March 3, 1931. F. N. ROPP 1,794,490

CAISSON PIT DIGGING MACHINE

Filed April 25, 1927 3 Sheets-Sheet 1

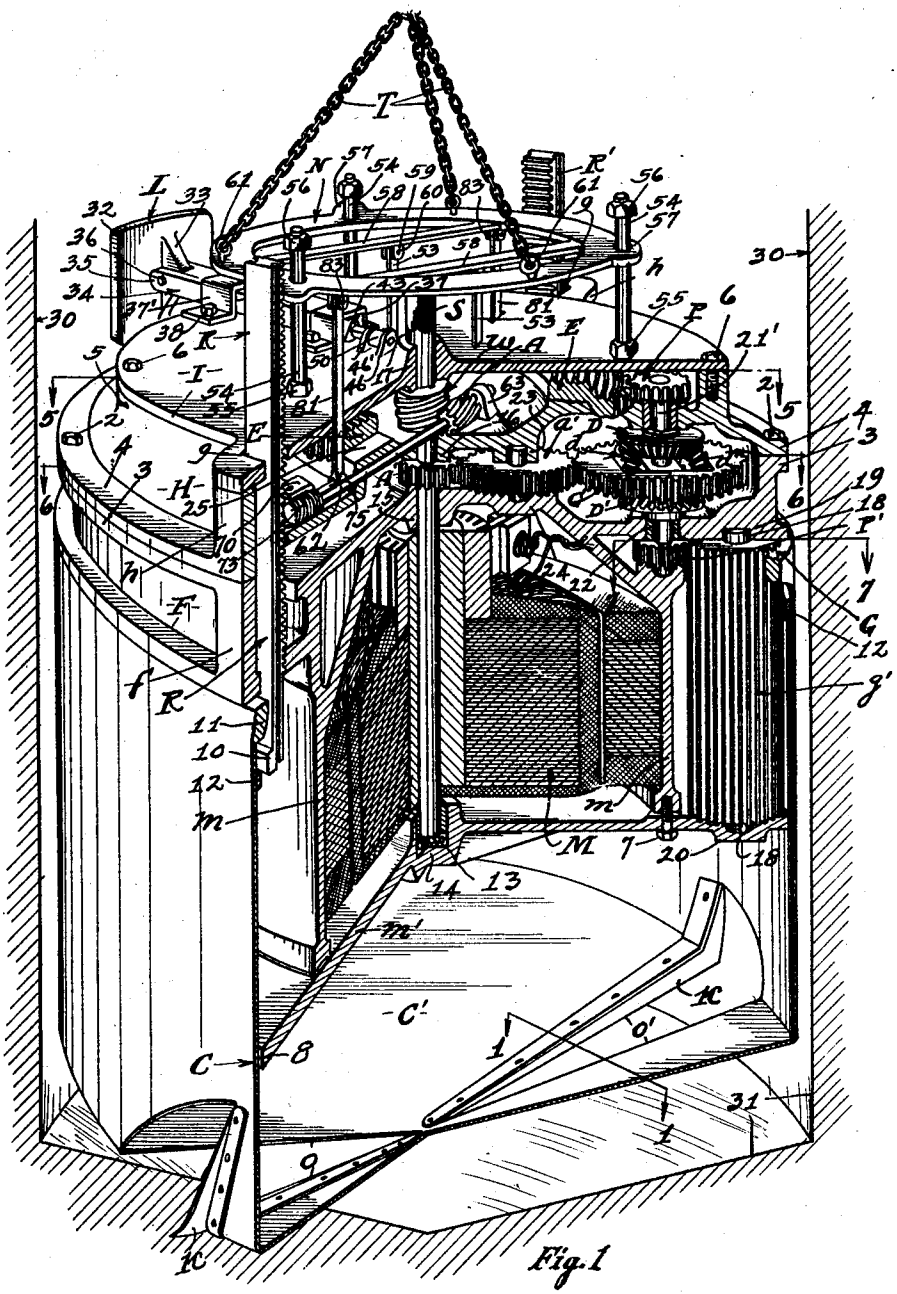
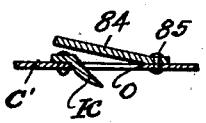


