5 Sheets—Sheet 1.

J. BEHEL.

GRAIN BINDER.

No. 93,165. Patented Aug. 3, 1869.

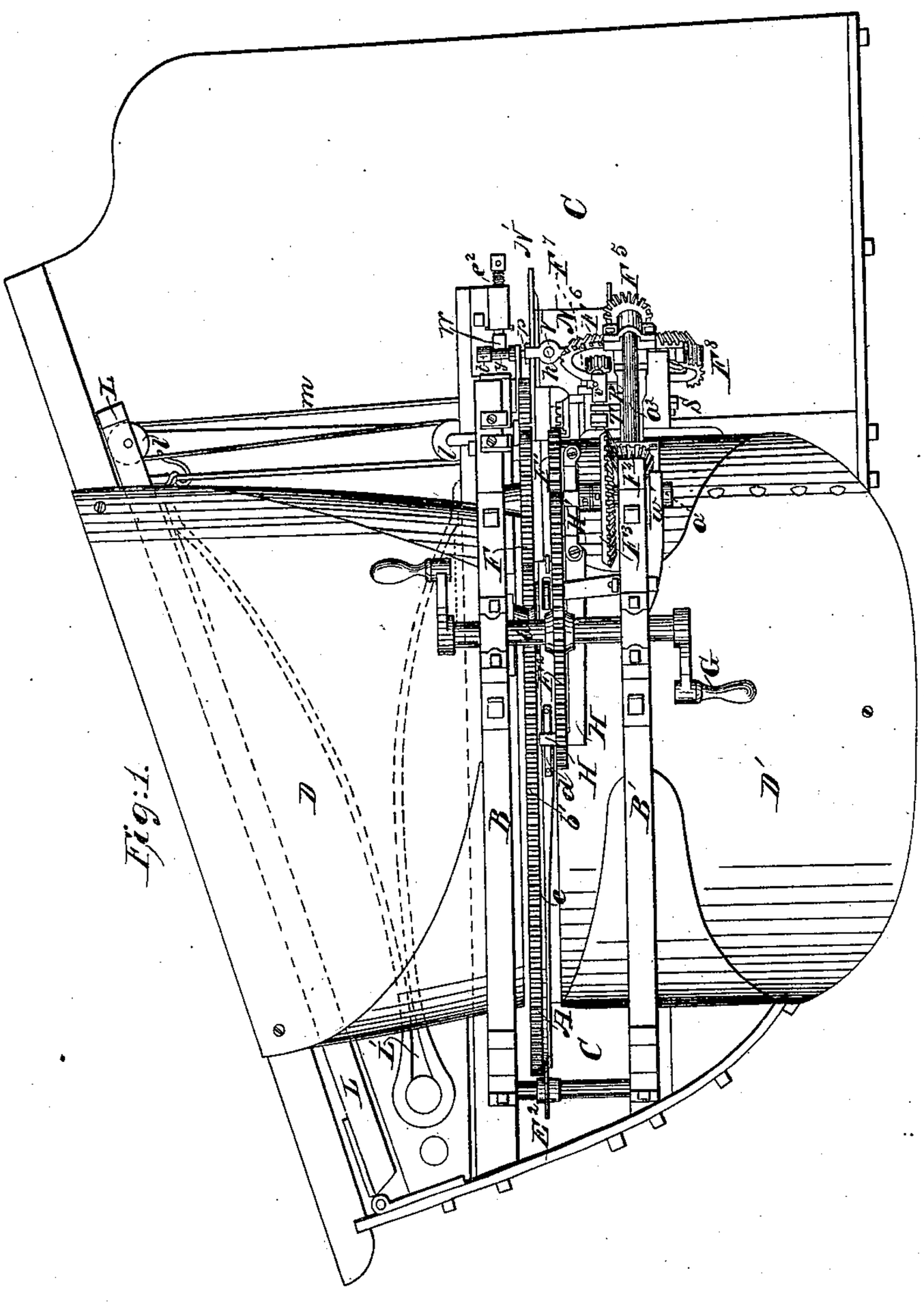


Fig: 1.

Witnesses:
A. Shedlock:
J. W. Thurston.

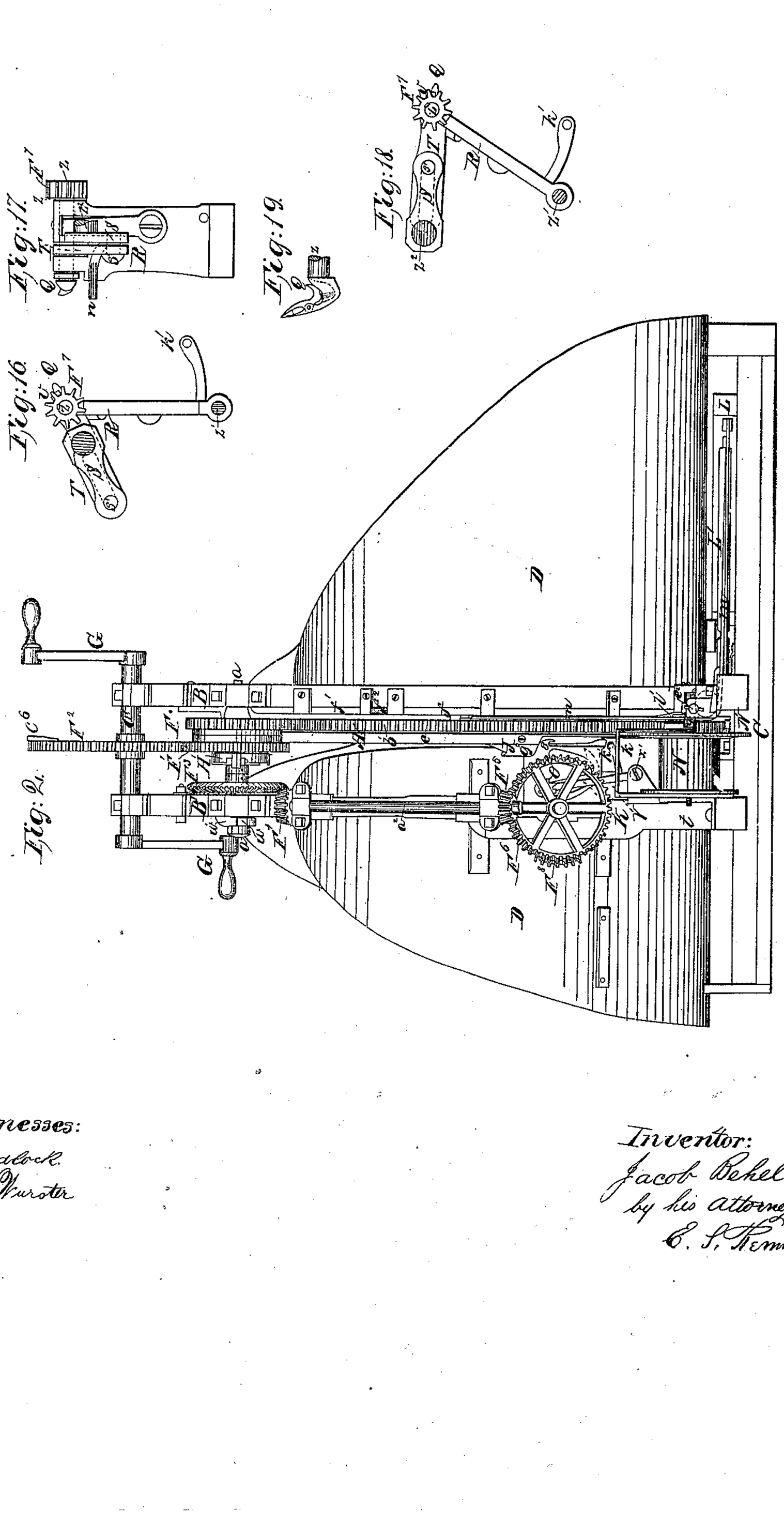
Inventor:
Jacob Behel
by his attorney
C. L. Kennicott

5 Sheets—Sheet 2.

J. BEHEL.

GRAIN BINDER.

