(No Model.)

10 Sheets—Sheet 1.

M. M. HOOTON.

GRAIN BINDER.

No. 327,086.

Patented Sept. 29, 1885.

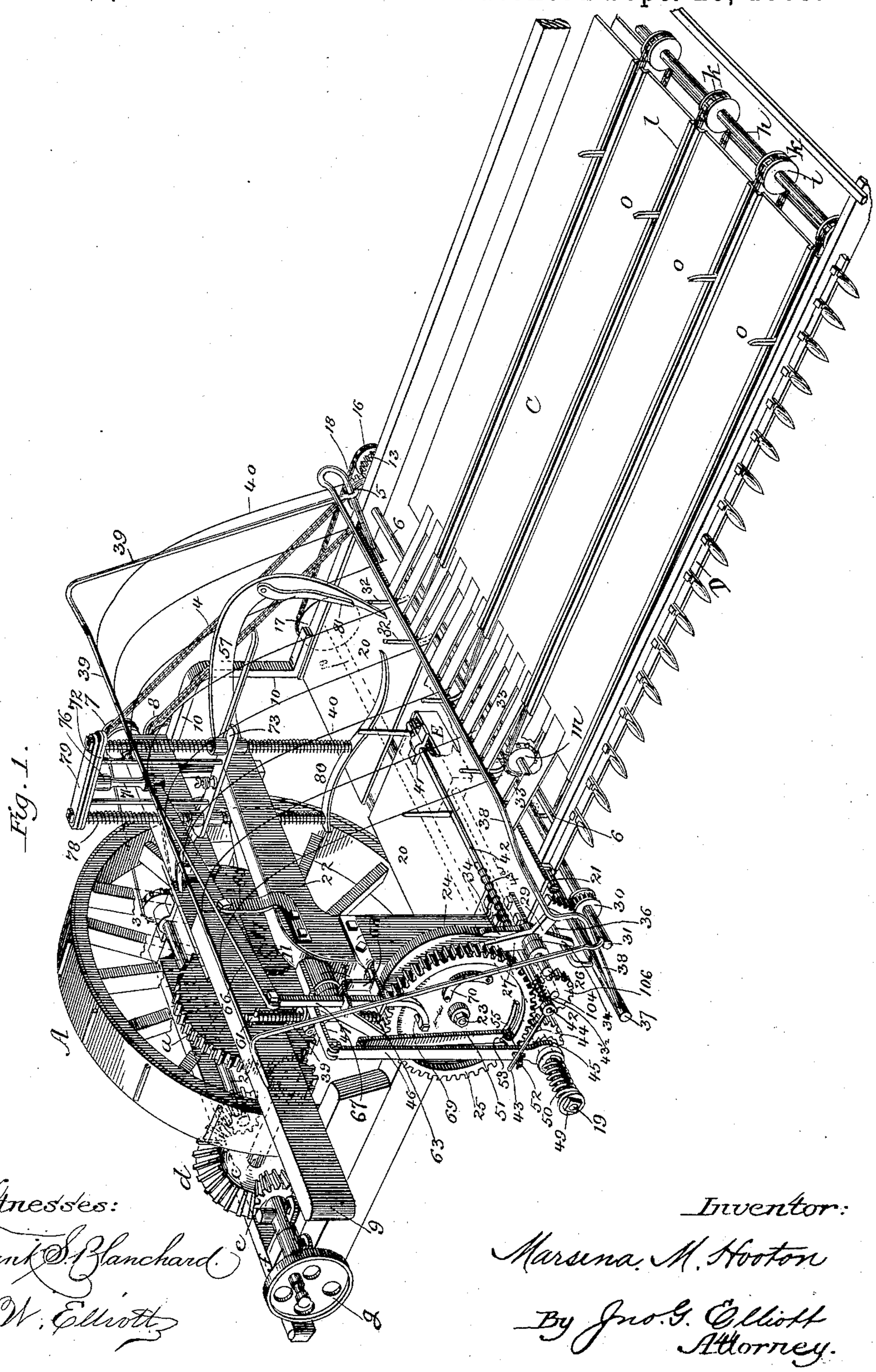

Fig. 1.

Witnesses:

Frank S. Blanchard.

W. W. Elliott.

Inventor:

Marsena M. Hooton

By Jno. G. Elliott

Attorney.

(No Model.) 10 Sheets—Sheet 2.

M. M. HOOTON.

GRAIN BINDER.

No. 327,086. Patented Sept. 29, 1885.

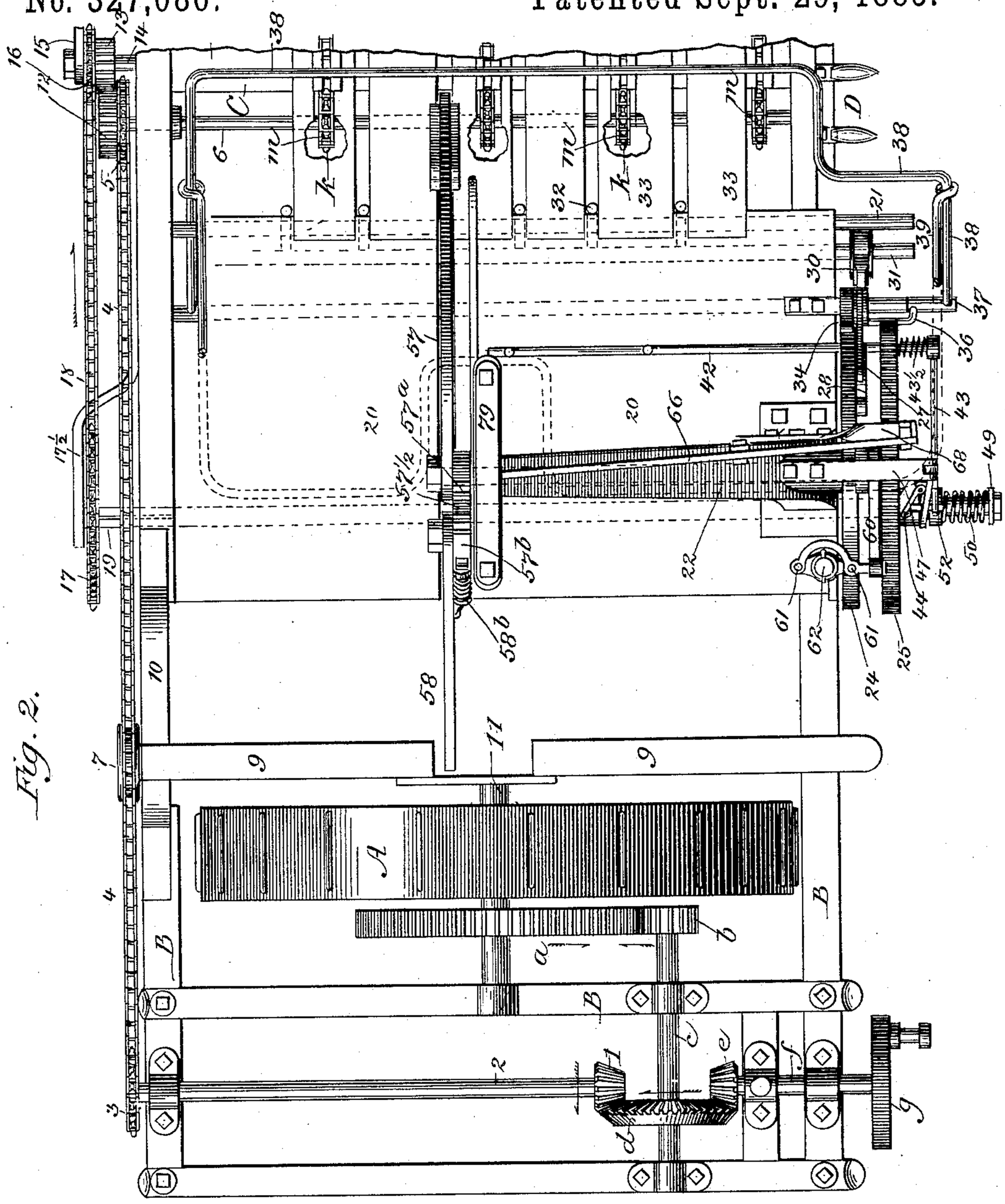

Fig. 2.

Witnesses:

Frank L. Blanchard.

W. W. Elliott.

Inventor:

Marsena M. Hooton.

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(No Model.)

10 Sheets—Sheet 3.

M. M. HOOTON.

GRAIN BINDER.

No. 327,086. Patented Sept. 29, 1885.

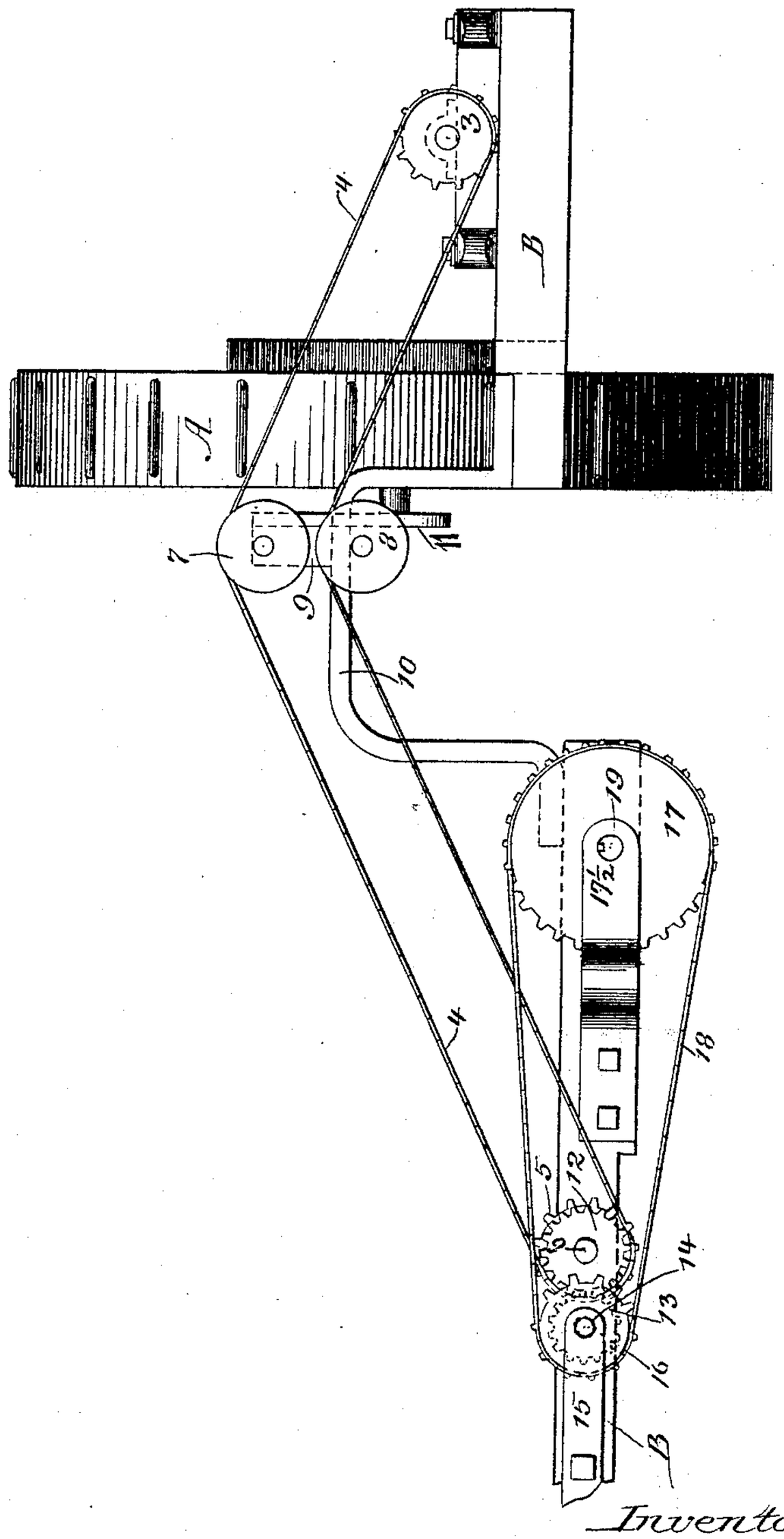

Fig. 3.

Witnesses:
Frank S. Blanchard.
W. W. Elliott

Inventor:
Marcena M. Hooton
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(No Model.) 10 Sheets—Sheet 4.

M. M. HOOTON.

GRAIN BINDER.

No. 327,086. Patented Sept. 29, 1885.

Fig. 4.

