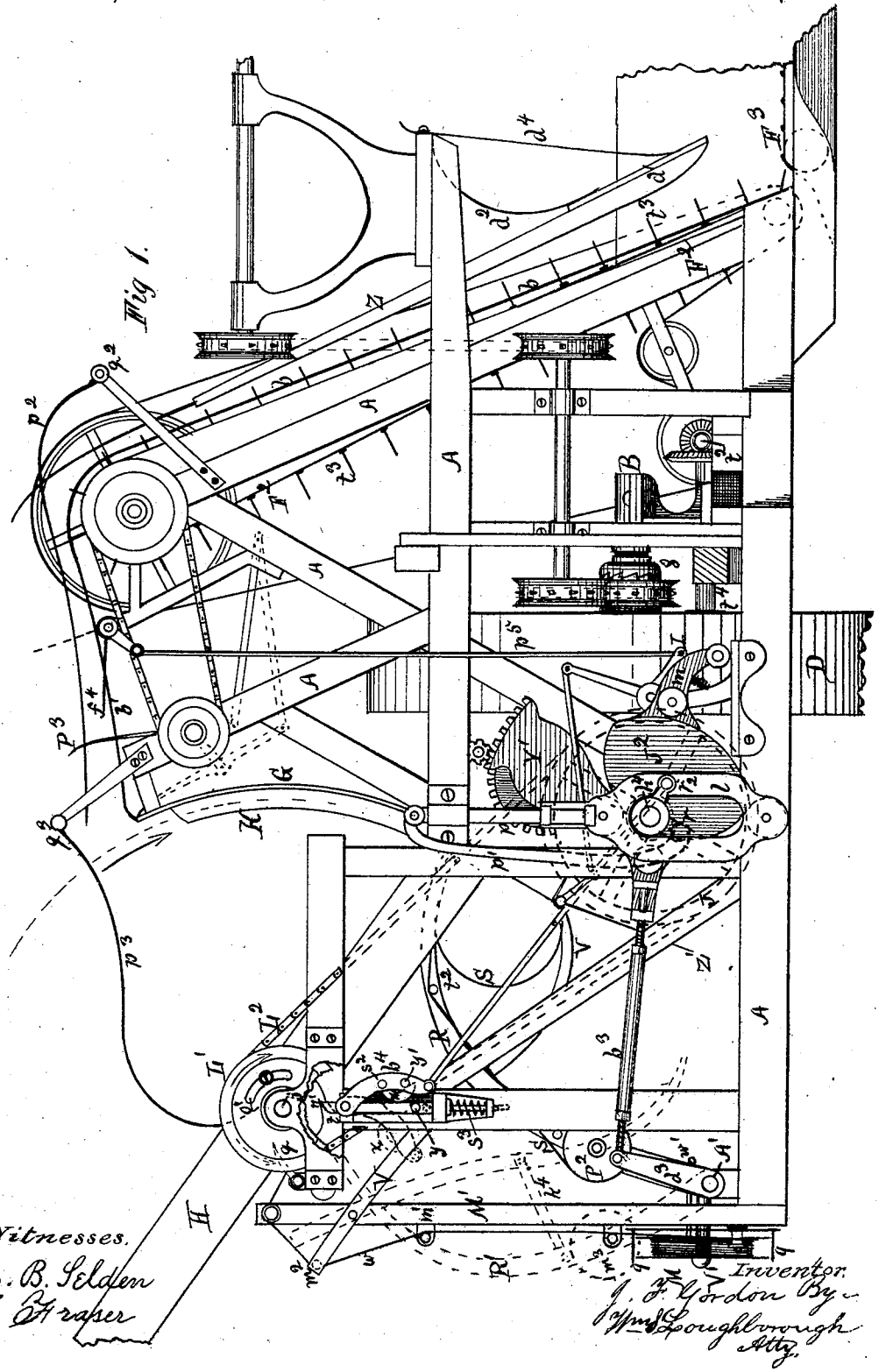
3 Sheets--Sheet 1.

J. F. GORDON.

Grain-Binders.

No. 151,967. Patented June 16, 1874.

Fig 1.



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3 Sheets--Sheet 2.

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Grain-Binders.

No. 151,967. Patented June 16, 1874.

