(Model.)

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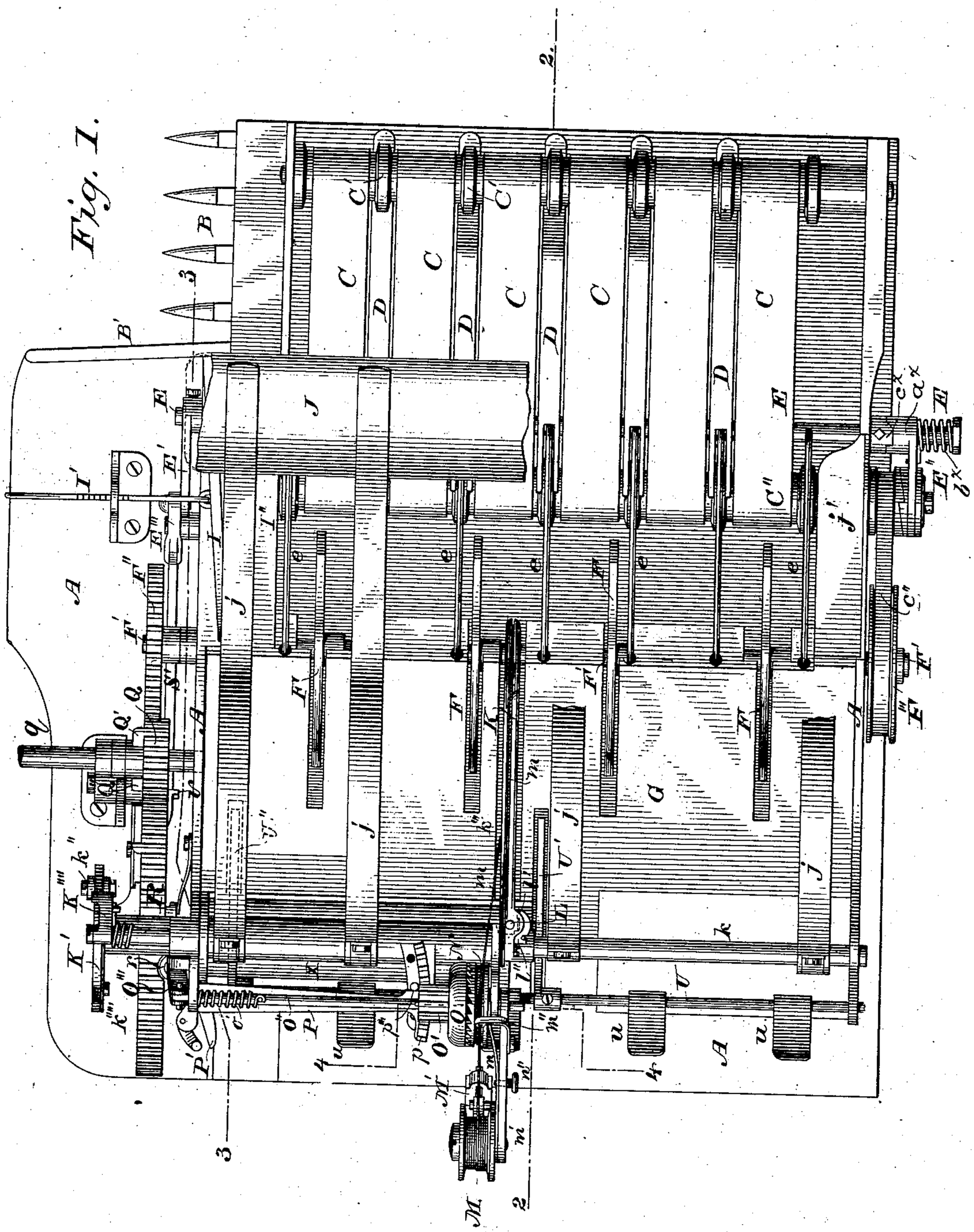
GRAIN BINDING MECHANISM.

No. 260,668. Patented July 4, 1882.

Fig. 1.



WITNESSES

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Geo W. Breck

INVENTOR

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Baldwin, Hopkins & Peyton

(Model.)

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GRAIN BINDING MECHANISM.

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Fig. 6.

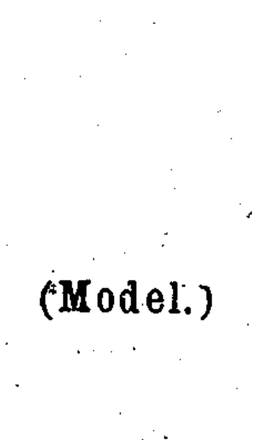


Fig. 5.

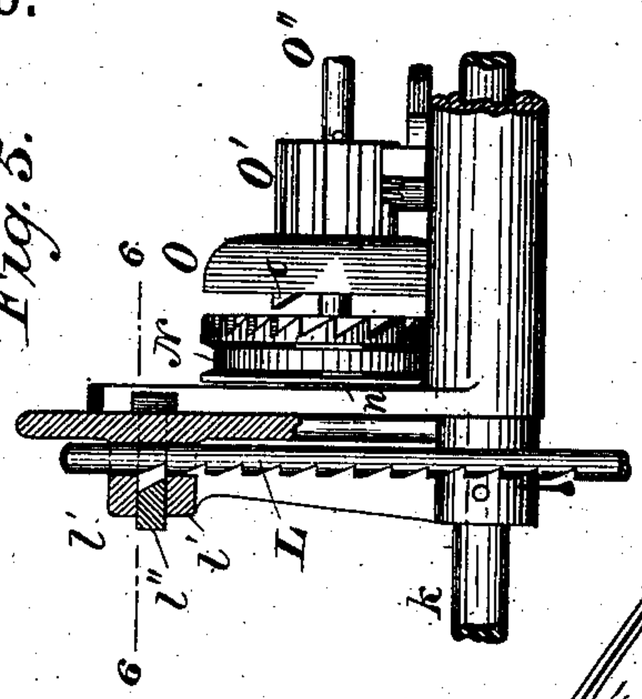
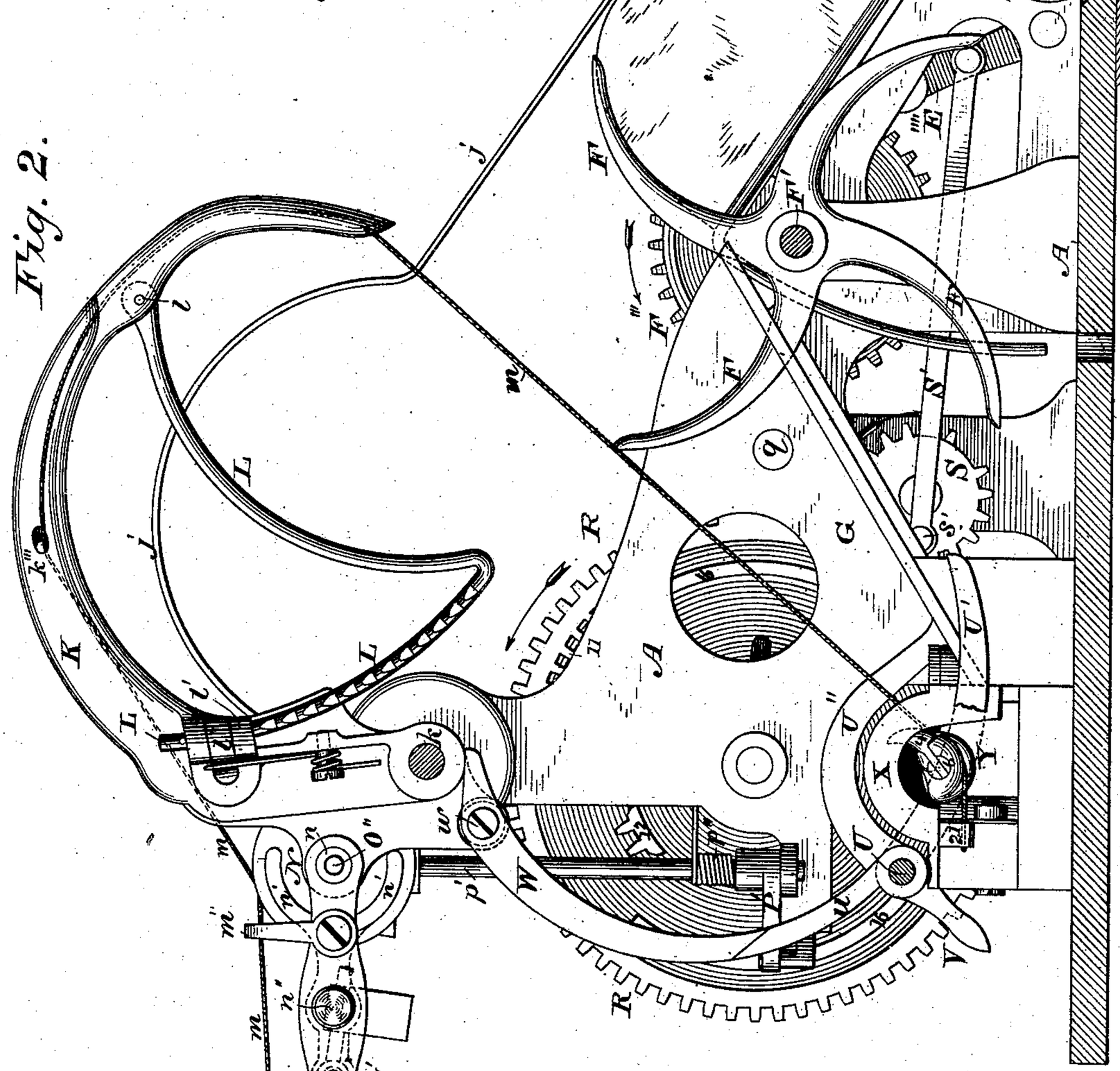


Fig. 2.



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(Model.)

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GRAIN BINDING MECHANISM.

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Fig. 8.

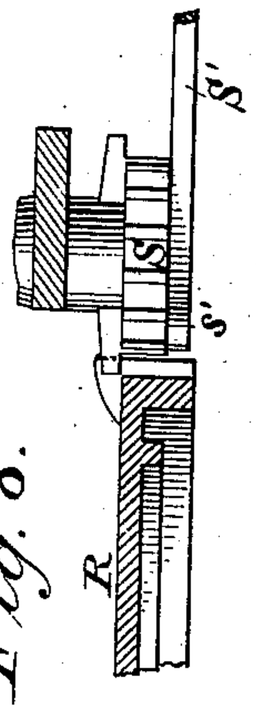


Fig. 9.