No. 93,165. Patented Aug. 3, 1869.



Witnesses:
A. Speedlock.
F. W. Wurster

Inventor:
Jacob Behel
by his attorney
E. S. Renwick

5 Sheets—Sheet 3.

J. BEHEL.

GRAIN BINDER.

No. 93,165. Patented Aug. 3, 1869.

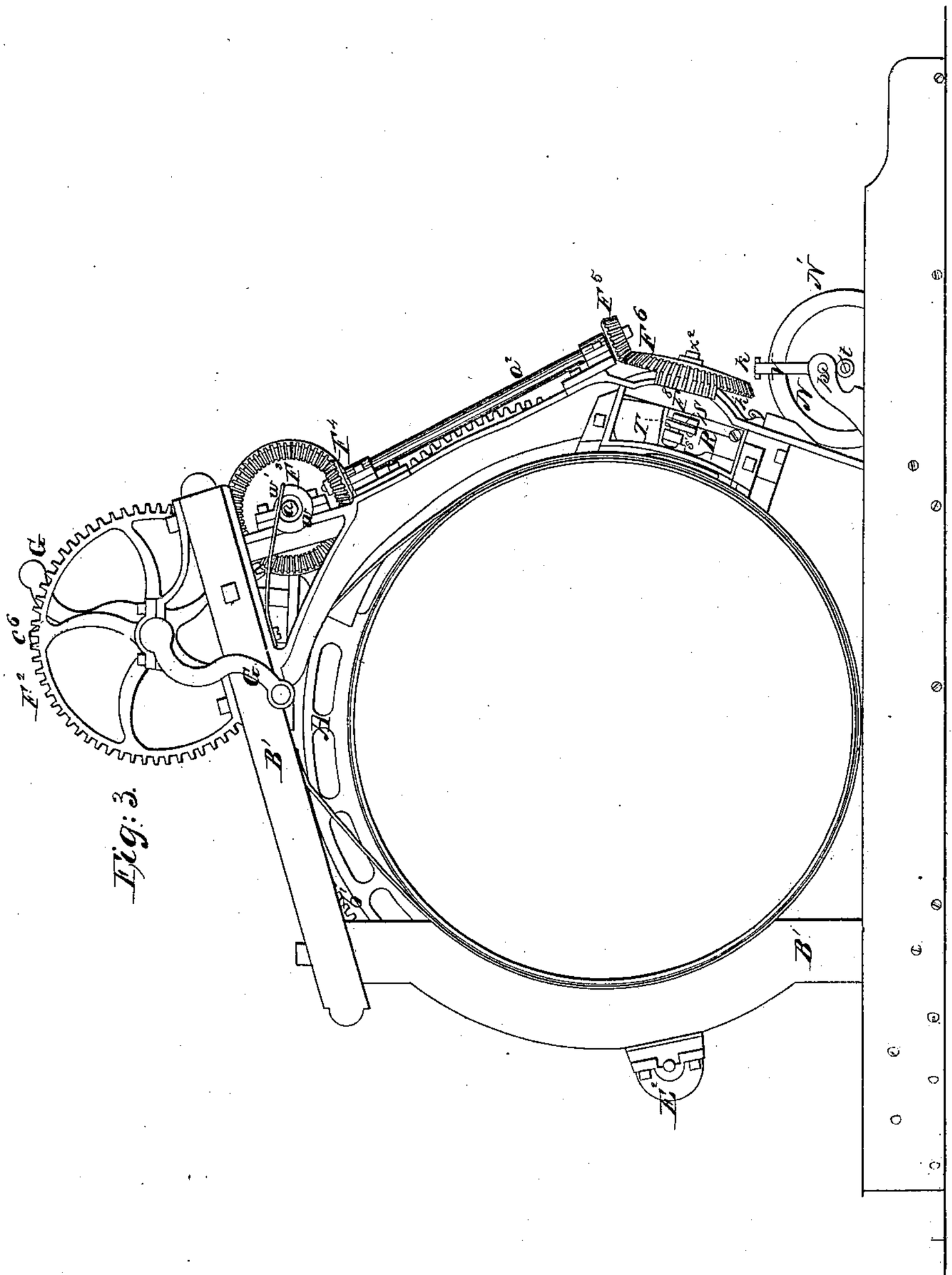


Fig: 3.

Witnesses:
A Shedlock
F. W. Kurster

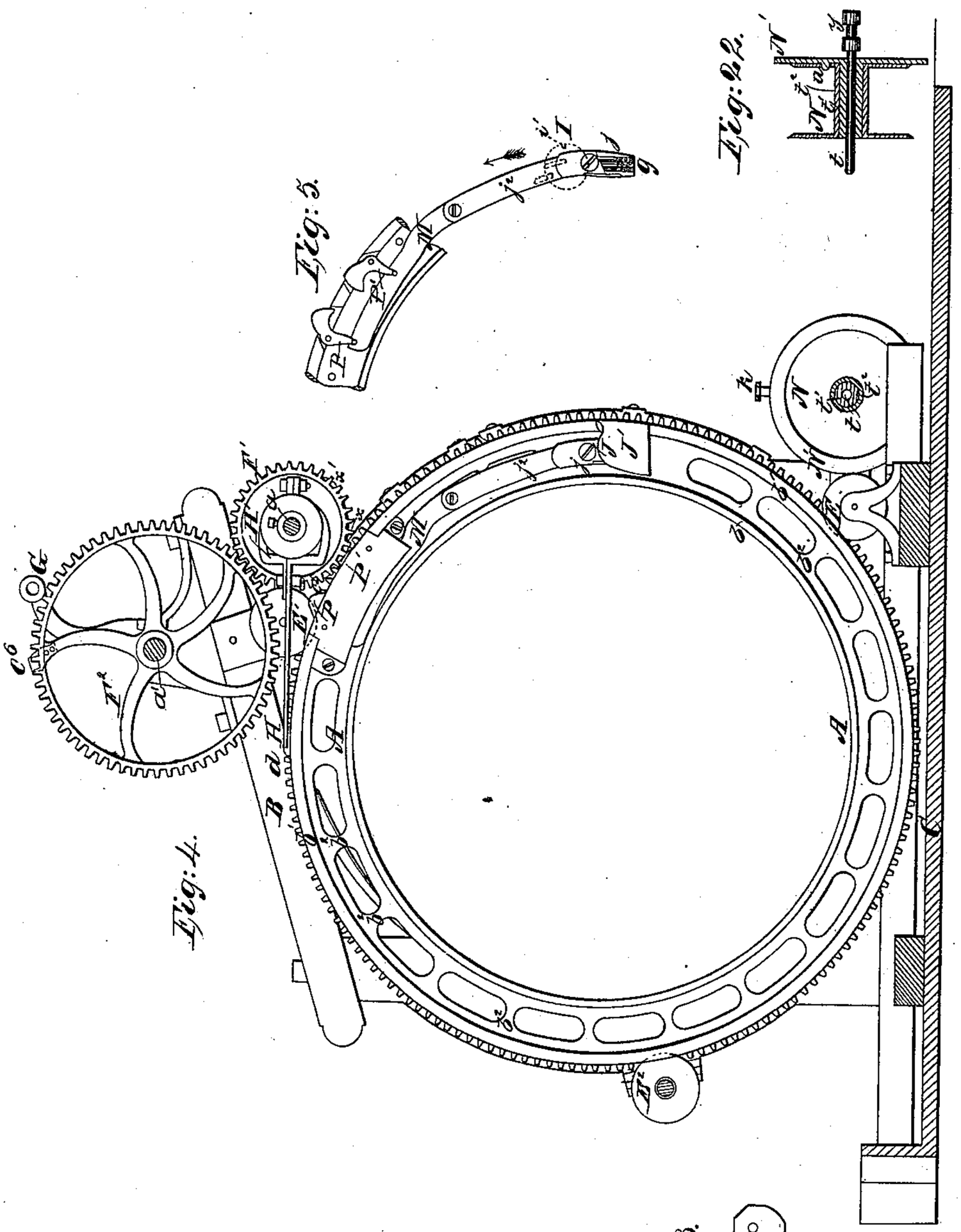
Inventor:
Jacob Behel
by his attorney
E. L. Ronrick

5 Sheets—Sheet 4.

J. BEHEL.

GRAIN BINDER.