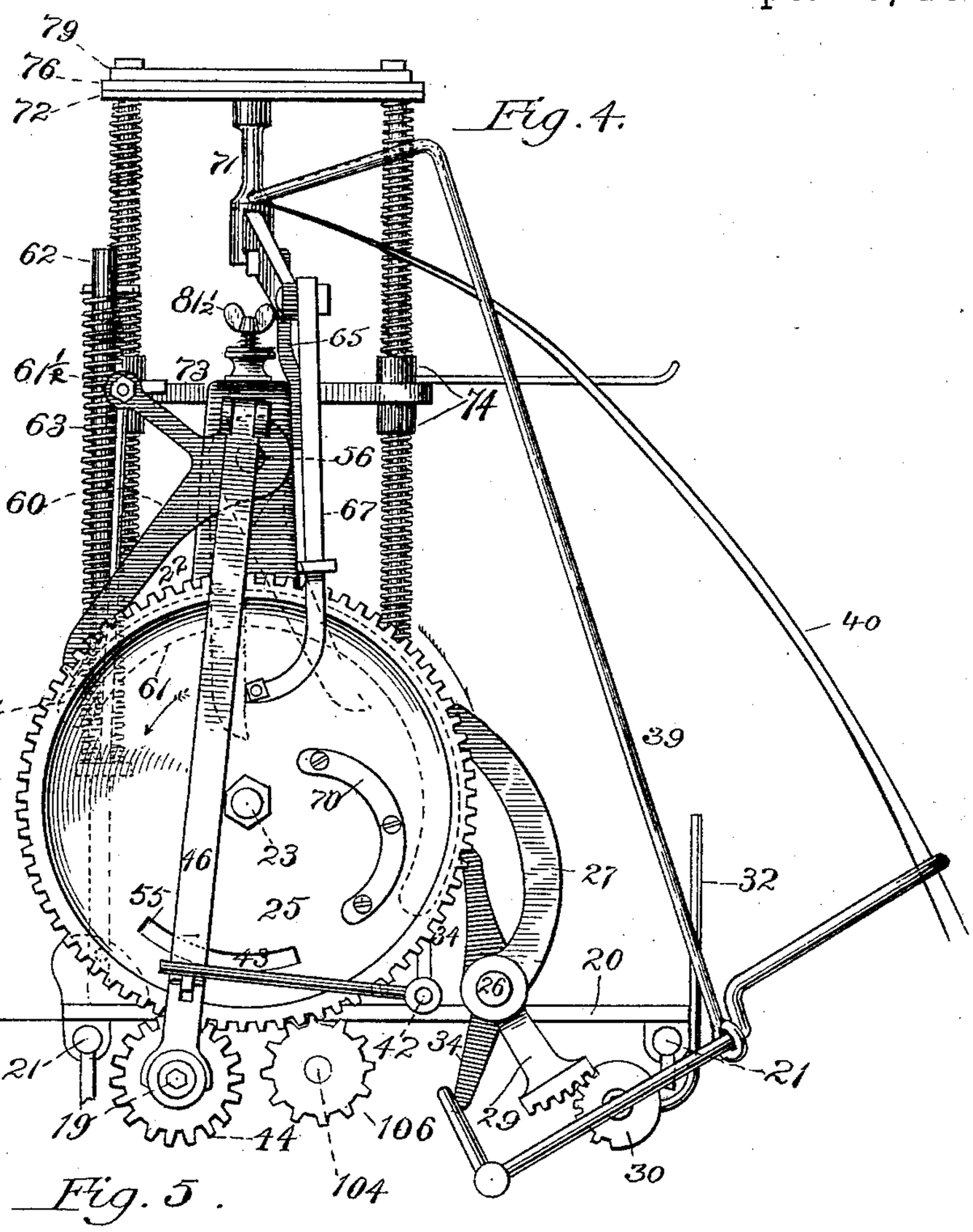
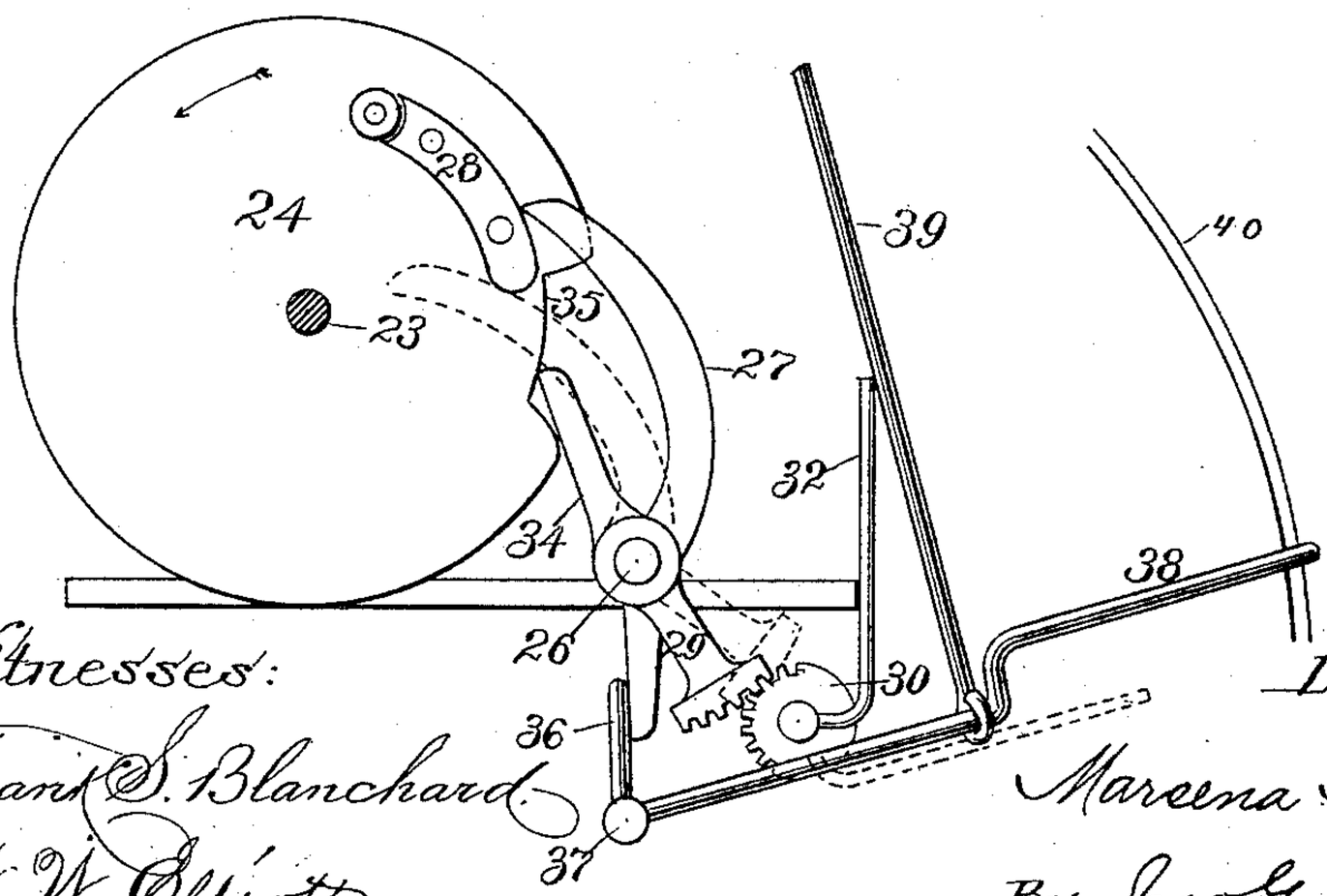


Fig. 5.



Witnesses:
Frank S. Blanchard.
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Inventor:
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Attorney.

(No Model.) 10 Sheets—Sheet 5.

M. M. HOOTON.

GRAIN BINDER.

No. 327,086. Patented Sept. 29, 1885.

Fig. 6.

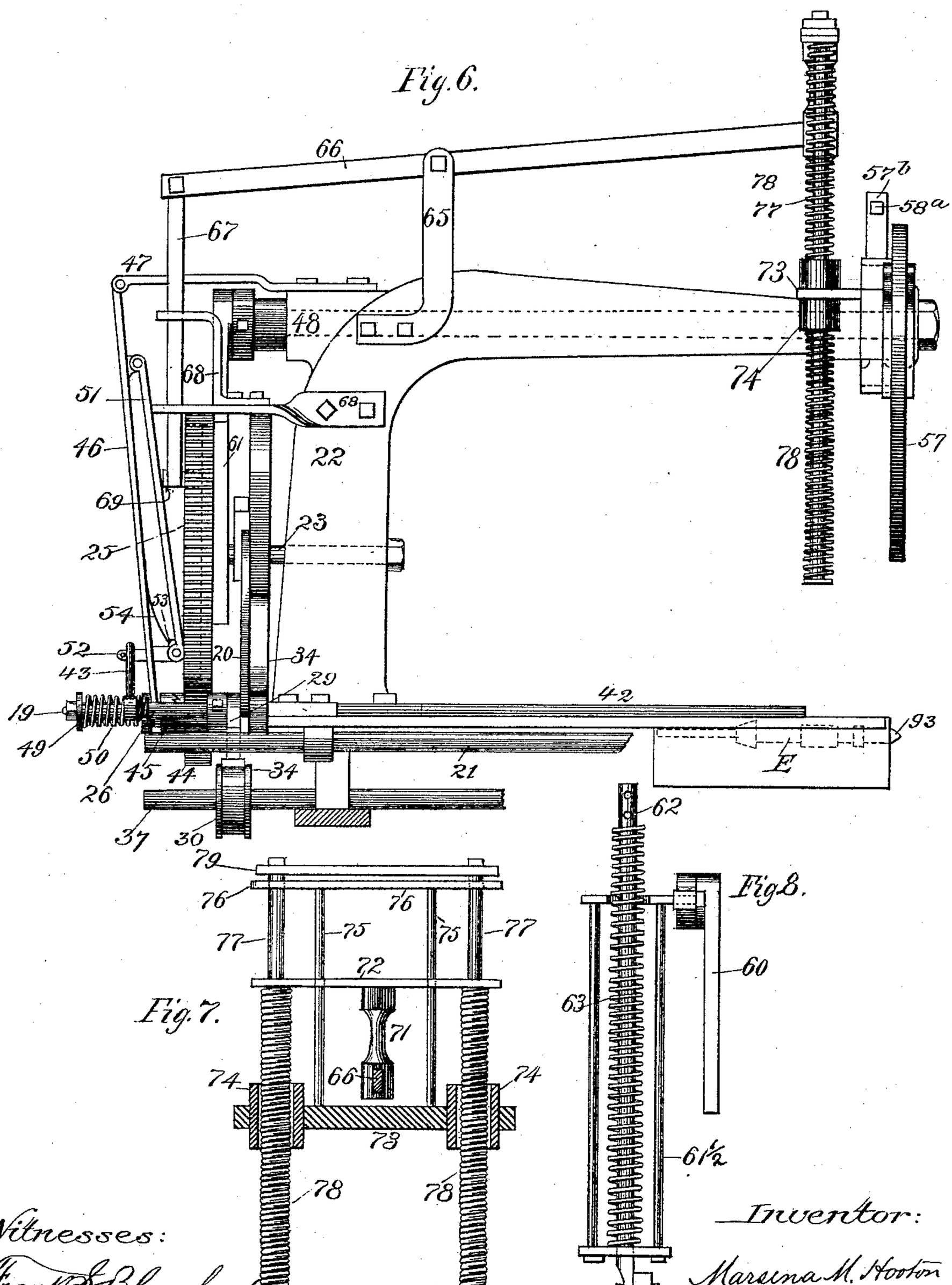

Fig. 7.

Fig. 8.

Witnesses:

Frank S. Blanchard

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Marena M. Hooton

By Jno. G. Elliott

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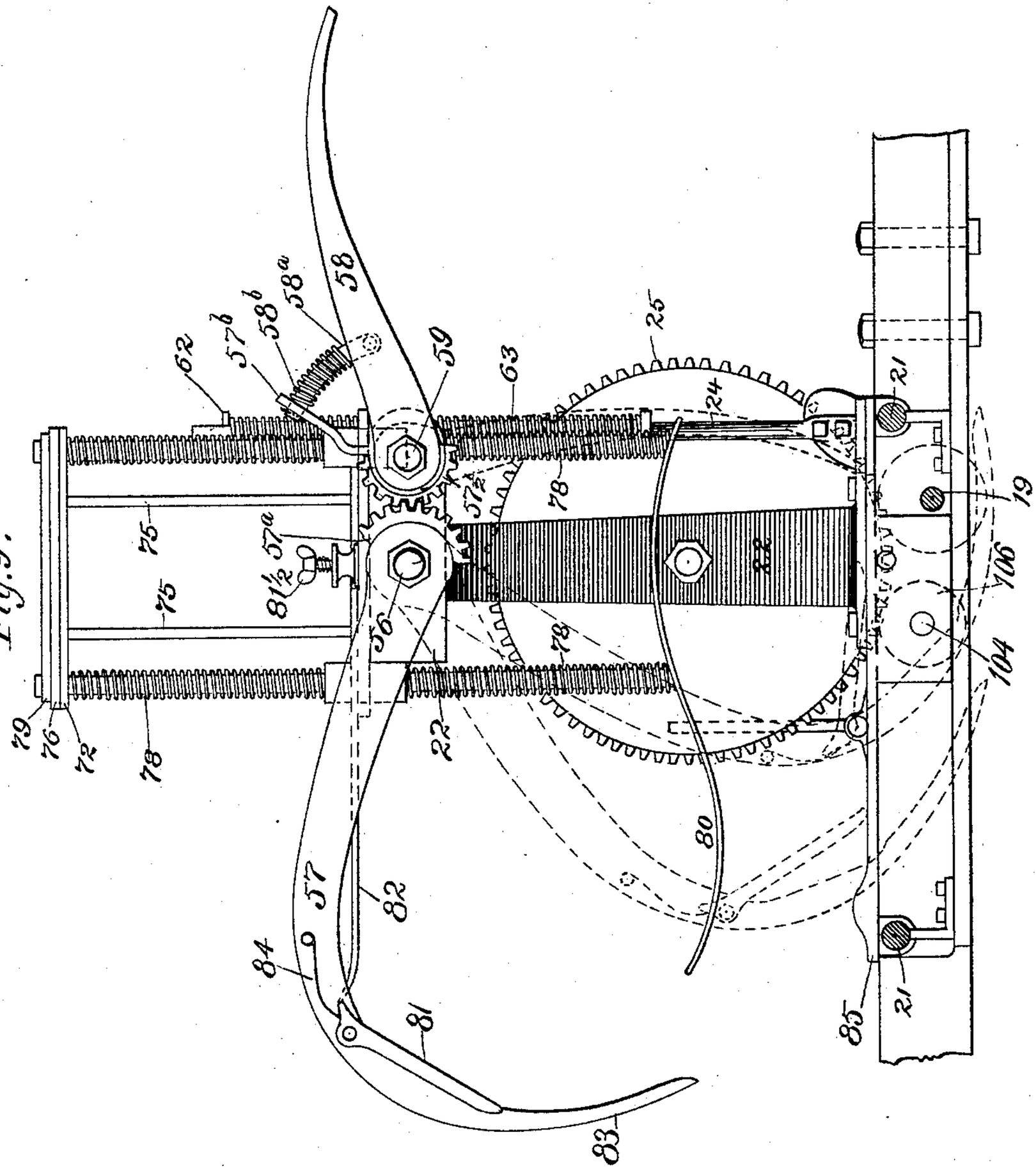
(No Model.) 10 Sheets—Sheet 6.

