(No Model.)

6 Sheets—Sheet 1.

B. S. BENSON.

STEAM PLOW.

No. 251,513.

Patented Dec. 27, 1881.

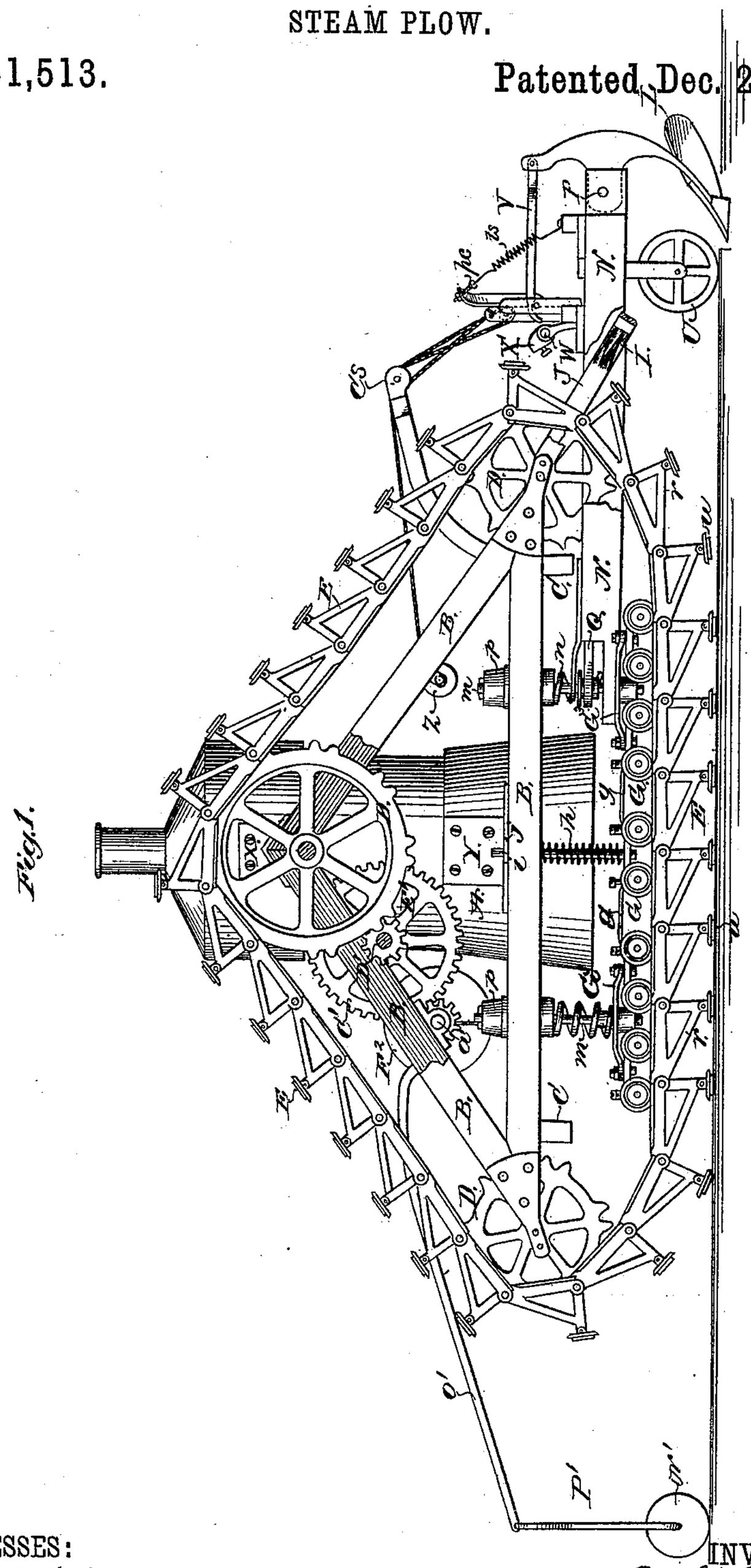

Fig. 1.

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INVENTOR:

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B. S. BENSON.

STEAM PLOW.

No. 251,513. Patented Dec. 27, 1881.

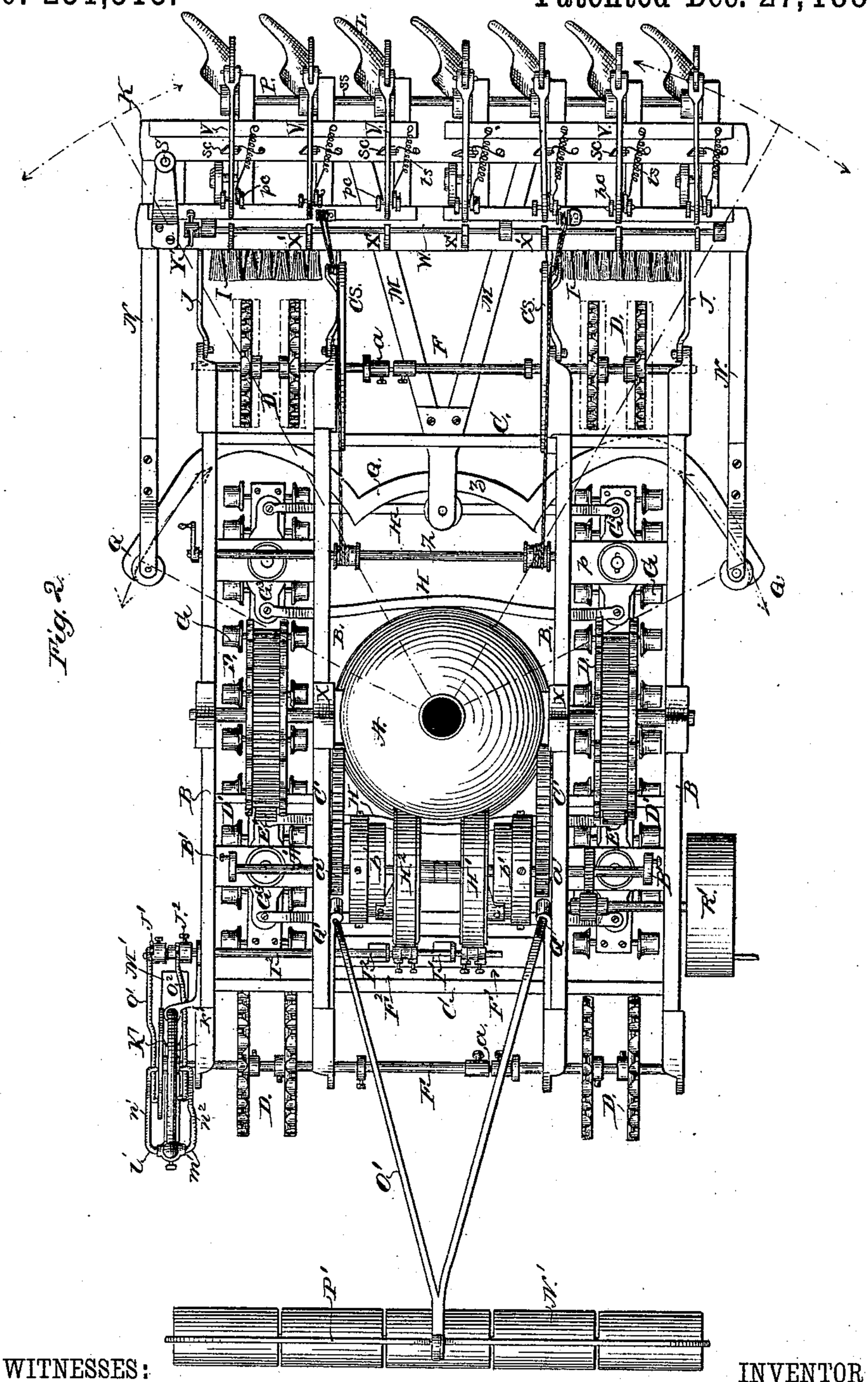

Fig. 2.

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(No Model.) 6 Sheets—Sheet 3.

