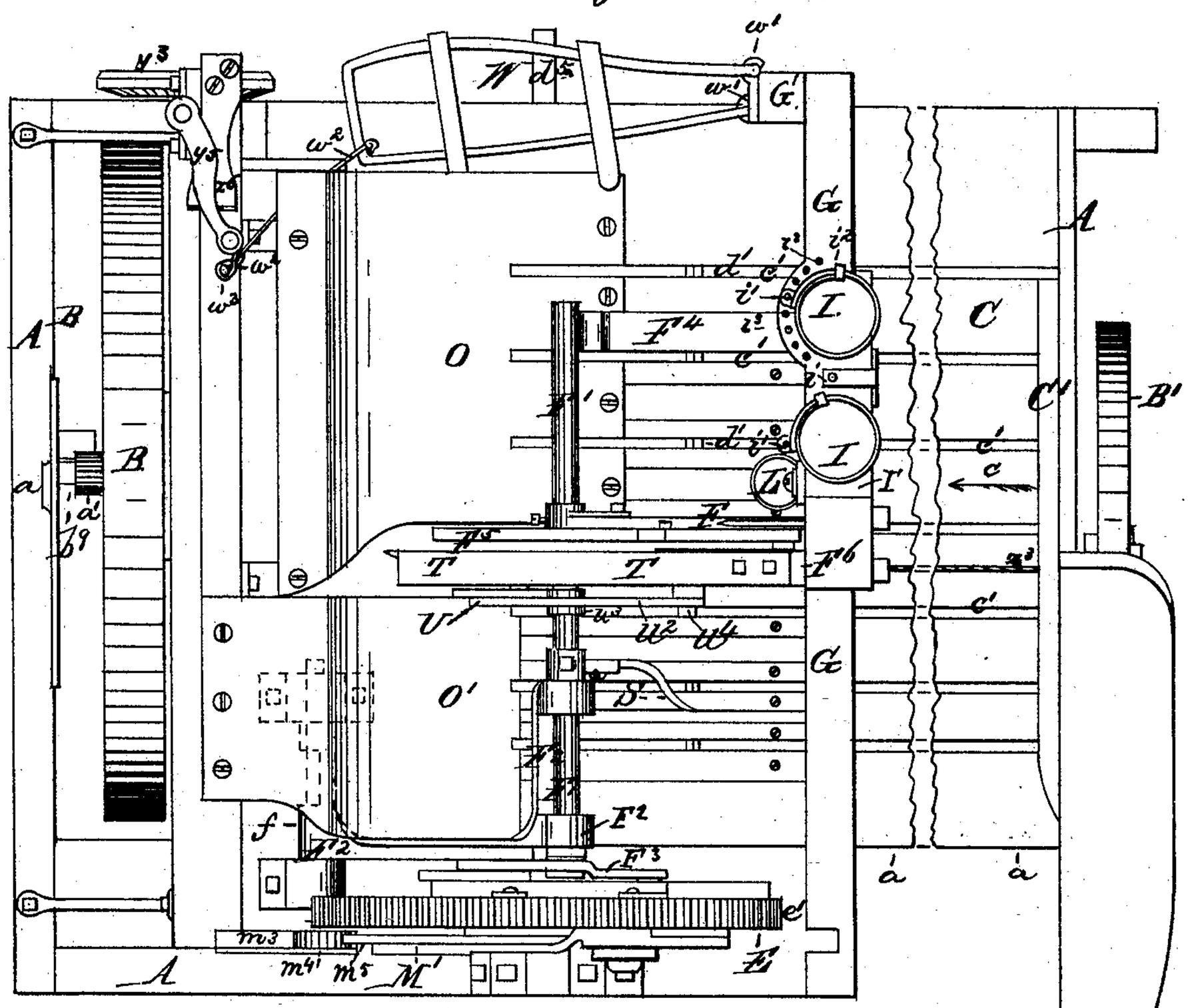
10 Sheets—Sheet 1.

W. W. BURSON.

BINDING REAPING MACHINE.

No. 603,827. Patented May 10, 1898.

Fig. 1.



Witnesses.
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C. L. Kennicky

10 Sheets—Sheet 2.

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Fig. 2a

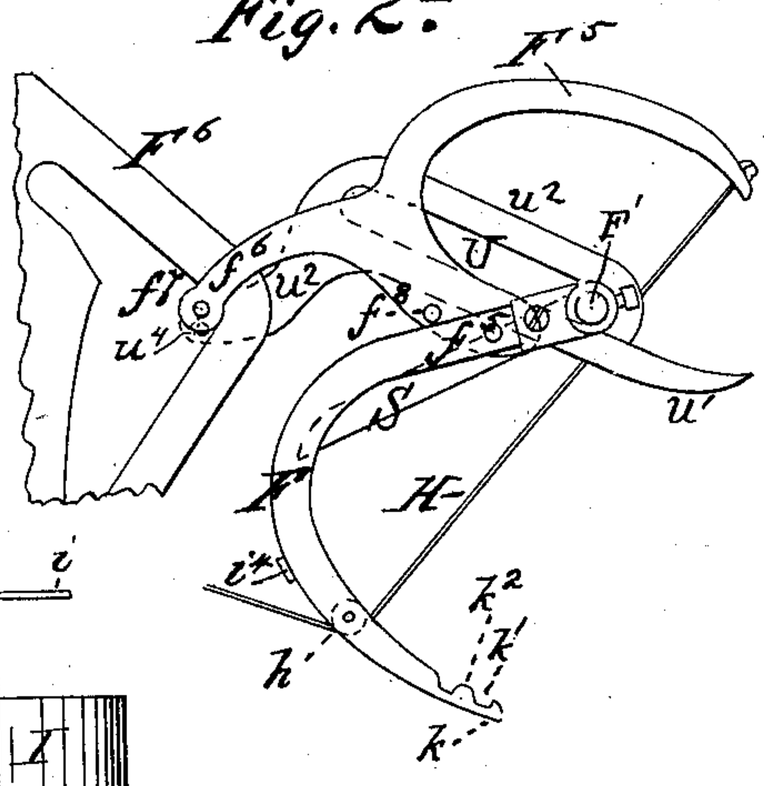


Fig 2b

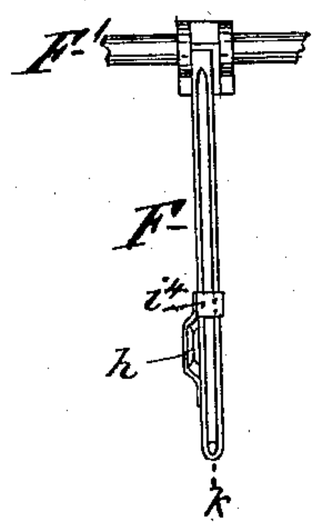
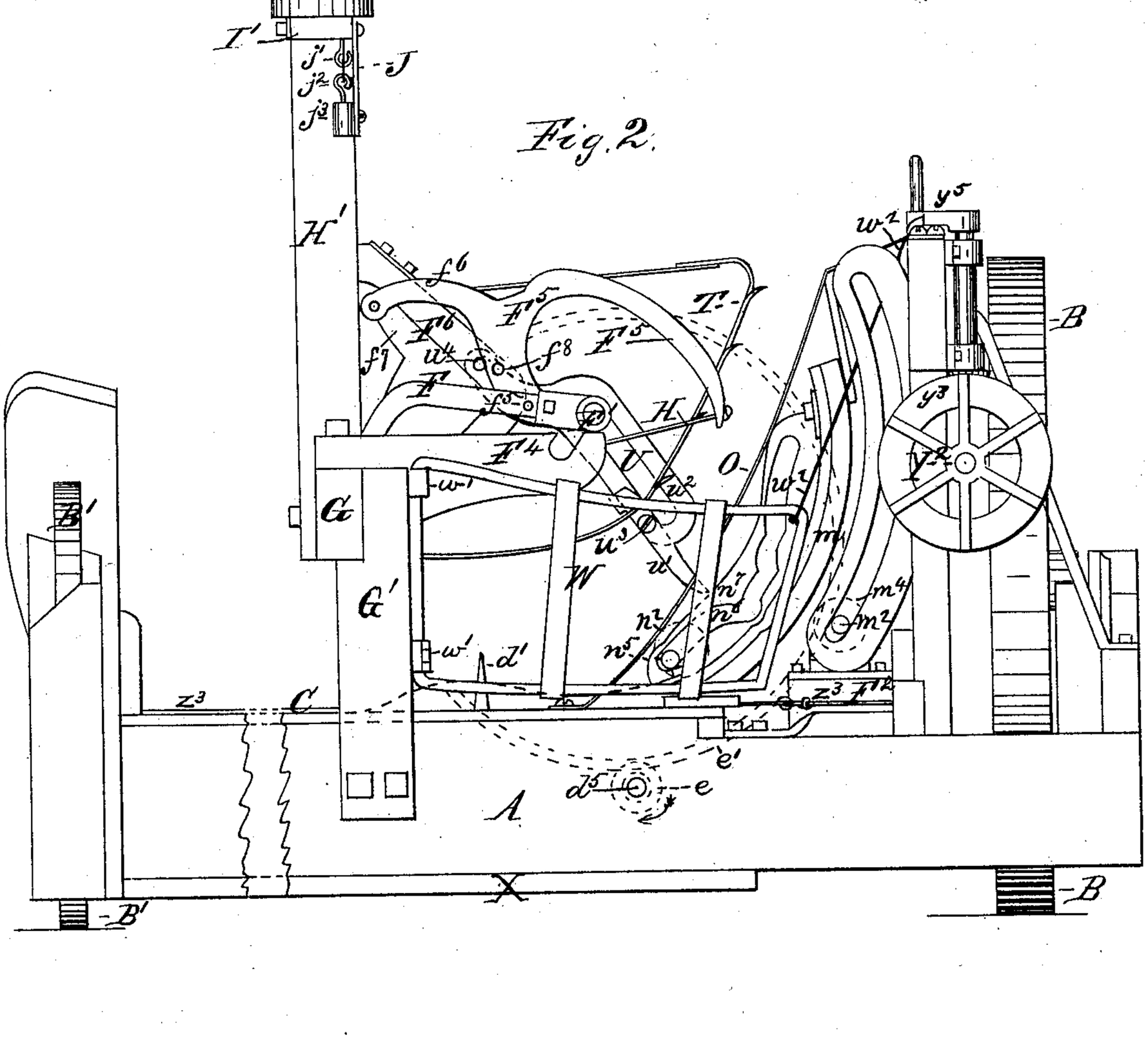


