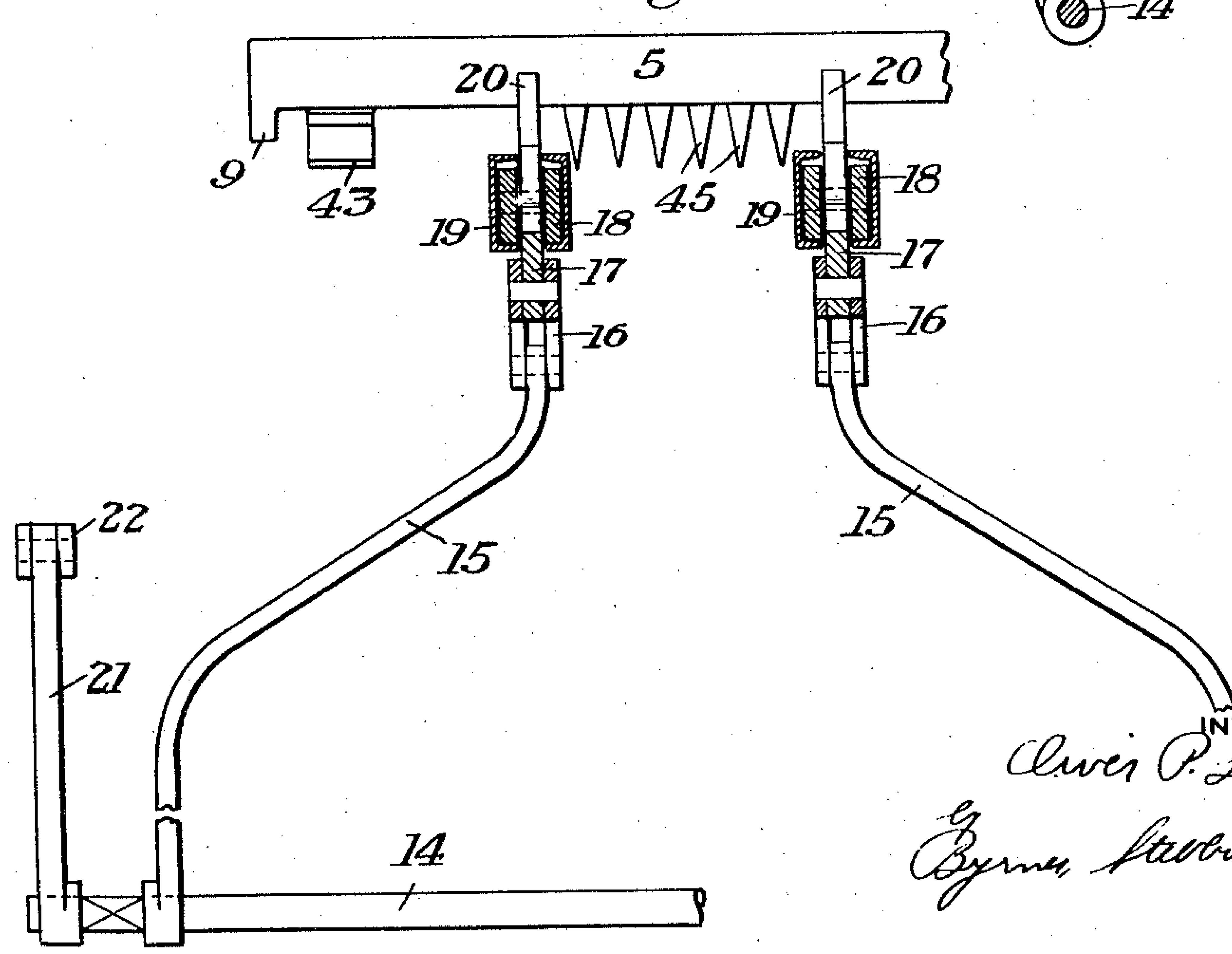


Fig. 6.