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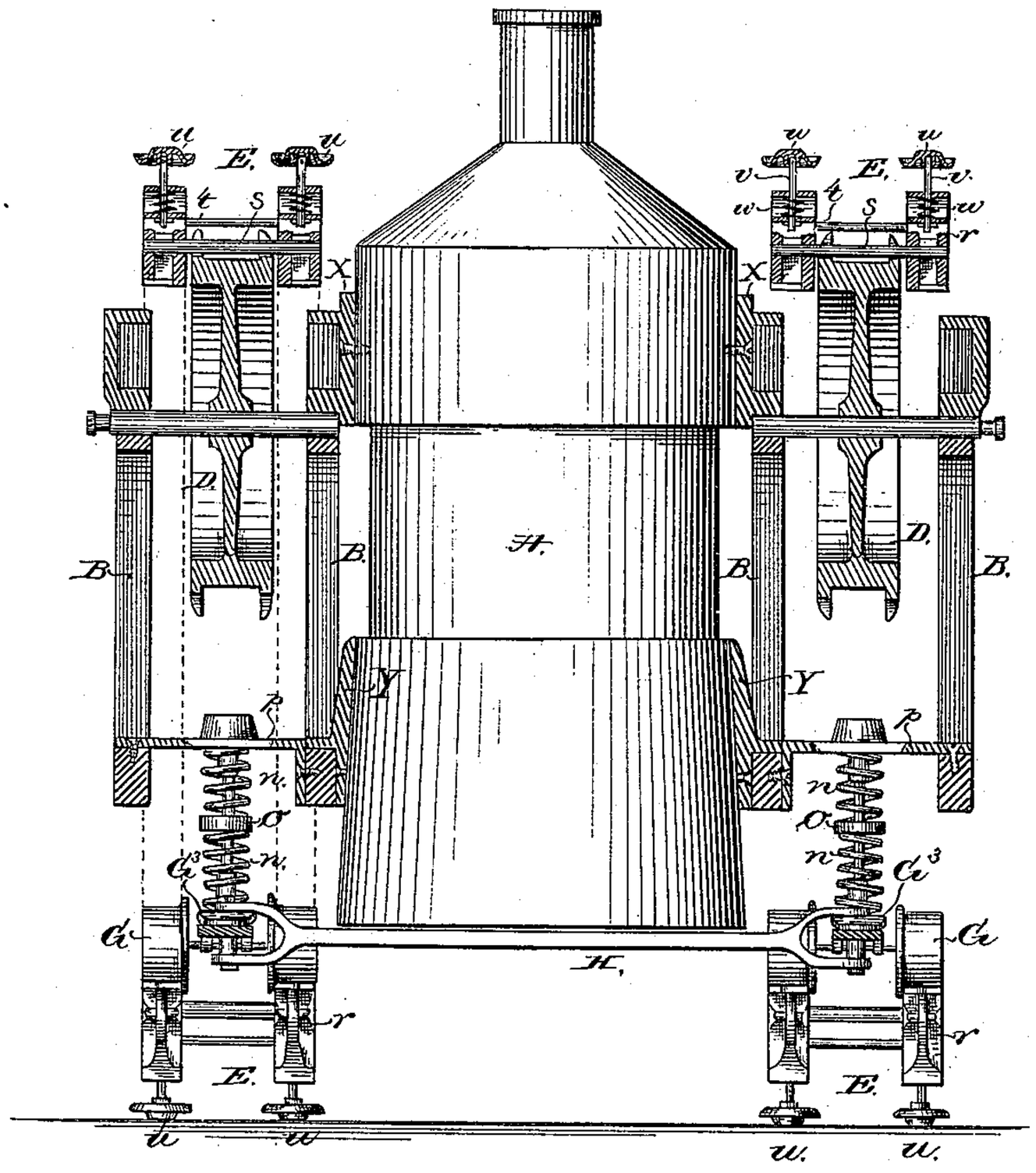
STEAM PLOW.

No. 251,513. Patented Dec. 27, 1881.

Fig. 3.



WITNESSES:
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(No Model.)

6 Sheets—Sheet 4.

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STEAM PLOW.

No. 251,513. Patented Dec. 27, 1881.

Fig. 4.

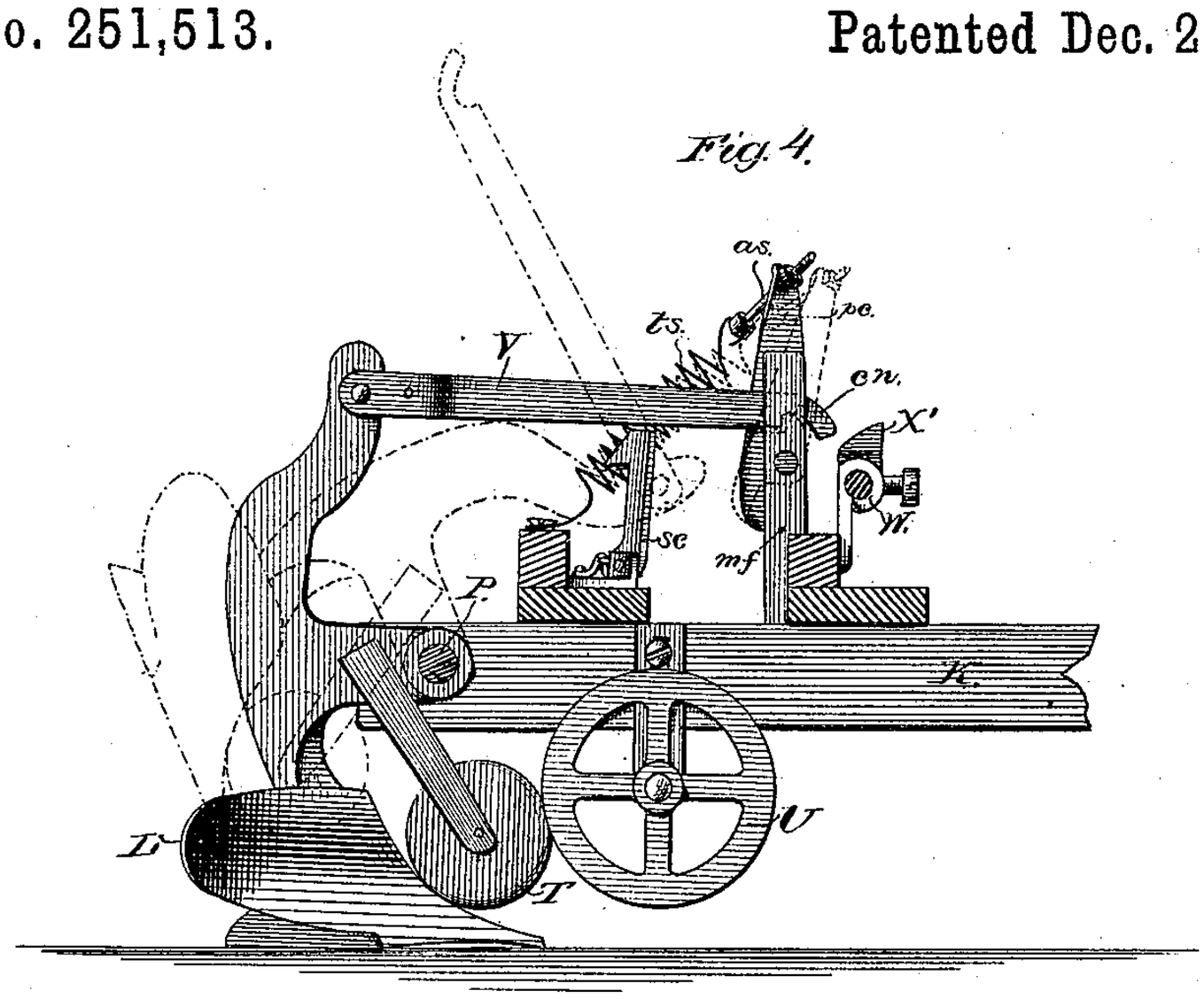
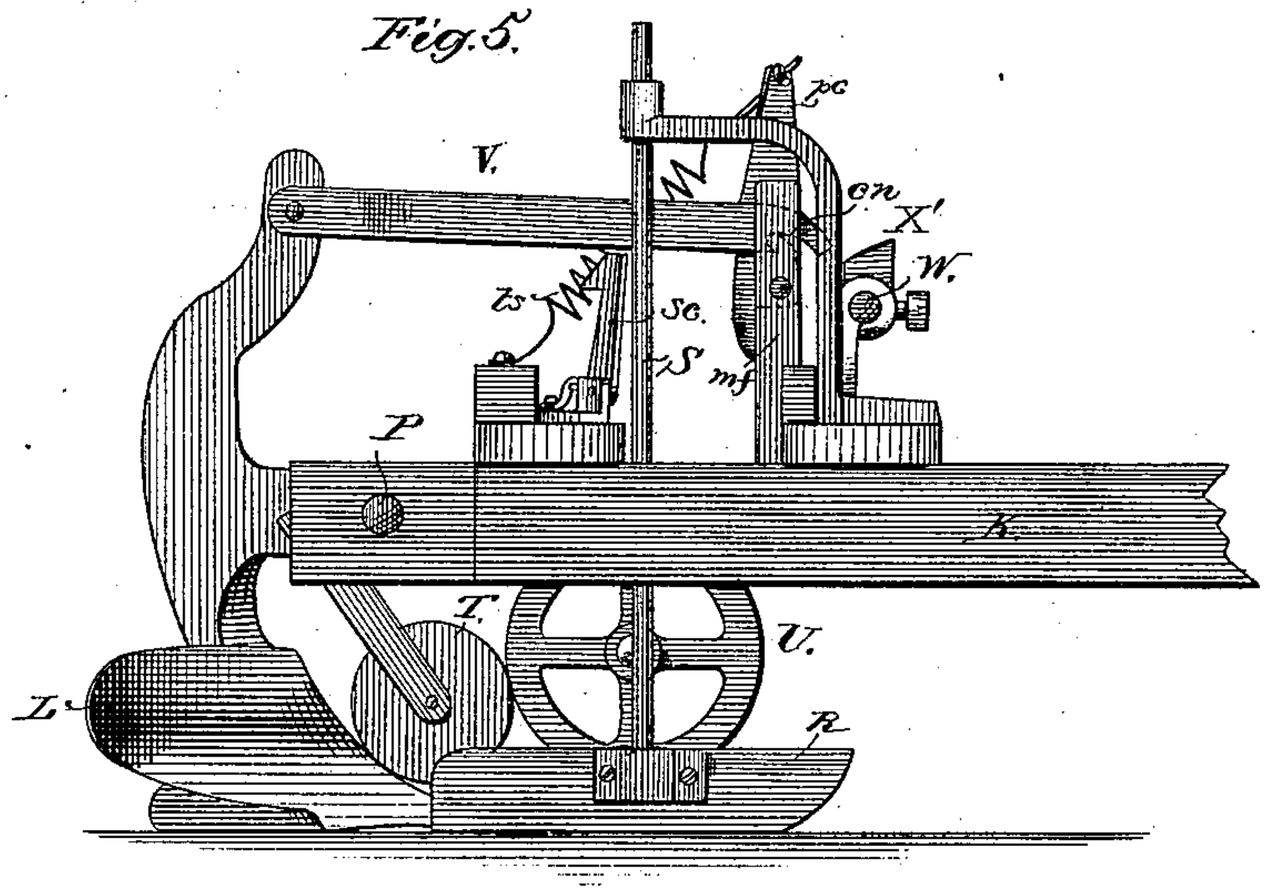


