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Grain-Binders.

No. 211,027. **Patented Dec. 17, 1878.**

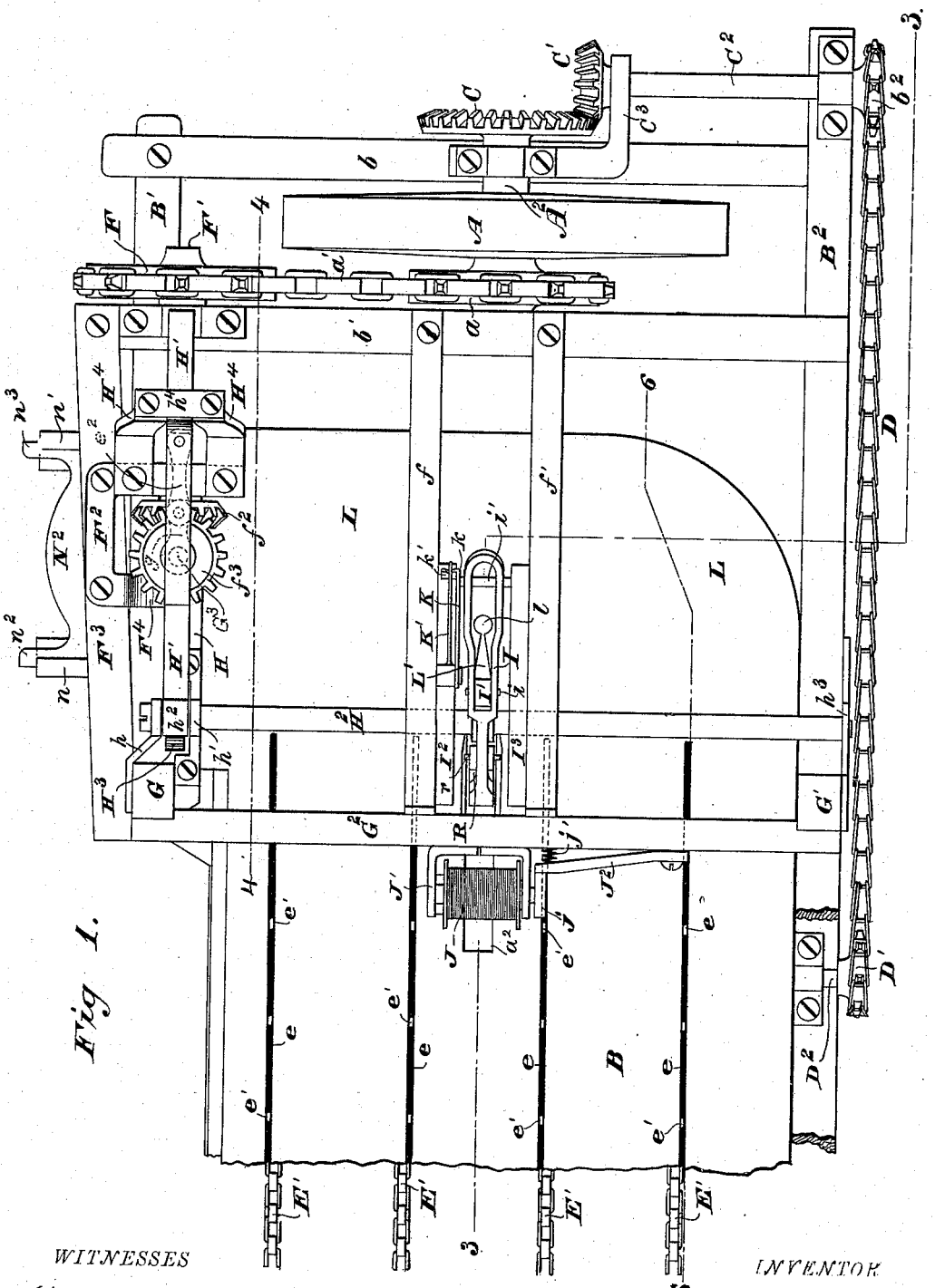

Fig 1.

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INVENTOR

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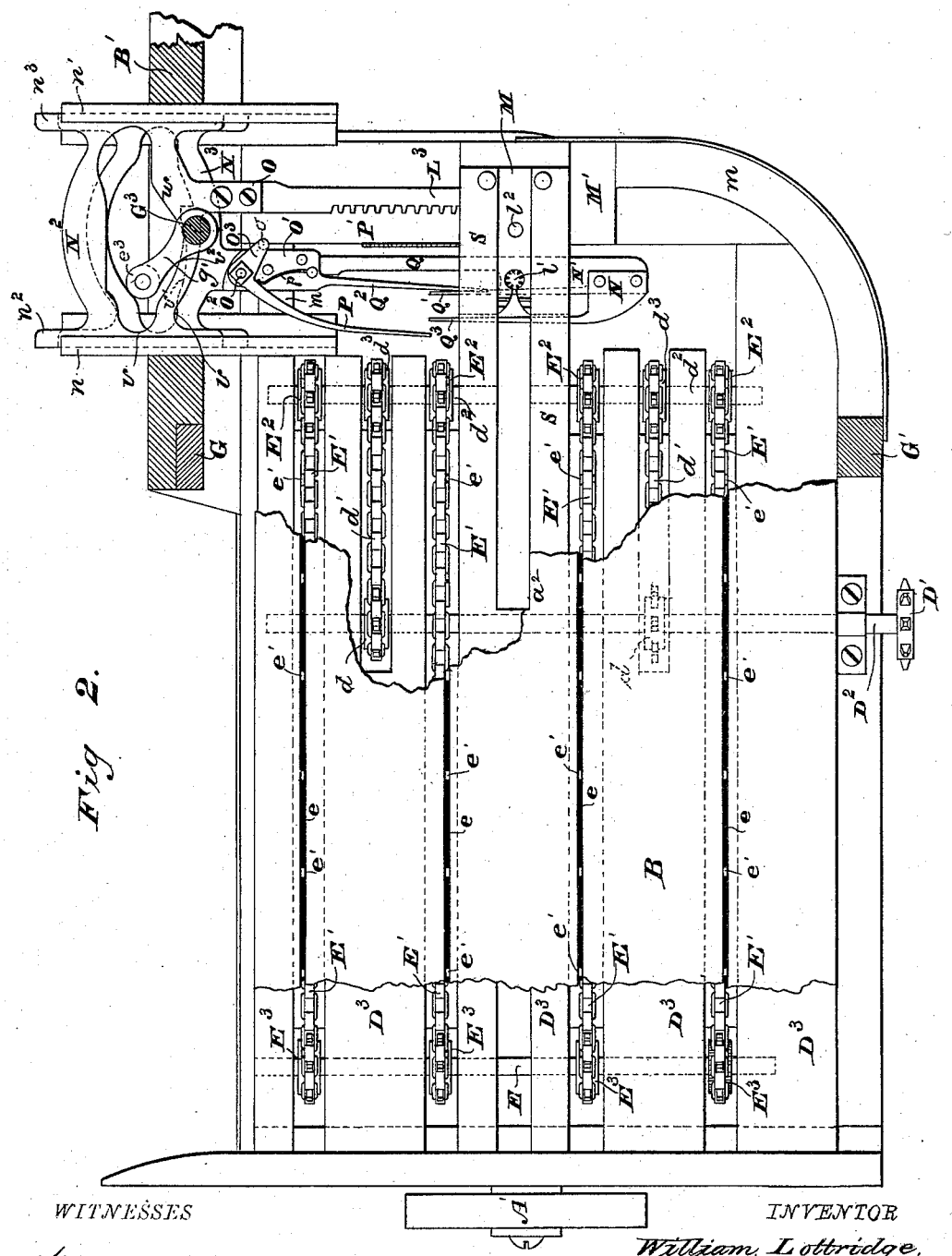

Fig 2.

