4 Sheets—Sheet 1.

J. F. APPLEBY.

Grain-Binding Harvesters.

No. 212,420 **Patented Feb. 18, 1879.**

Fig. 1.

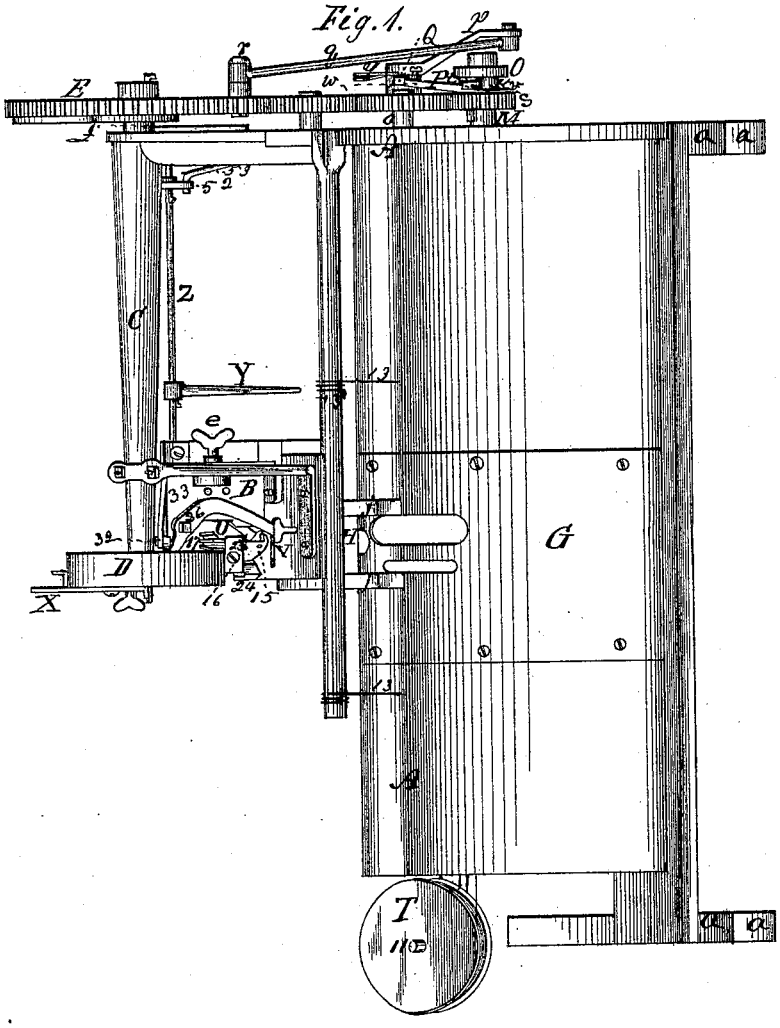
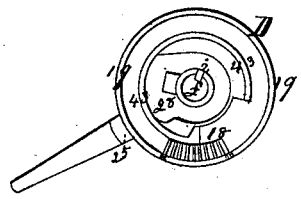


Fig. 6.



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Inventor,
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By his atty.
J. L. Brown.

4 Sheets—Sheet 2.

J. F. APPLEBY.

Grain-Binding Harvesters.

No. 212,420. **Patented Feb. 18, 1879.**

Fig. 2.

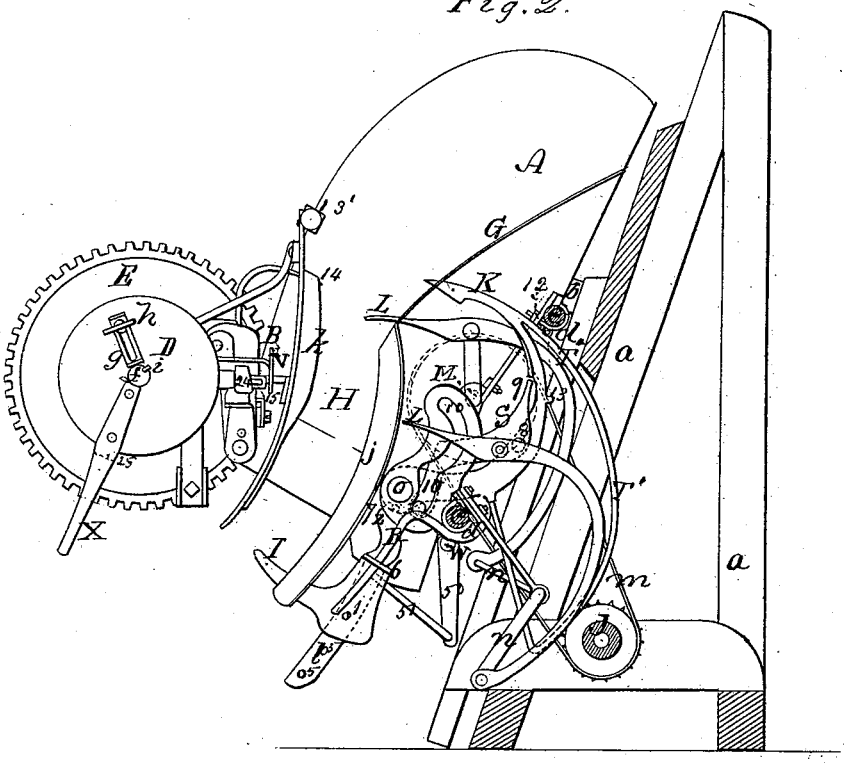
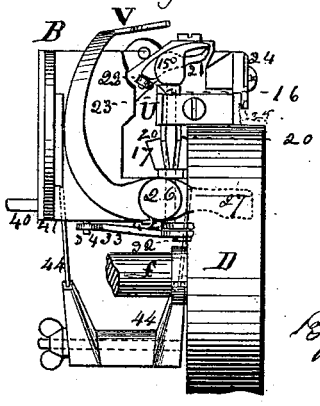


Fig. 4.



