(No Model.) 5 Sheets—Sheet 1.

D. STRUNK.

GRAIN BINDER.

No. 332,218. Patented Dec. 8, 1885.

Fig. 12.

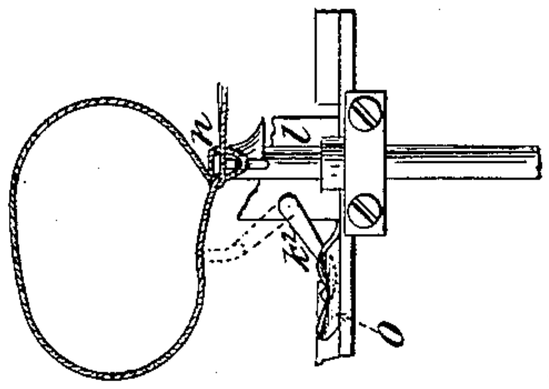


Fig. 11.

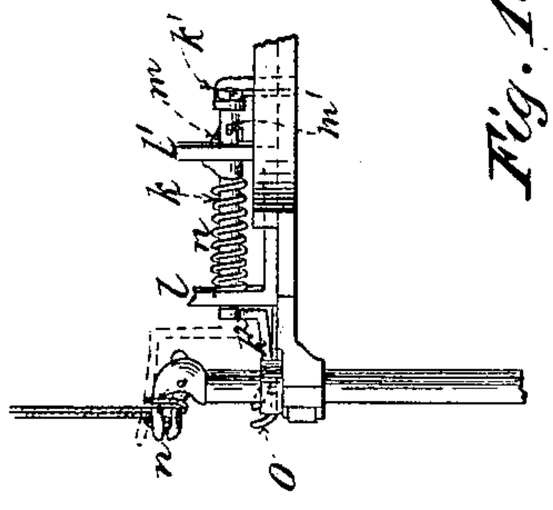


Fig. 13.

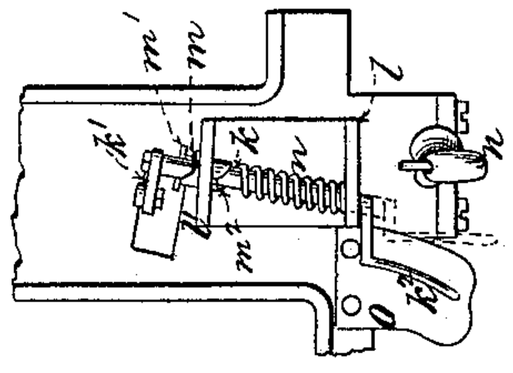
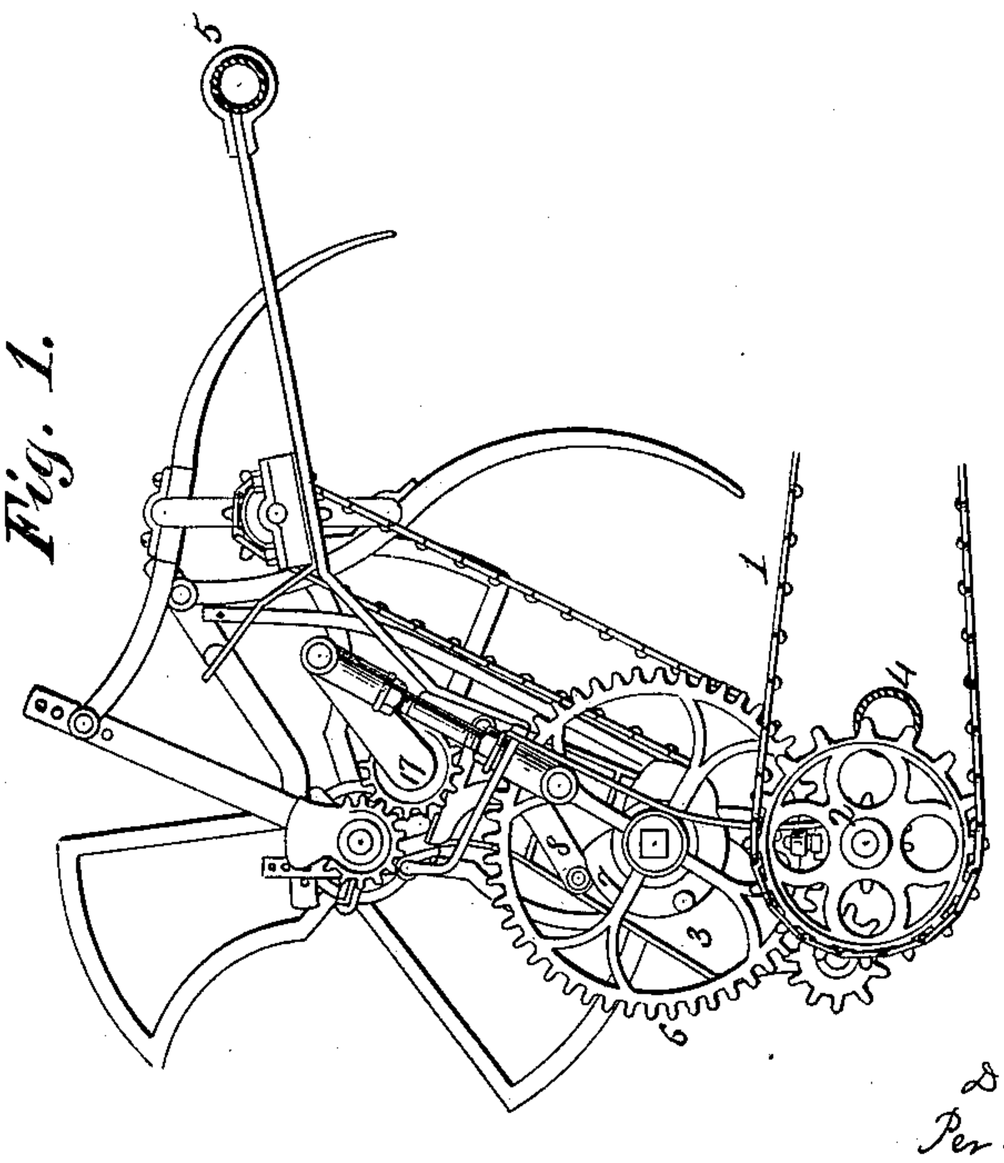


Fig. 1.