M. M. HOOTON.

GRAIN BINDER.

No. 327,086. Patented Sept. 29, 1885.

Fig. 9.



Witnesses:

Frank D. Blanchard.

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(No Model.)

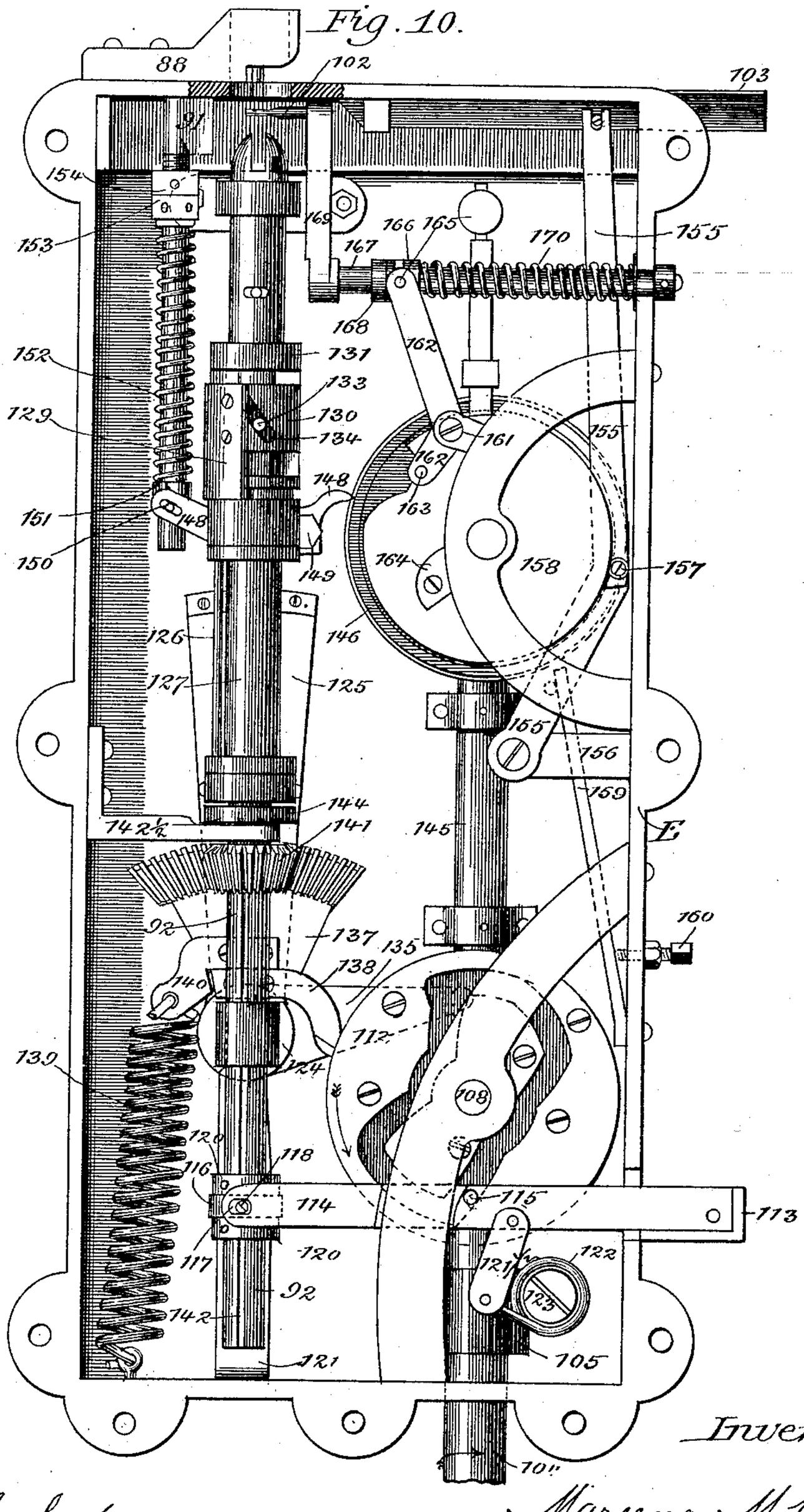
10 Sheets—Sheet 7.

M. M. HOOTON.

GRAIN BINDER.

No. 327,086. Patented Sept. 29, 1885.

Fig. 10.



Witnesses:

Frank S. Blanchard.

W. W. Elliott.

Inventor:

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Jno. G. Elliott

(No Model.) 10 Sheets—Sheet 8.

M. M. HOOTON.

GRAIN BINDER.

No. 327,086. Patented Sept. 29, 1885.

Fig. 11.

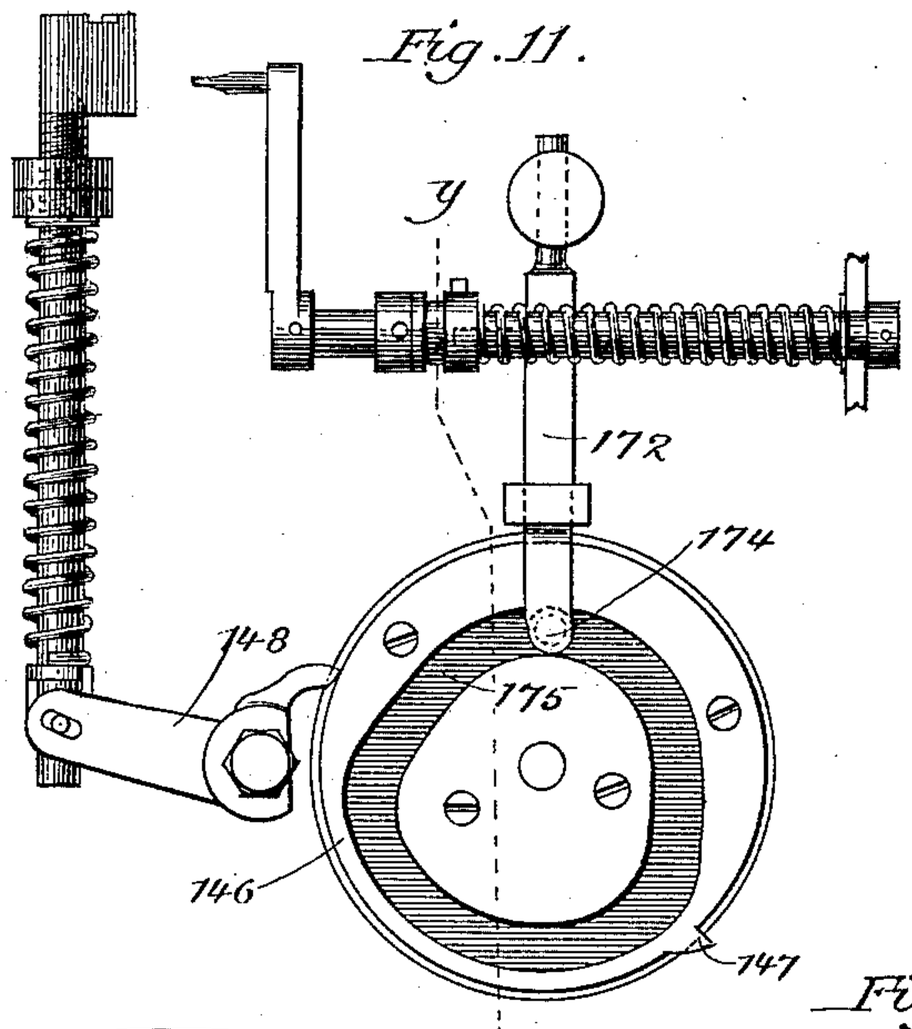

Fig. 12.

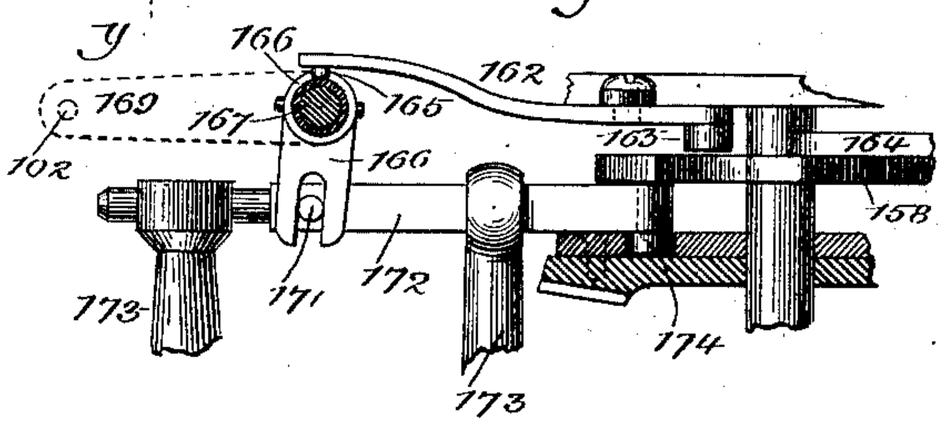

Fig. 13.

Witnesses:
Frank S. Blanchard.
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Inventor:
Marsena M. Hooton
By Jno. G. Elliott.
Attorney.

(No Model.) 10 Sheets—Sheet 9.

M. M. HOOTON.

GRAIN BINDER.

No. 327,086. Patented Sept. 29, 1885.

Fig. 14.

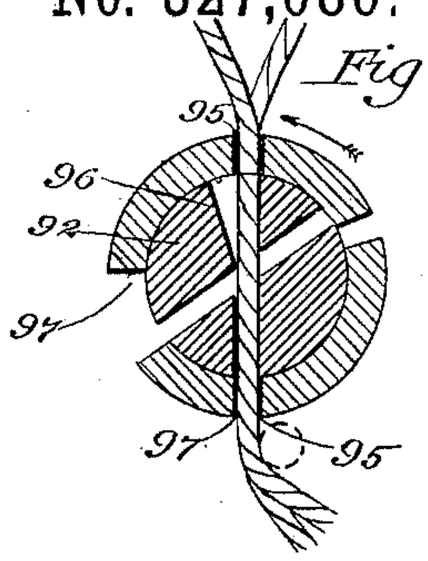


Fig. 15.

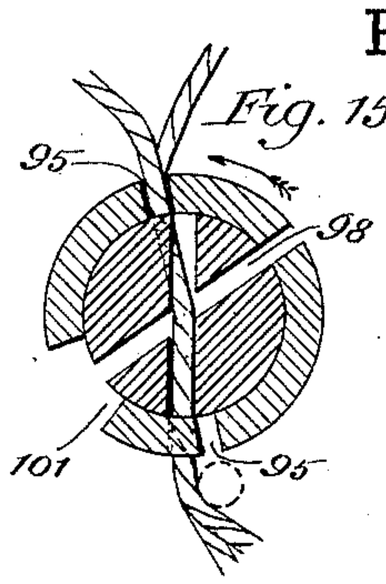


Fig. 16.

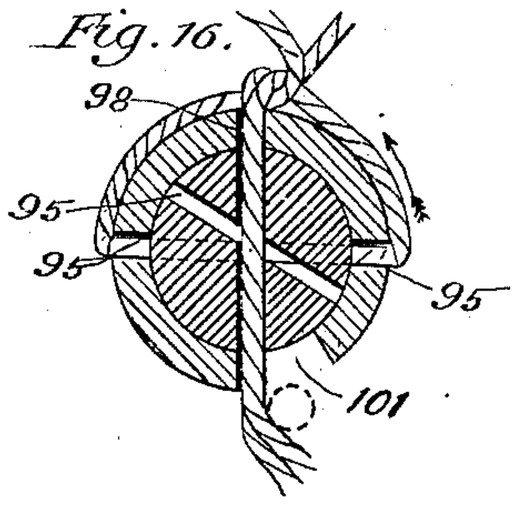


Fig. 17.

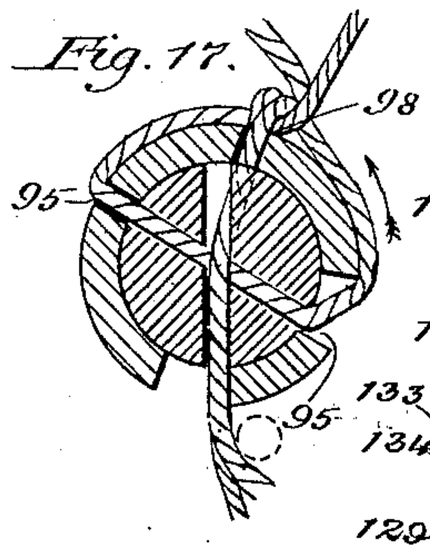


Fig. 18.

