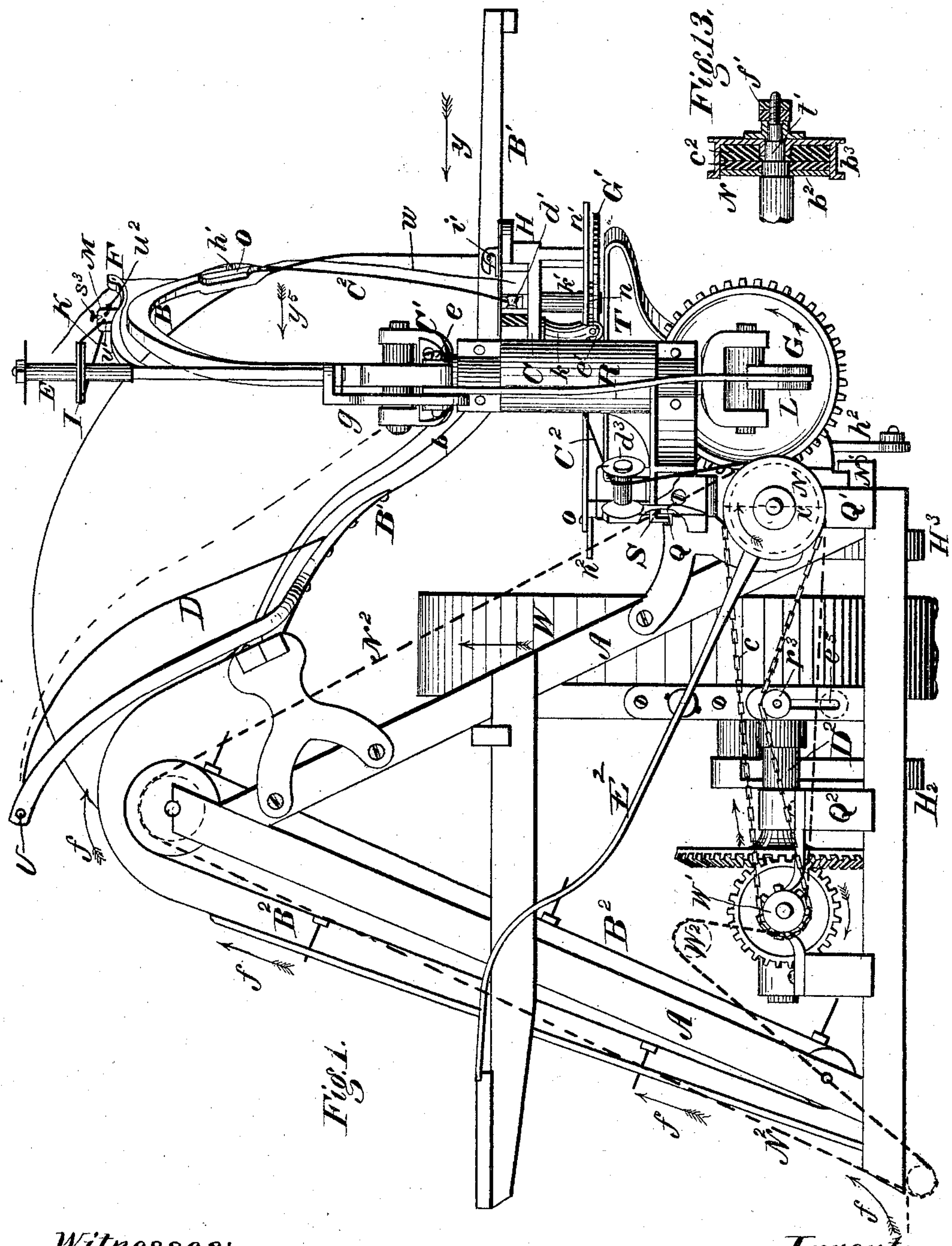
5 Sheets—Sheet 1.

J. F. GORDON.

Grain-Binder.

No. 198,104. Patented Dec. 11, 1877.



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Dodge & Son

5 Sheets—Sheet 2.

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Grain-Binder.

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Fig. 2.