Witnesses:
R. C. Howes
M. L. Adams.

Inventor:
Daniel Strunk,
Per Edw. E. Lemmon,
Atty.

(No Model.)

5 Sheets—Sheet 2.

D. STRUNK.

GRAIN BINDER.

No. 332,218. Patented Dec. 8, 1885.

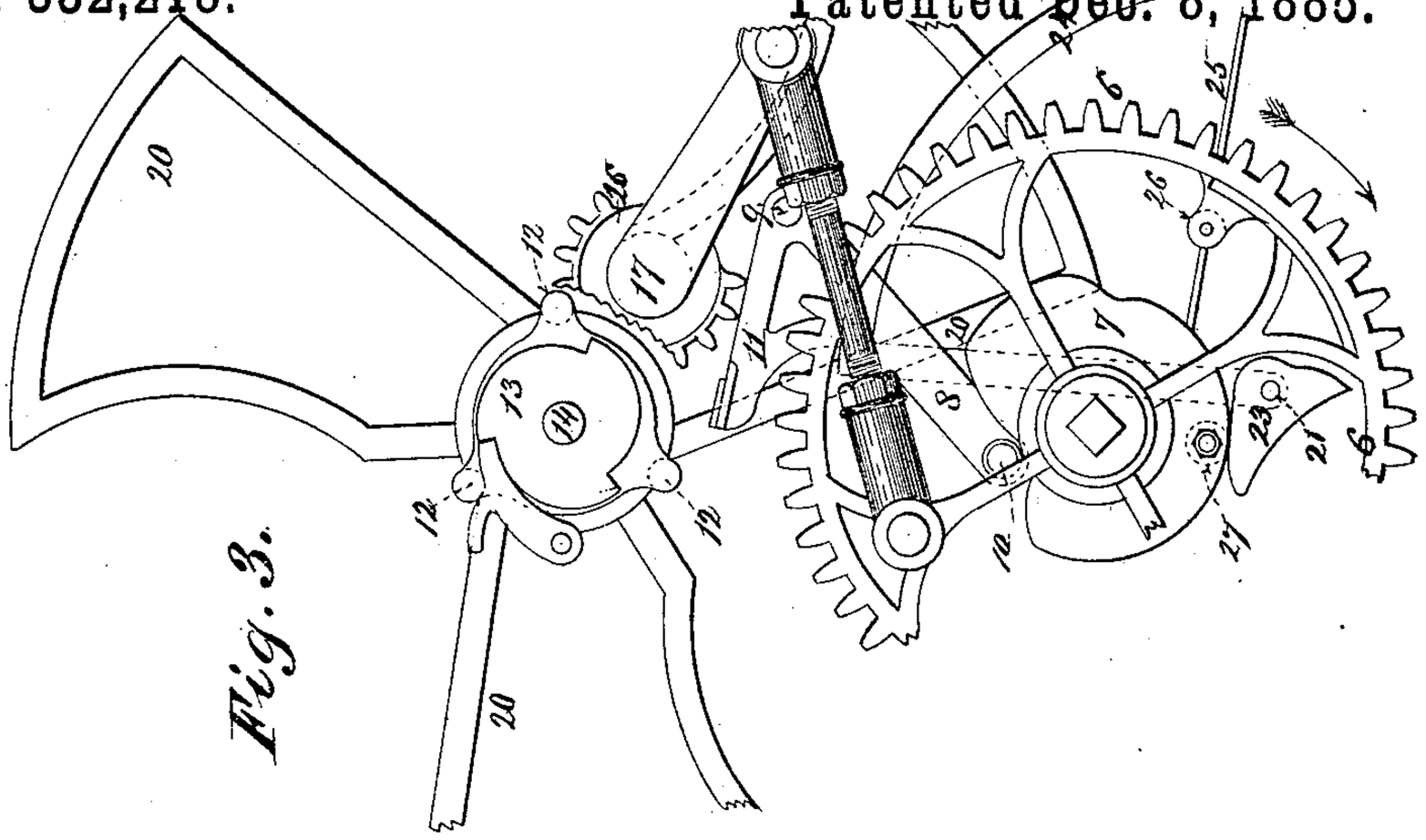


Fig. 3.