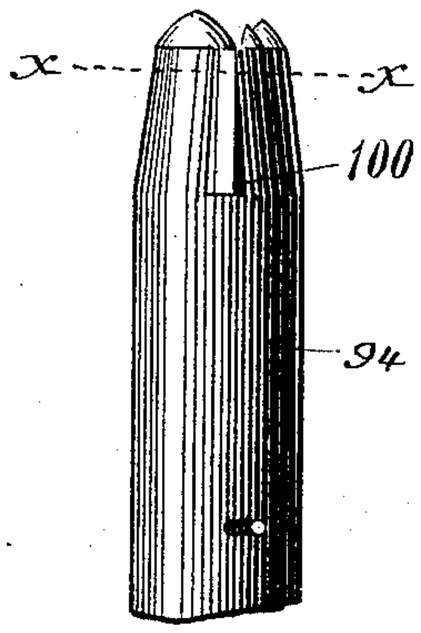


Fig. 19.

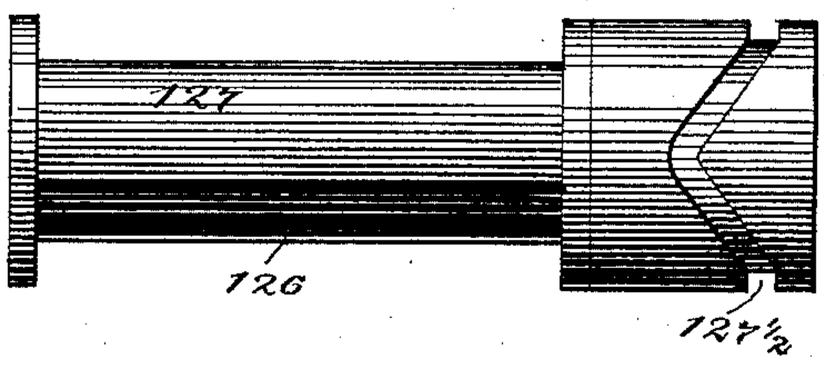
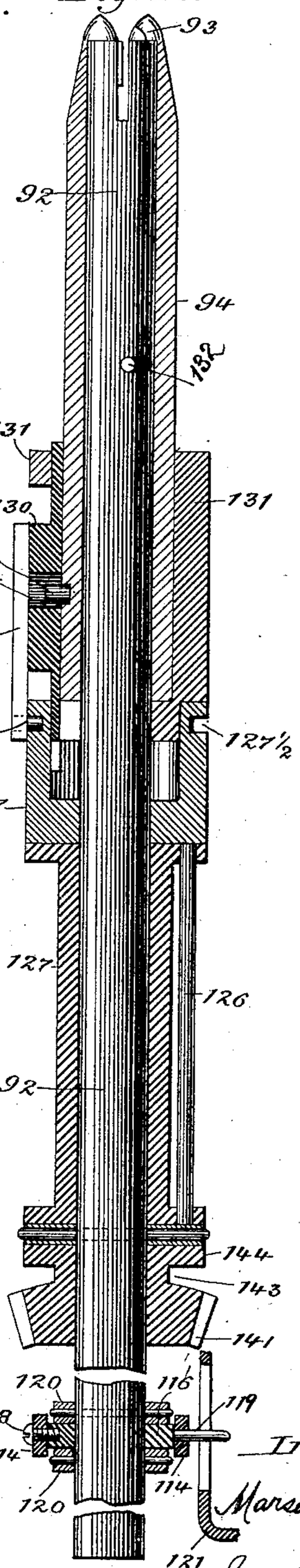


Fig. 20.



Witnesses:

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(No Model.) 10 Sheets—Sheet 10.

M. M. HOOTON.

GRAIN BINDER.

No. 327,086. Patented Sept. 29, 1885.

Fig. 21.

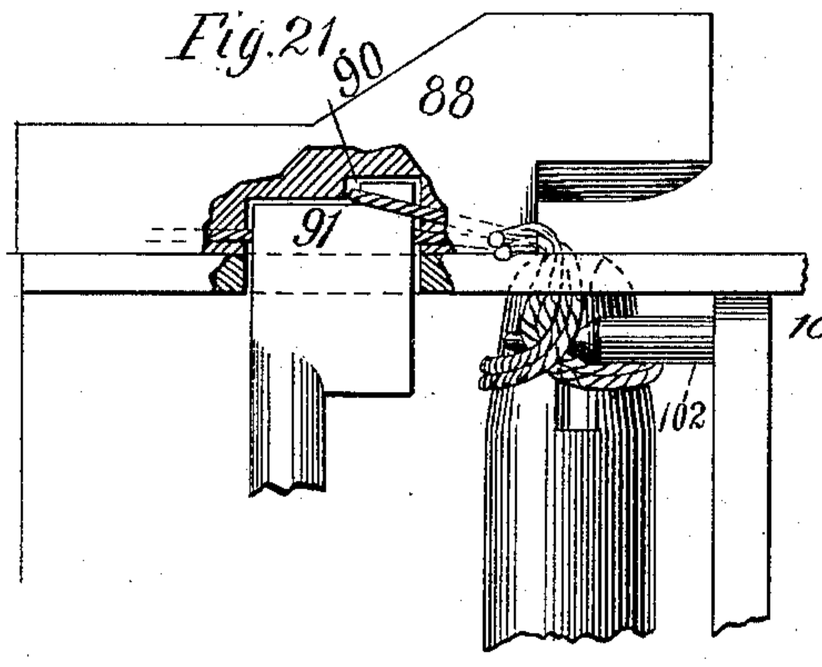
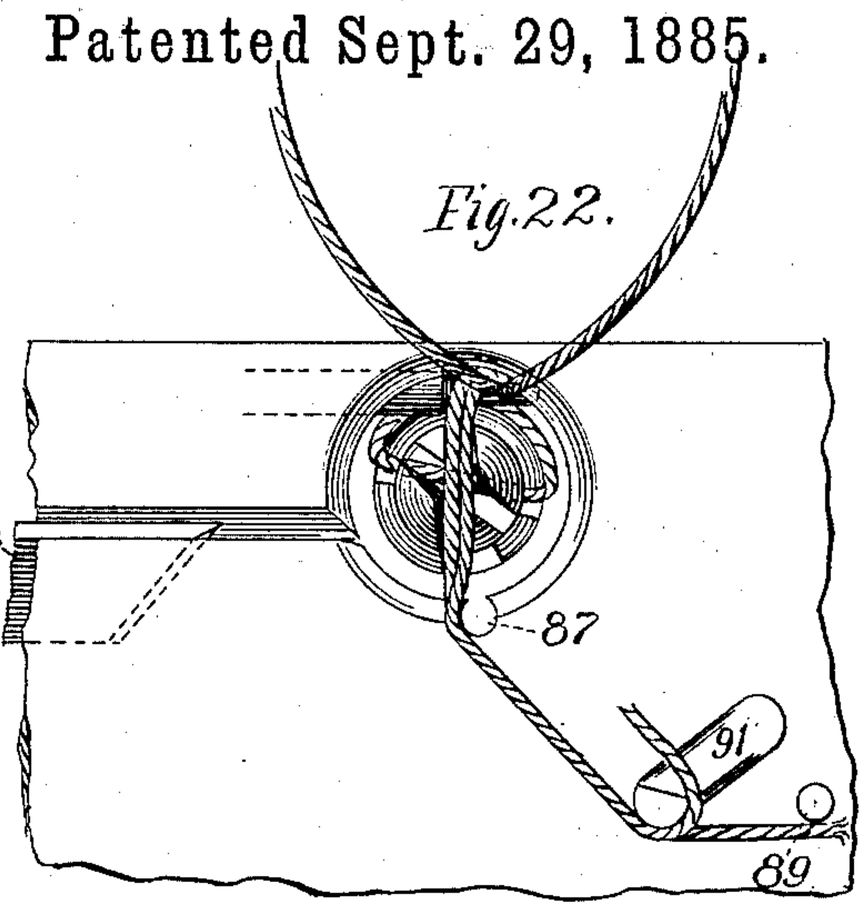


Fig. 22.



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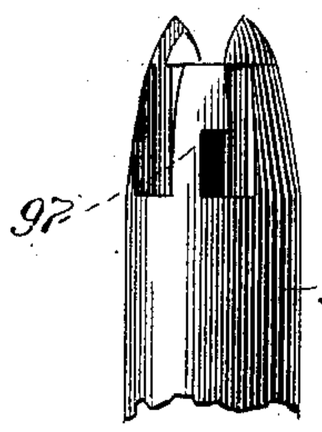


Fig. 30.

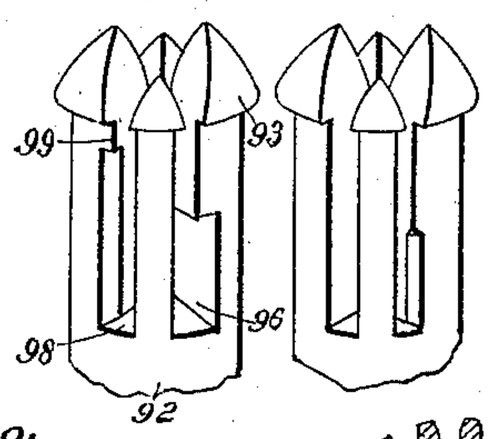


Fig. 31.

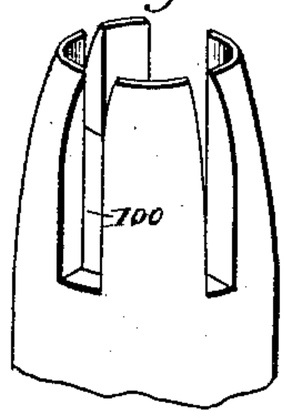


Fig. 25.

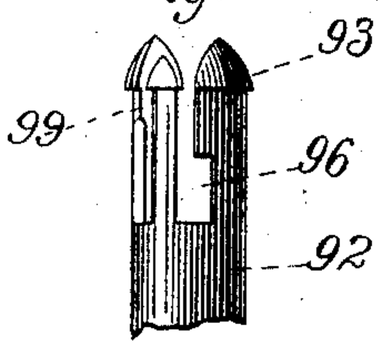


Fig. 24.

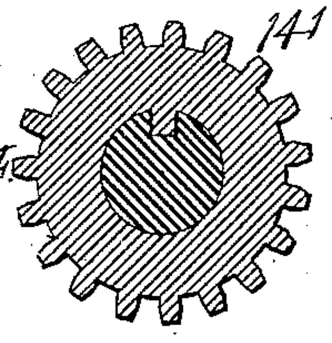


Fig. 32.

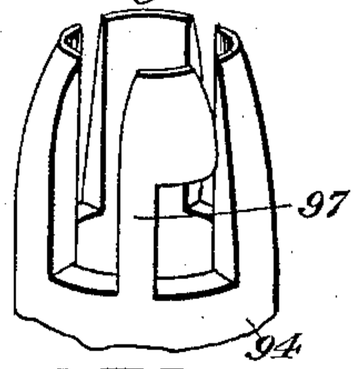


Fig. 26.

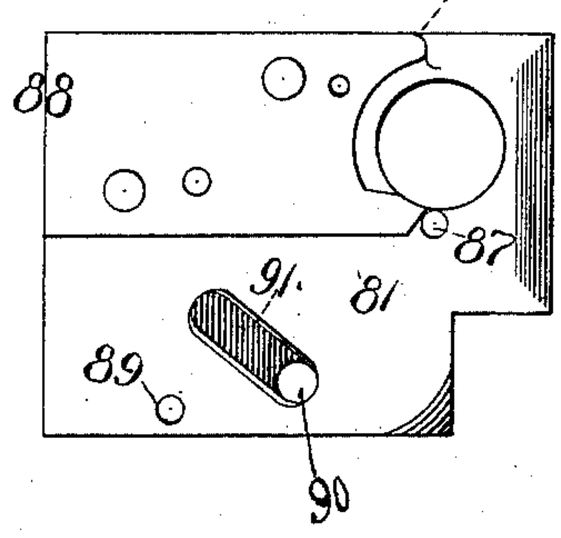
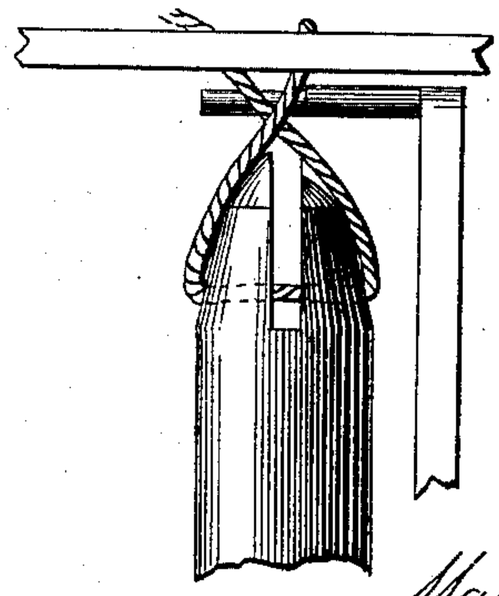


Fig. 28.



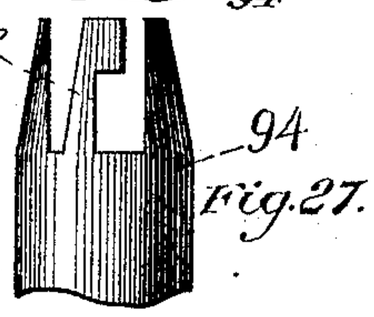


Fig. 27.

Witnesses:

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W. W. Elliott.

Inventor

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By Jno. G. Elliott

Attorney.

UNITED STATES PATENT OFFICE.

MARSENA M. HOOTON, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE OMEGA BINDER COMPANY, OF SAME PLACE.

GRAIN-BINDER.

SPECIFICATION forming part of Letters Patent No. 327,086, dated September 29, 1885.

Application filed November 10, 1882. (No model.)

To all whom it may concern:

Be it known that I, MARSENA M. HOOTON, a citizen of the United States, residing in Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Grain-Binders, of which the following is the specification.