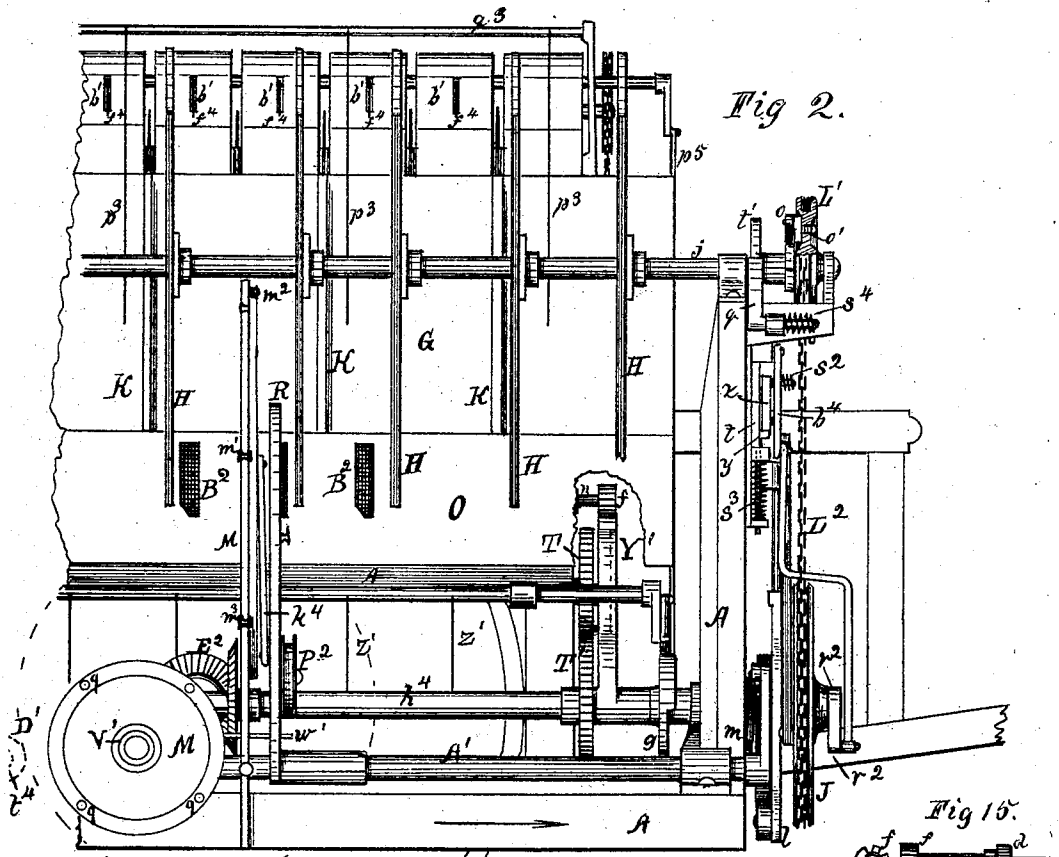

Fig 2.

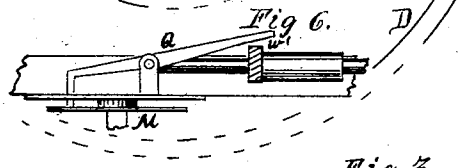

Fig 6.

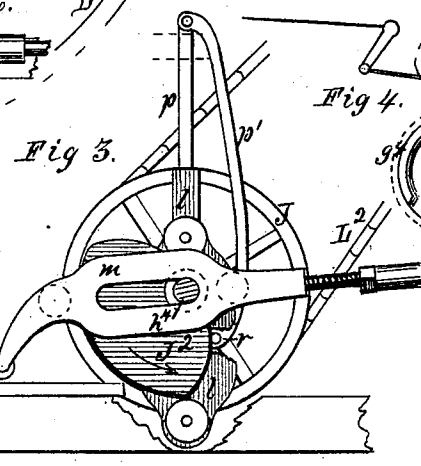

Fig 3.

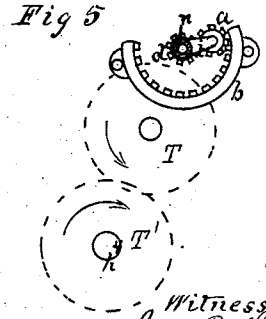

Fig 5

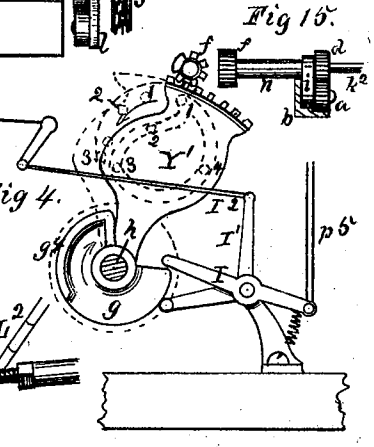

Fig 4.

Fig 15.

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Fig 12.

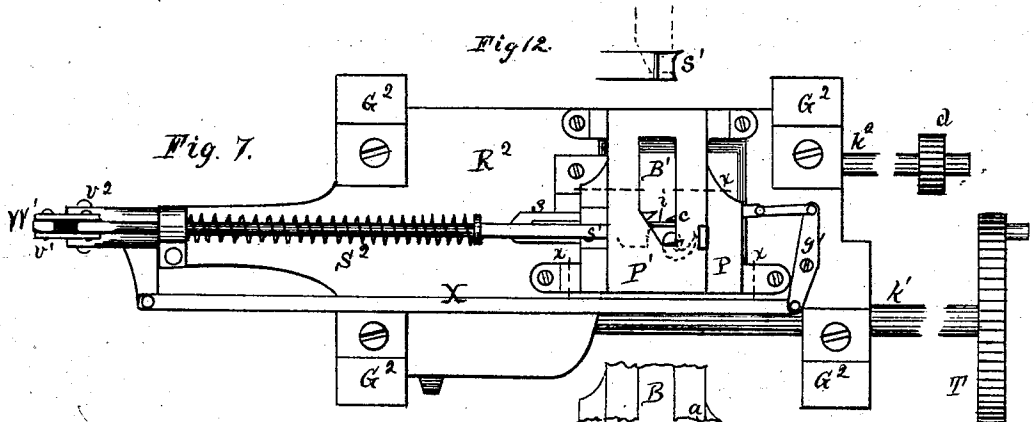


Fig. 7.

Fig 11.

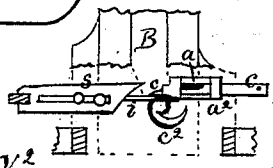


Fig 8.

