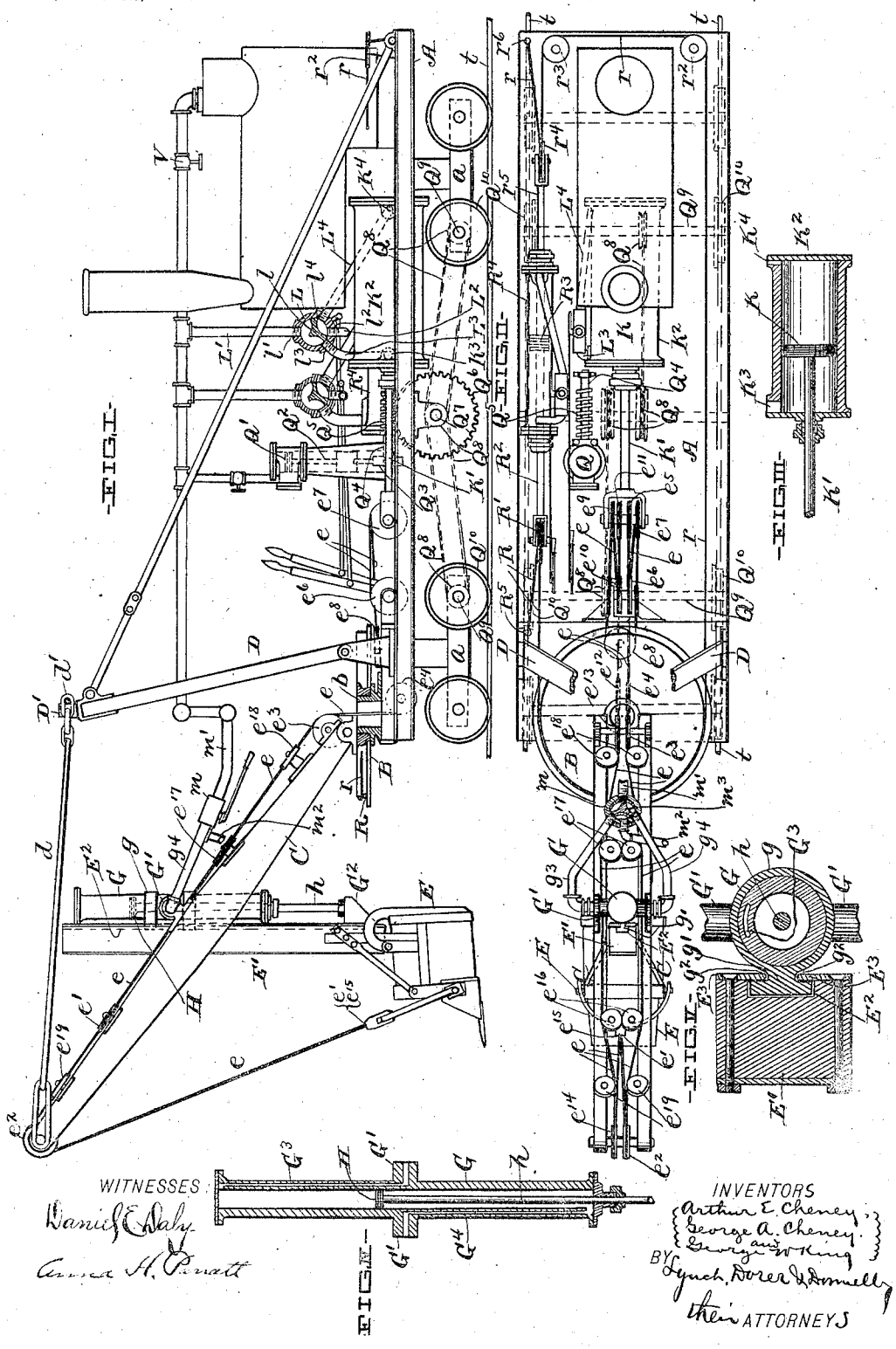
No. 655,758. Patented Aug. 14, 1900.