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Filed May 5, 1923 5 Sheets-Sheet 4

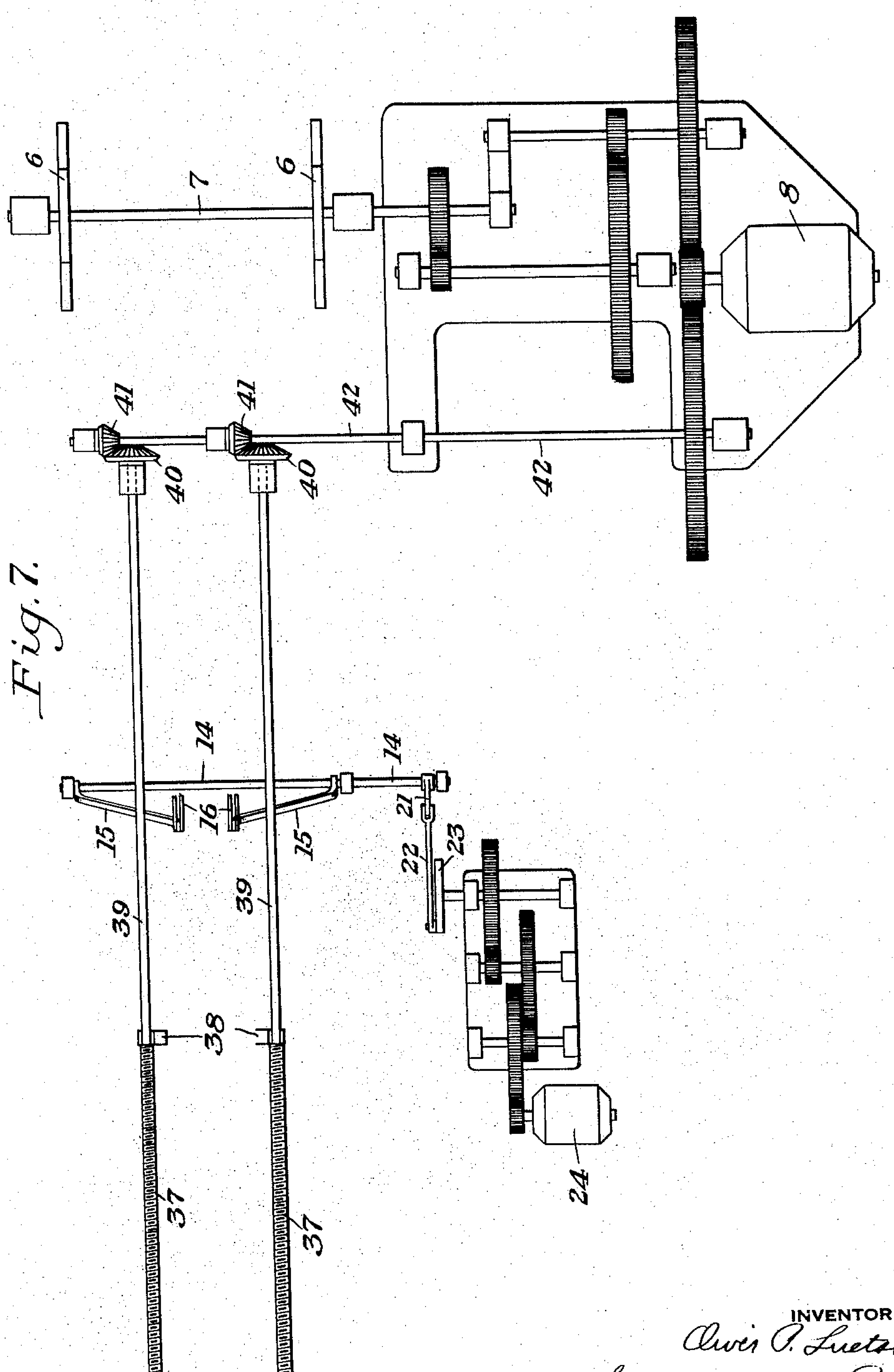

Fig. 7.