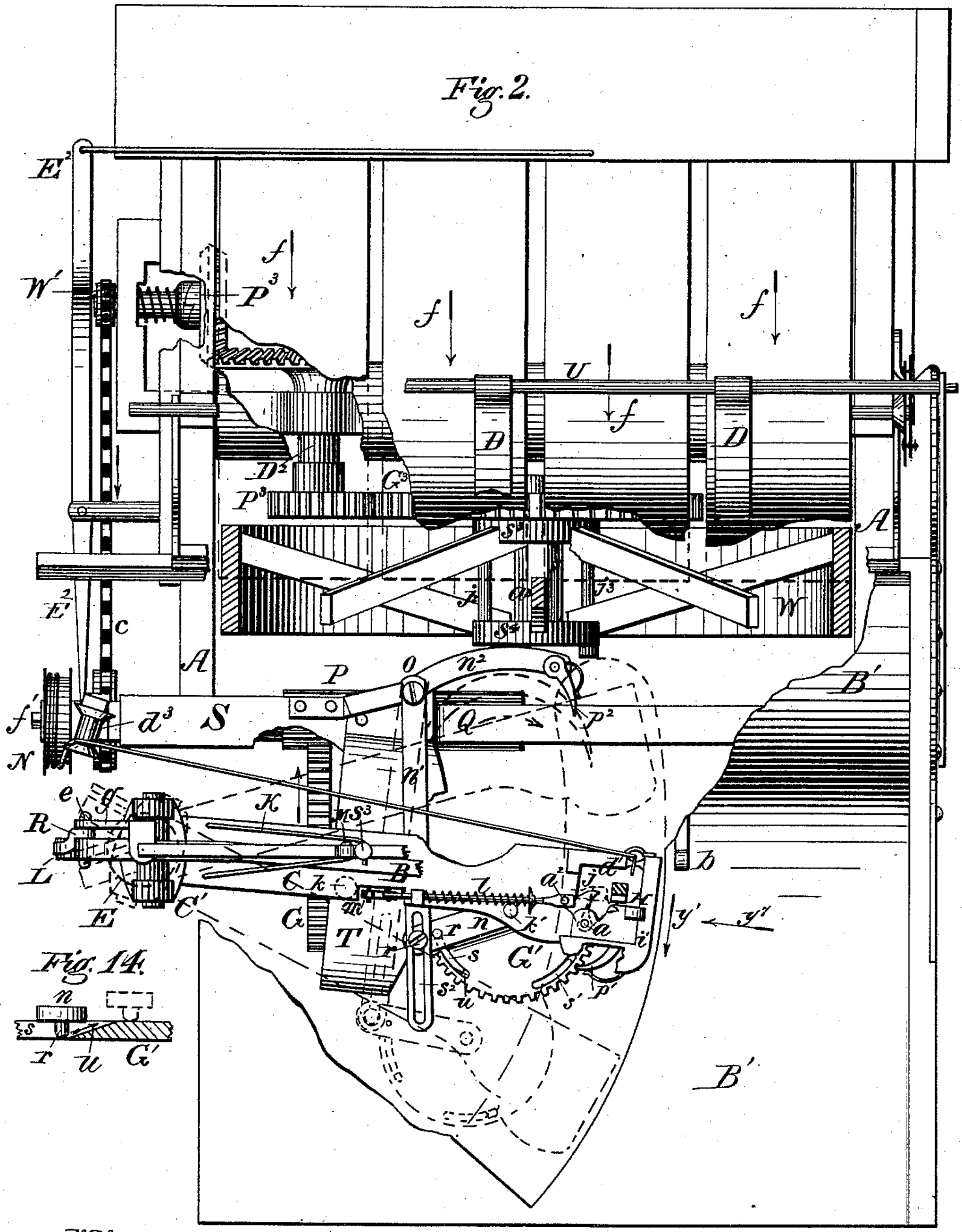

Fig. 14.

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Fig.3.

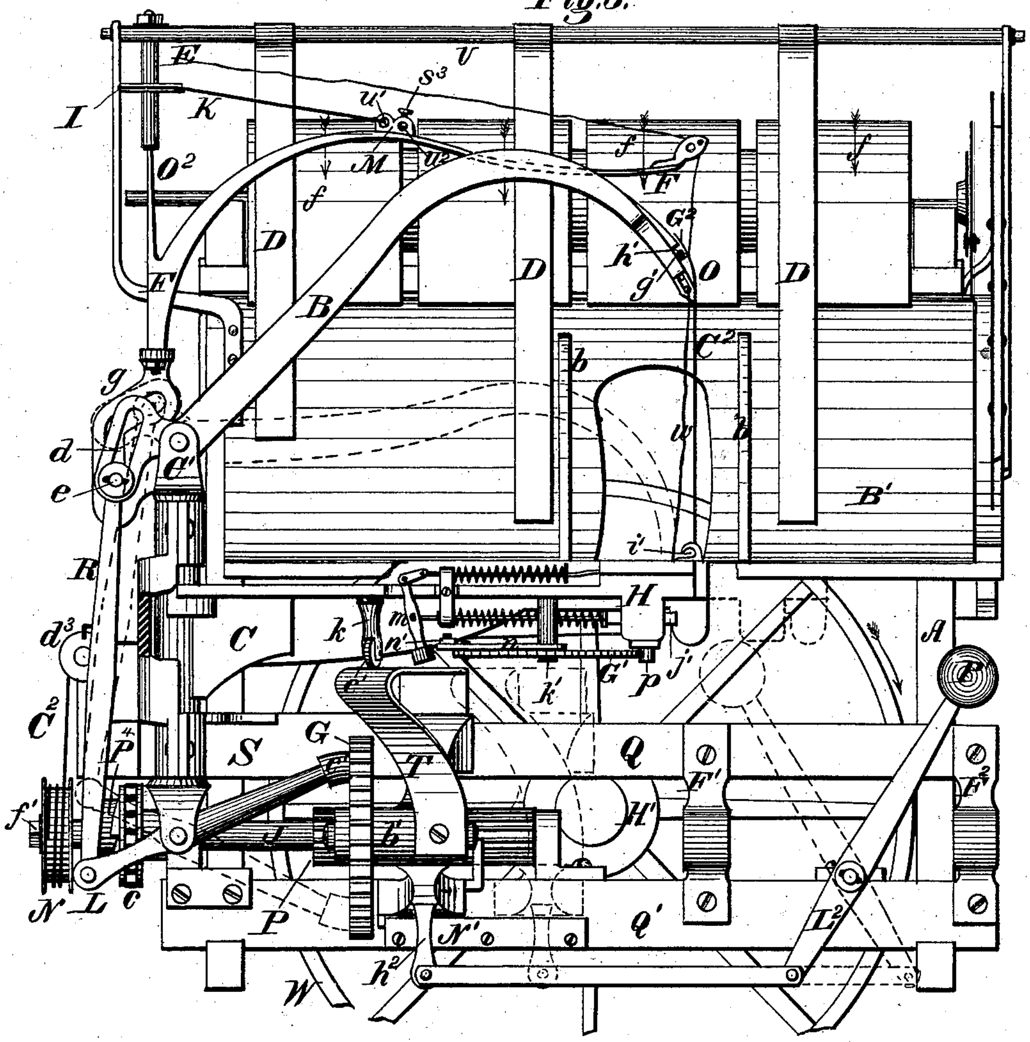
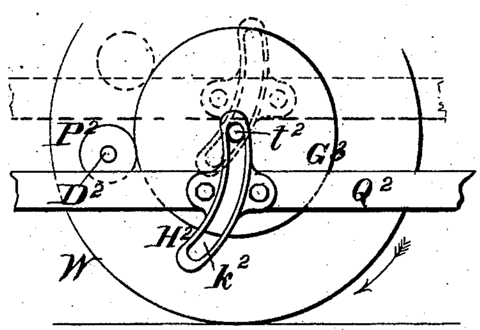


Fig.21.