Fig. 2.



Witnesses.
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10 Sheets—Sheet 3.

W. W. BURSON.

BINDING REAPING MACHINE.

No. 603,827. Patented May 10, 1898.

Fig. 3a

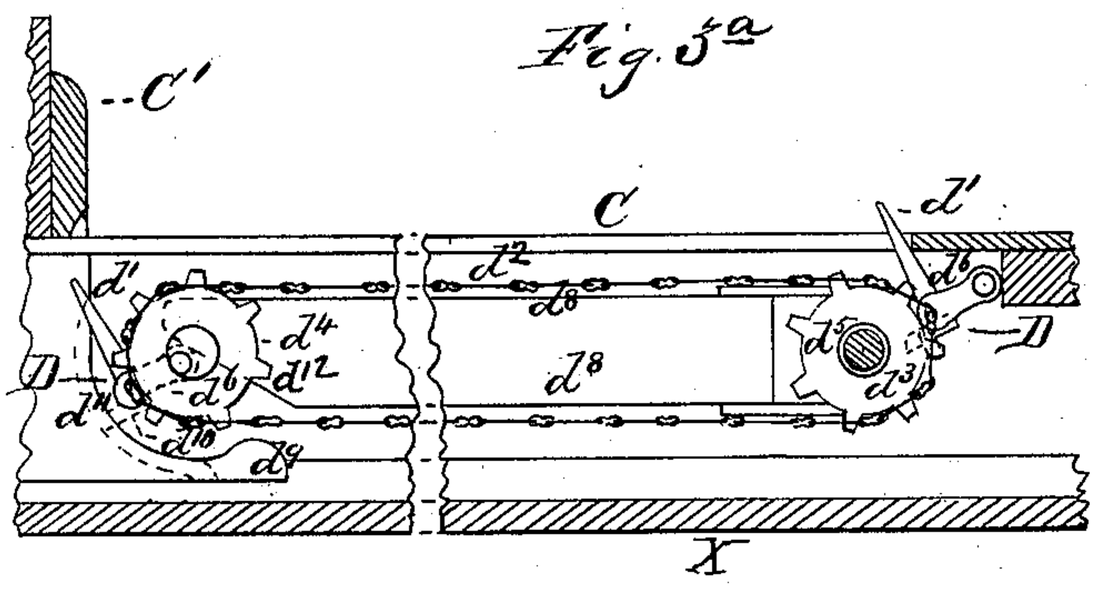


Fig. 3b

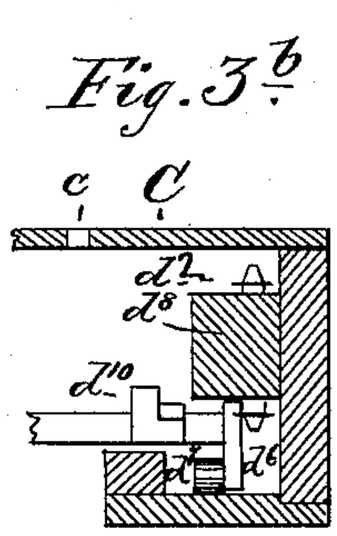
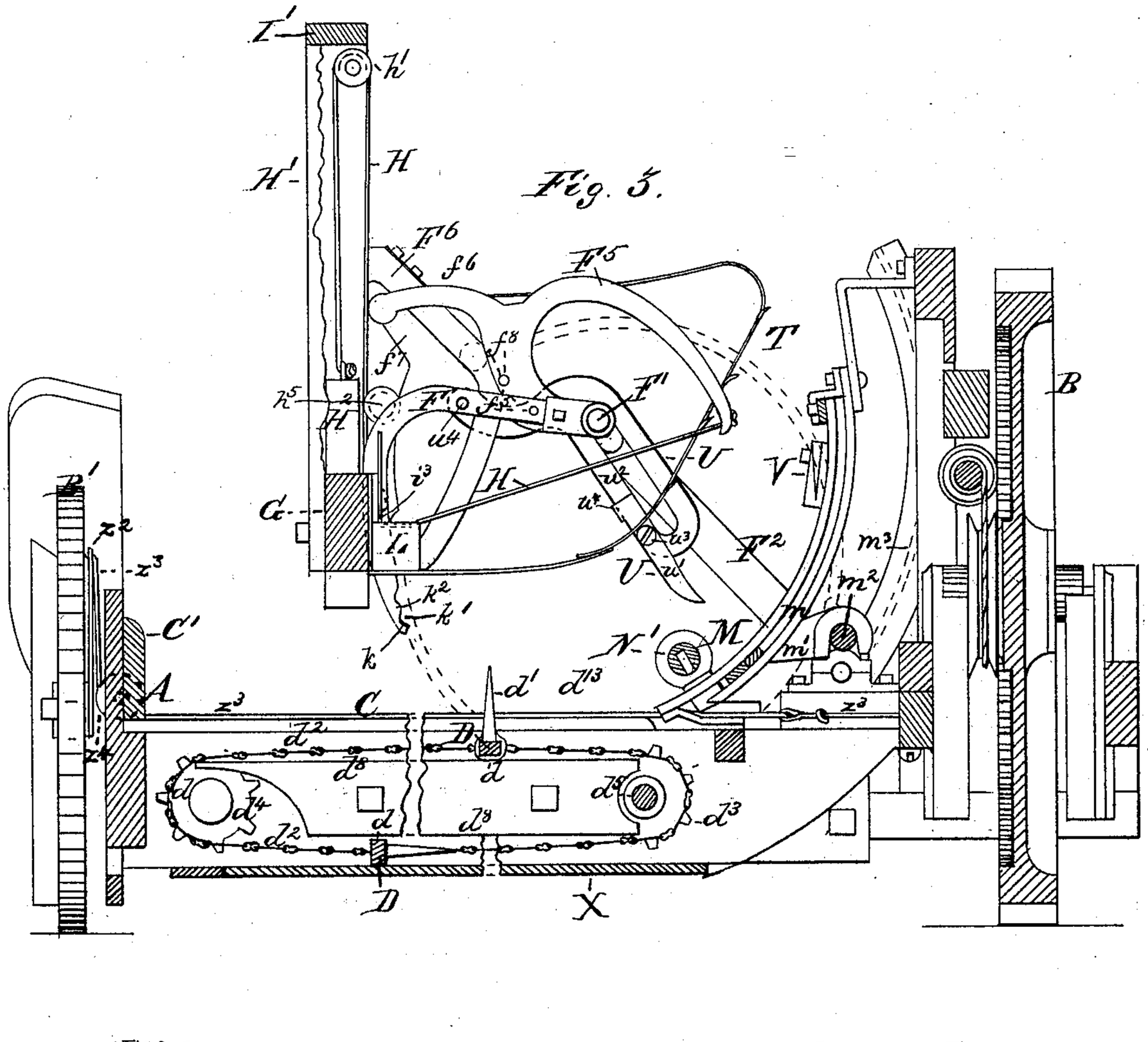


Fig. 5.



Witnesses
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10 Sheets—Sheet 4.