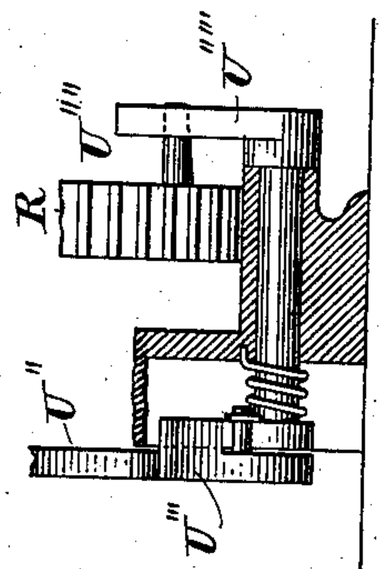


Fig. 10.

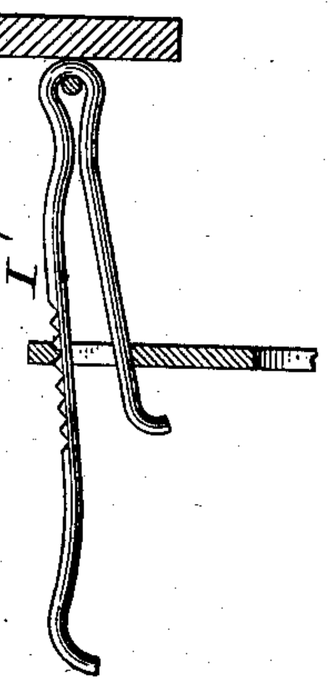


Fig. 7.

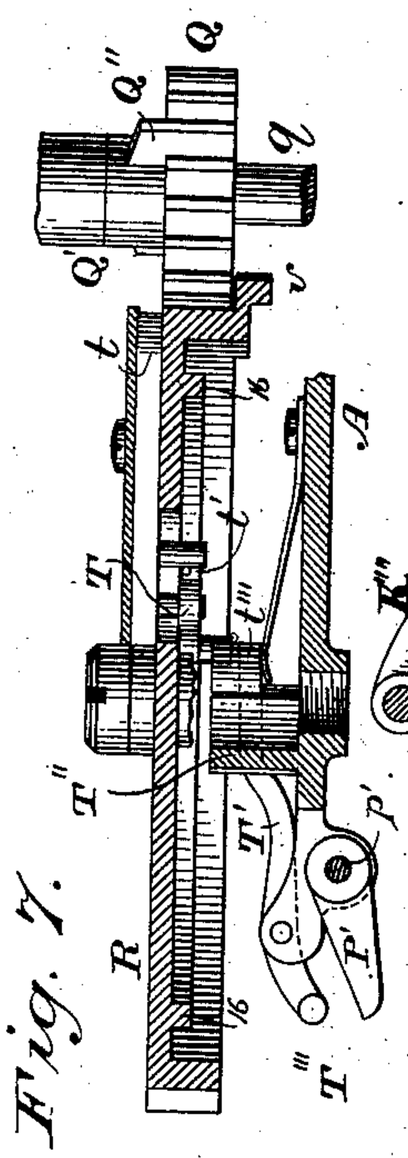
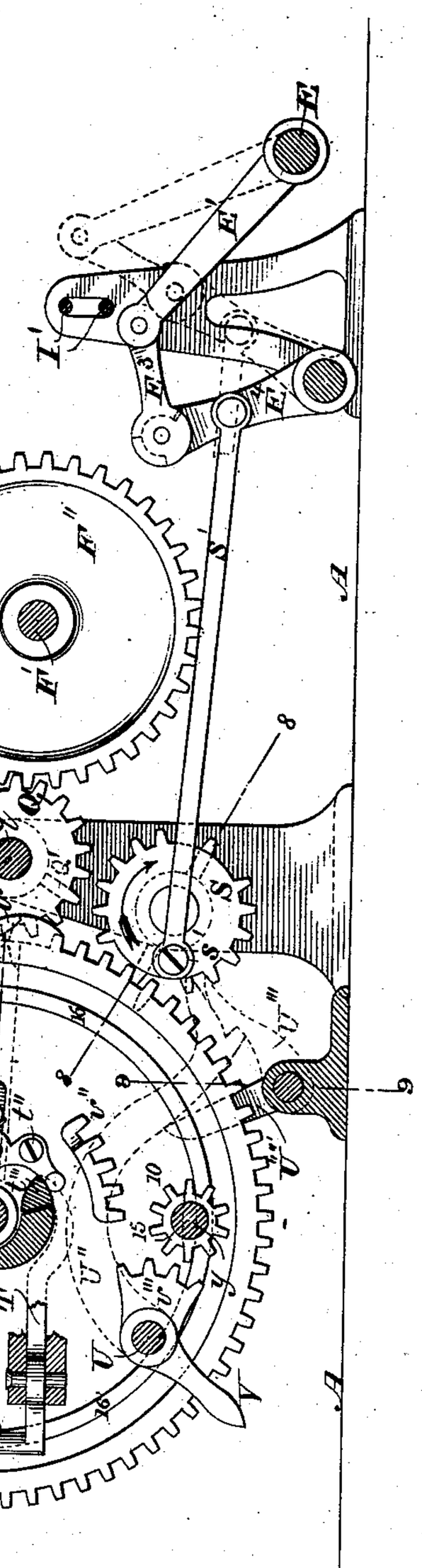


Fig. 3.



WITNESSES

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GRAIN BINDING MECHANISM.

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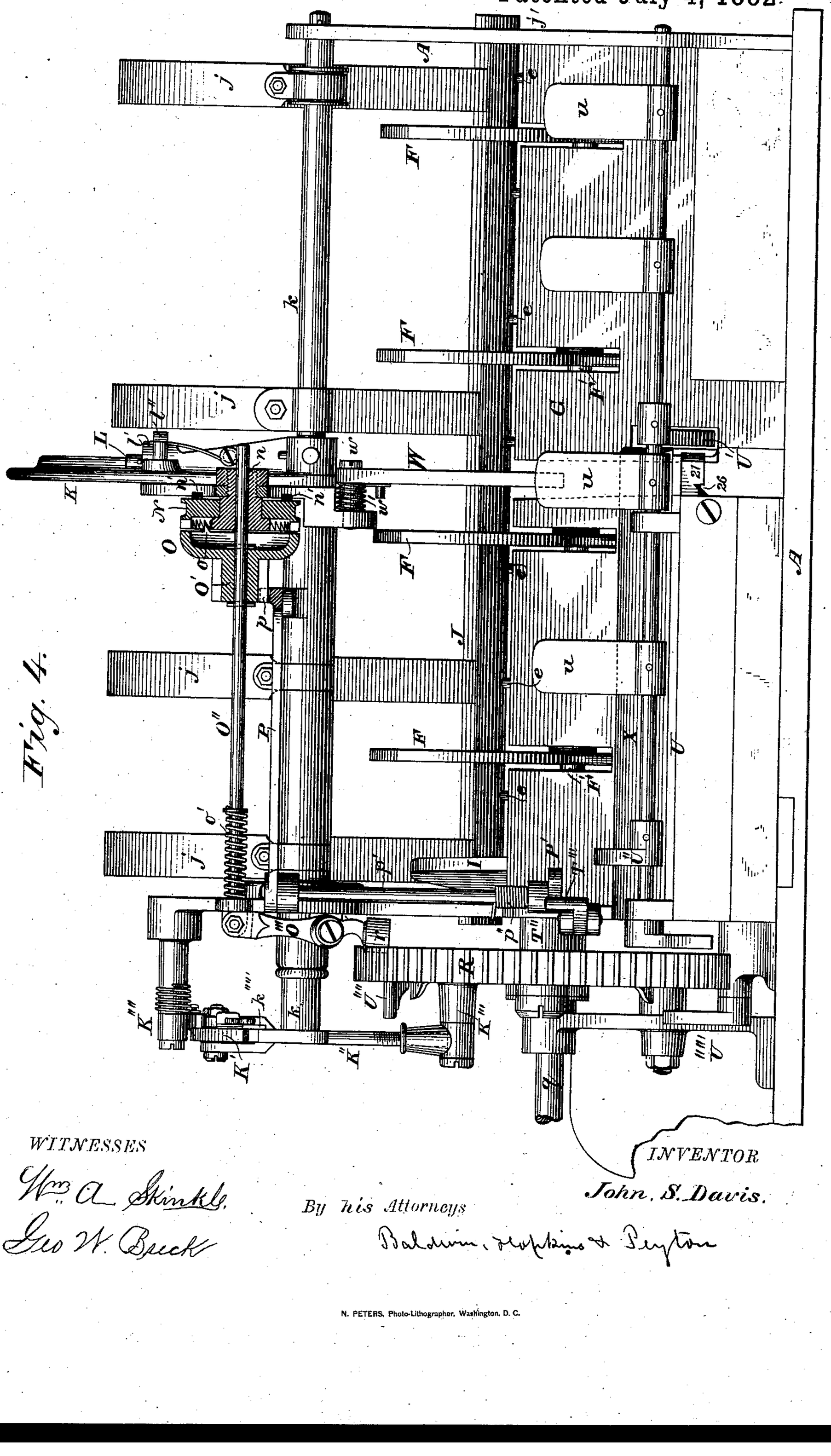

Fig. 4.

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GRAIN BINDING MECHANISM.

No. 260,668. Patented July 4, 1882.

Fig. 11.

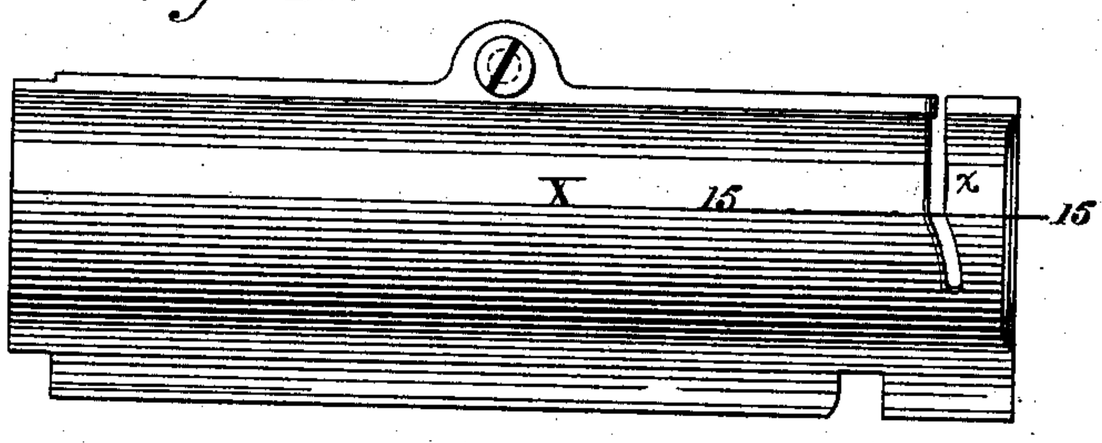

Fig. 15

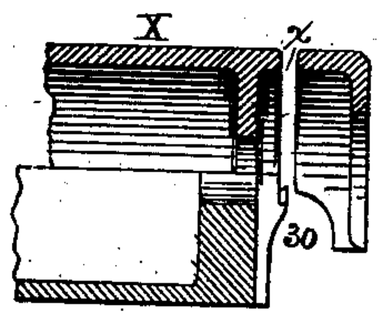

Fig. 12.