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EXCAVATOR.

(No Model.) (Application filed July 2, 1898.)



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UNITED STATES PATENT OFFICE.

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EXCAVATOR.

SPECIFICATION forming part of Letters Patent No. 655,758, dated August 14, 1900.

Application filed July 2, 1898. Serial No. 685,020. (No model.)

To all whom it may concern:

Be it known that we, ARTHUR E. CHENEY, GEORGE A. CHENEY, and GEORGE W. KING, of Marion, Marion county, State of Ohio, have invented certain new and useful Improvements in Excavators; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

Our invention relates to improvements in excavators.

The primary object of this invention is to produce a powerful excavator and to avoid the employment of complicated machinery heretofore required in the swinging of the boom and in the movements of the excavating-shovel.

With this object in view and to the end of rendering the excavator simple, durable, and convenient the invention consists in certain meritorious features of construction and combinations of parts hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure I is a side elevation of an excavator embodying our invention, and portions are broken away and in section in this figure to more clearly show the construction. Fig. II is a top plan of portions of the excavator. Fig. III is a central longitudinal section of the hoisting-cylinder. Fig. IV is a central longitudinal section of the cylinder employed in thrusting the shovel in and out, and Fig. V is a transverse section of the last-mentioned cylinder and shows the connection of the shovel-arm to the said cylinder.

Referring to the drawings, A designates the car or body portion of the excavator. A horizontally-arranged turn-table B is supported from the forward end of the body portion, and the boom, that comprises, preferably, two timbers or beams C C, arranged side by side, is supported at its lower end from the turn-table. The boom extends forwardly and upwardly from the turn-table and at its upper and forward end is supported from the upper end of an upright frame D, that is supported in any approved manner from the body portion. The connection between the said frame D and the boom comprises, preferably, a rod *d*, that has its forward end attached to the boom in any approved manner and has its rear end connected to the said frame D by a chain-loop *d'*, embracing a vertical bearing or pivot D', formed upon the upper end of the said frame.

E designates the shovel of the excavator. The said shovel is provided in the usual manner with an arm E', that extends upwardly between the two timbers or beams of the boom. A cylinder G is arranged longitudinally of the rear side of the shovel-arm and at or near its central portion and externally has two trunnions G' G' arranged horizontally at opposite sides, respectively, of the cylinder at the upper side of and supported from the different beams, respectively, of the boom. The shovel-arm is connected with but slidable endwise and independently of the cylinder, and the connection between the arm and cylinder comprises, preferably, an annular band or ring *g*, that is journaled upon the cylinder above trunnions G' and at the forward side of and adjacent to the cylinder provided with a lug or flange *g'*, that engages a slot E^2, formed in and longitudinally of the shovel-arm. Ring *g* is provided with two slideway-forming recesses g^2 g^2 at opposite sides, respectively, of the inner end of member *g'*, and the shovel-arm upon its rear side is provided with two slides E^3 E^3, engaging the different slideways g^2 g^2, respectively, and extending longitudinally of the arm and formed by plates or bars secured to the arm in any approved manner. The shovel-arm upon its rear side and at or near its lower end is provided with a projecting lug G^2, to which the rod *h* of the piston H, that operates within and endwise of the cylinder, is attached in any approved manner.

The shovel is provided with a bail E^4 in the usual manner. The hoisting-cable *e*, that is attached to the said bail, is instrumental in hoisting the shovel, and the latter is lowered by gravity. Cable *e* is in the case illustrated a continuous cable, having opposite ends attached to the shovel-bail at *e'* and e^{15}, respectively. Cable *e* leads, for instance, from the