Fig. 5.



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(No Model.)

6 Sheets—Sheet 5.

B. S. BENSON

STEAM PLOW.

No. 251,513.

Patented Dec. 27, 1881.

Fig. 6.

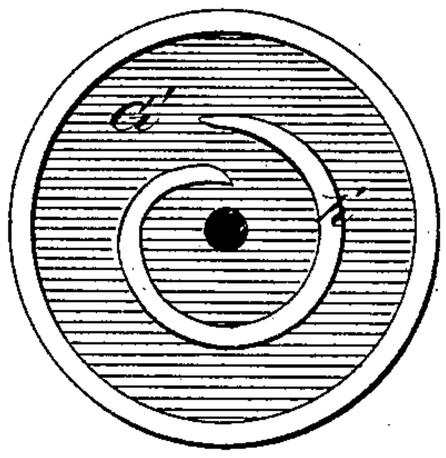


Fig. 7.

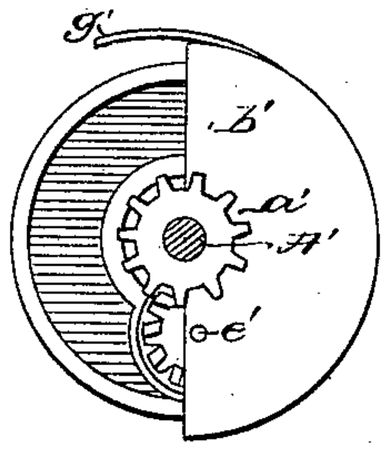


Fig. 8.

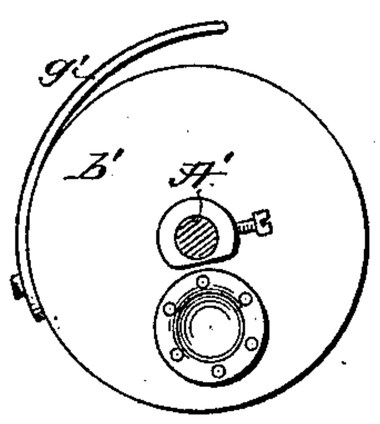


Fig. 9.

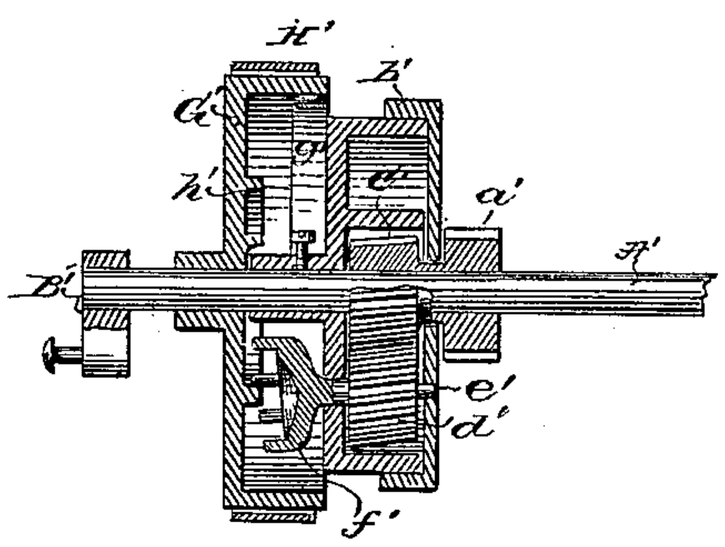


Fig. 10.