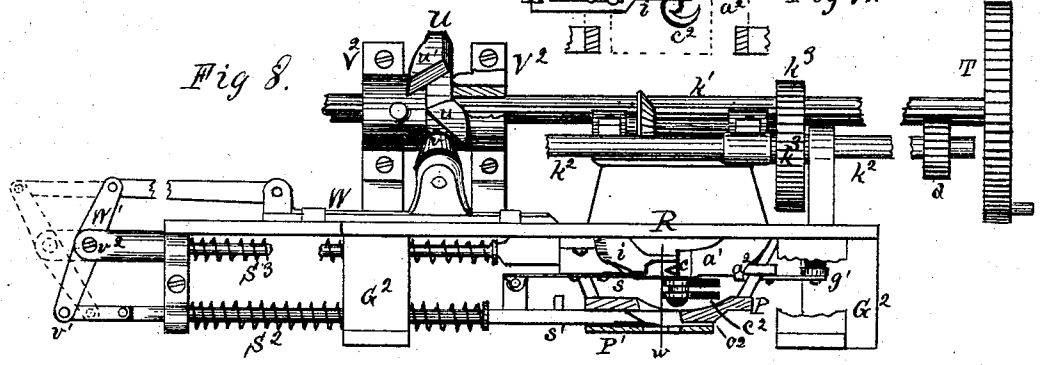


Fig 13.

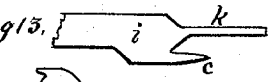


Fig 10.

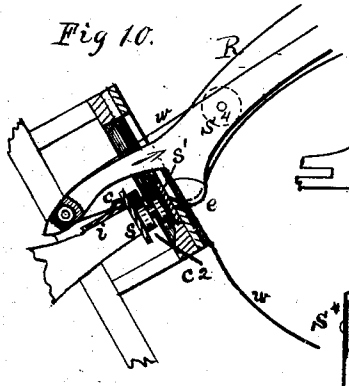


Fig 14.

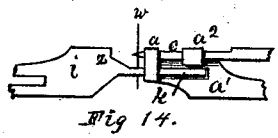


Fig 9.

Fig 16.

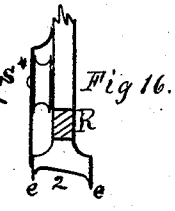
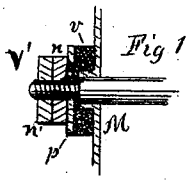


Fig 17.



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UNITED STATES PATENT OFFICE.

JAMES F. GORDON, OF ROCHESTER, NEW YORK.

IMPROVEMENT IN GRAIN-BINDERS.

Specification forming part of Letters Patent No. **151,967**, dated June 16, 1874; application filed February 21, 1874.

To all whom it may concern:

Be it known that I, JAMES F. GORDON, of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Self-Binding Harvesters; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings making part of this specification, in which—

Figure 1 is a front elevation of my improved self-binding harvester, having the reel and most of the cutting-platform broken away. Fig. 2 is a sectional rear elevation of the same. Fig. 3 is an obverse view of the cam J^2, the yoke *l*, which rotates the chain-wheel J, that drives the gaveler, and the yoke *m*, which operates the binding-arm R. Fig. 4 is a detached front elevation of the cam-wheel *g*, that operates the bell-cranks I and I^1; also, the cam Y′, which actuates the binding mechanism. Fig. 5 is a detached view of the internal or segmental gear *b*, with the planetary pinions *a* and *d*, that communicate reciprocating movements to the twister-shaft. Fig. 6 is a detached top or plan view of the reel-brake. Fig. 7 is a rear elevation of the binding apparatus. Fig. 8 is a top sectional view of the same. Fig. 9 is an obverse view of a portion of Fig. 7. Fig. 10 is a transverse sectional view of the wire clamping and twisting mechanism, showing the end of the binding-arm R in its relative position thereto during the act of clamping, cutting off, and twisting the ends of the bands together. Fig. 11 is a sectional view of devices behind that portion of Fig. 7 within the dotted lines *x* in said figure. Fig. 12 is a detached sectional front view of the clamping jaw s^1. Fig. 13 is a top view, showing a modified form of the jaw *i*. Fig. 14 is an inverted sectional view of the sliding jaw *i*, finger *c*, and stock or fixed jaw a^1. Fig. 15 is a transverse view of the planetary gearing shown in Fig. 5. Fig. 16 is a transverse section of the binding-arm at the shoulder, and looking in the direction of the arrow in Fig. 10. Fig. 17 is a sectional view of the wire-reel tension device.

The objects of my invention are, harvesting grain and binding it into bundles by means of suitable bands; and its general operations are, cutting the grain; conveying it by an endless revolving apron on a platform to an elevating-carrier, by which it is lifted over the driving wheel or wheels and delivered to the gaveling or binding apparatus; dividing the accumulating grain-stalks on their passage from the elevator from those delivered to the gaveler or binder; and, lastly, encircling the gavel with a wire band, and cutting off and twisting together the ends of the same preparatory to dropping the bundle upon the stubble.

Reference in the following description to the grain side of the machine is understood to mean that portion which moves in and cuts the grain; and reference to the stubble side, that portion which moves over the stubble, and upon which the operation of binding is performed.