No. 93,165. Patented Aug. 3, 1869.



Witnesses:
A. Shedlock.
F. H. Thurston.

Inventor:
Jacob Behel
by his Attorney
E. S. Renwick

5 Sheets—Sheet 5.

J. BEHEL.

GRAIN BINDER.

No. 93,165. Patented Aug. 3, 1869.

Fig: 9.

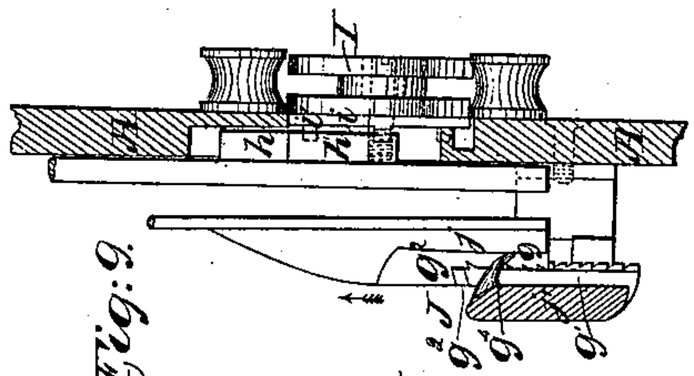


Fig: 8.

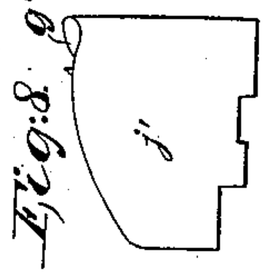


Fig: 15.

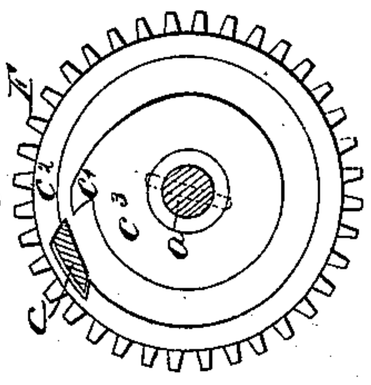


Fig: 7.

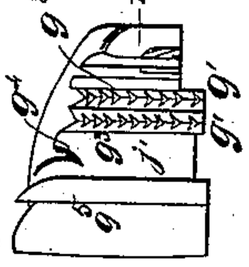


Fig: 6.

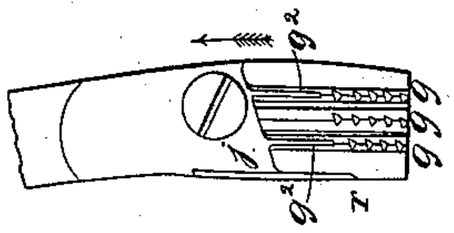


Fig: 14.

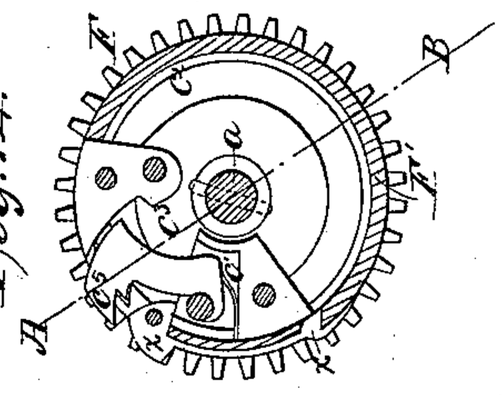


Fig: 13.

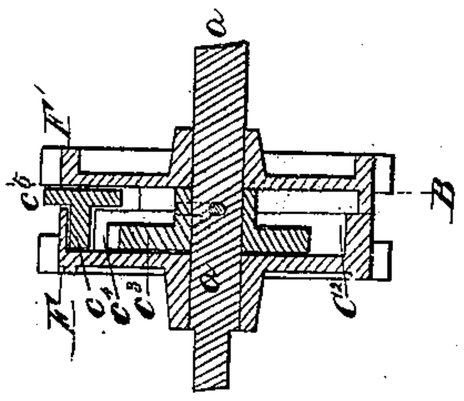


Fig: 11.

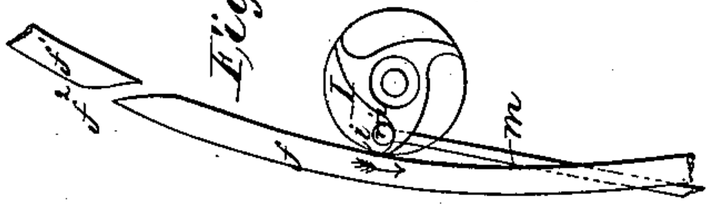


Fig: 12.

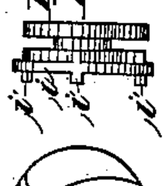


Fig: 10.

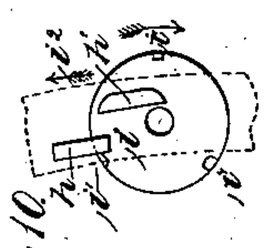


Fig: 20.

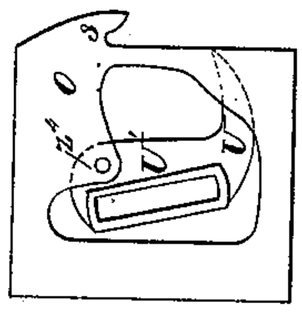
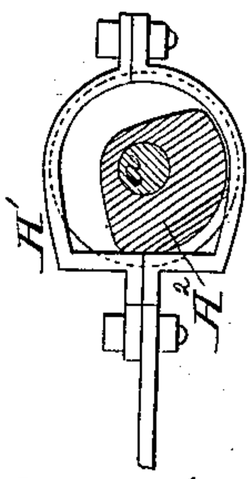


Fig: 21.



Witnesses:
A. Snedeker.
F. W. Wenster

Inventor:
Jacob Behel
by his attorney
E. L. Zerrick

United States Patent Office.

JACOB BEHEL, OF ROCKFORD, ILLINOIS.

Letters Patent No. 93,165, *dated August* 3, 1869.

IMPROVEMENT IN GRAIN-BINDERS.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, JACOB BEHEL, of Rockford, in the county of Winnebago, and State of Illinois, have invented certain new and useful Improvements in Binding-Apparatus, for the purpose of binding grain, and for other purposes to which such apparatus may be applicable; and that the following is a full, clear, and exact description of the same.

The general operation of the binding-apparatus I am about to describe, when applied to a harvester, is as follows:

The grain received upon the raking-platform of the harvester is collected, by a rake, into a gavel, and is pushed, heads foremost, into a cradle having a flaring mouth to admit it, and direct it into a ring-carrier, by which a compressing-belt or strap, and the binding-material, drawn from a spool, are carried around the gavel.

The end of the compressing-belt is carried round the gavel, under a spring-tension, sufficient to compress it for binding, and the binding-material carried round the compressed gavel, is severed from the mass on the spool, and has its ends united so as to secure the band, after which the compressing-belt is released and withdrawn from the bound sheaf, leaving the latter free to be discharged, by hand, or otherwise, from the cradle in which the binding is effected.

