(No Model.)

5 Sheets—Sheet 1.

F. O. KILGORE.

EXCAVATOR.

No. 590,990. Patented Oct. 5, 1897.

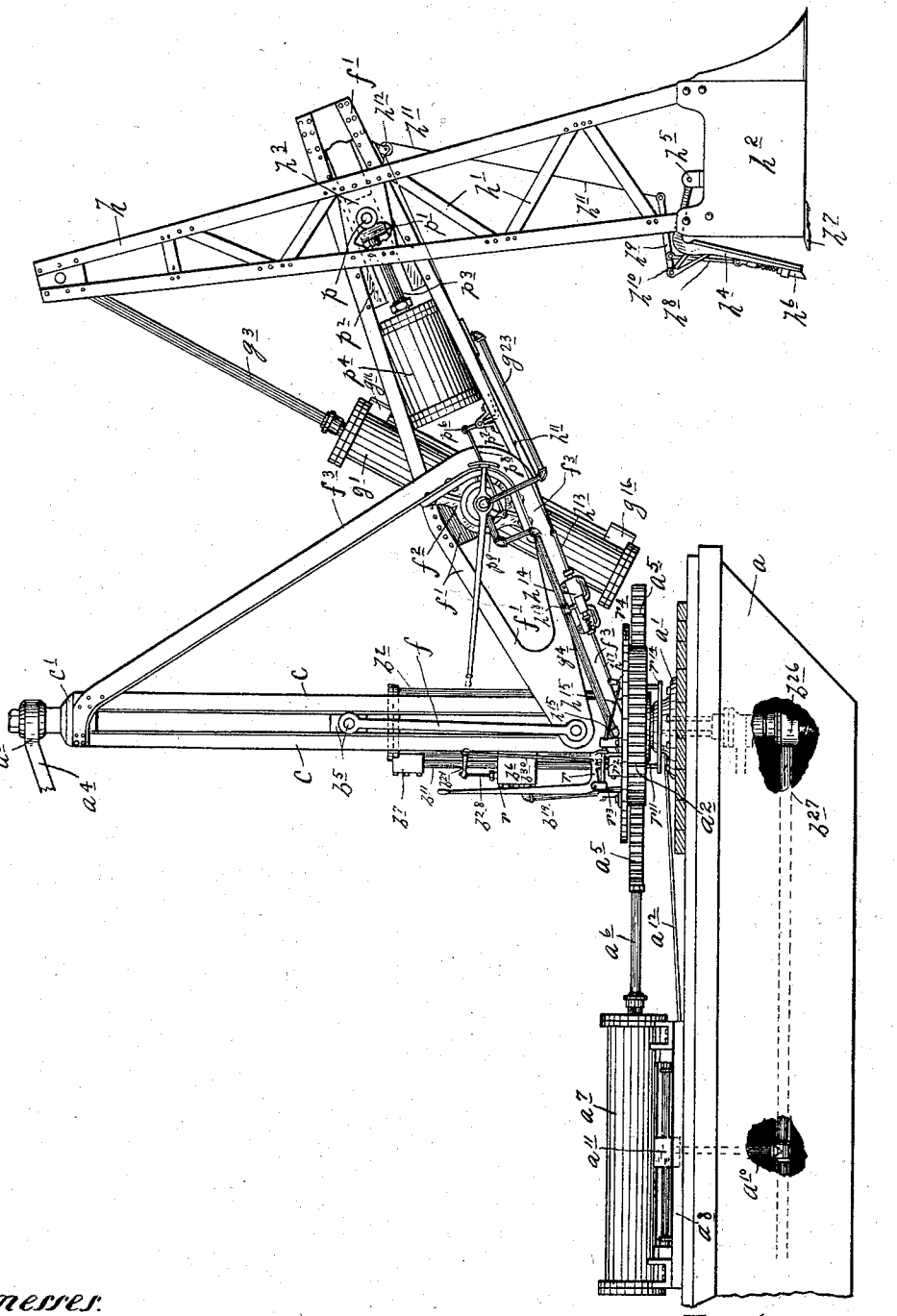


Fig. 1.

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5 Sheets—Sheet 2.

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Fig. 2.

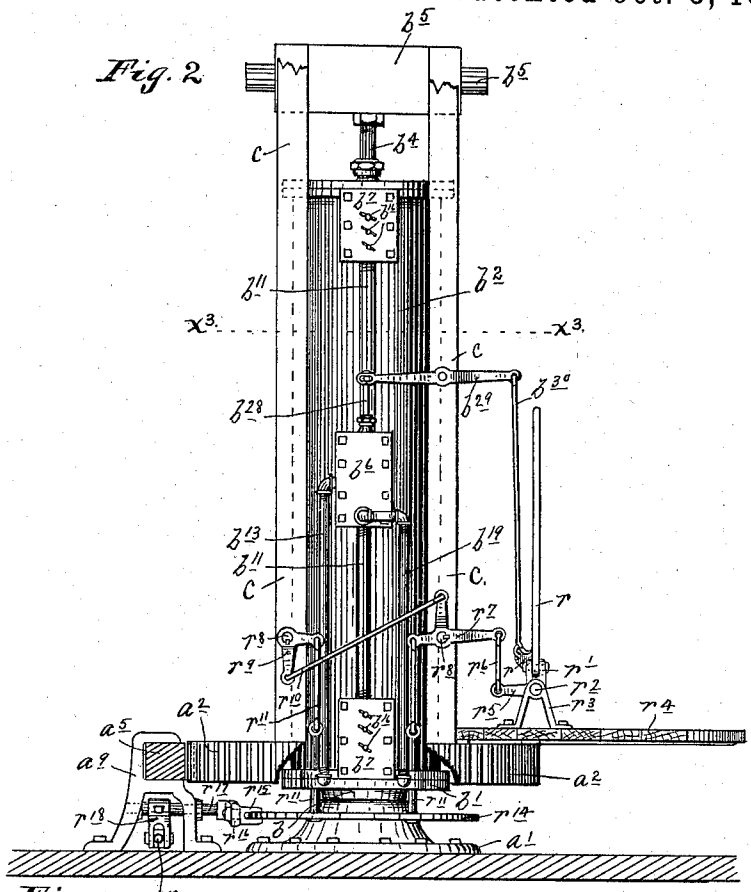
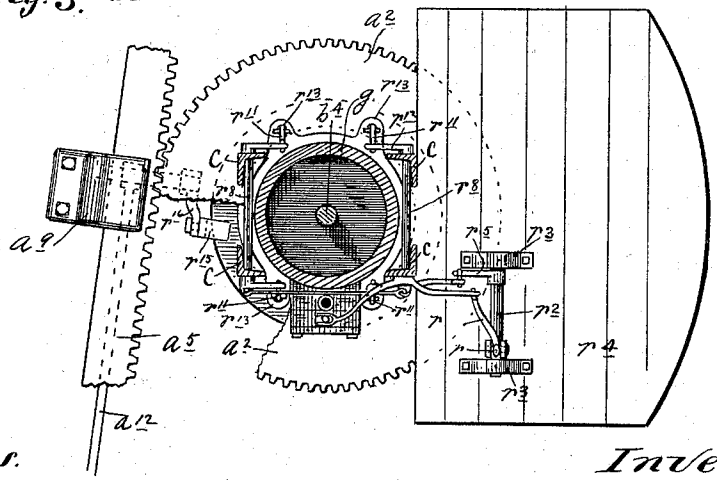