Fig. 1

Fig. 1a



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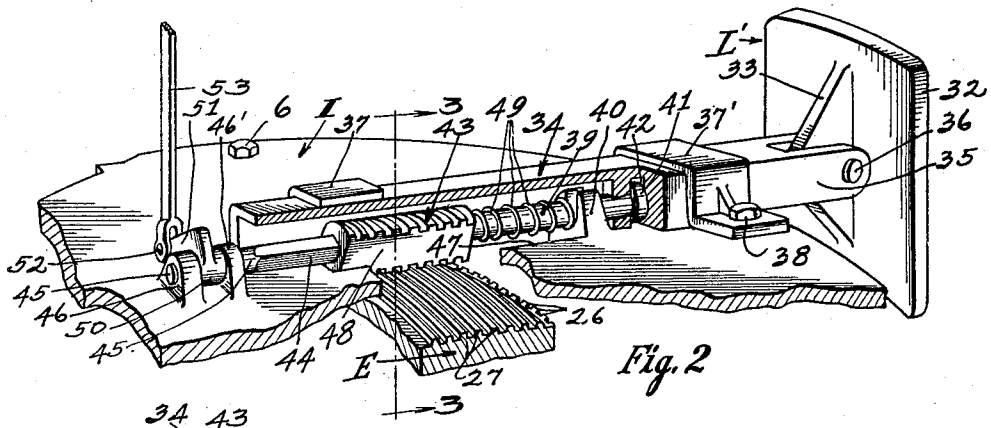