The object of the first part of the invention which constitutes the subject-matter of the present patent, is to enable the band to be compressed, and the binding-material to be applied and secured, by the application of power to one shaft or wheel, although the band-securing mechanism be stationary, or, in other words, be not carried around the gavel.

This part of the invention consists of the combination of a ring-carrier, or its equivalent, for carrying the binding-material, and a compressing-strap, or either of these, around the position of the gavel, and of a stationary band-securing instrument, with the same driving-shaft, by means of a clutch, or other suitable connecting and disconnecting-mechanism, operating in such manner that the ring-carrier, or its equivalent, and the band-securing mechanism, are alternately connected with the driving-shaft, so that while one is being operated thereby, the other is disengaged therefrom. This improvement retains all the advantages incident to a stationary band-securing mechanism, and yet relieves the operator of the apparatus from the necessity of shifting his hands from one part of the machine to another, whereby time is lost, and confusion apt to be created. The band-securing instrument which I prefer to use in this combination, is the tying-bill, heretofore invented and patented by me, but some other of the known band-securing instruments may be substituted for my tying-bill in this combination, provided the remainder of the band-securing mechanism be adapted to it, and the band-securing instrument be arranged so as to be stationary in the machine, while combined with the driving-shaft, that also operates the ring-carrier, by a clutch, or its equivalent.

My invention, consists further, of the arrangement of the mechanism for transmitting motion to the band-securing mechanism, and the ring-carrier, from the same driving-shaft or wheel, in such manner that the latter may be revolved in the same direction while operating the band-securing mechanism and the ring-carrier, whereby the necessity of reversing the movement of the driving-shaft or wheel is avoided.

My invention consists, further, of the combination of a turning detachable holder, for the compressing-belt or strap, with a detent fitted with two stops, and arranged to slide upon the ring-carrier, in the direction of its periphery, so that the liberation and subsequent arrest of the detachable strap-holder, for the purpose of letting go and recatching the compressing-belt, may be effected by sliding the detent in alternately opposite directions upon the ring-carrier, or its equivalent, for carrying said detent and detachable strap-holder.

My invention consists, further, of the combination of the ring-carrier with a curved guard set upon the frame-work of the binding-apparatus, so close to the ring-carrier that the head of the compressing-strap or belt cannot pass between the two, and that the head of the belt may be caught by the guard in case it escapes from the strap-holder.

My invention consists, further, of the combination of the ring-carrier with a curved belt-guard, composed of two members, separated by a gate-way, of sufficient size to permit the passage of the head of the compressing-strap, so that it may be readily passed to the inner side of the guard.

My invention consists, further, of the arrangement of the curved belt-guard, the detachable strap-holder, and the ring-carrier, in such manner that the inner curved surface of the belt-guard is in close proximity to the track pursued by the outermost arm of the detachable strap-holder, as carried by the ring-carrier, so that the head of the compressing-strap is held by the guard in the position to be picked up by the strap-holder in its movement by the ring-carrier, or its equivalent, for carrying the strap-holder.

My invention consists, further, of a cord-holder which is a combination of two jaws, provided with ribs, serrated in the same direction, the one jaw constructed to move longitudinally to and fro along the other, so that the binding-material, when once engaged between the jaws, is moved by each reciprocation of the sliding jaw towards one end of the cord-holder.

My invention consists, further, of the combination of

the serrated jaws of the cord-holder with one or more fingers, for the purpose of pushing the binding-material into the gripe of the jaws.

My invention consists, further, of the combination of the cord-holder, having jaws, one of which moves longitudinally upon the other, with a knife or knives operating in connection with said jaws, so that the binding-material is severed by said knives after it is in the gripe of the jaws, and at a point between the jaws and the position of the gavel, whereby the new end formed by cutting is left in the gripe of the jaws.

My invention consists, further, of the combination of the cord-holder, having jaws, one of which moves to and fro upon the other, with a belay-hook, that prevents the binding-material from being dragged longitudinally from the said jaws.

My invention consists, further, in the combination of a cord-holder, having jaws, one of which moves to and fro upon the other, with one or more fingers projecting across the slit between the jaws, and with a belay-hook, so that the binding-material is both pushed into the gripe of the jaws and prevented from being pulled out.

My invention consists, further, of the combination of the movable jaw of the cord-holder and the detent-stops of the detachable strap-holder, with the same slide, or its equivalent, so that the cord-holder and detachable strap-holder are both actuated by the same instrument.

My invention consists, further, of the combination of the ring-carrier, the movable jaw of the cord-holder, and the movable blade for severing the binding-material, with rotating cams, in such manner that the closing-movement of the cord-holder is effected by two steps, the first of which effects the seizure of the binding-material, and the last of which effects its severing.

My invention consists, further, of the combination of a stationary band-securing instrument, with the ring-carrier and the slide, or other instrument, for actuating either the movable jaw of the cord-holder, the movable shear-blade, or the detent of the detachable strap-holder, or two or more of these three appurtenances of the ring-carrier, with cams connected with the mechanism that transmits motion to the band-securing instrument, so that one or more of the said appurtenances of the ring-carrier may be operated by imparting motion to the stationary band-securing instrument.

My invention consists, further, of the combination of the band-securing instrument with a revolving shaft, by means of a crank and slotted connecting-rod (or their equivalents) and a segment and pinion, the whole operating in such manner that the movement of the band-securing instrument toward and from the position for tying, and the turning of said instrument for securing the band, are effected alternately by the revolution of one shaft.

My invention consists, further, of the combination of the swinging gate, or stock that carries the band-securing instrument, with a stud and stop, to determine the position of the band-securing instrument during the securing of the band.

My invention consists, further, of the combination of the swinging gate, or stock of the band-securing instrument, with a finger swinging on a centre distinct from that of the swinging gate, for the purpose of gathering or holding the two members of the band to the notch of the shield-plate.

My invention consists, further, of the combination of the swinging arm or frame for the spool of binding-material with a disk-head (for transmitting the detaining-force to the said material) that is separate from the spool, so that one spool of material may be substituted for another, without the necessity of having a disk-head upon each.

My invention consists, further, of the combination of the swinging frame or arm for the spool of binding-material with a spool-shaft that is removable endwise therefrom, and with a holder, to maintain the spool-shaft in its position, so that the spool may be readily withdrawn or replaced and secured in the spool-frame, by withdrawing or replacing the holder and the spool-shaft on which it acts.

My invention consists, further, of the combination of the stop that holds the ring-carrier in its position, during the securing of the band, with the band-securing instrument, by a cam (or other instrument) that permits the movement of the stop and ring-carrier during the securing of the band, so that binding-material is then rendered up for forming the tie of the band.

My invention consists, further, of the combination of the swinging frame or arm for the spool of binding-material with a spool-shaft that is removable endwise therefrom, a holder, to hold said shaft in its position, and a spring, to keep said holder in place, and determine the tension upon the binding-material, or perform either of these functions.

In order that the operation of my various combinations may be understood, I will proceed to describe a binding-apparatus, which embodies them all in the best form which I have thus far devised, and I will refer to the accompanying drawings thereof, in which—

Figure 1 represents a plan of the apparatus;

Figure 2 represents a side view thereof;

Figure 3 represents a rear elevation thereof;

Figure 4 represents a rear view thereof, with certain portions removed, to permit others to be seen; and

Figures 5 to 23 represent views of certain parts of the apparatus, detached from the remainder, and designated by the same letters of reference as are applied to them where they appear in the preceding figures, some of such parts being drawn upon a larger scale than the other figures.

The apparatus represented in the said drawings is of a suitable form to be applied to a harvesting-machine, and to receive a gavel of grain from the raking-platform thereof.