Fig. 3.



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Fig. 4.

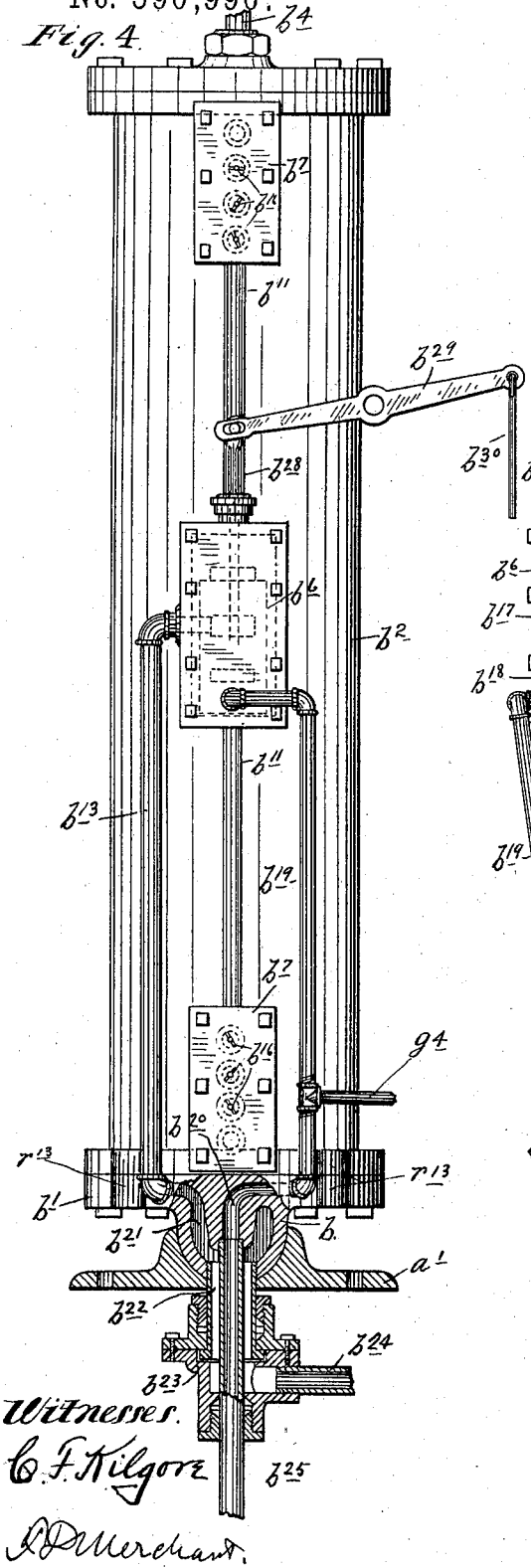
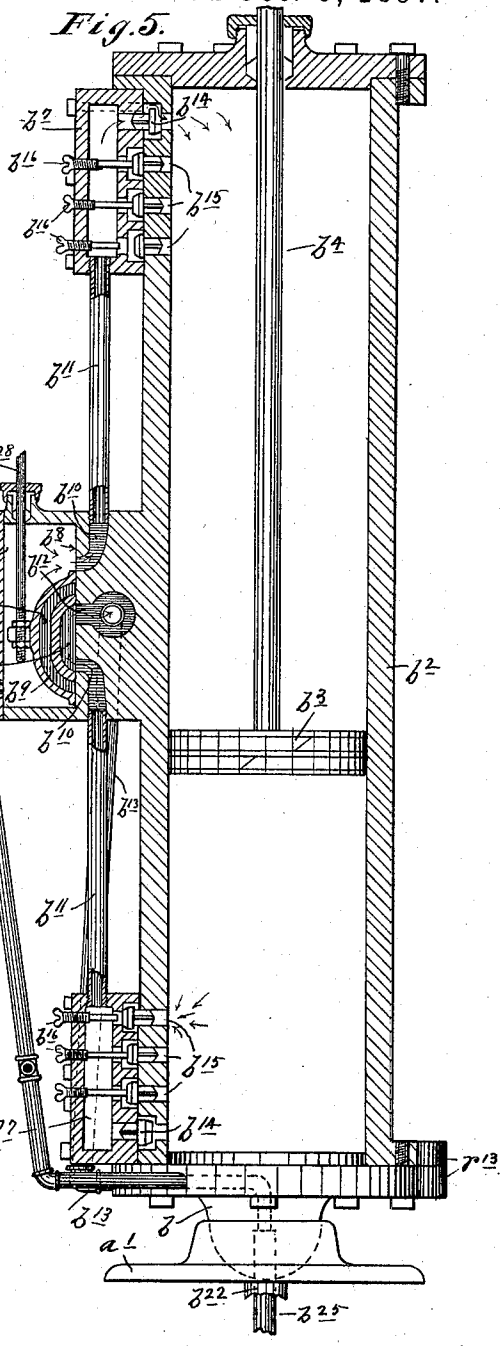


Fig. 5.