Fig. 2

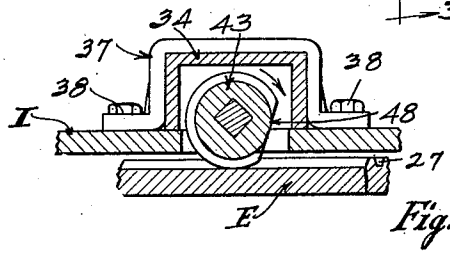


Fig. 3

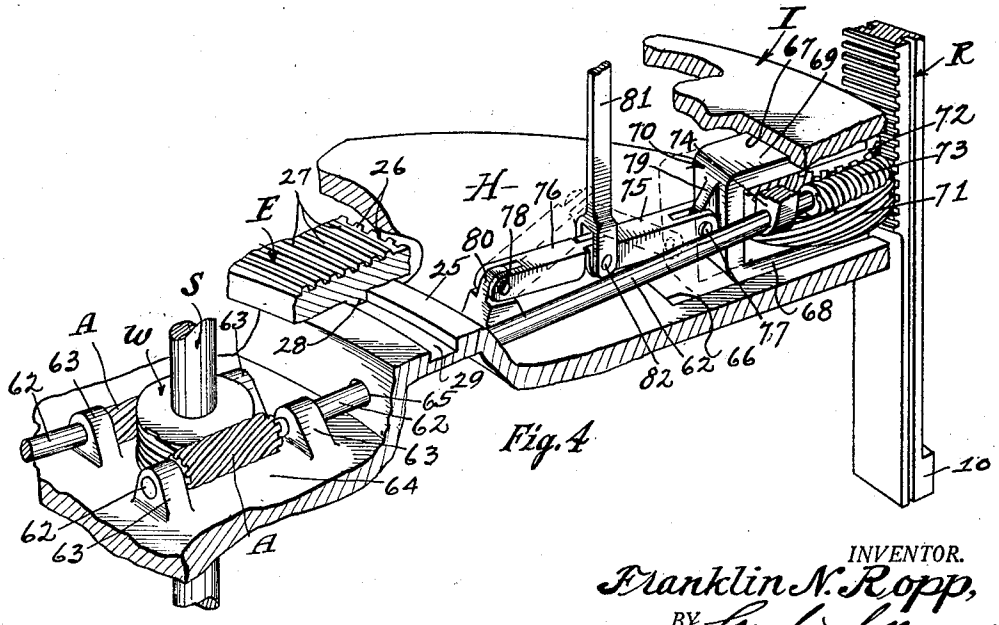


Fig. 4

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Fig.5

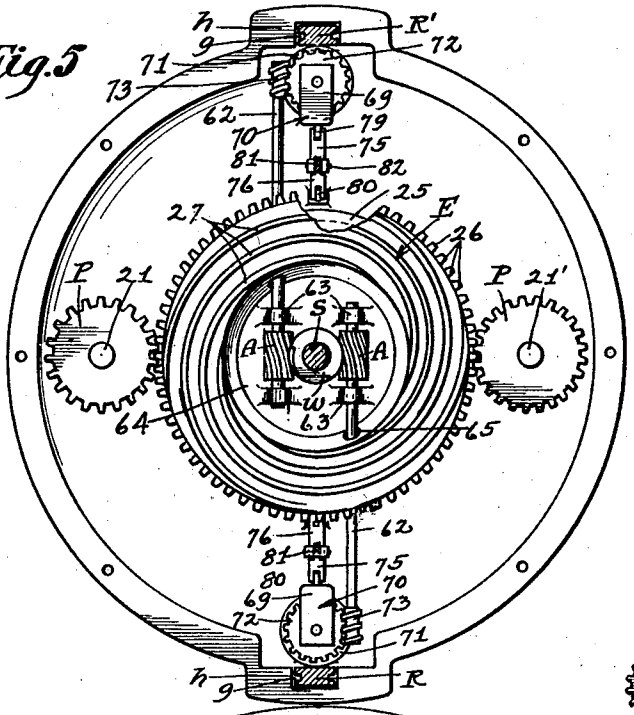
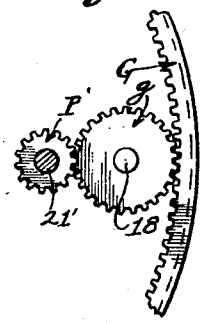


Fig.7



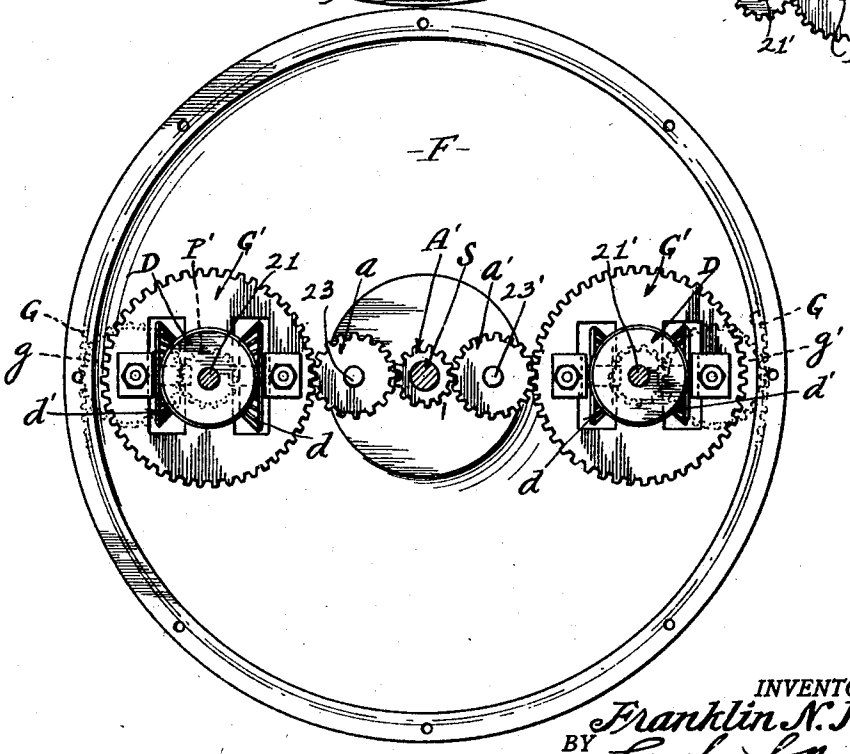


Fig.6

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Patented Mar. 3, 1931 1,794,490

UNITED STATES PATENT OFFICE

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CAISSON-PIT-DIGGING MACHINE

Application filed April 25, 1927. Serial No. 186,440.

This invention relates to and has for a primary object the provision of a new and improved type of caisson pit digging machine, embodying self-contained mechanisms and devices for rotating the digger and for anchoring the same in the pit, whereby the digger may be rendered operative for predetermined depths and removed for disposing of the loose material.

An important object of my invention is to provide a machine for the purpose described which will embody a self-contained motor or other source of power, so as to more readily permit of the removal of the machine from and its insertion in the pit.

Heretofore it has been the practice in digging caisson pits to drive the digger from a point on the surface of the ground above the pit, through the instrumentality of an elongated sectional driving shaft or stem, and due to this fact the diameter of the pits to be dug by the machines have been necessarily limited.