The ring-carrier A of this apparatus, and the devices for supporting it, are mounted in a frame-work, composed mainly of two circular frames, B B^1, and of the platform or base C, to which they are made fast.

These frames are lined at each side of the ring-carrier with sheet-metal, D D′, so as to form a cradle, in which the grain is inserted for binding, the front portion D of the cradle being made flaring, in order to admit the grain more readily, and direct it into the ring-carrier.

The ring-carrier A is constructed with an inner flange, *b*, and an exterior rim, furnished with cog-teeth b^1, and the flange and rim are connected by studs, b^2, so that a ring-frame of great strength and rigidity, and yet of light weight, is produced.

The periphery of this ring-carrier has a groove, *e*, turned in it, to receive the treads of three wheels, E E^1 E^2, whose arbors turn in bearings secured to the frames B B^1, and as the guiding-groove *e* is upon the ring-carrier, and is not formed in the treads of the wheels, the groove is protected from straws by the substance of the ring-carrier.

The cog-teeth b^1, at the rim of the ring-carrier, gear nto a wheel, through which motion is imparted to the ring-carrier.

This wheel F is fitted to turn loosely upon an arbor, *a*, which also supports a second cog-wheel, F^1, of the same size as the first, and this second wheel gears into a cog-wheel, F^2, whose shaft a^1 turns in bearings secured to the frame-work of the apparatus, and is fitted with two crank-handles, G G, to which the hands of the operator are applied, so that this crank-shaft a^1

becomes the driving-shaft of the apparatus, and the cog-wheel F^2, the driving-wheel.

In order that the band-securing mechanism and the ring-carrier may both be operated by turning the driving-wheel F^2, and yet that the band-securing mechanism may remain at rest on the frame-work of the machine, while the ring-carrier is carrying the band around the gavel, and that the ring-carrier may remain at rest while the band-securing mechanism is operated to secure the band, the intermediate cog-wheel F^1 is connected alternately, by means of a clutch, with the cog-wheel F (that transmits motion to the ring-carrier) and with the arbor *a*, (that transmits motion, as hereinafter described, to the band-securing mechanism,) and in order that the operation may be automatic, the clutch is controlled by the driving-wheel F^2.

The moving member of the clutch consists of a tooth, *c*, (fig. 15,) arranged within the casing formed by the disks and rims of the two cog-wheels F F^1, so that it is protected from straws and dust.

This tooth is connected with a spring, c^1, (fig. 14,) that tends to force it from the arbor *a* into a notch, formed in a circular rib, c^2, on the interior of the cog-wheel F, and when the tooth is engaged in this notch, the cog-wheel F and the ring-carrier A are connected with the intermediate cog-wheel F^1 and the driving-wheel F^2, and are forced to turn with the driving-wheel.

The arbor *a* is fitted with a hub, c^3, having a tooth, c^4, at its periphery, at such distance from the arbor that when the clutch-tooth *c* is disengaged from the notch of the rim c^2, it is in position to engage with the tooth of the hub c^3, and *vice versa*. Hence, when the movable clutch-tooth *c* is engaged with the arbor *a*, the cog-wheel F and the ring-carrier A are disconnected from the driving-wheel, and remain at rest, while the band-securing mechanism, connected with the arbor *a*, is operated by the same driving-wheel.

In order that the operation of the clutch may be controlled by the driving-wheel F^2, the movable clutch-tooth *c* is formed with a projection, c^5, that extends through an opening in the rim of the wheel F, within the range of travel of a cam, c^6, carried by the driving-wheel F^2, so that whenever the driving-wheel cam c^6 and the projection c^5 of the clutch-tooth come in contact, the clutch-tooth is forced inward, whereby it is disengaged from the notch of the wheel F, and engaged with the disk c^3 of the arbor *a*.

In order that the driving-wheel F^2 may be moved continuously in the same direction, whether operating the ring-carrier or the band-securing mechanism, the wheels F^3 F^4 F^5 F^6, that transmit motion from the arbor *a* to the instrument for securing the band, are so arranged that the arbor *a* may revolve in the same direction as the cog-wheel F.

In the apparatus represented in the drawings, I have proportioned the parts of the machinery in such manner that six revolutions of the wheels F F^1, when connected, are required to turn the ring-carrier one complete revolution for encircling the gavel with the compressing-belt and binding-material, and that one revolution of the arbor *a*, with the wheel F^1, is required to operate the band-securing mechanism for securing the band for a sheaf of grain.

In order, therefore, that the cluch may be operated by the driving-wheel cam c^6 only when the ring-carrier has completed its revolution, the driving-wheel is made two and one-third times the diameter of the cog-wheel F^1, so that three turns of the driving-wheel correspond with seven turns of the wheel F^1, and consequently the cam c^6 (of the driving-wheel) and the projection c^5 (of the clutch-tooth) will come in contact only every seventh turn of the cog-wheel F^1.

When the clutch is engaged with the disk-tooth c^4, it is carried around within the circular rib c^2 of the wheel F, (which, being disconnected from the wheel F^1, is then at rest,) and is thereby maintained in engagement with the disk c^3, until the latter, and the arbor with which it is connected, have completed a revolution, and brought the clutch-tooth again opposite the notch of the rim c^2, whereupon, as the cam c^6 has in the mean time been carried away from the position of the notch, the clutch-tooth is disengaged (by the action of its spring) from the disk and arbor *a* of the band-securing mechanism, and is re-engaged with the cog-wheel F of the ring-carrier.

In order that the ring-carrier may not retrograde under the strain of the compressing-belt, when the ring-carrier is disengaged (by the action of the clutch-tooth) from the driving-wheel F^2, a spring-stop, H, is provided.

This stop operates in connection with a tooth, *d*, that is secured to the ring-carrier A, and is inclined at its front side, so as to raise the stop H, and pass beneath it, as the ring-carrier completes its revolution.

The rear side of the tooth *d* is radial, or thereabout, with the ring-carrier, so that the tooth does not tend to disengage itself from the end of the stop H, with which it is brought in contact by the strain of the compressing-belt, as soon as the ring-carrier is liberated from the driving-power by the action of the clutch-tooth *c*.

The ring-carrier carries a detachable strap-holder, (for carrying the compressing-strap around the gavel,) and the cord-holder or forceps, for carrying the binding-material around the gavel.

The detachable strap-holder I is located at the side of the ring-carrier at which the gavel is entered, and the cord-holder J is located at the rear side of the carrier, so that the substance of the ring-carrier is interposed between the compressing-strap and the binding-material, thereby preventing the one from interfering with the other.

The detachable strap-holder I has three forked arms, to receive and hold the head of the compressing-strap, and is constructed to turn on a pivot. Its plate *i* (see, particularly, figs. 9, 10, 11, and 12,) is received in a circular socket formed in the face of the ring-carrier, and is provided, at its hinder side, with three teeth or pallets, i^1, which engage, in succession, with the two stops *h h'* of a sliding detent, M, that is operated (as hereinafter described) after the sheaf is bound, to release the pallet corresponding with the forked arm that holds the compressing-belt, and permit the strap-holder to turn sufficiently to let go the compressing-belt, and then stop the further revolution of the strap-holder, (by engaging with the next succeeding pallet,) so as to hold it, with its next succeeding arm, in the proper position to catch the head of the compressing-belt.

