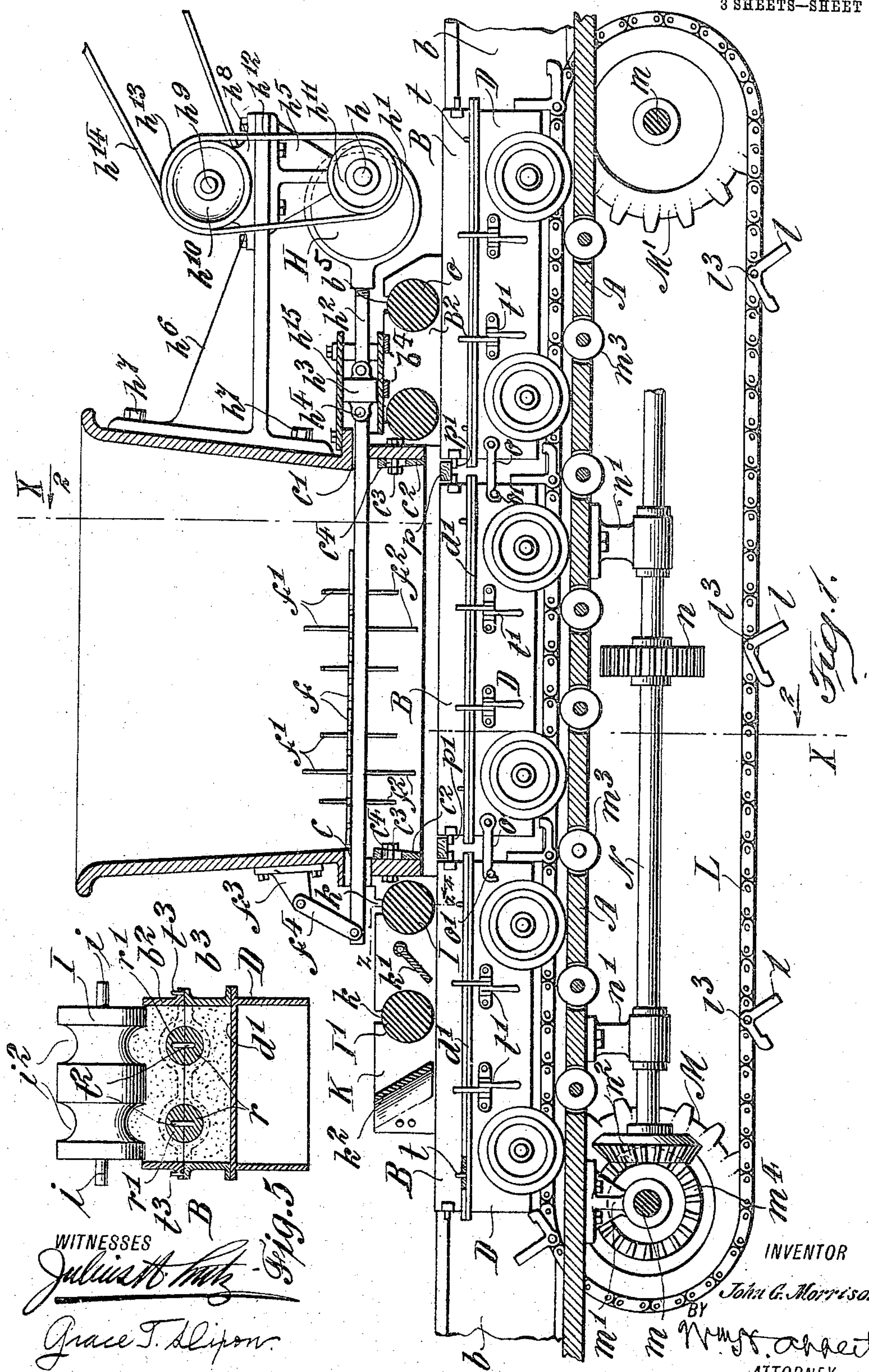


J. G. MORRISON.
MOLDING MACHINE.
APPLICATION FILED FEB. 18, 1909.

951,830.