Accordingly, it is an object of my invention to provide a machine in which the driving power is applied to the periphery of the digging cylinder, and in which the source of power, as for instance an electric motor, is axially mounted within the cylinder, thereby providing a maximum of driving power and making it possible to dig pits of substantially greater diameter than has heretofore been possible with other devices.

A further object is to provide a differential mechanism connected with the rotating means for the digger and also operably connected with anchoring devices and so arranged that upon the initial application of power the differential will be effective for operating the anchoring devices, and thereafter effective in turn for rendering the digger operative.

Another object is to provide means whereby upon the removal of the machine from the pit the anchoring devices may be rendered immediately inoperative, so that the removal and reinsertion of the machine may be facilitated.

Other objects will appear as the description progresses.

I have shown a preferred and practical embodiment of my invention in the accompanying drawings, subject to modification within the scope of the appended claims without departing from the spirit thereof.

In said drawings:

Fig. 1 is a perspective view of my improved machine operatively positioned in a caisson pit;

Fig. 1*a* is a transverse section of the same on line 1—1 of Fig. 1;

Fig. 2 is a fragmentary perspective view of a portion of the machine, showing the anchoring mechanism;

Fig. 3 is a sectional elevation of the same on line 3—3 of Fig. 2;

Fig. 4 is an enlarged fragmentary perspective view of means for feeding the digger downwardly in the pit during a digging operation;

Fig. 5 is a sectional plan of the machine on line 5—5 of Fig. 1;

Fig. 6 is a sectional plan of the same on line 6—6 of Fig. 1.

Fig. 7 is a fragmentary plan of the same on line 7—7 of Fig. 1.

It will be understood in the consideration of my invention that the mechanism shown and described, while primarily designed for the purpose of digging large holes or pits for caissons and the like, may be employed successfully for other purposes. For instance, substantially the same mechanism may be employed horizontally or vertically for boring out large castings, pipes, cylinders and the like, with minor modifications so as to render the same adaptable for such purposes.

Briefly described, my invention embodies a cylindrical digger C in which is operably mounted a motor M, axially supported in the digger and operatively connected, by means hereinafter described in detail, with and adapted to rotate the digger in a given direction when the same is effective for digging the hole.

Upon the digger C is mounted supporting members F, H and I for the operating mechanism, arranged as shown in Fig. 1. The mechanism includes a pair or more of members R and R′ supported in the members F

and H and having the form of racks, designed for the purpose of feeding the digger C downwardly from the motor M and members F, H and I when the anchoring devices L and L′ mounted upon the member I are positioned for anchoring the operating mechanism of the digger in the pit.

The digger C is provided with a bottom C′ thereof having a pair or more of openings O and O′ on one of the edges of which in each case is mounted a knife as at K, which depends downwardly from the bottom C′ and may be disposed at an angle corresponding to the conical form of the bottom of the hole for affording best results.

The members F and H are permanently connected together by means of bolts as at 2, 2, etc., extending through peripheral flanges 3 and 4 formed on said members, respectively. Likewise the member I is attached to a reduced portion 5 at the top of member H by means of bolts 6.

The motor M is enclosed in a separable casing including an upper member F having a depending portion m and a lower member m', which are suitably attached together by means of bolts 7. The member m' is disc-like in form and is extended substantially beyond the periphery of the member m so that the outer periphery 8 thereof will conform substantially to the internal diameter of the member C. Thus the member m' will serve as a guide for member C when the same is longitudinally moved with respect to member m'.

The members F and H are of substantially the same diameter as the cylinder C and are provided with extensions f and h, respectively, at points on their peripheries, for slidably receiving and holding a pair or more of racks R and R′, as shown in Fig. 1. The upper portions of said racks extend through openings 9 in the member I, while the lower ends thereof are provided with ribs 10 which are held internally of the cylinder C between annular ribs 11 and 12 respectively, formed on or attached to said cylinder so that when the racks are forced upwardly or downwardly with the application of power, the cylinder will be moved correspondingly.

The driving spindle S is rotatably mounted and axially positoned in the machine and has its lower portion held in a fricton-less thrust bearing 13 in a journal 14 in the lower member m'. Said spindle is additonally journaled in a bearing 15 in the center of member F, and in bearings 16 and 17 in the members H and I. The upper end of the spindle projects above the member I and is adapted to receive a gear pulley or sprocket whereby a sump pump may be operated for pumping out the liquid contents of the pit if desirable, though this is not material to my invention.