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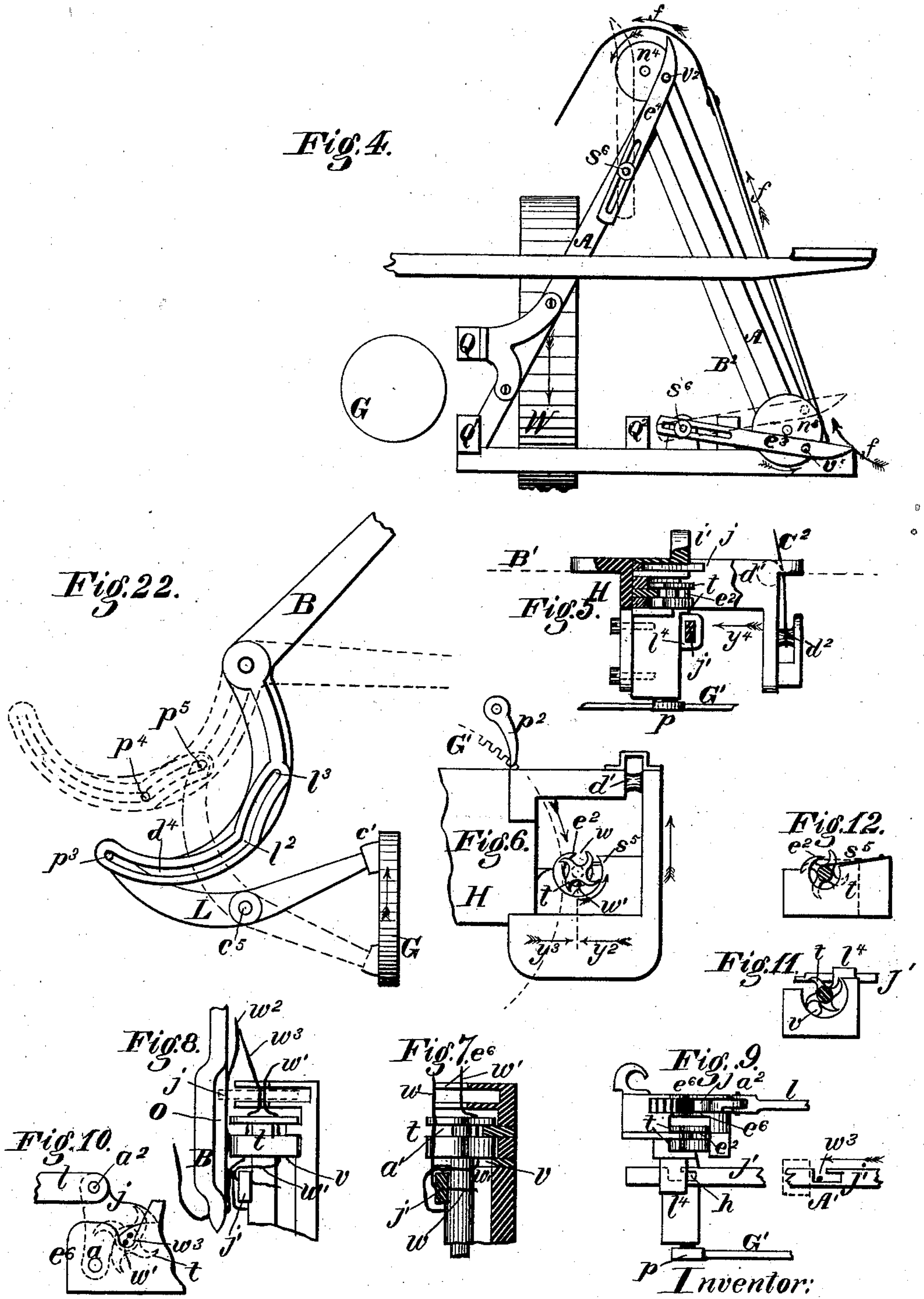

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Fig. 15.

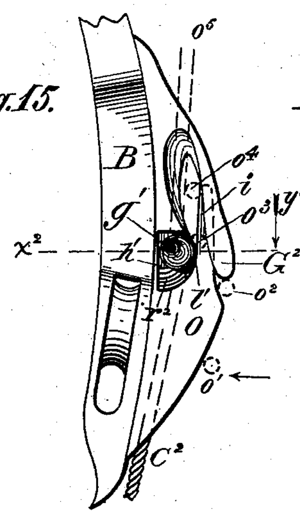


Fig. 16.

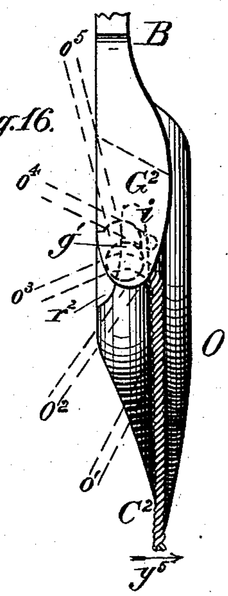


Fig. 17.

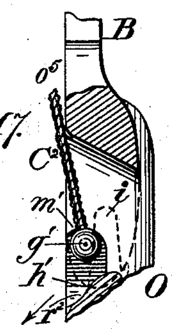


Fig. 18.

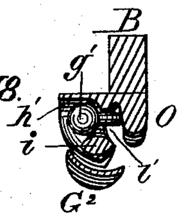


Fig. 19.

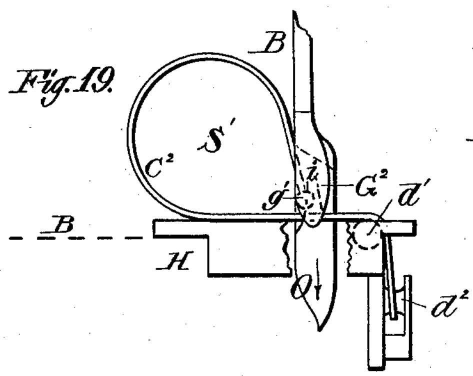
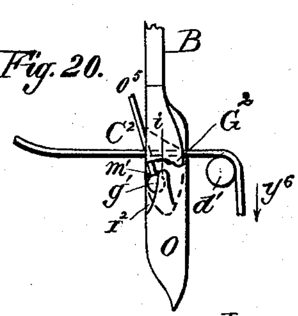


Fig. 20.