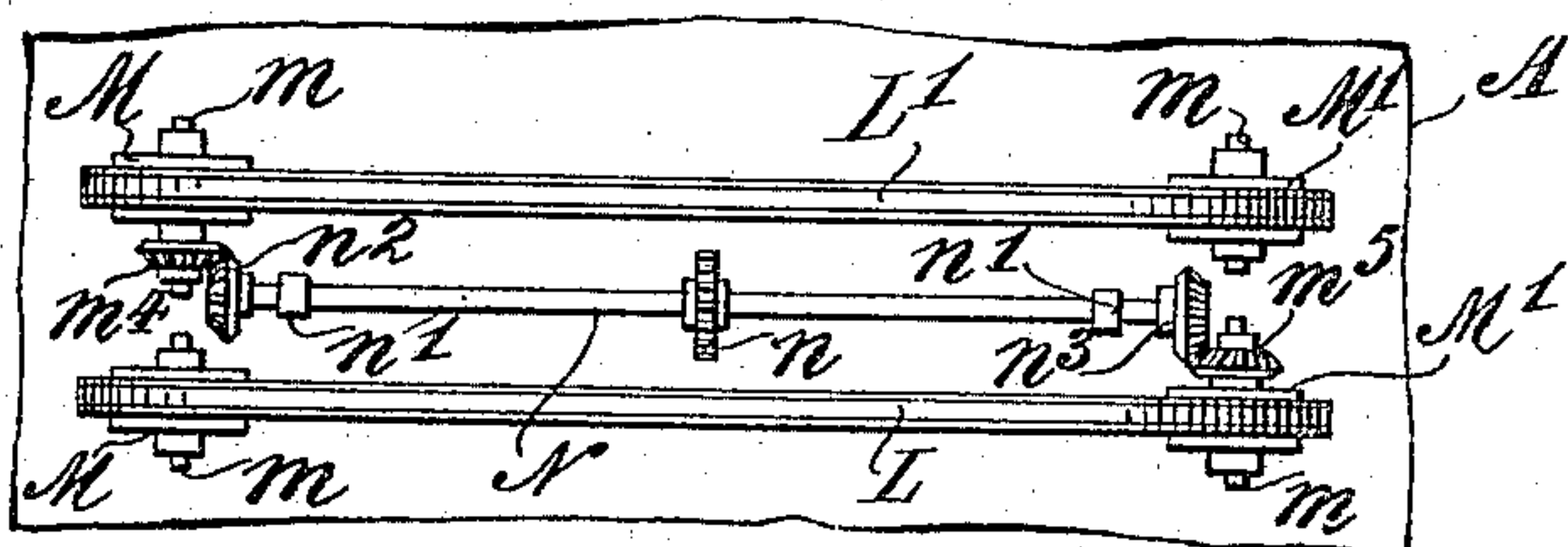
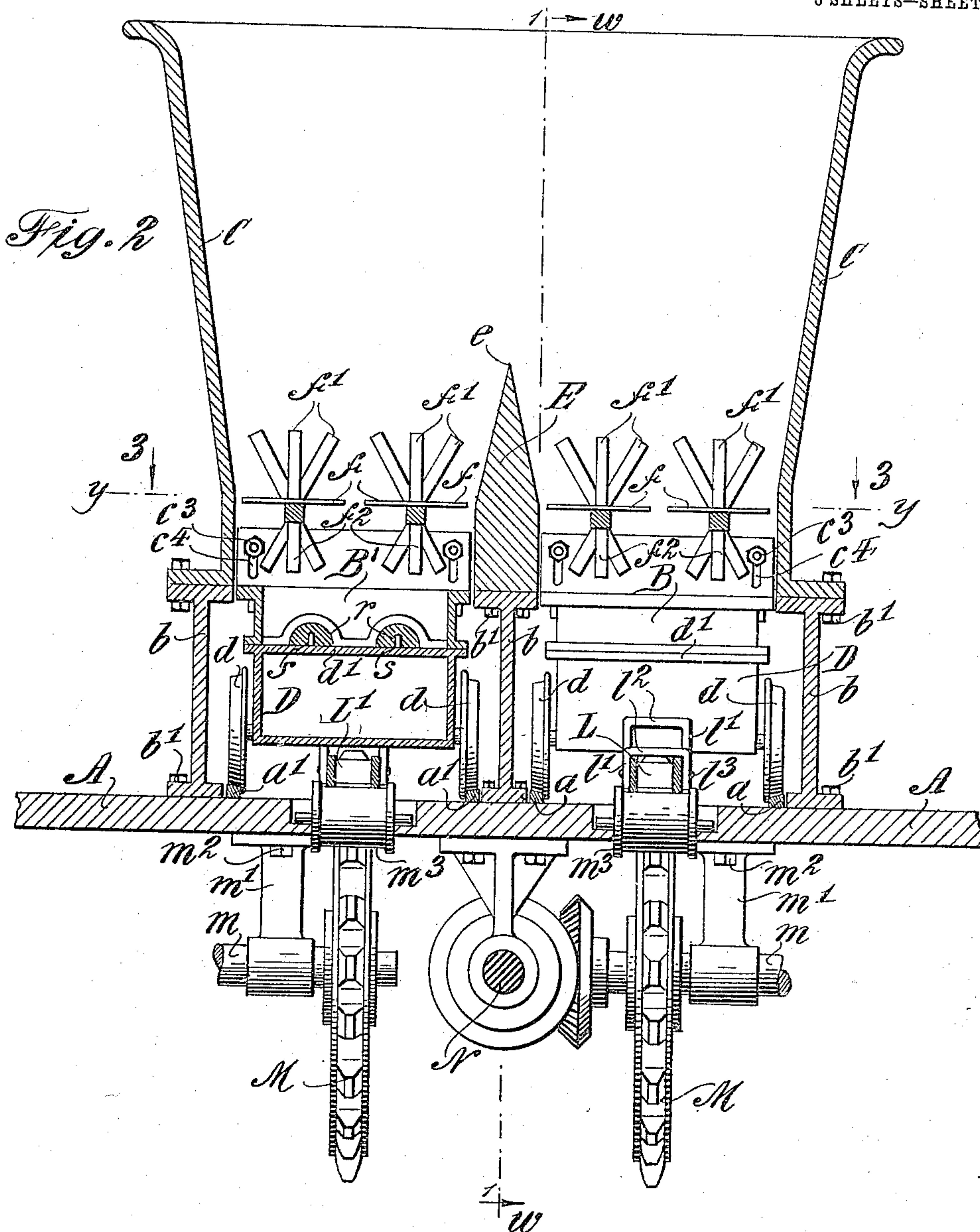
Patented Mar. 15, 1910.

3 SHEETS—SHEET 1.



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3 SHEETS—SHEET 3.