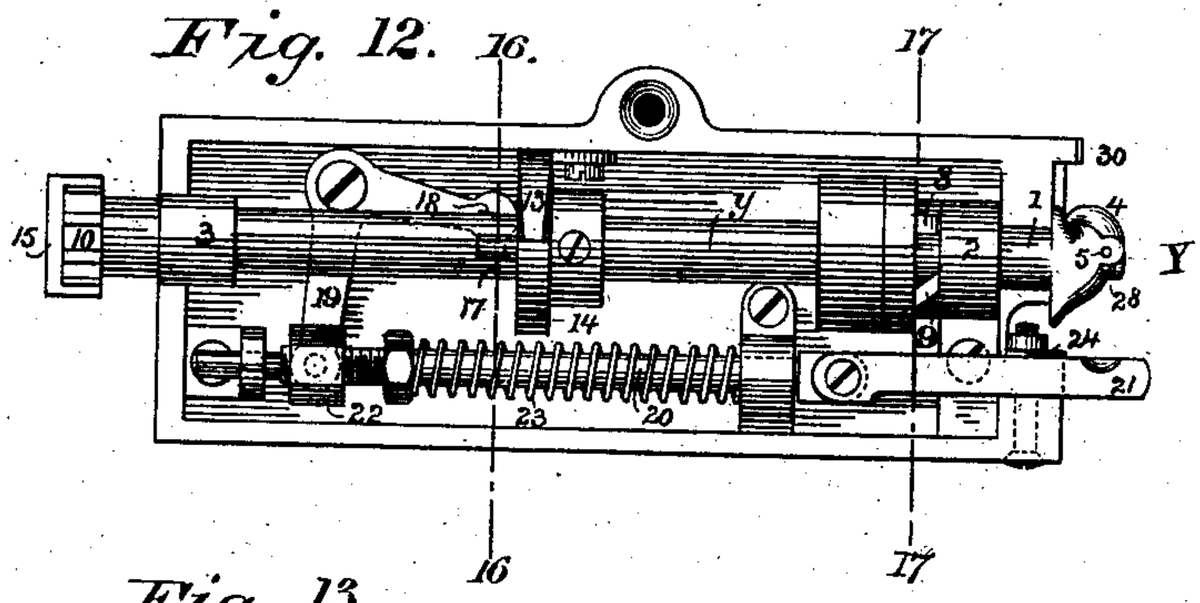

Fig. 16.

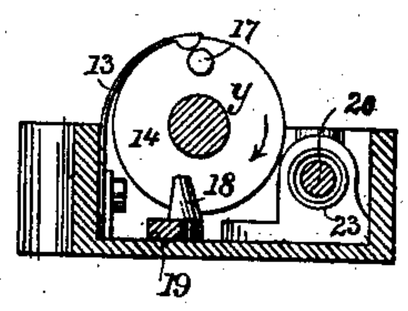

Fig. 13.

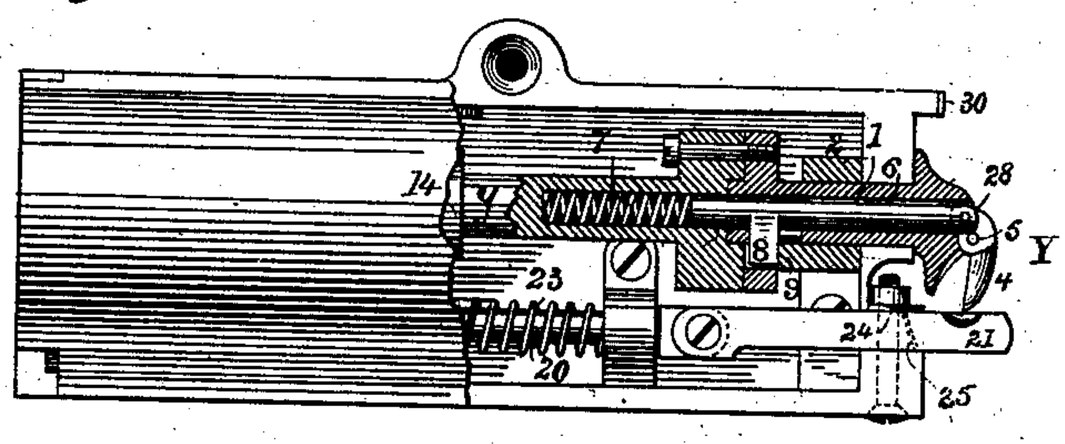

Fig. 17.

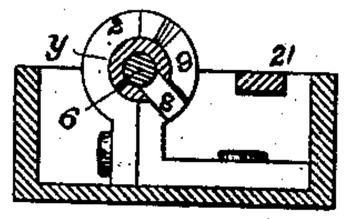

Fig. 14.

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(Model.)

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J. S. DAVIS.

GRAIN BINDING MECHANISM.

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Fig. 19.

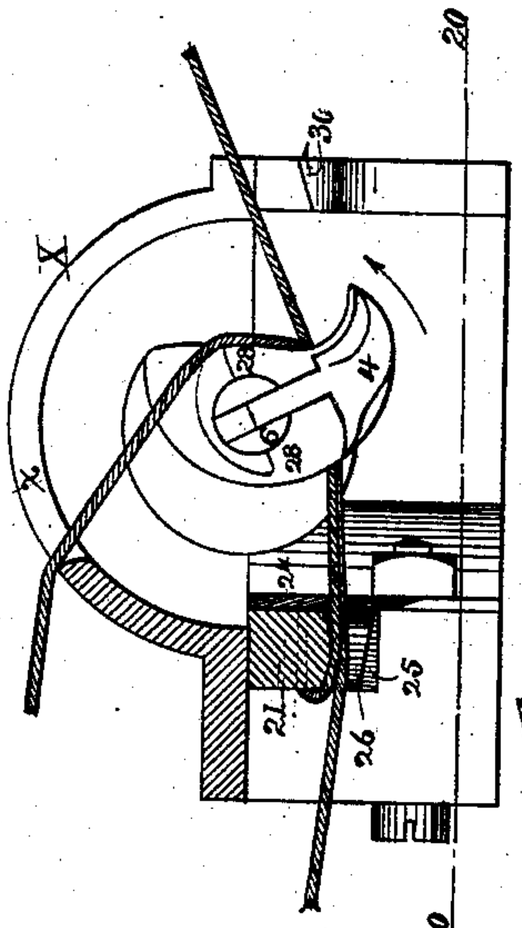


Fig. 24.

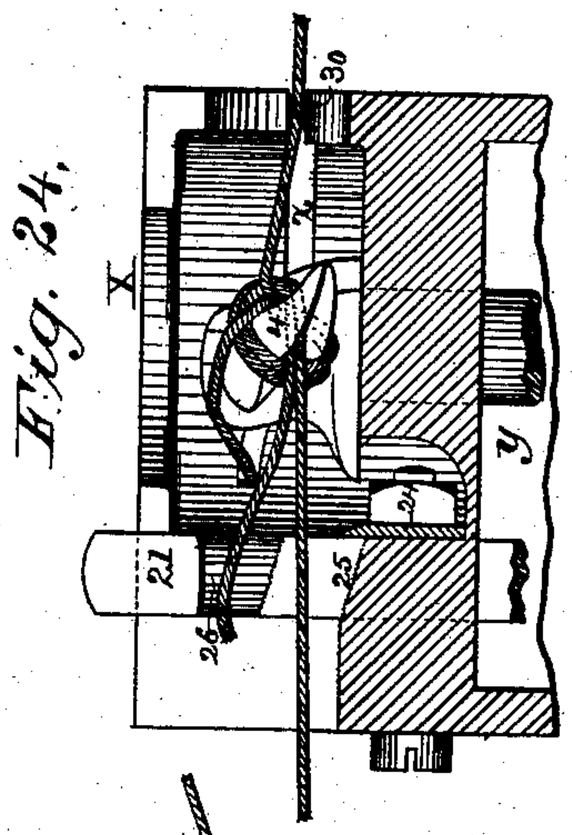


Fig. 23.

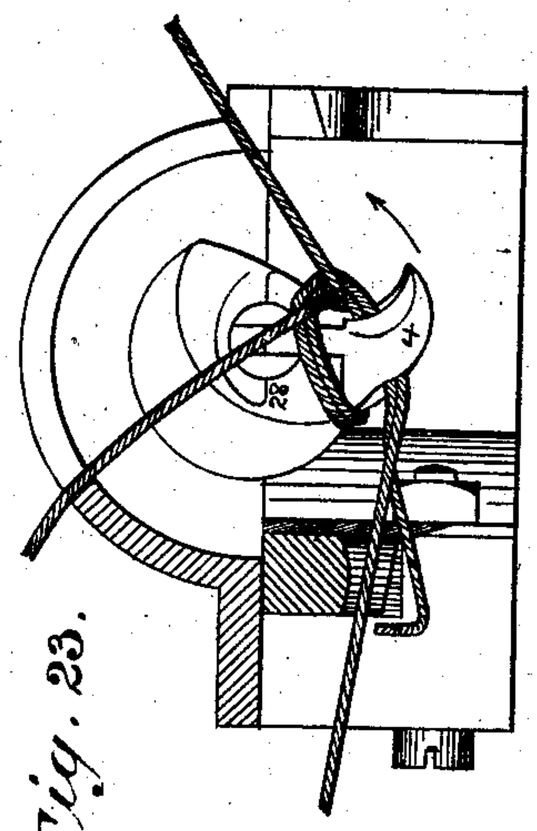


Fig. 18.