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4 Sheets—Sheet 3.

J. F. APPLEBY.

Grain-Binding Harvesters.

No. 212,420. **Patented Feb. 18, 1879.**

Fig. 3.

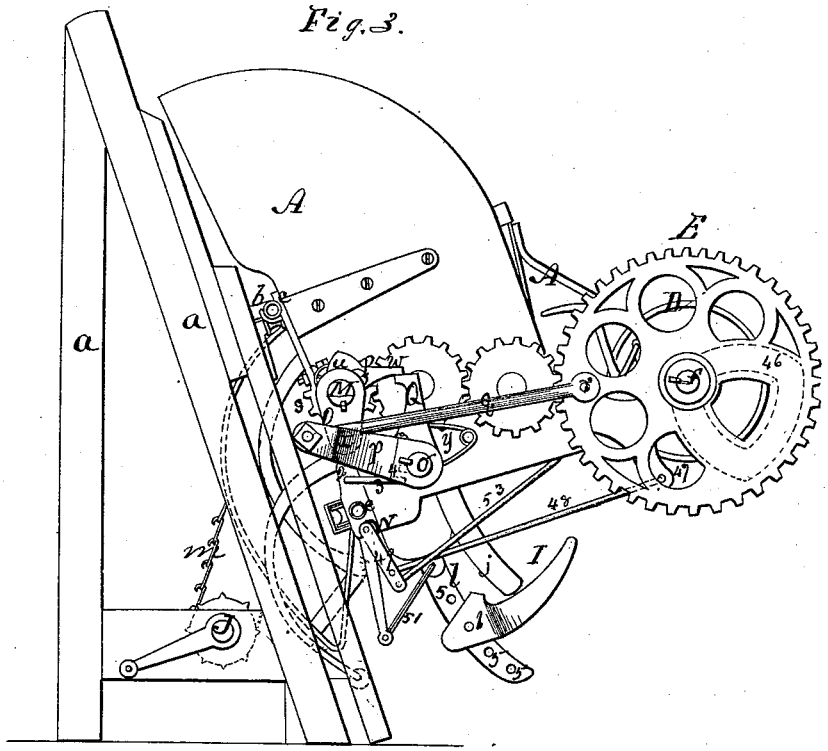
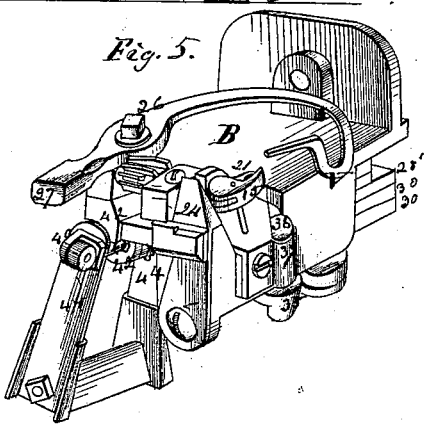


Fig. 5.



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4 Sheets—Sheet 4.

J. F. APPLEBY.

Grain-Binding Harvesters.

No. 212,420. Patented Feb. 18, 1879.

Fig 7.

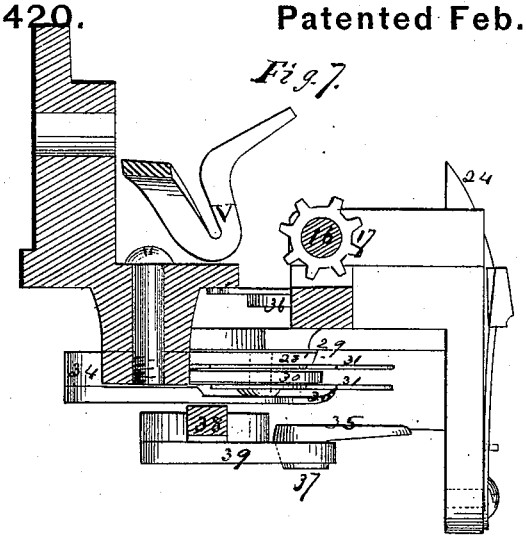


Fig. 8.

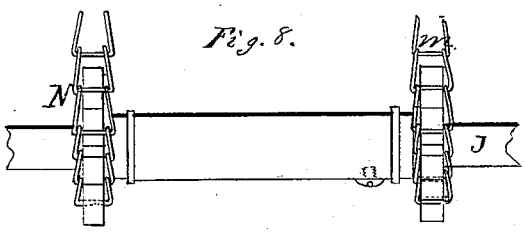
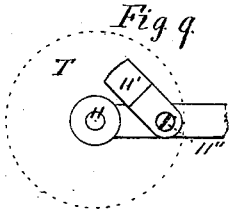


Fig 9



Witnesses,
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E. Marcellus Gallaher

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John F. Appleby,
By his atty.
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UNITED STATES PATENT OFFICE.