In order that the detent may thus operate, it is fitted with the two bar-stops *h h'*, separated transversely by a space as large as the breadth of a pallet, and so arranged that their adjacent ends overlap. Hence, when the detent is in the position represented at fig. 10, (which is the position it occupies while the ring-carrier is revolving around the gavel,) the bar-stop *h* is in the track of the pallets i^1, and prevents the strap-holder from turning. If, however, the detent be moved in the direction of the arrow i^2 in fig. 10, the stop *h* is withdrawn from the track of the pallet, and the strap-holder is permitted to turn (under the strain of the compressing-belt) a short distance, until the pallet comes in contact with the second bar-stop *h'*, as seen in Figure 10^a, by which the strap-holder is held from turning, until the detent is moved in a direction the opposite of that indicated by the arrow i^2 in fig. 10, a sufficient distance to carry the end of the second stop *h'* past the track of the pallet i^1, which is thus liberated, while the first stop *h* is interposed, by the same movement of the detent, in the track of the next succeeding pallet, so that the strap-holder is per-

mitted to turn (by the liberation of the first pallet) a sufficient distance to let go the compressing-belt from the forked arm that held it, and is then stopped or arrested, (by the contact of the next succeeding pallet with the first stop,) with its next succeeding forked arm, in the position required to catch the head of the compressing-bolt, and hold it, while being carried around the gavel of grain to be bound next.

The compressing-belt or strap *m* is, in this instance, a leather cord, or round belt, having one of its ends formed into a head, *m'*, fig. 11, by knotting it, so that it will not pass through the crotch in the forked arms of the compressing-strap holder I.

In order that this compressing-belt may compress the gavel with the requisite force, it is made fast to the end of a vibrating arm or lever, L, that is acted upon by a strong V-shaped spring, L', which thus exerts tension upon the belt.

The belt, proceeding from the vibrating arm, is passed to and fro over pulley-sheaves *l l*, so that the arm, in giving up and taking back the belt, need move only a distance equal to one-third of the movement of the belt.

The last pulley-sheave, *l'*, delivers the belt in a proper direction to pass to the strap-holder.

In order that the head of the belt may be readily taken up by the strap-holder when it becomes accidentally disengaged, a curved guard, $f f^1$, is applied to the frame B, with its flat side far enough from the adjacent face of the ring-carrier to form a slot, through which the body of the compressing-belt can pass easily, but not wide enough to permit its head to pass. Hence, if the head of the belt become disengaged from the strap-holder, it is caught upon the inner curved side of the guard $f f^1$, and, as this side of the guard is arranged in close proximity with the path pursued by the end of the forked arm of the strap-holder I that happens to be outermost, (see fig. 11,) and is concentric with the ring-carrier, the head of the belt is in the proper position to be picked up by this arm in its revolution with the ring-carrier.

In order that the belt-head may be readily applied to the strap-holder in preparing the apparatus for work, or after a new head has been made upon the belt, the guard is provided with a gate, f^2, large enough to permit the belt-head to pass easily.

The sides of this gate are inclined downward, so that the member of the guard above the gate overlaps the member that is below the gate, and as the strain on the belt tends to draw its head downward toward the guide-pulley *l'*, it cannot accidentally escape through the gate, because such escape could be effected only by an upward movement.

As the belt-head wears off in use, the belt, when first applied to the machine, is made considerable longer than necessary for work; and the surplus length is formed into one or more loops at the vibrating arm L, at the time it is made fast thereto Then, when a belt-head is worn off, a new head may be formed by knotting the free end of the belt, and if the effective length of the belt be thereby made too short, some of the surplus may be let out at the vibrating arm by untying the belt and retying it.

The cord-holder J is composed of two members, $j j^1$, one of which, j^1, is fixed to the ring-carrier A, while the other, *j*, is constructed to move thereon in the direction of its periphery.

The opposing faces of the two members are provided with serrated ribs $g g^1$, (see figs. 6 to 9) so as to form ribbed jaws to hold the binding-material, and the ribs of the movable jaw are arranged to enter between those of the fixed jaw.

The face of the movable jaw is pressed toward the face of the fixed jaw, by means of a spring, j^2, that connects the movable jaw with the slide M that operates it, so that the binding-material entered between the two is held by griping it. The serrations of the jaws are like saw-teeth, all pointing in a downward direction, so that the rise of the movable jaw does not tend to withdraw the binding-material from between the jaws, while its descent moves the material further downward. Hence, at each double reciprocation of the movable jaw, the fag end of the band, that remains between the two jaws after the band is cut loose, is worked progressively downward, and finally discharged at the lower ends of the jaws, where there is nothing to catch it.

The upper end of the fixed jaw j^1 is bevelled or inclined inward, so as to form a mouth which receives the binding-material and guides it to the face of the movable jaw *j*, and the movable jaw is fitted with two fingers, g^2 g^2, which project outward from its face, so that when it is raised, these fingers project across the slit between the serrated ribs of the jaws. Moreover, grooves g^3 are formed in the fixed jaw j^1, to permit these fingers to pass downward; hence when the binding-material enters the mouth of the cord-holder, it passes beneath said fingers, and when the movable jaw is then depressed, these fingers bear upon the binding-material and push it into the gripe of the two serrated jaws.

The binding-material is drawn from a spool, N, which is placed below the position from which the cord-holder starts, when the gavel is to be encircled with cord, and to which it is returned when the band around the gavel is ready to be secured and severed from the mass of material wound upon and extending from the spool; and the portion of the material extending from the spool to the band, is prevented from rising above the proper position for tying, and is retained within the range of the cord-holder by the tongue or projection *s* of a shield-plate, O, that intervenes between the cord-securing mechanism and the position of the gavel; hence when the cord-holder carried by the ring-carrier approaches the completion of its revolution round the gavel, to regain its starting-point, it rises under the line of binding-material extending from the notch formed by the tongue of the shield-plate to the spool, and takes it into its mouth, without releasing the end already griped, so that both members of the band around the gavel are then held by the cord-holder.

In order to sever the band encircling the gavel from the remainder, to loose it from the cord-holder, and to leave the newly-formed end of the mass wound on the spool in the gripe of the cord-holder, ready to be carried around the succeeding gavel of grain, a knife or shear-blade, *r*, is secured to the face of the movable jaw *j* of the cord-holder, between its ribs and the position of the gavel, and a corresponding blade, *r'*, is secured to the fixed jaw j^1.

The movable blade *r* projects from the face of the movable jaw across the track of the binding-material, as the fingers g^2 do, and the fixed blade *r'* is arranged to project crosswise beneath the binding-material, so that when the movable jaw is depressed, the edge of the movable blade passes by the edge of the fixed blade and severs the material between the two.

The blades are so arranged, relatively to each other and their respective jaws, that the distance between the edges of the blades, when the movable jaw is raised to its highest point, is greater than the distance between the under sides of the fingers g^2 of the movable jaw, and the upper ends of the serrated ribs g^1 of the fixed jaw; hence the knife-edges do not pass by each other, to sever the binding-material, until it has been pushed within the grasp of the serrated jaws by the fingers. The end of the binding-material extending to the spool is thus left in the gripe of the jaws of the cord-holder. In order to prevent it from being drawn forth in the direction of the length of the ribs of the jaws, a delay-hook, *g'*, is applied to the fixed jaw j^1 between

its ribs and the periphery of the ring-carrier. This hook projects across the slit between the ribs of the two jaws, and its upper side is inclined so as to guide the binding-material, when forced downward by the fingers, over its point; hence, when the binding-material is forced downward by the descent of the fingers of the movable jaw, the binding-material is pushed down below the point of the belay-hook, and passing beneath it, is thereby overlapped and prevented from rising between the jaws, although the fingers rise and leave it, so that whatever strain is applied to the binding-material, must of necessity be in a direction crosswise to the length of the ribs of the jaws.

The fixed jaw is connected at its outer edge with the ring-carrier by the portion g^5, which prevents the binding-material, when caught in the mouth of the cord-holder, from being dragged immediately through the slit between the serrated jaws by the tension applied to the mass upon the spool N.

In order to simplify the mechanism, the movable jaw of the cord-holder is connected with the same slide M that carries the stop-bars *h h'* of the detachable strap-holder, and acts as the detent therefor. This slide is operated to open and close the cord-holder and liberate and stop the movement of the strap-holder, in the following manner:

The slide is extended along the ring-carrier to a portion of it which is opposite the cog-wheel F^1 at the time the ring-carrier is disengaged from the cog-wheel F and the driving-wheel, by the action of the clutch, as hereinbefore described.