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Grain-Binders.

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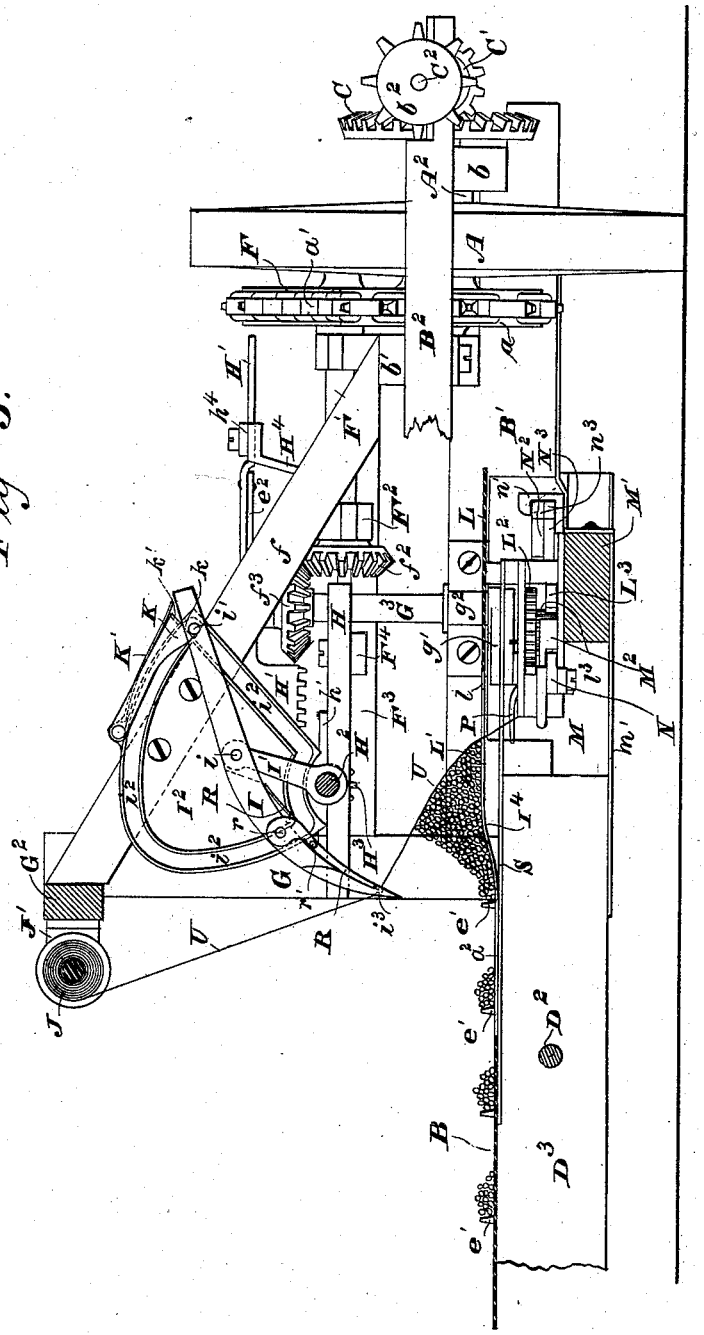
Fig 3.



WITNESSES

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W. LOTTRIDGE.

Grain-Binders.

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Fig 5.

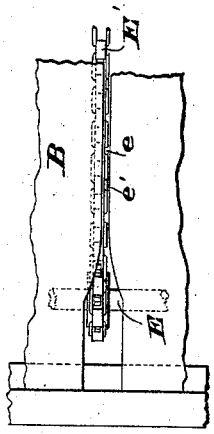


Fig 7.

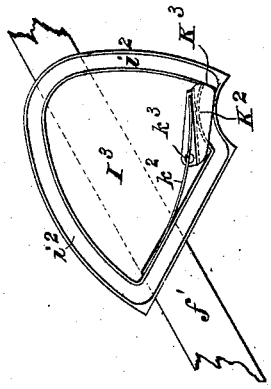


Fig 4.

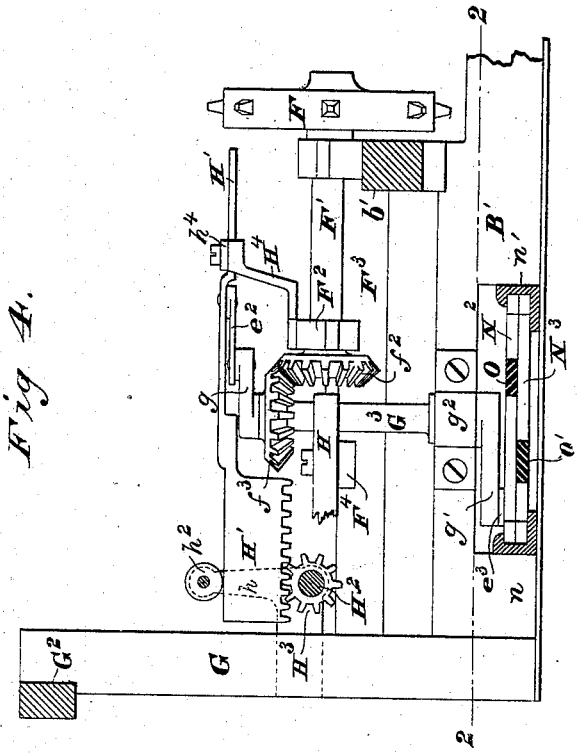
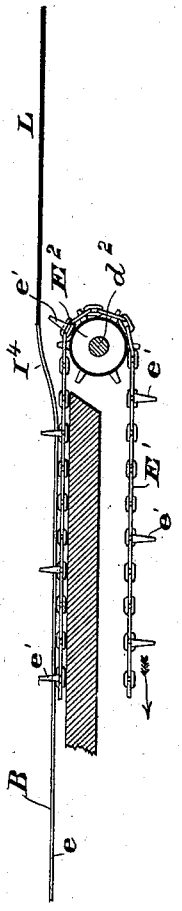


Fig 6.



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Grain-Binders.

No. 211,027. **Patented Dec. 17, 1878.**

Fig 9.

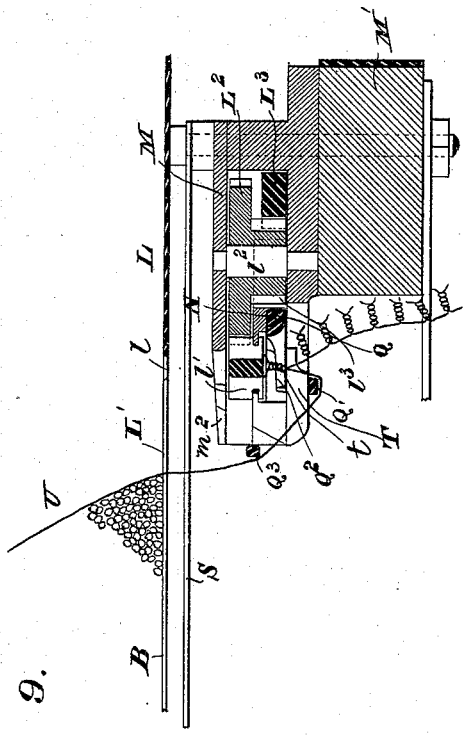


Fig 10.