W. W. BURSON.

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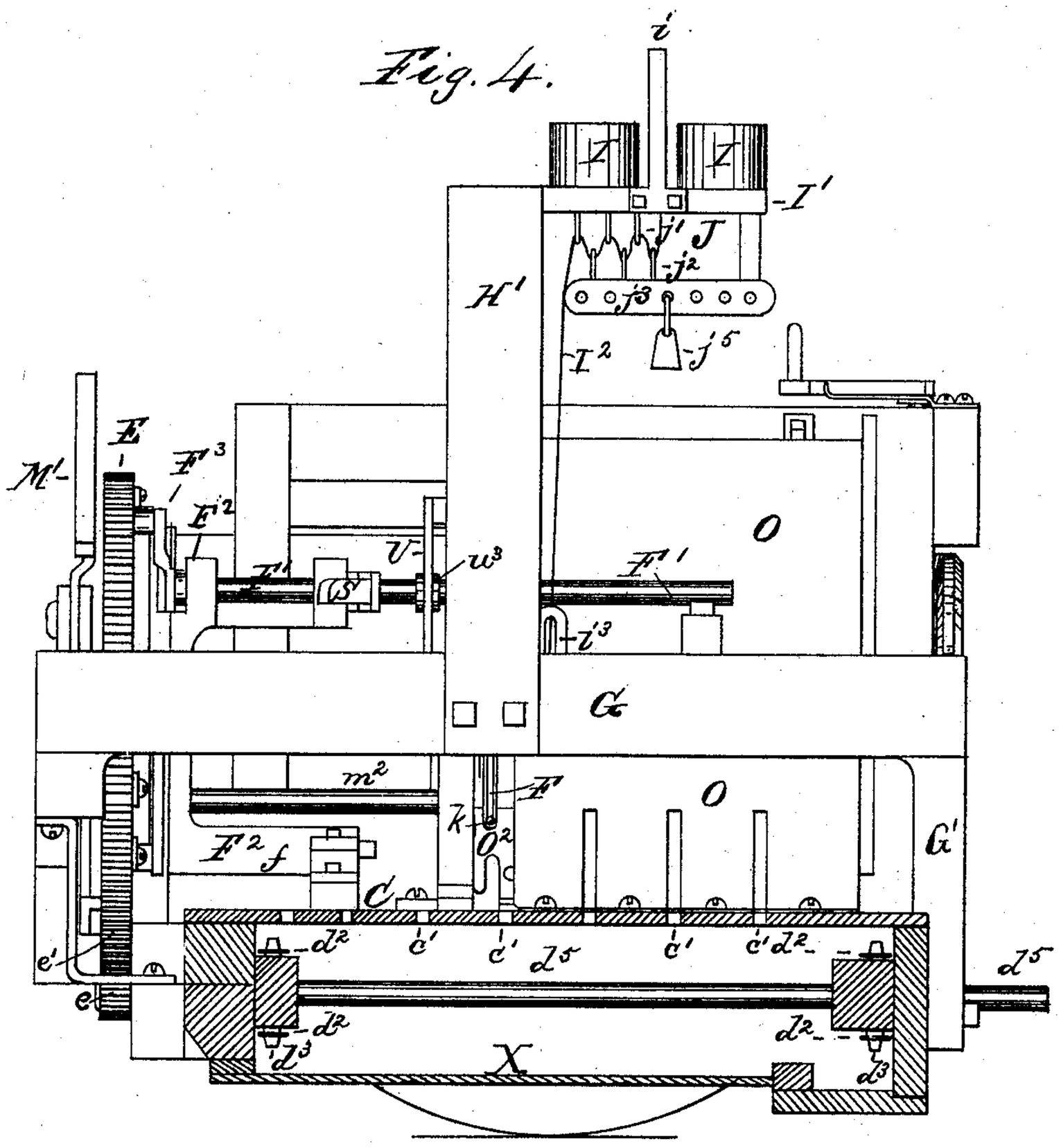
Fig. 4.



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W. W. BURSON.

BINDING REAPING MACHINE.

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Fig. 5.

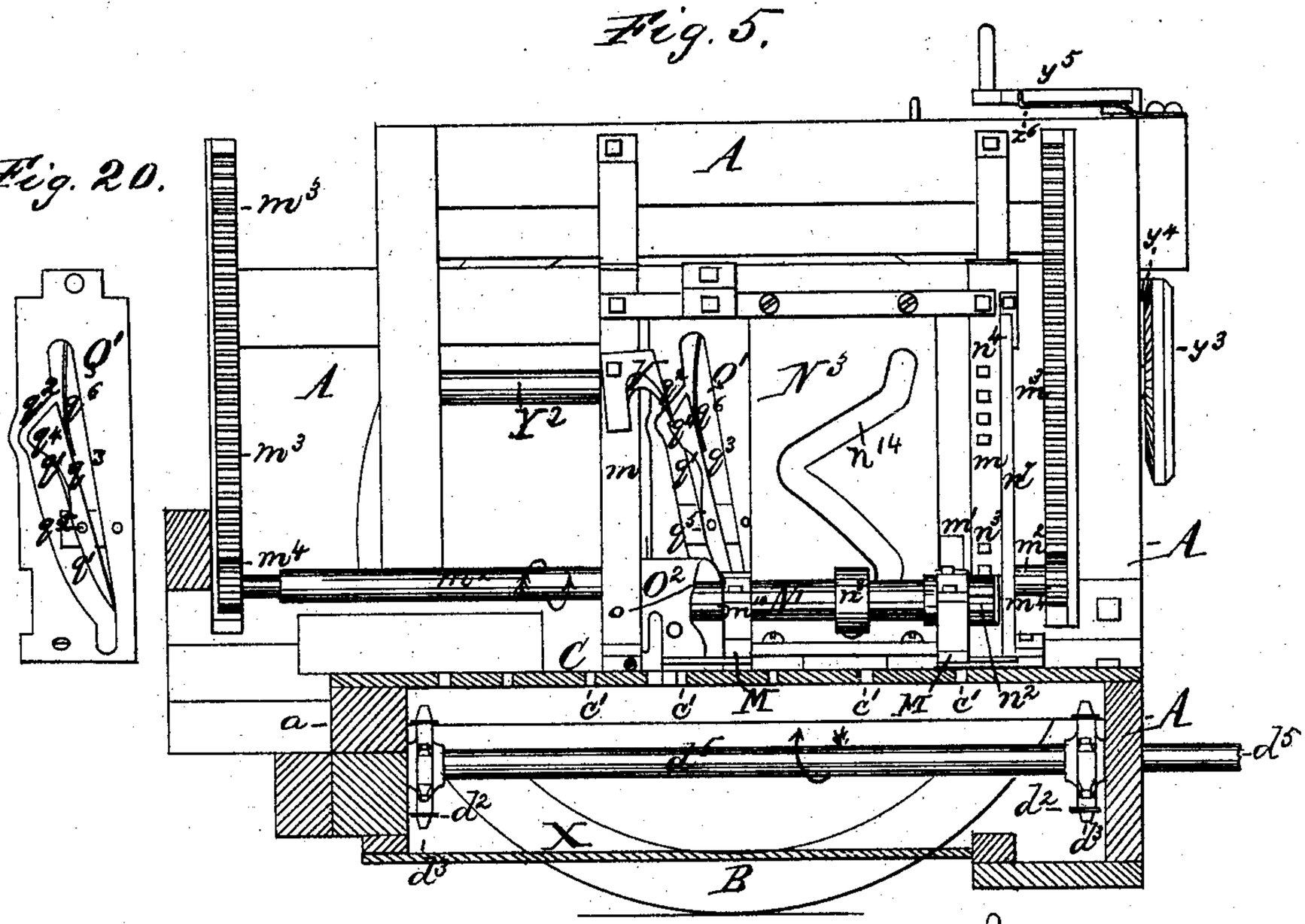


Fig. 20.

Fig. 6.