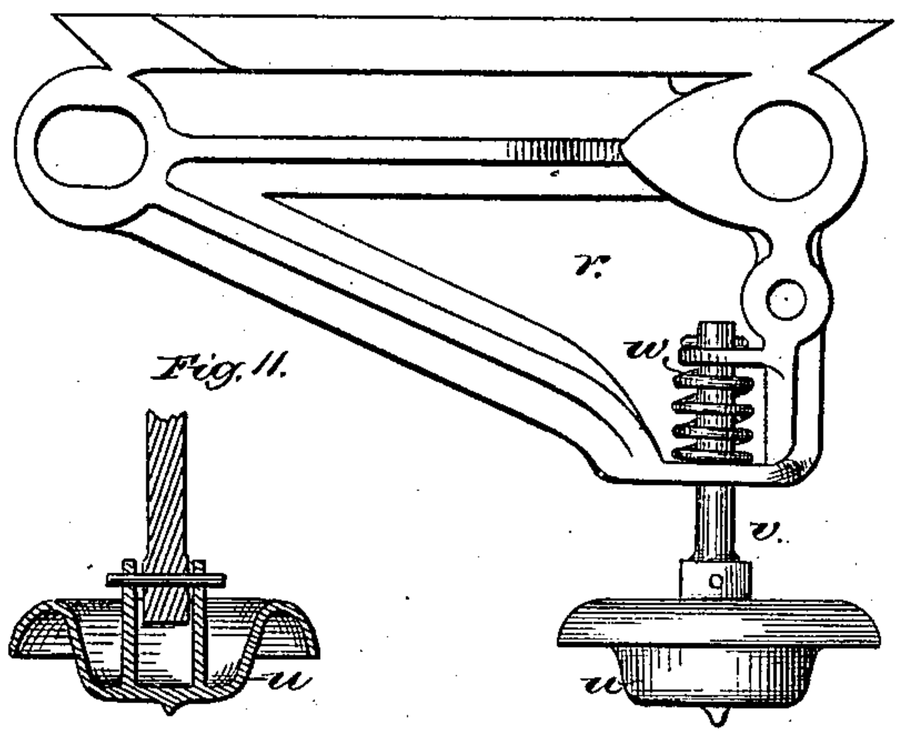


Fig. 11.

Fig. 12.

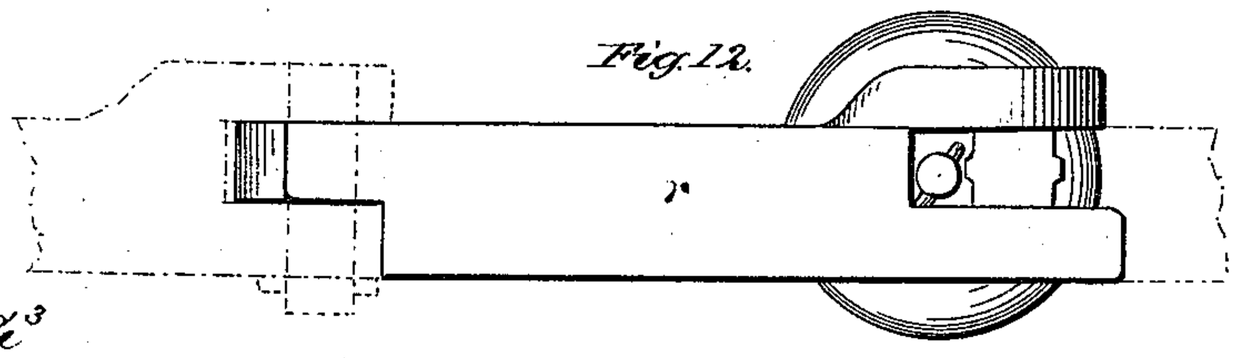


Fig. 13.

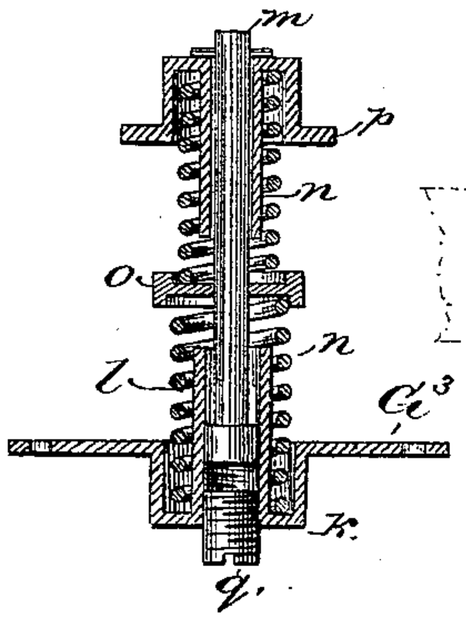


Fig. 14.

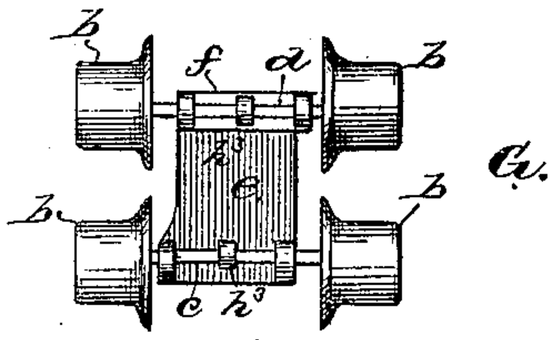
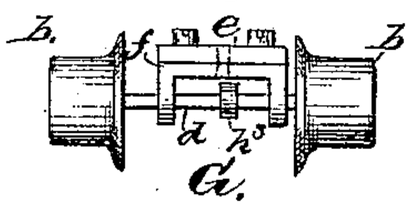


Fig. 15.



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ATTORNEYS.

(No Model.) 6 Sheets—Sheet 6.

B. S. BENSON.

STEAM PLOW.

No. 251,513. Patented Dec. 27, 1881.

Fig. 16.

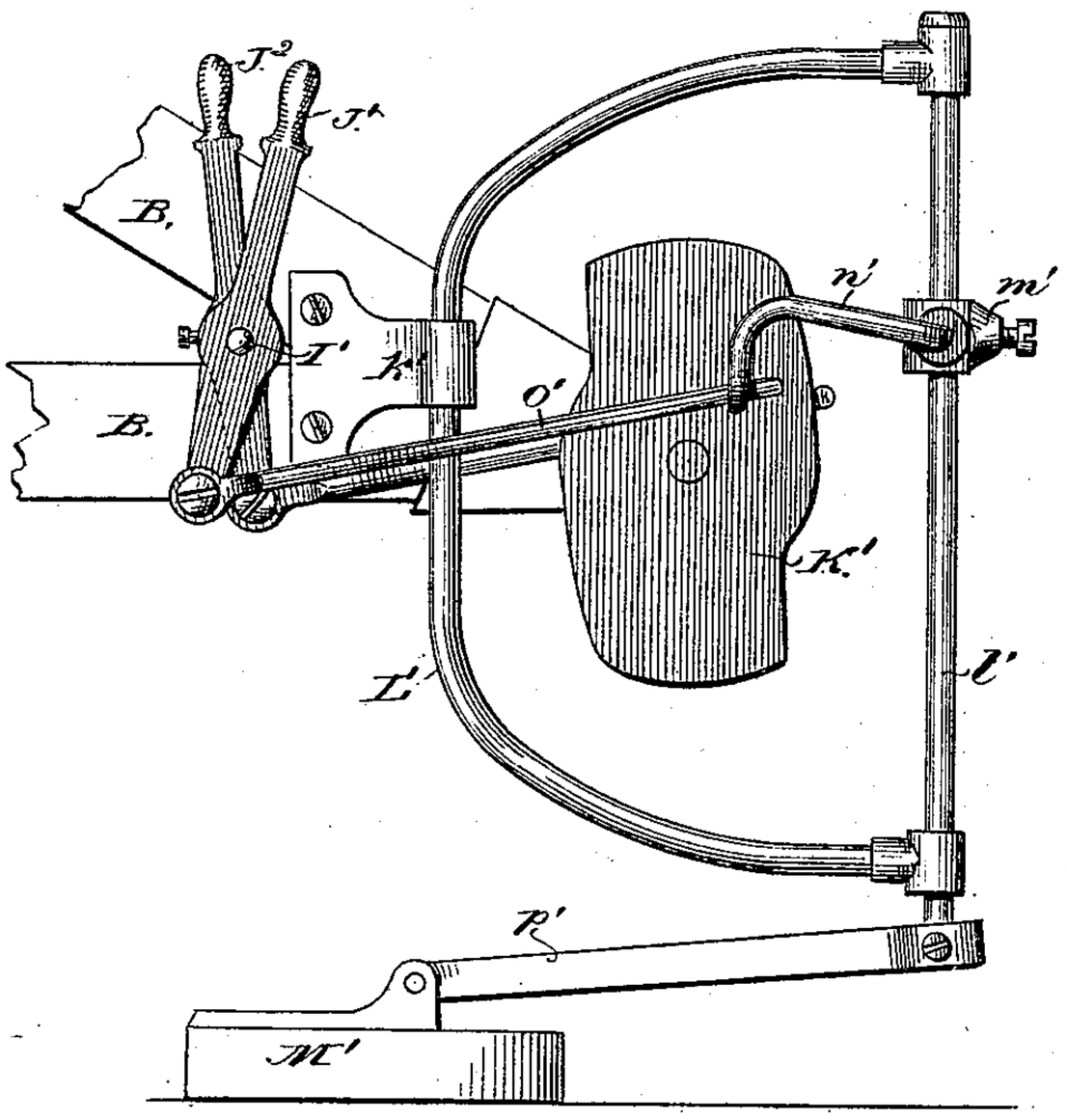


Fig. 17.