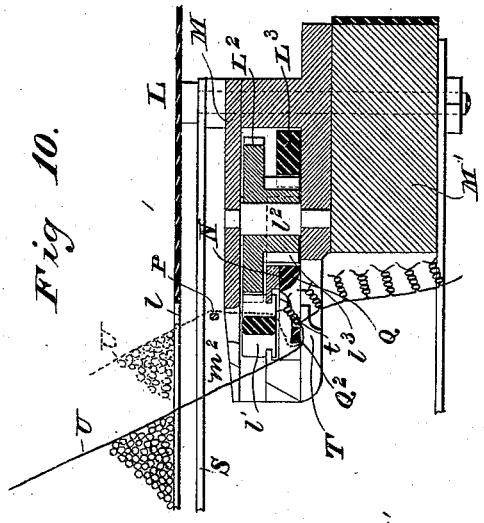
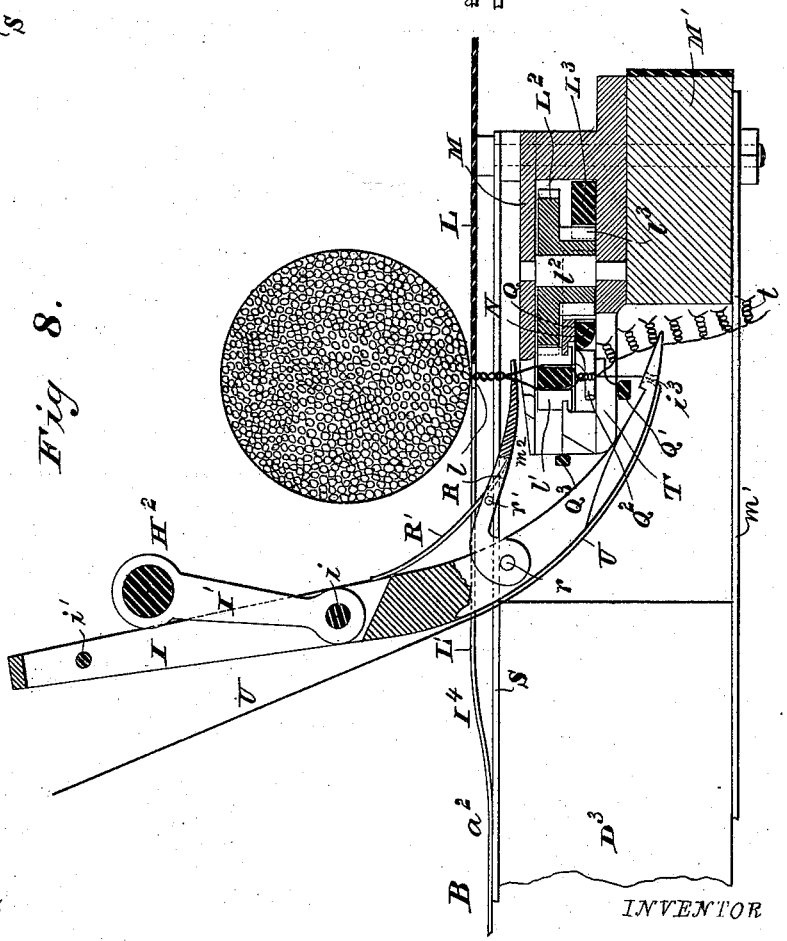


Fig 8.



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W. LOTTRIDGE.

Grain-Binders.

No. 211,027. **Patented Dec. 17, 1878.**

Fig 13.

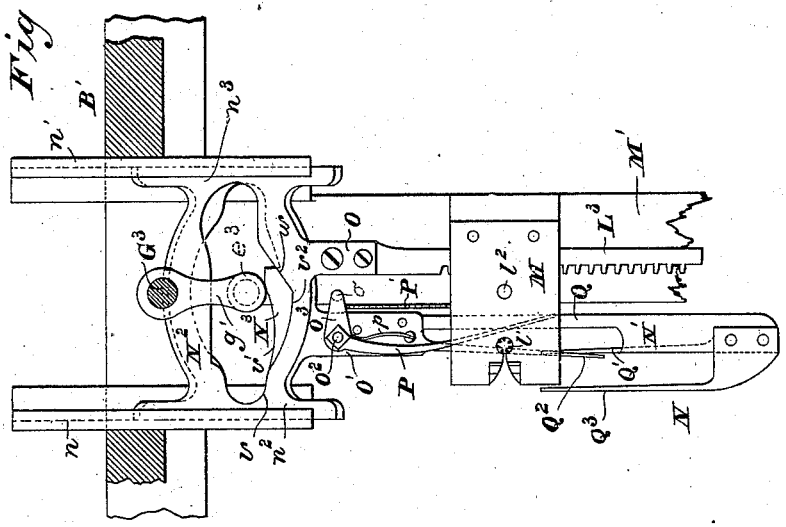


Fig 11.

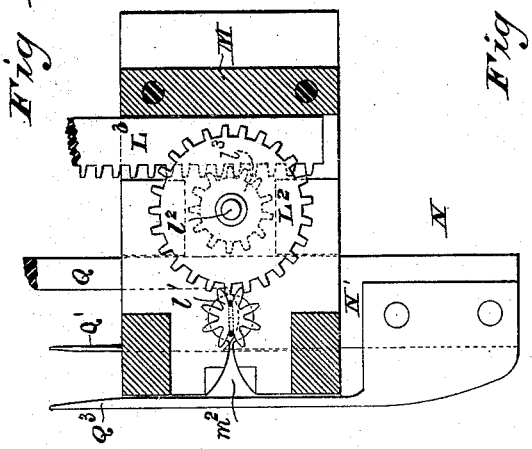
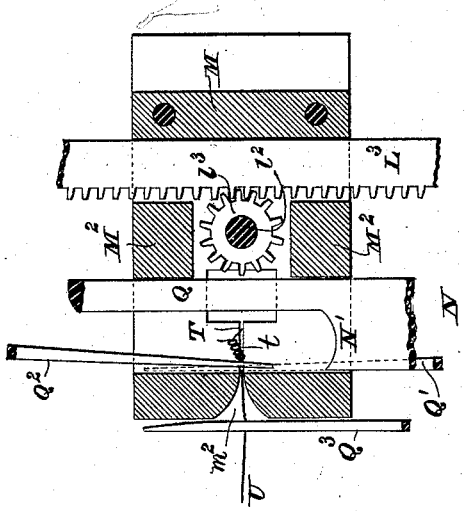


Fig 12.



WITNESSES

Wm a Skinkle.
Geo W Buck

INVENTOR

William Lottridge

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UNITED STATES PATENT OFFICE.

WILLIAM LOTTRIDGE, OF OSAGE, IOWA, ASSIGNOR OF EIGHT-EIGHTEENTHS OF HIS RIGHT TO MARTIN V. NICHOLS, AND FOUR-EIGHTEENTHS OF HIS RIGHT TO CYRUS H. COTTER, BOTH OF SAME PLACE.

IMPROVEMENT IN GRAIN-BINDERS.

Specification forming part of Letters Patent No. **211,027**, dated December 17, 1878; application filed August 8, 1878.