A in the drawings represents the frame-work of the machine, which is hung to the ground or driving wheel D by means of a suitable pillow-block or box, B, on each side. Motion is communicated to the reciprocating cutter-bar (not shown) by means of the crank-shaft t^2, which is driven through shaft t^4 by a spur-gear on the ground-wheel, and indicated by the dotted circle D′, Fig. 2, and a clutch may be arranged upon this shaft to be thrown in or out at pleasure. At the rear of the finger-bar, and in such a position as to receive the falling grain, is arranged an endless revolving apron, a portion of which is shown at F^3, Fig. 1, which may or may not be provided with transverse strips, and which passes over suitable rollers at the lateral extremities of the platform. This apron acts to convey the cut grain into a position at the inner end of the finger-bar to be caught by the teeth t^3 upon the endless elevator-belt F^2. These elevators are sustained and driven by suitable rollers at top and bottom, and act to convey the grain over the driving or ground wheel to the stubble side of the machine, delivering it to a gaveling or binding apparatus. The teeth t^3 upon the belts F^2 project between slats *b* b^1, Figs. 1 and 2, which are secured at the inner end of the platform, and are bent in such a shape at their upper ends as to extend over the upper elevator-roller, and be fastened to the upper edge of the apron G. The slats

are also so curved as to cause the teeth to withdraw gradually from between them toward the descending side of the belt F^2. The ascending grain-stalks lie upon these slats, and are moved along by the elevator-teeth t^3. After being lifted the grain is forced along the inclined or extended portion b^1 of the slats and discharged therefrom by the picker-teeth P^3. Independent ribs or grain-guides Z are provided, corresponding in number and lateral position with the slats b, their lower extremities being secured to the vertically-adjustable bar d^1, and their upper ends resting upon the slats b, or nearly so. The grain, in ascending, passes under these guides, and, by their being hung to the yielding bar d, which is sustained by the springs d^2 and adjusting-straps d^4, it is retained upon the slats b against the action of the wind or other disturbing influences. A rock-bar, q^2, has suitable bearings upon the upper end of the posts which sustain the upper roller of the elevator-belt, and long guard-fingers p^2, of metal or other suitable material, are secured to it, and rest upon the grain as it passes along the incline or extended portion b^1; and it will be seen that, since the guards Z project above these fingers, the grain-stalks are guided and kept in position during their entire passage to the gaveler or binding apparatus, and also prevented from passing over the divider or cut-off fingers f^4 when they are thrown up to check the discharge of the grain while a gavel is being removed. A similar rock-bar, q^3, and guard-fingers p^3 are placed, as shown in Figs. 1 and 2, to prevent the possibility of the grain-stalks being thrown out of reach of the revolving gaveler H by wind or other influence; or, if desired, the guards p^2 might be extended so as to answer for both. At a suitable point under the incline or extension b^1, I hang the rock-bar of the divider or cut-off fingers f^4 to the frame of the machine. The fingers swing up between the slats b^1, or through slots in them, being actuated by the cam g upon the shaft h^4, bell-crank I, and a connecting link or rod, p^5. The picker-fingers P^3 are arranged, as shown in Fig. 2, to operate upon the grain moving upon the incline b^1 and effect its uniform delivery to the binding mechanism, except when prevented by the divider. As the picker constitutes the subject-matter of a separate application, a detailed description of it is not deemed necessary here. H, Figs. 1 and 2, are the arms of a gaveler, secured at or near their center to the shaft j. The ends of these arms swing close to the apron G, and the grain that falls from the incline or extension b^1 rests upon these arms, and is retained in the angle between them and the apron G. A number of ribs, K, are provided on this apron, between which the ends of the gaveler-arms H pass. By this means the grain-stalks are kept away from the face of the apron, and prevented from dropping between the apron and the ends of the gaveler-arms. The dividers f^4 are thrown up by the cam g when sufficient grain has been delivered to the binding mechanism to form a bundle, and the descending mass of grain-stalks is thus checked from moving forward until the gavel already formed is removed by the gaveler or the binding-arm, as hereinafter described. The gaveler-shaft j has an intermittent rotary motion imparted to it by the following means: L^1, Figs. 1 and 2, is a chain-wheel, which revolves loosely upon the outer extremity of the shaft j, before mentioned. This shaft receives motion from the driving-axle by means of bevel-gears E^2, Fig. 2, and near the wheel J (shown in dotted lines in Fig. 1) is provided with a cam, J^2, Figs. 1 and 2, and in obverse view in Fig. 3, upon the sides of which the reciprocating yokes l and m are located. These yokes move nearly at right angles to each other, as shown, and are actuated by means of friction-rollers journaled upon the yokes, and resting upon the periphery of the cam J^2. This chain-wheel L^1 is loose upon the shaft j, and moves the latter in one direction only by means of the ratchet and pawl o, Fig. 2. This ratchet has only two teeth, equidistant on its periphery, whereby any impulse given to the wheel L^1 greater than one-half and less than one whole revolution will cause but one-half revolution of the shaft j and the gaveler H. The cam J^2 is so formed that the yokes l and m are stationary during one-quarter, more or less, of a revolution of the former at both extremities of their throw, and consequently the parts actuated by them have a similar intermittent motion. The yoke l is guided in its reciprocations by the rod p, extending from its upper end, and the pitman p^1 is pivoted to said rod, and to a crank-pin, r, in one arm of the wheel J, Figs. 2 and 3, also shown by dotted lines in Fig. 1, the wheel being omitted from the latter figure to uncover other parts. Thus it will be seen that the chain-wheel J is given an intermittent motion by the yoke l; and the crank r being attached near the center of the wheel, its periphery is moved nearly one-third of a revolution by the amount of throw given to the yoke. The wheel L^1, however, being much smaller than the other, the chain L^2 gives it more than a half revolution either way alternately. The movement of the gaveler, which is always forward, as indicated by the arrow in Fig. 1, is just one-half a revolution, its throw being governed by the two-toothed ratchet and its pawl, before mentioned. It will be seen that by these movements of the chain-wheels an intermittent movement is imparted to the gaveler, and that such movement is effected during one-quarter of a revoluion of the cam J^2 and its shaft. The pawl o of the two-toothed ratchet is pivoted to a sliding plate, o^1, Figs. 1 and 2, which is made adjustable on the chain-wheel L^1 by means of a set-screw through the segmental slot shown in Fig. 1. This adjustment is provided for the purpose of taking up any slack, or compensating for any wear of the parts, or stretch of the chain L^2, &c., and thus force the gaveler-arms to their proper position