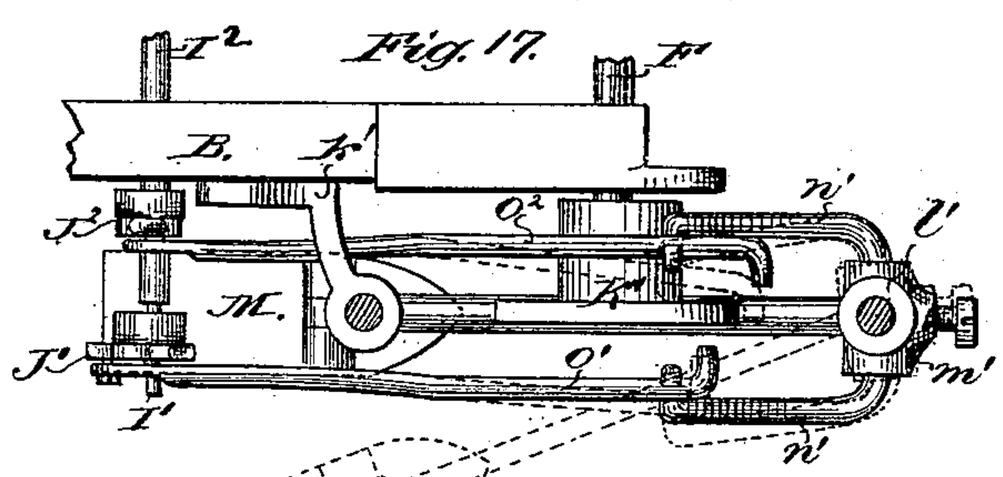
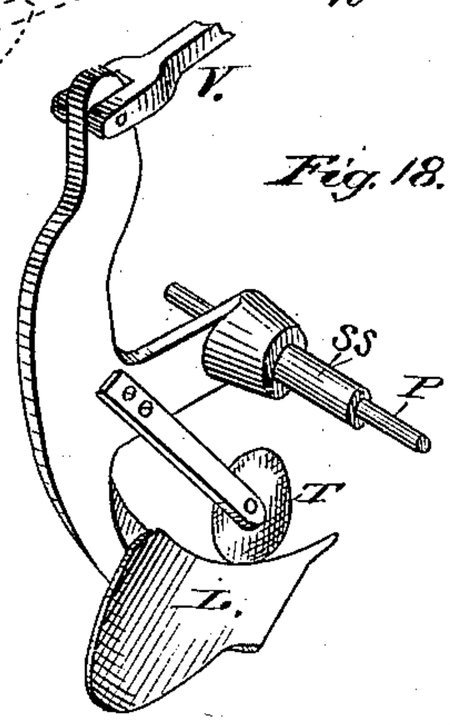


Fig. 18.



WITNESSES:

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INVENTOR:

B. S. Benson

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ATTORNEYS.

UNITED STATES PATENT OFFICE.

BENJAMIN S. BENSON, OF BALTIMORE, MARYLAND.

STEAM-PLOW.

SPECIFICATION forming part of Letters Patent No. 251,513, dated December 27, 1881.

Application filed March 3, 1880. Renewed October 21, 1881. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN S. BENSON, of Baltimore city, State of Maryland, have invented a new and Improved Steam-Plow; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a side elevation, with parts of the main frame and plow-frame broken away. Fig. 2 is a plan view, with the traction-chains removed to avoid complicating the view. Fig. 3 is a vertical transverse section of the traction devices, the section being taken about the center of the boiler. Fig. 4 is an enlarged detail side view of the plow-tripping devices, showing in dotted lines the position of the plow when thrown out of the ground. Fig. 5 is a similar view of the same devices, showing the same devices, with the addition of the runner for preventing the lateral thrust in the gang of plows. Fig. 6 is an inside view of the large cup-shaped disk shown in Fig 9. Fig. 7 is a half external and half internal side view of the hub or smaller casing shown in Fig. 9. Fig. 8 is a view from the opposite side of the same device. Fig. 9 is a sectional view of the gear for producing a differential movement in the two traction-chains, the gears being shown in proper relative position in Fig. 2. Figs. 10 and 12 are respectively a side and top view of one of the links of the traction-chain. Fig. 11 is a sectional detail of the presser-foot. Fig. 13 is a sectional detail of the devices for connecting the main frame with the trucks, the said parts being shown in proper relative position in Fig. 1. Figs. 14 and 15 are respectively an underneath and end view of one of the trucks. Figs. 16 and 17 are respectively a side and plan view of the devices for automatically starting the action of the differential gear, the relation of the parts being shown in Fig. 2. Fig. 18 is a detail in perspective of the plow and its appendages.

My invention relates to certain improvements in steam-plows of the same general character as that patented by me July 15, 1879, in which two endless-chain tracks carrying presser-feet are arranged to pass around sprocket-wheels at the ends of the machine on each side, and upon which tracks the machine is drawn forward by steam-driven gears, as said tracks are laid down with their presser-feet resting upon the ground.

The main objects of my improvements are to secure such a traction in the endless-chain tracks as will not interfere with the proper picking up of the same by the sprocket-wheels; to secure a perfectly flexible and uniform bearing upon uneven ground; to provide a differential movement in the two chain tracks, such as may be made available either for turning the machine or automatically guiding the same in a straight line.

The principal features of improvement consist in arranging the chain tracks around three sprocket-wheels disposed in triangular relation and connecting the driving mechanism directly with the sprocket-wheel at the apex of the triangle; in the peculiar construction and arrangement of trucks interposed between the flexible track and the carrying-frame; in a peculiar differential gear and guiding mechanism for automatically controlling the same, whereby one of the systems of two tracks may be slowed up or made to lose a part of its movement for turning and guiding the machine.

In addition to these general features of improvement, my invention covers an improved construction of the chain tracks; means for connecting the two sets of tracks for lateral adjustability; means for connecting the trucks on the opposite sides of the machine, to prevent such spreading or variation in the distance between the tracks as would interfere with the proper picking up of the same by the registering-notches of the sprocket-wheels; a peculiar construction and arrangement of the plows and their attachments, together with other subsidiary features, as hereinafter more fully described, and pointed out in the claims.

In the drawings, (see Figs. 1, 2, and 3,) A represents the boiler and engine, upon each side of which is arranged a pair of vertical triangular frames, B B B B, to which the boiler and its attachments are firmly connected by a plate, X, at the top and another one, Y, at the bottom, and by which frame the boiler is supported. These pairs of triangular frames on opposite sides of the boiler are connected and stayed by subjacent cross-beams C C near the front and rear ends of the machine.