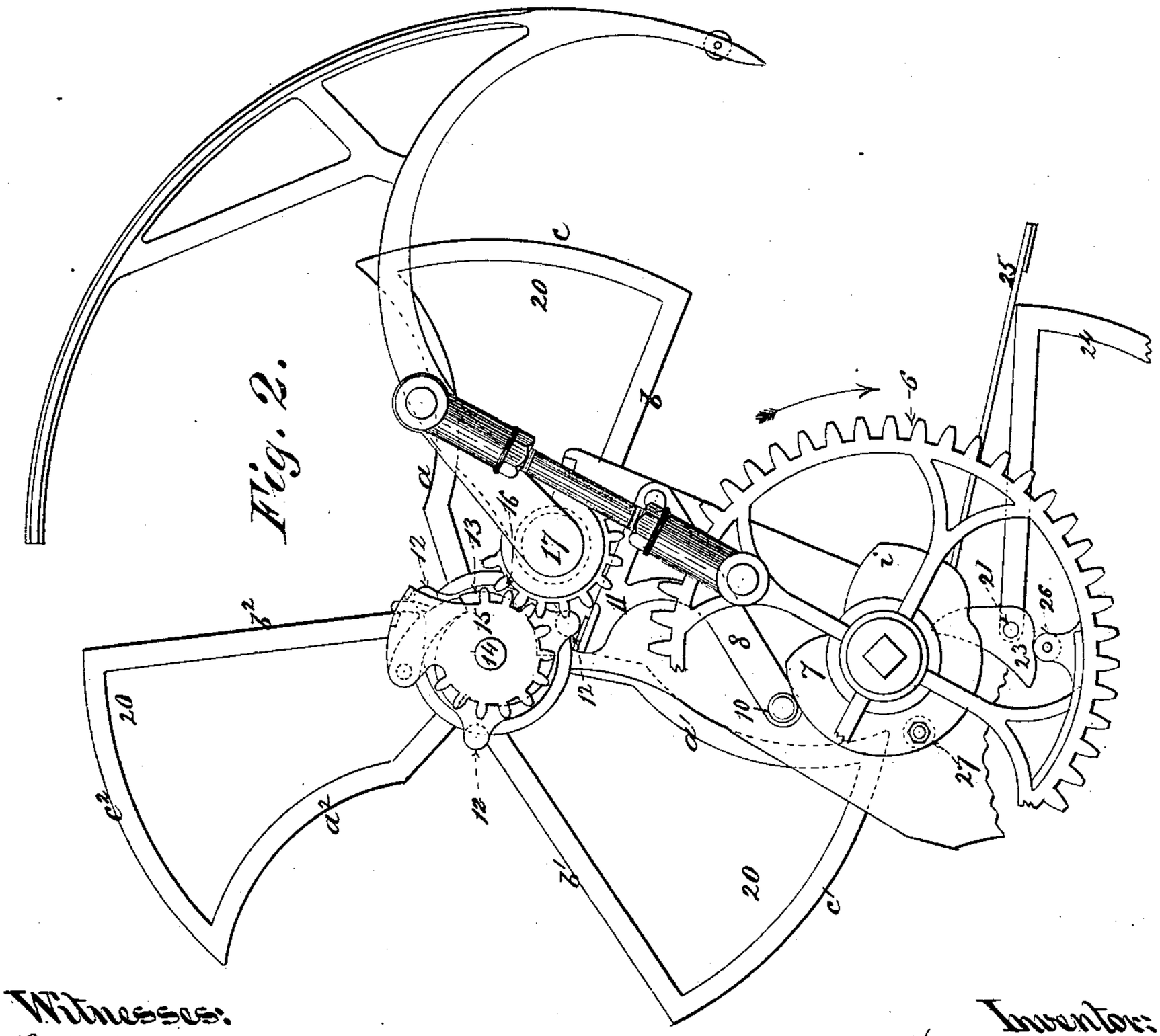


Fig. 2.

Witnesses:
R. C. Howes.
M. L. Adams.

Inventor:
Daniel Strunk,
Per Edw. E. Lucas,
Atty.

(No Model.)

5 Sheets—Sheet 3.

D. STRUNK.

GRAIN BINDER.

No. 332,218. Patented Dec. 8, 1885.

Fig. 3.

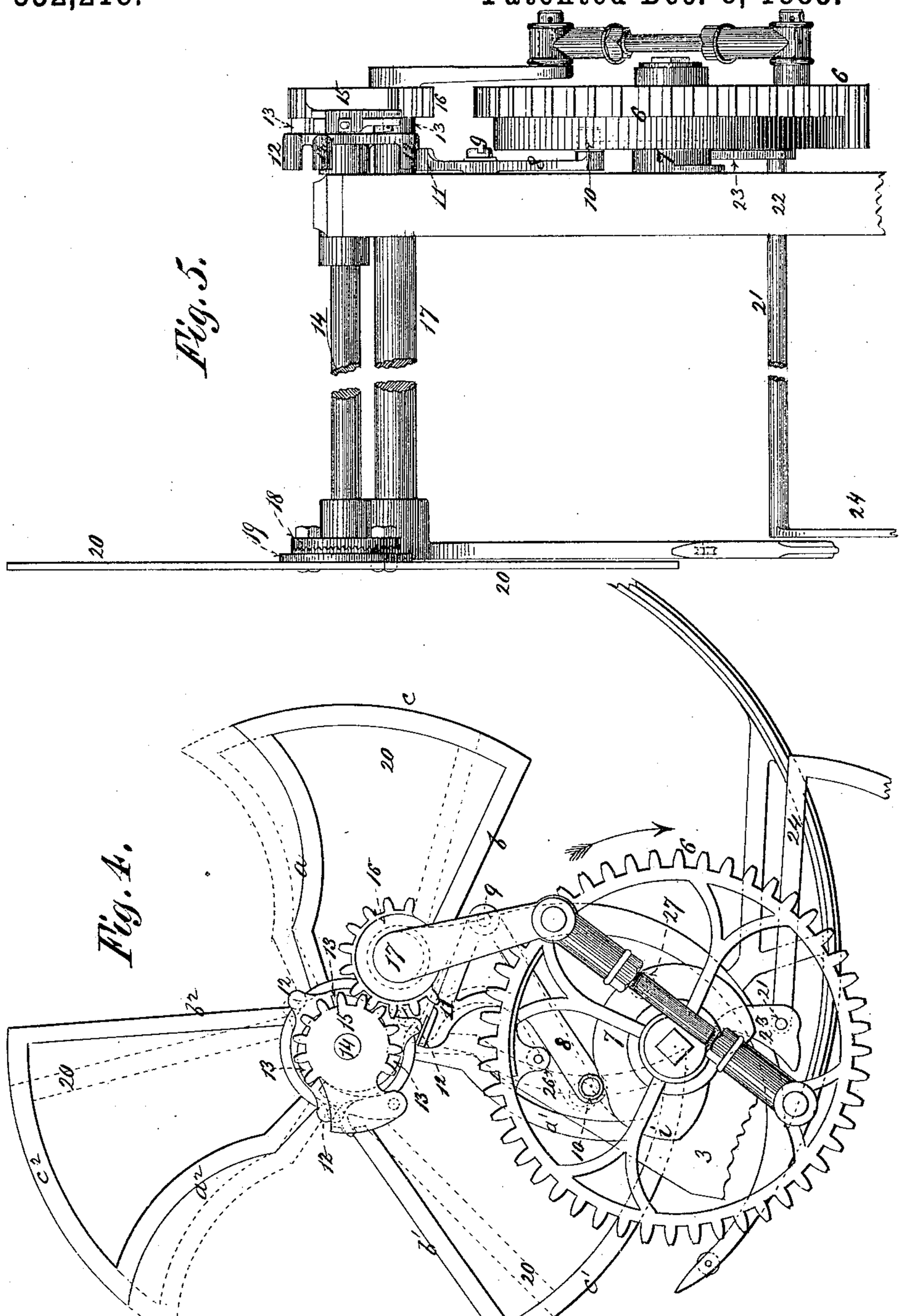


Fig. 4.