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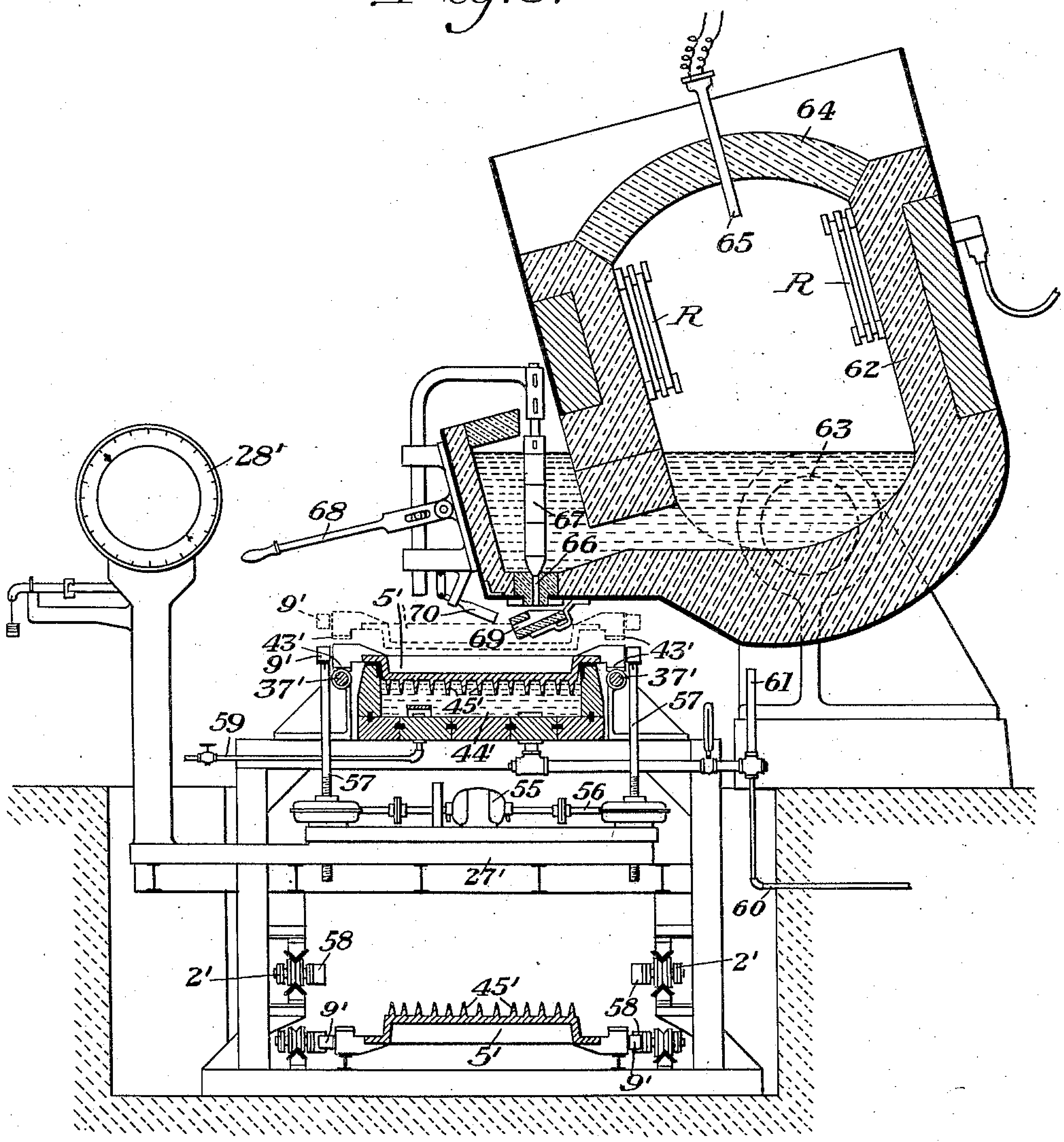
Filed May 5, 1923 5 Sheets-Sheet 5

Fig. 8.



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Patented Nov. 18, 1924. **1,516,049**

UNITED STATES PATENT OFFICE.

OLIVER P. LUETSCHER, OF PITTSBURGH, PENNSYLVANIA.

APPARATUS FOR CASTING.

Application filed May 5, 1923. Serial No. 636,857.

To all whom it may concern:

Be it known that I, OLIVER P. LUETSCHER, a citizen of the United States, residing at Pittsburgh, county of Allegheny, and State of Pennsylvania, have invented a new and useful Improvement in Apparatus for Casting, of which the following is a full, clear, and exact description.

The present invention relates broadly to metal casting, and more particularly to an improved apparatus for casting non-ferrous metals, such as zinc, although the applicability of certain features of the invention to other uses will be apparent.