Between the two sections B B of each pair of these triangular frames are arranged three sprocket-wheels, D D D, which are fixed on shafts journaled in the three angles of the frame, and around which there is disposed the endless tracks E E, one upon each side of the boiler. The weight of the boiler then rests upon the triangular frames, and is thence transmitted through trucks (hereinafter described) to the endless tracks. Now, I have found that if the driving-gears be connected with the rear sprocket-wheels the constant strain which is put upon these wheels will not allow said wheels to automatically shift laterally so as to pick up the track nicely, for it will be seen that when the track is laid down in front, if it be on an incline or slight knoll, even the track will naturally gravitate to the lowest side, and then, when the weight comes upon it, it cannot readjust itself, and when it reaches the rear sprocket-wheel its parts do not register with the notches of the sprocket-wheels unless the sprocket-wheels be free to adjust themselves laterally to this variation in the position of the tracks; and if the driving-gear be connected with the rear sprocket-wheels it is obvious that they will be more rigid and will not register with and pick up the track. If, on the other hand, the driving mechanism be connected to the front sprocket-wheels, the slack will then be thrown in that portion of the track which is sustaining the weight of the machine, and the track will therefore become distorted and inoperative. In overcoming all of these objections I place a third sprocket-wheel between the two end ones and above the same, in triangular relation thereto, and connect the driving-gears directly with them, which arrangement allows the rear sprocket-wheels to have a lateral swing, as shown in dotted lines in Fig. 2, in adjusting themselves to the lateral variations of the track, and thus pick up the same, and it keeps also the section of the track which bears the weight always under tension and free from slack.

Another advantage of the triangular arrangement is that the frame made deepest in the middle gives two points of attachment for the boiler—an upper and a lower one—which strongly braces the same, and yet allows it to be readily removed.

In arranging the front and rear sprocket-wheels of the two systems of tracks the said front wheels are arranged on the same shaft, F, and the rear wheels on a corresponding shaft, F, which shafts have a free endwise movement in their bearings, giving, as before described, a lateral play to the said sprocket-wheels. As, however, the two systems of chains are designed, as hereinafter described, to have a differential movement, I have made these shafts in two sections, connected by a swivel at *a*.

For transmitting a uniform and flexible pressure from the main frames B B to the chain tracks, a peculiar construction and arrangement of trucks G is employed. These trucks are constructed, in a manner somewhat similar to an ordinary car-truck, with four wheels, *b*, (see Fig. 14,) arranged in pairs upon axles *c d*, one of which axles, *c*, is journaled in bearings fixed to its platform-frame *e*, and the other of which axles, *d*, is journaled in movable bearings *f*, oscillating horizontally upon a center-bolt, which connects it with the platform. This oscillating character of one of the axles of the truck allows the wheels to follow any sway or lateral curve in the track without griping.

The wheels of the truck are flanged and arranged inside the tracks, as in Fig. 3, and the axles have in their bearings free endwise movement, limited by a hub, h^3, in the center. I arrange five of these trucks on each side of the machine and couple the end ones in pairs, while the middle one stands alone, and is coupled to the two end sets on each side by links *g*. (See Fig. 1.) These trucks I connect with the main frame through elastic bearing-springs, the spring *h* of the middle truck being arranged about a rod, *i*, rising from the truck-platform, and between the said platform and a perforated cross-plate, *j*, connecting the main frames, through which plate the rod *i* freely passes.

For coupling the end trucks of each system and connecting them with the main frame B B, I employ the following construction: A bridge-piece or reach, G^3, is loosely bolted to the platforms of the two trucks, and is formed in its middle with an annular depression, *k*, (see Fig. 13,) and a cylinder, *l*, rising above the bridge-piece. Into this cylinder there passes the lower end of a rod, *m*, which at its upper end is fixed in a cross-plate, *p*, arranged, like *j*, to extend from one frame B to the other (see Fig. 3) across the width of one of the track-chains.

Around the rod *m* is arranged a spiral spring, *n*, made in sections, and whose sections are steadied by a button, *o*. This spring, at its lower end, rests in the annular depression *k*, and forces the trucks down with an elastic pressure, and at its upper end rests in an annular recess formed in the under side of cross-plate *p*. (See Figs. 1, 3, and 13.) It will thus be seen that the weight of the machine is transmitted through the tension of the springs to the trucks, the lower ends of the rods *m* being free to move up and down in the cylinder *l*.

The object in making the annular depression with cylinder *l* in the bridge G^3 and cross-plate *p* is to secure as great a length of spring with as short a rod, *m*, as possible, a considerable length of spring being desirable to accommodate the various movements incident to the travel of the machine, and a short rod being desirable to prevent too great leverage in lateral strains or thrusts. To limit or stop this springing action, I form the lower end of the cylinder *l* with a screw-thread, and into the same I screw the stop-screws *q*. (See Fig. 13.) These screws may be found useful to support a great weight on one side of the machine, or

one end of the same. To increase the tension of the springs, one of the sections may be taken out and a longer one put in its place.

By means of the construction of the trucks as thus described it will be seen that they have perfect freedom of motion in adapting themselves to the varying position of the track, thus causing the track to bear equally and uniformly on the ground, although it may have an uneven surface.

The endless tracks E E on opposite sides of the machine are formed as follows: Each track is composed of two parallel series of right-angled triangular links, *r*, Figs. 1 and 10, jointed upon hinge-rods *s*, Fig. 3, which are seized by the forks or notches of the sprocket-wheels. These links are braced and held apart by rods *t*, and at one end have a perforated tongue and at the other a perforated fork, (see Figs. 10 and 12,) so that the fork of one link fits about the tongue of the next, and in which position they are held by the passage of the hinge-rods *s* therethrough. The tops or inner faces of these links are flattened to form the track upon which the truck-wheels run, and said faces are at the ends of each tongue rabbeted laterally, so as to form lap-joints, that cause the truck-wheels to pass smoothly from one link to another.

The rail-tracks on top of the links are prevented from swaying sidewise by each end of the cross-bar passing through the ends of the links, which are widened out, and the holes fit closely to the cross-bar, which prevents the chain from swaying sidewise.

The tongue or preceding end of the link is formed with a slotted hole, (see Fig. 10,) which allows end-play, and is also so formed at the sides as to allow considerable lateral sway and allow free up-and-down motion. Another advantage of forked links when turning short is the freely sliding of the slotted link around the cross-bar, which occurs while one end of the link and its cross-bar is yet engaged on the sprocket-wheel. The fork prevents the tongue from being pinched between the sprocket-wheel and the end of the following links.

At the bottom portions or outer angles of the links are loosely-pivoted presser-feet *u*, made of a hat shape, so as to give room for the pivotal joint, to secure a better friction with the ground, and to hold in the hollow or rim portion any loose dirt that may adhere, so that it cannot fall off into the mechanism when inverted and passing over the same. Instead of this special form of presser-foot, I may, if desired, simply make them of boards and bolt them to the lower side of the tracks. Said presser-foot I may also connect to the link by a shouldered rod, *v*, and spring *w*, so as to make it yielding, as shown in Fig. 10. This will permit the feet to run over stones or projections without raising the joints of the track so high, and thus secures the easier passage of the trucks over the track.

The object in making the links in the shape of a right-angled triangle and connecting the presser-feet at one end and immediately below the joint is as follows: In the first place, the hypotenuse or inclined section acts, when the draft-strain is exerted, as a more direct brace; the point of support is brought beneath the joint, which is the weakest part of the track; and, furthermore, if a presser-foot should strike a stone or other obstruction, only one joint is thrown upwardly.

To prevent the tracks on the opposite sides of the machine from spreading apart, the flanges of the wheels of the trucks hold the tracks to their places, and the trucks upon opposite sides of the machine are themselves held together by four rods, H, Figs. 2 and 3, which rods are forked at their ends, and are loosely connected to the bolts that fasten the ends of the bridge-pieces G^3 to the twin trucks. As the presser-feet have more or less dirt adhering to them as they rise at the rear end of the machine and travel over the same in inverted position, I have placed at the rear ends of the frames B B stirrups or loops J, Figs. 1 and 2, containing brushes I, against which the feet bear just as they rise at the rear end of the machine. These brushes may be made to revolve, if found desirable.

K, Figs. 1, 2, 4, 5, to 18, is the plow-frame, which is composed of short parallel bars arranged longitudinally with the draft-line, and having a shaft, P, extending through the same at right angles to the draft-line, upon which shaft P the plows L are jointed. Extending forward from this frame is a converging triangular tongue, M, (see Fig. 2,) which passes between the tracks and two outside arms or sway-bars, N. This tongue and these arms are provided at their front ends with friction-rollers, which rest against the front side of a curved metal bar, Q, firmly fixed to the cross-beam C, and which constitutes the draft attachment for the gang of plows. This bar Q has its front side made in the form of a rail, against which the friction-pulleys of the plow-frame bear, and it is formed with a center curve, *z*, and two corresponding forward curves on each side, which center curve, *z*, and the outer ends of which side curves are struck with a radius from the center of the machine, so that the plow-frame oscillates from side to side in a circular curve about the center of the traction-engine, which secures the equal distribution of the draft-strain on all parts of the said engine.