This invention relates to improvements in grain-binders in which twine is employed to bind the sheaf, and the binding mechanism is upon the same side of the binder as the sickle-bar, and the binding-table, on substantially the same horizontal plane with the grain-receiving platform, or, generally, to that class of binders known as the "low-down."

The objects of this invention in general are to gather and bind the grain with the least possible expenditure of power and with the greatest possible rapidity, and in particular to straighten the grain during its passage from the grain-receiving platform to the binding-table; to size and divide the gavel from the grain on the grain-receiving platform before the gavel is shifted into the binder; to shift the gavel, when formed, into the binder, and at the same time separate the gavel while being bound from the grain being conducted from the grain-receiving platform toward the binding mechanism; to subject the gavel to a first compression as it enters the binder, and then to a second compression during the operation of the knotter, so as to slacken the band at a proper time for effectually preventing the knotter from breaking or fraying the twine; to release the bound sheaf from mechanical compression after the band is knotted, but before it is released from the knotter, so that the expanding of the sheaf will tighten the knot prior to the removal of the sheaf from the machine; to retain such a hold on the twine when once in the knotter that the lateral escape of the twine therefrom is rendered impossible until the knot is formed and tightened; and, finally, to provide certain details of construction hereinafter described. I attain these objects by devices illustrated in the accompanying drawings, in which—

Figure 1 is a perspective view of a machine embodying my invention; Fig. 2, a plan view of the same with a greater portion of the receiving-platform broken off; Fig. 3, a detail rear elevation of the same, showing the drive-chains and sprocket-wheels connecting the binding mechanism with the drive-wheel of the reaper. Fig. 4 is a detail front end view of the binding mechanism; Fig. 5, a front end elevation of the separating devices and mechanism for operating the same; Fig. 6, a side elevation of the binding mechanism shown in Figs. 1 and 4; Fig. 7, a front elevation of the mechanism employed to compress the bundles; Fig. 8, a side elevation of a spring-seated yoke operating the bifurcated lever engaging with the cam-face of the large gear-wheel of the binding mechanism to swing the lever and with it the binding-arm and its opposing compressing arm, so that said arms will be released from a bundle of grain and open to receive another. Fig. 9 is a rear elevation of the binding and compressing arms open to receive a bundle of grain, the position of the arms when closed upon the bundle being shown in dotted lines; Fig. 10, a plan view of the knotting mechanism; Fig. 11, a detail plan view of the under side of the forward cam of the looper device and the mechanism connected therewith for lifting the loop over and upon the looper and for operating the twine-holder, (shown in part at the left of the figure.) Fig. 12 is a sectional view of the line *y y*. Fig. 11, with the twine-holder removed; Fig. 13, a plan view of the rearward cam-face underneath, (shown in dotted lines,) and the vibrating segment-plate, which engages with the beveled pinion of the looper-shaft or with the swing-studded arm which engages with the looper shell or tube; Fig. 14, a cross-section of the slotted point of the looper on the line *x x* of Fig. 18, showing the relative position of the looper-shell and the inclosed stem or shaft in position to receive the twine; Fig. 15, a similar view showing the position of the twine after the shell is revolved to grasp the twine between it and the shaft preparatory to forming the loop; Fig. 16, a similar view showing the position of the twine in the shaft after both the shaft and shell have been simultaneously withdrawn and revolved a three-fourths turn and advanced to receive the twine a second time; Fig. 17, a similar view showing the position of the twine during withdrawal of the looper in its final operation and before

the loop of the twine is slipped over the point of the looper to complete the knot; Fig. 18, a side elevation of the looper, showing the point of the same without the twine when in the position shown in Fig. 17; Fig. 19, a side elevation of the combined revolving sleeve and cam upon the inclosing-sleeve of the looper, which sleeve is engaged upon the studded arm shown in Fig. 13; Fig. 20 is a longitudinal section of the devices surrounding and engaging the looper sleeve and shaft, the shaft being shown in full lines; Fig. 21, a plan view of the twine-guide, the looper, and the pin for lifting the loop formed by twisting the twine over and upon the point of the looper; Fig. 22, an end view of the looper in the position shown in Fig. 21, with the twine-guide removed, and showing the relative position of the cutting-knife and the twine-holder to the looper; Fig. 23, a side elevation of the point of the looper-shaft and shell, showing the slot in the latter, which slot is on the under side thereof when the shell is first revolved to close the looper on the twine; Fig. 24, a cross-section through the beveled pinion of the looper-shaft, showing the spline of the pinion engaging with a longitudinal groove of said shaft; Fig. 25, a detail side elevation of the looper-shaft with the looper-shell removed, showing the slot which is on the upper side of said shaft when the looper is in its first position to receive the twine, which slot, when the looper-shell is first revolved, serves with the slot in the shell to close both extremities of the eye of the looper upon the twine. Fig. 26 is a plan view of the inner face of the twine-guide. Fig. 27 is an end elevation of the looper-shell removed from the looper-shaft. Fig. 28 is a detail of the looper and lifting-finger, showing the position of the formed loop before it is lifted over upon the looper; Figs. 29 and 30, enlarged perspective views of the notched shaft; Figs. 31 and 32, similar views of the shell.

Similar letters and numerals of reference indicate the same parts in the several figures of the drawings.

A represents the main supporting drive-wheel of the reaper; B, the frame in which one end of the axle of said wheel is journaled; C, the grain-receiving platform, and D the finger-bar of an ordinary reaper.

The grain-receiving platform is an ordinary double table, and the devices mounted thereon for carrying the grain (which devices are fully described in Letters Patent No. 255,510, granted me March 18, 1882) may be briefly set forth as follows: Rigid on the end bar next the standing grain is a shaft, *h*, on which loose sheaves *i i* have their bearing, which sheaves carry endless sprocket-chains K, traveling in the upper side of the grain-receiving platform in guides *l* in the top of said platform, said chains being driven (see Fig. 2) by sprocket-wheels *m m*, rigidly secured on the revolving shaft 6. At suitable intervals on the chains are pivoted teeth *o*, having heels (not shown) extending backward under the chains, by means of which the teeth are held in an upright position when in the guides, but when released therefrom swing downwardly until again engaged with the guides. The drive-wheel is provided with the usual external gear, *a*, rigidly secured thereto, (see Fig. 2,) gearing with the pinion *b* on the shaft *c*, extending at a right angle to the drive-wheel, which shaft carries on its outer end a beveled gear, *d*, engaged by a beveled pinion, *e*, through shaft *f*, journaled in the frame B and carrying on its outer end the crank-wheel *g*, which, by means of a connecting-rod, operates the cutter-bar in the usual manner. Opposite the pinion *e* is a corresponding pinion, 1, upon a horizontal shaft, 2, carrying upon its outer end a sprocket-wheel, 3, said pinion 1 gearing with the beveled gear *d*, by which it is actuated. Passing around the sprocket-wheel 3 is an endless drive-chain, 4, which passes around and operates a sprocket-wheel, 5, rigid on a shaft, 6, carrying a series of sprocket-wheels, which operate the conveyer-chains of the grain-receiving platform. Drive-chain 4 is elevated at a point between the drive-wheel and the grain-binder, hereinafter described, by means of sheaves 7 and 8, journaled in suitable brackets upon a sill, 9, (see Fig. 1,) supported at its front end upon the frame of the machine, and at its opposite end (see Fig. 3) upon an arch, 10, spanning a gap formed in the frame by cutting away its rear sill to provide an opening for the passage of the bundles of grain from the binder, said sill 9 being provided with a hanger, 11, in which the inner end of the axle of the drive-wheel is journaled, and serving as a lateral brace to the frame. The shaft 6 has rigidly secured thereto a pinion, 12, gearing with a corresponding pinion, 13, upon a short shaft, 14, journaled in the rear sill of the frame and in the strap 15, said shaft 14 also carrying a sprocket-wheel, 16, connected with a large sprocket-wheel, 17, by drive-chain 18. Sprocket-wheel 17 is confined between the rear sill of the frame and a bracket-plate, 17½, and is splined upon a shaft, 19, bearing in the plate 17½, said shaft being the drive-shaft of the binding mechanism, and is longitudinally grooved to receive the spline of the sprocket-wheel, so that while said shaft cannot revolve independent of the sprocket-wheel it is free to reciprocate therein for the purpose of adjusting the gavel and binding-tables, as hereinafter more fully described. Shaft 19 is journaled upon the under side of a table, 20, and is prevented from a longitudinal movement independent of the table by collars (not shown) rigidly fixed to the shaft on each side of the bearing, said table being mounted and adapted to be reciprocated on horizontal guide-rods 21 (see Figs. 1 and 4) and supporting the gavel-gage and binding mechanism, the knotter being secured on the under side of the table in the case E, and the binding-arm operating from above through a transverse slot in the table.

To promote a clear understanding of the operation of this machine, that portion of the table 20 which is inside of the gavel-gage may, for convenience, be termed a "gavel-table," because on that portion of the table 20 the gavel is fully formed and separated from the inflowing grain, and that portion of the table 20 outside of the gavel-gage and over the knotter may be called the "binding-table," which two tables as a whole are made adjustable fore and aft to provide for adjusting the gavel-gage and binding mechanism to operate the long or short grain, as the case may be. To adjust these devices for long grain, the table 20 is moved bodily toward the rear end of the machine; but for short grain it is moved toward the front end of the machine, the groove of the shaft 19 and spline of the sprocket-wheel 17 permitting this adjustment without interfering with the rotation of the shaft and the operation of the mechanism carried by the table.

Bolted to the front end of the table 20 is an overhanging bracket, 22, (see Figs. 1 and 2,) suspending the binding and compressing arms, and having rigidly secured in its upright portion a studded axle, 23, projecting at a right angle from the same, and forming a shaft for a cam-wheel, 24, and gear-wheel 25, which wheels are rigidly connected by a hub or sleeve, so as to revolve together, but are sufficiently separated from each other to provide for the operation between them of levers engaging with the inner cam-faces of the gear and cam wheels, to be hereinafter described.

Pivoted on the stud 26, secured to the sliding table, are two levers, one of which, 27, engages with the cam 28 on the side of the cam-wheel 24, and has a projecting arm, 29, provided on its end with a rack-bar or segment engaging with a pinion, 30, splined upon the shaft 31, journaled in the inner portion of the end sills of the grain receiving platform, and provided with one or more arms, 32, which are termed "transfer-fingers," for the reason that, operating between a series of slats, 33, bridging the space between the grain-receiving platform and the binding-table, they serve to transfer the gavel already formed between the gavel-gage and divider to the binding mechanism, said fingers being of such a length that when depressed they do not extend beyond the inner edge of the grain-receiving table. The other cam-lever, 34, works on the periphery of the cam 24, which is recessed at 35, and the lower projecting arm of the lever 34 engages with an elongated rib, 36, formed of a bent rod, the two ends of which are inserted in the shaft 37, journaled in the front and rear sills of the grain-receiving platform, and having attached thereto a "divider," consisting of a bent rod, 38, forming one side of a rectangular frame, the other three sides of which are formed of a bent rod, 39, having eyes on its ends encircling the rod 38, said frame having secured to its upper side wire teeth 40, which project through and are secured in the lower side of the frame, as clearly shown in Figs. 1, 4, and 5. This frame, with the teeth, forms a shield over the binder, and is supported entirely from the shaft 37 by the rod 38, and when let down upon the grain-receiving table separates the grain thereon from the formed gavel on the gavel-table, and prevents the grain lying on the said grain-receiving table from being drawn into the binder when the gavel is being moved forward to and upon the binding-table by the transfer-fingers. By this means a perfect division and separation is effected between the inflowing grain and the complete gavel, it being understood in this connection, however, that as soon as the transfer-fingers have carried the gavel forward in reach of the binder-arm which carries it to the binder the gavel-gage rises to a perpendicular position, and the divider is lifted, so that an inflowing of grain against the gavel-gage is permitted while the sheaf is being bound. The frame, when a heavy wind is blowing and there is a tendency to blow the grain therethrough or to tangle and twist it therein, may be covered with a piece of canvas or other piece of fabric to render such an objection impossible.

Pivoted on the line dividing the binding from the gavel table, and by means of straps or staples 41, is a gavel-gage, 42, consisting of a shaft provided with one or more teeth projecting at a right angle therefrom, which shaft has upon its end an arm, 43, secured upon a collar loose upon the shaft, but connected therewith by a coiled spring, 43½, permitting the shaft to make a partial rotation independent of the arm, and operated as hereinafter described. This gavel-gage operates as a back stop for the grain which, falling on the stationary grain-receiving platform C, is carried by the teeth of the endless carrier-chains against the gage, which, when overcome by the bulk and pressure of the grain, swings over backward until flat on the table, and permits the transfer-fingers to then move the completed gavel forward to and upon the binder-table. The gavel-gage is upheld by the retracting-spring 43ª, coiled about the shaft 42, and having one end of it fixed thereto and the other end projecting out and bearing upon the table, the tension of which spring is increased when the gage is depressed by the gavel, so that when the gavel has passed beyond the gage into the binder the spring will cause the gavel-gage to immediately assume an upright position for gaging another gavel from the grain which again begins to flow in upon the gavel-table during the operation of binding the first gavel. Gear 25 meshes with a pinion, 44, loose on the projecting end of the constantly-revolving shaft 19, and this pinion has rigidly secured thereto one half of a clutch, 45, (see Fig. 6.) the other half of which clutch is splined on the shaft 19, and by this means the teeth of the clutch may be disengaged and the pinion will then stand idle upon the shaft, though of course constantly meshing with the

gear 25. The splined portion of the clutch is grooved on its periphery (see Fig. 6) to receive a bifurcated lever, 46, hinged to an arm, 47, rigidly secured to and projecting from the shoulder 48 on the bracket 22, and on the end of the shaft 19 is a washer, 49, between which and the sliding portion of the clutch, and coiled about the shaft, is a spiral spring, 50, for throwing the clutch into engagement. Hinged lever 46 is provided, near its lower end, with an elongated slot, and has hinged near its upper end a swinging lever, 51, on the front and lower end of which is hinged a foot-piece, 52, projecting through the elongated slot, and having near its hinged end a heel, 53, projecting upwardly and engaged by a spring, 54, having a loose bearing on the heel and rigidly secured at its other end to the lever 46. This spring not only operates to push the lever 51 and the foot-piece away from the lever 46, but to lift the foot-piece, so that the shoulder or enlargement formed thereon will engage or catch on the inside of the lever 46 at the upper end of the slot, the foot-piece being provided at its free or outer end with a transverse pin or enlargement to prevent the spring from throwing it entirely out of the slot, and the lever 51 being operated by and through cam-projection 55 on the side of gear 25, (see Figs. 1 and 4,) which cam intermittently engages with the lever 51 near its lower end.