JOHN F. APPLEBY, OF WEST DEPERE, WISCONSIN.

IMPROVEMENT IN GRAIN-BINDING HARVESTERS.

Specification forming part of Letters Patent No. **212,420**, dated February 18, 1879; application filed February 27, 1877.

To all whom it may concern:

Be it known that I, JOHN F. APPLEBY, of West Depere, in the county of Brown and State of Wisconsin, have invented an Improved Grain-Binder for Harvesters; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, making a part of this specification—

Figure 1 being a top view of the entire apparatus composing the grain-binder; Fig. 2, a front view and partial vertical section of the same; Fig. 3, a rear view of the same; Fig. 4, a top view of the band-cord-tying apparatus; Fig. 5, a view, in perspective, of the said cord-tying apparatus; Fig. 6, a rear view of the cord-tying cam and rack-wheel; Fig. 7, a vertical section of the cord-tying apparatus; Fig. 8, view of a part detached; Fig. 9, a view showing the adjustable friction cord-tension device.

Like letters designate corresponding parts in all of the figures.

In this machine I make use of a cord or line for bands to bind the sheaves of grain, and the apparatus is designed especially therefor, though many of its features are applicable to binders employing wire for bands.

The mechanism composing the binder is mounted in a suitable frame, A, which is supported upon uprights *a a*, secured to the frame of the machine. This binder-frame is distinct and removable from the main frame by drawing it forward; but it is retained in its place by means of buttons *b b*, or their equivalent, closing down upon one of the supporting tubes or bars *c c*, thus holding it down in the supporting pulleys or grooves *d d*, in which it has at the same time an adjustable forward and backward movement, to adapt the binder to both long and short grain.

The cord-tying apparatus B, also, is made readily removable from the binder-frame, so that it may be housed separately, and the fine mechanism composing it may at all times be perfectly protected from the weather and danger of violence and injury. It is preferably secured to the binder-frame by a single hand-screw, *e*, to a flange projecting from a fixed sleeve, C, which forms part of the binder-frame and supports the said cord-tying apparatus, as well as the cam and rack wheel D, which operates the tying mechanism and the driving-wheel E, whereby the shaft *f* of the said cam and rack wheel is turned, the said shaft reaching through the sleeve for its only bearing. The cam and rack wheel is fastened to the shaft *f* by a pin, *g*, held in place by a thumb-screw, *h*, which screws into the wheel through a slot of the pin long enough to allow the insertion in and withdrawal of the pin from the shaft, thus keeping the pin always attached to the wheel. By tightening the thumb-screw against the pin, the latter is securely kept in place as the shaft revolves. A spline, *i*, entering grooves both in the wheel and shaft, couples the two together. The spline is held in the wheel, so that it cannot be lost out, by having heads or side shoulders at its ends, catching round the sides of the wheel to prevent its working endwise.

The grain, as fast as it is brought up by the usual elevating-apron, drops upon an inclined board or chute, G, which conducts it to the packing-receptacle H, formed between ways or bars *j j*, by the side of and below the chute-board and ribs *k k* on a plate, board, or other support, next to the cord-tying apparatus, and suitably held in place, as shown, or otherwise. At the bottom of the receptacle the grain is supported by fingers I I, pivoted to a holding-bar, *l*, the said fingers also serving to set the binding mechanism in motion when sufficient grain is deposited in the receptacle to form a gavel or bundle of the proper size. So the binding mechanism is automatically stopped after the binding of each sheave, and is held inactive while the gavel-receptacle is filling.

The entire mechanism of the binder is driven from a driving-shaft, J, of the harvester-machine. The operative movements of the binder thereby produced comprise the packing device, which compacts the grain in the gavel-receptacle, the needle or finger K, which carries and brings into action the binding-cord, and the cord-tying apparatus. For operating the cord-needle, the cord-tying mechanism, and one of the two packing-arms L L, I employ a belt-chain, *m*, or its equivalent, to transfer motion from the shaft J to a transmitting-shaft, M, and another belt-chain, N, communicates motion from the shaft J to a pinion which drives

the other packing-arm. The purpose of this separate movement is to cause the two packing-arms to operate alternately and on opposite sides of the cord-needle K.

The packing-arms L L are located beneath the chute-board G, by which, when out of operative range, they are covered, but through slots in which they project, to act upon the grain for compacting it in the receptacle. Their projecting ends are pointed, and curved about as shown, or otherwise, to properly perform their functions, which are, first, to project their points out laterally across, or nearly across, the receptacle, thus separating the grain below from the grain above them; then to descend laterally upon the grain below in the receptacle, thereby compacting it; and then to withdraw from the receptacle beneath the chute-board, to allow more grain to descend into the receptacle; and as one arm recedes from action the other comes into action, separating from above an additional quantity of grain successively, and compacting it with that previously received in the receptacle, so that the two arms not only alternately compact additional grain into the gavel-receptacle, but hold it compacted continually until a sufficient amount is thus gathered to form a sheaf. These movements of the packing-arms are conveniently produced by pivoting each near the middle on a crank-pin constantly revolving by means above specified, or the equivalent thereof, while the lower ends of the arms are guided in the desired way by being pivoted to the free ends, respectively, of pivoted arms *n n*, as shown, or otherwise, to effect the same or similar movement. These packing-arms may keep continually in motion, and do so operate by the mechanism represented in the drawings; but they need operate only while the gavel is forming in the receptacle.