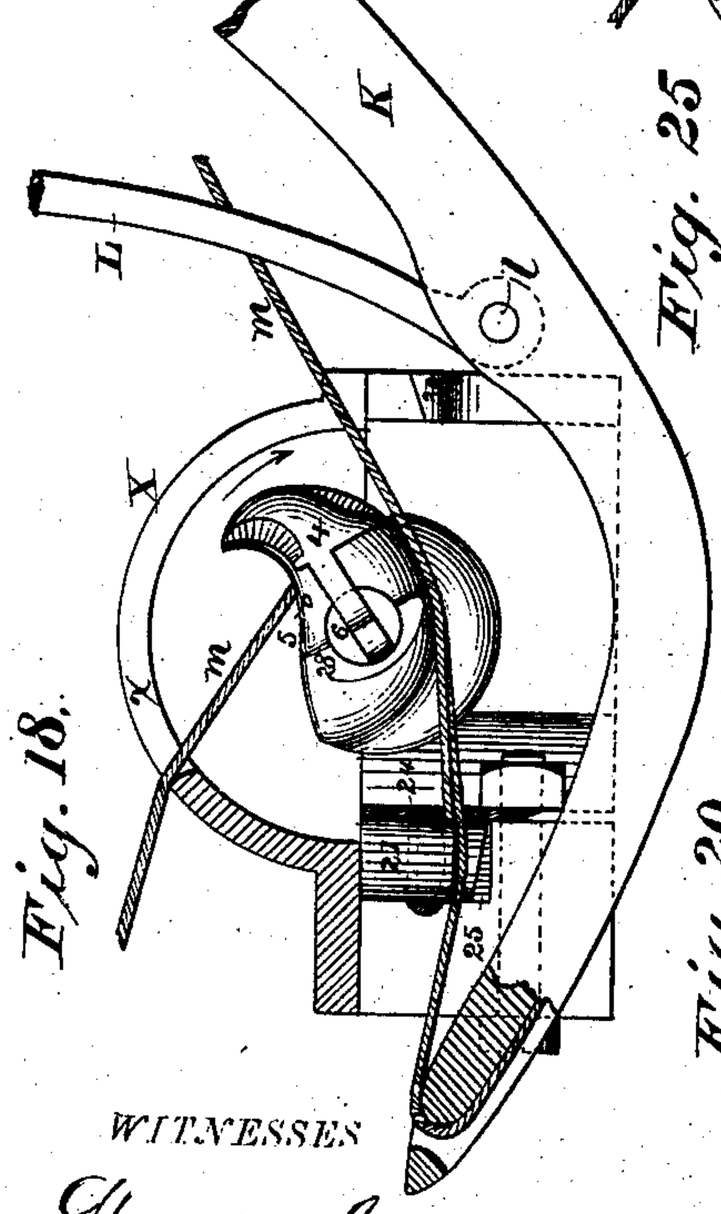


Fig. 25

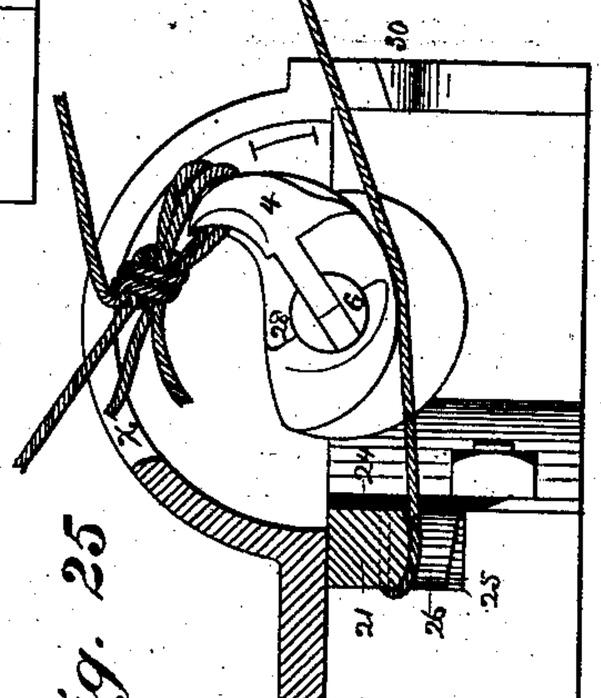


Fig. 22

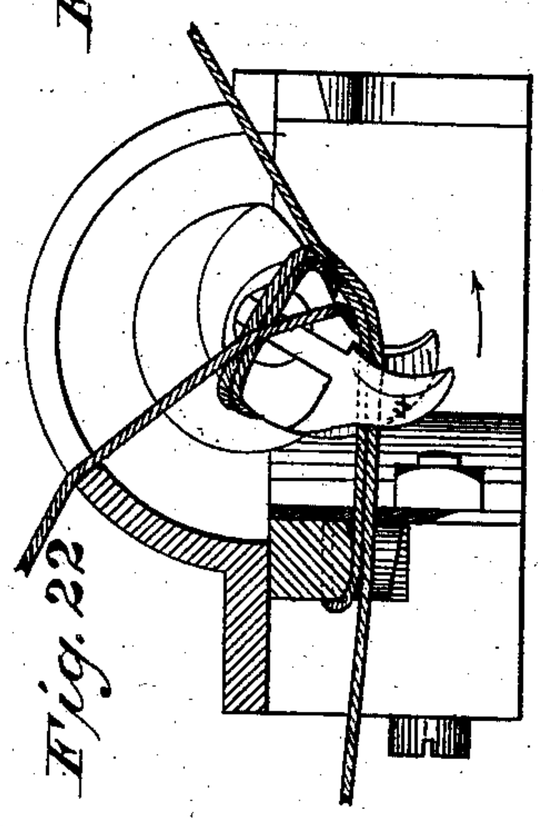


Fig. 20.

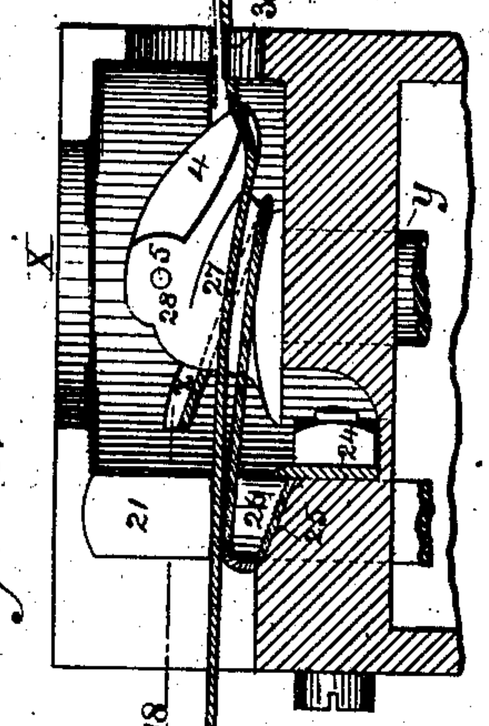
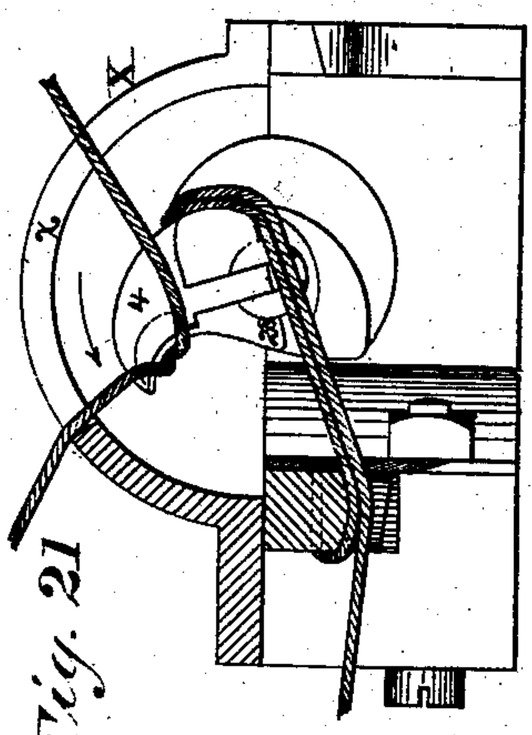


Fig. 21



WITNESSES

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UNITED STATES PATENT OFFICE.

JOHN S. DAVIS, OF TOLEDO, OHIO, ASSIGNOR TO THE TOLEDO MOWER AND REAPER COMPANY, OF SAME PLACE.

GRAIN-BINDING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 260,668, dated July 4, 1882.

Application filed April 23, 1881. (Model.)

To all whom it may concern:

Be it known that I, JOHN S. DAVIS, a citizen of the United States, of Toledo, in the county of Lucas and State of Ohio, have invented certain new and useful Improvements in Grain-Binding Mechanism, of which the following is a specification.

The first branch of my invention relates to the method of conveying the grain from the platform, upon which it falls when first cut, to a suitable receptacle.

The particular objects of this branch of my invention are to even the butts of the grain, and to adapt this equalizing device to the varying conditions under which it is required to operate, such as variations in the length of the grain, in the condition of the wind, and in the inclination of the ground to be traversed. These ends I attain by means of a wind-board or butt-guide pivoted to a fender or support, constituting a portion of the inner divider or equivalent part of the structure of the machine, extending substantially parallel with the cutting apparatus, but capable of being adjusted on its hinges transversely thereto over the surface or incline traversed by the grain from the cutting apparatus to the receptacle. This butt-guide is held in the desired relation to the other parts by means of a suitable adjustable locking device.

The object of the next part of my invention is to provide a space or chamber in which the cut grain may be straightened and arranged with its stalks parallel to each other before its delivery to the binding-receptacle. These ends I attain by employing an endless apron or carrier, which conveys the grain, when first cut, against a cut-off moving intermittingly at proper intervals, so as to constitute an abutment against which the grain is carried and straightened by the movement of the carrier. A space or chamber clear from the falling grain, for effecting this accumulation and straightening of the grain, is obtained by extending the carrier beyond the inner divider and organizing the cut-off in proper relation thereto. This straightening operation is further assisted by a packer consisting of arms rotating in slots in the cut-off or between rods constituting it, and by means of a presser-bar, between which and the cut-off the grain passes through the packer to the binding-receptacle.

The next part of my invention relates to the compression of the gavel. Its object is to enable the compressor to act with equal force on gavels differing in size—in other words, to accommodate itself to gavels of different sizes. This end I attain by combining with the binding-arm a hinged compressor and mechanism which automatically locks the compressor as the binding-arm starts in its forward movement.

The next branch of my invention relates to the method of throwing the binding mechanism into action, its object being to automatically regulate the size of the gavel and to secure bundles of uniform size. This end I attain by so organizing the mechanism that a definite amount of grain fed into the receptacle by the packer produces sufficient tension on the binding material to throw the binding mechanism into action, the parts being automatically restored to their normal position for repetition of the operation after the discharge of the bound bundle.

Another branch of my invention relates to the method of tying a knot, the organization of mechanism for which purpose is hereinafter fully set forth.

Other branches of my invention relate to the mechanism for holding and compressing the gavel while being bound, and to mechanism for discharging the bound gavel.

My invention mainly consists in novel combinations, constructions, or organizations of old instrumentalities.

The subject-matter claimed is particularly designated in the claims at the end of this specification.

The accompanying drawings represent my various improvements as embodied in one machine in the best way now known to me. The details of construction of my invention may, however, be modified in various ways without departing from the principle of my invention, and some of my improvements may be used without the others, and in machines differing in construction and organization from the one herein represented.

My invention contemplates the use of the most approved harvesting mechanism of the present day, the construction and operation of which are well known to those skilled in the art to which this invention appertains, and the details of which need not therefore be fully described here.