Witnesses:
R. C. Howes.
M. L. Adams.

Inventor.
Daniel Strunk
Per Edw. E. Lunney,
Atty.

(No Model.)

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D. STRUNK.

GRAIN BINDER.

No. 332,218.

Patented Dec. 8, 1885.

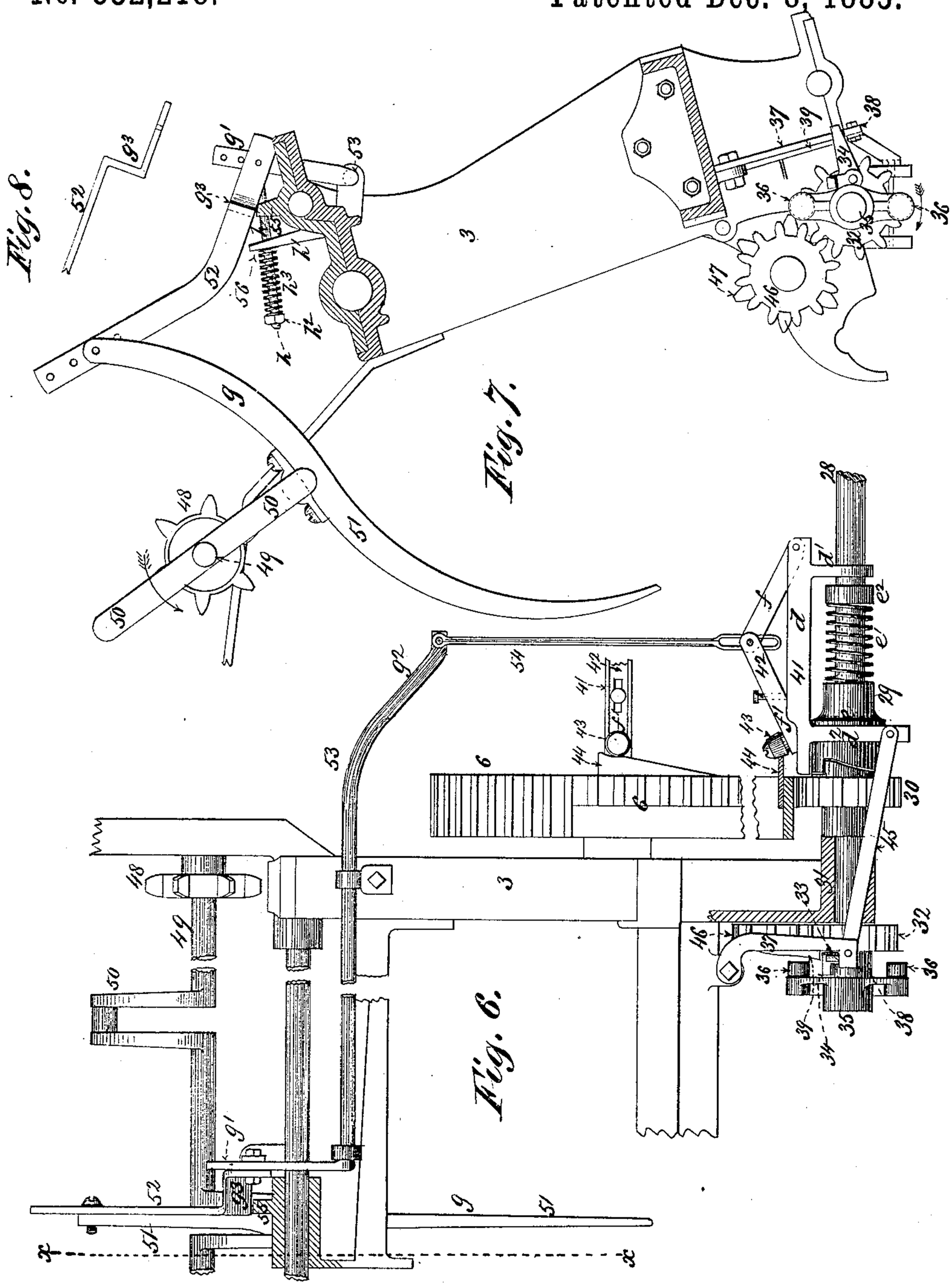

Fig. 8.

Fig. 7.

Fig. 6.

Witnesses:
R. B. Howes
M. L. Adams.

Inventor:
Daniel Strunk,
For Edw. E. Linney
Atty

(No Model.) 5 Sheets—Sheet 5.

D. STRUNK.

GRAIN BINDER.

No. 332,218. Patented Dec. 8, 1885.