To all whom it may concern:

Be it known that I, WILLIAM LOTTRIDGE, of Osage, in the county of Mitchell and State of Iowa, have invented certain new and useful Improvements in Grain-Binders, of which the following is a specification:

My invention mainly relates to improvements in grain-binders of the class in which a single wire is employed to encompass and secure the bundles of grain, and in which the grain is bound at or upon the inner end of the grain-platform, or an extension thereof, on or substantially in the same level as the platform. Some of my improvements are, however, applicable to machines of other types.

My improvements consist in a novel organization of mechanism, and in certain combinations of devices, which hereinafter first are fully described, and then specifically designated by the claims.

In the accompanying drawings, which represent so much of a harvester as is necessary to illustrate my invention, I have shown all my improvements embodied in the best way now known to me.

Obviously some of them may be used without the others, and in machines differing in some respects from that therein shown and hereinafter described.

Figure 1 is a plan or top view of the machine, with the grain-platform partly removed or broken away at the outer end; Fig. 2, a view partly in plan and partly in horizontal section in the plane of the line 2 2, Fig. 4, with the inner or stubble end of the machine (the driving-wheel and adjacent parts) removed, and portions of the grain-platform broken away; Fig. 3, a view as seen from the rear, partly in elevation and partly in vertical section on the line 3 3 of Fig. 1; Fig. 4, a view as seen from the rear, partly in elevation and partly in vertical section on the line 4 4 of Fig. 1, showing portions of the inner or main-frame end of the machine and mechanism carried thereby in advance of the driving-wheel. Fig. 5 is a detail view, showing a portion of the outer or grain end of the platform, and one of the endless chains for feeding the grain toward the binding mechanism, in plan. Fig. 6 is a vertical section, on the line 6 6 of Fig. 1, through the grain-platform and the gavel-table at the inner end thereof, which serves also as a gearing-protector or cover or casing for the wire twisting, adjusting, holding, and severing mechanism. Fig. 7 is a view in elevation, as seen from the front of the machine, of the rear plate or casting of the two-part cam for controlling the movements of the binder-arm or wire-carrying arm. Fig. 8 is a vertical section, showing the binding-arm or wire-carrier and co-operating mechanism in the positions occupied just at the completion of the operation of securing a bundle. Fig. 9 is a section similar to Fig. 8, with the binding-arm omitted and the wire shown in the position it assumes when the gavel is accumulating and the binder-arm retracted; Fig. 10, a similar view of the same parts at a different stage of the operation. Figs. 11, 12, and 13 are views in detail, partly in section and partly in plan, of devices for adjusting, holding, twisting, and severing the wire, shown in various positions, such as assumed during different stages in the operation of securing a gavel.

The machine is carried upon the main supporting and driving wheel A, and a grain-wheel, A^1, the latter suitably mounted at the outer end of the grain-platform B, and the former turning, with its axle A^2, in bearings secured to transverse bars b b^1 of the main frame. These bars are secured at their ends to longitudinal front and rear bars, B^1B^2, which are connected with the platform, and also with the binding mechanism, supporting portions of the main frame between the driving-wheel and platform.

The driving-wheel imparts motion to the binding mechanism through a sprocket-wheel, a, and chain a^1, as will hereinafter be explained.

A bevel-pinion, C, upon the outer end of the axle A^2, drives a corresponding and smaller pinion, C^1, fast upon a shaft, C^2, supported and rotating in a bearing in a bracket, C^3, secured upon the bar b, and in another bearing upon the bar B^2. A sprocket-wheel, b^2, upon this shaft, at the rear corner of the frame, drives a chain, D, passing around and impart-

ing motion to a corresponding sprocket-wheel, D^1, fast upon a shaft, D^2, turning in suitable bearings beneath the grain-platform, in this instance shown as formed by openings in its supporting-beams D^3. Sprocket-pulleys d, upon the shaft D^2, and chains d^1 impart motion to shafts d^2, turning in suitable bearings beneath the top surface of the platform at or near its inner end, and provided with sprocket-pulleys d^3 for the endless chain d^1, driven by the shaft D^2. A third shaft, E, also mounted in bearings beneath the platform in the same way as the other shafts, is located near the outer or grain end of the platform. The platform is slotted as at e, parallel with the finger-beam, and endless chains E^1, one for every slot, pass at their opposite ends around sprocket-pulleys E^2 and E^3 upon the shafts d^2 and E, respectively, and are provided with teeth e^1, in any desired number and at suitable intervals apart, which work in slots e of the platform. These teeth are shown as formed upon the short metallic coupling straps or clips which unite the chain-links together. The teeth are short lugs, bent up from the edges of the clips. The chains, when set in motion, move with the teeth projecting above the platform toward the inner end or main frame, and return beneath the platform from the stubble end to the outer or grain end, as will readily be understood, sweeping the cut grain toward the binding mechanism in a regular or constant current while the machine is at work.

The two shafts d^2 d^2 (see Fig. 2) are mounted in line with each other, and terminate at their inner or adjacent ends at either side of a slot, a^2, (see Figs. 1, 2, 3, and 8,) in the platform, into which slot a wire-carrying or binder arm descends, as will hereinafter be explained.

By providing the long slot a^2 at the inner end of the platform, using two sets of feeding or carrying chains, E^1—a set for each of the shafts d^2 on the opposite sides of the binder-arm slot in the platform—and mounting the shaft D^2 beneath and intermediate the ends of the platform, or well out toward its middle, and beyond or outside the end of the slot, I am enabled to deliver the grain well into the gavel-table of the binding mechanism, and deposit it over the slotted end of the platform inside of the point to which the binder-arm reaches in gathering a bundle. The binder-arm, as hereinafter explained, projects outward over the platform before descending into the outer end of the slot, and as it moves inward to gather the gavel for the binding mechanism it traverses the slot between the ends of the shaft d^2, without impediment from these shafts, from the shaft D^2, or from the grain-carrying chains.

The endless driving-chain a^1 passes around a sprocket-wheel, F, fast on a shaft, F^1, at the front of the main frame. This driven shaft revolves in bearings, one of which is secured to the transverse bar b^1 of the main frame, and the other formed in one of the forks or arms of a U shaped or yoke bracket, F^2, secured upon a bar, F^3, of the binding-mechanism-supporting portion of the main frame. This frame-bar F^3 is parallel, or nearly so, with, and above and slightly in advance of, the front longitudinal bar, B^1, and is secured at one end upon the front end of the transverse bar b^1, and at the other end to an upright standard or front corner post, G, supported at its lower end upon the bar B^1. This post is connected with a similar and rear post, G^1, by a brace-bar or transverse piece, G^2, which is connected, about midway its length, with the transverse bar b^1, by two inclined bars or braces, f f^1, to and between which bars the binding-arm-cam-controlling devices are secured, as will hereinafter be explained. The rear post, G^1, is mounted upon or near the inner rear corner of the grain-platform, and is connected above the platform with the longitudinal rear bar, B^2, of the main frame.