At the present time considerable difficulty is encountered in the handling of zinc throughout the entire process from melting to rolling.

It is well recognized that in accordance with present methods, there is a large waste due to imperfect sheets, crop ends and the like. This objection could be materially counteracted by the production of larger slabs, as the amount of scrap, while remaining substantially the same per slab, would then represent only a comparatively small percentage of the total amount of metal being handled, as compared to the present comparatively high percentage of waste. With the present systems, however, the uncontrolled cooling of the metal in the molds makes the production of larger slabs exceedingly difficult on account of the excessive shrinkage of the metal. This has resulted in limiting the commercial production of slabs that will be sound enough for good sheets to about one hundred pounds.

In some cases, heavier slabs are cast, but they are only utilized to make heavy zinc plate which does not require the high quality of metal that must be used in the manufacture of thin gauge sheets.

In accordance with this invention, there is provided means for effectively controlling the cooling of the metal in the molds, whereby a body of molten metal is always available to feed the shrinkage caused by cooling. This results in homogeneous slabs of any desired dimensions having substantially constant or uniform cross sectional areas.

These difficulties are further increased by the problems encountered in the production and delivery to the molds of high quality metal. These problems arise from contamination of the zinc during melting by reason of oxidation, ash from the coal which enters the melting chamber, and iron from the ladles used for dipping.

I have also found that the production of large slabs is materially influenced, not only by the quality of the metal initially supplied to the mold, and by the control of the rate of cooling of the supplied metal, but also by the temperature of the mold at the time it receives its charge. It has heretofore been impossible to control the mold temperature between the time of discharge of a formed slab and the return of the mold to the pouring station. Another object of this invention is to provide means whereby this mold temperature may be effectively controlled to produce the desired results.

This invention, by properly interrelating the various factors influencing the formation of slabs, enables the production of large slabs suitable for rolling thin gauge sheets. This makes it possible to radically change the methods now employed for rolling, so as to greatly increase the percentage of salable product produced from a given amount of molten metal.

In the accompanying drawings there are shown, for purposes of illustration only, certain forms of apparatus suitable for carrying out the present invention, it being understood that the drawings do not define the limits of my invention, as changes may obviously be made therein without departing from the spirit of the invention or scope of the broader claims.

In the drawings:

Figure 1 is a side elevation of one form of mold supporting and moving apparatus,

Figure 2 is a view similar to Figure 1, but on an enlarged scale, illustrating a portion of the right hand end of the apparatus illustrated in Figure 1,

Figure 3 is a transverse sectional view, on an enlarged scale, on the line III—III of Figure 2, looking in the direction of the arrows, one form of furnace being illustrated in dotted lines,

Figure 4 is a detail view illustrating a portion of the mold moving apparatus,

Figure 5 is a view similar to Figure 4, but showing the parts in slightly different position,

Figure 6 is a transverse sectional view on the line VI—VI of Figure 4,

Figure 7 is a top plan view illustrating the driving mechanism for the mold carrying and moving apparatus, and

Figure 8 is a view similar to Figure 3 illustrating a slightly modified embodiment of the invention.

In carrying out the present invention it is desirable to replace the somewhat cumbersome rotary tables heretofore used for carrying the molds with an endless carrying chain 2 as clearly shown in Figures 1 and 2. This chain may comprise suitable side links carrying anti-friction supporting rolls 3 as clearly shown in Figure 3, and connected at their ends by transversely extending pins 4. These carrying chains are adapted to directly carry the molds 5, in which the slabs are formed, throughout a portion of the mold travel and to this end may be dimensioned and constructed with respect to the particular molds to be used.

Conveniently, the carrying chains for each apparatus may be supported at each end by angular sprockets 6 around which they pass. These sprockets at at least one end of the apparatus may be mounted upon a shaft 7 adapted to be positively driven by a motor 8 through a suitable train of gears as clearly shown in Figure 7. The gear train will obviously bear such ratio to the motor speed that the carrying chains will be moved to deliver the molds continuously as required.

In order to permit the replacement of molds as may be necessary, the molds are preferably loosely carried by the chains 2. For this purpose the molds may be provided with downwardly extending projections 9 adapted to extend over the pins 4 to provide driving engagement between the chains and the molds. During such portion of the time as the molds are supported on the upper run of the chains, they are held in position by gravity. During the return movement of the molds, they may rest on supporting channels 10. Curved guards 11 may cooperate with the channels 10 at each end thereof to insure the passage of the molds to and from these channels.