point e' upwardly to and over a sheave e^2, supported from the upper end of the boom. The said sheave is arranged vertically and longitudinally of the boom and the cable is thence guided rearwardly and downwardly along one side of the boom, and at one side of the sweep of the shovel-arm to and over a sheave e^3, that is supported from the lower end of the boom. Sheave e^3 is arranged vertically and longitudinally of the boom forward of the axis of the turn-table, and the hoisting-cable leads from the said sheave downwardly through the hollow or tubular bearing b of the turn-table to and in under a sheave e^4, that is supported at the rear side of the table's axis from the forward end of the machine's body portion. Cable e leads from the sheave e^4 rearwardly to and in under a sheave e^5, that is arranged vertically and longitudinally of the machine's body portion and supported from the outer end of the rod K′ of the piston K, that is arranged to operate within and endwise of the steam-cylinder K^2, that in the case illustrated is supported from the machine's body portion and arranged horizontally and longitudinally of the machine. From the sheave e^5 the hoisting-cable leads forwardly to and over a guide-sheave e^6, that is supported from and arranged vertically and longitudinally of the body portion near the rear extremity of the turn-table. From the sheave e^6 the hoisting-cable leads rearwardly to and under the sheave e^7, that has its axis coincident with the axis of the sheave e^5 and is supported from the piston-rod K′. Cable e leads forwardly from sheave e^7, to and over an approximately horizontally arranged sheave e^8, that is supported from the body portion below the rear portion of the turn-table, and thence the cable leads again rearwardly to and over the sheave e^9, that is supported from the piston-rod K′ and has its axis coincident with the axes of the sheaves e^5 and e^6, and from the said sheave e^9 the cable leads forwardly to and in under the sheave e^{10}, that is supported from the body portion and has its axis coincident with the axis of the sheave e^6. The cable leads from the sheave e^{10} rearwardly to and over the sheave e^{11}, that is supported from the piston-rod K′ and has its axis coincident with the axes of the sheaves e^5 e^7 e^9, and from the sheave e^{11} the cable leads forwardly to and in under the sheave e^{12}, that is supported from the body portion and has its axis coincident with the sheave e^4, and thence the cable leads upwardly through the bearing of the turn-table to and over the sheave e^{13}, that is supported from the boom and has its axis coincident with the axis of the sheave e^3. From the sheave e^{13} the cable leads forwardly and upwardly along the other side of the boom and at the opposite side of the shovel-arm's sweep to and over the sheave e^{14}, that is supported from the boom's upper end and has its axis coincident with the axis of the sheave e^2, and from the latter the cable leads downwardly to the other point e^{15} of its attachment to the shovel-bail. It will be observed, therefore, that the hoisting-cable is provided at the body portion with a horizontally-arranged loop and two loops over vertical sheaves between the horizontal loop, that the closed end of the horizontal loop is engaged by the approximately horizontally arranged sheave e^8, supported from the body portion below the turn-table, that the cable at the open end of the said horizontal loop leads over the two outer sheaves e^7 e^9 of the piston-rod K′, that the cable from the said piston-rod sheaves is carried forward to and in under the two vertical sheaves e^6 e^{10}, that are supported from the body portion near the turn-table, and that the cable from the said sheaves e^6 e^{10} is carried again rearwardly to and over the two inner piston-rod sheaves e^5 e^{11}, whence the cable is carried forwardly to the upper end of the boom and thence downwardly to the shovel.

We would here remark that the two portions or sections of the cable that extend over the boom are held apart to accommodate the location and operation of the shovel-arm and attachments by two pairs of guide-sheaves arranged a suitable distance apart—one pair e^{16} forwardly of the shovel-arm's sweep, and the other pair e^{17} rearwardly of the said sweep—and we would remark also that the said portions of the cable are caused to converge rearwardly in front of the vertical guide-sheaves e^3 and e^{13} at the lower pivotal center of the boom by the two sheaves e^{18} e^{18}, that are supported from the boom and engage the outer sides of the different cable-sections, respectively, and are arranged the short distance apart required to effect the aforesaid convergence of the said cable-sections. The said cable-sections are caused to converge forwardly rearward of the vertical sheaves e^2 e^{14} upon the boom's upper end by the two sheaves e^{19} e^{19}, that are supported from the boom and have the arrangement required to effect the last-mentioned convergence in the said cable-sections.