at each movement. An automatic stop, *t*, Figs. 1 and 2, is employed to act upon the disk t^1, fixed upon the gaveler-shaft *j*. This disk has a ratchet tooth or a serrated notch, *w'*, Fig. 1, on two opposite sides, and the stop *t* is forced into either of them by means of a spring, s^3. As the gaveler swings over, the stop holds it from turning too far, and in position to receive the next gavel, and sustain the weight of the same while the gavel below is being bound. The stop is withdrawn by means of the crank r^2 upon the shaft h^4, which is linked to the pivoted arm b^4, Figs. 1 and 2. To the back of this arm is pivoted a cam-dog, *x*, the oscillation of which is checked in one direction by the pin y^1 upon the arm, against which it is returned by a suitable spring, s^2. By the revolutions of the crank r^2, which is keyed or otherwise fixed to the shaft, the arm b^4 is given a reciprocating motion, and this motion in one direction (toward that position shown in dotted lines) causes the descent of the stop *t*, by means of the cam-shaped edge of the dog *x* pressing down upon the pin *y*. When the arm returns to the position shown in full lines, the dog swings freely over the pin or lug *y* on the stop *t*. The crank r^2 is so arranged upon the shaft with relation to the cam J^2 that the withdrawal of the stop shall occur just previously to the action of the chain-wheels upon the gaveler. To prevent any reactionary vibration of the gaveler-arm shaft *j*, I provide the disk t^1 with two reverse serrated notches intermediately between the other two, into which the spring-pawl *q* catches, and effectually retains it in its proper position. The binding-arm R is secured to the rock-shaft A', Figs. 1 and 2, to which motion is imparted by the cam J^2 and yoke *m*, before mentioned, through the rock-arm d^3 and adjusting-link b^3. The binding-wire *w* is wound upon a reel, M, and passes from thence over or through guide-rollers m^3 and m^1 on the standard M', and the roller m^2 on the upper end of the compressing-arm V; then over the pulley at the top of the standard M', and thence to the pulley in the eye of the binding-arm, Figs. 1, 2, and 10, in which latter figure the parts are represented in the position as when the wire is being caught in the twister and by the jaw *i*. The gaveler-arms are so arranged that the binding-arm and wire may pass between them, and said arm being adjustable along the shaft A', its position may, and always must be, fixed between some two of the gaveler-arms. It is plain that, as soon as the gavel is formed, the gaveler-arms H may swing around in the direction of the arrow in Fig. 1, and allow the gavel to drop upon the binding-wire and the balancing-fingers Z', the opposite end of the arms H assuming the position necessary to receive the grain from the picker P^3 for the next gavel, and at the same time confining the gavel lying upon the binding-wire, and assisting to retain it in position while being bound. It will also be seen that the binding-arm may swing in toward the twister and encircle the formed gavel with the wire. The wire-reel brake consists of a bent lever, Q, Fig. 6, pivoted in such a position that the bent end shall rest against one head of the wire-reel M, when the other end, *w'*, Figs. 1, 2, and 6, is forced by the binding-arm R just at the extremity of its forward movement after encircling the gavel with wire, thus checking the momentum of the reel, and preventing it from continuing to pay off wire, which would be kinked and entangled in the parts. The tension device for the wire-reel M consists of a friction-pad, *v*, Fig. 17, placed upon the hub of one head of the reel, against which it is held by a washer or collar, *p*, and the double or jam nuts *n* and *n'*, both of which are indispensable, to prevent the traction between the reel-head and the pad from screwing the parts up with such force, when the reel revolves, as to actually lock it from turning at all, and consequently to cause it to break the wire, &c. It will be seen that when the binding-arm R swings to the position indicated by the dotted lines R^1 in Fig. 1, lever Q is released, and thereby liberates the reel. The object of this is to allow the wire to be paid off by the next forward movement of the binding-arm. There is a small pulley or friction-roller, Fig. 10, placed in a mortise in the end of the arm R, around which the wire passes, as indicated. I pivot a curved reciprocating arm, V, to the standard M, Figs. 1 and 2, and connect this with the binding-arm R by means of the pivoted link k^4, whereby the movements of the reciprocating arm V, carrying the compressing-cord S, is governed entirely by those of the binding-arm R. To the side of the latter I pivot a groove-faced pulley, P^2, Figs. 1 and 2. Within this pulley is placed a spring, (not shown,) one end of which is fixed to the pulley and the other to the arm, or to the axial pin of said pulley. One end of a cord, S, is passed two or three times around the pulley within the groove, and secured thereto, and the other end is put through a suitable loop, t^2, on the binder-arm, and over a roller indicated by a dotted circle, S^4, Fig. 10, (also shown in full lines in Fig. 16;) thence to the lower end of the reciprocating arm V. The action of this is as follows: When the binder-arm R swings forward, to carry the wire around the gavel, the end of this arm V is thrown up under the gavel in the opposite direction, the cord S, as well as the wire, assuming somewhat the position shown in Fig. 1 around the bundle. The wire band is thus relieved from the strain necessary to compress the gavel preparatory to binding; and it is more thoroughly compressed, because greater force may be applied through the arm V, the cord S, and spring-pulley P^2; and when the arm V is moved back in the opposite direction it also carries that end of the cord with it, thus permitting the free discharge of the bundle. It will be seen that this spring in the pulley P^1 also enables the cord to adapt itself to the various-