During the travel of the chains, the molds are adapted to be successively filled with molten metal, such as zinc, then allowed to cool at a rate which is regulated in a novel manner whereby the resulting slabs are of greater uniformity, and are then discharged.

Referring more particularly to Figures 1 and 2 of the drawings, the molds are shown as traveling from the right hand end of the apparatus to the left hand end thereof. After passing over the driving sprockets 6 the carrying chains incline downwardly over a suitable guide 12. As the carrying chains move downwardly, they force the molds onto spaced slides 13 along a portion of which the molds are positively pushed by the following molds. When a mold reaches the station A, shown in detail in Figures 4 and 5, it is adapted to be positively pushed ahead by a special mold pusher mechanism. This mechanism comprises a shaft 14 carrying upwardly and inwardly extending levers 15 pivotally connected at their upper ends to links 16. These links are in turn pivotally connected to lugs 17 extending downwardly from slides 18 mounted in the frame 19 of the apparatus. Carried by the slides 18 and projecting upwardly therefrom are pivoted pushers 20 arranged in sets spaced longitudinally of the slides. The spacing of the pushers is such that adjacent pushers will cooperate with adjacent or successive molds for effecting simultaneous movement thereof. The shaft 14 is adapted to be rocked to effect movement of the mold pushers from the position shown in Figure 4 to that shown in Figure 5 by means of a crank arm 21 secured to one end thereof and in turn connected by a pitman 22 to an eccentric 23. This eccentric may be rotated in timed relation to the movement of the carriers by means of a motor 24. It will be understood that the motors 8 and 24 may either be synchronous motors, or may be automatically controlled in such manner that rotation thereof may be maintained in substantial synchronism. Each movement of the pushers from the position shown in Figure 4 to that of Figure 5 will be effective for moving a mold from station A to station B at which the molds are adapted to be filled with molten metal. During the return movement of the pushers 20, they are permitted to pass freely under the molds due to their pivotal mountings and counterweighted end portions 25.

At station B, which may be considered as the pouring point, the molds may be supported in any desired manner. Preferably, however, they are directly carried on suitable supports 26 extending upwardly from a scale beam 27 connected in any well known manner to an indicator 28, whereby an operative may readily determine when the proper amount of metal has been run into the mold. At such time the supply of molten metal will be cut off to permit the removal of the filled mold and the delivery of an empty mold to the station B. This will be automatically accomplished by the movement of the mold pushers as before described. This movement causes the front pushers 20 to engage the filled mold at the station B while the rear pushers engage an empty mold at the station A. The movement thereof to the left will then be effective for moving the filled mold from the station B to station C while moving an empty mold from station A to station B as before set forth. At station C the filled molds are received by a counterweighted platform 29 vertically movable through the frame 19 and carried by one end of a counterweighted lever 30 having a pivotal mounting 31. This platform 29 is normally held in the position shown in Figure 4 to receive a filled mold by the action of the counterweight 32 as well as the action of a catch 33 pivotally carried by the frame 19. When the movement of a filled mold from the station B to station C has been completed, a lug 34 on the mold pushing mechanism engages the tail of the catch 33, as clearly shown in Figure 5, and releases the same from engagement with the platform. The weight of the filled mold causes the platform to descend to the position shown in Figure 5. The platform is temporarily positively held in this position by a swinging latch 35, carried by the frame 19, which swings over the pin 36 of the lever 30.

In order to positively move the filled mold from the position above the platform 29, to permit the platform to again return to mold receiving position, it is necessary to provide supplemental mold moving mechanism. This supplemental mechanism may conveniently comprise longitudinally extending spaced screws 37 supported at spaced points throughout their length in brackets 38 carried by the frame 19. Adjacent the right hand end of the apparatus, the screws are connected to drive shafts 39 carrying bevel gears 40. These bevel gears are simultaneously rotated in unison by bevel driving pinions 41 secured to a drive shaft 42 having an operative driving connection with the motor 8, as shown in Figure 7.