By the construction and arrangement of parts hereinbefore described it is obvious that when steam is admitted into the forward end of the steam-cylinder forward of the piston within the said cylinder a pull or draft will be exerted upon the hoisting-cable in the direction required to hoist the shovel and raise the shovel upwardly through the bank of material that is to be cut away or excavated. The illustrated arrangement of hoisting-cable accommodates the use of a cable of comparatively-small diameter and enables the cable to operate very freely over the different sheaves and does not in any wise interfere with the location and operation of the shovel-arm and attachments during the thrusting or endwise movements of the said arm. The sheave e^8, that engages the closed end of the horizontal loop of the hoisting-cable, operates as an equalizing-sheave, in that it equalizes the strain upon

both ends of the cable. It is obvious also that by regulating the amount of steam admitted to the steam-cylinder the shovel can be hoisted through the bank of earth or other material being operated upon either rapidly or slowly at the will of the operator, and it is obvious also that when the steam is exhausted from the load end of the cylinder the gravity of the shovel will cause it to descend and draw the piston into position ready for a new stroke.

L represents a valve-casing or steam-chest that contains the valve *l*, employed in establishing and interrupting communication between the chamber of the steam-cylinder and the steam-supply source. The valve-casing illustrated has four ports l' l^2 l^3 l^4. Port l' at the top communicates with a branch L' of the steam-supply pipe, that connects with the steam-dome or steam-space of a boiler, and is provided with a valve V for controlling the supply of steam to the steam-cylinder. Port l^2 is formed in the bottom of the valve-casing and communicates with the exhaust-pipe L^2, and the remaining two ports l^3 l^4 are formed at opposite sides, respectively, of the exhaust-port, between the latter and the central portion of the casing. Port l^3 is connected by a pipe L^3 with the steam-cylinder's port K^3, that connects with the forward end of the cylinder's chamber, and the other port l^4 of the valve-casing is connected by a pipe L^4 with the cylinder's port K^4, that opens into the rear or opposite end of the cylinder's chamber. The valve within the valve-casing is of the oscillating variety and is operated in any approved manner, and the valve's construction is such that it can establish open relation between the exhaust-port and one of the cylinder-connected ports of the valve-casing without interrupting open relation between the other cylinder-connected port and steam-inlet of the casing.

We would here remark that if the gravity of the excavating-shovel does not lower the shovel as rapidly as desired steam is admitted to the rear or exhaust end of the cylinder, and the port K^4, formed in the last-mentioned end of the cylinder, is made small enough to serve the purpose of preventing air and steam from escaping too rapidly, so as to form a steam or air cushion in that end of the cylinder, and thereby prevent an accident in case the shovel should slip from a piece of rock or boulder on which it was exerting a severe pull or in case the cable should break.

The means employed for actuating the shovel-arm longitudinally, as required to thrust the shovel in and out, comprises the steam-cylinder G, that, as already indicated, is capable of swinging with the said arm in a vertical plane longitudinally of the boom. The piston H of the cylinder G has its rod extending downwardly through the lower head the cylinder to the inner end of the shovel-arm and, as already indicated, is rigidly secured to a bracket or projection G^2, that is fixed to the rear side of the said end of the shovel-arm, and of course the shovel-arm is actuated longitudinally in the one or the other direction, according as steam is admitted to the one or the other end of the cylinder. The shovel-arm has, furthermore, as already indicated, such connection with the cylinder G as to render it (the arm) capable of movement laterally circumferentially of the cylinder. This lateral or twisting motion of the shovel-arm relative to and around the cylinder is accommodated by the narrow space provided between each side of the shovel-arm and the inner side of the adjacent timber or beam of the boom. It will be observed, therefore, that the shovel-arm is narrower than the space between the two timbers or beams that principally compose the boom and that the lateral motion of the shovel-arm is limited by the stop-forming inner sides of the said beams. The said lateral or twisting motion allows the shovel a limited degree of twist in the process of raising up through the bank without causing undue strain or twist to come upon the shovel-arm.