Referring to Fig. 1, in which the binder-arm, the divider, and the gavel-gage are raised, and the cam 55 (by levers 46 and 51) is pressing against lever 51, it will be seen that when the gavel has thrown down the gage it will cause the arm 43 to press down the foot-piece until the lever 46 is forced over it and the clutch-pinion engaged with the clutch-half 45 through the expansive force of the spring 50. The moment the pinion and clutch-half 45 are engaged, the gear 25 revolves, and releasing cam 55 from lever 51, the lever is thrown inwardly by a spring, 54, drawing the foot-piece in engagement with lever 46, where the foot-piece remains until again tripped by the gavel, after the cam 55 has made a revolution and engages with lever 51, and causes the disengagement of the clutch-half and pinion and the binding mechanism to stop. On the instant the gear 25 begins to revolve, the lever 27 is engaged by its cam, causing the transfer-fingers to rise and transfer the gavel toward and partially under the compressor and off the gavel-gage, which then, through its retracting spring, as before stated, immediately assumes an upright position to stop and cut off from the binder the incoming grain, constituting a fresh gavel. In this connection it should be stated that a single revolution of gear 25 causes a complete operation of the entire binding mechanism.

Journaled in the overhanging arm of the bracket 22 is a shaft, (see Figs. 4 and 9 and dotted lines, Fig. 6,) projecting beyond each extremity of the bracket, which shaft has rigidly keyed upon its rearward or inner end a hook-shaped binder-arm, 57, the butt of which is provided with a segment-gear, 57^a, engaging with a corresponding gear, $57\frac{1}{2}$, journaled on the stud 59, projecting from the overhanging arm of the bracket 22. The outer end of the stud has sleeved thereon a compressing-arm, 58, connected with the segment-gear $57\frac{1}{2}$ by a rigid arm, 57^b, projecting from the segment and perforated to permit a curved rod, 58^a, rigid on the compressing-arm, to play freely through it, a pin in the extremity of the rod 58^a serving to prevent their detachment, and has spring 58^b, spring-seating the arm 57^b and with it the segment-gear, on the compressing-arm 58. The purpose in so connecting the compressing-arm with the segment-gear is to permit an automatic yielding of the arm to accommodate varying sizes of gavels, and the pressure of the arm upon large and small gavels is correspondingly increased or diminished by the compression and expansion of the spring 58^b. It will now be seen that when a large gavel is in the binder the arm 58 cannot descend as low as with a small gavel; hence, as soon as the arm comes in contact with a large gavel, with the segment continuing to revolve, the arm 57^b compresses the spring 58^b and forces the compressing-arm tightly upon the gavel, and that when the compressing-arm is stopped in its forward movement by the resistance of the gavel the spring will permit the segment to move on to the end of its stroke, thereby avoiding any tendency to an over-compression of the gavel or to injure the segment or arm. It might be well to add that in view of the uniform downstroke of the binding-arm 57, if segment 57^a were rigid upon the compressing-arm 58, the compression last described would inevitably break some of the binding mechanism.

The binding and compressing arms are operated by bell-crank 60 on the forward end of shaft 56, (see Fig. 4,) the long arm of which engages intermittently with the segmental rib or cam 61 (see Fig. 6, and dotted lines, Fig. 4) upon the inner face of the gear 25, which cam describes a sufficient part of a circle so that when the lever is released from one end of the cam during the revolution of the gear, and is swung toward the opposite side of the gear from the position shown in Fig. 4, and as indicated in dotted lines, the lever will be in position to be engaged by the opposite end of the cam 61.

To positively and quickly operate or swing the bell-crank 60 after its release from the cam, the short arm of the bell-crank (see Figs. 7 and 8) is pivoted to a yoke, $61\frac{1}{2}$, sleeved upon a vertical rod, 62, and actuated by coiled spring 63, having its lower end bearing against the yoke and its upper end held by a pin passing through the rod 62. By this arrangement it will be seen that when the bell-crank is carried to the position shown in full lines in Fig.

4 the spring is compressed by the rising of the short arm, but as soon as the bell-crank is released from the cam the expansion of the spring will quickly swing the bell-crank to the position indicated in dotted lines and cause a corresponding movement of the binding and compressing arms 57 and 58. When the bell-crank is on the cam, as shown in Fig. 4, the binding and compressing arms are closed or swung to the lowest position indicated by dotted lines in Fig. 9, and are firmly held and compressing a sheaf; but when the bell-crank is released from the cam the arms are swung outwardly to the position shown in full lines in said figure.

For the purpose of relieving the friction of the bell-crank in its first engagement with the cam 61, an anti-friction roller, 64, (see dotted lines, Fig. 4,) forms the extremity of the cam, which extremity in its first engagement with the bell-crank slides over a suitable portion of the side edge of the bell-crank during the time the bell-crank is being swung to the left in Fig. 4, and to its highest position, and before the end of the bell-crank comes in contact with the cam.

The engagement of the side edges of the lever with the cam in the above-described manner results in a gradually increasing power of the lever and a corresponding increase of pressure of the binding and compressing arms as they descend upon the sheaf, or in any case an increasing pressure with a given amount of power at the beginning of the movement of the binding and compressing arms.

To compress the gavel to a size corresponding to that of the required size of band for successfully holding the grain forming the sheaf in its finished state, and to still further compress the sheaf, after it is encircled by the band, to give the band sufficient slack for permitting the knotter to operate without breaking the band, so that the expansion of the sheaf, when relieved from the compression, will tighten the knot and take up the slack of the band and still form a tight sheaf, I have provided what is termed an "auxiliary compressor," which will now be described.

Referring to Figs. 1, 4, and 6, 65 is a bracket-arm rigidly secured on the overhanging bracket 22, and has pivoted thereto a lever, 66, in the forward end of which is pivoted a depending arm, 67, guided in brackets 68, secured on the overhanging bracket 22, which bracket 68 has the arm 67 passing through it, said arm having an anti-friction roller, 69, and engaging with the short segmental cam 70, the operation of which is to intermittently lift the arm 67 and rock the lever 66 on its pivot in the bracket 65. The rear end of lever 66 is pivoted in the stud 71, projecting from the spring-seated bar 72 (see Fig. 7) of the auxiliary sheaf-compressor. Supporting the auxiliary sheaf-compressor above the binding-table and guiding it in its vertical reciprocation is a rigid frame composed of the bracket 73, bolted to the overhanging bracket 22 at a right angle to the same, and having at its outer ends two sleeves, 74, and two parallel rods, 75, rigid in the bracket 73, and connected at their upper ends by a bar, 76, having projecting ends perforated to provide guides for parallel rods 77, which pass through the sleeves 74. These rods are encircled by coiled springs 78, and projecting at their upper ends through the bar 76, and are connected by a bar, 79, which, in connection with a curved bar, 80, which connects the lower ends of the rods 77, serves to form a rigid frame adapted to be reciprocated through the sleeve 74. The end of the curved bar 80 projects over the inner end of the grain-receiving platform to guide the gavel, when thrown by the transfer-fingers, under the auxiliary gavel-compressor, and in position to be operated upon by the principal compressor. The tension of the coiled springs 78 is such that the compressor is projected by them so near the surface of the binding-table that the gavel is necessarily forced under the compressor and consequently slightly compressed, the forcing of the gavel lifting the frame of the compressor, as indicated in Fig. 7, thereby compressing the upper ends of the spring 78 against the bar 72, which is then stationary. This, which I term the "first compression" of the gavel, is sufficient, in connection with the binding and compression arms, to give the sheaf the desired size and tightness it will have when completed and discharged from the machine. By the time the first compression is completed the binding-arm has carried the twine taut around and underneath the gavel and in position to be taken hold of by the looper, and at the instant the looper seizes the twine the depending arm 67 is engaged by its cam 70, and depressing the bar 72 compresses the spring 78 and drawing down the compressor-frame, and subjects the gavel to a second compression, which permits the band to slack and prevents the looper breaking the band, as it would otherwise frequently do in taking up enough twine to form the knot.

The auxiliary compressor forms an important feature of my invention, for the reason that, operated by a direct steady movement, it effects no injury to the grain, as do packers, and, furthermore, by its co-operation with the binding and compressing arms, the pressure is more evenly distributed over the entire circumference of the sheaf, thus making a more perfect bundle without injury to the grain than other machines now employed.

Pivoted near the extremity of the binding-arm 57 is a tucking-arm, 81, a transverse section of which is wider than the slot in the table, and has its free end concave to form a guide for the twine, which, passing through an ordinary tension-guide, 81½, on the overhanging bracket, is upheld by the arm 82, Fig. 9, and passes thence through the eye 83 in the point of the binding-arm, and thence passes to and is held by the twine-holder, presently to be described. Said tucking-arm is provided

with a lug extending above its pivot, engaged by a spring, 84, on the binding-arm, which spring serves to hold the tucker against the binding-arm until forced away by contact with the binding-table. With the binding-arm raised and the twine held, the gavel, when transferred from the gavel-table to the binding-table, will be pressed by the descending binding-arm against the twine extending from the binding-arm to the twine-holder, and as the binding-arm continues, carrying the twine with it through the slot in the table and the gavel before it, the end of the tucker will strike against the incline formed of one or more curved projections or lugs, 85, on the gavel-table, which throw the tucker away from the binder-arm and forward on the table, so as to catch and tuck the twine under the sheaf, pressing the twine forward and sustaining it in contact with the extremity of the twine already held in a vertical line between the twine-guides and in position to be gripped by the knotter. These twine-guides (see Fig. 26) are formed by projections 86 and 87, respectively, formed above and below a perforation in a plate, 88, secured on the case E, containing the knotting mechanism, said perforations being in alignment with and adapted to permit the looper to project through it, and the guides being arranged a little to the one side of a vertical line through the perforation, so as to permit the twine when resting against them to be drawn across the center of the perforation and in a line with the receiving-slot in the looper. (See Fig. 22.) The twine-guide plate is also provided near its lower edge with a stud, 89, between which and the guide 87 is a depression or bearing, 90, to receive the projecting end of the twine-holder 91, which forces the twine into the depression and clamps it to the plate, the stud 89 serving as a guide, against which the twine is held over the depression to permit the reciprocating twine-holder 91 to clamp it, (see Figs. 21, 22, and 26,) the binding-arm carrying the twine downwardly and partially around the stud 89 for that purpose.

The knotter is contained in a suitable case, E, (see Fig. 10,) to protect the knotting mechanism from dust and other foreign substances, which case is secured to and underneath the binding-table by means of bolts or other equivalent means passing through lugs on the case into the table, which table forms a cover for the same, said case being provided with suitable openings in one end for the operation of the twine-holder, already described, and the knotter and cutter now to be described.

The looper is essentially composed of a stem or shaft and an inclosing shell or tube. The stem or shaft 92, which is a slotted rod, (or it may be a tube,) is provided at its forward end with a raised shoulder, 93, the forward portion of which converges toward a point, and the rear of the shoulder extends at a right angle to the length of the stem, and to form a seat for the end of the inclosing shell or tube 94, surrounding the stem and extending nearly one-third its length. The stem and its inclosing-shell are each provided with transverse intersecting slots, one of which (see Fig. 14) is a slot, 95, in the center of the end of the stem and its inclosing-shell, and of the depth shown in Fig. 20, and the rear end of the slot in the stem is notched at 96, (see Fig. 25,) so that one side wall of said notch is at an oblique angle to the opposite wall of the slot (see Fig. 14) and merges into it at about the center of the diameter of the stem, and the shell (see Fig. 27) is correspondingly notched at 97 on the opposite side and the corresponding side of the slot. These slots in the stem and shell, when coincident, permit the introduction of the twine when held in a perpendicular line to the slots, after which the shell is turned to the left, as in Fig. 15, throwing the twine against the inclined wall of the notch 96 of the stem, (see Fig. 14,) when at the same time the slot 95 on the under side of the shell passes the slot 95 in the end of the stem, and, the end of the shell closing, the slot of the stem confines the twine in the notch 97, and by this means the twine is held so that it cannot be drawn laterally, but is free to have a longitudinal movement through the stem and its inclosing-shell. When the stem and shell are in the position shown in Fig. 15, a slot, 98, extends through both the stem and shell nearly at a right angle to and bisecting the slot 95 in the shell, as will be seen by comparing the direction of the slots of the shell, as shown in Fig. 15. The corner of the one side wall of the upper end of the slot 98 in the stem or shaft is beveled (see Figs. 25 and 29) to form a lug, 99, and the opposite side wall of the slot in the shell is beveled to avoid cutting the twine. When the shell is revolved in the direction of the arrow, Fig. 17, the forward end of these slots will be closed, and a wedge-shaped recess, 100, (see Fig. 18,) will appear between the opposing side walls of the slot of the shell and stem, which recess incloses the twine, so that when the twine is drawn toward the point of the stem in the process of tying the knot it will be wedged between the walls of the narrow point of the wedge-shaped recess and held there until the knot is tightened, after which it is released by the further operation of the machine. The slot 98 in the shell is enlarged, as shown at 101 in Fig. 15, so that after the stem and shell are given a three-fourths turn to the left (see Fig. 15) and to the position shown in Fig. 16, the shell, continuing its revolution, will cause the slot 95 in it and the stem, respectively, to coincide, as shown in Fig. 17; but, as will be observed, although the lower end of the slot 98 is open, the upper forward end is closed by the shell, at which time the twine is held in the wedge-shaped recess 100.