Fig. 3

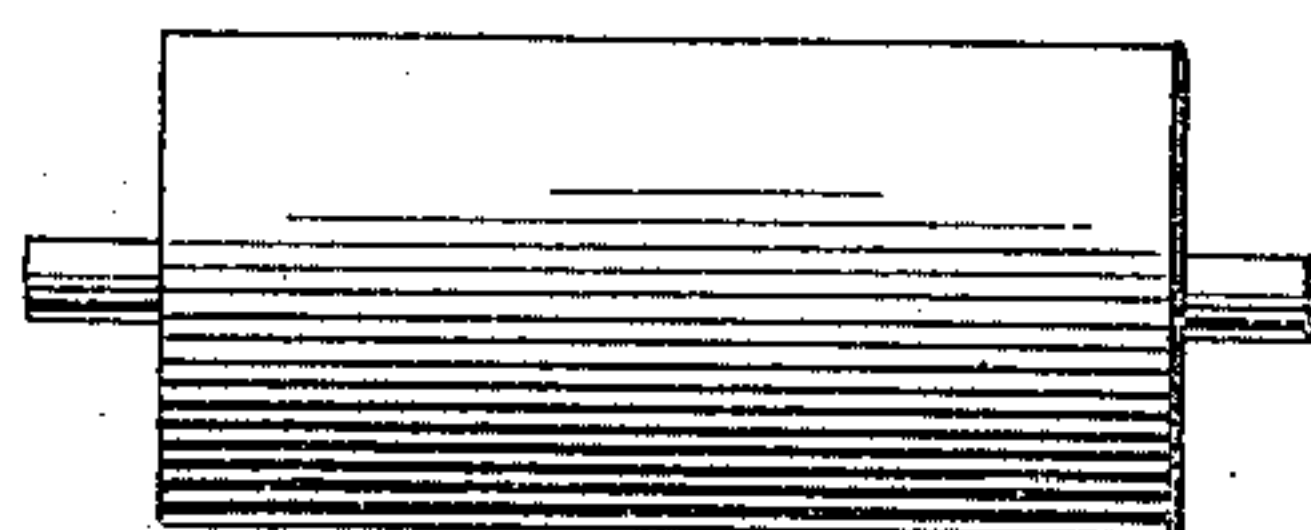
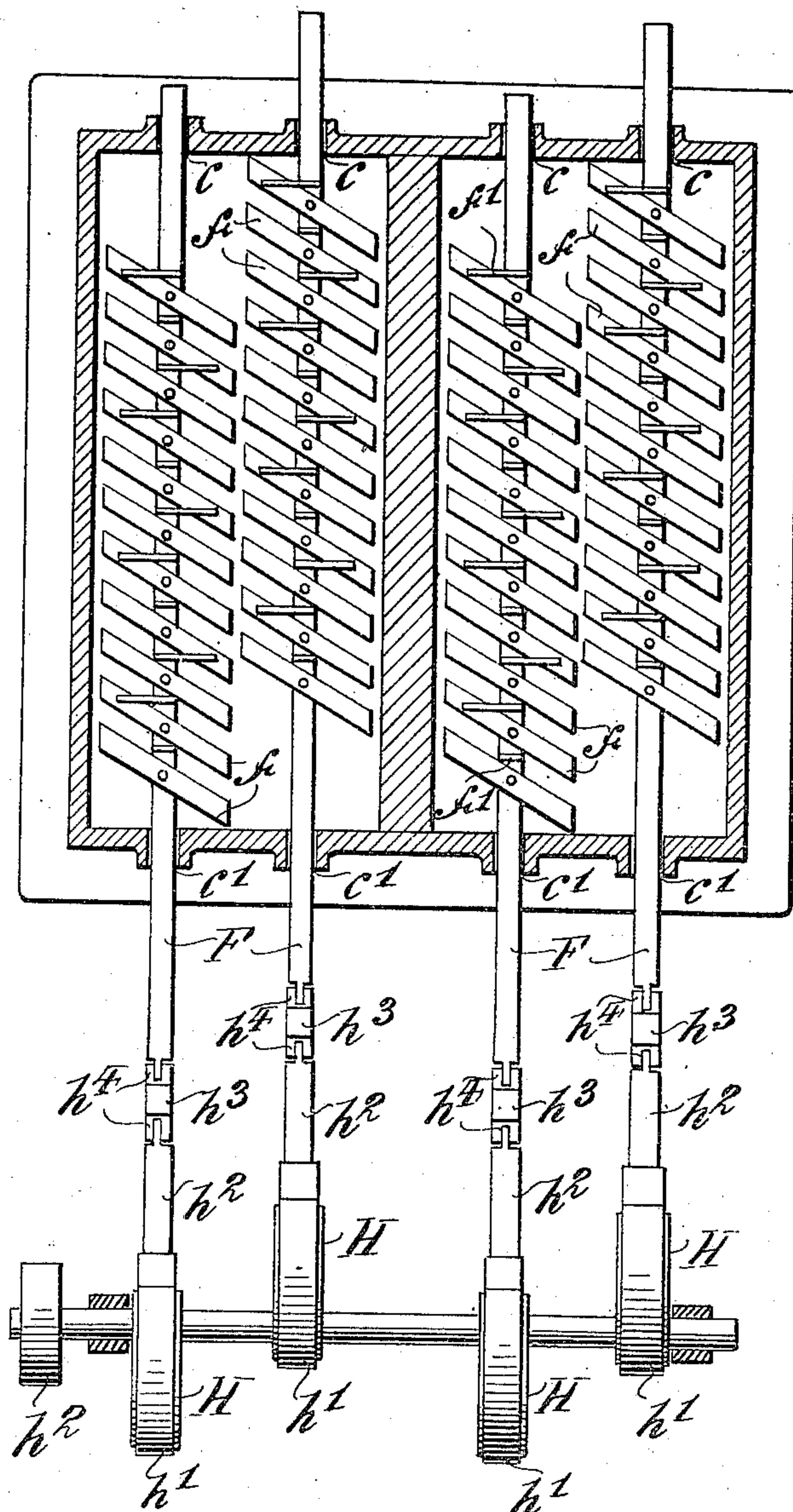


Fig. 6

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MOLDING-MACHINE.