sized bundles and compress them with equal force, and that the tension may be increased at any time by shortening the cord or by taking up the spring. A rubber or other elastic compressing-cord might be substituted for the spring and pulley, if desired. As the end of the binding-arm R swings toward the twister, the upper end of the arm V is thereby thrown outward, and the wire passing over the pulley m^2 therein, a certain extra quantity of wire is thus drawn off the reel, which affords a slack in the wire from the twister to the end of the arm R, when it is thrown back, or in its outward position, the object of which is to allow the wire to readily settle down to the level of the balancing-fingers by the weight of the gavel when deposited thereon. The spring in the pulley P^2 causes it to recoil, and thus produces a strain upon the cord during the act of compressing and binding. The balancing-fingers Z′, above mentioned, are arranged below the binding-wire, and are secured to the rock-bar extending along the lower edge of the board O. This rock-bar is operated by the cam *g*, the bell-crank I^1, link I^2, and rock-arm on the shaft, Figs. 1, 2, and 4, and the fingers, when thrown up, as shown in Fig. 4, act to steady the butts and heads of the bundles or gavels while being bound. Upon the completion of the binding process, the cam allows the fingers to drop and discharge the bundle, such position being shown in Fig. 1, which occurs just the instant before the gaveler, &c., change their position. That portion of the cam *g* which governs the position or action of the balancing-fingers describes about three-fourths of a circle, the fingers being held up during that part of its revolution. There is a projection, g^4, on one side of the cam, reaching about one-fourth of a circle, and this portion operates the bell-crank or lever I, connected with the divider or cut-off fingers f^4, whereby they are held up in the position indicated by the dotted line in Fig. 1 during one-fourth of the revolution of the cam-shaft, and while the gavel is being removed. A shield or board, O, is placed immediately below the gavel-apron G, and the wire-twisting apparatus is arranged upon horizontal timbers just behind it. The openings B^2 through this board are in the same horizontal line with the slot B^1, Fig. 7, in the twister, and as the arm R is adjustable along its shaft A′, any one of the openings B^1 may be used for the entrance of the said arm to the twister, the latter also being adjustable along its supporting-timbers. By means of this lateral adjustability of the binding devices upon the frame of the machine, the position of the band around the bundle may be accommodated to the grain of different lengths.

The binding apparatus consists, in general terms, of two sets of clamping-jaws, one of which retains the end of the wire while the gavel is being pressed by the binding-arm, while carrying the wire around the gavel, the other holding both ends of the encircling band, while the twister-hook c^2 (shown in my patent of July 15, 1873) cuts off and twists them together. The saddle P, Figs. 7 and 8, is secured to the frame R^2, which supports the twister, and is provided upon its upper face with a plate, P^1, having a slot, B^1, before mentioned. The lower end of this slot is contracted on one side, as shown, forming a somewhat wedge-shaped opening, for the purpose of forcing the wire or wires in a position to be more readily caught by the transversely-sliding jaw s^1, Figs. 7, 8, 10, and 12, which is so placed and arranged as to move its vertical clamping-edge into the groove o^2, just back of the plate P^1, which latter constitutes one wall of the opening. The jaw s^1 clamps the ends of the band against and between the edges of the plate P^1 and the other wall of said opening or mortise o^2, Fig. 8. By having this mortise o^2 open entirely through to the outer edge of the plate P^1, any foul matter which is liable to work in between the walls of the mortise by the action of the jaw is pushed out or through by it, thereby keeping it always open and clear, and insuring the clamping of the wires by the latter being firmly pressed around the front end of said jaw s^1, by which they are pressed between the metal walls of the mortise, as before stated. The kinks thus formed in the ends of the wire band also greatly assist to retain the grasp upon them, and hold them after they have been released by the inner jaw, *i*, and cut off by the action of the hook or twister, and during the twisting operation. There is a sort of guard or centering jaw, *s*, as shown more clearly in Fig. 11. This jaw is attached to the shank of jaw s^1, and so as to move with it; but it is located on the opposite side of the twister-hook, as shown in Fig. 8, and its functions are mainly to retain the wire, as it lies across from the front to rear or inner jaw, about to be described, as indicated in Figs. 8 and 10, down within the track of the revolving twister-hook, and to prevent the end of the wire from springing out of the grasp of the inner jaw, *i*, after being cut off by said twister-hook. The clamping-jaw *i*, Figs. 7, 8, 10, 11, 13, and 14, moves parallel to *s* and s^1, but is arranged flatwise, and its clamping notch or shoulder is made to move into the metal loop *a*, formed on the end of the finger-stock or fixed jaw a^1, Figs 8, 11, and 14. I provide a clamping-finger, *c*, Figs. 7, 8, 10, 11, and 14, fitted to slide within loops *a* and a^2 on the stock a^1, and motion is communicated to it by means of the pivoted lever g^1, the lower end of which is linked to the spindle of jaw *i* by the rod X, as shown in Fig. 7. When, therefore, the jaw is withdrawn, the finger *c* is also withdrawn, but in the opposite direction, thus leaving a free passage for the introduction of the wire, as will be more fully described hereafter. But when the jaw *i* moves up to and clamps the wire, the finger *c* also advances, and prevents the latter from slipping out or springing away from the jaw,

its action being to hold the wire down upon or against the beveled shoulder of the jaw, that portion of the wire next to the twister being below the finger, and that toward the pulley in the head of the binder-arm being above the shank *k* of the jaw *i*, as shown in Fig. 8.