The needle K, also, is situated beneath the chute-board G, where it is covered, except when moved out over the receptacle for carrying the binding-cord over the gavel to the tying apparatus. It is mounted on a rock-shaft, *o*, turning in a sleeve or bearings of the binder-frame; and its proper movement is obtained by rocking the said rock-shaft through the space of less than half a circle. This rocking movement is effected by means of an arm, *p*, on the end of a rock-shaft, and a rod, *q*, connecting it with a crank-pin, *r*, on the driving-wheel E of the cord-tying mechanism.

The movements of the needle K and packing-arms L L are arranged and timed so that one of the packing-arms always passes across the receptacle at nearly the same moment as when the needle performs the same movement. As by the organization herein described the needle travels somewhat slower than the packing-arms, the actual motions thereof are thus: The needle enters the grain a little before the packing-arm, which, however, overtakes it at about the moment when the needle reaches the opposite side of the receptacle, and from that moment its downward movement relieves the needle from the contact of the grain below. The effect of this movement is important, since there is thus always a clear separation of the grain below from the grain above, and no loose grain is ever left in the space just below the needle to interfere with the tying-cord, as hereinafter specified.

Motion is communicated to the driving-wheel E from the transmitting-shaft M through two intermediate pinions from a small gear-wheel, *s*, on the said shaft. Since the binding mechanism, which is driven by the driving-wheel E, and has an intermittent movement, is stopped entirely while the gavels are forming, the gearing which connects the shaft M, that turns continually, and the said driving-wheel, are provided with means for coupling and uncoupling at the proper times. I have effected this by having the gear-wheel *s* loose on its shaft M, while the driving-wheel E is not to move, and coupling it to its shaft, when required, by means of an arm, O, fast on the shaft, and provided with a pin or projection, *t*, extending toward the said gear-wheel, on which wheel is pivoted a lever-stop, P, against the short arm *u*, of which the said arm-projection strikes to couple the gear-wheel to the shaft, but passes outside of it when the said arm of the lever-stop is swung inward. Ordinarily this arm is held outward by a spring, *v*; but when the long arm *w* of the lever-stop strikes the upper end of an arm, Q, which is pivoted upon the rock-shaft *o* of the needle K, the short arm *u* is moved outward and couples the gear-wheel to the shaft. A spring, *y*, ordinarily keeps the arm Q pressed toward the lever-stop P far enough to cause the arm *w* thereof to rest and bear on its upper end, whereby the spring *v*, pressing against the opposite arm of the lever-stop, is forced back, and the said arm is forced inward far enough to allow the projection *t* of the coupling-arm O to pass around outside of it and cause the gear-wheel *s* to cease to revolve. During this arrangement, therefore, the driving-wheel E, and consequently all the binding mechanism, is at rest. The release of this uncoupling device to allow the gear-wheel *s* to become coupled to the shaft M and set the binding mechanism in motion is dependent on the downward pressure of the gavel formed in the receptacle through means substantially as now to be described.

The gavel-supporting fingers I I, in the lower part of the receptacle, being pivoted to their sustaining-bar *l*, act as levers upon an extension, *z*, of their pivot-shank beyond the pivot 1, on which they turn. This extension or arm *z* is connected with an arm, R, on a rock-shaft, 2, which extends in bearings back to a position where another arm, 3, thereon can reach the hub or socket of the arm Q, that surrounds the rock-shaft *o*. The said arm 3 is arranged to strike a tooth or projection, 4, on the said hub, so that when the shaft 2 is turned in the proper direction it will cause the arm Q to swing aside counter to the action of the spring

y, and thereby release the arm *w* of the lever-stop P, thus allowing the coupling-arm O of the shaft M to couple with the gear-wheel *s*, and so set the binding-mechanism in motion. The power of the spring *y* is so graduated in relation to the leverage exerted by the gavel-supporting fingers I I through the arm R on the rock-shaft 2 that when the pressure produced by the compacted grain in the receptacle in the completion of a gavel of the desired size is exerted on the said supporting-fingers, the said spring will yield and allow the binding mechanism to commence operation; but I provide for a variation of the size of the gavel by means irrespective of the force of the spring *y* which, when once adjusted to the proper pressure, may remain unchanged. I regulate the size of the gavel by adjusting the supporting-fingers I I up or down on the sustaining-bar *l*, there being a series of holes, 5 5 5, in the said bar, through any one of which the pivot 1 may be inserted. The arm R is connected with the extension-arm *z* of the fingers by an eye, 6, on the said extension-arm, through which the said arm R extends and may freely slide, it being long enough to still remain in the eye in whatever position the fingers may be placed. The greater leverage exerted on the arm R, as the fingers are adjusted downward, is nearly counteracted by the increased friction of the extended gavel between its ways. I prefer, however, and arrange to adjust the force of the spring *y* for the special purpose of producing greater or less compactness of the grain in the receptacle, and thus make a closer or looser bound sheaf, at pleasure, it being evident that, with the construction and operation above described, the greater the force of the spring *y* the more compact will the gavel become before springing it, and vice versa. But it is not desirable to produce very great compression of the gavel by the packing-arms L L, since they operate with considerable rapidity, and too much work put upon them would require considerable power and make the machine run harder than necessary. I therefore provide a means of compacting the gavel after the full amount of grain is packed into the receptacle, and the needle K has been brought over the gavel, and has separated it from the accumulating grain above.