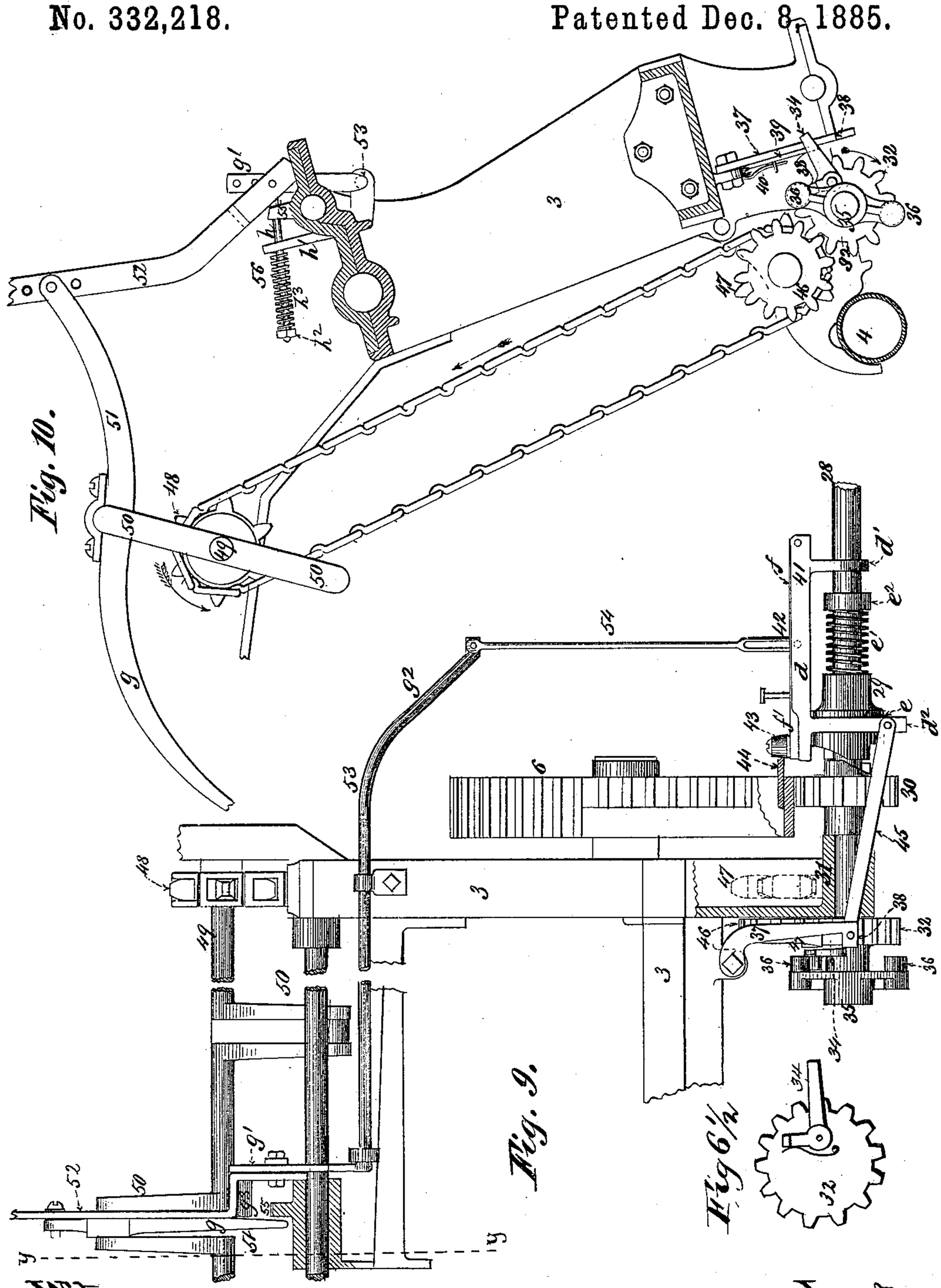

Fig. 10.

Fig. 9.

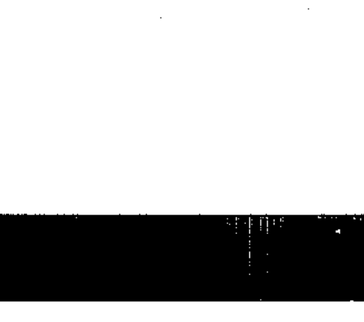

Fig 6½

Witnesses:
R. C. Howes
M. L. Adams.

Inventor:
Daniel Strunk,
Per Edw. E. Lunn,
Atty.

UNITED STATES PATENT OFFICE.

DANIEL STRUNK, OF MINNEAPOLIS, MINNESOTA.

GRAIN-BINDER.

SPECIFICATION forming part of Letters Patent No. 332,218, dated December 8, 1885.

Application filed November 24, 1884. Serial No. 148,687. (No model.)

To all whom it may concern:

Be it known that I, DANIEL STRUNK, of Minneapolis, Minnesota, have invented certain Improvements in Grain-Binders, of which the following is a specification.

My improvements, which relate to grain-binders of the type of that shown and described in Letters Patent of the United States No. 269,347, issued to me December 19, 1882, embrace the features of a rotary compressor and discharger which administers extra compression to the gavel during the binding operation, a vibrating discharger which acts in conjunction with the rotary compressor to discharge the bound bundle of grain, devices for adjusting the point in the path of movement of the packer at which it shall trip the binder into gear, and devices for giving the tucker an endwise movement in addition to its vibrating movement.

The accompanying drawings of a grain-binder containing my improvements are as follows: Figure 1 is a rear elevation. Fig. 2 is a rear elevation of portions of the binder, showing a portion of the main gear and the compressor, and showing the needle in its elevated position. Fig. 3 is a view similar to Fig. 2, with some of the parts broken away, showing the position of the rotating compressor and the vibrating discharger in the act of effecting the discharge of the bound bundle. Fig. 4 is an elevation of the parts shown in Fig. 2, illustrating the operation of the mechanism for effecting the extra compression of the gavel during the binding operation. Fig. 5 is a side elevation showing the parts of the binder in the position in which they are represented in Fig. 4. Fig. 6 is a side elevation illustrating the mechanism for automatically starting and stopping the binder and packers. Fig. 6½ is a detail view showing means for rocking crank-lever 34. Fig. 7 is a vertical section taken through the line X X on Fig. 6, showing that one of the packer-arms by which the tripping operation is effected, and further illustrating the tripping mechanism. Fig. 8 is a top view of the link connecting the packer to the crank-arm of the rock-shaft for operating the toggle by which the packers are thrown out of gear. Fig. 9 is a side elevation showing in a different position the stopping and starting mechanism illustrated in Fig. 6. Fig. 10 is a vertical section taken through the line Y Y on Fig. 9. Figs. 11 and 12 are respectively side and front elevations of my improved tucker, showing its relation to the knotting-bill, and showing the shield behind which it is withdrawn after performing its function. Fig. 13 is a top view of the parts shown in Figs. 11 and 12.