The upper annular rib 11 on the cylinder C is provided with teeth on the inner periphery thereof forming an internal gear G, which is meshed with and driven by a pair or more of uniformly spaced elongated driving pinions g and g'. Said pinions are mounted on vertical shafts 18 which are journaled in portions 19 and 20, respectively, of the members F and m'.

Inwardly of the pinions g and g', I provide a set of differential gears for each of the pinions g and g', said gears being mounted on vertical shafts 21 and 21′ which are journaled in the members F and H. Each of said differentials includes vertically spaced bevel gears D and D′ mounted on the shafts 21 and 21′, and right angularly disposed bevel gears horizontally spaced apart as at d and d' and meshing with the gears D and D′.

The gears d and d' are mounted in alinement on a common axis diametrically of and are suitably journaled in an encompassing spur gear G′ in each case, said gear G′ being recessed as shown in Fig. 1 to provide for the mounting of the gears d and d' thereon. The gear D′ in each of said differentials is operatively connected with a pinion P′ by means of a sleeve 22 for driving the pinion P′ so as to communicate power to the upper end of the elongated pinions g and g'.

The gear G′ of each differential is operatively connected with a driving pinion A′ on the spindle S by means of intermediate gears a and a' which are journaled in bearings 23 and 24 in the members H and F, respectively. Thus, power is communicated from the motor spindle S to the internal driven gear G of the digging cylinder C.

The member H is provided with an annular portion 25 on which is mounted a ring gear E having external gear teeth 26 thereon, and a plurality of spirally formed threads 27 on the upper face thereof, as shown in Fig. 4. The member E is rotatably held on the member H by means of an annular rib 28 which seats in an annular groove 29 formed in the upper side of the portion 25 of member H.

The extended end of the shafts 21 and 21′ on which the differentials are mounted are provided with pinions P which mesh with the external teeth 26 of the ring gear E, so that power may be communicated from the differentials G′, G′ through the gears d, d', D and pinion P to the member E, for purposes hereinafter described.

Upon the top of the uppermost member I, I provide a pair or more anchoring devices as at L and L′ which are adapted to be operatively connected with the ring gear E so that on the initial application of power to the machine said devices L and L′ will be expanded or forced outwardly from the periphery of the member I into forcible contact with the wall 30 of the hole 31 in which the machine is operatively positioned, for the purpose of holding the digging mechanism, with the ex-

ception of the member C, stationary as to rotation and elevation in the hole 31.

The anchoring mechanism includes shoes L and L′ of substantial area, with arcuate portions 32 and ribs 33 on the inner sides thereof which are pivotally connected with horizontal slides 34 having clevises 35 on the outer ends thereof pivotally connected by means of pins or bolts 36 to the ribs 33 of the members L and L′. Said slides are extensibly mounted in a pair of bearing straps 37 and 37′ which are secured to the upper side of the member I by means of bolts 38.

Inwardly of the members 37′ the anchoring devices are provided with rotatable shafts 39 held in slotted lugs 40 formed on the member I and provided with enlarged heads 41 confined in slots 42 in the slides 34, as shown in Fig. 2. Said shafts 39 inwardly of the lugs 40 and directly above the ring gear E are provided with worms 43 of segmental cross section, which may be suitably attached to the shafts 39 or integrally formed therewith. The inner ends of worms 43 are loosely connected with squared portions 44 of shafts 45, which are pivotally held in spaced bearings 46 and 46′ formed on and extending above the member I.

The member I is provided with apertures 47 in the top intermediate the lugs 40 and 46′, through which the worms 43 extend so that the threads on the periphery of said worm will engage the threads 27 on the upper face of the ring gear E. The threads 27 on member E, as hereinbefore stated, are spirally formed so that when member E is rotated the worms 43 will be moved longitudinally and the members 34 will be correspondingly moved due to their connection with the shafts 39 hereinbefore described.

Accordingly, when power is applied to member E the members L and L′ will be expanded or moved outwardly into forcible contact with the wall 30 of the hole 31 for clamping the wall of the pit to hold the operating mechanism stationary during the operation of the machine.