The cylinder G has two ports G^3 G^4, that connect opposite ends, respectively, of the cylinder's chamber with the chambers or ports of the different trunnions, respectively, and two pipes g^3 g^4 connect the different trunnion-ports, respectively, with the chamber of a valve-chest or valve-casing *m*. An exhaust-pipe m^2 leads from the chamber of the valve-casing between the cylinder-connecting pipes g^3 g^4, and a branch m' of the main steam-pipe connects with the casing's chamber opposite the latter's exhaust-outlet, and the valve m^3 within the said valve-casing has the arrangement and shape required to render it capable of placing the one or the other of the said cylinder-connecting pipes into open relation with the steam-pipe m' and simultaneously establish open relation between the remaining cylinder-connecting pipe and the exhaust-port. Valve mechanism or valve-chests for use in the operation of steam-cylinders are so well understood that further description or reference to the same in this specification is deemed unnecessary. The pipes g^3 and g^4 are connected to the trunnions of the cylinder by means of swivel-joints of any suitable form that will accommodate the tilting of the cylinder with the shovel-arm during the hoisting and lowering of the shovel without interrupting communication between the said pipe and the cylinder's interior.

The boom is revolved or swung laterally in the one direction by the cable R and is actuated in the opposite direction by the cable *r*. Cable R is fastened to the turn-table below the boom and, considered from a position forward of the machine, leads thence to the left and rearwardly to and over the guide-sheave R', that is arranged vertically and longitudi-

nally of the machine and supported by the free end of the rod R^2 of the piston R^3, that is arranged to operate within and endwise of the steam-cylinder R^1, that is arranged longitudinally of and supported from the machine's body portion, and the cable leads from the said sheave forwardly a suitable distance and has its opposite end fixed to the body portion at R^5. The other boom-swinging cable r is fixed to the turn-table at one end below the boom and thence leads to the right and rearwardly to the body portion's rear end, where it leads over a horizontally-arranged sheave r^2, that is suitably supported from the body portion, and thence the cable leads leftwardly to the body portion's opposite side, where it leads over a horizontally-arranged sheave r^3, that is suitably supported from the body portion, and thence the cable leads forwardly to and over the guide-sheave r^4, that is arranged vertically and longitudinally of the body portion and supported from the rear or free end of the rearwardly-extending rod r^5 of the piston within the cylinder, and from the said sheave r^4 the cable leads rearwardly a suitable distance and has its opposite end fixed at r^6 to the body portion. It will be observed, therefore, that the boom-swinging apparatus comprises a cylinder, a piston operated by fluid under pressure within the cylinder and having two rods extending through opposite ends, respectively, of the cylinder, and suitable operative connection between the outer ends of the piston-rods and the boom.

The valve mechanism and passage-ways for supplying the steam or fluid under pressure to opposite ends of the cylinder R^1 alternately and for exhausting from one end of the cylinder while pressure is supplied to the cylinder's opposite end is substantially the same as that described in connection with the endwise shifting of the shovel-arm and with the hoisting and lowering of the shovel, and it is obvious that the boom is swung in the one direction or the other according as the steam under pressure is admitted into the one or the other end of the cylinder R^4.

The apparatus for propelling the car or body portion along the track t, upon which it is mounted, involves a comparatively-small engine supported from the body portion and comprising an upright cylinder Q and the suitably-reciprocated piston Q', arranged within the said cylinder and having its piston-rod Q^2 operatively connected with the crank Q^3 of the engine-shaft Q^4, that is arranged longitudinally of the body portion and provided with a worm Q^5, that meshes with a worm-wheel Q^6, operatively mounted upon a shaft Q^7, that is arranged below and transversely of and supported from the body portion, and the shaft Q^7 is operatively connected, by means of pulleys and chains Q^8, with the wheeled axles Q^9 of the body portion's trucks a, whose wheels Q^{10} engage the track t.

Again referring to the shovel-thrusting apparatus, we would remark that the extension of the cylinder G through the boom accommodates the employment of a cylinder that is long enough to accommodate the desired stroke of its piston. Also the extension of the said cylinder an equal or approximately-equal distance above and below its trunnions causes the upper half of the cylinder to be counterbalanced or approximately counterbalanced by the cylinder's lower half.