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Fig. 6.

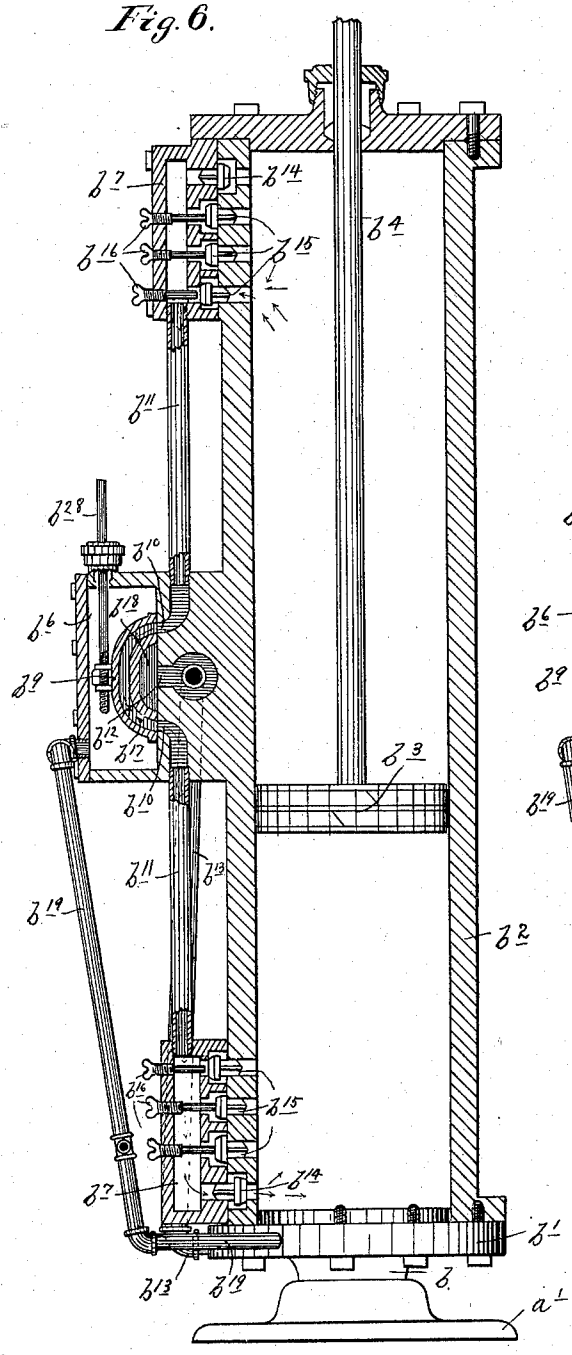
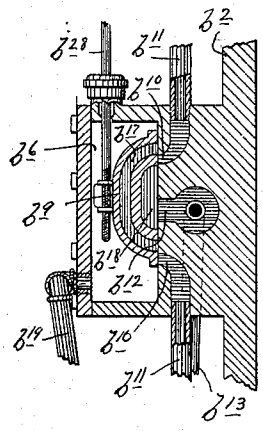


Fig 7



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Fig. 9.

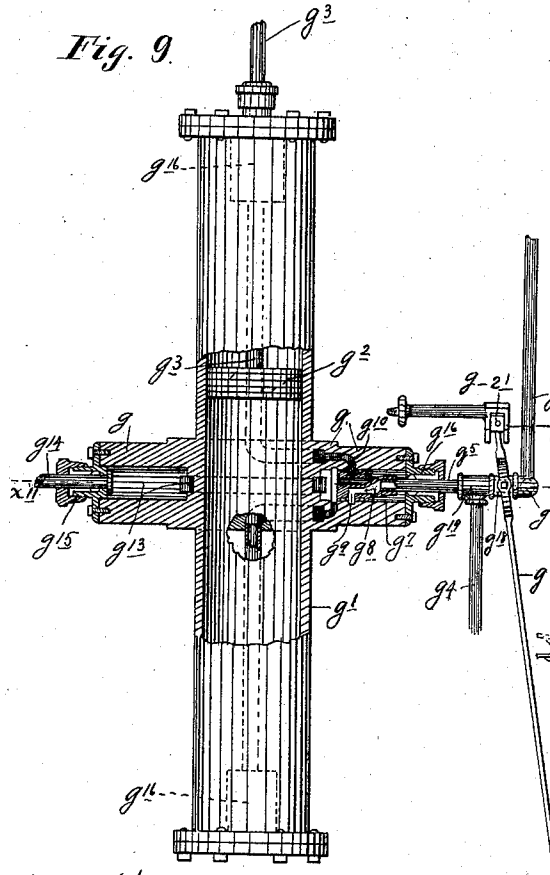


Fig. 10.

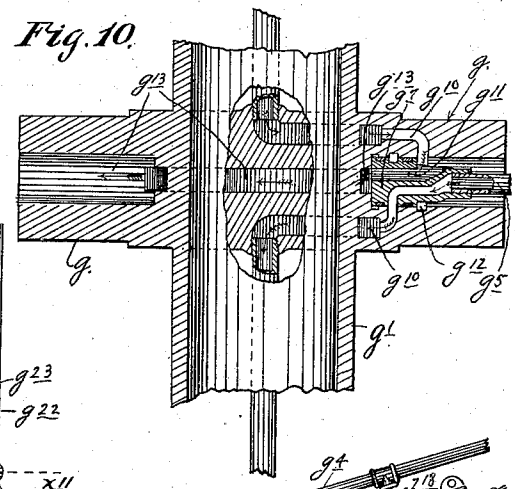


Fig. 12.

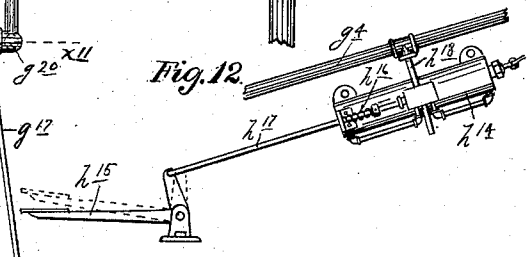


Fig. 8.