In my improved binder the needle-arm is rocked upon its axis by means of a pitman-connection with a pin upon the face of the main gear, the axis of which is below the axis of the needle-arm. The hub of the needle-arm is provided with a segmental gear engaging a loose pinion upon the shaft of the rotary compressor, and this pinion is provided with a driving-pawl for engaging the teeth of a ratchet-wheel affixed to the shaft of the compressor. During the upward swing of the needle-arm, after the conclusion of the binding operation, this pawl engages a ratchet-wheel upon the shaft of the binder and turns the compressor-shaft a third of a revolution. During the downward movement of the needle-arm to apply the binding-cord to the bundle this pawl rides over the ratchets, thus producing no effect upon the compressor-shaft. The compressor has three curved arms, which are in succession brought into position to present their concave faces toward the incoming grain, and three intermediately-placed straight arms, the outer end of each of which is connected with the outer end of one of the curved arms. The straight arms act in succession as discharging-arms for discharging the bound bundle during the upward swing of the needle-arm. The binding mechanism is actuated by power transmitted from the harvester by the sprocket-chain 1, (shown in Fig. 1,) which engages the sprocket-wheel 2, which is splined to the prime shaft of the binder. This prime shaft is provided with two clutches, by means of which power is alternately transmitted to the packers and to the needle-arm, extra compressing devices, and knotting mechanism. The binder-frame 3 is supported upon two of the horizontal members 4 and 5 of the main frame of the harvester. The main gear-wheel 6 of the binder has affixed to its hub a cam, 7, for administering the extra compression to the gavel, which it effects through the medium of the bell-crank lever 8, pivoted at 9 to the frame

of the binder, and provided at the end of its long arm with a roller, 10, which travels on the cam 7. The shorter arm 11 of the bell-crank lever is adapted to engage with the projections 12, cast on the ratchet-wheel 13. The ratchet-wheel 13 is keyed to the shaft 14 of the rotary compressor. A pinion, 15, is loosely mounted on the shaft 14, and carries a pawl for engaging the teeth of the ratchet-wheel 13. A segmental gear, 16, on the hub of the needle-shaft 17 engages and actuates the pinion 15. The needle-shaft is rocked in its bearings by means of a pitman-connection with the main gear of the binder, as shown in the drawings. A flanged casting, 18, is keyed to the compressor-shaft 14. A plate, 19, is bolted to the face of the flanged casting 18, and the system of bundle compressing and discharging arms composing the compressor and discharger 20 is bolted to the plate 19, as shown in Fig. 5. The plate 19 is concentrically slotted to admit the bolts by which it is secured to the flanged casting 18, in order to provide for adjusting the compressor and discharger upon the shaft 14. A rock-shaft, 21, is arranged below the binder deck or table and provided with bearings in the binder-frame, one of which bearings, 22, is shown in Fig. 5. At its rear end the shaft 21 has affixed to it a cam-shaped lever, 23. At its forward end it has affixed to it a discharge-arm, 24, which projects at first radially from the shaft 21, then has a backward curve, which is concentric with the shaft, giving it the shape of one of the straight sides and the curved side of a quadrant.

The rotary compressor and discharger consists of the three curved arms a a' a^2, and of the three straight arms b b' b^2. The arms a b and a' b', and a^2 b^2 are respectively connected at their outer ends by the concentrically curved braces c c' c^2. The straight arms b b' b^2 act successively as dischargers for the bound bundles, and are assisted in this function by the vibrating discharge-arm 24. A portion of the binder deck or table 25 is shown in Figs. 2 and 3. The discharge-arm 24 is swung backward into the position in which it is shown in Fig. 2 by the engagement of its cam-lever 23 with the roller 26, mounted upon the side of the main binder-gear. The discharger 24 is swung in the opposite direction to assist in discharging the bound bundle by the action upon its cam-lever 23 of the roller 27, mounted upon the side of the cam 7, as shown in Fig. 3.

The manner in which power is transmitted from the main shaft 28 alternately to the packers and to the main binder-gear will be understood on reference to Figs. 6, 7, 8, 9, and 10, in which 29 is a sliding clutch loosely splined to the main shaft. A clutch-gear, 30, mounted loosely on the main shaft 28, meshes with the main binder-gear 6. The main shaft 28 has its bearings in the binder-frame. One of these bearings, 31, is shown in Figs. 6 and 9. A pinion, 32, is loosely mounted on the main shaft 28, and has upon its face a projection, 33. (Shown in Fig. 6.) It also has pivoted to it a bell-crank lever, 34. A driving cross-head, 35, is keyed to the forward end of the main shaft 28, and is provided upon its rear face with two rollers, 36 36. An arm, 37, having upon its lower end a lateral projection, 38, is so pivoted to the binder-frame as to swing in a plane parallel with the driving-shaft 28, and has affixed to it a latch, 39, sprung outward by the spring 40. The bell-crank lever 34 is acted upon by a spring so arranged upon the pinion 32 as to rock the short arm of the lever outward from the center of the pinion 32.

The clutch-shifter 41 consists of a horizontal member, d, provided at one end with a downwardly-projecting perforated arm, d', which is adapted to slide on the main shaft 28, and provided at the other end with the downwardly-projecting yoke d^2, which embraces the usual circumferential groove, e, in the sliding clutch 29.

The expanding spiral spring e', surrounding the main shaft, abuts at one end against the face of the fixed collar e^2 and at the other end against the sliding clutch 29, and tends by its expansion to thrust the sliding clutch 29 toward and into engagement with the clutch-gear 30. The engagement of the clutch 29 with the clutch-gear 30 is permitted by the breaking of the toggle 42, one link, f, of which is pivoted to the horizontal member d of the clutch-shifter, while the other link, f', is provided with the roller 43, which, when the main gear 6 is at rest, is engaged by the cam 44 on the face of the main binder-gear 6.

In Fig. 6 of the drawings the main binder-gear is represented as broken in two, the lower part of the gear being represented in vertical section, in order to show the engagement of the cam 44 with the roller 43. The remaining portion of the main gear is represented in a different position, in order to afford a top view of a portion of the toggle and carrier and a top view of the cam 44 at the time of its engagement with the roller 43. A link, 45, connects the yoke d^2 of the clutch-shifter with the swinging arm 37.