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UNITED STATES PATENT OFFICE.

JAMES F. GORDON, OF ROCHESTER, NEW YORK.

IMPROVEMENT IN GRAIN-BINDERS.

Specification forming part of Letters Patent No. **198,104**, dated December 11, 1877; application filed October 25, 1877.

To all whom it may concern:

Be it known that I, JAMES F. GORDON, of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Grain-Binders, which improvements are fully set forth in the following specification, reference being had to the accompanying drawings.

Figure 1 is a rear elevation of a portion of a machine to which my inventions are attached. Fig. 2 is a plan view of the same; Fig. 3, a side elevation, looking in the direction of the arrow y in Fig. 1. Fig. 4 is a front elevation, drawn to a reduced scale, showing pickers e^3 e^4, &c. Fig. 5 is an enlarged sectional view of the twister-head H, looking in the direction of the arrow y^7 in Fig. 2, showing the twister t, &c.; Fig. 6, a plan view of the twister-head H, showing the top portion of the twister t uncovered, the pawl p^2, &c. Fig. 7 shows the twister, with the binding-wire in two positions, the view being taken as indicated by the arrow y^3, Fig. 6. Fig. 8 shows the twister t, binding-arm B, and several positions of the binding-wire, the view taken as in Fig. 7. Fig. 9 shows the wire-clamping jaws j and j^1, the view taken in the direction of the arrow y^4 in Fig. 5. Fig. 10 shows the wires clamped between the clamping-jaws j and centering-plates e^6 over the center of the twister t, the view taken as in Fig. 6. Fig. 11 shows the lower portion of the twister uncovered, and the point at which the wire is cut. Fig. 12 shows the annular pointed guard e^2, partially covering the lower portion of the twister, and the guard s^5. Fig. 13 shows a section of the tension or friction drum N, enlarged, on the line x^1 in Fig. 1. Fig. 14 is an enlarged detached figure, which will be explained in the specification. Fig. 15 is a side elevation of the compressor attachment O and the point of the binder-arm B, &c. Fig. 16 is a front elevation of the same. Fig. 17 shows much of the attachment O broken away to uncover an important position of the ball g^1 and compressing-cord C^2. Fig. 18 is a transverse section of Fig. 15, as indicated by the dotted line x^2 and arrow y^8. Figs. 19 and 20 show the compressor attachment O re-engaging the compressing-cord C^2. Fig. 21 shows the manner of hanging the frame upon the driving-wheel, and Fig. 22 shows a modification of the manner of the manner of connecting the binder-arm B and lever L.

My invention relates to certain improvements in that class of harvesters by which the grain, as it is cut, is bound by the operation of the machine.

The nature of the improvement consists in the employment of a compressing-cord and friction-drum, and in connection therewith novel mechanical means by which the cord is caused to encircle and compress the gavels, and automatically release the same, and at the same time bring the cord into position to compress each successive gavel, as will be hereinafter more fully explained; in providing the binding-arm with a driving mechanism, by which it has a period of rest from its vertical reciprocation during the binding of each gavel; in providing a twister by which the wire is relieved from strain while being twisted, and in other improvements which will be explained farther on.

Referring to the drawings, A is the frame and W the driving-wheel of a reaper, in which the cut grain is carried up over the driving-wheel, as indicated by the arrows f, and deposited in the receptacle B^1. Motion is communicated to the long pinion P from the driving-wheel by means of intermediate gearing and the chain c, as shown in Figs. 1 and 2. The gear G is driven by the pinion P, by means of which and the lever L and connecting-rod R the binding-arm and the rest of the binding mechanism are operated in a manner similar to that shown and described in my former patents.

The binder-arm B, Fig. 3, is formed with a slot, d, and the bracket g, which is rigidly fastened to the bifurcated head C^1, has a slot of a similar width, the upper end of which bends toward the right. The bracket g and that part of the binder-arm containing the slot d stand side by side, parallel, and a little distance apart; and in the space between them, Fig. 1, the upper end of the connecting-rod R is inserted, with its cross-pin or roller e, extending either way through the said slots. As the connecting-rod R presses upward, the pin e moves up along the perpendicular portion of the slot in the bracket g, moving the binder-arm till the slot d of the same coincides with the inclined portion of the slot in the bracket, (see dotted position,) when the vertical motion of the binder-arm ceases. While the hub c^1 is carried along the lower portion of the wheel G the pin e moves up the inclined portion of the slot in g, and no vertical motion of the binder-arm results until the said pin returns to the angle in the slot and commences to descend. By means of this arrangement the point of the binder-arm and the twisting device are kept relatively at rest while the ends of the wire are being twisted, and during the outward vibration of the binder-arm and twister-carrier.

It will be seen that the binder-arm is essentially a lever of the first order, rocking upon its fulcrum in the head C^1.

C, Figs. 2 and 3, is a twister-carrier, similar to that shown and described in my patent of October 26, 1875, No. 169,258. T is a track, having its ends fastened to the saddle S and hanger b^1, respectively, upon which the roller e^1 travels, by which, and the stud or bearing k, the twister-carrier is supported and steadied in its horizontal vibrations. The stud k^1 extends downward from the under surface of the twister-carrier C, and supports at its lower end in a horizontal position the gear G^1, which, at intervals, revolves the twister-pinion p.

The gear G^1 is provided with curved slots, two of which are seen at s and s', Fig. 2; and n is a bar pivoted upon the stud k^1, resting upon the gear G^1, which is provided with a fixed pin, r, that reaches downward into the slot s, &c. The slotted connecting-bar n^1 is pivoted to the fixed bar n^2 at o, and rests upon the bar n, to which it is movably attached by means of the headed pin r^1, as shown.