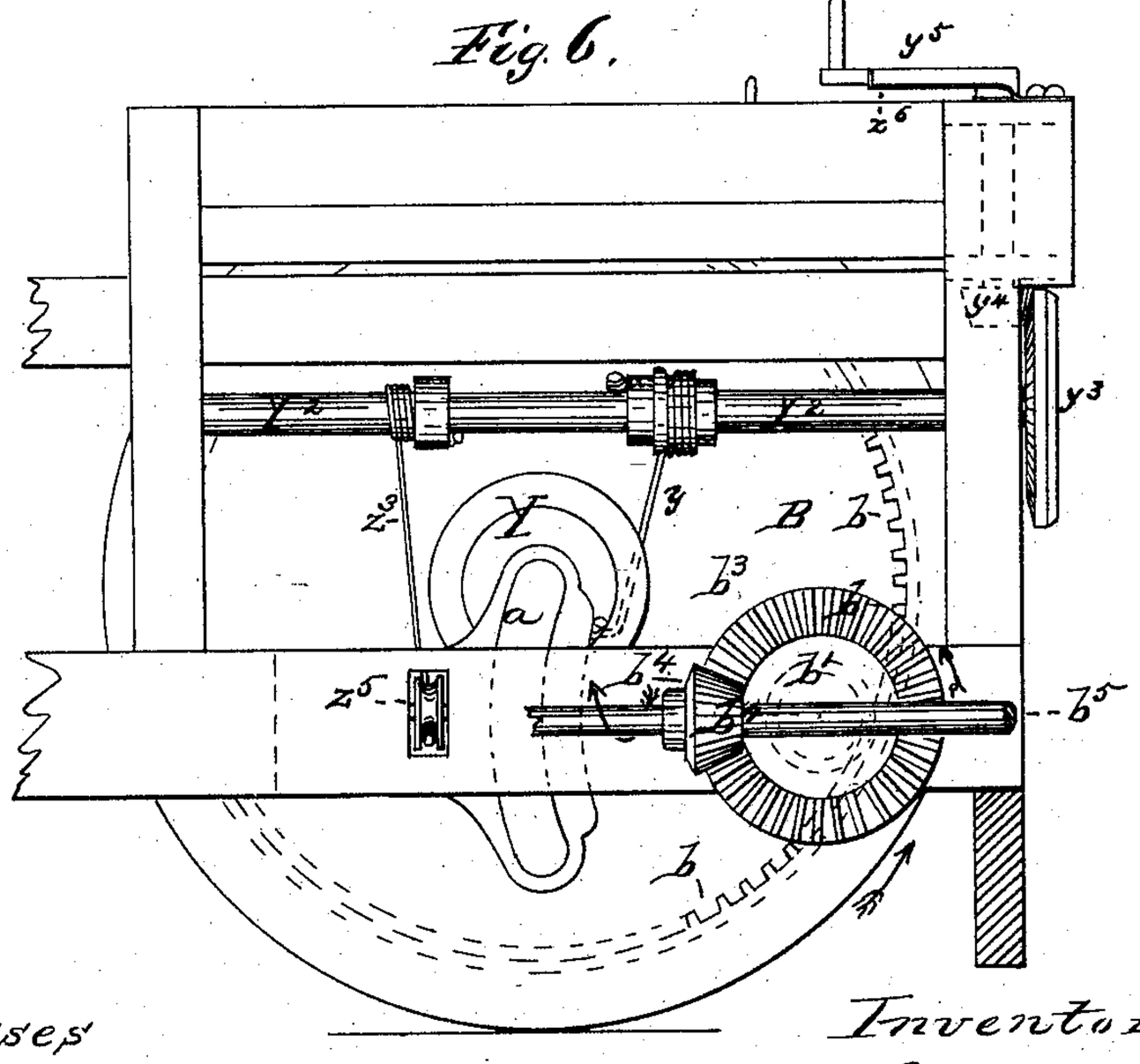
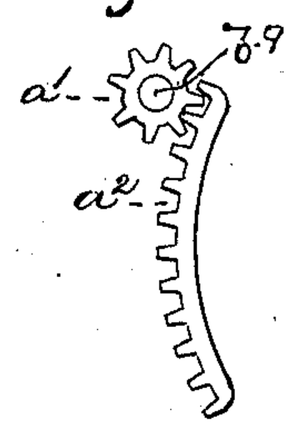


Fig. 6a.



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10 Sheets—Sheet 6.

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Fig. 24.

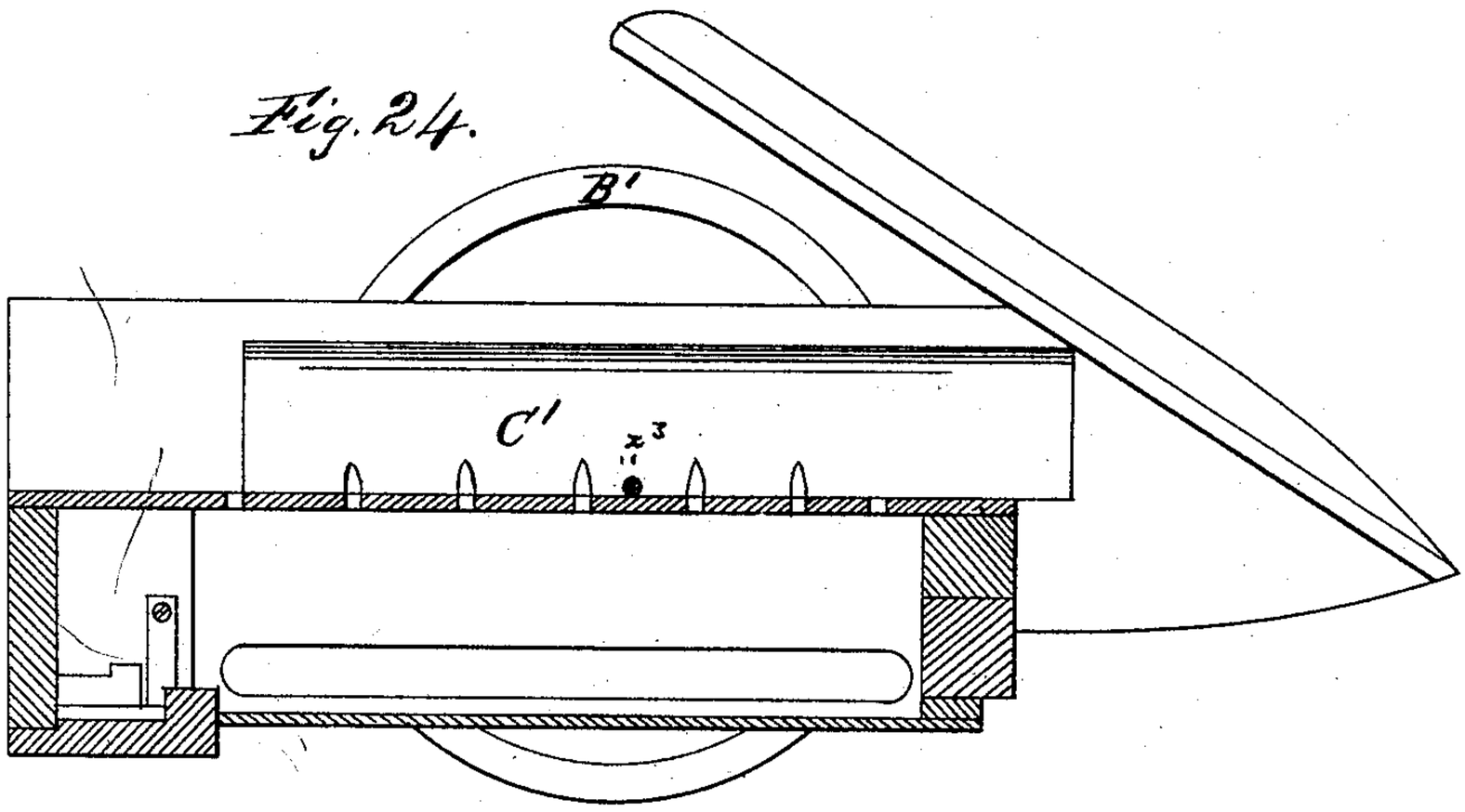
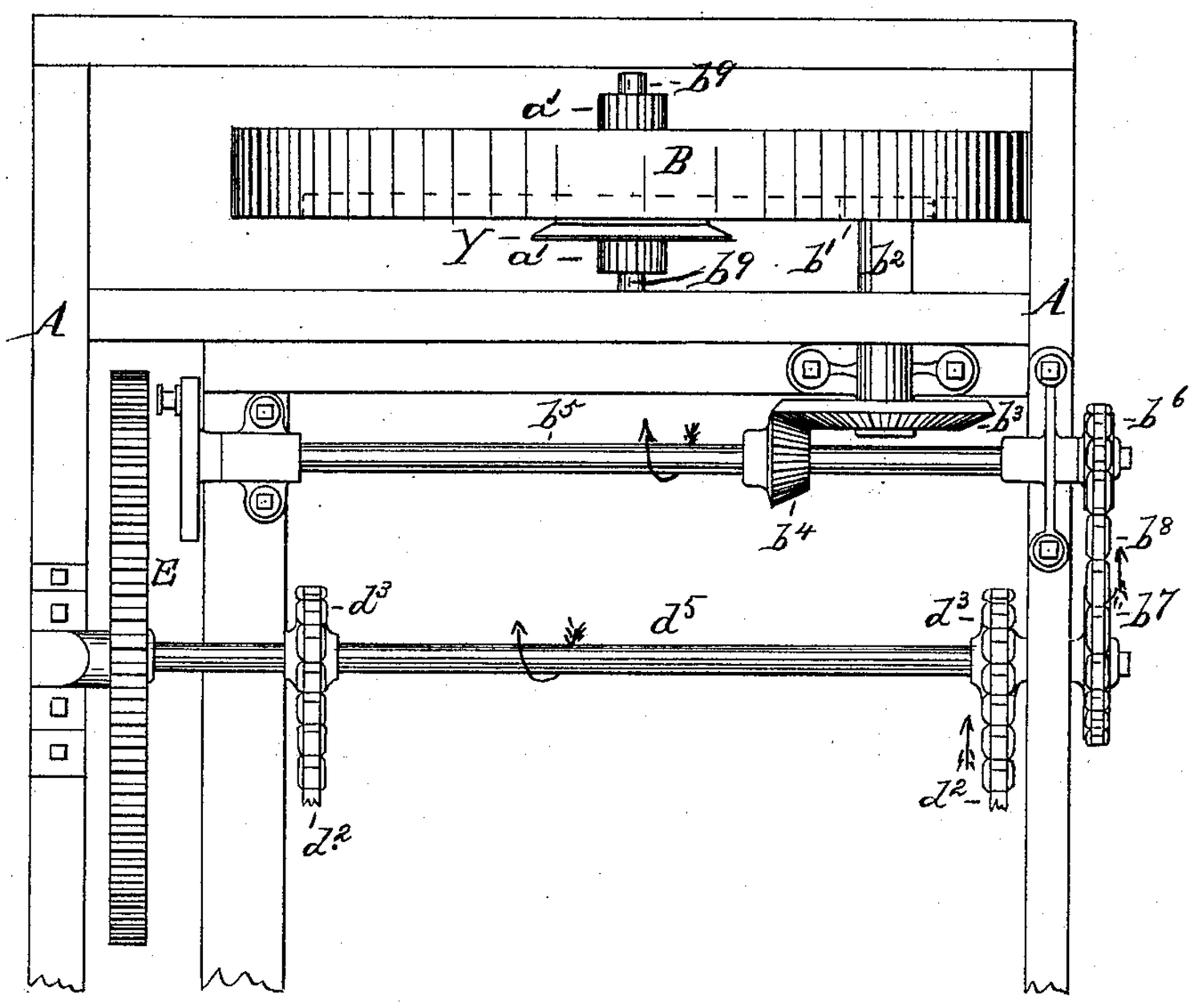