In arranging the plows it will be seen that they extend straight across the frame at right angles to the line of draft. When so arranged the clearance between the plows is less than when the gang is arranged obliquely, and there is a greater tendency in the plows to thrust to the land side, and when so arranged a special provision is required to avoid this thrust. For this purpose a long horizontal blade or runner, R, (see Figs. 5 and 2,) is fixed to the lower end of a standard, S, Figs. 5 and 2, held in a suitable support, and is arranged slightly in ad-

vance of the plows in the preceding furrow, where by bearing against the land side of the furrow it tends to correct the difficulty.

In coupling and holding the plows stiffly on the shaft P the proper distance apart a short sleeve, *s s*, Figs. 18 and 2, is fixed upon a forward extension from the plow-standard, and is made to turn upon the shaft between the parallel longitudinal bars of the frame. To the forward extension of the plow-standard is also attached a rolling colter, T, which cuts the sod, while vertically-adjustable gage-wheels U support the plow-frame and regulate the depth of the plowing.

In connecting the plows I have found it desirable to have them so arranged that they may automatically yield to obstruction and be thrown out to prevent breakage, as when one of them strikes an embedded stone, a stump, or other obstruction; and for this purpose the upper ends of the standards are jointed to a push-bar, V, Figs. 4 and 5, whose forward end is provided with a curved notch, *c n*, that pushes against a forwardly-yielding pivoted catch, *p c*, arranged on the metal forks *m f*. These pivoted catches have a stop-extension below and an arm extending upwardly, which is attached to a tension-spring, *t s*, connected with the plow-frame, which spring holds the catch against the forward tendency of the push-bar, and the tension of which spring, in connection with the leverage of the upward extension from the pivoted catch, supplies the power for holding the push-bar back and the plow in the earth against the draft-strain. For adapting this tension to the varying resistance of different soil, an adjusting-screw, *a s*, Fig. 4, is made to regulate the tension of the spring. Now, with this arrangement, whenever an unusual resistance is opposed to one of the plows the push-bar V is thrown forward, tilting the catch *p c* against the tension of spring *t s*, and the curved notch in the push-bar being thrown out of the catch, the plow passes back and is thrown out of action. When the plow is thus thrown out the upper portion of its standard passes underneath the spring-catch *s c* and the plow is permanently held up, as in dotted lines in Fig. 4.

For throwing all of the plows out of the ground simultaneously, a transverse shaft, W, is arranged in bearings on the plow-frame, and is provided for each plow with a tappet, X′, which, when the shaft is rocked by its lever Y′, simultaneously lift the notched ends of the push-bars from these catches and allow all of the plows to be thrown up.

For raising the plow-frame bodily when the gang of plows is to be transported, a shaft, Z, is journaled in the main frame B B, and is provided with a crank and two winding-drums, around which passes a cord, which passes over pulleys arranged in davits or curved supports C S, and which cords at their other ends are connected with and pass around pulleys on the plow-frame.

For turning the machine, or for automatically correcting any deviation from a parallel line with the preceding furrows, I have devised a peculiar differential gear, which may be made to act upon the driving mechanism of either chain track to retard its movement, and which will now be described.

A′, Fig. 2, is a transverse shaft arranged in bearings in the frames B B, and carrying at its ends cranks B′, which connect with and derive motion from the piston-rods of the engines. (Not shown.) This shaft carries two peculiar gears, the pinions *a′* of which are connected with the shaft for positive revolution, and transmit the motion thereof to the gear-wheels C′, fixed on shafts D′, Figs. 1 and 2, and which shafts D′ also carry pinions E′, that engage with the gears of the sprocket-wheels at the apex of the triangular frames.

On the shaft A′ are placed, side by side, duplicate gears F′ F², (see Fig. 2,) one of which governs one of the chain tracks and the other of which governs the other. As both these gears are exactly alike, it will be sufficient to describe one of them. It consists (see Figs. 6, 7, 8, 9) of a hollow circular casing or hub, *b′*, which is rigidly fixed to the shaft A′. Centrally within this hub *b′* is arranged, in a pocket or inclosure, a spiral gear-wheel, *c′*, Fig. 9, which is connected to the pinion *a′* outside the hub by a hollow sleeve. Engaging with the spiral gear-wheel *c′* is another spiral gear-wheel, *d′*, fixed on a shaft, *e′*, arranged obliquely to the shaft A′, or out of parallel position therewith. Upon the end of this shaft *e′*, outside of the hub *b′*, is affixed a crown-wheel, *f′*, having open teeth.

Loosely turning on the shaft A′, but connected with the hub *b′* by a friction-spring, *g′*, is a cup-shaped or peripherally-flanged disk, G′, Figs. 6 and 9, whose hollow side is next to the hub and incloses or houses the crown-wheel. This cup-shaped disk has upon its inner face a spiral flange or worm, *h′*, which rests in between two of the teeth on the crown-wheel, one side of said crown-wheel being projected closer to the flanged disk than the other by reason of the oblique position of its shaft. Now, the pinion *a′*, it will be remembered, is the wheel through which motion is transmitted from shaft A′ to wheel C′ to drive the chain track on that side. It will be seen, then, that if the track on this side is to be "slowed up" to turn the machine around to that side the pinion *a′* must not act positively, but have a constantly loosing action. The devices just described accomplish this result in the following way: If the hollow disk be allowed to revolve with the hollow hub *b′* fixed on the drive-shaft, as it would do by reason of the tension-spring *g′*, the spiral flange *h′* would rest simply between the teeth of the crown-wheel without moving through them, and would lock the crown-wheel so it could not turn. The crown-wheel would, in turn, lock the spiral gears against independent axial movement, and these

would lock the drive-pinion a' against independent or loose movement on the shaft A'. The result, then, would be that the disk G', hub b', and pinion a' would all revolve together positively with the shaft A', and pinion a' would positively actuate wheel C', the same as if said pinion were keyed rigidly on the shaft. If, however, the cup-shaped disk be held stationary, as with one of the strap-brakes H' H^2, so that said disk cannot move, then as the hub b' revolves the crown-wheel will be carried over the spiral flange or worm h', and an independent movement will be transmitted to the crown-wheel and its shaft e', the spiral gear will be correspondingly actuated, and the pinion a', connected with the spiral gear, will have an independent revolution on the shaft A', which will cause pinion a' to travel slower than the shaft A' which carries it, and the track on that side will consequently be moved slower to cause a different movement in the two tracks, which turns the machine around.

By arranging the worm or spiral flange to throw the crown in the other direction the gear which effects the differential movement may be made to give an accelerated speed to one of the tracks instead of slowing it up.

In providing means for the manipulation of the straps and controlling through them the gears, as described, I connect one strap-brake, H', to a horizontal shaft, I', and the other, H^2, to a concentric hollow shaft, I^2, (see Fig. 2,) encompassing the first shaft. Both these shafts extend to one side of the machine, and are connected respectively with corresponding hand-levers J' J^2. (See Figs. 2, 16, and 17.) To automatically guide the machine through the agency of these differential gears, I extend the front sprocket-wheel shaft, F, outside of frame B B and place upon the end of the same a cam, K'. Around this cam is arranged a bent frame, L', Fig. 16, fixed at its rear side on a support, k', and carrying a straight vertical rod, l', which turns in bearings at the top and bottom of the frame, and upon which a cross-head, m', is fixed rigidly at any height by a set-screw. This cross-head has rigid arms n' n^2, which swing horizontally with the cross-head, and in which loosely rest draw-rods o' o^2, of which draw-rod o' is jointed in the rear to one hand-lever, J', and the other, o^2, to the other hand-lever, J^2. (See Figs. 16 and 17.) The forward ends of these draw-rods are bent inwardly, (see Fig. 17,) and may be alternately brought into range of the cam K' by the oscillation of the rod l' and the cross-head m', with its arms, so that when rod o' comes into range with the cam the cam pulls the lever J', and when rod o^2 comes into range of the cam said cam pulls the lever J^2. For automatically bringing these rods into engagement with the cam, according to the necessities of the case in correcting any crooked movement of the machine, I fix to the bottom of the oscillating rod l' a drag-bar, p', and to the rear of this I hinge a heavy foot or runner, M', which is designed to run in the preceding furrow. Now, if the machine swerves from this furrow the foot or runner turns the rod l', brings one or the other of the rods o' o^2 into engagement with the cam, and sets into action one of the differential gears to cause the track on one side to move faster or slower to correct the variation.