As the twister-carrier C swings in the direction indicated by the arrow y^1, the pin r^1 glides outward along the slot s^2 till it reaches the end of the same, as shown in the adjacent dotted position, when the gear G^1 is caused to revolve sufficiently to cause the twister-pinion p to make several revolutions, sufficient to twist the wire. When the twister-carrier moves in the opposite direction, the pin r^1 slides back to the opposite end of the slot s^2, at which point its motion is arrested, in consequence of which the bar n is forced around its center k. As the pin r is brought by this motion of the bar n to the end of the curved slot s, it slides up the incline u of the same, Fig. 14, and rides on the surface of the gear G^1 until it drops into the next slot s^1. Now, when the twister-carrier C again swings in the direction shown by the arrow y^1 sufficiently far to bring the pin r^1 to the end of the slot s^2, as above described, the gear G^1 is caused to turn, as before, by the pin r pressing the end of the curved slot. The pawl p^1 engages a tooth of the gear G^1, and prevents any backward motion of the same which might tend to take place as the pin r is forced up the incline u, as above mentioned.

The gear G^1, by the means above mentioned, is caused to move on its axis intermittently, the periods of motion occurring when the wire is brought into position to be twisted together upon each successive sheaf.

The twister I design to use is shown in plan at t, Fig. 6, being a series of hooks, and in elevation in Fig. 7 and other figures. It is divided into an upper and lower portion by the annular groove a^1, in which groove is inserted the pointed annular guard e^2, Figs. 6 and 12. Fig. 12 shows this guard e^2 unobstructed and partially covering the lower portion of the twister t, the upper portion of the twister being shown in section. The twister t is attached to the upper end of a vertical shaft, at the lower end of which is fastened the pinion p, as shown in Figs. 5 and 9, the said pinion p being intermittently revolved by the gear G^1, as above described.

The pawl p^2, as shown in Fig. 6, and in the general view, Fig. 2, is attached to the fixed bar n^2, against which pawl a tooth of the gear G^1 is brought just before the twister-head H reaches the limit of its throw toward the driving-wheel W. This turns the gear G^1 slightly upon its axis, just sufficient to give the pinion p and twister about one-half a revolution, the use of which will presently be seen.

A^1, Fig. 9, shows the lower jaw j^1 open, and, as it is closed by means hereinafter described, it confines the end of the wire, which lies across it and within the opening against the loop l^4, as indicated by the letter h. The wire thus held is fully shown at w, in Fig. 7, the upper end extending upward to the point of the binder-arm, as shown in the general view, Fig. 3. The relative position of the wire w, as thus held, with reference to the twister t and guard e^2, will be more fully understood by looking at Fig. 6, which shows the wire w as being in a convenient position to be swept by the hooks of the twister into the annular space between the stem of the twister and the inner concentric circumference of the guard e^2. Now, as the gear G^1, Fig. 6, is brought in contact with the pawl p^2, and the twister is thereby turned one-half way around, as above described, the wire w is caused to take the position opposite, as represented at w^1. This new position of the wire w^1 is clearly shown in elevation in Fig. 7, in which position it is held until the point of the binder-arm brings the wire around the gavel and down alongside of the twister, as shown at w^2, Fig. 8. At this point the upper jaw j closes and gathers the said wire w^2 in with the wire w^1 over the center of the twister, as shown by the position w^3, the two wires w^1 and w^3 being now tightly clamped between the jaw j and centering-plate e^6, as shown in Fig. 10. As soon as the upper jaw clamps the wires against the centering-plate e^6 the under jaw j^1 releases the end of the wire it has firmly held up to this time. The twister now being revolved by the gear G^1, as above described, the two wires w^1 and w^3 are sheared off at the under side of the twister at v, Figs. 8 and 11, and the ends twisted firmly together below the point where the upper jaw j grasps the same.

It will be observed, by referring to Fig. 8, that when the twister commences to revolve, and has made a half-revolution, the wires w^3 and w^1 will have changed places—that is, the former will occupy the position represented by w^1, drawn across the open lower jaw j^1 and into the opening h of the same, as shown at w^3 in the sub-figure A^1, Fig. 9. After the wire w^3 is severed at the cutting-point v, and before the binder-arm commences to rise, the lower jaw j^1 will slide shut and seize the said wire near its end, and, when the binder-arm rises, the wire w^3 becomes in its turn the wire w, as originally described in Fig. 7. When the lower jaw closes on the wire, as just described, the upper jaw opens and releases the sheaf just bound, which falls from the machine.

The upper jaw j, Figs. 2 and 10, is pivoted to and between the upper and lower sections of the centering-plate e^6, Fig. 9, at the point a, and the jaw-rod l is jointed to the said jaw at a^2. This arrangement of the jaw, together with the hooked form of the same, causes it to act favorably in bringing the wire held by the binder-arm w^2, Fig. 8, into the center of the centering-plate and between the hooks of the twister.

The lever n, Fig. 3, connecting the ends of the jaw-rods, I design to operate substantially as in my patent above referred to.

I form an offset in the binder-arm near its point, as shown in Fig. 8, the offset being away from the twister, so that there will be space back of the tightly-drawn wire w^2 for the point of the jaw j to reach in, in the act of gathering the said wire into the centering-plate, as above described.

It will be observed, on reference to Figs. 1 and 8, that the offset in the binding-arm does not extend entirely across the same, but that it is limited to the inside corner, and that the outer edge or corner of the arm extends down in a straight line past the offset, serving as a guard to prevent the pressure of the grain from forcing the wire back into the offset out of the reach of the twisting devices.

In Fig. 12 will be seen the spring-guard s^5, fastened to a distant part of the metal plate forming the guard e^2, and reaching across the annular space to a point on or near the stem or shaft of the twister. As the wires press against the guard while being carried around by the twister, it springs out to the point of the guard e^2, thus closing the opening at which the wires entered, and preventing their escape.

The annular space between the guard-plate e^2 and the shaft of the twister is sufficiently large to allow the wire to move freely, and at the same time the guard-plate keeps the ends of the wire from spreading or turning out horizontally while being carried around, as they are inclined to do.