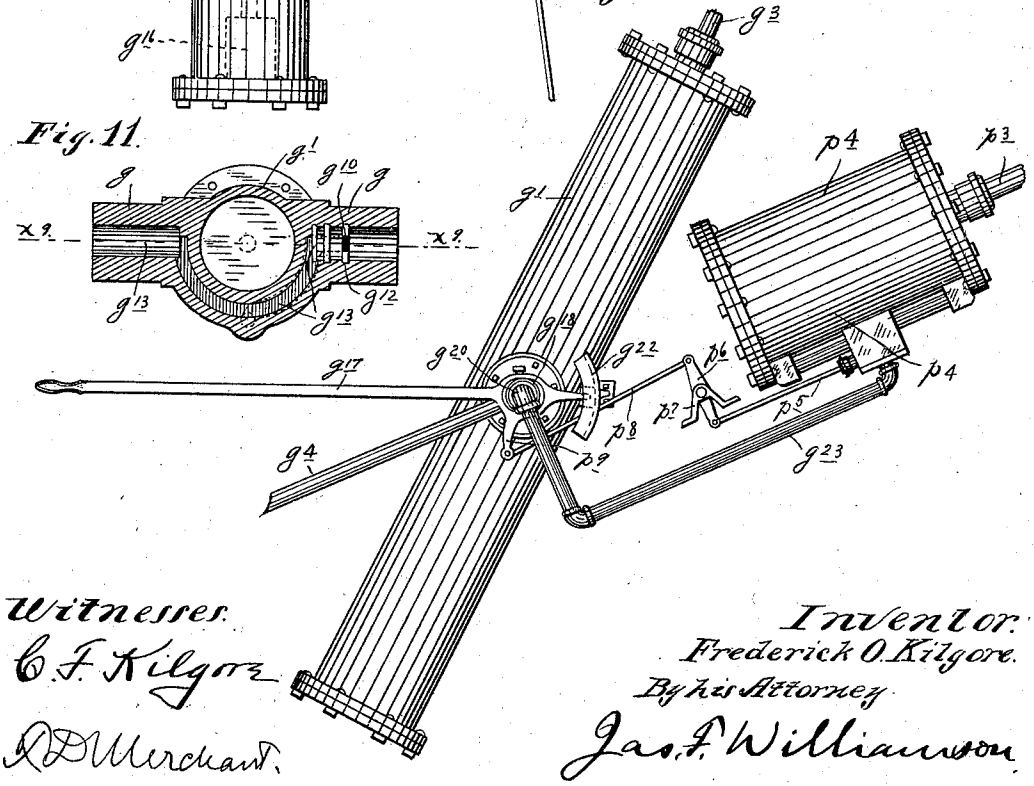


Fig. 11.

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UNITED STATES PATENT OFFICE.

FREDERICK O. KILGORE, OF MINNEAPOLIS, MINNESOTA.

EXCAVATOR.

SPECIFICATION forming part of Letters Patent No. 590,990, dated October 5, 1897.

Application filed April 24, 1896. Serial No. 588,852. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK O. KILGORE, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Excavators; and I 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 appertains to make and use the same.

My invention relates to excavators, power-cranes, and similar machines, and has for its object to provide improved mechanism for this class of work with a view of increased capacity and economy in operation.

To these ends my invention consists of the novel devices and combinations of devices which will be hereinafter described, and defined in the claims.

In the accompanying drawings I have illustrated my invention as applied to an excavator mounted for use as a dredge, but the same could equally well be mounted on a truck or other support for use on the land as a steam-shovel.

Several of the features of the invention are equally well capable of use as a power-crane.

In the said drawings, Figure 1 is a side elevation of the excavator mounted for use as a dredge with some parts removed and others broken away. Fig. 2 is a view of some of the parts shown in Fig. 1, chiefly in rear elevation, but partly in vertical section, with some portions broken away and others removed. Fig. 3 is a horizontal section, on the line $x^3 x^3$ of Fig. 2, with some parts removed and others broken away. Fig. 4 is a view of the vertical engine carried with the mast for operating the oscillating boom with its lower end bearing and some of the connected parts shown in vertical section. Fig. 5 is a longitudinal central section through the cylinder and steam-chest of the engine shown in Fig. 4 with some parts broken away. Fig. 6 is a similar view to Fig. 5 of the same parts, but with the valve shown in its central position. Fig. 7 is a detail showing the same valve and valve-seat as in Figs. 5 and 6, but with the valve shown in a different position. Fig. 8 is a side elevation of the oscillating engine and the fulcrum-shifting engine employed to operate the dipper-arm. Fig. 9 is a view of the oscillating engine, looking from the left at right angles to the engine, as shown in Fig. 8, with some parts shown in horizontal section on the line $x^9 x^9$ of Fig. 11. Fig. 10 is an enlarged view of the sectioned parts shown in Fig. 9 with some portions broken away. Fig. 11 is a cross-section on the line $x^{11} x^{11}$ of Fig. 9; and Fig. 12 is a detail in side elevation showing the trip-engine detached, which is used to operate the dipper-gate.

a represents the scow or other support on which the excavator may be mounted. To the platform of the scow is rigidly secured a bearing-plate a' for the lower end pintle b of the mast. The said pintle b is formed integral with the lower end head b' of the cylinder b' b^2 b^3 of the vertical engine. A large spur-gear a^2 rests on the lower end flange of the cylinder b^2. On the said gear a^2 rest the lower ends of four angle-iron posts c, which are rigidly bound together in any suitable way for coöperation with the cylinder b^2 to form the upright mast. The said angle-iron posts c form a box-like mast-body, which is reinforced and supported by the cylinder b^2 of the vertical engine, and at the same time the said engine-cylinder is held between the posts c of the mast. The said corner-posts c are bound together at their upper ends by an upper end pintle-head c' of any suitable construction, which works in the bearing-eye a^3, which is supported in any suitable way from the scow a, as by suitable guys a^4.