951,830.

Specification of Letters Patent. Patented Mar. 15, 1910.

Application filed February 18, 1909. Serial No. 478,604.

To all whom it may concern:

Be it known that I, JOHN G. MORRISON, a citizen of the United States, and a resident of the borough of Brooklyn, in the county of Kings and city and State of New York, have invented a certain new and useful Improvement in Molding-Machines, of which the following is a specification.

My invention relates to that class of molding machines in which the sand for molding is supplied in bulk to a hopper and the molding of the successive articles is accomplished by passing the flasks, in which the articles are molded, one after another beneath the hopper, to receive the sand, and then beneath the compacting devices by which the sand is compacted within the flask to effect the molding operation. In Letters Patent No. 906,259, which were granted to me December 8, 1908, I have shown and described a molding machine of this class, in which the compacting devices are arranged within the sand receiving hopper, and the molding operation is automatically accomplished by passing the flask in which the articles are to be molded successively beneath them, upon carriers which are properly actuated to effect that result. My present invention differs from this, in that, instead of the compacting devices being located within the sand receiving hopper, they are located outside of the same, whereby to act upon the sand, to complete the molding operation, after the flask containing the sand has passed beneath the hopper and to one side thereof, and, in that, instead of employing a train of gear wheels, operating in connection with racks, for moving the carriers which carry the flasks beneath the sand supplying hopper and the compacting devices, I make use of other appliances; the object of the invention being, to simplify the parts and thereby cheapen the cost of construction, while yet increasing the efficiency of the machine.

To these ends, the invention consists in various peculiarities of construction and combinations of parts, which, in their preferred forms, will be hereinafter first described, and the novel features of the invention then pointed out in the subjoined claims.

Referring to the accompanying drawings, which form a part of this specification, Figure 1, is a longitudinal vertical section of a molding machine constructed in accordance

with my invention, taken in the line *w w* of Fig. 2 and looking in the direction of the arrow 1, with parts broken away and the driving mechanism for the sand agitating devices shown in side elevation; Fig. 2, a transverse vertical section of such machine, taken in the line *x x* of Fig. 1, and looking in the direction of the arrow 2; Fig. 3, a horizontal sectional view of the sand receiving hopper, taken in the plane *y y* of Fig. 2, and looking in the direction of the arrows 3, with the sand agitating devices and their operative mechanism shown in plan; Fig. 4, a reverse plan view of the operating devices for the carriers which sustain and carry the molds; Fig. 5, a vertical transverse sectional view of a flask, of the patterns arranged therein and of one of the carriers for the flask, showing the flask filled with sand and one of the compacting rolls in elevation, taken in the line *z z* of Fig. 1 and looking in the direction of the arrow 4, and Fig. 6, a side elevation of the rear compacting roll detached.

In all the figures, like letters of reference are employed to designate corresponding parts.

A indicates the main platform or base of the machine, which is or may be of any appropriate design and construction, and *a* and *a*¹ indicate pairs of tracks with which it is or may be provided.

B and B¹ indicate the flasks in which the molding operations are performed, and C indicates the hopper to which the sand made use of in such molding operations is supplied and from which it is fed to the flasks as they are successively presented to receive it. In the construction of these flasks and this sand receiving and delivering hopper, various forms may be adopted. It is preferred however to construct the flasks in the form of the ordinary and well known two or more part flasks heretofore in use, as the nature of the articles to be molded may require, and to construct the hopper C in the shape of an open ended tubular receptacle of rectangular form in cross-section, with its side walls inclining inward from its upper to near its lower end, whereby to permit of the sand being supplied to its top, and, passing downward through it to its lower end, of being discharged from its bottom. With the flasks and hopper as thus constructed, the sand required in the molding operations is supplied to the flasks by

passing the flasks beneath the lower end of the hopper, to permit of which the hopper is supported in an upright position above and from the base or platform A by frames or girders b , which extend between them and are respectively connected at their top and bottom edges to the hopper and to the platform by bolts b^1 as shown.

For supporting the flasks B and B^1 and passing them beneath the hopper C during the molding operation, carriages D are employed, which, constructed of the requisite lengths to receive and carry the flasks, are provided with flanged wheels d that are adapted to run upon the pairs of rails a and a^1 , and are equipped with smooth flat tops d^1 , which, in practice, may serve as "mold-boards" to the flasks in the molding operation. In some instances but a single row of these carriages D will be employed, and, in that case, the carriages with the flasks thereon will be passed beneath the hopper in only one direction, and the hopper C will be made of a width to supply the sand to only one row of flasks in being passed beneath it. It is preferred however to employ two rows of these carriages, as, in such case, the carriages, after having been successively passed beneath one side of the hopper on one pair of rails, as, for instance, upon the pair a , and, after having the molding operations performed in the flasks B carried by them, may be transferred to the other pair of rails, as, for instance, to the pair a^1 , and, after having received fresh empty flasks B^1 , be successively passed backward beneath the other side of the hopper in an opposite direction, and have a similar molding operation performed in their flasks, and so on, two different molding operations being thus performed at the same time. When this last mentioned arrangement is employed the hopper C will be made of a width to extend across and over the paths of movement of the two oppositely moving rows of flasks B and B^1 , and will be preferably provided with a dividing wall E, which, extending across the hopper from one of its interior sides to another, in parallel relationship to the lines of travel of the oppositely moving rows of flasks, will be constructed of a width sufficiently great to extend substantially across the space between such rows of flasks, and have the opposite sides of its upper portion gradually incline inward toward each other until they meet and form a sharp edge e at its top. With the hopper constructed with either of these capabilities it is provided with a series of reciprocating bars F, which extend inward through apertures c and c^1 formed in its side walls across the interior of the hopper near its lower end, and are severally provided with means for, not only supporting the sand within the hopper and feeding it downward to its lower end in the