Motion to operate the packers is taken from the main shaft 28 by means of the pinion 46, which is driven by the spur-wheel 32. The pinion 46 has formed with it, or attached to it, the sprocket-wheel 47, which is connected by a sprocket-chain with the sprocket-wheel 48 on the packer-shaft 49. The usual cranks, 50, are provided for vibrating the packer-arms 51.

In my machine only one of the packer-arms—the one indicated by the letter g, in addition to the figures 51—is employed for tripping the binding mechanism into gear, and, for the sake of clearness of illustration, the packer-arm g is the only one shown in Figs. 6, 7, 9, and 10.

To enable the packer-arm g to perform its function of tripping, it is connected by the link 52 with the upper end of the crank-arm g' upon the forward end of the rock-shaft 53, the rear end of which bends laterally, forming

the crank-arm g^2, which is connected by means of the link 54 with the toggle 42.

At every vibration of the packer-arm g the link 52 is swayed upward and downward upon the axis afforded by its pivotal connection with the crank-arm g', and a shoulder, g^3, formed upon the link 52, is thereby alternately dropped in front of and raised clear of a projection, 55, upon the binder-frame.

The crank-arm g' is held in its upright position during the packing operation by the adjustable spring-holder 56, which consists of a rod, h, pivoted at one end to the crank-arm g' and inserted loosely through the standard $h,'$ projecting upward from the frame, and having upon its opposite end the adjusting-nut h^2. An expanding spiral spring, h^3, surrounding the rod h, abuts at one end against the standard h' and at the other end against the nut h^2. As will be seen, by turning the nut h^2 forward or backward the tension of the spring h^3 may be varied, and the stress necessary to sway the crank-arm g' varied accordingly.

The tension of the spring h^3 is so regulated as to be sufficient to prevent the crank-arm g' from being swayed outward during the operation of packing the grain into the grain-receptacle to form the gavel; but, finally, when the desired quantity of grain has been collected, the resistance which the gavel then opposes to forward movement of the lower end of the packer-arm g causes the upper end of the packer-arm, when in suitable position, to be swayed laterally toward the crank-arm g' with sufficient force to overcome the resistance of the spring h^3 and sway the crank-arm g' outward, and thus sway upward the crank-arm g^2 and pull up the link 54 and break the toggle 42, thereby releasing the clutch 29 to the action of the spring e', by which it is driven into engagement with the clutch-gear 30. This starts the binding mechanism into operation and concurrently stops the packers, because when the clutch 29 moves forward into engagement with the clutch-gear 30 it carries the shifter forward and swings outward the pivoted arm 37, which is connected with the yoke d^2 by the link 45. The swinging outward of the arm 37 carries the projection 38 into the path of rotation of the long arm of the bell-crank 34, which consequently strikes against the projection 38 and rocks upon its pivotal connection with the gear 32, thereby moving the short arm of the bell-crank lever toward the center of the gear 32 and out of the path of rotation of the driving-rollers 36, which thenceforward in their rotation pass outside of the short arm, continuing to revolve without revolving the gear 32. The gear 32 and all of its connections, including the packers, thereupon come to rest, and are kept positively from advancing by the resting of the long arm of the bell-crank lever upon the projection 38, and are prevented from any backward motion by the latch 39, which snaps over the projection 33 on the side of the gear 32. The packer-shaft 49 has the same speed that the main binder-shaft 28 has.

The projection 55 serves as a stop for the shoulder g^3 upon the link 52, which prevents the possibility of tripping the binding mechanism into gear, excepting when the packer g has arrived at such a position in its path of movement as to raise the shoulder g^3 clear of the projection 55. This is of importance, because the packers are thus prevented from stopping, except in a prescribed position, in which they will hold the compacted gavel in such a way as to assist the needle in its work, and also assist in separating the bound from the unbound grain.

After the binding mechanism has been tripped into gear, the parts move forward from the positions in which they are shown in Fig. 2, and the rotation of the main gear 6 causes the needle-arm to descend until it occupies the position in which it is shown in Fig. 4.

During the downward swing of the needle-arm the segmental gear 16 on the needle-shaft turns the pawl-carrying gear 15, and thereby carries the pawl backward from its position of engagement with one of the ratchet-teeth of the ratchet-wheel 13 a distance somewhat greater than that required to carry it into engagement with the next succeeding tooth of the ratchet-wheel 13. The movement of the pawl beyond the point required to enable it to engage the next succeeding ratchet-tooth allows room between the point of the pawl and the ratchet-tooth for the reverse movement of the compressor, by which it is brought into the position in which it is represented in dotted lines in Fig. 4. The object of this reverse movement is to administer the extra compression to the bundle during the knotting operation.

The reverse movement of the compressor is effected by the engagement of the roller 10 with the protruding portion i of the cam 7. This rocks upward the short arm 11 of the bell-crank lever 8, and, by the engagement of the short arm 11 with one of the projections 12, cast upon the ratchet-wheel 13, rocks the compressor backward, the cam 7, the bell-crank lever 8, the ratchet-wheel 13, and the compressor all assuming the positions in which they are represented in dotted lines in Fig. 4. At the time when this reverse movement takes place the bundle is confined between the needle-arm on one side and the concave side of one of the curved arms of the compressor on the other. This extra compression of the bundle relieves the cord from undue strain, and permits the bundle to be bound much tighter.

Soon after the knot has been tied, the parts assume the positions in which they are represented in Fig. 3, in which, as will be seen, the main gear of the binder has brought the roller 25 on the cam 7 in contact with the cam-shaped lever 23 on the rock-shaft 21, causing it to rock in its bearings and swing forward

the discharge-arm 24, which, coming from below the binder-deck 26, behind the bundle, serves to assist the discharge-arm b, b', or b^2, as the case may be, in discharging the bound bundle.

The discharge of the bundle is effected during the backward swing of the needle-arm, during which, by the engagement of the segmental gear 16 on the needle-shaft with the pawl-carrying gear 15, and the engagement of the pawl with one of the teeth of the ratchet-wheel 13, the compressor is turned one-third of a revolution.

The relative positions, and the manner in which the rotating discharge-arms $b\,b'\,b^2$ work in conjunction with the vibrating discharge-arm 25, in effecting the discharge of a bundle, are illustrated in Fig. 3.