What we claim is—

1. In an excavator, the combination with the excavating-shovel; a cylinder; the piston within the cylinder; the piston-rod, and such operative connection between the shovel and the piston as will hoist the shovel upon the actuation of the piston in the one direction; of a fluid-pressure-supply source; two passage-ways connected with the said source and in open relation with opposite ends, respectively, of the cylinder, and the passage-way communicating with the cylinder's hoisting-pressure-receiving end having a capacity of fluid transmission greater than the other passage-way; an exhaust-outlet, and valve mechanism arranged and operating to establish and interrupt the pressure-supply through each cylinder-connecting passage-way alternately, and to connect the exhaust-outlet with one of the cylinder-connecting passage-ways while it establishes open relation between the other cylinder-connecting passage-way and the pressure-supply source, substantially as set forth.

2. In an excavator, the combination of the boom, the excavating-shovel; a cylinder; a suitably-actuated piston within the cylinder; the piston-rod bearing two sheaves; an equalizing-sheave supported at an equal or approximately-equal distance from both piston-sheaves, and the hoisting-cable looped around the equalizing-sheave from the piston-sheaves and leading around the piston-sheaves to and being suitably guided over the boom and operatively connected with the excavating-shovel, substantially as set forth.

3. In an excavator, the combination of the boom; the excavating-shovel; a suitably-actuated reciprocating rod; four sheaves e^5, e^7, e^9 and e^{11} supported from the said rod; the equalizing-sheave e^8, the pair of guide-sheaves e^6 e^{10}, and the hoisting-cable e engaging all of the said sheaves, and guided along the boom and operatively connected with the shovel, all arranged and operating, substantially as shown, for the purpose specified.

4. In an excavator, the combination of the boom; the excavating-shovel; a cylinder; a suitably-actuated piston within the cylinder; the piston-rod; the four parallel sheaves e^5, e^7, e^9 and e^{11} supported from the piston-rod; the equalizing-sheave e^8 supported an equal or approximately-equal distance from both outer piston-sheaves; two guide-sheaves e^6 e^{10} supported an equal distance, or approximately-equal distance, from the different inner piston-sheaves, respectively, and a continuous hoisting-cable having its opposite ends oper-

atively connected with the excavating-shovel and leading from each end to and being suitably guided along the boom and thence leading to and engaging all of the aforesaid sheaves in the manner substantially as shown, for the purpose specified.

5. In an excavator, the combination of the body portion; the laterally-swinging boom supported from the forward end of the body portion, and comprising two beams extending upwardly and outwardly from the body portion, and arranged far enough apart to accommodate the movements of the shovel-arm between them; the excavating-shovel having its arm extending between the aforesaid beams and suitably connected with and movable endwise and capable of tilting independently of the boom; the two guide-sheaves supported from the boom's upper end; the hoisting-cable sections operatively connected with the excavating-shovel and thence leading upwardly to and over the different sheaves, respectively, and thence leading rearwardly and suitably guided along opposite sides, respectively, of the shovel-arm's sweep into engagement with the guide-sheaves at the lower end of the boom, and means for pulling upon the said cable-sections in the direction required to hoist the shovel, substantially as set forth.

6. In an excavator, the combination of the boom comprising two beams arranged far enough apart to accommodate the movements of the shovel-arm between them; the excavating-shovel having its arm extending between the aforesaid beams and suitably connected with and movable endwise and capable of tilting independently of the boom; two guide-sheaves supported from the boom's forward end and arranged vertically and longitudinally of the boom and a suitable distance apart; two other guide-sheaves arranged vertically and longitudinally of the boom and supported a suitable distance apart at the rear end of the boom; the hoisting-cable sections operatively connected with the excavating-shovel, thence leading upwardly to and over the different forward sheaves, respectively, and thence to and engaging the different rear sheaves, respectively; means for pulling upon the said cable-sections in the direction required to hoist the shovel; two cable-spreading sheaves supported from the boom at the forward side of the shovel-arm's sweep, and arranged between and in position to spread apart the cable-sections; another pair of sheaves supported from the boom between the said spreading-sheaves and the boom's forward guide-sheaves and arranged to cause the cable-sections to converge in the direction of the last-mentioned sheaves from the said spreading-sheaves; another pair of spreading-sheaves supported from the boom at the rear side of the shovel-arm's sweep and arranged between and in position to spread apart the cable-sections, and another pair of sheaves supported from the boom at the outer sides of the different cable-sections, respectively, and between the last-mentioned cable-spreading sheaves and the guide-sheaves at the boom's rear end and close enough together to cause the cable-sections to converge in the direction of the last-mentioned sheaves, substantially as and for the purpose set forth.