Before a detailed description of the mechanism for causing the several movements of the looper be given, it may first be well to describe the manipulation of the twine by the shaft or stem and shell comprising the looper,

and the operation of the lifting-finger and the cutter. Above and forward of the looper, when withdrawn, is a vibrating lifting-finger, 102, (see Figs. 10 and 21,) which extends at a right angle to the looper and serves to lift the loop, which is formed in front of the looper, over and upon the looper-shell, and afterward take a position back of the loop, so that when the looper is withdrawn from its forward position in the final movement to tie the knot the finger aids in pushing the loop off, as will be presently described. Forward of this lifting finger, and bearing in the end and side of the case, is a flat obliquely-arranged reciprocating knife, 103, the cutting-edge on the end of which is at an oblique angle to the length of the knife, which is adapted to reciprocate across the path of the knotter to sever the band from the twine after the knot is tied and drawn taut.

As before described, and by reference to Figs. 21, 22 and 26, it will be understood that the end of the twine, when the twine is being carried around the sheaf to form the band, is in the grasp of the twine-holder, and bears upon the guides 86 and 87 in a line coinciding with the slot 95 of the looper, and the shaft and shell of the looper stand in their first position. (Shown in Fig. 14.) The tucker 81 (see Fig. 9) carries the spool portion of the twine under the bundle against the guide 86, and the binding-arm, continuing its downward movement, brings it against the guide 87. Both parts of the twine forming the band are thus carried and held contiguous to and parallel with each other, so that in actual operation slot 95 receives a double instead of a single twine, as shown in Figs. 14, 15, 16, and 17. After the looper and twine are in their first position (shown in Fig. 14) the looper is projecting through the case, and the lifting-finger is below the plane of the looper. With the parts in this position the shell is revolved to the position shown in Fig. 15, closing the forward end of the slot 95. The shaft and shell then recede to the limit of their backward stroke, during which they simultaneously make a three-fourths turn, twisting the twine upon itself to form the loop, which at this time extends forward of the point of the looper, as shown in Fig. 28. After completing their backward stroke and forming the loop the shaft and shell advance, slacking the loop, and then the lifting-finger rises, throwing the loop over the looper-shell, as shown in Figs. 16 and 21, the twine between the lifting-finger and twine-holder passing into slot 98 as the looper continues to advance, during which time the lifting-finger is withdrawn. The shaft and shell completing their forward stroke, the latter then makes its last rotary motion, closing the slot 98 at its outer end only, as shown in Figs. 17 and 18, and at the same time the lifting-finger advances across the top of the shell in the rear of the loop, (in the form shown in Fig. 17,) and the shaft and shell recede without revolving, the loop comes in contact with the finger and is pushed off the point of the looper; but it is necessary that the band should be put under tension between the receding looper and expanding sheaf to tighten the knot when the loop is slipped off the point of the looper, and the effect of this tension is to sometimes draw the loop off before it comes in contact with the lifting-finger. The instant the twine is locked in the looper for the last time, as shown in Fig. 17, the pressure from the binding and compressor arms and the auxiliary compressor is released from the sheaf, and, with the knotter receding and sheaf expanding, the lower ends of the twine are drawn forward and wedged in the recess 100, the knife severing the twine the instant the looper clears the knife, and the looper, continuing its backward movement, pulls on the severed end of the band, while the expansion of the sheaf tightening the band co-operates to tighten the knot, after which the looper-shell revolves and releases the band. After the band is released the shaft and shell of the looper revolve backward to the first position, (shown in Fig. 14,) and then advance at the proper time through the case to receive the twine for forming a knot in another band. As soon as the twine is locked in the looper for the last time, and the lifting-finger has advanced across the top of the shell in the rear of the loop, the twine-holder 91 (see Figs. 10, 21, and 22) recedes, when the twine assumes a straight line between the guide 87 and the stud 89 and in the path of the twine-holder, which then advances, clamps the twine between the ends of the twine-holder and the recess 90 in the plate 88, (see Fig. 26,) firmly holding the end of the continuous twine down, while the binding-arm 57 swings to its position above the binding-table ready to receive another sheaf.

It will be observed that the twine-holder is provided at its lower end with a projecting lug, around which the twine is given a partial turn when the binding-arm ascends, and the effect of this partial turn is to give the holder such a firm grip on the twine as to effectually prevent the accidental detachment of the twine from the holder by any strain exerted by the binding-arm or the pressure of the sheaf.

Having described the construction and operation of the parts of the tying mechanism which operate directly on the cord, it remains necessary to describe the actuating mechanism of those parts. The main shaft 104 of the tying mechanism (see Figs. 1, 4, 9, and 10) has its bearings in a journal-box, 105, in the case E of the tying mechanism, (see Fig. 10,) and projecting beyond the front of the machine is another bearing in the journal-box, (not shown,) secured near the front edge and to the bottom of the binding-table, said projecting end on the shaft having rigidly secured thereon a pinion, 106, (see Figs. 1 and 4, and dotted lines, Fig. 9,) meshing with the gear 25, through which the entire tying mechanism is actuated. The inner end of the main shaft

104 is provided with a pinion (not shown) engaging with a corresponding gear, 107, (see Fig. 13,) on a vertical shaft, 108, said gear having on its under face a plate, 109. (see dotted lines, Fig. 15,) provided with a cam-groove, 110, and on the upper side of the gear is a semicircular cam-plate, 111, secured to the gear and having one of its corners rounded; but these plates may be cast with the gear instead of as above described. On the shaft 108, above and separate from the gear 107, (see Fig. 10,) is a cam-grooved wheel, the groove of which is on its upper face. Pivoted to a projection, 113, on the case is a bifurcated lever, 114, having about midway its length a stud, 115, engaging with the cam 112. The bifurcated end of the lever straddles a collar, 116, sleeved upon and toward the rear end of the looper-shaft 92, said lever being provided with elongated slots 117, through the upper one of which projects the pin 118, and through the lower one a long pin, 119, the elongation of the slots providing for the accommodation of the pins to the radius of the circle described by the movements of the lever. On each side of the collar 116 are rigidly secured to the looper-shaft collars 120, and on the under side of the bifurcated end of the lever is a plate, 121, provided with an elongated slot in which the pin 119 is guided to maintain the collar 116 in its operative position. With these parts in the position shown in Fig. 10, the main shaft and cam turned in the direction indicated by the arrows, the looper will recede until the pin 115 on the lever reaches the lower corner of the cam-groove, when the looper will remain stationary until the cam is revolved to engage the pin with the opposite side of the cam at the point of the arrow, when the lever will be carried forward, pushing the looper with it, the sleeving of the lever on the looper permitting the looper to be revolved, as hereinafter described, a single revolution of the cam 112 serving to cause two forward and two backward movements of the looper necessary in the tying of the knot. The lever 114 is provided with a link, 121½, pivoted at one end of the lever and at its other end to the upturned end of the coil-spring 122, on and secured at its lower end to a vertical stud, 123. Pivoted to a stud, 124, which also forms a bearing for the looper, is a studded arm, 125, the studs of which, five in number, are shown at the extremity of the arm, and engage with the segment of a lantern-gear, 126, on a sleeve, 127, on the looper, which sleeve is joined to or cast with a cam, 127½, (see Figs. 19 and 20,) engaged by a pin, 128, on a plate, 129, on a slide, 130, bearing upon the looper-shell and guided in a slot in a thimble-shaped keeper, 131, made rigid to the looper-shaft, a tongue at one end of the slide 130 being guided between the keeper and the shell, and a tongue at the other end of the slide being guided between a cam, 127½, and the looper-shaft, said keeper being recessed for that purpose. A pin, 132, rigid on the shaft and working in an elongated slot in the shell, limits the revolution of the shell when closing the eye of the looper. Rigid in the looper-shell is a pin, 133, playing in a slot, 134, obliquely cut in the slide 130, which causes a partial rotation of the looper-shell when the slide is reciprocated, as will presently be described. Studded arm 125 has at its rear end (see Fig. 13) an arm, 135, provided at its extremity with a vertical stud, 136, engaging with the cam-plate 109 on the under side of the beveled gear 107, by means of which the studded arm 125 is oscillated to rock sleeve 127. Sleeved on the stud 124 is a segment rack-bar, 137, an arm, 138, which engages with a semi-circular cam-plate, 111, on the upper face of the gear 107, which cam 111 serves to swing the segment-rack toward the cam and revolve the looper by reason of the engagement of the rack with a pinion, 141, on the looper-shaft, the rack being withdrawn at the proper time by a retraction-spring, 139, fast to one end of the case and to its other end to a projection, 140, on the rack 137. Pinion 141 is splined to the shaft, the spline fitting a longitudinal groove, 142, therein, so as to permit it to reciprocate through the pinion, but not to be revolved independently, the reciprocation of the pinion on the shaft being prevented by a forked bracket, 142½, (see Fig. 10,) engaging with the groove 143 (see Fig. 20) in a hub, 144, cast with the pinion.

These devices for actuating the looper will operate as follows: When the looper is at the limit of its backward stroke, and in position to advance through the case to grasp the twine for the first time, if the shaft 104 and the cam 112 be revolved in the direction indicated by their respective arrows in Fig. 10, the lever 114 will engage with cam 112 and advance the looper shaft and shell without turning to the limit of their forward stroke, when the lever 135 of the studded arm 125 will engage with the cam of the plate 109, revolving the shell, as shown in Fig. 15, by reason of the pin 128 engaging with the V-shaped portion of the cam 127½, and pushing the slide 130 forward, causing the engagement of the pin 133 with the oblique walls of the slot 134, thus turning the looper-shell. As soon as the shell is revolved to the position shown in Fig. 15, the looper shaft and shell are withdrawn by the lever 114 and are simultaneously revolved a three-fourths turn during their backward movement by the engagement of the arm 138 of the segment-rack 137 with the semicircular cam 111 swinging the rack 137 toward the cam and revolving the pinion 141 on the looper-shaft. Reaching the end of the backward stroke, the looper shaft and shell are again advanced by lever 114, without turning, to the limit of their forward stroke, and having obtained this position remain stationary until the lever 135, engaging with its cam, causes the studded arm 125 to oscillate the looper-shell, as before described, closing the slot 98 of the looper shaft and shell, as shown in Fig. 17, after which

lever 114 draws the looper back, and after the then completed knot is tightened and released from the looper, and the looper having reached the limit of its backward stroke, the arm 138 being freed from its cam, the segment 137 is quickly swung away from the cam by its spring 139 revolving the looper a three-fourths turn backward, and in position to be then advanced for tying another knot. Geared to the beveled cog-wheel 107 by a pinion (not shown) is a shaft, 145, carrying upon its opposite end a beveled pinion (not shown) engaging with a beveled gear on the under side of the cam-faced wheel 146, (see Figs. 10 and 11,) which wheel has on its periphery a lug, 147, which is engaged by a bell-crank lever, 148, on a post, 149, the other end of the lever having an elongated slot, 150, working on a pin or the sliding collar 151 on the shaft of the twine-holder 91, the same forming a bearing for the spiral spring 152, having its other end bearing against a collar, 153, on and toward the forward end of the twine-holder. The collar 153 is screw-threaded on the shaft of the twine-holder to adjust the tension of the spring 152, and locked by a second collar, 154, both of which collars may be further tightened by screws (shown in Fig. 10) passing through the collar and impinging on the shaft. It will here be observed that the bevel-gears 107 and 146 revolve in the same time, and that the lug 147 operates but once during the operation of tying the knot, to draw the twine-holder back in position to receive the twine and clamp the same at a point between the binding-arm and the knot on the sheaf, and this operation of the twine-holder is very quickly performed, owing to the small size of the lug 147, for, as will be seen, the bell-crank 148 has but to travel up the short inclined side of the lug when it (the lever) will drop back to its position on the periphery of the gear. The knife 103 is pivoted near its rear end to a bent lever, 155, pivoted at its other end on a bracket-plate, 156, and provided at the angle of its bend with an anti-friction roller, 157, working on the periphery of a cam face or plate, 158. (See Fig. 10.) Pressing against a rigid pin on the lever 155 is a flat spring, 159, secured at the other end of the case and adjusted by means of a set-screw, 160, which spring operates to quickly throw the cutting-knife forward across the path of the looper to sever the twine below the completed knot when the anti-friction roller 157 sinks in the depression of the cam 158, which depression is shown in Fig. 10, opposite the anti-friction roller. Pivoted on a stud, 161, (see Fig. 10,) rigid to the frame of the bearing of the shaft of the gear 146, is a bell-crank lever, 162, the short arm of which is provided with a vertical projecting stud, 163, (see Fig. 12,) adapted to be engaged by a cam-lug, 164, on the face of the cam 158, to swing the long arm of the lever 162, which arm is provided at its extremity with a stud, 165, engaging with a groove in the downwardly-projecting arm 166 of the rock-shaft 167 of the lifting finger, said shaft being journaled at one end in the side of the case and toward its inner end in a post, 168, and connected with the lifting-finger by a rectangular arm, 169, rigid on the shaft; and on the finger abutting against the arm 166 of the rock-shaft and the case is a spring, 170, coiled about the shaft 167, to throw the shaft forward, and with it the lifting-finger, across the path of the needle at the proper time. The rock-shaft arm 166 has an elongated slot engaging with a pin, 171, (see Fig. 12,) projecting at a right angle from the reciprocating lever 172, bearing in parallel posts 173, and provided with a stud, 174, engaging with a cam-groove, 175, in the upper face of gear 146, which cam-groove operates to reciprocate the lever 172 and rock-shaft 167, causing the lifting-finger to be raised and lowered over the point of the looper. When the knotter is at the limit of its backward stroke, and in position to start forward to grasp the twine the first time, the lifting-finger is across the path and directly in front of its point a little below its center, and as the looper advances the lifting-finger, by the operation of the rock-shaft through the cam-groove 175 and the connecting-lever 172, is caused to sink to its lowest position below the looper, where it remains until the looper has advanced, and its shell is rotated to the position shown in Fig. 15, and the looper has taken a three-fourths turn and withdrawn to the limit of its backward stroke. A second operation of the rock-shaft lifts the finger across the path of the looper, which carries with it the loop above the plane of the looper, the looper at the same time being advanced and its upper half projecting through the loop as it seizes the twine the second time. As soon as the looper seizes the twine the second time, the cam 164 engages with the bell-crank 162, draws the lifting-finger directly to one side of the looper, which continues to advance until the loop is in front of the lifting-finger, when the latter is again advanced by the release of the bell-crank from its cam, the finger remaining in its advanced position until the looper is withdrawn, the loop pushed off by the finger, the then formed knot tightened, and the band cut from the twine, after which the knot is released, and the looper continuing to recede taking a three-fourths turn backward, while, in the meantime, the lifting-finger sinks to its first position to repeat the operation above described.