The slide is there connected with two elbow-levers P P', whose rounded heads are constructed to protrude beyond the periphery of the ring-carrier. The form and relative arrangement of the levers are such that when the head of one protrudes from the periphery of the ring-carrier, that of the other does not; and as the heads of the elbow-levers extend toward each other, the depression of one, P, moves the detent-slide M in the direction (see arrows in figs. 5, 6, 9,) required to open the mouth of the cord-holder, and permit the first movement (before described) of the strap-holder, at the same time turning the second elbow-lever P', and causing its head to protrude, while the depression of the head of this second lever, P', moves the detent-slide in the opposite direction, thereby closing the cord-holder, causing its fingers g^2 g^2 to push the binding-material into the gripe of the serrated jaws, and finally effecting the severing of the cord by the shear-blades, and also at the same time liberating the pallet of the strap-holder and letting go the compressing-belt.

The opening of the cord-holder may be effected at one operation, or by a single continuous movement of the detent-slide, by the elbow-lever P; but as there must be a period of time between the griping of the binding-material and its cutting, to permit the band to be secured, the movement of the slide M, by the elbow-lever P' in the direction opposite to that indicated by the arrows in figs. 5, 6, and 9, must be effected by two steps separated by an interval of rest, the first step being of sufficient length to push the binding-material into the gripe of the serrated jaws, and the second of sufficient length to effect the severing of the material by the shear-blades, and the liberation of the pallet of the strap-holder, so that the compressing-belt may be released, and may be withdrawn from the gavel by the action of the swinging-belt arm L and its spring L'.

The several movements of the elbow-levers P P' required to thus move the detent-slide M, are effected by two cams, *x x'*, applied to the cog-wheel F^1. The first, *x*, of these cams, projects sufficiently from the rim of the wheel that carries it, to depress the head of either elbow-lever P or P' to its greatest extent.

This cam and the elbow-lever P are so located upon the members that carry them respectively, (the cog-wheel F^1 and ring-carrier,) that when the cord-holder arrives at the proper position (relatively to the band-securing mechanism) for receiving the binding-material, the cam *x* and the head of the elbow-lever P are then at those parts of the cog-wheel F^1 and ring-carrier A that come opposite each other. Consequently the continued movement of the cog-wheel and ring-carrier causes the cam *x* to act upon and depress the first elbow-lever P to its full extent.

The second cam *x'* and the second elbow-lever P' are so located in like manner, that when the cord-holder arrives at the proper position for griping the binding-material, they are at the parts of the cog-wheel and ring-carrier which then come opposite to each other. Consequently the movement of the cog-wheel F^1 causes this second cam to act upon and depress the second elbow-lever; but as this cam is shorter than the first one, the depression is sufficient only to move the detent-slide the first step of its return movement, and to effect the griping of the binding-material, without cutting it or liberating the pallet of the strap-holder.

The second cam *x'* is at such a distance from the clutch-tooth *c* on the cog-wheel F^1, that the clutch-tooth is operated by the cam c^6 of the driving-wheel F^2, immediately after the second elbow-lever head is depressed. Consequently the ring-carrier is then disengaged from the cog-wheel F^1, as before described, and remains at rest with the second elbow-lever P', opposite the centre of cog-wheel F^2, while this cog-wheel continues to revolve in connection with the arbor *a* that transmits motion to the band-securing instrument, for the purpose of actuating this instrument.

As this cog-wheel F^2 completes its revolution for this purpose, the first cam *x* is brought in contact with the head of the second elbow-lever P', and completes its depression, thus effecting the severing of the band and the liberation of the compressing-belt, and leaving the cord-holder and detachable strap-holder in the proper conditions for carrying the end of the binding-material and compressing-belt around the next succeeding gavel to be bound.

The mechanism for securing the band is attached to the frame-work of the machine in such position that the band-securing instrument can operate upon the portions of the band extending between the cord-holder and the notch of the shield-plate, when the ring-carrier completes its revolution.

I prefer to use in my present apparatus the band-securing mechanism, invented and described in previous patents granted to me for binding-apparatus, and consisting essentially of a tying-bill and its appurtenances.

This tying-bill Q (a detailed description of which and its appurtenances is given in my said previous patents) is secured to a shaft, *z*, which is carried by a gate, R, that is constructed to swing upon an arbor, z^1, toward and from the adjacent face of the ring-carrier A, so that in its forward movement its beak is carried across the slit (between the shield-plate O and the ring-carrier) through which the binding-material extends from the gavel to the cord-holder.

The arrangement of the swinging gate also is such, relatively to the tongue *s* of the shield-plate, and the position of the cord-holder when the ring-carrier stops for the tying of the band, that the tying-bill, when moved forward, (as seen in fig. 18,) comes in contact with those portions of the two members of the band around the gavel, which extend between the notch of the guard-plate (formed by the tongue *s*) and the cord-holder.

When the tying-bill is in this forward position, it is revolved by turning its shaft *z* to tie the band into a knot, and is then immediately drawn back from the

face of the ring-carrier to let go the knot, and resume its position out of the track of the binding-material when extended from the spool around the gavel.

The forward and return movements of the tying-bill and its revolution for tying, are all effected by the revolution of a shaft, z^2, which is connected by two sets of bevelled wheels F^3, F^4, F^5, F^6, and the shaft a^2, with the arbor a of the cog-wheel F^1.

In order that this shaft z^1 of the band-securing mechanism may move the tying-bill forward and back, it is fitted with a crank, S, whose pin s' engages in a slot of a rod, T, that is pivoted to the swinging gate R of the tying-bill, so that during one portion of the revolution of the shaft z^2, the crank-pin bears against one end of the slot, and pushes the swinging gate forward, and during the last portion of the revolution of the said shaft, the crank-pin bears against the other end of the slot, and draws the swinging gate back to its position of rest, while, during an intermediate portion of the revolution of the shaft, the crank-pin traverses the length of the slot, leaving the swinging gate and its tying-bill at rest in their forward positions for tying the knot.

In order that the shaft z^2 may also effect the revolution of the tying-bill, the tying-bill shaft z is fitted with a cog-pinion, F^7, and the shaft z^2 has a cog-segment, F^8, secured to it in such position, relatively to the crank S, that the first tooth of the segment engages with the pinion F^7 as soon as the tying-bill has reached its forward position, and then commences to turn it, while the length of the cog-segment and its radius are such that it completes the revolution of the pinion F^7 and tying-bill Q before the crank begins to draw the tying-bill back.

As it is desirable that the tying-bill should be retained at its forward position during tying, a stud, v, is affixed to the swinging gate R, in a position to come in contact with the adjacent face of the ring-carrier A when the tying-bill is in its forward position, and prevent it from moving beyond its proper position, while the action of the segment F^8 upon the pinion F^7 prevents the tying-bill from retrograding until the tying is effected.

The stud v and face of the ring-carrier thus act as stops to determine the position of the tying-bill, which is the band-securing instrument in the present example; but the face of the ring-carrier may be replaced by a fixed stop, without changing the mode of operation.

When the revolution of the crank S has been completed, the clutch-tooth c, carried by the wheel F^1, returns to the position of the notch of the circular rib of the wheel F, and disengages from the hub of the arbor a, as before described, thus leaving the tying-bill at rest until the next succeeding gavel has been compressed and surrounded with binding-material.

As it is desirable that the tying-bill should not be misplaced by the accidental turning of the wheels F^3 F^4 F^5 F^6 or shaft a^2, during its disconnection from the driving-wheel, the arbor a is fitted with a disk, w, flattened at one side, and a spring, w', is provided to press upon this flat side when the disconnection takes place, and exert a sufficient detaining-force to hold the members of the band-securing mechanism from moving accidentally from their proper positions.