7. In an excavator, the combination of the boom; a cylindrical member journaled upon and transversely of the boom; a ring or annular band embracing and turnable upon the journaled cylindrical member; the excavating-shovel having its arm arranged longitudinally of the said journaled cylindrical member and connected with and slidable longitudinally and independently of the aforesaid turnable ring or band, and means for limiting the circumferential movement of the aforesaid band or ring, substantially as set forth.

8. In an excavator, the combination of the boom comprising two beams arranged far enough apart to accommodate the movements of the shovel-arm between them; a cylindrical member journaled upon and transversely of the boom; a ring or annular band embracing and turnable upon the journaled cylindrical member; the excavating-shovel having its arm extending between the boom-beams and connected with, and slidable longitudinally and independently of, the aforesaid turnable ring or band, and means for limiting the circumferential movement of the aforesaid annular band or ring, substantially as set forth.

9. In an excavator, the combination of the boom comprising two beams arranged far enough apart to accommodate the movements of the shovel-arm between them; the excavating-shovel having its arm extending between the aforesaid beams and less in dimension, transversely of the boom, than the space between the said beams; a cylindrical member journaled transversely of and supported from the boom; an annular band or ring embracing and turnable upon the journaled cylindrical member, and such a connection between the said ring and the shovel-arm as will hold the latter to the ring without interfering with the endwise movement of the shovel-arm independently of the ring, substantially as set forth.

10. In an excavator, the combination of the boom; an upright member journaled transversely of and supported from the boom; a slideway formed upon a member embracing and turnable upon the said upright member, and the shovel having an arm provided with a slide engaging the said slideway and extending longitudinally of the arm, substantially as set forth.

11. In an excavator, the combination of the boom; a member journaled transversely of and supported from the boom; two parallel slideways formed, a suitable distance apart, upon a laterally-turnable member embracing the said journaled member; the shovel having an arm provided with slides engaging the

said slideways and extending longitudinally of the arm, and means for limiting the movement of the arm circumferentially of the aforesaid journaled member, substantially as shown, for the purpose specified.

12. In an excavator, the combination of the boom; a member journaled transversely of and supported from the boom; the excavating-shovel having an arm slotted longitudinally upon its back side; a member supported and turnable upon the said journaled member and having a flange or lug engaging the arm's slot and two slideway-forming recesses at opposite sides, respectively, of the lug or flange, and slides formed upon and extending longitudinally of the shovel-arm and engaging the said recesses, substantially as and for the purpose set forth.

13. In an excavator, the combination of the boom; a cylinder that has trunnions arranged transversely of and supported from the boom and being tubular, and has a piston internally, and two passage-ways connecting the chambers of the different trunnions, respectively, with opposite ends, respectively, of the cylinder's chamber at opposite ends, respectively, of the piston's travel; the piston-rod; the suitably-hoisted shovel attached to the said rod, and the fluid-pressure source, valve mechanism and passage-ways, whereby fluid under pressure is admitted alternately to opposite ends of the cylinder, and whereby pressure is admitted to the one trunnion while the other trunnion is exhausting, substantially as set forth.

Signed by us at Marion, Ohio, this 1st day of April, 1898.

ARTHUR E. CHENEY.
GEORGE A. CHENEY.
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Witnesses:
W. R. WADDELL,
F. H. KING.