A bevel-pinion, f^2, on the end of the driven shaft F^1, meshes with and drives a corresponding pinion, f^3, on an upright shaft, G^3, having cranks g g^1, one at each end, the upper crank, g, having pivoted to its outer end, or connected with its wrist-pin, a pitman or connecting-rod, e^2, and the lower crank, g^1, being provided with an anti-friction roller, e^3, freely revolving around a stud at its outer end. Through or by way of the shaft G^3 and its cranks all the moving parts of the binding mechanism are actuated, as hereinafter to be explained. That the binding mechanism, in the organization shown and to be described, may be so actuated through or by way of the shaft G^3, this shaft is mounted near its lower end, just above its cranks g^1, in a suitable sectional journal box or bearing, g^2, upon the inside of the bar B^1, just above which bearing the shaft is shouldered or provided with a collar, or its equivalent, to prevent downward movement. Near its upper end, and below the pinion f^3, the shaft is mounted in a bearing in a bar, H, which is supported near one end by the arm F^4 of the yoke-bracket F^2, and at the other by the front post, G, of the binder portion of the frame, to the inside of which post it is bolted or otherwise secured.

A bracket, h, bolted to the ouside of the front corner post, G, curves or bends inward, and then upward, to form one side of a guideway or sustaining and controlling frame, in which a rack-bar, H^1, reciprocates. The opposite or inner side of this sectional guideway is formed by an arm or post, h^1, having a flanged base bolted upon the bearing-bar H. At the top of this rack guideway, between its sides h h^1, is a roller, h^2, beneath and in contact with which the rack-bar moves to and fro. The roller is mounted upon a short shaft or bolt connecting the two parts h and h^1 of the guideway at top.

In the bearing-bar H and under side of the flanged base of the post h^1 a bearing is formed for the front end of an intermittently-operating rock-shaft, H^2, which is caused to oscillate,

first in one direction, and then in the other, (making about half a revolution, or a little more than half a revolution, in each direction,) by a pinion, H^3, fast on the front end of the rock-shaft and driven by the rack-bar H^1. At its rear end the rock-shaft is supported in a suitable bearing. (Shown as formed in a plate or bracket, h^3, on the rear post, G^1, and bar B^2 of the frame.) The wire-carrying or binder arm is actuated by the shaft H^2, as will hereinafter be explained.

The reciprocating movement of the rack or toothed bar H^1 is imparted to it through or by way of the top crank, g, of the doubly-cranked shaft G^3 and the short pitman e^2, which is pin-jointed at its outer end to the under side of the shank or extended portion of the rack-bar, as will readily be understood from an inspection of the drawings. When the machine is in operation the pinion f^3 of the shaft G^3 is always rotated in one direction, thus giving the rack a complete reciprocation or advance and return stroke upon each revolution of the shaft. At the end of the rack-bar opposite that which is toothed and guided by the way $h\ h$ it moves in a suitable guide-way. (Shown as formed by a supplementary forked and bent bracket, H^4, secured to the yoke-bracket F^2, and a cap-piece, h^4, fitting over the rack-shank and secured by bolts or screws.)

A binder-arm or wire-carrying arm, I, is slotted vertically or made loop shape from or near its heel end to or about midway its length, and a crank-arm, I^1, fast on the oscillating shaft H^2, is pin-jointed by a pivot, i, in this slot at its outer end. The movements of the binder-arm are controlled by a cam or two cams. In this instance a two-part or double cam is employed to give a steady movement and prevent binding or twisting of the parts. One cam guide or way would answer; but I prefer two. Each cam is formed in its plate or casting I^2 or I^3, respectively secured to the inner sides of the inclined bars f and f^1, and facing each other. As these cams are alike, a description of one of them will answer for both. A cross-pin or roller, i^1, passing transversely through the heel or near the heel end of the binder-arm, moves in a cam track, groove, or way, i^2, in each of the cam-plates. This pin may either be fastened in the heel of the binder-arm, and have rollers upon its ends to move in the cam-tracks, or it may revolve in the binder-arm. The binding-wire passes through an eye, i^3, near the point of the binder-arm, and is supplied from a spool, J, mounted in a bracket, J^1, upon the cross-bar G^2, and held under tension by an arm, J^2, jointed at one end to said bar, and pressed at its opposite end against a collar or head, j, fast on the end of the spool-shaft by a spring j^1.

From the above description, with the aid of the drawings, it will be seen that when the machine is in motion and the binder-arm and its actuating mechanism in the positions in which they are shown in Figs. 1, 3, and 4—that is, with the rack H^1 retracted and the binding-arm in its elevated position, with the roller or cross-pin i^1 at the top of the rear inclined portion of the cam-track i^2 (the rear upper corner of the cam-track)—the binding-arm will remain stationary or move very slowly for a short while as the crank g and pitman e^2 are on or about the dead-center point of revolution of the pinion f^3 of the crank-shaft G^3. The rack-bar next advances, setting in motion the pinion H^3 during this outward movement, and through it the rock-shaft H^2. At the same time the crank I^1 of the rock-shaft rocks outward over or toward the grain-platform and draws the roller i^1 of the binder-arm down the incline at the back of cam i^2. The first movement imparted to the binder-arm causes its point to move outward and slightly upward over the platform. It next descends into the stream of grain being moved inward toward the binding mechanism, enters the slot a^2, and moves quickly inward with the current of grain, thus offering no impediment to the flow of grain; but on the contrary, it separates a portion of it from the rest and accelerates its delivery at the point where bound. The teeth e^1 of the endless-chain conveyer clear themselves from the grain when it has been swept in to the slightly-elevated inner end of the platform past the upwardly bulged, curved, or inclined portion I^4, where the openings or slots e of the platform terminate.

An accumulation of grain takes place at this raised point on the platform and inside of it, thus facilitating the gathering of a gavel by the binder-arm, as will readily be understood by an inspection of Figs. 3 and 6. By the time, or a little before the time, the crank g has made a quarter of a revolution the binder-arm commences to sweep in the grain for a gavel, as above explained, and during the time the crank g is on the second quarter of its revolution the binder-arm roller i^1 moves in the bottom abruptly-curved portion of the cam-track. By the time the crank g completes a half-revolution, and the pitman e^2 is in line, or nearly so, with the rack-bar, (the second dead-center point,) the outward stroke of the rack-bar is completed and the binder-arm has been moved to its full extent inward to carry the wire to the twister-pinion, presently to be described. During the time the crank is on or about the dead-center, or about the point of half-revolution, and during the commencement of the third quarter of a revolution of the crank, the binder-arm is at rest and its roller i^1 is stationary at the lower front corner of the track, or at the front end of the differentially-curved lower part of the cam-track and bottom of the front incline part of this track. During the balance of the movement of the crank g, (the latter part of its movement on the third quarter, and the whole or greater portion of the final quarter of revolution,) the rack-bar is retracted, the direction of rotation of the pinion H^3 reversed, and the rock-shaft rocked back to the starting-point.

At the time of the first part of this final movement the roller i^1 of the binder-arm ascends the front inclined or slightly-curved part of the cam-track i^2, and during the latter part of the time occupied by the completion of a revolution of the rack-driving crank the binder-arm roller traverses the long slightly curved or arched top portion of the track, stopping at the starting-point, ready for the above-described operations to be repeated upon another revolution of the crank.

The front part of the cam-track i^2 has an inclination much greater than the inclined rear portion, and is nearly vertical, the result of which is that as the binder-arm is being withdrawn it moves outward but a slight distance, not near so far as on its downward and advancing movement, and does not materially, if at all, interfere with the inward movement of the grain to the binding devices.

A vertically-moving stop arm or latch, K, pivoted upon the top of the cam-plate I^2, and pressed downward by a spring, K^1, is elevated by the roller i^1 acting upon its inclined under edge shortly before the binder-arm completes the movement above described. When the roller i^1 reaches the position in which it is shown in Figs. 1 and 3, this latch drops so as to bring its nose or outer end, k, behind the roller, and guard against the movement of the binder-arm at the start in the wrong direction.