Fig. 7.



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10 Sheets—Sheet 7.

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Fig. 8a

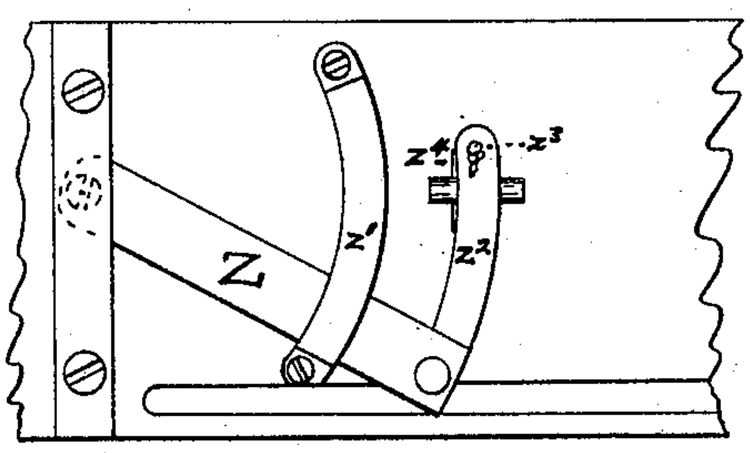
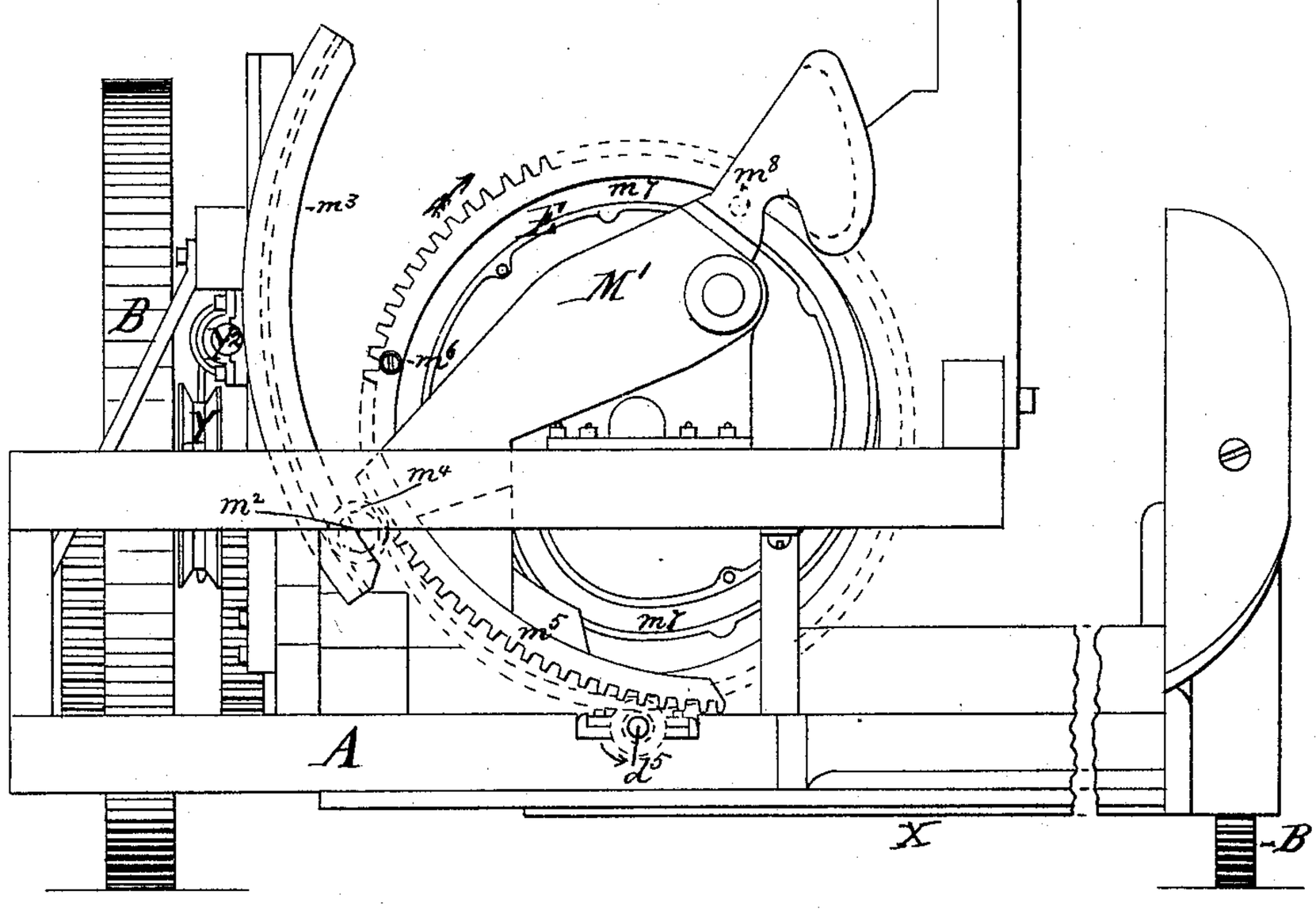


Fig. 8.



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BINDING REAPING MACHINE.

No. 603,827. Patented May 10, 1898.

Fig. 11.

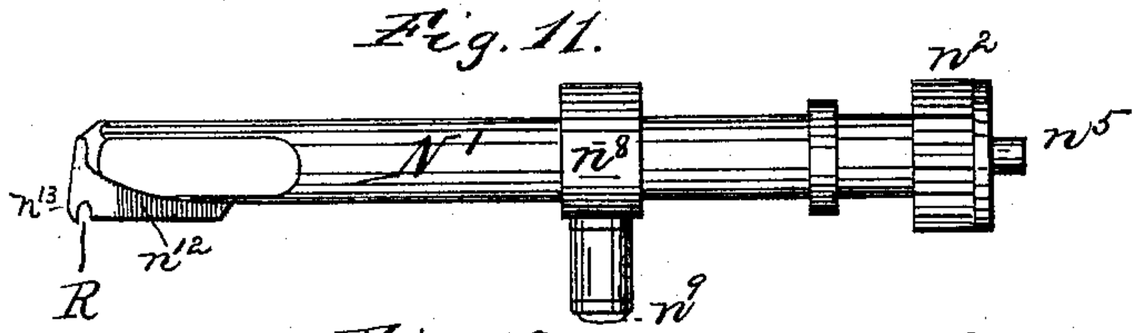


Fig. 12.

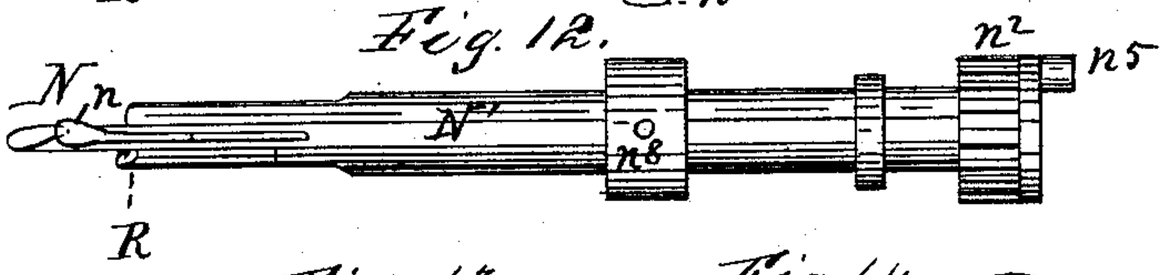


Fig. 13.