The wire for binding the grain is wound upon the reel E, Figs. 1 and 3, and passes thence through the end of the guide-arm F, which is provided with a roller, and point of the binder-arm, down to the lower jaw j^1.

I is a cord-pulley, forming part of the reel around which the friction or tension cord K passes, which cord is drawn tight, having its ends fastened in the clamping-block M. One end of the cord K is made fast in the hole u^1 of the said block, and the other, after being carried around the pulley and drawn to any degree of tension, is passed through the hole u^2 under the clamp-screw s^3, by which it is made fast. The friction between the pulley I and cord K serves as a tension for the wire.

The guide bar or arm F, (best shown in Fig. 3,) is fastened to the bracket g, and swings laterally with the same, which keeps the end of the wire-guide at all times nearly over the point of the binder-arm. This relieves the cramping and friction of the wire as it is drawn through the opening in the point of the binder-arm that attends the guiding of the same through a relatively-fixed guide, as heretofore practiced.

The guide-arm F is designed to be made stiff, so that it will not yield downward as the wire is drawn from the reel by the descent of the binding-arm; but the reel is purposely mounted upon a yielding spring-standard, o^2, by which any unusual tension upon the wire may be relieved. For instance, when the reel is wound full, it is easily revolved by the wire drawing upon the outer circumference of the coil, and the tension of the wire is only maintained by the friction between the cord K and the pulley I; and when the reel is nearly exhausted the wire draws from a point near the axis of the same, in which case the friction upon I has the advantage of leverage, which would cause too much tension on the wire were it not that the spring-standard O^2 yields forward in obedience to this tension, and relieves the friction on I above mentioned. By this arrangement the tension upon the binding-wire is equalized, and the same may be made greater or less by regulating the strain upon the cord K, as above described.

C^2, Figs. 1, 2, and 3, is a compressing cord or cable, one end of which is detachably connected to the compressor attachment O fixed to the binder-arm, near its point. From the attachment O the said cord extends down to the twister-head H, over the roller d^1, and under the roller d^2, Figs. 1 and 2 and Fig. 5, thence back over the roller d^3, and downward around the tension or friction drum N, which is preferably attached to the driving-shaft J.

The said drum N is so constructed that it revolves with the shaft J, or in the opposite direction when the upward movement of the binder-arm draws upon the compressing-cord C^2.

The interior construction of the drum N will be understood from observing the enlarged sectional view, Fig. 13, Sheet 1. b^2 is a circular metal disk, made fast to the shaft J. The drum b^3 fits freely upon the shaft at t^1, and its interior diameter is made slightly greater than the diameter of the disk b^2. Within the drum are confined several friction-disks, c^2, of leather, wood, rubber, or other suitable material, and by adjusting the pressure on the same by turning the jam-nuts f^1 any desirable amount of tension or strain may be put upon the compressing-cord C^2.

The cord C^2 is provided with a ball or enlargement, g', at its end, which is lodged in the cavity h^1 of the compressor attachment O, as shown in the enlarged Fig. 15. The tortuous opening in the attachment O is of such a nature that the said ball is released only at a critical moment in the movement of the binder-arm, as will presently be explained.

Fig. 16 is a front elevation of the attachment O, and Fig. 18 a cross-section upon the line x^2 of Fig. 15, showing the ball g' lodged in place. If we conceive the binder-arm with this attachment O as occupying the position shown in Fig. 1, and moving against the grain in the receptacle, as indicated by the arrow y^5, the compressor-cord C^2 will be pressed back by the grain in a curved form, as shown. As the binder-arm moves on, the said cord will assume sharper curves, and its various positions with reference to the attachment O will be represented by the numerous dotted positions shown in Fig. 16, O^5 being its relative position when the binder-arm is at its lowest point and pulling downward on the same. The narrowness of the space l^1 in the attachment O back of the tongue i, Fig. 18, prevents the ball g' from being drawn through at any time, and the cord C^2 is drawn around the tongue i at every position until it slips over the top of the same, which occurs when near the position represented at O^4, Figs. 15 and 16. When the cord slips off the end of the tongue i it assumes the position represented at O^5, but the ball is not yet released, being temporarily caught in the concave ledge m', Fig. 17, forming the upper wall of the cavity h^1. The ball is held in this position with the cord drawn tightly around the gavel during the period the binder-arm is at rest at its lowest point, as heretofore described. When the twisting has been effected and the binder-arm commences to rise, the tension on the cord ceases, and the ball thus released drops upon the lower inclined wall r^2 of the cavity h^1, and escapes, releasing the bound sheaf.

Just before the ball g' escapes from the cavity h^1, as above described, the cord C^2 is again caught within the meshes of the attachment O at a point some distance away from the ball, preparatory to its becoming a compressor for the next gavel. It is accomplished as follows: Overlapping and outside of the tongue i is the thin, broad, and slightly-curved guard G^2, pointing downward. When the binder-arm moves downward through the twister-head H, the point of the same passes immediately back of that portion of the cord C^2 that is drawn taut from the roller d^1; across the head H, and around the gavel S′, as shown in Fig. 19. As the said arm continues downward and reaches its lowest point the cord C^2 is brought to the relative position shown at Fig. 20, inside of the guard G^2, and some distance above the point of the tongue i. Now, as the arm rises the ball drops out, as above described, and the cord easily slips down back of the tongue i, as will be readily understood by observing Fig. 20, and the position of the cord represented at O^4, Fig. 15.

As soon as the ball is disengaged, relieving the tension on the compressor-cord, the friction-drum N, Fig. 1, which had its motion reversed, unreeling the cord while the binder-arm encircles the gavel, and which was held relatively at rest while the binder-arm rested, commences to turn with its shaft, and winds in the surplus compressor-cord in the direction shown by the arrow y^6, Fig. 20. This brings the ball g^1 back to the cavity h^1 in the attachment O, from which it had just escaped, as above described, the position of the compressor-cord and ball becoming again as shown in Figs. 15, 16, and 18. This operation of the ball and compressor-cord is repeated with the binding and releasing of each successive sheaf.