The angle-iron posts c of the mast are spaced apart and properly reinforced above the cylinder b^2 to afford guides for a vertically-movable cross-head b^5, to which the upper end of the piston-rod b^4 of the vertical engine's piston b^3 is attached. The said cross-head b^5 is connected by a pair of rigid links f, outside the mast-post c, to the inner end of an oscillating boom f'. This oscillating boom f' is made up of heavy steel angle-iron bars, rigidly bound together into box-like form, and is mounted to oscillate on a fulcrum afforded by the inner portions of trunnion-bearings g, which are cast integral with the cylinder g' of an oscillating engine. The said trunnions g are mounted in suitable bearings f^2, which are rigidly secured to the boom-supporting arms f^3, which are made up of steel angle-bars bent upon themselves into approxi-

mately triangular form with their extremities rigidly secured to the upper and lower ends of the mast and the bearings f^2, located at the bends or outer angles of the same. The oscillating engine and the boom f' are therefore both supported from the mast, through the arms f^3 and the bearings f^2, with the boom f', mounted to oscillate on the trunnions g of the oscillating cylinder. The piston g^2 of the oscillating cylinder has its rod g^3 pivotally connected to the upper end of the dipper-arm h, which is also made up of steel angle-bars built into box shape, with the angles rigidly connected together by suitable braces h'. The corner bars of the dipper-arm diverge slightly at their outer ends and take hold of the dipper h^2 at the upper corners of the same. The dipper-arm $h\,h'$ is provided with bearing-blocks h^3, rigidly secured thereto, which engage trunnions p, projecting from a cross-head or thrusting-block p', which is mounted for sliding movement lengthwise of the boom f', between suitable guides p^2, fixed to the angle-bars of the boom f'. The said cross-head p' is connected to the outer end of the piston-rod p^3 of the fulcrum-block-shifting engine, the cylinder p^4 of which is shown in Figs. 1 and 8, and is rigidly secured to the boom f', between the angle-bars of the same.

The dipper-gate h^4 is pivoted to the dipper-body at h^5 and provided with a spring-catch h^6, which will automatically engage with a keeper-lug h^7, projecting from the dipper bottom. The gate will automatically close by gravity. The spring-latch h^6 is connected by a link h^8 to a lever h^9, pivoted to a bearing-lug h^{10} on the gate. The lever h^9 has attached thereto a flexible connection h^{11}, which passes over a suitable guide-sheave h^{12} on the outer end of the boom f' and thence inward and downward to the outer end of the piston-rod h^{13} of a small trip-engine, the cylinder of which is shown at h^{14} and is bolted fast to one of the boom-supporting arms f^3. The valve of this little trip-engine is subject to the action of a bell-crank foot-lever h^{15} and a spring h^{16}, acting on a valve-rod h^{17}. The spring h^{16} normally holds the valve in position to throw the piston of the trip-engine into its outermost position, but may be overcome by the foot-lever h^{15} to throw the valve to an opposite extreme position for the admission of steam to the outer end of the cylinder for forcing the piston inward and releasing the latch h^6 of the dipper-gate from the keeper-lug h^7 when the dump is required.

The valve mechanism for the vertical engine on the mast, for the oscillating engine, and for the fulcrum-shifting engine will be noted later on.

The large horizontal gear a^2 engages with a rack a^5, carried at the outer end of the piston-rod a^6 of a horizontal engine, the cylinder a^7 of which is rigidly secured to a suitable bed a^8 on the scow a or other support for the excavator. The rack a^5 works at its outer end on a suitable guide-bracket a^9. The said horizontal engine through the parts a^5 a^2 serves to impart the pivotal motion to the mast in the horizonal plane. The vertical engine forming a part of the mast serves, through the parts b^5 and f, to oscillate the boom f' in the vertical plane. The oscillating engine carried on the boom f' serves to effect the necessary pivotal movement of the dipper-arm $h\,h'$ in respect to the boom f'. The fulcrum-shifting engine, carried on the boom f', serves to shift the dipper-arm lengthwise of the boom by moving its fulcrum in or out thereon, and the little gate-trip engine serves to release the gate, as hitherto noted. The valve mechanism for the several engines, except the trip-engine, will now be described.

It will be most convenient to consider first the valve mechanism for controlling the vertical engine carried with and forming a part of the mast.

Referring to Figs. 4 to 7, inclusive, it will be noted that the cylinder b^2 is provided with the main steam-chest b^6 and two supplemental steam-chests b^7, with the former located at the center and the latter at the opposite ends of the same. In the main chest b^6 is the seat b^8 for the main distributing-valve b^9. The said seat b^8 is provided with the ports b^{10}, connecting by pipes b^{11} with the supplemental chests b^7, and the said seat b^8 is provided with the central final exhaust-port b^{12}, leading to the exhaust-pipe b^{13}. In the supplemental chests b^7 and the cylinder casting, directly thereunder, are mounted a series of check-valves b^{14} and b^{15}, of which the members b^{14} are at the outer extremities of said chest b^7 and arranged to open inward for the admission of the steam to the opposite ends of the cylinder, while the members b^{15} are arranged at different distances toward the center from the members b^{14} and mounted to open outward for permitting the exhaust from the cylinder on opposite sides of the piston. The said exhaust check-valves b^{15} are subject to the action of thumb-screw bolts b^{16}, by means of which all except the desired member of said exhaust check-valves b^{15}, at the opposite ends of the cylinder, may be locked in their closed position.

The main or distribution valve b^9 is provided with a central passage b^{17}, which, when the valve is central, as shown in Fig. 6, may be made to connect the two cylinder-ports b^{10}. The said valve b^9 is also provided with the usual exhaust-cavity b^{18} for coöperation with the ports b^{10} and final exhaust-port b^{12} at the proper time in the usual way for effecting the exhaust. As shown, the steam is supplied to the main chest b^6 through a pipe-section b^{19}.