A lateral lug, k^1, on the end of the latch overhangs the cam-plate and limits the downward movement of the latch, thus holding it, normally, in position to be operated upon by the roller or to dog it against reverse movement.

A suitable trip block or dog, K^2, pressed upon by a spring, k^2, is pivoted at k^3 upon the cam-plate I^3, near the bottom and inside or above the rear inclined portion of the cam-track i^2, (see Fig. 7,) so that its outer end or nose, K^3, crosses or overhangs the front lower corner of the track at the juncture of the bottom abruptly-curved portion and the front inclined portion of the track.

As will appear from an inspection of the drawing, the binder-arm roller i^1 may move freely past this trip arm or block in the proper direction, but is dogged against reverse movement when it reaches the bottom of the front inclined portion of the track past the nose of the block, the spring yielding for the passage of the roller by the upward movement of the block and holding the block behind it afterward. This device may be placed upon the plate I^2, if desired.

The wire twisting, adjusting, holding, and severing mechanisms, to be described hereinafter, are protected by a cover or casing plate, L, having a slot, L^1, in line with or forming a continuation of the platform-slot a^2, into the wider portion of which slot L^1 the binding-arm I enters far enough to bring its curved point or eye i^3 beneath the eye or wire opening l at the narrow inner termination of the slot over the twister-pinion l^1. This protecting-plate or gearing-cover serves as a table, upon which the gavel accumulates and is supported while being bound. That portion, at least, of this table or cover at and near the wire-guiding slot L^1 should be made of metal, and may be formed separately from the rest of the table or cover and suitably attached to it.

The upper surface or covering material of the grain-platform preferably is of metal, and continues inward to form the table L, as shown in the drawings.

The wire-twisting pinion l^1 is driven by a pinion, L^2, fast on the shaft or trunnions l^2 of a pinion, l^3, or formed with this latter pinion, which is driven by a reciprocating toothed bar or rack, L^3. This rack-bar has an intermittent movement imparted to it on the advance—that is, it pauses near the completion of its advance or thrust movement, and then again moves forward. The twister-pinion has an annular groove or peripheral slot in the teeth, and is supported by ledges or a two-part plate entering said slot in a well-known way. These pinions l^1 L^2 l^3 are secured in a box, frame, or casing, M, mounted upon a cross-piece, M^1, supported by the inwardly-projecting ends m m of the front and rear beams upon the under side of the platform, and constituting parts of the platform-frame. The rear beam is shown as curved inwardly, to connect with the cross-piece M^1, and as strengthened by a metallic plate. Brace pieces or arms m^1 also project from the platform beneath the cross-piece about midway its length, and directly under that part of the piece on which the casing M is secured.

An opening or slot of less diameter than the twister-pinion is made in the upper plate or top of the casing directly over the pinion, so as to keep the wire in place when being twisted to secure a bundle, and a slot, m^2, is provided to admit the binding-wire. The lower part of the casing has two guideways or openings transversely through it, one on each side of a partial vertical partition or short uprights, M^2. The pinion L^2 rotates above these uprights, and the pinion l^3 between them. One of the guideways is for the rack-bar L^3, and the other for a peculiar three-armed reciprocating knot holder and releaser, N, which I term a "triple shuttle," and a wire-cutter, N^1, hereinafter more fully described.

The rack-bar L^3 and three shuttles, or triple shuttle N, and cutter N^1 are reciprocated through or by way of the crank g^1 on the revolving upright shaft G^3 and mechanism which will now be described.

Two eccentrically and irregularly slotted plates or cams, N^2 N^3, (see Figs. 2 and 13,) are fitted in guideways or flanged and grooved rails n n^1, in which ways the similarly-formed and respective cross-heads or ends n^2 n^3 of the differently-slotted plates or cams reciprocate. A varying or differential movement is imparted to these cams by the crank g^1 and its roller, because of the differences in the shape of the slots or cam-tracks, and the cams may freely

be moved independently of each other by the crank, as their supporting cross-heads slide the one above and upon the other. The cam N^2—in this instance the top one—has secured to it the shank or extended portion of the rack-bar L^3. An arm, O, on the cam and screws or bolts serve to connect the cam and rack-bar. The cam N^3 carries the three united shuttles, or triple shuttle N, and its attached knife N^1. The shuttle is suitably secured to an arm or plate, O^1, projecting inwardly from the cam N^3. Upon this arm or projecting portion O^1 of the bottom cam a short upright post or stud, O^2, is mounted. A horizontally swinging or vibrating wire-placing arm or finger, P, is pivoted at or near its heel or inner end upon the post O^2 of the shuttle and knife-securing arm. This finger, at its heel end, is bell-cranked or bent about at a right angle, forming a laterally and horizontally projecting short crank-arm or heel-projection, O^3, having a short down-hanger lug, pin, or roller-stud, *o*, at its outer end. A spring, *p*, secured at one end upon the top part of the shuttle shank or arm in front of the pivot O^2, and bearing against the finger P, near its crank, just in advance of its fulcrum, acts upon the finger with a tendency to keep it in its inoperative position, (see Fig. 2,) with the stud *o* at the crank end pressed against the vertical inner edge of the shuttle and knife shank or carrier. The outward movement of the reciprocating finger, as it vibrates on its fulcrum O^2, is thus limited by the crank-stud, acting as a stop and bearing against the arm O^1 or inner end or shank of the shuttle and cutter. At the proper time during the advance movement of the reciprocated finger the crank end or pin *o* strikes against a stationary stop-plate or tripping-piece, P^1, in line with the crank end, and shown as fixed to the inner edge of the cross-piece M^1, and projecting vertically above it a distance sufficient to cross the path of travel of the finger-crank as it is advanced toward the twister pinion or casing M.

The back bar, main piece, or shank Q of the triple shuttle and cutter has suitably (and preferably detachably) connected to it and carries the three arms or members Q^1 Q^2 Q^3 of the shuttle N, and the knife or wire-cutter N^1 is formed upon it. This carrier or back bar Q reciprocates in its opening or way in the box-frame or casing M, with its rear edge close to the partial vertical partition or studs M^2, between which the rack-driven pinion l^3 is mounted. The shuttle-arm Q^1 passes beneath the casing or bottom plate of the frame M, the arm Q^2 plays back and forth in the opening in the casing just above its bottom, and the arm Q^3 plays outside of and across the front end of the casing, so as to be across the wire-entering slot m^2 at times. The cutter or shearing-knife N^1 plays close to the base of the twister-pinion, so as to act upon the wire, and, in connection with the pinion, make a shear-cut every time the shuttle and knife are retracted and drawn to the extent of their movement in that direction toward the cams N^2 N^3.

The binding-arm I has a vertically-operating latch or swinging wire-placing arm, R, pivoted to it at *r*, and normally held down upon the front and near its lower end or point by a spring, R′. (See Figs. 3 and 8.) This latch is forked at its rear end to embrace the binder-arm and receive its pivot. A pin or rod, *r*′, passing through the latch at the forked part in front of its pivot, serves to secure or aid in securing the spring R′, which bears at its free end against the inner side or front of the binder-arm above the latch. The ends of the rod *r*′ (which may turn in the latch, if desired, so as to act as a roller) project beyond the sides of the latch, and serve as trippers to rock the latch on its pivot *r* and throw up the outer end.