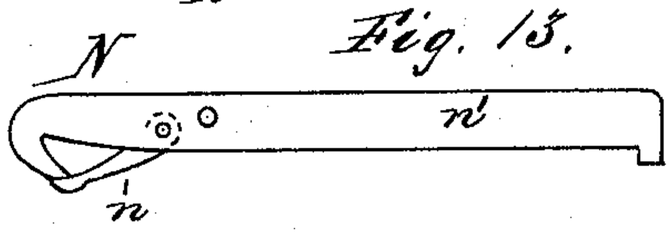


Fig. 14.

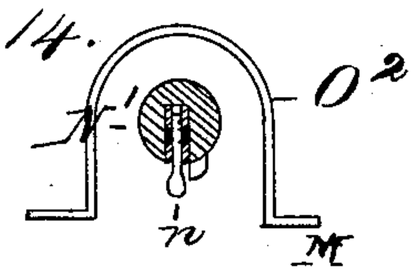


Fig. 9.

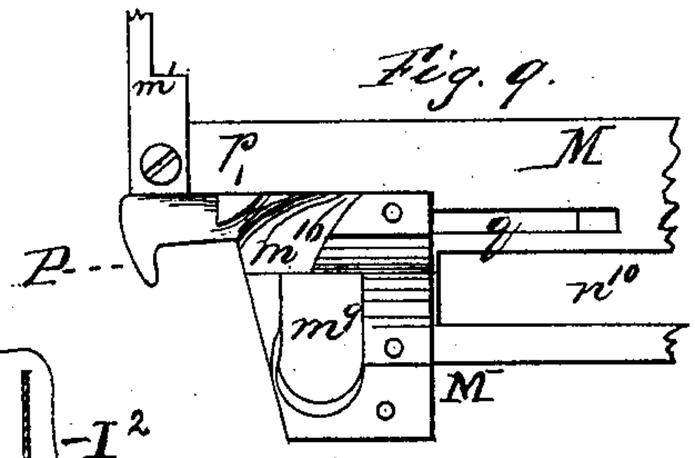


Fig. 10.

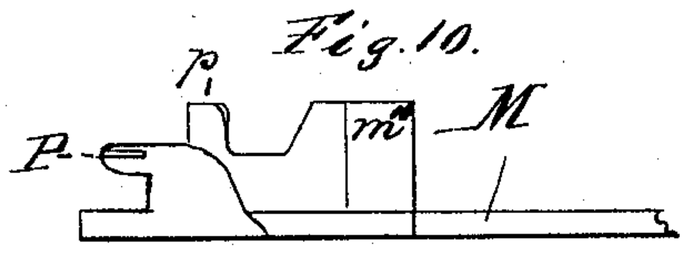


Fig. 25.

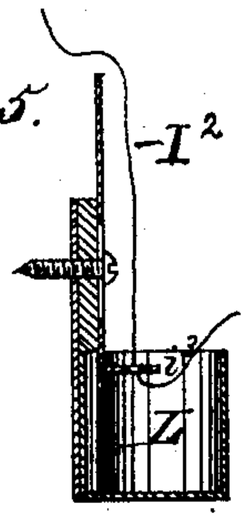


Fig. 17.

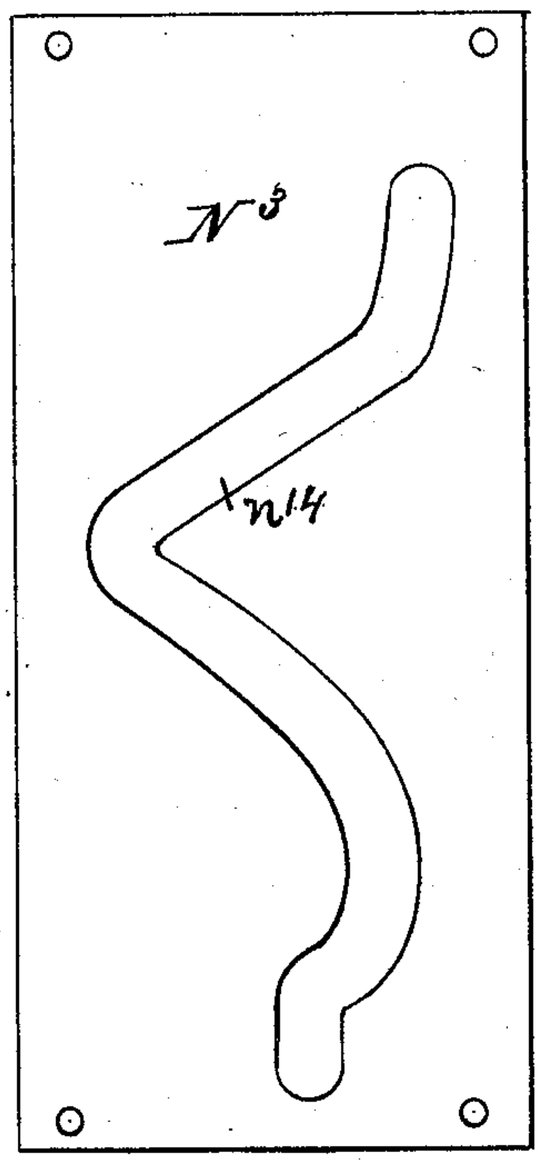


Fig. 18.

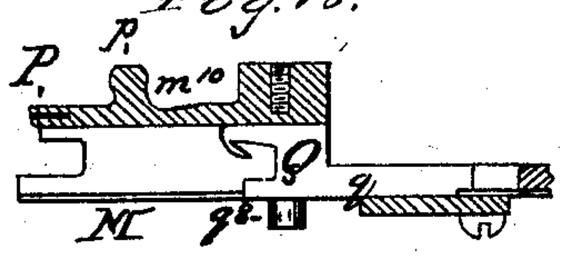
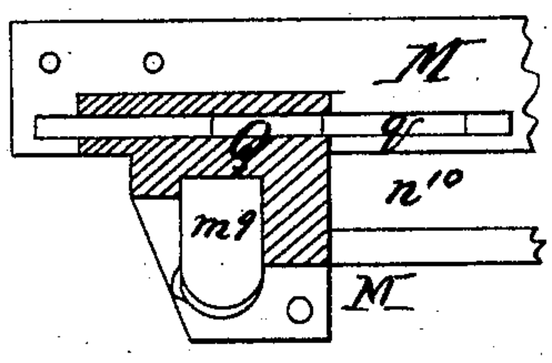


Fig. 19.



Witnesses.
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10 Sheets—Sheet 9.

W. W. BURSON.

BINDING REAPING MACHINE.

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Fig. 21.

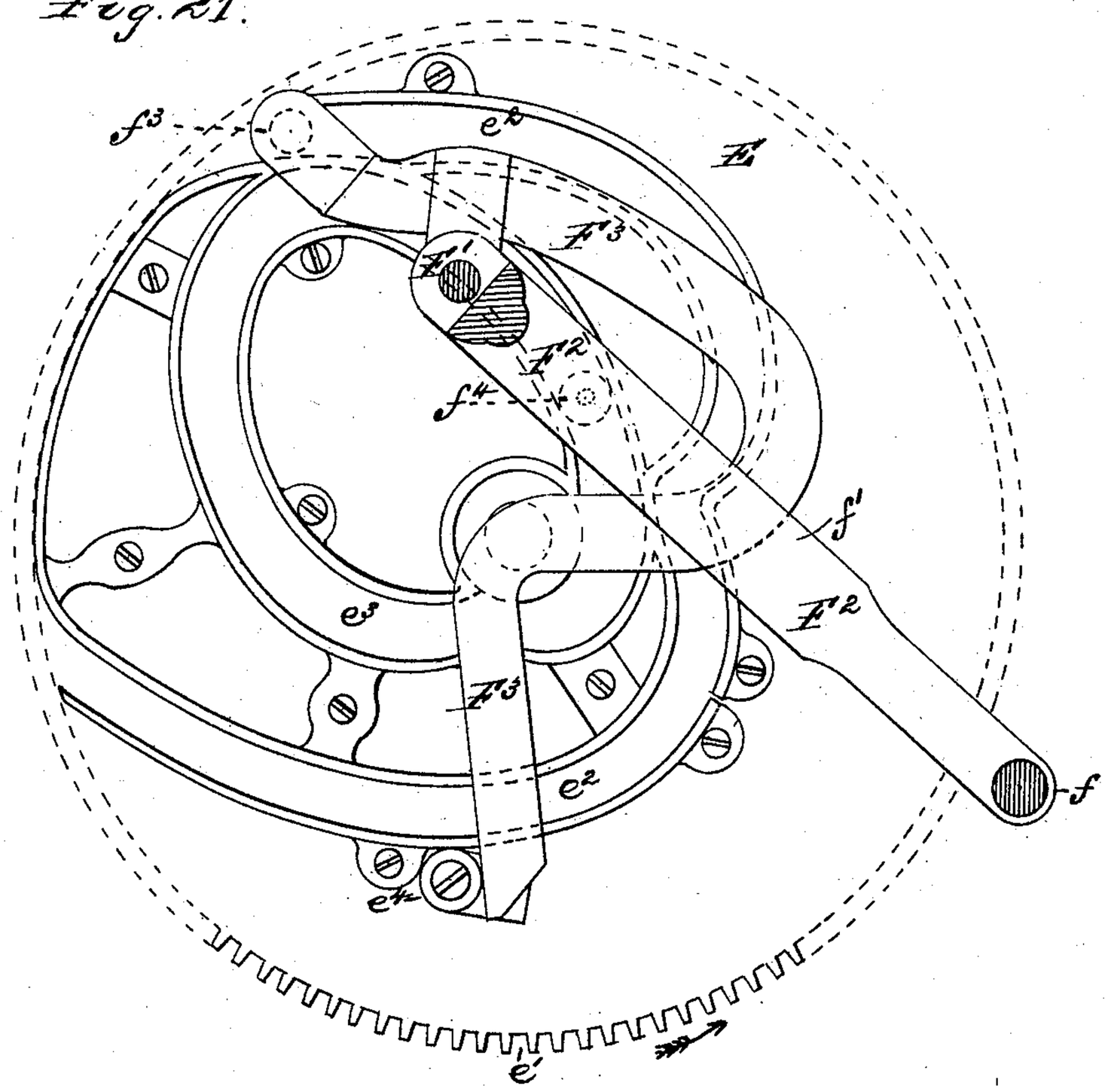


Fig. 15.