For mashing down weeds, cornstalks, and other obstructions which might become entangled with the working parts of the machine, I have provided a set of sectional rollers, N', Figs. 1 and 2, revolving upon an axis in a yoke or frame, P', loosely hung upon the diverging supports O', detachably fixed in sockets Q' in the main frame.

With respect to that portion of my invention which has reference to drawing the plows, I would state that I have constructed the same with special reference to a steam-plow; but it is obvious that it may be used generally as a traction-engine, without regard to this special use.

In utilizing the steam-power also for other purposes I may employ the same for thrashing grain or other purpose by keying a band-pulley, R', on the drive-shaft and disconnecting the gears of the traction-engine.

Having thus described my invention, what I claim as new is—

1. The combination, with a traction-chain having presser-feet for contact with the earth, of three sprocket-wheels arranged in triangular relation to each other, and mechanism for driving the traction-chain, connected directly with the upper sprocket-wheel to secure a better draft and the better picking up the track, as described.

2. The combination, with the two systems of traction-chains having presser-feet for contact with the earth and the triangularly-arranged sprocket-wheels, of a shaft, F, connecting the end sprocket-wheels and having free lateral movement, as described.

3. The combination, with the two systems of traction-chains and the sprocket-wheels carrying the same, of the sectional shafts F F, connecting the end sprocket-wheels, and having a swiveling connection, a, as and for the purpose described.

4. A traction-chain composed of links made in the form of right-angled triangles, with a rail or way formed on one side of the right angles, and with a presser-foot arranged at one end of said link and below the joints of the chain, for the purpose described.

5. The combination of a traction-chain having rails or ways on the upper surface of its links, a set of stationary trucks resting on said rails, and a set of spring-seated presser-feet connected to and supporting the traction-chain, substantially as described.

6. A traction-chain composed of hinge-rods and jointed links, having rails or ways on one side and presser-feet on the other, and having at their opposite ends tongues and forks, with elongated slots in the tongues, through which

the hinge-rods pass to render the chain flexible in lateral direction, as described.

7. The combination of a set of stationary trucks and a traction-chain composed of links having presser-feet on one side and rails or ways on the opposite side, shouldered or rabbeted so as to form lap-joints, as described.

8. A traction-chain having a jointed presser-foot made in hat shape, with a hollow crown and a curved rim, as and for the purpose described.

9. The combination of a traction-chain having a smooth track formed on its inner surface, a carrying-frame, and a set of wheeled trucks connected permanently with the carrying-frame and resting upon the smooth track or rail of the traction-chain, as and for the purpose described.

10. The combination, with the traction-chain having a smooth way or rail, and the carrying-frame B B, of a set of wheeled trucks connected flexibly together throughout the series, and having an elastic connection with the carrying-frame, as described.

11. The combination, with the double frame B B, having cross-plates *p*, of the endless traction-chain, the trucks resting thereupon and connected with the cross-plates by a vertical pin or rod, and an interposed spring, as and for the purpose described.

12. A truck composed of four wheels and two axles, and having one of its axles arranged in fixed bearings and the other arranged in bearings free to oscillate horizontally, in combination with the flexible traction-chain and the carrying-frame arranged to bear upon said trucks, as and for the purpose described.

13. The trucks having one axle arranged in fixed bearings and the other in horizontally-oscillating bearings, with both axles having a free endwise movement, in combination with the flexible traction-chain and carrying-frame, as and for the purpose described.

14. The combination, with the traction-chain and the carrying-frame, of two four-wheeled trucks and a loosely-coupling reach or bridge-piece, G^3, together with a spring and a sliding rod for connecting the bridge with the carrying-frame, as shown and described.

15. The bridge-piece G^3 and cross-plate *p*, formed with an annular recess, *k*, and cylinder *l*, in combination with a rod, *m*, and a spring, for the purpose of securing the greatest length of spring and the shortest rod, as herein described.

16. The bridge-piece G^3, having an annular depression, *k*, and a hollow cylinder, *l*, screw-threaded below, in combination with the slide-rod *m* and the stop-screw *q*, to act as a stop or render the trucks non-yielding, as set forth.

17. The spring *n*, made in sections, and separated by one or more steady-buttons, *o*, in combination with the bridge G^3, and cross-plate *p*, and the central rod, as and for the purpose set forth.

18. The combination of two traction-chains having feet to engage the ground and a set of trucks for each chain with one or more coupling-bars or cross-rods, H, substantially as and for the purpose described.

19. The metal bar Q, fixed to the frame of the engine, and having a forward center curve, *z*, and two forward side curves, in combination with the plow-frame K, having central tongue, M, and arms or sway-bars N N, both provided with friction-rollers, and adapted to bear against the bar Q and oscillate, as described, about the center of the engine.

20. The plow-frame having a shaft, P, at right angles to the line of draft, carrying a series of plows, arranged side by side and at right angles to the line of draft, in combination with a standard, S, carrying an elongated blade or runner, R, arranged to press against the land side of the preceding furrow to counteract the lateral thrust, as set forth.

21. The plows L, having elevated standards and forward extensions midway of said standards, provided with rigid sleeves *s s*, in combination with an axial shaft, P, parallel separating frame-bars, and push-bars V, by which the plows are held or rocked on said shaft, as described.

22. The combination, with the plows, hinged or jointed upon a horizontal shaft and having their standards extended above the said shaft, the push-bar V, having notch *c n*, and the hinged catch *p c*, having an arm or extension held by a spring to resist the normal draft-strain of the plow and allow the plow to be tripped by an unusual strain, as described.

23. The combination, with the hinged plows L and their push-bars V, of a continuous shaft, W, having a series of tappets, X′, for each plow, and means for rocking the shaft, whereby the tappets are made to trip the push-bars and throw all of the plows out simultaneously, as described.

24. The combination, with the traction-chain and independent driving-gears connecting respectively with each, of a differential gear, which is an element on one of the train of driving-gear, and is permanently connected to both the shaft from which it receives motion and the gear to which it transmits motion, whereby either an accelerated or a diminished speed is imparted to one of the traction-chains without variation in the speed of the main drive-shaft and without disconnection of the gears, as described.

25. The differential gear composed of the central shaft, A′, a hollow hub, *b′*, fixed to said shaft, the loose drive-pinion *a′*, and spiral gear-wheel *c′*, fixed on a sleeve encompassing the shaft A′, the shaft *e′*, carrying spiral gear-wheel *d′* and crown-wheel *f′*, the loose cup-shaped disk G′, having a spiral flange, *h′*, gearing with the crown-wheel, and a friction-brake or means for arresting the motion of the disk G′, substantially as and for the purpose described.

26. The combination, with the differential gears F′ F^2, constructed as described, of the

strap-brakes H′ H², the concentric shafts I′ I², and the hand-levers J′ J², substantially as and for the purpose described.

27. The combination, with the differential gears and mechanism for setting them in action, of a second train of mechanism for automatically operating them, consisting of a cam, K′, located on one of the shafts of the sprocket-wheels, a swinging frame or cross-head carrying draw-rods connected respectively with the two differential gears, and a drag-bar and block or runner adapted to run in the preceding furrow and operate the swinging frame to throw one or the other of the draw-rods into engagement with the cam to automatically start the action of the differential gears, as described.

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