required quantities, but also for agitating and loosening it up and maintaining it in that condition both above and below its supporting and feeding devices. Of these, the means for supporting the sand within the hopper and feeding it downward to its lower end consists of a series of narrow thin blades f , which are secured to each of the bars F, and which, extending outward therefrom in horizontal relationship across the interior of the hopper, are preferably inclined to their respective bars at an angle somewhat less than a right-angle, with a narrow space left between each two blades, and between both ends of the blades of one series and the ends of the blades of the adjacent series, and between the ends of the blades of the outer series and the interior of the hopper and the partition therein respectively; while the means for agitating and loosening up the sand both above and below the blades f consists of two series of relatively thin slats f^1 and f^2 secured to each of the bars F, and, extending outward therefrom at approximately a right-angle, are respectively disposed around the portion of the bar above and below the blades f in spiral lines, with their flat surfaces lying in planes which extend transversely of the hopper. As thus arranged, whenever the sand is supplied to the hopper C, it rests upon the blades f , which practically serve as a bottom to the same, and which, by their back and forth reciprocation, act to slice off from the bottom portion of the sand in the hopper the required amounts necessary to the efficient molding operation, and feed them forward to the lower end of the hopper for supplying the flasks B and B^1 ; while the slats f^1 and f^2 , by their back and forth movement through the mass of sand contained in the hopper above and below the blades f , serve to agitate and loosen it up and maintain it in that condition in both of those locations.

For imparting the requisite back and forth reciprocating motions to the blades f and slats f^1 and f^2 , various means may be employed. It is preferred however to impart these motions to them by eccentrics H, through their carrying bars F. To this end, the eccentrics, of which there will be a separate eccentric for each bar, are mounted upon a shaft h , and are separately connected with their respective bars, through the intervention of an eccentric strap h^1 , a connecting rod h^2 , and a cross-head h^3 , to which last, one end of their respective bars is connected by a joint h^4 . As thus connected the back and forth reciprocation of the blades and slats are effected by simply rotating the shaft h ; and, in order to provide for this rotation, the shaft h is mounted in suitable bearings formed in the lower end of hangers h^5 , that are secured to and depend from the

under side of brackets h^6 , which, secured to the hopper C by bolts h^7 , extend outwardly therefrom, and support near their outer ends bearings h^8 , in which are journaled a shaft h^9 , that is connected with the shaft h through the intermediaries of pulleys h^{10} and h^{11} and an endless belt h^{12} , and is itself equipped with a pulley h^{13} , by means of which, and a belt h^{14} , it may be connected with a motor or other source of power, not shown. With the blades f and slats f^1 and f^2 thus operated, the bars F in or upon which they are secured and carried extend outwardly at their opposite ends through the walls of the hopper C, and have their free ends connected with stands f^3 thereon through the intervention of pivoted links f^4 , with their opposite ends supported by the cross-heads h^3 through the pivotal joints h^4 . By this arrangement, as will be seen, the wear of the bars incident to the working of the sand into the bearings, when the bars are fitted to slide back and forth in bearings formed in the walls of the hopper, is obviated; and in order to provide for the up and down movements of the bars, caused by the swinging movements of the links f^4 , the apertures c and c^1 in the walls of the hopper, through which the bars pass, are made somewhat larger than such bars, as shown. While thus the bars F partake of the back and forth longitudinal and the up and down movements imparted to them by the eccentrics H and the links f^4 , the cross-heads are confined in their movements to back and forth rectilinear lines by guides h^{15} , which are supported from the frames or girders b through the intervention of bearing blocks B^2 and bars b^4 , with the inner ends of the lower guide slightly removed from the apertures c^1 , whereby to prevent the sand working out through these latter from reaching them.

In some instances it may be found desirable to so reciprocate the bars F, with their respective blades and slats, that they may all move back and forth in unison, and, in that case the eccentrics H will be so secured upon the shaft h that the longest radii of all shall extend outward therefrom in the same direction. It is preferred however to so reciprocate them that the adjacent bars, with their attached blades and slats, shall move in opposite directions, and, when this mode of operation is adopted, their respective eccentrics H shall be so disposed upon the shaft h that their longest radii shall extend outward from it in opposite directions, as shown, for instance, in Fig. 3, but this is merely illustrative and other modes of operation may be adopted if so desired.

While the supply of sand to the flasks B and B^1 is thus effected by the hopper C and the appliances coöperating with it, the amount of sand thus delivered is determined by the height at which the lower edge of

the hopper C is located with respect to the tops of the flasks B and B^1 . In order therefore to provide for varying this height, to suit the deliveries of the sand to the requirements of the particular articles being molded, it is preferred to render this lower edge adjustable, and to that end the inner surface of the front and rear sides of the hopper at its lower end are each provided with a strip c^2 , which is secured thereto by bolts c^3 , with the slots c^4 in this strip, through which the bolts are passed, vertically elongated, whereby the adjustment of the strip upward within or downward therefrom may be effected, and the height of its lower edge with respect to the top of the flasks thereby adjusted. By these means, as will be seen, the deliveries of sands to the flasks, as the requirements of the different articles to be molded demand, may be regulated and controlled by simply raising or lowering the strips c^2 , as a greater or lesser amount is required, and firmly clamping the strips in place by their bolts c^3 .