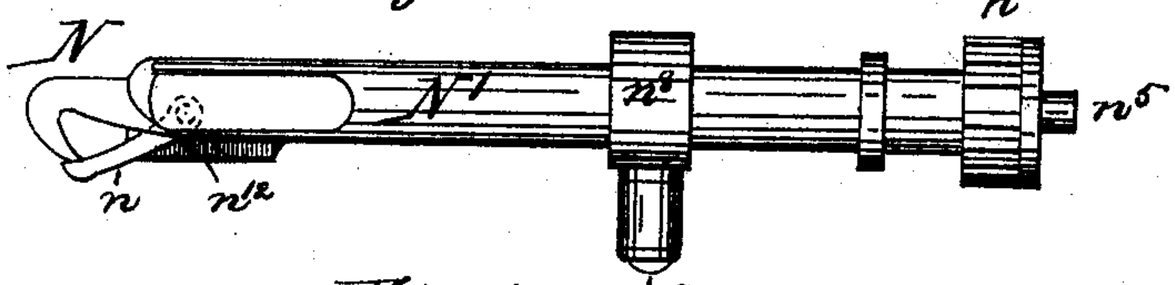
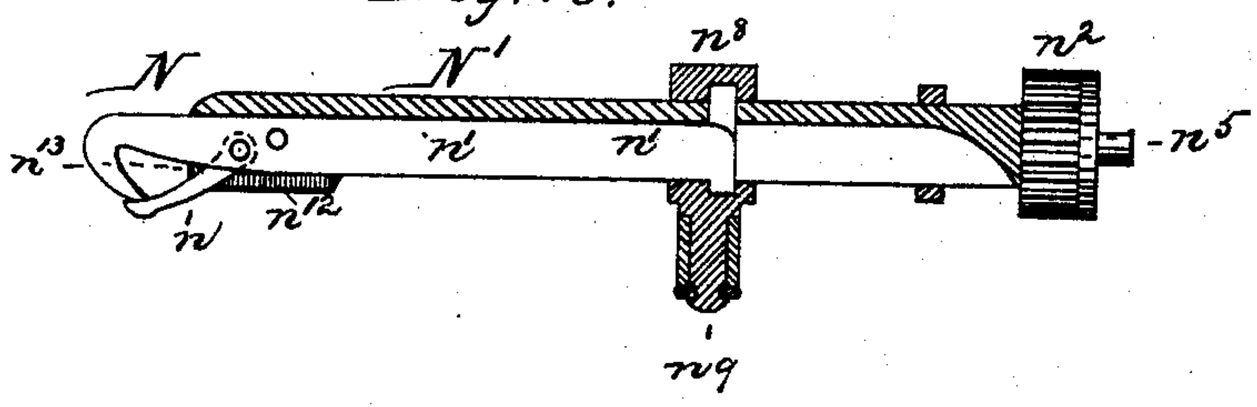


Fig. 16.



Witnesses.
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C. L. Semmick

10 Sheets—Sheet 10.

W. W. BURSON.

BINDING REAPING MACHINE.

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Fig. 22.

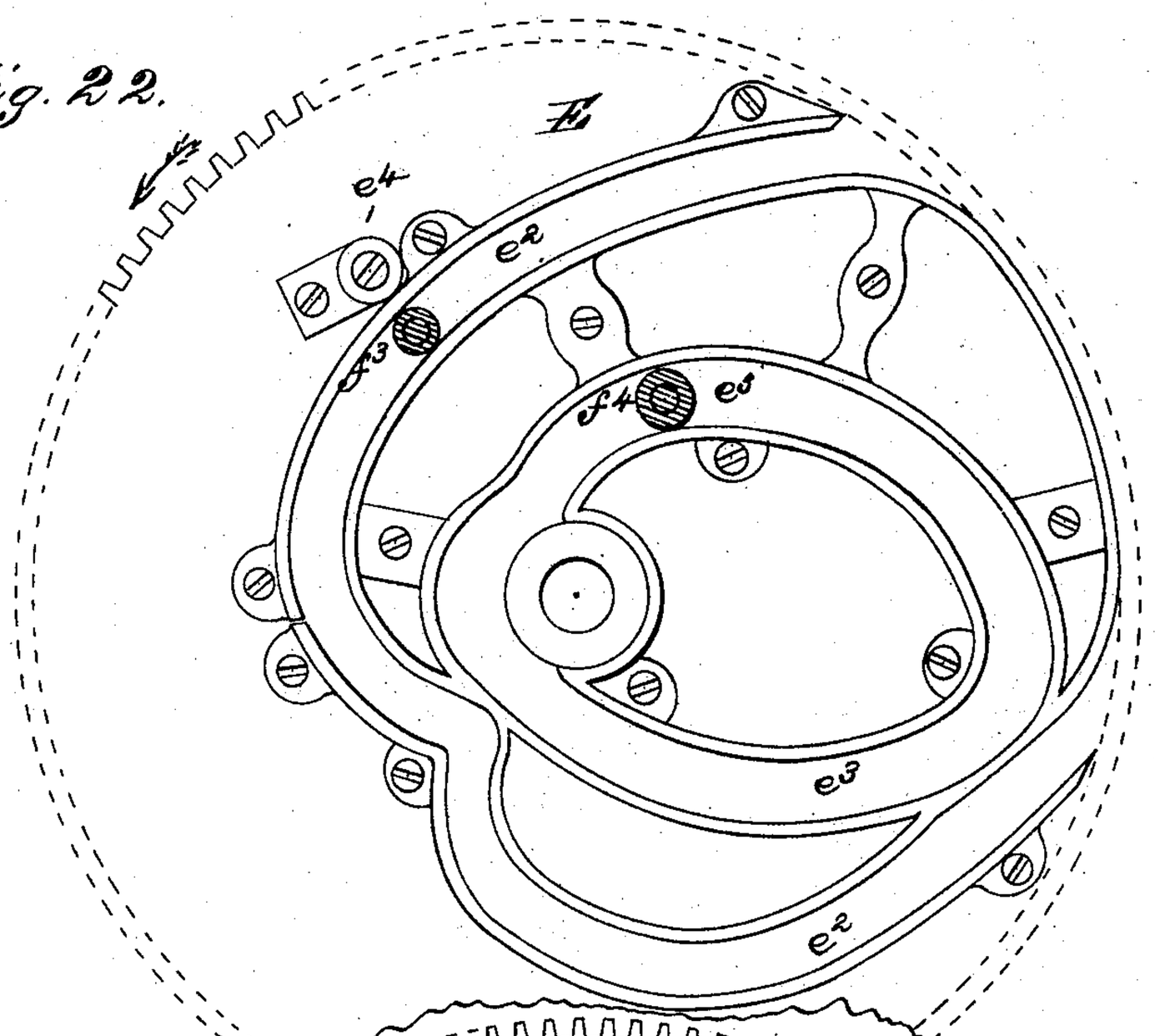
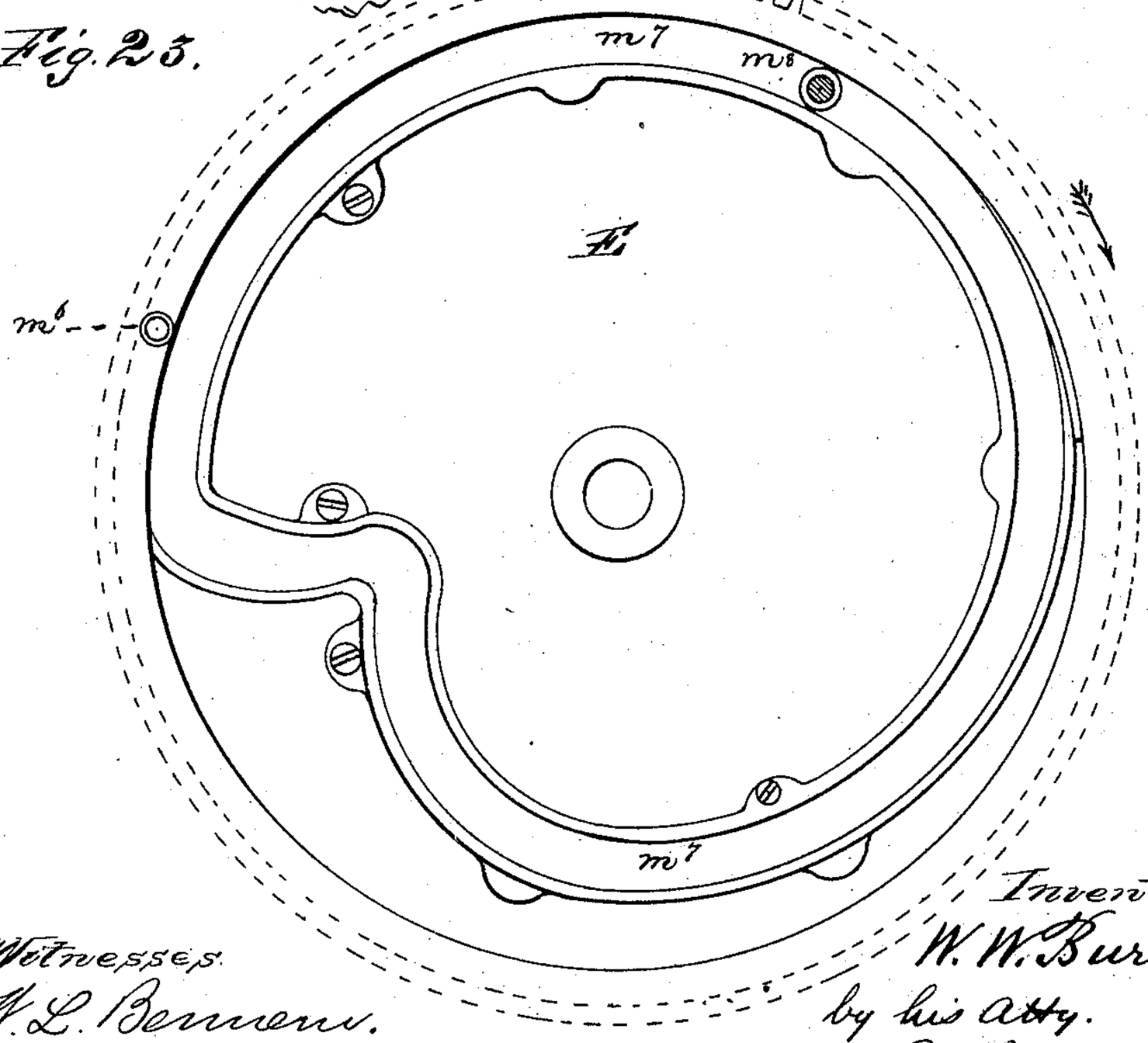