The distribution-valve b^9 is controlled by hand through connections which will be presently noted. The action of the valve mechanism (shown in Figs. 4 to 7) may, however, be best considered at this point. The admission and the exhaust to and from the cylinder-ports b^{10}, under the control of the valve

b^9, occur in the ordinary well-known way under the movement of the valve. In Fig. 5 the valve is shown as admitting steam to the upper end of the cylinder and exhausting from the lower end of the same. When the valve is at the opposite extreme of its travel, the same actions would be taking place for admission to the lower end and exhaust from the upper end of the cylinder; but suppose that the said valve b^9 should be thrown to its central position, as shown in Fig. 6. Then it must be obvious that neither admission nor final exhaust could occur from either end, but that the fluid could freely pass through the cylinder-ports b^{10} and the passage b^{17} in the valve from one to the other side of the piston until the pressures equalize. By then throwing the valve into its cut-off position, as shown in Fig. 7, the fluid will be confined within the cylinder on opposite sides of the piston, and hence the piston will be held central or stopped with a cushioned action. The oscillating boom f', which is operated by the piston of said vertical engine, can therefore be stopped at any point of its movement without shock or jar. This is a most important feature for the control of the boom. The purpose of the supplemental chests b^7 at the opposite ends of the cylinders and the series of check-valves b^{14} and b^{15} therein, arranged as described, is to insure a confined volume of steam for cushioning the stroke of the piston on and after reaching any desired point of its travel. For example, as the parts are shown in Figs. 5 and 6, the exhaust can only take place through the outlets from the cylinder ends controlled by the innermost members of the check-valves b^{15}, and hence whenever the piston reaches the said innermost check-valve b^{15} all steam in advance of the piston on the exhaust side of the same will be confined within the cylinder and serve to cushion its further movement toward the end of the cylinder. If the innermost members of said check-valves b^{15} had been locked down by the thumb-screws b^{16} and one of the outer ones toward each end had been set free, then the extent of the cushion, or point at which the caging of the steam would begin, would have occurred at a later point in the outward travel of the piston. Hence, by said check-valves b^{15} and their locking-down devices b^{16}, any desired amount of cushion can be provided for the piston at the outer end of its stroke. This is an extremely important function for preventing bad accidents with a hand-controlled engine handling such heavy weights as in the class of machines herein shown.

The valve mechanism for the horizontal engine a^6 a^7, which rotates the mast, is of exactly the same construction as that fully shown and described for the vertical engine. (Shown in Figs. 4 to 7.) Hence the complete control for stopping the rotary motion of the mast and the parts carried thereby at any point with a steam-cushioned action is available in the same way as the control of the up-and-down motion of the oscillating boom f', as hitherto described. The distribution-valve for the fulcrum-shifting engine p^3 p^4 is also the same in construction as that shown and described for the vertical engine, and the check-valves are also applied to the fulcrum-shifting engine p^3 p^4 in the same way as to the vertical engine.

Returning to a consideration of the piping for the vertical engine on the mast, the supply-pipe section b^{19} on the engine-cylinder b^2 taps a passage b^{20} in the lower cylinder-head b' and the inside or central part of the pintle b and the exhaust-pipe b^{13} taps a corresponding passage b^{21} in said head b' and pintle b. A pipe b^{22} is screwed into the pintle b, so as to tap the exhaust-passage b^{21}, and extends outward and downward through the bearing-plate a' for the mast to a joint-box b^{23}. The said pipe b^{22} is flanged at its lower end and, working through a suitable gland in said joint-box b^{23}, is free to turn therein under the motion of the mast and cylinder b^2. The box b^{23} is tapped by a discharge-pipe b^{24}, leading to the outside of the scow. A pipe b^{25} works through a gland in the lower end of the pipe-box b^{23}, and, extending inward through the exhaust-pipe b^{22}, is screwed fast to the inner portion of the pintle b, so as to tap the supply-passage b^{20}. This pipe b^{25} also turns with the mast. To permit this motion, the pipe b^{25} extends downward to a joint-box b^{26} (shown in Fig. 1) and is connected thereto with freedom for rotary motion in substantially the same way as the pipe b^{22} is connected to the joint-jox b^{23}. As said box b^{26} is of substantially the same construction as the box b^{23} it has not been deemed necessary to detail the same on the drawings. The said supply or feed box b^{26} is tapped by a supply-pipe b^{27}, which extends to the boiler. (Not shown.) In this way the supply of the steam to the vertical engine and the exhaust therefrom may be effected at any point in the rotation of said engine as part of the mast. The boiler-pipe b^{27} is tapped by a branch pipe a^{10}, leading to the main chest a^{11} of the horizontal engine a^6 a^7. The stem b^{28} of the distribution-valve b^9 of the vertical engine is attached by slot-and-pin connection to the inner end of a lever b^{29}, which is centrally pivoted to one of the posts c of the mast, as best shown in Fig. 2. The outer end of the lever b^{29} is connected by rod b^{30} with the lower or horizontal arm of a bell-crank hand-lever r. The said lever r has its elbow pivoted, as shown at r', to a rock-shaft r^2, mounted in suitable bearings r^3 on the operator's platform r^4, suitably supported by and movable with the mast. The said rock-shaft r^2 is provided with a crank-arm r^5 for imparting motion, through connections about to be noted, to the valve-rod a^{12} of the horizontal engine a^6 a^7. In virtue of the way in which the bell-crank lever r is mounted it is obvious that the said lever r is capable of rocking on the elbow-pivot r' for operating