Figure 1 represents a plan or top view of so much of my improved machine as is necessary to illustrate the subject-matter herein claimed. Fig. 2 is a view in elevation, partly in vertical longitudinal section, on the line 2 2 of Fig. 1; Fig. 3, a similar view and section on the line 3 3 of Fig. 1; Fig. 4, a view in elevation of the binding mechanism as seen from the back or discharging end, with the shipping-pulley shown in vertical longitudinal central section on the line 4 4 of Fig. 1. Fig. 5 represents a front elevation, showing a detailed view of this shipping mechanism and portions of the compressor and its locking mechanism, partly in section, on the line 5 5 of Fig. 6; Fig. 6, a plan view of the compressor-locking mechanism, partly in section, on the line 6 6 of Fig. 5. Fig. 7 represents a horizontal transverse section through the main actuating-gear of the binding mechanism on the line 7 7 of Fig. 3; Fig. 8, a transverse section through a portion of the gearing on the line 8 8 of the same figure; Fig. 9, a vertical transverse section on the line 9 9 of the same figure; and Fig. 10 represents a detailed view of the adjustable locking detent of the butt-guide. Figs. 11 to 25, both inclusive, represent various detail views of the knotting mechanism. Fig. 11 is a plan view of the knotter shield or cover; Fig. 12, a similar view of the knotting mechanism with the cover removed; Fig. 13, a similar view of the same, partly in section, showing the details of the tying-bill. Fig. 14 represents a vertical longitudinal section through the casing of the knotter, showing the details of the cutter and holder. Fig. 15 represents a longitudinal transverse section through the knotter-shield on the line 15 15 of Fig. 11; Fig. 16, a vertical transverse section on the line 16 16 of Fig. 12; Fig. 17, a corresponding section on the line 17 17 of Fig. 12. Figs. 18 to 25 represent on an enlarged scale the details of the method of forming the knot, Figs. 18, 19, 21, 22, 23, and 25 being end elevations of the knotting mechanism, partly in section, on the line 18 18 of Fig. 20, and Figs. 20 and 24 being bottom plan views, partly in section, on the line 20 20 of Fig. 19. Fig. 18 shows the nose of the binder-arm in its most advanced position, in which it is locked during the operation of forming the knot, the cord being shown in its proper relation to the knotter, which is just commencing its backward quarter-turn, which carries the tying-bill on one side of or beyond the binding-cord, which position is shown in Fig. 19, in which figure the tying-bill is shown as commencing its forward revolution. Fig. 20 is a bottom plan view, showing the hook in a position midway between the positions shown in Figs. 18 and 19, with the hook pushing past the cord. Fig. 21 shows about one-half of the forward revolution completed, with one part of the double cord slipping off the back part of the hook, while the hook of the bill engages with another part. Fig. 22 shows the revolution as nearly completed, the tying-bill having opened and straddled the double cord. Figs. 23 and 24 represent the movement at a still further advanced stage, with the cord slipping off the tying-bill, though still held therein; and Fig. 25 represents the position of the parts at the moment of completing the action of knotting.

The drawings show the mechanism as organized for binding with cord substantially on the level of the grain-platform. The mechanism is mounted on a suitable main frame, A, provided with a suitable cutting apparatus, B, behind which is a suitable carrier or endless apron, (shown as consisting of a series of separate endless belts, C,) traversing suitable carrying rollers, C′ C″, mounted in suitable bearings on the frame. Spring-teeth D are secured upon the frame between these belts on the grain side, and project inwardly between them, parallel therewith and at substantially the same general level, but projecting slightly above them at the inner ends to prevent the belts from breaking the straws during their temporary lodgment. They are forked or slotted so as to embrace a series of cut-off rods, *e*, mounted on the shaft E. These spring-teeth thus serve as clearers and to remove the grain from the apron as it passes between the rods of the cut-off.

Under the organization shown, the carrier and cut-off are intermittingly and harmoniously actuated by mechanism hereinafter described, which operates them alternately, the cut-off being elevated and maintained in its operative position while the carrier is inoperative, and vice versa.

A packer, F, consisting of a series of S-shaped arms mounted in pairs on a shaft, F′, rotates between the cut-off rods and through slots in the binding-receptacle G. In this instance the packer is shown as so organized as to rotate continuously, while the endless apron and cut-off rotate intermittingly. The inner divider is extended upward, so as to form a shield or fender, B′, to which a butt-guide, I, is secured by hinges *i*. By means of this hinged connection between the butt-guide and divider-heel or lateral projection the upper end of the butt-guide is free to be moved backward or forward, as desired, and can be held in any desired position by a locking-detent consisting of a locking-spring, I′, or other equivalent device, within easy reach of the driver when in his seat on the machine. The butt-guide moves over and close to a way or floor, I″, extending from the level of the carrier to the upper edge of the grain-receptacle, at about the same angle as the cut-off when in its lowest position, forming a part of the surface over

which the cut grain traverses. In passing over this floor the butts of grain rub against the butt-guide, which pushes in the projecting ends and causes the butts to lie with their ends smooth and even in a way that is readily understood.

A pressure-bar, J, mounted on spring-arms *j*, hinged to or otherwise suitably connected with the cross-bar *k*—which, under the organization shown, constitutes a binder-arm shaft—of the main frame, normally rests upon the butt-guide and upon a fixed shield, *j'*, at the back of the platform, being thus held at a suitable level above the platform.

The carrier, clearer, and cut-off, it will be observed, extend inward some distance beyond the fender to which the butt-guide is hinged, or, in other words, the inner edge of the cutting apparatus, so as to leave a space or chamber in which the grain may accumulate and its stalks be arranged parallel to each other before it is fed to the receptacle.

The operation of the apparatus so far as above described is as follows: The grain as it is cut falls upon the carrier, which conveys it into the straightening-chamber above mentioned, where the continued motion of the apron forces the accumulating grain gradually up the inclined surface afforded by the cut-off rods, straightening it as it rises. The pressure-bar serves to prevent the grain from rising or being blown away. The straightening of the gavel is also facilitated by the movement of the packer, which tends slightly to retard the grain during the first part of its ascent, until it has accumulated a certain amount of pressure from the grain behind it.

In Figs. 1 and 2 of the drawings the parts are shown in the position they occupy while the grain is being fed into the receptacle, the cut-off being depressed. When the packer has forced enough grain into the receptacle to form a gavel of the size desired, the carrier is automatically stopped by mechanism hereinafter described, and the cut-off rises, so as to prevent the passage of any more grain into the receptacle, the cut grain mainly falling upon the now stationary carrier.

One object of my invention is to diminish the power required to drive the machine as much as practicable, and one of the methods employed by me in attaining this end is to cause the various parts to move successively, the apron being stopped while the binding is progressing, and vice versa.

After the gavel is bound and the binding-arm retracted to its normal position for the reception of a fresh one, the cut-off descends, the apron starts, and a fresh gavel is fed into the receptacle.

The binding-arm K is shown as mounted on a rock-shaft, *k*, constituting a cross-bar, passing through a tubular frame or support on which some of the binding appurtenances are mounted. The binder-arm may be connected with its rock-shaft by a collar, a set-screw, or other equivalent locking mechanism, which permits it to be swung around the arm to vary its relation to the other portions of the mechanism, and thus secure its proper adjustment relatively to the twister or knotter, as well as to the driving mechanism and other parts of the apparatus.

Under the organization shown, gavels of uniform size are fed into the receptacle, and a fixed compressor would therefore exert a substantially uniform degree of pressure upon them while being bound.

To adapt my apparatus to exert an equal pressure upon gavels of different sizes, I form the compressor L of a **V** shape in outline, with the branch next the grain somewhat concave, and connect this curved end by a pivot, *l*, to the binder-arm a short distance from its forward end.

The rear end of the compressor is provided with ratchet-notches, and slides endwise through a guide, *l'*, in the binder-arm, so that as the gavel is accumulated underneath by the packer it gradually rises as the tension of the bundle is sufficient to overcome the weight of the compressor or the force with which it is held down.

A spring-bolt, *l''*, on the binder-arm is normally held out of contact with the ratchet of the compressor by a fixed stop on the frame; but as soon as the binder-arm commences its forward movement to encircle the gavel the bolt is released from this stop and locks the compressor securely in the position it may then occupy, holding it rigidly during the closing of the binder-arm upon the gavel. (This device is fully shown in Figs. 2, 5, and 6.)

My binder belongs to that class in which the binding mechanism is automatically thrown into action by the strain of the gavel itself upon the binding material, and is automatically thrown out of action after each bundle is bound with its parts in the normal position for the reception of the succeeding bundle. The binding-cord *m* is wound on a suitable spool, M, revolving on a pivot, *m'*, and maintained under proper tension, preferably by a friction-brake, M', bearing with the force of a weight or spring, in a well-known way, upon the surface of the binding material itself. The binding material passes from the spool through an eye, *m''*, and passes around a pulley, preferably a tension-pulley, N, revolving loosely on a tubular stud, *n*, fixed on the frame. This pulley serves, as will presently be explained, to start the binding mechanism, and the tension exerted by it on the binding material is controlled by means of a friction-spring, *n'*, bearing upon its side and regulated by means of a set-screw, *n''*. After passing around the tension-pulley the cord is led through an eye, *k'''*, in the arm, and through a slot therein, and out through the nose of the arm to the knotting mechanism. (See Figs. 1, 2, and 18.) As the packer forces the grain into the receptacle the cord is pressed back by it and tight-

ened, thus drawing more binding material from the spool and turning the tension-pulley forward.

A clutch-disk, O, fastened to a pinion, O′, turns freely on a shaft, O″, capable of sliding freely endwise in its bearings. When in proper position a clutch-tooth, *o*, on the disk engages with the ratchet-teeth of the tension-pulley N, and is consequently caused to turn with it. This movement also turns the pinion O′, which gears with a rack, *p*, on a radius-bar, P, mounted on a rock-shaft, *p′*, which is provided with a tripping-toe, P′. A recoil-spring, *p″*, tends to restore the parts to their normal condition when the clutch is ungeared. The range of motion of this radius-bar may be regulated by means of a pin, *p‴*, taken into a series of holes, a slot and set-screw, or other well-known adjustable stop mechanism, and this whole mechanism regulates the size of the gavels by stopping and starting the binding mechanism, as will be hereinafter explained. The sliding shaft O″ is concentric with the combined starting and tension pulley, its clutch-disk, and pinion. Its spring *o′* tends to force the clutch normally into contact with the tension-pulley. A rocking lever, O‴, pivoted at one end to the shaft O″, carries a friction-roller, *r*, which, when the knotting mechanism is at rest, takes into a notch in an intermittingly-actuated main gear-wheel, R, preventing it from being suddenly moved, and allowing the clutch to be in engagement with the tension-pulley, whereby the rotary movement of the pulley is imparted to the pinion and starting mechanism. When the wheel R starts and the binder-arm commences to descend, the roller *r* rides out of its notch, communicating an endwise movement to the shaft O″, which disengages the clutch O from the tension-pulley, leaving the pulley free to revolve and pay off a sufficient amount of string to encircle the bundle, while the starting mechanism is restored to its normal position by the spring *p″*.