Having now described the construction and operation of my machine as a whole in detail, it may be well for a more perfect understanding to briefly state its general operation, which is as follows: With the gavel-gage, the divider, and the binding-arm elevated to their highest positions, and the twine passing from its tension device through the arm 82, and the eye of the binding-arm to the twine-holder of the knotter, the harvester is advanced through the standing grain, and the cut grain, falling from the cutting apparatus on the platform, is car-

ried forward by the rake-teeth to the gavel-table, where it will lie until a sufficient quantity has accumulated to form a gavel, after which the gavel-gage is pressed down, and at the same moment the divider descends and the lifting-fingers rise, throwing the gavel against the twine, between the point of the binding-arm and binding-table, and under the gavel-compressor in position to be grasped by the then descending binding-arm and its opposing compressor-arm. The binding-arm draws the twine tightly around the gavel and in position to be grasped by the looper, at which instant the auxiliary sheaf-compressor descends forcibly upon the gavel, still further compressing it and slacking the twine, to enable the knotter to operate without danger of breaking the twine. It should first be stated that when the gavel-gage is pressed over the clutch mechanism is engaged, thereby starting the gear 25 and quickly and simultaneously operating the binding and compressing arms and lifting-finger, and then successively operating the auxiliary compressor and knotter mechanism.

In the position shown in Figs. 1 and 2 the binding-table is at its extreme adjustment for long grain; but for shorter grain it is correspondingly drawn forward on its supporting guide-rods and held by any suitable means, so as to bring the binding-arm and tying devices toward the butt of the grain to enable the band to be placed centrally on the bundle.

In conclusion, it should be stated that the shaft 92 and shell 94 have for convenience, when taken together, been termed a "looper;" but from their operation hereinbefore described it will be understood that in themselves they not only form the loop, afterward lifted over them by the lifting-finger, but actually draw the twine through the loop to form the completed knot, so that as a matter of fact the shell and shaft actually constitute a complete knotter, excepting that the lifting-finger or some other device is required for elevating the loop in the path of the shaft and shell, which loop has already been formed by their joint operation.

In other loopers the loop is formed on a shell or tube; but in this device the loop is completed in front of the looper and afterward elevated over upon it.

Having thus described my invention, what I desire to secure by Letters Patent, is—

1. The combination, with the grain-receiving platform or table, of the binding-table and the intermediate gavel-table, all of said tables being arranged substantially in the same horizontal plane, substantially as and for the purpose described.

2. The combination, with the grain-receiving platform, the gavel-table, and a binder-arm, of the divider suspended above said platform and table and mechanism operating said divider independently of the binder-arm, substantially as described.

3. The combination, with the grain-receiving platform, and with the binding-table, of the divider suspended above the table and the transfer-fingers, substantially as described.

4. The grain-platform and the fixed gavel-table, in combination with the divider between said platform and table, substantially as described.

5. The combination, with the binding-table and the perpendicular gavel-gage mounted thereon, of the vibrating transfer-fingers, substantially as described.

6. The combination, with the gavel gage and the transfer-fingers, of the divider, substantially as described.

7. The combination, with the gavel-table, the stationary grain-receiving platform, and the carrier, of the divider and the vibrating gavel-gage mounted upon the gavel-table, all arranged substantially as described.

8. The combination, with the gavel-table, the stationary grain-receiving platform, and the carrier, of the gavel-gage mounted on the gavel-table and vibrating transfer-fingers, all arranged substantially as described.

9. The combination, with the stationary grain-receiving platform and the carrier, of a gavel-gage, the grain-divider, and transfer-fingers, all arranged substantially as described.

10. The combination, with a grain-divider having its bearings in the stationary grain-receiving platform and provided with an elongated rib on its shaft, of a sliding binding-table, a cam-wheel, and a lever pivoted on the table, said lever being operated by the cam-wheel and engaged with an elongated rib on the divider-shaft for actuating the divider, substantially as described.

11. The combination, with the shaft of the gavel-gage mounted on or below the binding-table, and with the operating mechanism of the grain-binder, of the arm 43, pivoted on the shaft of the gavel-gage and free at its opposite end, substantially as described.

12. The combination, with the gavel-gage, and with the operating mechanism of the grain-binder, of the arm 43, loosely seated upon the gavel-gage shaft, and the spring-connection between the shaft and arm, substantially as described.

13. The combination, with the transfer-fingers having the pinion on their shaft, a revolving cam, and a lever, one end of said lever engaging with the cams, and the other end being provided with a segment rack and engaging with the pinion on the shaft of the transfer-fingers, substantially as described.

14. The combination, with the sliding gavel and binding-table and a revolving cam mounted thereon, of the transfer-fingers journaled in the grain-receiving platform, an actuating-pinion adapted to slide on the shaft of the transfer-fingers, and a lever pivoted on the sliding binding-table and engaging with said cam and pinion, substantially as described.

15. The combination of the transfer-fingers

and the divider, of their respective actuating cams and levers, simultaneously engaging and operating said fingers and divider, substantially as described, whereby the divider sinks upon the grain-receiving platform and the fingers rise to transfer the gavel to the binding-table, as set forth.

16. The combination, with the transfer-fingers and the divider, of their respecting actuating cams and levers, simultaneously engaging and operating said fingers and divider, and a toothed grain-conveyer co-operating with said divider and transfer-fingers, substantially as described.

17. In a gavel-compressor, the combination, with the rigid frame provided with perforated end bars, of a reciprocating frame, the side bars of which are guided in said perforations, a spring-pressed cross-bar, a lever connected therewith, and mechanism actuating said lever to depress the spring-bar, and with it the reciprocating frame of the compressor, substantially as described.

18. The combination, with the shaft 19, the clutch-pinion, the gear 25, and the spring-actuated clutch-half, of the hinged lever 46, the lever 51, pivoted thereto, the foot-piece connecting said levers, the cam 55, and mechanism for operating said levers, substantially as described.

19. The combination, with the shaft 19, the clutch-pinion, the gear 25, and the spring-actuating clutch-half, of the hinged lever 46, the lever 51, pivoted thereto, the spring-actuating foot-piece connecting said levers, the cam 55, and the gavel-gage, substantially as described.

20. The combination, with the shaft 19, the clutch-pinion, the clutch-half revolved by the shaft and adapted to be engaged with the clutch-pinion, the gear 25, the cam 24, revolving with said gear, the grain-divider, and means, substantially as described, connecting the divider with the cam to actuate the divider, substantially as described.

21. The combination, with the shaft 19, the clutch-pinion, the clutch-half revolved by the shaft and adapted to be engaged with the pinion, the gear 25, the cam 24, revolving with said gear, the transfer-fingers, and means, substantially as described, connecting the fingers with the cam to actuate the fingers, substantially as described.

22. In a grain-binder, the combination, with the binding-arm, its actuating-shaft and segment-gear, of a compressing-arm sleeved upon the stud parallel to its actuating-shaft, and a segment-gear sleeved on said stud, and connected with said arm by a spring, and meshing with the gear of the binding arm, substantially as described, whereby the stroke of the compressing-arm is adapted to yield to various sizes of gavels, as set forth.

23. The combination, with the binding-arm, and its segment gear, and its opposing compressing-arm 58, of curve rod 58^a, actuating-spring 58^b, sleeved thereon, segment-gear $57\frac{1}{2}$, and arm 57^b, substantially as described.

24. The compressing-arm, the shaft, and the lever 60, in combination with the cam-faced gear, the cam of which has a bearing along the length and against the end of said lever, substantially as and for the purpose described.

25. The combination, with the binding and compressing arms, their actuating-shaft, and the lever 60, of the cam-faced gear, the cam of which has a bearing along the length of the lever and against its end, substantially as described, whereby the power of the lever is gradually increased and the pressure of the binding-arm and compressing-arm is correspondingly increased as they descend upon the gavel.

26. The looper-shaft provided with intersecting slots receiving the twine, in combination with devices external thereto adapted to retain the twine in or permit it to be discharged from said slots, substantially as described.

27. In a knotter, the combination, with the slotted stem or shaft, of the slotted inclosing shell or tube and means for actuating said stem and shell, substantially as described.

28. The combination, with the stem or shaft provided with intersecting slots receiving the twine, of the device or devices external thereto adapted to retain the twine in and permit it to be discharged from said slots, and mechanism intermittently and simultaneously reciprocating and oscillating said stem or shaft and retaining devices, substantially as described.

29. The combination, with the inclosing shell or tube, the point of which is provided with transverse intersecting slots for receiving the twine, of a stem or shaft and mechanism intermittently and simultaneously reciprocating and rocking the said stem or shaft, substantially as described.

30. The combination, with the stem or shaft slotted at its point to receive the twine and mechanism for rocking and reciprocating said stem or shaft, of an inclosing shell or tube, the point of which is provided with slots adapted to receive the twine and co-operate with the slots of the stem or shaft in receiving the twine and forming and tying a knot, substantially as described.

31. The combination, with a stem or shaft slotted at its point to receive the twine, and mechanism for rocking and reciprocating said shaft, of the slotted and inclosing shell or tube and means for rocking said tube independently of the stem, substantially as described.

32. The combination, with the stem or shaft and the inclosing shell or tube, of the pivoted lever 114, sleeved and collared upon the shaft, and a revolving actuating-cam engaging with said lever to reciprocate the stem or shaft, substantially as described.

33. The combination, with the looper-shell provided with a pin, 113, of the slide 130, having its bearing on said shell and engaging with

the pin 133, and means for reciprocating said slide to revolve the shell, substantially as described.

34. The combination, with the looper-shaft, the pin 133, and the slotted slide 130, of the cam-grooved sleeve 127, plate 129, connecting said sleeve and slide, and means for actuating the cam-sleeve, substantially as described.

35. The combination, with the looper-shaft, the slide, and the cam-grooved sleeve 127, of a lantern-gear mounted upon said sleeve, the vibrating studded plate 125, and means for actuating the studded plate, substantially as described.

36. The combination, with the cam-sleeve 127 and the studded plate 125, engaging the segment-gear on the sleeve, of the arm 135 and a cam engaging with said arm and actuating said studded plate, substantially as described.

37. An adjustable spring-studded reciprocating twine-holder provided with a stud projecting from and at a right angle to its operative face, in combination with a fixed plate or jaw recessed to correspond with and receive said holder and its stud, substantially as described.

38. The combination, with the looper stem or shaft and the inclosing shell or tube, of a lifting-finger, substantially as described.

39. The combination, with the stem or shaft and the inclosing shell or tube, of a lifting-finger and mechanism for intermittently reciprocating and oscillating said finger across the path of the looper, substantially as described.

40. The combination, with the lifting-finger and its arm 169, of the spring-actuated rocking and reciprocating shaft 167 and means for operating the same, substantially as described.

41. The combination, with the lifting finger and its rocking and reciprocating shaft, of the downwardly-projecting arm 166, the levers 172 and 162, connected with said shaft, and means for actuating said levers, substantially as described.

42. The combination, with the reciprocating stem or shaft, of a plate, 88, provided with a perforation intermittently receiving the point of said stem, and with guides 86 and 87, for holding the twine in alignment with the receiving slot or eye of the stem, substantially as described.

43. The combination, with the reciprocating stem or shaft, of a plate, 88, provided with a perforation intermittently receiving the point of the stem, and with guides 86 87 and stud 89, for holding the twine across the path of the looper, substantially as described.

44. The combination, with the reciprocating stem or shaft, of the twine-guides 86, 87, and 89, and the twine-holder bearing 90, intermediate between guides 87 and 88, substantially as described.

45. In a grain-binder, the grain-receiving platform, the binding-table, and the intermediate gavel-table, arranged in the same horizontal plane with each other, in combination with the gavel-gage operating at a point between the grain-receiving platform and binding-table, substantially as described.

46. In a grain-binder, the grain-receiving platform, the gavel-table, and the binding-table, in combination with the gavel-gage arranged in front of the binding-table, whereby said gage operates as a cut-off between the inflowing grain and that being bound on the binding-table, substantially as described.

Signed at Chicago, Illinois, September 21, 1882.

MARSENA M. HOOTON.

Witnesses:
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