the valve of the vertical engine on the mast or of rocking sidewise with the rock-shaft r^2 on the bearings r^3 for operating the valve-rod a^{12} and the valve of the horizontal engine a^6 a^7. It must also be obvious that the said lever r is capable of these two motions simultaneously as well as independently, or, otherwise stated, the said lever r may be made to move on an angular or diagonal line to the lines through its respective pivots, which diagonal line would be the resultant of its two simultaneous pivotal motions. Still otherwise stated, the hand-lever r is mounted in such a way as to be capable of universal motion and through the connections therefrom serves to control the valves both of the vertical engine and the horizontal engine. The single lever r therefore gives complete control for the rotation of the mast by the horizontal engine and for the oscillation of the boom by the vertical engine, and in such a way that these movements may be made independently or simultaneously at the will of the operator. Inasmuch as the said controlling-lever r must rotate with the platform r^4 and the mast, the direct connections b^{29} and b^{30} are available to the valve-rod b^{28} of the vertical engine, but especial connections must be provided which will render the motion of said controlling-lever r and the rock-shaft r^2 available on the valve-rod a^{12} of the fixed horizontal engine a^6 a^7. For this purpose the arm r^5 of the rock-shaft r^2 is connected by link r^6 with one arm of a three-armed lever r^7, which is fixed to a rock-shaft r^8, extending through one pair of the mast-posts c. A similar rock-shaft r^8 extends through the other pair of mast-posts c and is provided with a bell-crank lever r^9, connected by rod r^{10} with one of the arms of the lever r^7. The levers r^7 and r^9 are fixed to corresponding ends of the shafts r^8 and connect to the upper ends of sectional jointed rods r^{11}. The opposite ends of the shafts r^8 are provided with crank-arms r^{12}, which also connect to corresponding jointed rods r^{11}. All the jointed rods r^{11} are disposed lengthwise of the mast with their lower sections extending through suitable passages of guide-lugs r^{13}, projecting from the lower cylinder-head b' of the engine b^2 b^3, and carry at their lower end a flat ring r^{14}, which turns with the mast. The said ring r^{14} engages between the jaws of a crank-pin r^{15} on the crank-arm r^{16} of a rock-shaft r^{17}, which is mounted in suitable bearings on the guide-pedestal a^9, as shown in Fig. 2. The said rock-shaft r^{17} is provided with another crank-arm r^{18} near its outer end, which connects to the forward end of the valve-rod a^{12} for operating the valve of the horizontal engine a^6 a^7. The said connections from the arm r^5 of the rock-shaft r^2, which carries the controlling-lever r to the valve-rod a^{12} for the horizontal engine, are best shown in Figs. 2 and 3 and are so arranged that the rocking motion of the arm r^5 or sidewise motion of the controlling-lever r will move the ring r^{14} upward and downward and thereby through the parts r^{15} to r^{18} operate the said valve-rod a^{12}. The said hand-lever r is therefore capable of controlling the horizontal engine, as well as the vertical engine, in the manner hitherto described.

The connections for controlling the oscillating engine and the fulcrum-shifting engine will now be noted, reference being had to Figs. 1, 8, 9, 10, and 11.

The supply-pipe b^{19} for the vertical engine b^2 b^3, forming a part of the mast, is tapped by a pipe g^4, which is provided with a short branch g^5, entering into the hollow trunnion g of the oscillating engine g' g^2. The said branch pipe g^5 enters said trunnion through a suitable stuffing-box g^6 and is made fast to a sliding valve g^7, suitably seated in said trunnion. The said valve g^7 is provided with an axial port or passage g^8, intersecting with an annular port g^9 on its periphery, which can be made to register with ports g^{10} in the seat for the admission of the steam to the cylinder. The said valve is also provided with an axial passage g^{11}, intersecting with an annular port g^{12} on its periphery, which may be made to register with the said cylinder-ports g^{10} of the seat and connect the same with the final exhaust-port g^{13}, which final exhaust-port g^{13} extends around the cylinder-casting g' and into the opposite hollow trunnion g. The said port g^{13} is tapped by the exhaust discharge-pipe g^{14}, which passes out through a suitable stuffing-box g^{15}. The cylinder-ports g^{10} are piped or otherwise extended to supplemental chests g^{16}, located at the opposite ends of the cylinder g', and which are preferably equipped with check-valves operating in the same way as the check-valves b^{14} and b^{15}, as shown on the vertical engine in Figs. 4, 5, and 6, for cushioning the piston g^2 in the final part of its stroke.

The valve g^7 is moved in and out at the will of the operator by means of a hand-lever g^{17}. The said lever g^{17} is provided with an eye embracing a sleeve g^{18}, which works between the pipe-union heads g^{19} and g^{20}, as best shown in Figs. 8 and 9. The upper end of the lever g^{17} is pivoted to a cross-head g^{21}, which is mounted in a segmental guide g^{22}, fixed to the boom-supporting arm f^3, as shown in Fig. 1. This guide g^{22} serves to afford a fulcrum for the said lever g^{17} in the lateral movement of the said lever for operating the valve g^7 of the oscillating engine.

By the union g^{20} a pipe g^{23} is tapped into the pipe g^4, which pipe g^{23} extends to the main chest of the fulcrum-shifting engine p^3 p^4. The valve stem or rod p^5 of said shifting-engine p^3 p^4 is attached to the lower arm of a rocker p^6, pivoted to a bearing p^7 on the boom f', and the upper arm of said rocker p^6 connects by rod p^8 with a crank-arm p^9 on the lever g^{17}. Hence by rocking the lever g^{17} on its pivotal support the valve for the fulcrum-shifting lever may be operated in either direction at will. The single lever g^{17} therefore serves to control both the oscillating en-

gine g' g^2 and the fulcrum-shifting engine p^3 p^4 in substantially the same way as the other hand-lever r, hitherto described, controlled the vertical and horizontal engines. It will be seen that the lever g^{17} is capable of universal motion, and hence the said engines g' g^2 and p^3 p^4 for oscillating the dipper-arm and shifting the same lengthwise of the boom may be controlled by the lever g^{17} for either simultaneous or independent action at the will of the operator. The lever g^{17} extends to a point within reach of the operator standing on the platform r^4. Hence the operator can manipulate the lever r with one hand and the lever g^{17} with the other. All the movements of the several engines are therefore under the control of a single workman standing on the platform r^4. The said workman's control of the little engine h^{13} h^{14} for tripping the dipper-gate has already been noted. He does the same with the use of his foot, operating on the treadle h^{15}. The said little trip-engine is supplied with steam through a small pipe h^{18}, which taps the supply-pipe g^4, as shown in Figs. 1 and 12. It has already been stated that the valve mechanism for the fulcrum-shifting engine p^3 p^4 is substantially identical with that fully illustrated in its application to the vertical engine in Figs. 4 to 7. It has also been stated that the oscillating engine has the check-valves operative in the same way as on said vertical engine. Hence provision is made for cushioning the pistons of all the engines used on the excavator at the final part of their outward strokes, with the single exception of the little engine for tripping the dipper-gate, which does not require cushioning. Violent shock or jar is therefore guarded against at all points where the same might possibly occur under the hand manipulation of the strong engines required to operate the different parts of the excavator. The possibility of accident from any such a cause is therefore reduced to a minimum; and with the single exception of the oscillating engine the pistons of all the engines can be first balanced and then stopped under a cushioned action by first setting the valve to connect the cylinder-ports through the passage and valve and then shifting the valve into its cut-off position for confining the fluid within the cylinder on opposite sides of the piston, as illustrated, for the vertical engine in Figs. 6 and 7. In practice I also provide a valve capable of this same function for use on the oscillating engine. It is therefore possible to operate the engines with a full head of steam and nevertheless preserve complete and perfect control at all points of their movement. In view of all these facts and the control by a single operator it must be obvious that the excavator herein disclosed is extremely quick and nimble in all of its actions. The general effect is an excavator of greatly-increased capacity for any given unit of time with the use of less human labor than has been hitherto employed for operating this class of machines.