As soon as the clutch 29 has been driven into engagement with the clutch-gear 30, the rotation of the main gear 6 carries the cam 44 out of engagement with the roller 43. The links f f' of the toggle then drop by their own gravity from the positions in which they are represented in Fig. 6 into the horizontal positions in which they are shown in Fig. 9. As the main gear completes its revolution, the cam 44 re-engages the roller 43, and pushes back the shifter, and thus disengages the clutch 29 from the clutch-gear 30, and, by swinging the arm 37 backward, permits the re-engagement of the driving cross-head 35 with the gear 32, and thus, simultaneously with the stopping of the main gear, starts the packers into operation.

The mechanism for operating the knotting-head in this machine is substantially the same as that shown and described in Letters Patent of the United States No. 269,347, issued to me December 19, 1882. It is set into action by the engagement of a section of the gear on the main binder-wheel 6 with a pinion on the knotter-shaft. I have, however, made an improvement in the tucker shown and described in the said patent, which consists in giving to the tucker, in addition to its rocking movement, an endwise movement, and I have provided a shield behind which the tucker is withdrawn after it has performed its function, and which prevents the cord from coming into contact with the tucker during the movement of the needle-arm.

My tucker has a horizontal shaft, k, which is inclined to the plane of movement of the binder-arm and is provided with bearings in the standards l and l'. At its rear end the shaft k is provided with a crank-arm, k', for connection with the usual pitman, by means of which the tucker is operated. At its front end the shaft k is provided with the offset tucking-arm k^2. Endwise motion is given to the tucker during its rocking motion by means of the stationary spiral cam m, secured to the standard l'. The spiral edges of this cam are engaged by pins m' m^2, inserted transversely through the shaft k. If desired, a spiral spring, n, may be fastened at one end to the shaft k and at the other to the standard l, to serve by its torsion to hold down the tucker-arm k^2 when at rest in the position in which it is represented in solid lines in Figs. 11 and 12, and in which, as will be seen, it lies behind the curved shield O, which prevents the cord from coming in contact with the tucker-arm during the movements of the needle.

The axis of the tucker-shaft k is perpendicular to the axis of the knotting-bill n, therefore the endwise movement of the shaft k, when the tucking-arm k^2 is swung upward, causes the tucking-arm to be projected, so that it intersects the plane of the cord, which insures the successful performance of the tucking operation. On the other hand, when the tucking-arm k^2 is swung downward, the reverse endwise movement of the shaft k withdraws the tucking-arm k^2 out of the plane of the cord, so that when at rest it lies behind the shield O.

It will of course be understood that the range of endwise movement of the shaft k may be made sufficiently great to withdraw the tucker so far out of the way of the cord that the shield O may be dispensed with.

I claim as my invention—

1. The herein-described compressor and discharger, composed of a series of compressor-arms and a series of discharging-arms mounted upon the shaft 14, having affixed to it the ratchet-wheel 13, provided with the projections 12, in combination with the pawl-carrying pinion 15, loosely mounted upon the shaft 14, the segmental gear 16, affixed to the needle-shaft 17, the main gear 6, connected by a suitable pitman with the needle-arm, the cam 7, affixed to the main gear, and the bell-crank lever 8.

2. The rotary compressor and discharger and means, substantially such as described, for imparting step-by-step rotation thereto, in combination with a vibrating discharger, the axis of which is parallel with the axis of the rotating compressor and discharger, and means for swinging the vibrating discharger upon its axis concurrently with the discharge movement of the rotating compressor and discharger, for the purpose of effecting the discharge of a bundle of grain from a gavel-receptacle situated between the axis of the rotating compressor and discharger and the axis of the vibrating discharger, the said axes being located on opposite sides of the binding-table.

3. The vibrating discharger 24 and the cam-shaped lever affixed to the rock-shaft 21, in combination with the rollers 26 and 27, carried by the main gear 6, for operating the discharger 24, substantially as set forth.

4. In a grain-binder in which the binding mechanism is tripped into gear by the resistance opposed by the collected gavel to the continued forward movement of the packers, mechanism, substantially such as herein described, for preventing the tripping of the

binding mechanism into gear, except when the packers have reached prescribed positions, the same consisting of the link 52, connecting the packer trip-arm *g* with the crank-arm *g'* of the trip rock-shaft 53, and the projection 55 from the binder-frame, in front of which the shoulder g^3 is carried during a portion of the stroke of the packer trip-arm *g*, and the adjustable spring-holder 56, for regulating the stress required to effect the tripping operation.

5. Mechanism, substantially such as herein described, for holding the packers in position out of operation while the bundle is being bound, the same consisting of the swinging arm 37, provided with the projection 38, and carrying the spring-latch 39, and the gear 32, loosely mounted upon the binder-shaft 28 and provided upon its face with the projection 33, and having pivoted to it the bell-crank lever 34, the long arm of which lodges upon the projection 38 when the arm 37 is swung forward by the forward movement of the clutch-shifter 41, whereby the short arm of the bell-crank lever is swung toward the axis of the main shaft and within the path of movement of the rollers 36 on the driving cross head 35, and the gear 32, thus released from the driving action of the cross-head and prevented from continuing its rotation with the cross-head by the lodging of the long arm of the bell-crank lever 34 upon the projection 38, is, in addition, prevented from any reverse movement by the snapping of the latch 39 over the projection 33.

6. In a grain-binder, the combination of the knotting-bill with a tucker vibrating upon an axis perpendicular to the axis of the knotting-bill, and having, in addition to its vibrating motion, a reciprocating endwise motion, as and for the purpose set forth.

7. The vibrating tucking-arm k^2, affixed to the shaft *k*, in combination with the spiral cam *m* and cam-pins for engaging the said cam and imparting reciprocating endwise movement to the said shaft *k* during its rocking movement, as and for the purpose described.

8. The combination of the vibrating tucker-arm k^2 with the shield O, as and for the purpose set forth.

DANIEL STRUNK.

Witnesses:
R. C. STEPHENS,
HENRY OOTHOUT.