The organization shown is such that the movement of about one-third of the amount of string necessary to encircle the bundle will rotate the starting-pulley far enough to actuate the starting mechanism. The pulley then being disengaged from the clutch is free to pay off the other two-thirds or any required amount drawn from it by the binder-arm. Under this organization the strain upon the binding-cord produced by the incoming grain operates the starting mechanism and throws the binder into gear, and then disconnects the starting mechanism, as a consequence of which organization the amount of binding material paid out is simply dependent upon the size of the bundle, and the circumference of the tension-pulley need have no fixed relation to the circumference of the bundle. On the contrary, were the organization such that the feed was positive—that is, were a certain amount paid out at each revolution of the main driving-gear—the amount required to encircle the bundles would be greater or less than the fixed amount of the feed, as the size of the bundles varied, and consequently the feeding and starting mechanisms would be thrown out of time and the organization disarranged.

It will also be noticed that the organization is such that the starting-pulley may be used simply as such, or as a tension device and a means of starting the binding mechanism; but I prefer to have it act in both capacities.

Before describing the operation of the machine further, I will now set forth the manner in which the mechanism is connected and actuated. The arrows show the direction of rotation of the gears.

A shaft, *q*, mounted on the frame and driven from the main driving-wheel in any suitable well-known way, carries a spur-gear, Q, meshing into a spur-wheel, F″, on the packer-shaft F′, to which it imparts a continuous rotary motion when in gear. The gearing may be disconnected from the driving-power by a shipping-clutch, in one of the usual well-known ways. The spur-wheel Q drives the before-mentioned gear-wheel R, and as this wheel actuates the binding mechanism proper I call it the "binder" gear-wheel. This gear is deprived of three or four of its teeth, so that when this mutilated portion comes opposite the driving-gear Q, the binder gear-wheel may remain at rest and out of gear while the driving-gear Q revolves. The position of the parts when occupying this relation is that represented in the drawings. (See particularly Fig. 2, which shows the binder-arm elevated, the grain being fed into the receptacle by the packer, while the binding mechanism proper is out of gear.)

A spur-gear, S, mounted on the frame has three or four of its teeth removed on opposite sides. A pitman, S′, pivoted at one end at *s′* to the side of this mutilated gear—which is, in fact, a crank-wheel—is pivoted at the other end to a rock-arm, E^4, connected by a link, E^3, to a rock-arm, E′, mounted on the shaft E. The arm E^4 and link E^3 are connected by the well-known "rule-joint," so that when operated on by the pitman and brought into a straight line, as shown by dotted lines in Fig. 3, the arm E′ is firmly locked against any pressure of the grain against the "cut-off" rods during the operation of binding. The shaft E extends clear through the machine, is mounted in suitable bearings on the frame, and carries on it at its rear end a sliding spring-clutch, E″, of well-known construction, which clutch throws the carrying-roller C′ into or out of gear, as required, this carrier being driven by a belt, *c″*, from a driving-pulley, F‴, mounted on the packer-shaft. As shown in Fig. 1, this spring-clutch is connected with a sliding collar, $a^{\times}$, which is supported on the shaft E, and is normally held against movement endwise of the shaft by a spring, $b^{\times}$. When the shaft E is rocked to elevate the cut-off the clutch-collar $a^{\times}$ is shifted outward by the action of a cam,

$c^{\times}$, against the pressure of the spring $b^{\times}$, and the clutch E″ is disengaged from the loosely-mounted pulley on the carrier-roller, thus leaving the pulley free to rotate as actuated from the packer-shaft without operating the carrier.

The organization of the shifted mechanism above described, and co-operating mechanism, is such that with the parts in the position shown in the drawings, the carrier conveys the grain over the cut-off to the packer, the cut-off being depressed; but when the binding mechanism is thrown into operation and the binder-arm begins to advance to surround the bundle the cut-off rods are thrown up and the carrier thrown out of gear, and remains out until the binding operation is completed and the binder-arm has resumed its normal position, when the cut-off swings back, the carrier is thrown into gear, and the feeding of the grain into the receptacle is resumed.

An adjustable tooth or spring-actuated locking-bolt, *t*, is mounted on the outer face of the binder gear-wheel R, so that it may be slid endwise in radial guides thereon. When free to move, as presently to be explained, this bolt is thrust forward by means of the spring *t′*, and is caused to engage with one of the spurs or teeth Q′ Q″, projecting from the outer face of the driving-gear Q. This spring-bolt serves to engage the binder-gear during one revolution with the driving-gear. It is normally held in a retracted position against the action of its spring by means of a lever, T, rocking on a pivot, *t″*, by which it is supported between its ends on the inner face of the binder-gear. One end of this lever engages a stud on the spring locking-bolt, which stud passes through a slot in the binder-gear, and the other end is normally held by a locking-catch, *t‴*, carried by a rocking shipping-lever, T′, actuated by the tripping-toe P′, hereinbefore described, which strikes the stud T‴ at the outer end of this shipping-lever. A fixed cam, T″, on the frame, and partially surrounding the hub of the binder gear-wheel, acts on the lever T to retract the spring locking-bolt *t*, and leaves this bolt-controlling lever dogged by the catch of the shipping-lever T′ at the end of a revolution of the binder gear-wheel, and at the time that the toothless portion of this wheel is opposite the driving-gear.

The binder-arm is actuated by means of a sector-crank, K′, fastened on the rock-shaft *k*. The sector-crank is provided with a slot, *k′*, in which a pivot-pin, *k″*, on pitman K″ plays. The opposite end of this pitman is connected with a crank-pin, K‴, by means of an adjustable connection of well-known construction, which permits the length of the pitman to be varied to secure the necessary relation to the various parts of the mechanism. The slot in the sector-crank allows the binder-arm to remain stationary at the terminal of its forward movement during the interval of the tying of the knot. During this intermission the binder-arm is positively locked by means of a spring-detent, K⁗, taking into a notch on the sector-crank. Just previous to the commencement of the backward movement of the binder-arm the pitman moves upward in its slot, shoving before it a tripping-slide, K⁗′, working in suitable guides on the inner face of the sector-crank, (see Fig. 3,) and releases the spring-catch from the notch, thus leaving the binder-arm free to rise.

The grain-receptacle may be considered as consisting essentially of a V-shaped trough, one side being composed of an inclined board or shield, G, suitably perforated, the other side consisting of a series of retaining-teeth, *u*, mounted on a rock-shaft, U, and capable of being adjusted and clamped thereon in the desired relation to the other parts. The nose of the binder-arm works in a slot in the inclined side of the binding-receptacle, and passes beneath the knotting mechanism to direct the cord thereto by a suitable guideway, as soon to be explained.

A kicker or discharge-arm, U′, is mounted on the rock-shaft U, so as to lie within a slot in the receptacle and parallel with the binder-arm. The rock-shaft, kicker, and retaining-teeth are normally locked in position to retain the gavel in the receptacle by means of a curved locking-lever, U″, normally held in position by a rocking spring-latch, U‴, (see Figs. 3 and 9,) which latch is released at proper intervals by a pin, U⁗, on the outside of the actuating-gear striking the toe U⁗′ of the spring-latch. (See Figs. 3, 4, and 9.) When released a tappet, V, on the rock-shaft is struck by a corresponding projection, *v*, on the inner side of the same wheel, thus rocking the shaft throwing the retaining-teeth down and the kicker up, so as to discharge the bound bundle as the binder-arm rises to resume its normal elevated position. At the proper time a sector-gear, *v″*, on the inner side of the actuating-lever engages the teeth *v‴* of a sector-gear mounted on the rock-shaft U, and restores the kicker, retaining-teeth, and locking-latch to their normal position.

A retaining-lever, W, rocking on a pivot, *w*, just beneath the binder-arm shaft, is provided with a coiled spring, *w′*, which normally holds it pressed forward and downward, so as to retain the gavel while being bound. The central retaining-tooth, *u*, abuts against the lower outer end of this lever, (see Figs. 2 and 4,) and locks it positively until the rock-shaft U is released for the discharge of the gavel, when it moves out of the way and the spring-retainer yields to allow the gavel to pass as it is thrown out by the kicker, the spring returning the retainer as soon as the gavel has passed.

Instead of a single retaining-lever, as shown, a series of teeth corresponding with those of the retainer might be employed.

The cord tying and severing mechanism is inclosed by a shield or cover, X, provided with a slot, *x*, so shaped as properly to guide the bind-

ing material to the knotter as the nose of the binder-arm passes underneath the shield and knotter. The knot is formed by a tying-bill, Y, mounted on a shaft, *y*, and having imparted to it first a backward rotary movement of about a quarter of a circle from its normal position, and then a forward rotation of about a circle and a quarter, so as to bring it back to the position from whence it started, the tying-bill always revolving in the same vertical plane.

The main portion of the tying-bill is of a conical form, constituting a volute or spiral of about one turn, secured to a tubular shaft, 1, revolving in suitable bearings, 2 3. A movable jaw, 4, rocks in the plane of the tying-bill shaft on a pivot, 5, its projecting end being pin-jointed to a rod, 6, capable of moving endwise in the tubular shaft 1 of the main portion of the tying-bill. A spiral spring, 7, inside this shaft tends to force the rod outward, so as normally to keep the jaws of the tying-bill tightly closed. A stud, 8, on the side of this slide-rod, during a portion of its revolution, rides over an incline, 9, on the side of the bearing 2, which retracts the rod and opens the bill for the admission of the tying-cord, as hereinafter more fully explained.

The tying-bill is driven by means of a spur-pinion, 10, on the end of its shaft *y*, meshing alternately with the sector-gears 11 12 on the inner side of the actuating-gear R, hereinbefore described. A spring, 13, bearing in a notch on an enlargement, 14, of this shaft serves to lock and prevent the turning of the tying-bill until the proper moment. The same end may be attained by means of a projecting tooth, 15, on the tying-bill shaft, which tooth slides on a guide-flange, 16, on the inner surface of the actuating-wheel R, which latter plan I prefer, as by it the tying-bill is positively held and released at the proper time.

A driving-pin, 17, on the enlarged portion of the tying-bill shaft (in its revolution) strikes a corresponding pin, 18, on a bell-crank lever, 19, pin-jointed to a rod, 20, capable of sliding freely endwise in its bearings, and carrying a shearing clamp-head, 21. The sleeve 22, to which this lever is pin-jointed, may be adjusted on the rod by means of a screw, or in other well-known ways, to vary the range of motion of the knife. The pin 17 moves the clamp-head 21 outwardly, and then releases it, it being suddenly retracted by a coil-spring, 23, on the rod, draws the cord against the stationary knife 24, and at the same time clamps the severed end against the fixed clamping-face 25, back of the knife, in a manner clearly shown in the drawings.

The shearing clamp head moves transversely to the plane of the tying-bill to sever the cord at the proper moment. One end of the binding-cord is securely held by being jammed between the clamp and the surface with which it is in contact in a well-known way, the other end being of course held by the nose of the binding-arm. In its forward movement the binding-arm, after encircling the gavel, passes under and beyond the tying-bill and clamp, so that the cord lies in the notch 26 of the clamp-head and in the neck 27 under the tying-bill, and in or above a hook, 30, of the slot *x*, the binding-arm being at this moment securely locked by the dogging of the sector-crank K, above described.