In order to hold the two members of the band that is around the gavel together at the notch of the shield-plate, a finger or latch, U, is provided. This finger is secured to a stock, U', figs. 2 and 20, which is constructed to swing upon a pivot, z^4, fig. 20, secured to the shield-plate O, and the swinging-finger stock is slotted, to receive the end of a stud, n, fig. 17, which projects from the swinging gate of the tying-bill, so that when the tying-bill is moved forward, the finger U is moved in advance of it by the action of the stud n upon the side of the slot in the swinging-finger stock U', and is caused to pass beneath the binding-material and gather the lower member of it to the notch of the shield-plate. When the tying-bill is withdrawn, the finger is also withdrawn by the reverse movement of the stud n in the slot of the swinging-finger stock U'.

The spool N, from which the binding-material is drawn, is mounted on a swinging frame, V, which is constructed to swing upon pivots, p, so that the spool can be pressed toward the rim of one of the guide-wheels E of the ring-carrier A, and the spool is connected with a disk-head, N', whose rim is borne by the action of a spring (hereinafter more particularly described) against the rim of the guide-wheel, so that the frictional contact of the two tends to turn the spool in the direction required to wind up the binding-material, and furnishes the detaining-force required to impart the requisite tension to that material.

The material is conducted from the spool through an eye-guide, k, in the cross-bar of the frame V, and, as this guide and the spool-arbor are at opposite sides of the pivots p of the frame, the strain upon the material in pulling it off the spool tends to draw the rim of the disk-head N' from the rim of the guide-wheel E, and relaxes the tension when the binding-material is being carried around the gavel.

The material is conducted from the eye-guide of the swinging spool-frame to an eye-guide, k', supported by the swinging gate R of the tying-bill, and as the direction of the material in passing from one of these guides k to the other, k', is substantially at right angles to the length of the arm of the spool-frame V, the strain incidental to the drawing off of the binding-material acts to the greatest advantage in relaxing the tension upon that material.

In order that the spool N, when emptied of binding-material, may be withdrawn from the machine and replaced by a full spool, it is not made permanently fast to the shaft t, on which it turns, nor to the disk-head N', but the disk-head N' is fitted (see fig. 22) to a hollow shaft, t^1, which revolves on the shaft t of the spool-frame, and the spool-barrel t^2 is slipped over the hollow shaft t^1 of the disk-head, and is connected with the disk-head by a pin, u, which, being fast in the disk-head, enters a socket in the spool, and connects the two, so that they revolve together. Hence, by drawing the spool-shaft t endwise from the spool-frame V, the spool N and disk-head N' may be removed from the spool-frame, the spool may be withdrawn from the disk-head, another spool may be applied, and the new spool and disk-head may be secured in the spool-frame by reinserting the spool-shaft t.

In order that the spool-shaft t may be held in its place in the spool-frame V, it is constructed with a grooved head, y, and a sliding holder, W, is provided to engage in the groove, and thus prevent the shaft from being moved endwise.

The holder is held in the said groove by means of a spring, q, (see fig. 23,) which, also acting through the holder upon the spool, bears the disk N' against the rim of the guide-wheel E with the force required to produce the requisite tension upon the binding-material, as before stated.

The tension of the spring q is regulated by a screw, e^2, by turning which the pressure of the spring q may be increased or diminished. When the spool is to be removed, the screw e^2 is turned sufficiently out of its socket to permit the head of the holder W to be readily disengaged from the groove in the head y of the spool-shaft t.

In order that sufficient binding-material to form the tie or knot may be rendered up during the securing of the band, the stop H, that holds the ring-carrier after its liberation from the driving-power, is connected with a stock, H^1, whose position is controlled by a cam, H^2, fig. 21.

This cam, H^2, is secured to the arbor *a*, which transmits motion to the band-securing instrument, (the tying-bill in this example.) It is concentric with the arbor at its periphery, and is so set upon the arbor, that when the revolution of the ring-carrier is stopped, the concentric portion of the cam H^2 is on the same side of the arbor *a* as the stop H. Hence, as the arbor *a* turns to move the tying-bill, and the cam is turned, its concentric portion holds the stop H in its position until the band-securing instrument has seized the band, then the concentric portion of the cam, turning away from the side of the stock H^1 on which it acted, permits the stock and stop H to move toward the arbor *a*, thereby permitting the ring-carrier to retrograde sufficiently to render up slack of binding-material for forming the loop of the knot.

The apparatus thus described embodies all my improvements in a suitable form to be used for the binding of grain, but they may be embodied in other forms, as the peculiar circumstances of the work to which they are applied, or the peculiar views of constructors may render expedient.

What I claim as my invention, and desire to secure by Letters Patent are, the following combinations and arrangements of mechanical instrumentalities in binding-apparatus, viz:

1. The combination of the ring-carrier and stationary band-securing instrument with the same driving-shaft, by means of connecting and disconnecting mechanism, substantially as set forth.

2. The arrangement of the transmitting-mechanism between the driving-shaft, the ring-carrier, and the band-securing mechanism, in such manner that the said shaft may be revolved in the same direction, whether operating the ring-carrier or the band-securing mechanism, substantially as set forth.

3. The ring-carrier, composed of an internal flange and an external toothed ring, combined by means of radial studs, substantially as set forth.

4. The combination of the detachable strap-holder with a detent, arranged to move to and fro in a circular direction upon the ring-carrier, substantially as set forth.

5. The combination of the ring-carrier and curved belt-guard, for the compressing-belt, substantially as set forth.

6. The combination of the ring-carrier with a curved belt-guard composed of two members, separated by a gate-way, for the insertion of the belt-head, substantially as set forth.

7. The arrangement of the curved belt-guard, detachable strap-holder, and ring-carrier, so that the belt-head may be held by the said guard within the range or track of the strap-holder, substantially as set forth.

8. The cord-holder, composed of two jaws, provided with serrated ribs, one of which jaws is constructed to move to and fro relatively to the other, substantially as set forth.

9. The combination of the serrated jaws of the cord-holder with a finger, for pushing the binding-material into the gripe of said jaws, substantially as set forth.

10. The combination of the cord-holder, composed of jaws, one of which moves to and fro, as above set forth, with a knife, for severing the binding-material after it is in the gripe of said jaws, substantially as set forth.

11. The combination of the cord-holder, composed of jaws, one of which moves to and fro, with a belay-hook, substantially as set forth.

12. The combination of the cord-holder, composed of jaws, one of which moves to and fro, with a finger and a belay-hook, substantially as set forth.

13. The combination of both the movable jaw of the cord-holder and the detent-stops of the strap-holder with one slide, substantially as set forth.

14. The combination of the ring-carrier, movable jaw of the cord-holder, and movable shear-blade with rotating cams, substantially as set forth.

15. The combination of the stationary band-securing-instrument, ring-carrier, slide, and cams, substantially as set forth.

16. The combination of the band-securing instrument, revolving shaft, crank, slotted connecting-rod, segment, and pinion, substantially as set forth.

17. The combination of the swinging stock of the band-securing instrument, stud, and stop, substantially as set forth.

18. The combination of the swinging stock of the band-securing instrument and separate swinging-band finger, substantially as set forth.

19. The combination of the swinging frame of the spool with the disk-head that is separate from the spool, substantially as set forth.

20. The combination of the swinging spool-frame, removable shaft, and shaft-holder, substantially as set forth.

21. The combination of the stop for the ring-carrier and the band-securing instrument, substantially as set forth.

22. The combination of the swinging spool-frame, removable spool-shaft, shaft-holder, and spring, substantially as set forth.

In testimony whereof, I have hereto set my hand, this 24th day of January, 1867.

JACOB BEHEL.

Witnesses:

THOMAS J. RUDD,

H. J. SAWYER.