It is evident that by means of the beveled shoulder *z*, Fig. 14, on the jaw *i*, when it and the finger *c* approach each other, the intervening wire is thereby forced into the V-shaped angle formed between them, and its more thorough clamping is thus insured. The finger *c* also forms a ledge, over which the wire is drawn when the binding-arm retreats, and by its use the latter action cannot detach and withdraw the wire from the grasp of the jaw. If desired, this finger might be formed upon the jaw *i*, as shown in Fig. 13. The shank *k* of this jaw is never withdrawn from its bearing in the stock a^1, and therefore the wire can never be forced below the range of the clamping-shoulder of the jaw. The two spindles of the clamping-jaws are each provided with a strong spring, S^2 S^3, which hold said jaws in their seats or clamping position, except when withdrawn by the cam U, and also takes up any slack which might occur by the action or wear of the parts. W′ is a lever, which is pivoted to each of the jaw-spindles, and is connected by a link to the reciprocating slide W. From the back of this slide projects, obliquely, a lug, to which is pivoted a conical friction-roller, *v*, Fig. 8. Through these parts the jaws receive an intermittent reciprocating movement from the compound cam U. This cam has a sleeve projecting on each side, which are made to constitute its journals, and they have bearings in the hangers V^2. The link is shown broken away, so as to permit the roller of the slide to occupy a central position, while at the same time the front jaw and guide are held open. The spindle of the rear jaw *i* is also shown broken away, so as to allow that jaw to be shown open. The natural draft or force of the springs tends to keep the roller and slide in their present position; but the former is held upon the right-hand side of the cam during about two-thirds of each revolution, which position holds the front jaw s^1 open. As the cam is revolved, an instantaneous or sudden impulse is given to it in the opposite direction by the lug *u* of the cam, which changes the position of the lever W′ to that indicated by the dotted lines in Fig. 8, which closes the jaw s^1 and opens the jaw *i*, and it is immediately returned to the right side by the lug *u′*, and, of course, reverses the position of the jaws. This compound cam is splined upon the cam k^1, the opposite end of which has a suitable bearing upon the frame of the machine, and receives its motion therefrom through the spur-gears T and T′, the latter of which is keyed to the shaft h^4. The extent of the reciprocations of the slide W is such that when the inner clamping-jaw *i* is closed the center v^2 becomes a fulcrum for the lever W′, and the jaw s^1 is thereby opened; and conversely when s^1 is closed, the center v^1 becomes the fulcrum, and *i* is opened. The importance of this action will appear more clearly hereafter. The stock R, upon which the twisting devices are arranged, is hung to two timbers just under the gaveler-apron G, and behind the board O, by means of the hanger-lugs G^2; and by means of the shaft k^1 being splined to the cam U, and the shaft k^2 to the spur-gear k^3, this stock may be hung in such a position as to receive the binding-arm through the central opening B^2 in the board O, or through either of the others, as may be required. The outer end of shaft k^2 near pinion *d* has a bearing in the sleeve *n*, Fig. 15.

The twister c^2 is the subject-matter of a separate application; therefore only its operation in connection with the other parts will be explained here. It is given several revolutions in either direction alternately by the bevel-pinions y^2, which receive motion from the swinging segment Y′, Figs. 1 and 2, and the planetary gearing, Figs. 5 and 15. In these figures the planetary pinion *a* is hung loosely to the arm *i*, and acts as an intermediate between the internal segmental gear *b* and the central pinion *d*. This latter is rigidly fixed upon the shaft k^2. The arm *i* and pinion *f* are fixed upon the sleeve *n*, as will be seen, while the latter only receives a partial turn or revolution either way from the cam or segment Y′. The motion of the pinion *d* is multiplied by the planetary pinion *a* traversing the internal segment *b*. The segment Y′ is journaled upon the shaft h^4, and is made to oscillate by a wrist-pin, 1, in the gear-wheel T, which pin carries a friction-roller, and moves in a cam-groove shaped about as shown by dotted lines in Fig. 4. It is thus shaped in order to give both the forward and reverse movement of the twister-hook during about one-fourth to one-third of a revolution of the shaft k^1, which latter operates the clamping-jaws. The forward movement of the hook is produced while the pin is passing from 1, which indicates its position at the end of the extreme backward throw of the cam, Fig. 4, to the point 2, and the backward or reverse movement or throw while passing from 2 to 3, from which latter point around to 4 and to 1. The groove being a true circle, and brought into a concentric position with the axial center of wheel T, around which the wrist-pin swings, the twister is held at rest during that portion of the revolution of said wheel T. Since the movements of all the parts of the binding apparatus are derived either directly or indirectly from the shaft h^4, it follows that a bundle is bound at each revolution of the same, and all the parts are, therefore, timed together. The lips *e*, Figs. 10 and 16, prevent the wire from working off from the shoulder or inclined rest 2 on the binder-arm. An ordinary clutch, 8, Fig. 1, is employed to couple the driving-wheel D to its shaft. There may be guard-wires 9, Figs. 1 and 2, on the reel M, to prevent the wire from

getting discharged therefrom, except as required by the movements of the arm R. It will be seen that without a spring on at least one of the spindles neither of the wire-clamping-jaws could be kept closed, and both are indispensable in order to secure the closing of either jaw when necessary.