For compacting the sand in the flasks B and B^1 , after it has been supplied to them by the hopper C and other appliances coöperating with it, various means may be adopted. It is preferred however to employ rolls for this purpose, under which the flasks are passed, after having been supplied with the requisite sand. In some instances but a single roll for compacting the sand in the flasks will be required in connection with each row thereof, while in other instances a greater number of rolls may be found necessary. In the drawings however a pair of these rolls I and I^1 are made use of for that purpose in connection with each row of flasks; and to permit of their accomplishing the required compacting results, and, at the same time, to render the successive steps of the molding operation continuous, these rolls are journaled in bearing blocks K, which, are secured to the upper edges of the frames or girders b , with the rolls for each row of flasks so supported in them that their peripheries will come in close relationship to the top of the flasks as the latter are passed under them. With the rolls I and I^1 thus arranged, whenever the machine is in operation and the successive flasks of each row are carried forward by their supporting carriage D, these flasks will first pass beneath the hopper C, where the sand required in the molding operation is supplied to them, after which, in their continued forward movement, they will travel beneath their respective compacting rolls I and I^1 , where the compacting of the sand in them by the rolls is effected and the molding operation thereby completed.

In some instances the supporting of the rolls I and I^1 in their respective bearing blocks K, as, for instance, when the weight

of the rolls is not sufficient in itself to compact the sand in the flasks to the required density, may be effected through bearings which prevent any vertical movement to them, and, in such cases, the rolls will be positively held in operative position by them. It is preferred however to construct these rolls of such diameter that the compacting of the sand in the flasks will be effected by their gravity alone, and, when thus constructed, their journals i , instead of rotating in fixed bearings, will rest in open bearings, as shown at k . When the machine is employed in the molding of articles varying in thickness or in width throughout their length, these rolls I and I^1 may both be constructed cylindrical throughout, without any grooves or depressions formed in the periphery of either. When however it is employed in the molding of pipes or other articles that are of uniform width and thickness throughout, then, with a view to insuring of a uniform compacting of the sand in the flask at all points therein, the roll I appropriate to each row of flasks, may be provided with a correspondingly shaped circumferential groove or grooves i^2 in its periphery, as illustrated, for instance, in Fig. 5, wherein the operation of molding two pipes is shown, with the cope b^2 deposited upon the drag b^3 , with the patterns r r^1 arranged in proper positions in the flask, and the whole resting upon the top d^1 of the carriage D . While the roll I appropriate to each row of flasks B or B^1 may thus be provided with a groove or with grooves i^2 , the respective rolls I^1 cooperating with them are preferably made smooth on their peripheries, without any groove or grooves formed in them; and the sand in passing beneath the rolls I and in being compacted by them, either in the drags b^3 of the flasks, when the drags are used by themselves, as shown in Figs. 1 and 2, or in the copes b^2 when the copes are applied to the drags, as shown in Fig. 5, has a ridge or ridges, corresponding in size, shape, and location to the groove or grooves in the roll I under which it is passed, formed throughout the length of the drags when used alone, or the copes when the cope is applied to the drag, which has or have to be removed, or the sand composing them distributed over the upper surface thereof, before the drags, or the copes and drags when united, are passed beneath the roll I^1 , otherwise the final compacting of the sand in them by this last mentioned roll will not be insured. To provide therefore for the removal of the sand composing this ridge or these ridges, or its distribution over the upper surface of the drags or of the copes when applied to the drags, a plate or bar l^1 is employed in connection with each row of flasks, which extending across from one of the bearing blocks K to the other, is

secured in place between them, with its lower edge disposed in close relationship to the top of the drags, or of the copes when applied to the drags, as respectively shown in Figs. 1 and 5. As thus arranged the ridge or ridges of sand formed by the groove or grooves in its or their respective roll I , as the ridge or ridges pass under this plate or bar l^1 , will be flattened down or distributed over the surface of the respective drags or copes when applied to the drags, and the drags when used alone or the drags and copes when united, in their continuous movements then passed beneath their respective rolls I^1 , where the final compacting of the sand in them will be effected. With the sand thus compacted, the drags, or the drags and copes united, in their further movements will be passed onward under a scraper l^2 , which is provided for each row of flasks, and which, extending across from one of the bearing blocks K to its companion block and between which blocks it is secured in place, has its lower edge arranged in close relationship to the top of the drags when used alone or of the copes when applied to the drags, with the result that in passing under it, all excess of sand is scraped off the tops of the drags or copes and the molding operation thereby completed; after which the successive drags, or the drags and copes united in the completed flasks, may be removed, their respective carriages D transferred from one pair of rails, as, for instance, from the pair a to the other, as, for instance, to the pair a^1 , where, after having received empty drags, or drags and copes united, may be passed backward beneath the hopper and beneath similar compacting, distributing, and scraping devices at the opposite end of the machine over the tracks a^1 , and a second molding operation performed in the drags or copes and so on.

With the delivering and compacting devices thus constructed and operated, the propulsion of the carriages D beneath them may be effected by any of the ordinary or well known means of propulsion usually employed for such purposes. The means which have been selected for purposes of illustration however, consists of endless bands or chains L and L^1 , which are severally provided with pushers l , by means of which the engagement of the chains with the carriages are effected. As thus equipped each of these bands or chains is supported upon sprocket wheels M and M^1 , with one of the bands or chains, as, for instance, the chain L , arranged between the tracks a , and the other, as, for instance, the band or chain L^1 , located between the tracks a^1 . With the chains L and L^1 thus supported, the sprocket wheels M and M^1 are disposed beneath the main platform or base A , with the wheels M located near one of its ends, and the wheels