The compressor attachment upon the binder-arm, as shown in Figs. 1 and 3, is differently constructed from the one just described, being substantially the same inverted. It operates by releasing the ball in a manner similar, but contains no tongue i, and catches the compressor-cord in back of the guard G^2, when it moves upward instead of downward. As the binder-arm moves downward into the twister-head H, the point of the same presses the cord into the hook i^1, which holds the same steady, and in a position convenient to pass in back of the guard G^2 as the binder-arm rises, said guard pointing upward.

The grain, as it is brought up by the elevators, drops onto the receptacle B^1 and under the strips D, Figs. 1 and 3, the latter forming a wind-guard, which prevents the grain from being blown off and scattered by the wind. The strips D are hung to the shaft U, which is mounted on projecting hangers fastened to the adjustable receptacle B', and located some distance above the elevator, said strips resting by their weight upon the grain as it lies in position to be bound.

The upper surface of the twister-head H stands above the surface of the horizontal portion of the receptacle B^1, Figs. 1 and 3, upon which the sheaf while being bound is carried along over the said portion of the receptacle, comparatively free from and without dragging upon the same.

Fig. 4 shows a front elevation on a reduced scale of a portion of the machine, showing the pickers or feathering-fingers e^3 and e^4. They are pivoted upon the pins v^1 and v^2, respectively, of the revolving disks n^3 and n^4, fitted upon the roller-shafts that carry the elevator-belts B^2, and are provided with slots that slide upon the studs s^6. The lower arm serves to clear the point at which it is located from straw that is inclined to lodge and tangle, and to start the straw on up the elevator. The upper one, e^4, serves to pack the butts of the grain as it accumulates in the receptacle, which butts, from their comparative lightness, tend to sprawl and lie up loose.

The binding mechanism is arranged to slide forward and backward, in order to apply the wire to the middle of grain of different lengths, and will be connected with suitable devices for effecting its adjustment.

P^1 is a counter-weight, supported upon the lever L^2, which is pivoted to the timber Q^1, Fig. 3. The bottom end of the lever is connected to the stud h^2, and by means of this arrangement the binding mechanism and weight P^1 move in opposite directions when the former is being shifted, keeping the aggregate weight of both substantially balanced upon the driving-wheel.

I do not desire to claim, broadly, in the present patent the automatic balancing of the machine as the binding mechanism is adjusted forward and backward, as means to that end are provided in my patent of October 26, 1875.

In that patent, however, provision was made more especially for shifting the driver's seat and reel or other part of the machine as a balance. The present invention is designed to overcome objections incident to the shifting of said parts, and consists in the use of a counter-weight for the special purpose of balancing the binding mechanism.

In Fig. 2 the driving-wheel W is shown in section. The flange s^3 and the hexagon-shaped hub a^3 form one piece, and to the said flange s^3 is fastened the gear G^3, which turns with the driving-wheel. The flange s^4 is provided with a hexagon-shaped eye, which fits and may slide upon the hub a^3, the two flanges being tied together by the tie-bolts j^2 j^3, &c.

The spokes of the driving-wheel being placed obliquely between the felly and the flanges, as the latter are brought toward each other with the tie-bolts the spokes will be forced out against the felly, tightening the same within the tire. By this arrangement the tire may be tightened within a few minutes at any time, and the labor upon the wheel is distributed equally upon both sets of spokes, and the gear G^3 is not drawn sidewise or out of line with the pinion P^2, for the flange s^3 is stationary, and only the flange s^4 moves when the tie-bolts are drawn up.

Fig. 21 shows the manner of hanging the frame upon the driving-wheel W. The view is taken in the same direction as that of the adjacent figure, 3, drawn to a reduced scale, with everything on the side of the driving-wheel toward the observer removed.

Q^2 is a timber mating with Q^1, lying beyond the driving-wheel, the position of which timbers and driving-wheel between being shown in Fig. 1.

H^2 H^3 are hangers bolted to the opposing faces of the said timbers, each hanger being provided with a circular groove or slot, as shown at K^2, Fig. 21, made concentric with the shaft D^2. Within these slots, which stand facing each other, the ends of the shaft t^2, that passes through the hub a^3 of the driving-wheel, rest. The shaft t^2 does not revolve, the hub of the driving-wheel being loosely fitted to turn upon the same.

Fig. 1, and the full lines of Fig. 21, show the frame dropped to its lowest position, the shaft t^2 of the wheel W resting at the upper end of the slots k^2. By raising the frame as shown by dotted lines in Fig. 21, and securing the ends of the shaft in the slots k^2 by some suitable fastening, the height of the cut of the sickle-bar may be regulated at pleasure. The concentricity of the slots k^2 and the shaft D^2 serve to keep the teeth of the gear G^3 and pinion P^2 in gear at all times.

The slack of the chain c^1, Fig. 1, is designed to be taken up by adjusting the roller r^3 up or down along the slot e^5, as shown.

By means of the clutch P^3, Fig. 2, the whole moving portion of the binding mechanism may be thrown out of gear at pleasure. I also employ the clutch P^4, Fig. 3, on the pinion-shaft J, by which the binding mechanism may be stopped at any time. This clutch is designed to be operated by the lever E^2, Figs. 1 and 2, a connecting-rod from which is to extend to within reach of the driver.

It may be desirable to employ a long chain, as shown by the continuous heavy dotted line N^2, to drive the rollers, &c., around which it passes, all directly from the driving-chain wheel W^1, employing an idler, as shown at W^2, located so as to keep the chain sufficiently around the wheel W^1.

The lever L, Fig. 3, may be so constructed as to operate directly upon the extended rear end of the binder-arm, as shown in the modification, Fig. 22.