As the nose of the binder-arm passes under the tying-bill a sector-rack, 12, of two teeth, on the inner side of the main actuating-gear R, engages the pinion 10 on the tying-bill shaft, and gives it a quarter backward turn, bringing it to the position shown in Fig. 19, where it will be observed that the bill has passed outside of and beyond both bights of the knotting-cord.

The hooked projection 30 on the side of the slot *x* catches and prevents the cord from dropping too low to be properly engaged by the bill-hook in case of any slackness or insufficient tension, its operation being clearly shown in Fig. 20.

Just about the time the binder-arm is locked the internal sector-gear, 11, on the inner side of the actuating-gear R, meshes with the pinion 10, above mentioned, on the tying-bill shaft, and gives it a forward revolution of a circle and a quarter, carrying it successively through the stages shown in Figs. 21 to 25 of the drawings, which show the various positions of the parts so clearly as scarcely to require description.

As the tying-bill rises after the backward movement above mentioned it hooks over both ends of the cord and carries them around to the position shown in Fig. 21, the bight of the binding-cord previously lying underneath the neck of the tying-bill gradually slipping off therefrom behind the portion engaged by the point of the hook. It is arrested and held from slipping off before the bill seizes the cord, which would spoil the knot, by means of a shoulder, 28, in the bill. At this moment the stud 8 on the tying-bill shaft slides over the incline 9 on the bearing 2. Consequently the endwise movement of the slide-rod above mentioned causes the tying-bill to open, as shown in Figs. 13 and 22, to receive both ends of the binding-cord between the tying-bill and the cutter. As the stud 8 passes the incline 9 the sliding rod 6 is released and shoved forward by its spring, so as to close the jaws of the tying-bill on the cord. At the same time its outer end pushes the loops from off the shoulders 28, enabling them to slip toward the point of the bill, as shown in Fig. 23. As the parts assume the position shown in this figure the clamp is thrust forward into the position shown in Fig. 14, the cord slipping from the notch 26 into the space between the projecting shoulder of the shearing-clamp 21 and the fixed cutting-blade, and immediately thereafter the clamp is quickly retracted by a spring simultaneously severing the cord and jamming the end to be retained securely in place, the

parts by this time assuming the position shown in Fig. 25, at which point the bundle is discharged by the kicker, and the cord thereby pulled from between the jaws, leaving the parts in position for the next stroke, they being locked in this position by the devices above described.

As the tying-bill requires somewhat nice workmanship, I propose making its parts of cast-steel; and to enable these parts readily to be removed and replaced the tying-bill shaft is made in two sections, with flanges on the abutting ends, which ends are countersunk or counterbored, so as to insure accurate fitting, and held together by clamp-screws.

I disclaim the combination, broadly considered, of the carrier, the cut-off to which the grain is delivered by the carrier, mechanism for intermittingly and alternately operating the carrier and cut-off, and the packer, as I am not the first inventor thereof.

I claim as of my own invention—

1. The combination of the cutting apparatus, the shield or lateral projection at the heel of the inner divider for evening the butts of the grain, the carrier extending inside of or beyond the divider toward the binding mechanism, and the inclined rods of the cut-off, also inside of the divider, to which cut-off the grain is conducted by the carrier with its butts acted upon by the shield preparatory to being delivered to the binding-receptacle over the cut off in straightened condition, substantially as hereinbefore set forth.

2. The combination, substantially as hereinbefore set forth, of the intermittingly-moving carrier, the intermittingly-actuated cut-off, and means by which the carrier and cut-off are operated alternately, the one being operative while the other is inoperative, as described.

3. The combination of an intermittingly-moving carrier, a binding-receptacle toward which the grain is conducted by the carrier, and an intermittingly-actuated cut-off operated alternately with the carrier, substantially as and for the purpose hereinbefore set forth.

4. The combination, substantially as hereinbefore set forth, of the cutting apparatus, the intermittingly-moving carrier, the clearers, the intermittingly-actuated cut-off, and mechanism for moving the carrier and cut-off alternately, the one being operative while the other is inoperative, to regulate the delivery of the gavel to the binding mechanism, as described.

5. The combination, substantially as hereinbefore set forth, of the cutting apparatus, the inner divider, the carrier extending inside of or beyond the divider, the way or floor to and along which, past the divider, the grain is directed by the carrier, and the adjustable butt-guide having hinged connection with the divider-heel or lateral projection, and acting upon the grain to even it as it passes along said way or floor.

6. The combination, substantially as hereinbefore set forth, of the cutting apparatus, the carrier, the cut-off, the inner divider, and the butt-guide, to the action of which the grain is subjected after passing the divider and while supported by the cut-off.

7. The combination, substantially as hereinbefore set forth, of the carrier, the cut-off, the clearers serving to free the grain from the carrier as delivered to the cut-off, and the butt-guide acting upon the grain while moving along the cut-off.

8. The combination, substantially as hereinbefore set forth, of the cutting apparatus, the inner divider, the carrier delivering the grain inside of or beyond the divider, the cut-off to which the grain is directed by the carrier, the clearers freeing the grain from the carrier, and the butt-guide for evening the grain during its passage by way of the cut-off to the binding-receptacle.

9. The combination, substantially as hereinbefore set forth, of the cutting apparatus, the platform-carrier, the cut-off to and upon which the grain is delivered at the inner end of the platform by the carrier, the clearers freeing the grain from the carrier as delivered to the cut-off, and the packer acting upon the grain to direct it along the cut-off to the binding mechanism.

10. The combination of the carrier, the clearers consisting of the series of forked or slotted ended spring-teeth mounted between the belts of the carrier, and the cut-off consisting of a series of inclined rods projecting upward from between the carrier-belts and embraced by the clearer-teeth, substantially as and for the purpose hereinbefore set forth.

11. The combination, substantially as hereinbefore set forth, of the cutting apparatus, the carrier, the cut-off to which the grain is delivered by the carrier, the packer acting upon the grain between the rods of the cut-off, and the butt-guide for evening the grain as it is conducted by the packer along the cut-off to the binding-receptacle.

12. The combination of the platform carrier-belts, the inclined cut-off rods, the rock-shaft at the inner end of the platform, between the upper and lower surfaces of the carrier-belts, and supporting the cut-off, and the packer, these members being and operating substantially as hereinbefore set forth.

13. The combination, substantially as hereinbefore set forth, of the intermittingly-actuated carrier, the intermittingly-actuated cut-off, the binding-receptacle, the binding mechanism, and mechanism for actuating the cut-off and operating the binding mechanism during the intermissions in the operations of the carrier.

14. The combination, substantially as hereinbefore set forth, of the intermittingly-actuated carrier, the intermittingly-actuated cut-off operated alternately with the carrier, the packer, the binding-receptacle, the binder-arm, and mechanism for operating the binder-arm alternately with the carrier to bind a bundle

while the cut-off is elevated and the carrier at rest, for the purpose described.

15. The combination, substantially as hereinbefore set forth, of the carrier, the rocking cut-off rods supported between the carrier-belts, and to which the grain is delivered by the carrier, the packer acting upon the grain between the cut-off rods when the cut-off is depressed and working clear of it when the cut-off is elevated, and the pressure-bar holding the accumulated grain down upon the cut-off and to the action of the packer.

16. The combination, substantially as hereinbefore set forth, of the binder-arm, the compressor pivoted thereto, and the bolt which automatically locks the compressor when the binding-arm starts into operation.

17. The combination, substantially as hereinbefore set forth, of the binding-receptacle, the packer, the binder-arm, the compressor hinged thereto, and mechanism which automatically locks the compressor as the binding-arm begins its forward movement.

18. The combination, substantially as hereinbefore set forth, of the cut-off, the packer, the binder-arm, the compressor, the locking-bolt, and the receptacle.

19. The combination, substantially as hereinbefore set forth, of the cut-off, its rock-shaft, its crank-arm, its pitman, and the jointed lever interposed between the crank-arm and pitman, and constituting a lock to hold the cut-off in its elevated position.

20. The combination, substantially as hereinbefore set forth, of a binder-arm, means for supplying binding material thereto under tension, a pulley around which the material passes, and by the strain on which material, as the grain accumulates against it, the pulley is rotated, clutch mechanism actuated by the pulley by direct engagement therewith during a portion only of the time of the revolution of the pulley while the binding material is being supplied, and grain-binding mechanism thrown into operation by said pulley-actuated clutch mechanism, for the purpose described.

21. The combination, substantially as hereinbefore set forth, of the binding-receptacle, the binder-arm, means by which the binding material is supplied under tension to the binder-arm, a pulley around which the binding material passes, clutch mechanism intermittingly and directly engaged with and actuated by said pulley at intervals or during portions only of its revolutions, mechanism for supplying the grain to the receptacle and forcing it against the binding material, binding mechanism, mechanism connected with the pulley-actuated clutch mechanism, and operated by the movements imparted to the pulley by the strain on the binding material to throw the binding mechanism into operation, and means by which said clutch mechanism and pulley are disengaged during the operations of the binding mechanism, and while the pulley is being rotated, thus leaving the pulley free to supply the requisite amounts of material for securing bundles.

22. The combination of the binder-arm, the receptacle, the starting-pulley around which the binding material passes as conducted to the binder-arm, the clutch engaging with the pulley, the shaft upon which said clutch is mounted concentrically with the pulley, and means by which said shaft is moved endwise to throw the clutch into and out of engagement with the starting-pulley, substantially as and for the purpose hereinbefore set forth.

23. The combination of the packer, the binding-receptacle, the binder-arm, the spool supplying the binding material, the ratchet-toothed pulley around which the binding material passes as conducted to the binder-arm, and the clutch-disk and its pinion actuated by and rotating with the pulley for a portion of the time of its revolution in supplying the binding material, substantially as and for the purpose hereinbefore set forth.

24. The combination of the tension-pulley around which the binding material passes, and which is rotated by the strain upon said material by the pressure of the grain, the clutch engaged with and rotated by the pulley, the pinion attached to the clutch, the rack actuated by the pinion, and binding mechanism thrown into operation by mechanism connected with said rack, substantially as and for the purpose hereinbefore set forth.

25. The combination of the binding-receptacle, the packer, the binder-arm, the spool supplying the binding material to the binder-arm, the starting-pulley around which said material passes between the spool and binder-arm, the radius-bar, the rack thereof, the pinion engaging the rack, the rock-shaft to which the radius-bar is secured, and the clutch-connection between the starting-pulley and the rack-engaging pinion, substantially as and for the purpose hereinbefore set forth.

26. The combination, substantially as hereinbefore set forth, of the ratchet-toothed starting-pulley, the toothed disk with which it engages, its pinion, the rack, the radius-bar, the toe on the rock-shaft, with which rock-shaft the radius-bar swings, the shipping-lever actuated by the toe, the spring locking-bolt, and the driving-gear with which it meshes.