First, I provide for raising the sustaining-fingers I I as much as necessary for the purpose against the gavel after the needle is brought over it. This is simply and automatically done by suspending the finger-sustaining bar *l* from an eccentric pivot, 7, on the heel of the needle K, or upon its rock-shaft *o*, the pivot being so arranged that as soon as the needle divides the gavel from the grain above, and while it is further traveling to its position in the tying apparatus, it lifts the bar *l* and the fingers I I with it as far as required, and holds them thus while the operation of tying the band is going on.

Second, the gavel also is partially compressed downward by the needle itself, the under side of which is eccentric to the center of its motion, and acts as a wedge upon the grain. Besides this, there is a compressing-finger, S, on the under side of the needle, pivoted, at 8, thereto, its point 9 fitting into a notch or recess in the needle, so that ordinarily its under edge is flush with the under side of the needle, and does not interfere with the needle's penetration of the grain in the receptacle. At the proper moment, as the needle approaches the tying apparatus, this finger is caused to swing on its pivot down on the gavel, thus finally compacting the same and holding it thus while tying the band. This operation of the finger is effected by the heel thereof working in a fixed slot, 10, of the proper form to produce the required movement. The finger also acts as a guide to bring the cord into position for tying, as will be seen by the following description of the arrangement of the band-cord, and the method of carrying it over the gavel into position for tying.

The cord, in quantity, is wound upon a spool, T, which turns on a nearly vertical pin, 11, on the binder-frame, and rests upon a friction-support at the lower end of the pin, so that the weight of the spool and cord produces a certain amount of friction to restrain the unwinding of the cord from the spool, and thereby to create the requisite slight tension thereof. This simple arrangement of the spool is thus made to effect a constant tension, since, when the spool is filled with the cord, the leverage thereon by the drawing of the cord is greater than when the spool is nearly empty; and, with parallel effect, the friction caused by the weight of the spool on its support is greatest when the spool is filled with cord, and least when it is nearly empty; and this arrangement is sufficient for the purpose. To render this friction-tension fully practicable and sufficiently perfect in its operation under all circumstances, not only is the spool made as light as possible, so that the variation of the friction may be simply proportional to the weight of the cord itself, or nearly so, but I provide for an adjustment of the friction-support on which the spool rests. To accomplish this I have invented the device shown in Fig. 9. The friction-support 11′ is attached to the spool-holder at one end by a set-screw, 11″, so that the support may be adjusted from or toward the center of the spool, and thereby produce more or less friction at will.

I do not confine myself to this special mode of adjusting the friction-support.

The cord is carried through the binder-frame from the spool to a position near the heel of the needle, where it passes through an eye, 12; thence through an eye, 13, on the top of the needle itself; thence through a longitudinal tube or passage in the needle to a position near and just below the point thereof, where it comes out, all substantially as represented. When the cord is carried over a gavel by the needle it extends from this exit at the point of the needle back over and down under

the gavel, and thence to the tying apparatus, by which the working end of the cord is continually held.

It is important that the cord should be kept as free as possible from any obstruction or interference, except where it touches the parts required, during the operation of tying, so that it will always be brought to the tying apparatus in the right position, and that there shall be no impediment to the operation of the tying mechanism. For this purpose the finger S of the needle performs an important function—first, by compacting the gavel below the needle, leaving a free space between the needle and the gavel for the cord to lie in; and, second, by having its forward end broad enough to always catch the cord and carry it down to the right position, by the side of the terminal part of the cord, ready for tying the two parts together. Besides, there is a guard, T′, on the top of the needle, of a shape concentric with the shaft *o* of the needle, as represented, so that after the needle has penetrated through the grain in the receptacle it holds the grain above at the full height, while the eccentric form of the lower side of the needle, as well as its finger S, and the packing-arms L L presses the gavel down away from it; and the grain which accumulates above the needle, and is held between the chute-board and the opposite side-board, as in a hopper, is prevented from tipping down at either end by two light spring-fingers, 13 13, attached to the supporting-bar 13′, reaching across to and pressing lightly against the chute-board. The guard T′ reaches and holds the grain entirely above the points of the packing-arms L L, so that they may continue in motion while the cord is tying without touching the grain above; but as soon as the needle, after the binding of a sheaf is completed, recedes from over the receptacle, the grain above falls a little down upon the spring-fingers 13 13, so that the points of the packing-arms catch hold of a small quantity at each movement, and thus gradually and regularly feed it down into the receptacle.

And still further protection is secured for the cord and against entanglement of the grain by the open space given between the needle at one side and the adjacent packing-arm; by the two supporting-fingers I I, with space between them; by the two ways *j j*, projecting from the chute-board or side of the receptacle, with free room between them; and especially by the projecting ribs or ways *k k*, projecting from the side-board, with free room between them. In the spaces between these several parts the cord invariably comes, and is thereby shielded from all obstruction.