Beneath the inner end of the platform or gavel-supporting table and gear-cover L are two plates or metal strips, S S; or a single slotted plate may be used instead of the two plates. These plates are placed a short distance apart, (or the slot in the single plate made of a proper width,) so as to admit the binder-arm between them and serve as a way or guide, in which it moves and is steadied. When the arm is moved down between these plates S S and reaches the proper point, the tripping-projections formed by the ends of the rod *r*′ bear upon the plates and trip or throw up the latch. The recessed or slotted end of the latch is thus caused to engage and properly direct and present the wire to the twister-pinion. The recessed point of the latch where it rests upon the binder-arm reaches nearly to the wire-eye i^3 therein, and when swung up by the guide-plates or slotted plate and the tripping-lugs or rod ends *r*′ against the pressure of the spring R′, its latch passes above the twister-pinion l^1, and its end extends beneath the wire-opening *l* in the table, having carried the wire by way of the slot m^2 to the proper position to be engaged by the pinion.

From the above description, with the aid of the drawings, it will be seen that at first, or in starting the machine, a twist or knot, *t*, has to be made in the end of the wire, and this end secured by passing the twist or knot behind the shuttle-arm Q^1, or lower member of the triple shuttle N, then into, or partially into, the wire slot T in the base of the frame M, and outside of the guard arm or member Q^3 of the three-part shuttle. At this time the binder-arm has been partially retracted, and is about to ascend or just starting on its upward movement, and the shuttle N, knife N^1, and rack-bar L^3 are at the end of their inward stroke or movement toward their cams. The binder-arm next ascends, leaving the binder-wire U in position to intercept the current of grain fed in from the platform B. (See Figs. 3, 9, and 10.) About or soon after the time the binder-arm reaches its most elevated position and pauses, the rack L^3 and shuttle begin to

advance. During this time the grain to form a gavel has been accumulating against the wire at and inside the curved part I^4 of the platform and on the table L. Before the shuttle-arm Q^1 (on the advance of the shuttle) withdraws from across the wire-slot T, the inside shuttle arm or member, Q^2, moves across the slot, as shown by Figs. 10 and 12, and prevents the knotted end of the wire from being displaced. During the first part of the advance of the rack and shuttle the rack starts or makes a short movement before the shuttle, and they move then together, or nearly so, or at the same rate, or substantially the same rate, of speed. The preliminary movement of the rack is not essential. The simultaneous movement of the shuttle and rack is due to the similarity in form of the corresponding ends or cam-surfaces *v v* of the cams N^2 N^3 first acted upon by the roller e^3 of the crank g^1 of the driven shaft G^3. This synchronous movement of rack and shuttle-carrier continues for the greater portion (say, three-fourths or more) of the advance or thrust of the shuttle and rack; and at about the time of, or just previous to, the completion of this joint movement the outer shuttle-arm or guard-member, Q^3, of the triple shuttle is withdrawn from across the wire-slot m^2, and the pressure on the wire causes it to move farther into, or acts with a tendency to press it back into, this slot, and the wire is in position to be properly placed in the twister-pinion by the finger P, which does not quite reach, at its outer or free end, to the corresponding end of the shuttle-arm Q^3. At this time the point of the binder-arm has entered, or is about to enter, its guide-slot beneath the platform and between the plates S S. The slight slack in the wire when the guard-arm Q^3 releases it facilitates the placing of the wire by the finger P. Next, the crank-roller acts on the inwardly-projecting side v^1 of the lower cam, N^3, beneath the cut-away or recessed side v^2 of the rack-carrying cam, thus stopping the advance of the rack and continuing that of the shuttle.

By imparting this differential movement to the cams and the rack and shuttle, the wire-placing finger P is swung inward from outside of the wire against the wire, and places it in the teeth of the pinion l^1 while it is at rest and before the finish of the motion imparted to it on the inward movement of the rack L^3. This finger acts upon the back part of the wire, or lower portion of that part of the wire, against which the grain has accumulated. The finger is swung inward by the contact of its crank or heel-projection with the fixed stop, before fully described.

The abrupt incline or shouldered portion *w* of the rack-cam or upper cam, N^2, is next acted upon by the crank-roller, (while the finger P is still held against the wire by the action of the crank on the cam N^3,) and a partial or about half revolution is imparted to the twister-pinion (with which the back wire is now engaged) on the finish of the inward movement of the rack L^3. The back wire, or portion of the wire behind or outside of the bundle, is thus brought to the position shown by dotted lines, Fig. 10. About the time this stage of the operation is reached, and the outward movement of the rack and rotation in one direction of the twister-pinion completed, or immediately afterward, the latch R of the binder-arm places the front part of the wire—that part on the inside of the bundle or toward the platform—in the twister-pinion. On the retrograde movement of the rack and shuttle which now follows, while the binder-arm is still in the lower operative position, several revolutions are imparted to the twister-pinion, and the two parts of the wire now held together both above and below the twister are twisted, two knots formed, and the bundle completed, as represented by Fig. 8. At the finish of the retracting movement thus imparted through the cams, the knife N^1 severs the wire close to the bottom of the twister, leaving the parts in the position represented by Fig. 9, (the starting-point,) when the binder-arm ascends, as it does immediately after the severing of the wire.

The operation above described is then repeated. The lower knots, which retain the wire in the slot by the aid of the shuttle, are removed as occasion requires.

I do not confine myself to the precise details of construction, in all respects, shown in the drawings and specifically described herein, as in some particulars my improvements may variously be modified. For instance, a cam might be substituted for the pitman-connection between the crank *g* and rack-bar H^1, for operating the rock-shaft H^2, actuating the binder-arm; and the outer arm or guard-member, Q^3, of the triple shuttle might in some instances be dispensed with altogether, or some equivalent employed for it, thus making the shuttle a two-part one instead of three-armed. This guard-arm, however, performs important functions, and I prefer to employ it and the crank-and-pitman connection between the shaft G^3 and rock-shaft-driving rack H^1. If preferred, a cam such as could readily be provided by an inspection of those employed to operate the twister, shuttle, and wire-cutter might be substituted.

I do not broadly claim the combination, with the binder-arm, of devices whereby reverse movement of the binder-arm or gavel-gatherer in its cam-track is prevented; nor do I broadly claim a gavel-gatherer or binder-arm controlled by a cam, and caused to reach out over the platform, descend into the grain thereon, move quickly inward to the binding mechanism, then ascend without passing over the platform, and be stopped in position to repeat its movement. Neither do I claim, broadly, the combination of a controlling-cam, a gavel-gatherer or binder-arm, and an oscillating shaft connected by a crank with said arm, with either a swinging stop or latch, K, or a trip

block or dog, K^2, for preventing reverse movement of the binder-arm or gavel-gatherer as it traverses the cam-track, such devices and combinations being older than my invention, unless qualified essentially as in my claim.

I claim as of my own invention—

1. The combination, substantially as hereinbefore set forth, of the platform having the binder-arm slot a^2 at its inner end, the two driven-shafts d^2 d^2, mounted beneath the platform at its inner end, and terminating at their adjacent ends at the opposite sides of said slot, and the endless chains having teeth working in slots *e* in the platform, which extend inward beyond the outer end of the slot a^2, to deliver the grain well in toward the binding mechanism, over the slot in the inner end of the platform, and inside the point to which the binder-arm reaches when it descends into said slot in gathering a gavel, as set forth.