It must be obvious that by the removal of the dipper-arm and the substitution of a suitable tackle or grapple lever all the other parts of the mechanism shown would be capable of use as a power-crane for a great variety of purposes. Otherwise stated, the horizontal engine and the vertical engine, under the control of a common operating-lever, constitute an important improvement capable of use for rotating the mast and oscillating the boom regardless of whether the said mast and the said boom are used as part of an excavator or as part of a power-crane. It will also be understood that some of the other parts disclosed might be independently used.

It will be obvious that many of the minor details of the construction might be changed without departing from the spirit of my invention.

The special form of valve mechanism herein disclosed and fully illustrated as applied to the vertical engine in Figs. 4 to 6 is made the subject-matter of a companion application filed by me of even date herewith entitled "Valve mechanism for hand-controlled engines."

In respect to the dipper-gate it should be further added that the same may be closed in any position of the dipper by simply imparting a quick motion to the dipper-arm, which may be done either by the vertical engine, the oscillating engine, or the fulcrum-shifting engine. The engines are so sensitive and quick that any of the pivoted parts controlled thereby can be given a movement which will cause the dipper-gate to close under a slamming action, because the dipper can be moved before the inertia of the gate is overcome. By actual experience I have demonstrated that I can thus close the dipper-gate even when the dipper is at its highest point or position most unfavorable in respect to gravity.

What I claim, and desire to secure by Letters Patent of the United States, is as follows:

1. The combination with a rotating mast and a boom-support projecting therefrom, at an angle thereto, of an oscillating boom pivoted to said support intermediate of the extremities of the boom, an oscillating lever carried by said boom for manipulating a dipper or other device, and an oscillating engine carried on the same support as the oscillating boom and turning on a common center with said boom, for operating said oscillating lever, substantially as described.

2. The combination with a rotating mast and an oscillating boom, of an oscillating lever carried by said boom and a cross-head or fulcrum-block for said lever carried by said boom adjustable lengthwise of said boom, substantially as described.

3. The combination with a rotating mast and an oscillating boom, of an oscillating lever carried by said boom, a cross-head or ful-

crum-block for said lever movable lengthwise of said boom and an engine also carried by said boom and applied to shift said fulcrum-block, substantially as described.

4. The combination with a rotary mast, of an oscillating boom on said mast, an oscillating lever on said boom, an oscillating engine turning on the same center as said boom, for operating said lever, a cross-head or fulcrum-block for said oscillating lever movable lengthwise of said boom and an engine on said boom applied to move said fulcrum-block, substantially as described.

5. The combination with a rotary mast, of an oscillating boom on said mast, an oscillating lever on said boom, a shiftable fulcrum-block for said lever, an oscillating engine for operating said lever, turning on the same center as said boom, an engine for shifting said fulcrum-block, and valve mechanism for said two engines operative from a common controlling-lever, substantially as described.

6. The combination with the rotary mast and oscillating boom, of the dipper-arm or lever pivoted to said boom, the cross-head or fulcrum-block for said dipper-arm, movable lengthwise of the boom, and four engines, one stationary and applied to rotate the mast, a second carried on the mast and applied to oscillate the boom, a third oscillating on a common center with the boom and applied to oscillate the dipper-arm, and the fourth carried on the boom and applied to shift said fulcrum and dipper-arm lengthwise of the boom, substantially as described.

7. The combination with the rotary mast, oscillating boom, pivoted dipper-arm, and shifting fulcrum-block for the dipper-arm, of the horizontal stationary engine, for rotating the mast, the vertical engine carried with the mast for oscillating the boom, the oscillating engine on same center as the boom for oscillating the dipper-arm, the fulcrum-shifting engine on the boom, the valve mechanism for the horizontal and vertical engine, operative independently or simultaneously from a single controlling-lever, and the valve mechanism for said oscillating and fulcrum-shifting engines, operative independently or simultaneously from a single lever, with said two hand-levers both within reach of an operator riding with the mast, whereby a single operator can control all the actions, substantially as described.

8. The combination with a rotating mast and an oscillating boom carried thereby, of a horizontal engine supported independent of the mast, but applied to rotate the same, a hand-lever rotating with the mast, and connections therefrom, for controlling said horizontal engine, involving a device, controlled by said hand-lever, which is movable on the mast while rotating therewith, and devices independent of the mast but engageable by said movable device on the mast, at any point of the rotation, substantially as described.

9. The combination with a rotating mast and an oscillating boom, of a horizontal engine independent of the mast, but applied to rotate the same, a vertical engine rotating with the mast and applied to oscillate the boom, a hand-lever carried with the mast, mounted for universal movement, direct connections from said hand-lever to the valve of said vertical engine on the mast, and indirect connections from said hand-lever to the valve of said horizontal engine, comprising, as a part thereof, a ring rotating with the mast and vertically movable thereon by said hand-lever, and connections to the valve of the horizontal engine engageable with and operated by said ring, at all points of its rotation, substantially as described.

10. The combination with a rotating mast and an oscillating boom, of a horizontal engine on the mast-support, applied to rotate the mast, a vertical engine rotating with the mast and applied to oscillate the boom, a hand-lever carried with the mast, mounted for universal movement, direct connections from said lever to the valve of said vertical engine on the mast, and indirect connections from said hand-lever to the valve of said horizontal engine on the mast-support, including a ring rotating with the mast and vertically movable thereon by said hand-lever, which ring is engageable with the crank-pin of a rock-shaft connected to the valve-rod of said horizontal engine, substantially as described.

11. The combination with a rotary mast and an oscillating boom thereon, of an oscillating lever on said boom, for manipulating a dipper or other device, and an engine carried by the boom and applied to oscillate said lever, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

FREDERICK O. KILGORE.

Witnesses:
JAS. F. WILLIAMSON,
E. F. ELMORE.