It will be noted that the worms 43 are provided with cordal facets 48 which, when the worms 43 are turned for a portion of a revolution in a clock-wise direction, as seen in Fig. 2, will release said worms from operative engagement with the ring gear E. In such event coil springs 49 which are carried on the shafts 39 between the outer ends of the worms 43 and the inner faces of the lugs 40 of the member I, will be effective for retracting the members 34, 43 and L and L′ so as to release the mechanism and render the same removable from the pit at will. For this purpose the squared portion 44 of the shaft 45 is slidably though rotatably connected with the worms 43.

The outer portions of the shafts 45 are fixed to the hubs 50 of levers 51 held between the lugs 46 and 46′ on member I, and said levers are pivotally connected at 52 with upwardly extending links 53, as shown in Figs. 1 and 2.

Above the member I, I provide an annular member N which is slidably connected to and held on the member I by means of a plurality of bolts or studs as at 54, 54, etc., attached to the member I by means of nuts 55, 55 on opposite sides of the member I and carrying nuts 56 at their upper ends. The member N is positioned between the nuts 55 and 56 and the bolts 54 extend through portions 57, 57 thereon.

Said member N may be provided with a pair of transverse ribs 58, 58 having spaced lugs 59 depending therefrom and adapted to be pivotally connected at points 60 with the upper ends of the links 53 connected with the anchoring mechanism. The member N is also connected with a plurality of lifting chains as at T, connected by means of I-bolts 61, 61, etc., with said chains at a plurality of points, and the chains T may be commonly connected with a larger single chain for lifting and removing the entire mechanism from the pit.

When the device is about to be removed from the pit and tension is placed on the chains T, the member N will slide upwardly on the bolts 54 and will serve to elevate the links 53. This operation effects a sufficient rotation of the shafts 45 and worms 43 to disengage said worms from the member E, consequently the anchors L and L′ will be retracted inwardly from frictional engagement with the wall 30 of the pit so as to release the mechanism for removal.

The driving spindle S is provided with a worm W intermediate the members I and H, which meshes with and drives at uniformly spaced points a plurality of worms as at A, A, which are carried on substantially parallel and oppositely extended shafts 62, 62. Said shafts are journaled in spaced lugs 63, 63, formed on the central portion 64 of member H, and extend through apertures 65 in the annular portion of said member, as shown in Fig. 4.

Near the outer periphery of the member H the upper face of the member H and the inner face of the member I are provided, respectively, with guide-ways 66 and 67 in vertical alinement with each other, and in which the lower and upper arms 68 and 69, respectively, of slidable members 70 are slidably held. Said members 70 each carry a worm 71 and a worm gear 72, arranged one above the other and rotatably held between and on the arms 68 and 69 of said members.

The worms 71 are adapted to mesh with and to elevate and lower the racks R and F′, while the worm gears 72 are adapted to mesh with and to be driven by worms 73 on the outer extremities of the shafts 62. Said

shafts may be additionally journaled in bearings 74, depending from the member I. Thus during the operation of the spindle S the worms 73 serve to drive the worm gears 72 and the worms 71 which are connected for rotation therewith.

When the slides 70 are extended outwardly, as shown in Fig. 4, into engagement with the racks R, the worm wheels 71 are operative for elevating and lowering the racks. Said slides 70, however, are arranged for retraction inwardly of the members H and I so as to disengage the worm wheels 72 from the racks R and R′ at will, for purposes hereinafter described. To this end the members 70 are retractibly and extensibly connected with the member H by means of a pair of toggle arms 75 and 76, which are pivoted at points 77 and 78, respectively, to lugs 79 on the inner sides of members 70, and to lugs 80 extended upwardly from the member H. Said toggle arms 75 and 76 are pivotally connected together at their inner extremities and also to an operating link 81 by means of a chain or bolt 82, as shown in Fig. 4.

Inasmuch as it is necessary to render the racks R and I′ inoperative when the machine is removed from the pit, the members 81 are pivotally connected to depending lugs 83 on the annular member N, so that when tension is applied to the chain T for removing the machine from the pit the upward movement of member N will elevate the members 81 and break the toggle joint between the members 75 and 76. Thus the slides 70, together with the worm wheel 72 and the worm 71 will be moved inwardly for a sufficient distance to disengage the worm wheels 71 from the racks R and R′.

In operation, it will be observed that power is communicated differentially to and for rotating the digging cylinder C and the ring gear E through the instrumentality of the pinion A′, the idler gears a and a', the differential gears D, D′, d and d' and the associated spur gears G, G′, said differential gears being connected to the internal gear G through the medium of the pinions P′ and the driving pinion g'. Likewise the power is communicated from the differential through the member E to the pinion P.