2. The combination of the slotted platform, the series of toothed endless chains, the shafts d^2 E beneath the platform, the sprocket-pulleys thereon, around which the toothed chains pass, the shaft D^2, also beneath the platform, and its sprocket-pulleys and chains for imparting motion to the shafts d^2 and driving the toothed chains, substantially as and for the purpose set forth.

3. The combination, substantially as hereinbefore set forth, of the platform, the shafts d^2 d^2 beneath the platform, and terminating at their inner or adjacent ends upon opposite sides of the binder-arm slot a^2 at the inner end of the platform, the shaft E beneath the outer end of the platform, the grain-feeding chains, the shaft D^2 beneath the platform intermediate its ends, the sprocket-wheel and chain connections between said shaft and the shafts d^2 d^2, the sprocket-wheel on the end of said intermediate shaft, and its driving-chain, for the purpose specified.

4. The combination of the driving-wheel axle, the sprocket-wheel thereon, the endless chain driven by the sprocket-wheel, the driven shaft having a sprocket-wheel around which said chain passes, the bevel-pinion on the driven shaft, the upright shaft having a pinion meshing with the pinion on the driven shaft, and the cranks on the upright shaft, by which all the moving parts of the binding mechanism are actuated, substantially as hereinbefore set forth.

5. The combination, substantially as hereinbefore set forth, of the main frame, the driving-wheel axle, the driven shaft F^1 at the front corner of the main frame, the upright shaft driven therefrom, the crank upon its upper end, the reciprocating rack-bar driven by connections with said crank, the oscillating binder-arm shaft crossing above the platform at its inner end, and its pinion driven by the rack-bar.

6. The binder-arm-controlling cam, having the cam-track formed with the abruptly-curved bottom portion, for the purpose set forth.

7. The combination, substantially as hereinbefore set forth, of the rack H^1, the oscillating shaft H^2, its crank, the pinion on the shaft driven by the rack, the slotted or loop-shaped binder-arm to which the crank is pivoted, the pin or roller at the heel end of the binder-arm, and the cam in which said roller works, having a long cam-track at back, an abruptly-curved track at bottom, an abruptly-inclined front track, and a long curved top track, for the purposes specified.

8. The combination of the oscillating binder-arm shaft, its crank, the binder-arm vibrating and traversing on its heel pin or roller, and the two-part cam for controlling the binder-arm, consisting of the plates or castings I^2 I^3, provided with corresponding cam-tracks i^2 upon their inner sides, facing each other, and having the stops K K^2, to prevent the movement of the binder-arm at its heel in the wrong direction, these members being constructed and operating substantially as hereinbefore set forth, whereby the binder-arm is caused to descend at the back of the cam-tracks, and reach outward at its point by the oscillating in one direction of its actuating-shaft, and to ascend at the front of said tracks, without reaching outward, by the oscillating of the shaft in the opposite direction to complete the circuit of the tracks.

9. The combination, substantially as hereinbefore set forth, of the inclined bars over the gavel-supporting table and inner end of the grain-platform, the two-part controlling-cam for the binder-arm, secured to and between said bars, with their cam-tracks facing each other, the pin or roller at the heel of the binder-arm, the oscillating binder-arm shaft beneath said bars and cam, and its crank, pivoted in the slotted binder-arm intermediate its heel and point, and working between the two parts of the cam, to cause the binder-arm to traverse at its heel around the irregularly-shaped cam-tracks.

10. The triple shuttle consisting of the combination of the arms Q^1 Q^2, for holding the wire, and the outside front guard arm or member, Q^3, substantially as hereinbefore set forth.

11. The combination, substantially as hereinbefore set forth, of the twister-pinion and the reciprocating triple shuttle, having the arms or members Q^1 Q^2, for holding the wire at its end in its slot or guideway to the twister, and the guard arm or member Q^3, to prevent the wire being presented to the twister at an improper time.

12. The combination, substantially as hereinbefore set forth, of the binder-arm, the twister-pinion, and the reciprocating shuttle, having the two arms or members Q^1 Q^2, reciprocating beneath the pinion, with one arm above and the other below the slotted base-plate of the pinion frame or casing, for the purpose specified.

13. The combination, substantially as hereinbefore set forth, of the binder-arm, the

twister-pinion, and the triple shuttle having the wire-holding arms and the guard-arm.

14. The combination of the binder-arm, the twister-pinion, its frame or casing, the reciprocating shuttle having the wire-holding arms Q^1 Q^2, the one above and the other below the slotted base-plate of the pinion-frame, and the cutter carried by the shank or back bar of the shuttle at the heel end of one of said arms, these members being constructed and operating substantially as hereinbefore set forth.

15. The combined triple shuttle and cutter, consisting of the wire-holding arms Q^1 Q^2, guard-arm Q^3, and knife N^1, these four elements being carried by the reciprocating shank or back bar Q, and operating upon the wire, and in connection with the twister-pinion and its frame or casing, substantially in the manner and for the purpose hereinbefore set forth.

16. The combination, substantially as hereinbefore set forth, of the upright rotating shaft having two cranks, one at its upper end and the other at its lower end, the rack-bar actuated from the upper crank, for operating the binder-arm through connecting mechanism, and the cams actuated by the lower crank, for operating the wire twisting, adjusting, holding, and severing mechanisms.

17. The combination, substantially as hereinbefore set forth, of the twister-pinion, its operating-rack, having an intermittent advance movement imparted to it, and the reciprocating swinging wire-placing finger operating upon the wire to place it in the teeth of the twister during the pause in the movement of the rack-bar.

18. The combination, substantially as hereinbefore set forth, of the pivoted wire-placing finger P, alternately moved toward and away from the twister-pinion, its laterally-projecting heel end or crank, the spring, and the fixed stop in the line of movement of the crank at the heel of the finger, whereby the finger, after being brought up to the twister, is caused to swing in to press the back wire into its teeth, as set forth.

19. The combination of the reciprocating shuttle, the swinging wire-placing finger, mounted on the shuttle shank or carrier, the stop against which the heel of the finger abuts, and the intermittently-advancing rack-bar, substantially as and for the purpose hereinbefore set forth.

20. The combination, substantially as hereinbefore set forth, of the shuttle, provided with the guard-arm or outside member Q^3, the swinging wire-placing finger on the shuttle shank or carrier, the tripping-stop for swinging in the finger against the wire, and the intermittently-moving rack-bar, imparting motion to the twister-pinion through connecting gearing, whereby the guard-arm is retracted from across the slot through which the wire enters to the pinion (the wire is placed in the pinion-teeth while it is at rest) during the interval in the inward movement of the rack-bar, and is held there during the finish of the advance movement of the rack ready to be twisted upon the return movement of the rack, as set forth.

21. The combination, substantially as hereinbefore set forth, of the shuttle, the twister-pinion, the rack-bar, and the two cams, connected respectively with the shuttle-carrying bar or shank and the rack-bar, and having differential movements imparted to them by a common crank.

22. The combination, substantially as hereinbefore set forth, of the twister-pinion, the shuttle-carrier or reciprocating bar, the wire-placing finger carried thereby and operating upon the back part of the wire to place it in the pinion, the binder-arm, and the swinging arm or latch carried thereby for placing the front part of the wire in the pinion.

In testimony whereof I have hereunto subscribed my name.

WILLIAM LOTTRIDGE.

Witnesses:
M. V. NICHOLS,
F. A. NICHOLS.