M^1 located near the other end thereof. As thus arranged each of the sprocket wheels M and M^1 is fixedly secured upon a shaft m , that is journaled in suitable hangers m^1 , which, depending from the under side of the main platform or base A , is secured thereto by appropriate bolts or screws m^2 . With the sprocket wheels M and M^1 thus supported, the operative portion of each of the bands or chains extending between them travels above the main platform or base, while the inoperative part thereof returns beneath the same; and in order to prevent this operative part from sagging, it is supported by flanged rolls m^3 , which are journaled in the main platform or base A , as shown. As thus arranged and organized, the movement of the chains may be effected by simply rotating the sprocket wheels M and M^1 . To effect this rotation, a shaft N is employed, which, provided with a spur-gear n for connection with a motor or other source of power, not shown, and mounted in suitable hangers n^1 depending from and secured to the under side of the main platform or base, is equipped at one end with a bevel gear n^2 for engagement with the gear m^4 , fixedly secured to the shaft m carrying the sprocket wheels M of one of the chains, and at its other end is provided with a second bevel gear n^3 for engagement with the bevel gear m^5 fixedly secured to the shaft m of the sprocket wheels M^1 of the other chain. By this arrangement as will be seen, provision is made for the rotation of the sprocket wheels M and M^1 , and through them for the requisite movements of the chains L and L^1 in the opposite directions.

In the construction of the pushers l , various forms may be adopted. In the drawing however they preferably consist of two right angular or bell-crank shape side plates l^1 , which are disposed at the proper distances apart to embrace the chains and are connected at their opposite ends by bars l^2 extending across between them. As thus constructed they are applied to their respective chains at the proper distance apart to engage with the successive carriages, by being pivoted to the chains by pivot pins l^3 , which pass through the angular portions of their side pieces l and through the chains, as shown. In being thus applied to the chains, each of the pushers as it is brought into operation to carry forward a carriage along the tracks will have one of its arms stand upright with respect to its chain and engage with the rear of the carriage, or with an appropriate abutment suitably placed on the carriage for coöperating with it, with its other arm lying horizontally upon such chain; and, by its cross bar engaging with the top of the same, serving as a stop to hold its other arm in the upright position to which it is brought when engaging with a

carriage and carrying it forward along the tracks.

In some instances the carriages with the flasks upon them may be carried along the tracks and beneath the hopper and compacting devices singly. It is preferred however to combine them in trains, as shown in the drawings, and when thus combined the carriages may be connected by any appropriate connecting devices, as, for instance, by pivoted hooks o on one car engaging with pins o^1 projecting from another, and so on throughout the series. Again, when thus combined in trains the space between the adjacent cars may be closed by a filling piece p , which extends between them and rests upon the handles p^1 of the flasks, whereby to prevent the sand delivered by the hopper from falling down between the cars and between the flasks, as it would do if such filling pieces were not employed.

With the parts constructed and organized as above explained, the molding of any particular article, as, for instance, a pipe, is as follows: The machine being in operation and sand supplied to the hopper C , a pattern for the pipe or other article to be molded will be divided into its two constituent parts, and one of these parts, as, for instance, the part r placed in the required position with its flat side downward upon the top d^1 of the carriage D , in which location it may be held by pins s extending upwardly from such top and entering correspondingly shaped holes formed in it, as shown, for instance, in Fig. 2, in which two pipes are illustrated as undergoing the molding operation. As thus arranged a drag b^3 of a flask is next placed in the required location upon the top d^1 of the carriage, surrounding the portion or portions of the pattern or patterns r , in which situation it may be held by any appropriate means, as, for instance, by pins t and clamps t^1 , and the carriage D , with the drag and portion or portions of the pattern or patterns, then placed on one of the pairs of tracks, as, for instance, upon the pair a , and pushed forward along them until the carriage is engaged by one of the pushers l of the chain L . In being thus carried forward by its chain, the pusher will force the carriage D forward, with the drag and the portion or portions of the pattern or patterns r upon it, beneath the hopper C , where the drag will be supplied with sand that will not only fill the drag itself, but extend upward above it to the lower edge of the strip c^2 . As thus supplied, the carriage D in its continued forward travel under the action of the pusher l , will next carry the drag b^3 beneath the successive compacting roll I , the distributing plate or bar l^1 , and the second compacting roll I^1 , when the compacting of the sand in the drag will be thereby effected, after which

the drag in its continued forward movement will pass beneath the scraper k^2 , where all surplus sand remaining on its top will be removed and the molding operation of the drag thereby completed. With the molding operation of the drag thus completed, the drag and the part or parts of the pattern or patterns retained therein may then be removed from the carriage D, and the drag with the sand and the part or parts of the pattern or patterns therein turned bottom upward, when the other part or parts r^1 of the pattern or patterns may then be placed in position upon the respective part or parts r in the drag b^3 , where it or they is or are held in that or these position or positions by pins t^2 extending between them. The cope b^2 of the flask is next placed in position upon the drag b^3 , to which it may be fastened in any appropriate way, as, for instance, by fins t^3 passing through suitable orifices formed in their abutting flanges and, as thus united, the flask, embracing the cope and drag, may then be placed in proper position upon the top d^1 of the carriage D, as shown, for instance, in Fig. 5, when the carriage may then be transferred to the other pair of tracks a^1 , and thence passed backward along them, by a pusher l on its carrying chain L^1 , beneath the hopper C and the successive compacting roll I, the distributing plate or bar k^1 , a second compacting roll I^1 , and the scraper k^2 , located at the opposite end of the machine, when the same operations of supplying the sand to the cope, of compacting the sand therein, and of scraping all surplus sand remaining thereon from its tops will be performed in the same way upon the cope as was the case with the drag b^3 in being carried by the pusher l on the chain L , with the result that the completion of the molding operation will be thereby effected. The flask comprising the cope and drag may now be removed from the carriage and the constituent part or parts of a second pattern or patterns and an empty drag again supplied to the top d^1 of the carriage, when the same may be passed forward beneath the hopper and the compacting devices, and a second molding operation effected, and so on.