When the machine is deposited in the pit or in position for beginning a digging operation, the weight of the entire mechanism being substantially great, the inertia of the mechanism will effect the communication of power initially to the ring gear E through the differential operation of the gears D, D′, d and d'. This rotation of the member E relative to the members C, F, H and I will cause the extension of the anchor shoes L and L′ into forcible engagement with the wall 30 of the pit, or with other elements installed, for instance at the beginning of an operation, for the purpose of holding the members F, H and I and the mechanism supported thereon stationary during the rotation of the digger C.

When the pressure of the anchors L and L′ on the walls 30 of the pit 31 is sufficient to overcome the inertia of the mechanism, the differential gears connecting the driving pinion A′ with the elongated driving pinion g' operate to communicate power to the internal gear G for setting up rotation of the digger C.

At the beginning of a digging operation the position of the several members supporting the driving mechanism is substantially as shown in Fig. 1, with the upper end of the driving pinions g and g' in mesh with the internal gear G, but as the cutters K, K, on the bottom of the cylinder are rotated with the cylinder C the earth and material which is cut at the bottom of the pit 31 is forced upwardly through the openings O and O′ in the cylinder into the chamber between the bottom C′ and the member m'. As the pit is deepened by the operation of the cylinder C and the earth and matter accumulates in said cylinder, the members F, H, I and m', together with the mechanism supported thereon, are correspondingly elevated and the driving pinions g and g' are elevated with respect to the internal gear G.

The range of operativeness of the machine corresponds to the length of the pinions g and g', and the depth of the pit or hole formed by the cylinder C in each operation will be determined by the length of said driving pinions.

In order that the earth and matter may be retained in the bottom of the cylinder C, I may provide a common expedient as shown in Fig. 1a. Said device may consist of a flap 84 of flexible material, suitably secured at a plurality of points 85 to the sides of the openings O and O′ and having their free edges overlapping the opposite sides of said openings. Thus the pressure of the material from below will elevate the flaps 84 so that the material may pass through the openings O and O′, but the weight of the material above when the machine is removed from the pit will serve to press the flaps 84 downwardly over and to close the openings O and O′ to prevent the loss of the material therefrom, except as desired.

The operative connection of the racks R and R′ with the driving spindle S, as shown in Fig. 4 and hereinbefore described, insures a sufficient pressure applied to the cylinder C and exerted downwardly so as to effect the proper boring or cutting at the bottom of the hole.

At the completion of each digging operation, by placing tension on the chains T the member N may be elevated for disengaging and retracting the anchors L and L′ and also for disengaging the worms 71 from the racks R and R′. At such time said racks will

be extended downwardly to a maximum extent, and when the machine has been removed from the pit and the earth and material discharged therefrom, the machine may again be deposited in the pit and the racks being disconnected from their driving mechanism will be forced upwardly preparatory to a subsequent digging operation and the application of power thereto, the members F, H and I and the mechanism mounted thereon being moved by gravity into contact with the upper end of the digger C, as shown in Fig. 1.

When tension on the chains T is released the member N will settle downwardly and reengage the worms 71 with the racks, while at the same time re-engaging the worms 43 with the member E. Thus when the motor M is reenergized the initial application of power to the differentials will effect the setting of the anchor so as to immovably hold the machine in the pit and to render the digger C operative for extending the depth of the pit during a subsequent operation.

What I claim is:

1. A caisson pit digging machine comprising a frame, a cylindrical digger rotatably and longitudinally movable with respect thereto, a self-contained power mechanism supported on said frame and operatively connected with said digger, and power operated anchoring device, and means for connecting the anchoring devices with said power mechanism for holding the same stationary during the operation of the digger.

2. A caisson pit digging machine comprising a frame, a cylindrical digger rotatably and longitudinally movable with respect thereto, a self-contained power mechanism supported on said frame and operatively connected with said digger, anchoring devices operatively connected with said power mechanism for holding the same stationary during the operation of the digger, and means for differentially connecting said digger and said anchoring devices with said power mechanism for rendering the anchoring devices and the digger successively effective, as described.

3. A caisson pit digging machine comprising a frame, a cylindrical digger rotatably and longitudinally movable with respect thereto, a self-contained power mechanism supported on said frame and operatively connected with said digger, anchoring devices operatively connected with said power mechanism for holding the same stationary during the operation of the digger, means for differentially connecting said digger and said anchoring devices with said power mechanism for rendering the anchoring devices and the digger successively effective, and means for releasing said anchoring devices to permit the removal of the machine from the pit.