Still further provision is made against entanglement of the grain and obstruction of the cord where the needle and its guard meet the ribs or ways *k k*. The upper ends of the ribs terminate abruptly, beginning at the corners 14, at their outer edges, and sloping upward therefrom moderately to the plate, whereto they are attached. The points 14 are so situated that the needle-point and the top of the needle-guard T′, as the needle passes over to the tying apparatus, will come nearly or exactly between them. Thus the dividing-line between the grain below and the grain above coincides at these points, and there is no tendency to carry down the grain which is above, since the needle makes an obtuse angle with the upper ends of the ribs *k k*, and the needle cannot catch any grain below its point upon the ribs to cause entanglement there.

The tying apparatus automatically ties the cord in a complete knot, cuts the cord beyond the knot, and holds the end of the cord securely after a knot is tied until the next sheaf is ready to be bound, and also releases one end and seizes and retains the next end during the operation of tying, so that the cord end is never loose, and the cord, once started in the machine, requires no further attention, except to connect new spools of cord to the last ends of the previous spools before they are run entirely out of the machine.

The complete apparatus comprises a tier proper, provided with an improved knotting-hook and means of operating the same, an improved cord-severing device, a device for seizing and holding the cord before severing and for releasing the end already held at the proper moment, a special device for guiding the two folds of the cord upon the tier, and particularly for drawing the band from the knotting-hook as the knotting is completed, and improved means of operating these several functional parts.

All the operative parts of the tying apparatus are actuated by a single revolution of the cam and rack wheel D, which is brought into action at the proper moment when the needle has brought the cord or string into position for tying.

First, as to the construction and operation of the tier proper, U, and its knotting-hook 15, which extends laterally from the end of the tier-shaft 16. The said shaft is mounted in bearings close by the inner face of the cam and rock-wheel, in a nearly horizontal position, directed toward the gavel-receptacle. When at rest it lies with the knotting-hook 15, also nearly horizontal, projecting laterally from the tier-shaft, so that when the needle passes over the tying apparatus it lays the cord directly over and across the said knotting-hook.

The operation of tying the knot is performed with this hook by a single revolution of the tier-shaft in its bearings, thus bringing it into position again for the next tying. This revolution of the tier is produced by means of a pinion, 17, on its shaft gearing intermittently into a segmental rack, 18, on the cam and rack wheel D, there being as many teeth, less one, on the rack as on the pinion. The rack occupies only a small portion of the circumference of the cam and rack wheel, the remainder of the circle being a simple rim or flange, 19, projecting as far as, or farther than,

the teeth of the rack, against which rim or flange a plane face, 20, notched into the pinion, or attached to it, slides, and thereby holds the pinion from turning while this part of the wheel is passing by it. The rim or flange being intermitted where the rack 18 is, as soon as one end thereof comes to the pinion the rack gears into the same, causing it to turn until its rear end passes over and from the pinion. Upon the knotting-hook 15 is a finger, 21, pivoted thereto, as shown, so that the tip of the finger can close against the point of the hook, and thereby serve to seize the cord at the right time and hold it, and again release the cord when required. The other end of this finger has a cam-projection, preferably provided with an anti-friction roller, 22, which, when it is desired to open or separate the finger from the hook-point, strikes a stationary cam, 23, situated on or near the adjacent bearing of the tier-shaft, in such a position as to perform the said office at the proper time and keep the parts separated as long as required. The finger is closed against the point of the hook by spring-pressure from a spring-cam, 24, attached to the frame of the tying apparatus in a suitable position, as shown.

Thus constructed and organized, the tier operates thus: As the needle descends into position for the tying it brings the body-fold of the cord over the knotting-hook and lays it there side by side with the end fold of the cord to be tied thereto. Then, at the required moment, the tier begins to be turned on its shaft, first bringing upward the knotting-hook, with the two folds of the cord around it. The knotting-hook continues to turn over and then downward, and before it reaches a vertically-downward position, the cam-roller 22 on the finger strikes the cam 23, and separates the finger from the point of the knotting-hook, so that when the hook is brought in line with the continuation of the cords below the knotting-hook the hook-point goes by one side and the finger by the other side of the said cord-folds. Directly after the two parts of the cord are thus caught between the hook and finger the cam-roller 22, having left the cam 23, is brought against the spring-cam 24, which causes the finger and hook to pinch the cord with sufficient pressure to hold the same for completing the tying. Then the knotting-hook, having made a complete revolution and returned to its first position, the guide V, which had previously directed and helped to hold the two folds of the cord over the knotting-hook, has imparted to it a rearward movement, carrying with it laterally the cord far enough to draw the cord-loop from the knotting-hook around the folds of the cord held between the hook and finger, and thus, since the tension on the cord continues, the band is tied in a complete knot. The finger continues to clamp the ends of the band-cord, being held thus by the action of the spring-cam, until released by means of a projection, 25, on the cam and rack wheel D, which, as the said wheel turns, is brought into contact with the said spring-cam, and forces it away from the heel of the finger, thereby allowing the band to be withdrawn entirely from the knotting-hook. The cord-guide V is a sort of hook, with sides terminating at the bottom in a nearly V-shaped notch, thereby holding the cord brought therein in the proper line. It is pivoted on a vertical pin, 26, to the frame of the tying apparatus, and its motion for casting off the cord-loop from the knotting-hook is produced by a heel-projection, 27, thereof being struck by a cam projection, 28, on the hub or other part on the shaft of the cam and rack wheel.