Carried by each of the molds are threaded projections 43 constituting in effect half-nuts. Upon the lowering movement of the platform 29 as before described, the half-nuts 43 come into engagement with the continuously rotating screws 37 and are thereby moved to the left, as viewed in the drawings. This movement brings the leading edge of the mold, as indicated in dotted lines in Figure 5, into engagement with the tail of the catch 35 thereby moving it to a position to release the pin 36, and permit the counterweight 32 to return the platform to the position shown in Figure 4 ready for the reception of the next mold. This operation is repeated each time a filled mold is delivered to the platform.

The screws 37 may be of any desired length in accordance with the capacity of the particular apparatus and in accordance with the length of time which it is desired to keep the material in the molds before discharge thereof. As clearly shown in Figure 3 they may be located on opposite sides of a trough 44 adapted to contain a supply of cooling water which may be continuously delivered thereto in any manner. The molds may each be provided with a series of depending fingers or flanges 45 adapted to enter the water in the trough and thereby assist in cooling the metal in the mold during its travel through the apparatus. This cooling, which has heretofore been uncontrolled, produces a shrinkage of the metal. Due to the fact that the upper surface of the metal has heretofore been exposed to the cooling action of the air, the metal has been caused to sink downwardly and frequently crack, thereby producing an imperfect slab. In accordance with this invention there is preferably provided means for controlling the rate of heat dissipation or cooling of the upper body of molten metal in the molds, either by heat insulating the same or by positively supplying additional heat thereto. This means, as shown in Figure 1, may comprise a hood 47 which may be of any suitable material, and which may if desired have located therein suitable heaters or burners 48. This hood is of such width as to completely enclose the molds as they are received after travel from the platform 29 and may be of a length such that the desired rate of cooling may be effectively controlled. In this manner it is possible to keep the upper portion of the metal in the molds in liquid form whereby it is available to "feed" the shrinkage and thereby insure the production of a solid slab of uniform composition.

The carrying chains, which after leaving the inclined guides 12, may extend downwardly below the screws 37 where they are supported on guides 49. After leaving the guides 49 they travel upwardly to the sprockets 6 at the left hand end of the machine. During this movement, the pins 4, or the rollers 3 thereon, engage the leading lugs 9 and lift the mold having a chilled slab therein from the end of the trough 44. These molds are then carried to the station D, shown in Figure 1, at which the slabs fall outwardly, under the influence of gravity, onto supporting arms 50. These supporting arms 50 are preferably pivotally mounted and provided with suitable counterweights 51 whereby the weight of a discharged slab may swing them into the dotted line position shown in Figure 1. This permits the slab to be automatically discharged and delivered to any desired point from which they may be carried to an annealing furnace to prepare them for rolling as is customary in the art.

During the return travel of the molds, while supported by the channels 10, they may be shielded in any desired manner to prevent further cooling thereof, or a separate hood 52 similar to the hood 47 and having suitable heating means 53, may be provided. In this manner the objectionable cooling of the molds which has heretofore occurred between the point of discharge and the return to the pouring point is obviated, it being possible to keep the molds from losing their heat, or delivering them to the pouring point at any predetermined temperature.

In Figure 8 in the drawings there is illustrated a slightly modified form of the invention in which parts corresponding to parts already described are designated by the same reference characters having a prime suffixed thereto. With this construction the screws 37′ are indicated as being of greater length than those illustrated in Figures 1 and 2 of the drawings, as they are preferably long enough to extend beyond station B or the pouring station which is the position illustrated in Figure 8. In order to prevent the continuous travel of the molds during the delivery of the metal thereto, it is obviously necessary to raise the same out of engagement with these screws. For this purpose the scale beam 27′ may carry a motor 55 adapted to drive a transversely extending shaft 56 having a worm and worm wheel connection (not shown) with lifting rods 57. When the motor is operated in one direction the lifting rods 57 will be raised to lift the mold which is in pouring position into the position indicated in dotted lines in Figure 8. After the mold has received the desired amount of metal, the motor may be driven in the reverse direction to again lower the half-nuts 43′ onto the screws 37′. This construction is advantageous for certain purposes for the reason that it is possible to raise the mold into a position more closely adjacent the point of discharge of the molten metal and thereby prevent cooling of the metal to an undesirable extent and materially reduce oxidation.