The operation of my invention is as follows: The grain, having been cut in the usual manner, falls upon the revolving apron F^3, from whence it is elevated by the belt F^2, and carried over the driving-wheel upon the slats b^1, and delivered by the pickers P^3 to the binding mechanism. The end of the binding-arm R has, by the revolution of the shaft h^4, been previously forced into the twisting apparatus, and the end of the wire caught in the jaw i, in the manner before described. At the proper moment, and while the arm R is returning to its open position, the cam g throws up the dividing or cut-off fingers f^4, arresting for the time the forward movement of the grain, and immediately thereafter the chain-wheel J acts, by means of the cam J^2, to give the gaveler a half revolution in the direction of the arrow in Fig. 1. The gavel is thereby deposited upon the binding-wire and balancing-fingers Z′, the weight of the gavel, together with the pressure of the gaveler-arms H, bearing the band down, as before shown. The end of the binding-arm is thrown forward into the twister, drawing a quantity of wire from the reel M, and carrying it around the gavel, and through that one of the openings B^2 in range with which the binder-arm and the twisting apparatus are arranged, and into the slot B^1 in the twister. While these movements have been going on, the jaw i has been kept closed and the jaw s^1 open by the roller v being held on the right-hand side of the cam U, Fig. 8, through their intermediate connections. When the end of the arm has reached the extremity of its inner movement, as in Fig. 10, the said cam reaches that portion of its revolution which drives the slide W to the opposite extreme of its movement by the reversing portion u, Fig. 8, and this causes a sudden reversal in the position of the jaws, closing s^1 and opening i by the means before explained. Jaw i is opened but an instant, simply to release the end of the wire previously held, and to receive and grasp the first end of the wire to form the next band after being severed by the twister-hook. This jaw i is opened and closed after the entrance of the end of the binder-arm, and while the jaw s^1 is closed, during which time, also, the twister is operated. The opening of the jaw i retracts the finger c, as before shown, and vice versa. The jaw s^1 is opened to discharge the bound gavel or bundle, and is held open until the binding-arm carries the wire around the next gavel, and returns to the position shown in Fig. 10, when it is again closed to grasp the ends of the wire encircling the bundle, and holding them until cut off and twisted together, as before shown, and just as the bundle is to be dropped, the fingers Z are permitted to fold down, as shown in Fig. 1, and thus allow the discharge of the bound grain.

I lay no claim in this case to either the picker, the divider, or cut-off, or to the guard-fingers p^2, as they constitute the subject-matter of a separate application.

What I claim as my invention is—

1. The combination of the apron G, gaveler H, and guard-fingers p^3, as and for the purposes set forth.

2. The cam J^2 and yoke l, in combination with the chain-wheels J and L^1, arranged to operate conjointly, substantially in the manner and for the purposes set forth.

3. The stop t and spring s^3, in combination with the swinging arm b^4 and pivoted spring-dog x, operating conjointly, substantially in the manner and for the purposes set forth.

4. The adjustable ratcheted chain-wheel L^1, in combination with the intermittently-rotating gaveler H, for the purposes set forth.

5. In combination with the pivoted or swinging arm V, support M′ and binding-arm R, substantially in the manner and for the purposes shown and described.

6. The compressing mechanism, consisting of the binder-arm R, compressing-arm V, cord S, and spring-pulley P^2, arranged to operate substantially as set forth.

7. In combination with the wire-pulleys on the standard M′, the swinging pulley m^2 and arms R and V, for the purposes set forth.

8. The brake-lever Q, in combination with the binding-arm R and wire-reel, substantially as and for the purposes set forth.

9. In combination with the binding-arm R and the wire w, the balancing-fingers Z′, pivoted to the lower edge of the apron G, so as to swing down to drop the bundle, as set forth.

10. The fixed jaw P P^1, provided with the opening o^2, through which any refuse matter may be discharged by the action of the jaw s^1.

11. The clamping-finger c, in combination with the clamping-jaw i and fixed jaw a^1, operating conjointly to clamp the outer end of the wire after the band has been applied, and while the end of the binding-arm is returning to its open position, substantially as set forth.

12. In combination with the clamping-jaws i and s^1 and the twister c^2, the centering-jaw s, as and for the purposes set forth.

13. In combination with the wire-clamping jaws i and s^1 and springs s^2 and s^3, the lever W′, with its movable centers or axial points v^1 and v^2, arranged to operate conjointly, substantially as and for the purposes set forth.

14. The compound cam U, constructed to operate substantially as shown and described, in combination with the wire-clamping jaws, for the purposes set forth.

15. The cam Y′ and wheel T, arranged to operate substantially as shown and described, in combination with the twister-hook c^2, for the purpose of imparting to the latter an intermittent forward and reverse rotation, as and for the purposes set forth.

16. In combination with the cam Y′ and pinion *f*, the planetary gearing *a*, *b*, *d*, and *i*, Figs. 5 and 15, and twister-hook c^2, for the purposes set forth.

17. The reciprocating clamping-jaws s^1, operating conjointly with the fixed jaw or plate P^1, to grasp and hold the free ends of the wire band during the action of the cutting and twisting hook, as set forth.

18. The stock or fixed jaw a^1, provided with the metal loop *a*, to form the open slot into which the jaw *i* forces the wire in the act of grasping the same, and permit said jaw to force any wire cuttings or other waste matter through, so as not to interrupt the effective action of said clamping-jaw, as set forth.

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Witnesses:
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