The cord severing and seizing and holding devices, operating in connection with the knotting-hook, are of peculiar construction. The results effected thereby are to hold the end of the cord securely till the needle brings the next fold of the cord into position for tying the band, to seize the next body-fold of the cord before the end is set free, and to securely fasten in position and sever the said succeeding fold from the cord required for the band immediately after setting the cord free, there being no time in which the successive ends, as severed from the band, are not securely retained.

The severing-knife 28′, acting by a shearing cut, in connection with a stationary cutting-edge, 29, and one, two, or more movable cord-holding plates, 30, acting in connection with stationary plates 31, to hold the successive ends of the cord, after severing each band therefrom, have a sliding or reciprocating movement to perform their functions communicated from or in time with the tier. As represented, the movement is produced by means of a crank or cam, 32, on the tier-shaft, and a connecting-rod, 33, extending therefrom to a pivoted vibratory lever, 34, the other end of which lever is connected with the said knives and cord-holding plates.

The arrangement of this mechanism is such that the crank has thrown and holds the lever backward to its farthest extent when the knotting-hook is in its resting position, thereby retaining the holding-plates closed between or in alternating positions with the stationary plates, between which movable and stationary plates the cord is held by several bends around the successive edges thereof, and thus securely retained. This device holds the end of the cord while the gavels are forming, and until the needle comes over again for binding another sheaf. Then, before the last end is released and another fold of the cord is laid in to be cut off, provision is made for retaining the cord end, when set free, until the knotting of the band is completed since the end must be set free and retained, so as to yield until the knotting is effected; also, it is requisite or best to bring the last fold of the cord under control and into position before setting the end free. For these purposes two hooks or fingers, 35 and 36, are employed, one situated

above and the other below the severing-knife and holding-plates. These hooks are attached to a rock-shaft, 37, and a reciprocating movement is communicated to them on this shaft by means of a sliding bar or rod, 38, and connecting-rod 39, connecting the bar and a crank-pin on one of the hooks or on their shaft. The bar 38 is secured to a sliding rod, 40, having a backward and forward movement from and toward the cam and rack wheel in suitable bearings or ways 41 42. The rod, with the bar, is kept forced against the face of the cam and rack wheel, or a cam, 43, thereon, by a spring or springs, 44, in which position the said hooks or fingers are held close upon the cord, since most of the time the rod bears against the cam and the hooks are lifted; but when it is time to seize and hold the folds of the cord, just after the needle has come down into position, the forward end of the rod, or an anti-friction pulley, 45, thereon, passes off from the cam and is forced against the face of the wheel by the spring 44, thereby causing the lower hook, 35, to catch the last fold of the cord, and the upper hook, 36, to seize the same fold and the preceding, or end, fold of the cord. The last fold of the cord is thereby pressed upon or against the holding-plates and severing-knife, so that, as soon as the said plates and knife recede, the cord enters into position in front thereof, whereby, when they again come forward, the plates seize and hold the cord and the knife severs it, the part of the cord held by the plates being that next to the needle. As the holding-plates recede to admit the last fold of the cord they release the end previously held. This released end is one end of the band just beginning to be tied, and it, as well as the end of the band last severed by the knife from the main cord, is retained in place by the upper hook, 36, until the knotting-hook has turned and made the loop for the knot and has seized the two folds of the cord thus held. The retention of the cords being by spring-pressure, they are thus allowed to be drawn out somewhat, if necessary, in forming the knot above. Then the rod 40 rides upon the cam 43 and releases the ends of the cord, which, therefore, are free to yield in the completion of the knot. The end which was previously held by the holding-plates, and consequently is a little longer than the end last severed by the knife, forms a bow in the tied knot. There is no waste of cord, only what is necessary to form a secure knot being used.

After the sheaf is bound, and before the needle has entirely receded and the binding mechanism is again at rest, the bound sheaf is discharged from the receptacle. First, the supporting-fingers I I are moved from under the receptacle, to allow the removal of the sheaf downward. This movement is effected by means of a cam or cam-groove, 46, (shown by dotted lines in Fig. 3,) on or in the forward face of the driving-wheel E, (or of a cam-wheel on its shaft,) in which groove slides a stud on a crank-lever, 47, pivoted to the frame, and connected by a rod, 48, with a crank-arm, 49, on a rock-shaft, W, upon the other end of which is another crank-arm, 50, that is connected by a rod, 51, with the pivoted sustaining-bar *l* of the said supporting-fingers. The arrangement of the several parts is such that, at the proper time, the bar *l* is swung back far enough to withdraw the supporting-fingers from beneath the receptacle, leaving the sheaf free to drop, and, directly after the discharge of the sheaf, to return the supporting-fingers to the position beneath the receptacle to sustain the next forming gavel therein. As soon as the supporting-fingers are removed from beneath the receptacle, an arm, X, projecting from the cam and rack wheel, or from its shaft, in the revolution thereof, strikes the top of the bound sheaf, and causes it to be discharged from the receptacle upon the ground.