In this figure, there are illustrated carrying chains 2′ of a slightly modified construction, and the molds are each indicated as provided with laterally extending projections 9′ adapted to engage suitable pockets 58 carried by the side links. The particular construction of the molds and chains may, however, be changed in accordance with the requirements of the particular installation for which the equipment is designed, it being only essential that the molds be readily disengageable from the carrying chains and that the chains be capable of imparting the desired movement to the molds.

For the purpose of maintaining the desired level of cooling water in the trough 44′, the water may be delivered thereto through an inlet connection 59. The trough is in turn connected to an outlet connection 60 having an intermediate overflow device 61. With this construction, the rate of cooling of the lower portion of the molds may be varied by suitably changing the volume of flow of cooling water.

While it will be apparent that the molten metal may be delivered to the molds in any desired manner, the full advantages of the present invention are obtained where the molten metal is produced and maintained under conditions in which contamination by reason of oxidation, ash, or iron from dipping ladles is prevented. For this purpose there is preferably employed an electric furnace of the type illustrated in Figures 3 and 8. This furnace comprises suitable refractory walls 62 carried by a base pivotally mounted on trunnions 63. The top of the furnace is preferably closed at all times by a cover 64 through which one or more temperature controlling pyrometer couples 65 may extend, as desired. The furnace may be heated by suitable means such as resistors R. By reason of this construction it is possible to maintain a non-oxidizing atmosphere within the furnace at all times. Furthermore, by reason of the use of electricity, contamination from ash is prevented.

This furnace is also preferably of the direct pour type having an outlet opening 66 controlled by a vertically movable plug 67 of a type similar to that used in ordinary steel ladle work. This plug may be operatively connected to an operating lever 68 whereby when the scale shows that the proper amount of material has been delivered to the mold, the operative may move the plug to cut off the further flow of metal.

Adjacent the outlet 66, there may be provided a boot or spout 69 adapted to receive the molten metal and transfer it to the mold. This boot not only minimizes splashing but restricts the period of contact with the air and the consequent cooling and oxidation. If desired, there may be provided a burner 70 for maintaining the metal in molten condition.

This furnace may be constructed so that during the normal operation thereof it is adapted to occupy an inclined position as clearly shown in Figure 8. With such a construction, in the event of injury to the plug or outlet, the furnace may be tilted in the opposite direction to entirely uncover the outlet and thereby permit repair thereof without shutting down the operation of the entire furnace or withdrawing all of the molten metal therefrom.

A furnace of this type has many advantages, among which may be mentioned its comparatively small capacity, whereby the investment represented by molten metal is decreased, its cleanliness of operation whereby contamination by foreign material is prevented, its closed condition materially restricting oxidation, and its direct pour whereby ladling is made unnecessary. This admirably cooperates with the improved mold handling apparatus as it delivers a higher quality metal to the molds and thereby contributes an improved factor involved in the production of large slabs.

By the present invention there is provided means for easily controlling the temperature at which the molds are brought to the pouring point. After the desired amount of metal has been delivered to the molds, the rapidity of cooling of the metal in the molds may be accurately controlled to feed the shrinkage as required. This is accomplished by either varying the amount of cooling water, varying the amount of heat supplied to the upper portions of the molds or controlling the rate of heat dissipation, or by a suitable interrelation of these factors.

The advantages of the mold handling apparatus arise from the ease of control of the molds, their delivery automatically as required, and the control in the rate of cooling whereby the shrinkage caused by the cooling of the metal in the lower portion of the mold may be fed by the molten metal in the upper portion thereof.

Still further advantages arise from the provision of a mold handling apparatus in which, after the discharge of the slabs from the molds, the molds may be prevented from further cooling, or may be preheated as desired.

Still further advantages arise from the provision of a compact mold handling apparatus of large capacity so constructed that molds of different sizes may be substituted, or repairs made, as may be necessary.

I claim:

1. In a casting apparatus, a scale, means for supporting a mold thereon, means for delivering molten metal thereto, and means for removing a filled mold from the scale beam, substantially as described.

2. In a casting apparatus, a trough containing a cooling medium, and means on opposite sides of said trough for supporting a mold and moving the same through the trough, substantially as described.