27. The combination, substantially as hereinbefore set forth, of the starting-pulley, its ratchet, the toothed disk with which it engages, its pinion, the rack, the radius-bar, the toe on the rock-shaft, with which rock-shaft the radius-bar swings, the shipping-lever actuated by the toe, the spring locking-bolt, and its retracting-cam on the frame which throws the binding mechanism out of gear at the end of each complete movement.

28. The combination, substantially as hereinbefore set forth, of the starting-pulley, its ratchet, the toothed disk, the pinion carried

thereby, its endwise-moving shaft, and the rocking-lever bearing on the actuating-gear to keep the disk and pulley out of gear after the binding mechanism starts.

29. The combination, substantially as hereinbefore set forth, of the starting-pulley, its ratchet, the toothed disk, the endwise-moving shaft, the thrust-spring on said shaft, the pivoted rocking lever, and the locking-notch in the actuating-gear, whereby when the binding mechanism is at rest the actuating-gear is prevented from moving and the toothed disk of the pulley-actuated clutch mechanism simultaneously locked in position to be thrown into operation by the forward movement of the starting-pulley.

30. The combination of the binder-arm, the starting-pulley, the clutch engaged with and rotated by the pulley, the pinion attached to the clutch, the rack actuated by the pinion, the rock-shaft, the radius-bar carrying the rack and attached to the rock-shaft, the shipping-lever acted upon by the rock-shaft, and the recoil-spring acting on the rock-shaft, substantially as and for the purpose hereinbefore set forth.

31. The combination, substantially as hereinbefore set forth, of the binder gear-wheel, the driving-gear having one or more spurs, Q′, the spring-tooth or locking-bolt on the binder gear-wheel, the shipping-lever, the rock-shaft, its toe, the spring by which the rock-shaft toe is moved away from the shipping-lever, the radius-bar secured to the rock-shaft, the rack on the radius-bar, the clutch, its pinion, the starting-pulley, and the endwise-moving shaft on which said clutch and pinion are mounted.

32. The combination, substantially as hereinbefore set forth, of the adjustable racked radius-bar, the intermittingly-actuated pinion engaging the radius-bar rack, binding mechanism thrown into operation by the actuation of the radius-bar, and adjustable stop mechanism to vary the range of motion imparted to the radius-bar by the pinion to start the binding mechanism according to the sizes of the gavels.

33. The combination, substantially as hereinbefore set forth, of the starting-pulley, its ratchet, the clutch-disk, its pinion, and the radius-bar and rack adjustable to limit the range of motion of the bar.

34. The combination, substantially as hereinbefore set forth, of the grain-receptacle, the packer, the binder-arm, means for supplying binding material thereto under tension, the starting-pulley around which said material passes, clutch mechanism directly engaged with and actuated by the starting-pulley during a portion of its revolution in supplying the binding material, means by which the pulley is unclutched while revolving and supplying the binding material, grain-binding mechanism thrown into operation by said pulley-actuated clutch mechanism, and adjusting mechanism by which to regulate the amount of binding material required to be supplied to start the binding mechanism by the rotation of the starting-pulley, for the purpose described.

35. The combination, substantially as hereinbefore set forth, of the binding-receptacle, the packer, the binder-arm, means for supplying binding material thereto under tension, the starting-pulley, clutch mechanism directly actuated by the pulley by engagement therewith during a portion only of the time of the revolution of the pulley, the knotter, and mechanism which locks the binder-arm while the knot is being tied.

36. The combination, substantially as hereinbefore set forth, of the radius-bar, the rack thereon, the intermittingly-actuated pinion engaging said rack, binding mechanism thrown into operation by the movements of the radius-bar, and means whereby the binder-arm is locked while the knot is being tied.

37. The combination, substantially as hereinbefore set forth, of the intermittingly-actuated binder gear-wheel, the binder-arm, its rock-shaft actuated by connections with the binder gear-wheel, the knotter actuated by connections with the binder gear-wheel, and mechanism also actuated by connections with said gear-wheel to lock the binder-arm while the knot is being tied.

38. The combination, substantially as hereinbefore set forth, of the actuating or binder gear-wheel, the pitman, the sector-crank, the rock-shaft, the binder-arm mounted thereon, the detent taking into the notch on the sector-crank, and the tripping-slide operated by the pitman.

39. The combination, substantially as hereinbefore set forth, of the intermittingly-actuated binder gear-wheel, the driving-gear engaging said gear-wheel at intervals to impart a single revolution thereto at each actuation, the binder-arm, its rock-shaft, the oscillating sector-crank on said shaft, the knotter, its actuating mechanism, and the detent by which the sector-crank and binder-arm are locked during the tying of the knot.

40. The combination of the driving-gear, the binder gear-wheel intermittingly engaged therewith, and having imparted to it a revolution at each actuation, the knotter, its actuating mechanism operated by the binder gear-wheel, the binder-arm, its rock-shaft, mechanism operated by the binder gear-wheel for actuating the binder-arm, and mechanism, also actuated by the binder gear-wheel, for locking the binder-arm rock-shaft while the knot is being tied, substantially as hereinbefore set forth.

41. The combination of the binder-arm, the tying-bill always revolving in the same vertical plane, and beneath which the nose of the binder-arm passes, and the cord-guideway, substantially as and for the purpose hereinbefore set forth.

42. The combination, substantially as here-

inbefore set forth, of the binder-arm, the revolving non-reciprocating tying-bill turning in opposite directions to cross and engage the cord ends, the cord-guideway, the knife, and the cord-clamp.

43. The combination, substantially as hereinbefore set forth, of the binder-arm, the non-reciprocating rotary tying-bill, beneath which the nose of the binder-arm passes, the cord guideway or slot in the knotter-cover, and mechanism by which the tying-bill is turned first backward to present it outside of or across the cord ends, and then rotated forward to engage the cord ends, for the purpose described.

44. The combination, substantially as hereinbefore set forth, of the binder-arm, the rotary non-reciprocating tying-bill, the movable jaw thereof, mechanism by which the tying-bill is turned first in one direction to present it outside of or across the cord ends, and then rotated in the opposite or forward direction to engage the cord ends, the spring acting on the rod of the movable jaw to close it, and mechanism by which said jaw is opened and closed while the tying-bill is nearing the position from which it started on its forward rotation, for the purpose described.

45. The combination of the non-reciprocating tying-bill, the movable jaw thereof, mechanism by which the tying-bill is given first a backward turn of a portion of a revolution to pass across or outside of the binding material, and then a forward rotation to engage the binding material, the pivoted jaw of the tying-bill, the endwise-moving rod by which the jaw is normally held closed, means by which said rod is retracted to open the jaw and then released to allow it to close upon the binding material, the cutter, and the cord-clamp, substantially as and for the purpose hereinbefore set forth.

46. The combination of the conical volute-shaped non-reciprocating tying-bill provided with the shoulder 28, the pivoted jaw, and its endwise-moving rod, substantially as and for the purpose hereinbefore set forth.

47. The combination, substantially as hereinbefore set forth, of the conical volute-shaped portion of the tying-bill turning in opposite directions to first cross over or outside of and then to hook or engage the binding material, the tubular shaft thereof, the movable jaw of the tying-bill pivoted thereon, the slide-rod reciprocating at its end through the tying-bill and pivoted to its movable jaw, the spring acting on said rod, and means whereby the movable jaw is opened against the action of its spring, for the purpose described.

48. The combination, substantially as hereinbefore set forth, of the conical volute-shaped fixed member of the tying-bill, the retaining-shoulder thereon, the pivoted jaw, and its rearwardly-projecting end, which at the proper moment releases the cord from the retaining-shoulder.

49. The combination, substantially as hereinbefore set forth, of the non-reciprocating or fixed member of the tying-bill, its tubular shaft, means for turning it first one way and then the other, the pivoted jaw, the slide-rod, the stud thereon, which acts on a fixed incline to open the jaw at predetermined intervals, and the spring which closes the jaw.

50. The combination, substantially as hereinbefore set forth, of the non-reciprocating tying-bill, means by which it is turned first one way and then the other, the tying-bill shaft, the projection or tooth at the end thereof, the actuating-gear, and the guide-flange thereon, against which said tooth bears to hold the tying-bill in its locked position.

51. The combination, substantially as herein set forth, of the tying-bill, its spur-pinion, and the sector-gear on the main actuating-wheel, which gives it its backward quarter-turn at the commencement of its stroke.

52. The combination, substantially as hereinbefore set forth, of the tying-bill, its shaft, the pinion on said shaft, the actuating-wheel, and the sector-gears which give the backward and forward turns to the tying-bill shaft.

53. The combination, substantially as hereinbefore set forth, of the actuating-gear, the sector-gears 11 and 12 thereon, the guide-flange on the actuating-gear, the tying-bill shaft, and the pinion and projecting tooth thereof.

54. The combination of the tying-bill, its tubular shaft, the pinion thereon, the sector-gears acting on the pinion, and by which the tying-bill is turned first backward and then forward, the movable jaw pivoted to the tying-bill, its rod, the spring acting upon said rod to hold the jaw closed, and means whereby said jaw is opened to receive the binding material, substantially as and for the purpose hereinbefore set forth.

55. The combination, substantially as hereinbefore set forth, of the endwise-moving knife, its retracting-spring, its actuating-lever, and the driving-pin on the tying-bill shaft.

56. The combination, substantially as hereinbefore set forth, of the tying-bill and the tubular shaft thereof, composed of the two sections having flanged ends fitted together and secured by clamping.

57. The combination, substantially as hereinbefore set forth, of the stationary slotted binding-receptacle, the binder-arm working at its nose through the slot in the receptacle, the rock-shaft by which it is supported above the binding-receptacle, the swinging retainer between which and the binder-arm the grain is compressed in binding, means for positively locking said retainer during the binding operations, and means by which it is restored to its working position after having yielded to admit of the discharge of a bound bundle from the receptacle.

58. The combination, substantially as hereinbefore set forth, of the binding-receptacle, the

retainer, the kicker, and the mechanism by which the kicker is locked and the retainer dogged while the knot is being tied.

59. The combination, substantially as hereinbefore set forth, of the rock-shaft, the kicker mounted thereon, the retaining-teeth, also mounted on said shaft, the locking-lever, and its latch, for the purpose described.

60. The combination, substantially as hereinbefore set forth, of the binding-receptacle, the rock-shaft at the side thereof, the locking-lever, the spring-latch, means for operating said latch, and means for actuating the rock-shaft, for the purpose described.

61. The combination, substantially as hereinbefore set forth, of the binding-receptacle, the rock-shaft at the side thereof, the locking-lever, the tappet and sector-gear of the rock-shaft, the spring-latch engaging the locking-lever, and the actuating-gear by which said latch, tappet, and sector-gear are operated.

In testimony whereof I have hereunto subscribed my name this 21st day of April, A. D. 1881.

JOHN S. DAVIS.

Witnesses:
W. D. BALDWIN,
NELLIE HOLMES.