As thus far described the molding operation has been confined to only a single flask and to a single carriage. It is to be understood however that in practice a series of carriages arranged in trains, with a drag and a pattern, or a united drag and cope with a pattern will be employed in connection with each carriage, as the molding operation is performed in the drag or in the cope, and that the molding operation above described will be performed in connection with each, as they are successively passed beneath the hopper and the sand compacting devices. Moreover, it is also to be under-

stood that, in order to enable the machine to perform the molding operation in either the drags or in the copes, the height of the carriages D will be so regulated as to adapt them to carry the one or the other, as they may be respectively employed in connection with the drags, or with the copes when applied to the drags.

While in most instances the weight or gravity of the drags when used alone, or of the copes and drags when united will be sufficient to hold them down firmly upon the tops d^1 of their respective carriages, it is preferred to render this action more certain, and, to that end, rolls O are made use of, which resting upon the tops of the drags or copes as these drags or copes are passed beneath them in advance of the hopper, are journaled in bearings b^5 formed in the bearing blocks B^2 as shown.

From the foregoing therefore it will be seen that a machine is produced in which the automatic molding of articles, in a continuous operation, may be performed, and the same be operated with equal facility, whether employed in connection with the drags of the flasks when they are used alone, or with copes when the copes are applied to the drags.

Although the mechanism for propelling the carriages beneath the sand supplying and compacting devices, and embracing the endless bands or chains L and L^1 , with the pushers l and the parts upon which the chains are supported and operated, is shown in the drawings and described in the foregoing, no claim to such mechanism when separately considered is made herein, as the same forms the subject of application No. 532,998, which is a division of the present application, and which was filed by me in the United States Patent Office December 14th, 1909.

Having now described my invention and specified certain of the ways in which it is or may be carried into effect, I claim and desire to secure by Letters Patent of the United States,—

1. The combination, with a sand receiving hopper, provided with reciprocating sand supporting and feeding devices arranged therein, and sand compacting devices, of means adapted to support molder's flasks and carry them beneath the hopper and compacting devices, substantially as described.

2. The combination, with a sand receiving hopper provided with reciprocating sand supporting and feeding devices and with mechanism for agitating and loosening up the sand both above and below the sand supporting and feeding devices, and sand compacting devices, of means adapted to support molder's flasks and carry them beneath the hopper and the sand compacting devices, substantially as described.

3. The combination, with a sand receiving hopper constructed with an open top and bottom and provided in its opposite sides near their lower ends with apertures, of a series of bars extending inward through such apertures and across the hopper, a series of horizontally arranged supporting and feeding blades secured upon each of said bars at a slight distance apart, an eccentric for each of such bars, connecting devices between the eccentric and the bar, and means whereby the eccentric may be rotated, substantially as described.

4. The combination, with a sand receiving hopper constructed with an open top and bottom and provided in its opposite sides with apertures near their lower ends, and bars arranged in such apertures and extending across the hopper in parallel relationship to one another, of horizontally arranged blades secured upon each of said bars at a slight distance apart, slats also secured to each of said bars at approximately right-angles thereto and disposed around its upper and under sides in spiral lines, of an eccentric for each of said bars, connecting devices intermediate the eccentric and the bar, and means by which the eccentric may be rotated, whereby the support and feeding downward of the sand in the hopper and the agitation and loosening of the same both above and below the sand supporting and feeding devices will be effected, substantially as described.

5. The combination, with a sand supporting hopper constructed with an open top and bottom and provided in its opposite walls near their lower ends with apertures, bars arranged in such apertures and extending across the hopper, and each provided with devices for supporting the sand in the hopper and feeding it forward and for agitating and loosening it up both above and below the sand supporting and feeding devices, of a link connected at one end with the hopper and at the other end with each of the bars, a cross-head in which the other end of such bar is supported, slides in which the cross-head moves, an eccentric, and connecting devices intermediate the eccentric and the cross-head, substantially as described.

6. The combination, with a sand receiving

hopper provided with sand supporting and feeding devices, carriages adapted to support and carry molder's flasks beneath the hopper, tracks upon which the carriages are mounted, and mechanism for propelling the carriages thereunder, of transversely arranged strips adjustably secured to the lower end of the hopper, whereby the space between such lower end of the hopper and the top of the carriage may be varied in width, substantially as described.

7. The combination, with a sand receiving hopper provided with sand supporting and feeding devices, carriages for supporting molders' flasks and carrying them beneath the hopper, and mechanism for propelling such carriages, of a compacting roll arranged in the rear of the hopper for compacting the sand in the flasks after it has been supplied thereto from the hopper, substantially as described.

8. The combination, with a sand receiving hopper provided with reciprocating sand supporting and feeding devices arranged thereon, and a plurality of compacting rolls supported above the tracks, of mechanism for supporting and carrying molders' flasks first beneath the hopper and then beneath the compacting rolls, substantially as described.

9. The combination, with a sand receiving hopper provided with devices for supporting the sand therein and feeding it downward, of a plurality of compacting rolls, one of which is provided with a circumferential groove corresponding in shape to the article to be molded, a sand distributing bar or plate arranged between the compacting rolls, a scraper for removing all surplus sand from the top of the flask, and mechanism for supporting and carrying the flasks beneath the hopper and thence beneath the compacting rolls, distributor and scraper, substantially as described.

In witness whereof I have hereunto in the presence of two witnesses set my hand this 15th day of February, 1909.

JOHN G. MORRISON.

Witnesses:

W. C. HAUFF,
GRACE T. DIXON.