3. In a casting apparatus, an endless conveyor, a plurality of molds detachably carried thereby, said endless conveyor being adapted to deliver the molds successively to a charging station and a discharging station, and means intermediate said stations for cooling the bottoms of the molds and for controlling the rate of cooling of the metal in the upper portions thereof, substantially as described.

4. In a casting apparatus, an endless conveyor, a plurality of molds detachably carried thereby, said endless conveyor being adapted to deliver the molds successively to a charging station and a discharging station, and means intermediate said stations for adding heat to a portion of a charged mold and for cooling another portion thereof, substantially as described.

5. In a casting apparatus, an endless conveyor, a plurality of molds detachably carried thereby, said endless conveyor being adapted to deliver the molds successively to a charging station and a discharging station, and a heat retaining hood arranged to enclose the molds during a portion of their travel from one of said stations to the other, substantially as described.

6. In a mold handling apparatus, a screw, means for rotating the same, a mold adapted to be moved by said screw, means to move the mold to a charging station, and means for delivering a charged mold to a position for cooperation with said screw, substantially as described.

7. In a mold handling apparatus, a trough adapted to contain a cooling medium, a screw at one side of said trough, a mold having a portion projecting into said trough and a portion engaging said screw whereby the mold is moved through the trough, and means cooperating with the mold during its travel through the trough for controlling the dissipation of heat therefrom, substantially as described.

8. In a mold handling apparatus, a trough adapted to contain a cooling medium, a screw at one side of said trough, a mold having a portion projecting into said trough and a portion engaging said screw whereby the mold is moved through the trough, and means cooperating with a mold during its travel through the trough for adding heat to a portion of the metal therein, substantially as described.

9. In a mold handling apparatus, a trough, a screw on each side thereof, means for rotating said screws, a plurality of molds having means for engagement with said screws, means for delivering said molds successively into position to be engaged by said screws, and means for charging said molds during their delivery to screw-engaging position, substantially as described.

10. In a mold handling apparatus, a mold, a screw for moving said mold through a portion of its travel, an endless carrier for moving it through another portion of its travel, and a counterweighted transfer device between said screw and said endless carrier, substantially as described.

11. In a mold handling apparatus, a mold, a screw for moving said mold through a portion of its travel, an endless carrier for moving it through another portion of its travel, and a vertically movable transfer device between said screw and said endless carrier, substantially as described.

12. In a mold handling apparatus, means for successively moving a plurality of molds from a charging station to a discharging station and then returning the same to the charging station, and heat retaining hoods intermediate both of said stations, substantially as described.

13. In a mold handling apparatus, means for successively moving a plurality of molds from a charging station to a discharging station and then returning the same to the charging station, and a heat retaining hood through which the molds pass in traveling from the discharging station to the charging station, substantially as described.

14. In a mold handling apparatus, a charging station, a discharging station, means for delivering molds successively from the charging station to the discharging station, and means intermediate said stations for retarding the dissipation of heat from a portion of a charged mold, substantially as described.

15. In a mold handling apparatus, a charging station, a discharging station, means for delivering molds successively from the charging station to the discharging station, means intermediate said stations for retarding the dissipation of heat from a portion of a charged mold, and means intermediate said stations for artificially chilling another portion of a charged mold, substantially as described.

16. In a mold handling apparatus, a charging station, a discharging station, means for successively moving molds from the charging station to the discharging station, and means intermediate said stations for adding heat to a portion of a charged mold during its passage from one station to the other, substantially as described.

17. In a casting apparatus, mold supporting means, and means for melting metal in a non-oxidizing atmosphere and flowing the same directly therefrom into a mold supported by said mold supporting means, substantially as described.

18. In a casting apparatus, means for carrying a plurality of molds in succession past a charging station, means at said charging station for melting metal in a non-oxidizing atmosphere and charging the molds therewith as they are brought to said station, and means adjacent said station for cooling a portion of each charged mold, substantially as described.

19. In a casting apparatus, means for moving a plurality of molds in succession from a charging station to a discharging station, means at the charging station for melting metal in a non-oxidizing atmosphere and charging the molds therewith, and means intermediate said stations for controlling the rate of cooling of the metal in the upper portions of the molds, substantially as described.

In testimony whereof I have hereunto set my hand.

OLIVER P. LUETSCHER.