As shown, the rear end of the lever L is extended and bent upward, having a pin or roller, p^3, projecting from its side near the end, which plays in the sinuous slot d^4 of the binder-arm. The slot d^4 must be so shaped that the traversing of the pin or roller p^3 along the same, as the gear G is revolved, will give to the binder-arm the desired motion. For instance, when the said gear revolves so as to carry the pin p^3 up to the point p^4 in the dotted arc, it will have reached the point l^2 in the slot d^4, and the binder-arm will be at its lowest position, as shown in dotted lines. The remainder of the slot l^2 to l^3 will occupy the position in dotted lines from p^4 to p^5, which coincides with the dotted arc centered at c^5, and consequently there will be no vertical motion of the binder-arm while the pin p^3 traverses the same. This gives the binder-arm the period of rest necessary, as above described.

The movement of an arm vertically and laterally around an axis by the direct action of a crank, I do not claim *per se*, being aware that a similar arrangement has been hitherto employed in connection with harvester-rakes.

Instead of the long pinion P, I may use a short pinion to drive the gear G, fitted to slide upon the shaft J, said shaft being provided with a spline of sufficient length to accommodate the longitudinal movement of the pinion, which is provided with a groove or keyway, fitting the spline.

Flanges cast at the ends of the teeth of the pinion would prevent the gear moving away from it as the same was shifted.

A spoked wheel might be used instead of the slotted plate-gear G^1, the spokes being properly beveled, so the pin r of the bar n would slide up over them as the bar n moved back. Also, instead of the teeth on the gear G^1 and pinion p, a chain might be run on the periphery of the two, by which the pinion would be driven.

Having thus described my invention, what I claim is—

1. The combination of the binding-arm B and actuating-arm L, both extended in rear of their pivots, with a connecting-bar, R, attached to their rear ends, substantially as shown, whereby an unobstructed space is left for the grain under the entire length of the binding-arm.

2. The vertical rock-shaft, provided with the twister-carrying arm, and with the binder-arm mounted on a horizontal pivot, in combination with operating mechanism, substantially such as shown, arranged to rock the shaft and to hold the binder-arm down, and prevent a vertical motion of the same during its movement backward with the grain.

3. The combination, in a grain-binder, of a slotted bracket or guide, g, a pivoted slotted binder-arm, and an actuating pin or roller, e, arranged to play in the slots of said parts, substantially as shown and described.

4. The combination, in a grain-binder, of the slotted pivoted binder-arm, the slotted bracket g, the connecting-rod R, with pin e, and the actuating-lever L, substantially as shown.

5. The vertical rock-shaft, having the binder-arm and the wire-guiding arm F, both mounted thereon.

6. In a grain-binder, the combination of a reel, E, provided with a pulley, I, and mounted on a yielding support, o^2, a friction-band, K, and the binding-wire, substantially as shown, whereby the wire is caused to control its own tension.

7. The binder-arm B, wire-guide F, reel E, and tension devices, all arranged to vibrate horizontally about a common center, as shown.

8. In a grain-binder, a device, o, constructed substantially as shown and described, in combination with a binding-arm and a compressing-cord, substantially as shown, whereby the cord is caused to encircle the bundle, and released at its end to permit the escape of the same.

9. In a grain-binder, the combination, substantially as herein shown and described, of a compressing-cord, C^2, a device for taking the same up when released, and a movable device, o, substantially such as shown, arranged to carry the free end of the cord around the bundle, and at the proper time release said end and seize the cord at a point one side of the bundle, as described.

10. In a grain-binder, the combination of a compressor-cord, C^2, or its equivalent, a binder-arm or equivalent device for passing the same around the bundle, and a drum, N, driven by friction, arranged to take up said end when released or slackened, substantially as shown and described.

11. In a grain-binder, the combination of a vibrating binder-arm, a continuously-rotating take-up drum, N, driven by friction, and a compressing-cord, C^2, or its equivalent, having one end attached to the drum and the other connected with the binder-arm, substantially as shown.

12. In a grain-binder, the combination of the compressor-cord C^2 and the device o, arranged to operate as shown and described, with the hook i^1, as and for the purpose set forth.

13. In a grain-binder, the combination of a slotted table and a twister-head mounted on a carrier below the table, and extending upward through the slot and above the face of the table, as shown.

14. The pivoted wire-clamping jaw j, in combination with the centering-plate e^6, substantially as shown.

15. A track, T, and roller e^1, in combination with the swinging twister-carrier C, as and for the purpose set forth.

16. The combination of the twister and its actuating-wheel mounted on the vibrating carrier C, with mechanism, substantially such as shown, for imparting an intermittent motion to the actuating-wheel and twister.

17. A pawl, p^2, in combination with a fixed bar, n^2, or its equivalent, wheel G^1, and twister-carrier C, substantially as and for the purpose set forth.

18. In combination with the rolls n^3 and n^4, having the carrier-apron mounted thereon, the teeth e^3 and e^4, mounted on crank-pins on the outer ends of the rolls, outside of the edges of the apron, as and for the purpose described.

19. In a twisting mechanism for grain-binding machines, a guard-plate provided with an annular opening, having an inlet closed by an extension, e^2, and a spring-guard, s^5.

20. A twister, t, longitudinally furrowed, so as to form a series of hooks, the same being divided into an upper and lower portion by a groove, a^1, in combination with the annular guard e^2, substantially as and for the purpose set forth.

21. In a harvesting and binding machine, the combination of the shifting binding mechanism, the special counter-balance P^1 therefor, and intermediate connecting mechanism, substantially such as shown, whereby the binding mechanism and weight are moved in opposite directions and the proper balance of the machine maintained at all times.

22. In combination with a binding-arm, or similar device to carry it around the bundles of grain, a compressing-cord having one of its ends held by a frictional device in such man-

ner that it may yield when subjected to a given strain.

23. In a grain-binding machine, the combination of a binding or wire-carrying arm with a compressing-cord connected therewith, and held at one end by friction, so that it will act with a uniform unchanging pressure upon the grain.

24. In a grain-binding machine, a vertically-reciprocating and horizontally-vibrating binder-arm, having its end extended in rear of its horizontal axis, and operating devices connected with said extended end, whereby an unobstructed grain-space is afforded under the binder-arm, as shown.

JAMES F. GORDON.

Witnesses:
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