4. A machine of the character described including a frame, a driving mechanism mounted thereon, a cylinder rotatable and longitudinally movable on said frame, anchoring devices for holding said frame and said driving mechanism stationary during the operation of said cylinder, and differential means connecting said anchoring devices and said cylinder with said driving mechanism for rendering said anchoring devices initially operative for clamping the machine in position for use, and for rendering said cylinder thereafter operative, as described.

5. A boring machine comprising a frame, a driving mechanism thereon, a boring member operatively supported on said frame, independent means operatively connecting said driving mechanism with and for simultaneously rotating and lowering said boring member in the hole, anchoring devices and means for applying power from said driving mechanism to the anchoring devices for preventing the movement of said frame during the operation of the boring member, and means for rendering said lowering means and said anchoring means inoperative at will, for the purpose described.

6. A boring machine comprising a frame, a driving mechanism mounted thereon, a cylinder rotatably and reciprocably mounted with respect to said frame, anchoring devices for holding said frame against rotation, and differential gearing connecting said anchoring devices and said boring cylinder for rendering said elements operative successively.

7. A boring machine comprising a frame, a driving mechanism mounted thereon, a cylinder rotatably and reciprocably mounted with respect to said frame, anchoring devices for holding said frame against rotation, differential gearing connecting said anchoring devices and said boring cylinder for rendering said elements operative successively, and means for releasing said anchoring devices when the operation of the boring member is discontinued.

8. A boring machine including a frame having a driving mechanism mounted thereon, a cylindrical boring member at one end of said frame provided with cutters at the end thereof, means connected with said driving mechanism for rotating said boring member with respect to said frame, means also connected with said driving mechanism for longitudinally extending said boring member during the rotation thereof with respect to said frame, means for disengaging said extension means from the driving mechanism to permit the retraction of said boring member, and means connected with said driving mechanism for automatically anchoring said frame and said driving mechanism during the operation of said boring member.

9. A caisson pit digging machine compris-

ing a frame, a cylindrical digger rotatably and reciprocably mounted on said frame, a power mechanism mounted on said frame, gearing connecting said power mechanism and said digger for rotating and longitudinally moving the digger, said gearing including a ring gear on the digger, and a plurality of elongated pinions mounted on said frame and engaging the ring gear for permitting the reciprocation of the digger to correspond to the length of said pinions.

10. A caisson pit digging machine comprising a frame, a cylindrical digger rotatably and reciprocably mounted on said frame, a power mechanism mounted on said frame, gearing connecting said power mechanism and said digger for rotating and moving the digger longitudinally, said gearing including a ring gear on the digger, and a plurality of elongated pinions mounted on said frame and engaging the ring gear for permitting the reciprocation of the digger to correspond to the length of said pinions, and means for limiting the reciprocating movement of the digger.

11. A caisson pit digging machine comprising a frame, a cylindrical digger rotatably and slidably mounted on said frame, a power mechanism mounted on said frame, gearing connecting said power mechanism and said digger for rotatating and longitudinally moving the digger, said gearing including a ring gear on the digger, and a plurality of elongated pinions mounted on said frame and engaging the ring gear for permitting the longitudinal movement of the digger to correspond to the length of said pinions, and anchoring devices differentially connected with said power mechanism for stationarily holding said frame in a pit.

12. A caisson pit digging machine comprising a frame, a cylindrical digger rotatably and slidably mounted on said frame, a power mechanism mounted on said frame, gearing connecting said power mechanism and said digger for rotating and longitudinally moving the digger, said gearing including a ring gear on the digger, and a plurality of elongated pinions mounted on said frame and engaging the ring gear for permitting the longitudinal movement of the digger to correspond to the length of said pinions, anchoring devices differentially connected with said power mechanism for stationarily holding said frame in a pit, and means for rendering said anchoring devices inoperative at will.

13. A caisson pit digging mechanism comprising driving means, a cylindrical boring member encompassing said driving means, means operably connecting said digger with said driving means for rotation and longitudinal movement, anchoring devices for holding the machine against rotation in a pit, and gearing connecting said driving means with said anchoring devices and including differentially connected gears adapted to be operated at will for rendering said anchoring devices operative or inoperative.

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