To insure the discharge of the sheaf properly, another arm, Y, at the rear of the tying apparatus, acts simultaneously with the arm X upon the other end of the sheaf. This arm may be attached to the shaft of the cam and rack wheel, to receive its proper motion; but I have represented it as attached to a rock-shaft, Z, extending back to the rear end of the binder, and there having a crank-arm, 52, connected by a rod, 53, to the crank-arm 49 on the rock-shaft W. The arrangement is such that the vibration of the said arm 49, for the purpose herein set forth, will cause the arm Y to move down upon the sheaf simultaneously with the arm X.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. Retaining-buttons *b b*, in combination with the sustaining-bars *c c* of the frame A and the grooved pulleys *d d*, substantially as and for the purpose herein specified.

2. The combination of the slotted pin *g* and set-screw *h* with the cam and rack wheel D and shaft *f*, substantially as and for the purpose herein specified.

3. In combination with a gavel-receptacle, a finger or fingers, I I, at the bottom thereof, having first an upward movement to compress the gavel before binding, then backward to permit the discharge of the bound sheaf, then downward and forward to its original position, substantially as and for the purpose herein specified.

4. The combination of the needle K and packing-arms L L, arranged to operate in such a manner that one of the packing-arms shall have a movement simultaneous with the needle through the grain in the receptacle, substantially as and for the purpose herein specified.

5. In combination with a pivoted supporting-bar, *l*, the gavel-supporting fingers I I, pivoted to and adjustable on the said supporting-bar, substantially as and for the purpose herein specified.

6. In combination with the gavel-receptacle of a self-binding harvester, two or more grain-compacting arms, L L, acting alternately or

successively, and each having a continuous curved movement, first forward across the receptacle to separate a quantity of grain, then downward in the receptacle to pack the grain thus separated, then outward from the receptacle, and upward to complete the movement, substantially as and for the purpose herein specified.

7. The combination of a cog-wheel, *s*, loose upon a driving or transmitting shaft, M, through which motion is communicated to the driving mechanism of the needle and cord-tying apparatus, a fixed coupling-arm, O, upon the said shaft, and a lever-stop, P, pivoted to the said cog-wheel, and actuated by a spring to automatically bring it into the path of the said coupling-arm, for the purpose of coupling the cog-wheel to its shaft at a stated time, substantially as herein specified.

8. The combination of the sustaining-bar *l*, the supporting-fingers I I, adjustably pivoted thereto, and the needle-arm K, having a vibrating heel, from which the said bar is suspended by a pin or pivot, 7, substantially as and for the purpose herein specified.

9. In combination with the coupling-arm O, on the shaft M, and spring-lever stop P, on the cog-wheel *s*, an arm, Q, mounted on the needle rock-shaft, and provided with a spring, *y*, to press it toward, and thereby to catch and hold, the lever-stop P, so as to prevent the coupling of the said cog-wheel to its shaft while the gavel is forming in the receptacle, substantially as herein specified.

10. The combination of the stopping-arm Q and its spring *y* with the supporting-fingers I I of the gavel-receptacle, so arranged that when the receptacle is filled to produce a certain pressure on the said fingers the spring *y* will yield, and the arm Q will be moved away from the lever-stop P, and allow the cog-wheel *s* to be coupled to its shaft and start the movement of the needle and band-tying mechanism, substantially as herein specified.

11. The combination of the pivoted bar *l*, supporting-fingers I I, adjustable thereon, arm B, rock-shaft 2, arm 3, and arm Q, provided with a projection, 4, for the arm 3 to strike, substantially as and for the purpose herein specified.

12. In combination with the cord-spool T, variably weighted by the cord, a friction-tension device, 11′, receiving the cord-weighted spool thereon, and adjustable toward or from the center of the said spool, substantially as and for the purpose herein specified.

13. In combination with the needle K, a compressing-finger, S, shutting closely into the under side thereof, and, near the close of the forward movement of the same, having a positive movement downward therefrom directly upon the grain of the gavel, substantially as and for the purpose herein specified.

14. Projecting ways or ribs *j j* and *k k*, at opposite sides of the gavel-receptacle, for further shielding the binding-cord from obstruction and allowing its motions to be free, substantially as herein specified.

15. In combination with the needle having a concentric guard, the ribs *k k*, at one side of the receptacle, constructed to have angles where the point of the needle enters between them, and to form an obtuse angle with the needle at the top, substantially as and for the purpose herein specified.

16. A guard, T′, on the needle, concentric with the needle's motion, for keeping the grain above at the proper height away from the reciprocating packing-arms while the sheaf is binding, substantially as herein specified.

17. In combination with the spring-cam 24 and tier U, a projection, 25, on the cam and rack wheel, for forcing aside the said cam at the required moment, substantially as and for the purpose herein specified.

18. The hooks or fingers 35 36, in combination with the holding-plates 31, for seizing and bringing into position the cord-folds, and temporarily holding the same when severed from the main cord, substantially as herein specified.

19. The combination of the spring 44, bars 38 and 39, rock-shaft 37, hooks 35 and 36, sliding rod 41, and a cam, 40, on the cam and rack wheel D, substantially as and for the purpose herein specified.

20. The combination of the sustaining-bar *l*, having a reciprocating movement, and the supporting-fingers I I, having a swinging movement on the said sustaining-bar, substantially as and for the purpose herein specified.

21. The combination of the revolving arm X and vibrating arm Y, substantially as and for the purpose herein specified.

Specification signed by me this 19th day of October, 1876.

JOHN F. APPLEBY.

Witnesses:
J. S. BROWN,
JNO. D. PATTEN.