Fig. 23.



Witnesses.
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H. H. Isaacs

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by his atty.
C. L. Renwick

UNITED STATES PATENT OFFICE.

WILLIAM WORTH BURSON, OF ROCKFORD, ILLINOIS, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO THE McCORMICK HARVESTING MACHINE COMPANY, OF CHICAGO, ILLINOIS.

BINDING REAPING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 603,827, dated May 10, 1898.

Application filed May 22, 1879. Serial No. 115—83.

To all whom it may concern:

Be it known that I, WILLIAM WORTH BURSON, a citizen of the United States, residing at Chicago, but formerly of Rockford, in the State of Illinois, have invented certain new and useful Improvements in Grain-Binding Harvesters, which are made and used substantially as set forth hereinafter and as shown in the accompanying drawings, in which—

Figure 1 is a plan view of the harvester. Fig. 2 is a rear view of the same. Figs. 2^a and 2^b illustrate details of the binder and compressor arms. Fig. 3 is a rear elevation of the harvester, partly in section. Figs. 3^a and 3^b illustrate details of the platform raking mechanism on a plane parallel with that of Fig. 3. Fig. 4 is a sectional elevation of the harvester, looking from grain side. Figs. 5 and 6 illustrate details looking from grain side. Figs. 6^a and 20 illustrate details relating to the same. Fig. 7 is a plan view illustrating the shafting and gears for driving the several parts. Fig. 8 illustrates parts seen from front. Fig. 8^a illustrates parts relating to the grain-wheel. Fig. 13 illustrates the sliding hook of the knotter and parts. Figs. 11, 12, 15, and 16 show the knotter. Figs. 9, 10, 14, 18, and 19 illustrate accompanying parts. Fig. 17 illustrates camway to reciprocate knotter. Fig. 25 illustrates the liquid-bearing cup. Figs. 21, 22, and 23 illustrate cams and parts to operate the binder and compressor arms and other parts. Fig. 24 illustrates the grain-wheel and parts.

This invention consists in the device and arrangement of parts for making, compressing, and binding grain on a harvester and for carrying the sheaves and dropping them in bunches of three or four and for operating the whole in concert from the drive-wheel of the harvester with little attention.

The harvester-frame A is suitably mounted upon drive-wheel B and grain-wheel B′ and bears mechanism for raking, compressing, and binding the grain and for carrying and dropping it, arranged in suitable relations thereon, as shown, together with necessary and peculiar gearing and connections for operating them in concert from drive-wheel B.

The grain as cut falls upon the grain-platform C from the cutter-bar at *a* and is carried by rakes D, drawn by endless chains, which run under the platform, having teeth *d′* projecting up through slots *c′* to move the grain across the platform to the binder, where they pass down out of the way, leaving it free.

The grain is carried by the rakes across the platform C toward the drive-wheel B and rises up a curved track into an upward grain-passage between the side walls or guides T O, up which it is forced and compressed by the rakes and by two reciprocating binder and compressor arms F F^5, which grasp and raise and compress it, while other parts coact to bind it into sheaves while it is moving up this passage under one or more sheaves already bound. The grain is compressed in this passage by the side walls or guides and by binder and compressing arms F F^5 and by a self-adjusting compressor cord or strap H, held by them, as well as by the weight of the bound bundles of grain above it. These arms F F^5 are curved concave toward each other to compress the grain between them into a sheaf and are operated each in a peculiar alternating or reciprocating step-like way by suitable means, as shown, to clasp the grain as forced into the passage by the rakes and to move it upward while compressing it and while it is being bound and to discharge the bound sheaf upward and return for the next grain below. The first or upper and inner wall or guide T of this upward grain-passage is provided with upward-projecting barbs or catches toward the grain, arranged to let the grain be forced up, but prevent its descent, and the walls or guides of this passage extend up to such height as to hold one or more bound sheaves above the grain which is being compressed and bound and to such height that the bound sheaves fall to be discharged from the harvester by their own weight. The arrangement shown discharges the sheaves from this passage by tilting them endwise backward upon a sheaf holder or retainer W; but this might be arranged otherwise.

The binding-cord is carried in a series of balls having open cores, in which the cord runs from the outside of one to the core of the next.

Two cord cups or holders I are provided,

made with elastic and expansible walls of volute sheet metal or otherwise to allow for variations of size of balls and to hold them securely, into each of which a ball is placed with the cord connecting them, so it will unwind from the core of one after the other without requiring stoppage to replace one the moment it runs out, so as to save time in the harvest-field. The binding-cord passes from these cups through a tension device J, formed of a fixed and a movable part, which bear opposed rows of cord friction-hooks, opening to one side for insertion and removal of the cord, as shown in Fig. 2. The movable part is held by an adjustable weight or spring. This device enables the tension on the paying out of the cord to be readily adjusted as required.

The binding-cord is carried dry, and as it is run out of the holders, after passing the tension device, it is let through a wetting device L. This consists of a cup or liquid-carrying vessel having a cord-bearing eye i^3 in an adjustable part held therein, through which the cord passes to the binder-arm F and the tying apparatus, where it is applied to the grain as bands, one bundle after another. It is known that cord, especially the cheaper kinds used for binding, works to better advantage wet than dry; but there is a disadvantage in wetting it in the balls. This process is devised to provide for this. The fluid may be water alone or with carbolic acid or any suitable coating, strengthening, or preservative solution or compound, petroleum, or fluid paint. From the wetting device the cord is taken by the binder-arm F through an eye in its end and extends to the cord holding and knotting hooks. It is carried around the grain by the binder-arm F to the knotter-hook N, the end being held by the holding-hook Q. The cord is thus arranged in such way that the hook N will engage with both ends together after being drawn very tight around the compressed bundle and will by a peculiar rotary and reciprocating action tie the two parts into a knot, thus binding the sheaf.

A holding device is used to hold the end of the cord in binding. This consists in a hook Q arranged to slide into a socket q and catch and hold the cord between the tying-hook and the end of the binding-arm, so that when the tying-hook releases the bound sheaf and the cord is cut therefrom the end leading to the ball will be held secure and so that when the arm F draws back and again advances under another mass of grain the cord will be drawn around the grain by arm F and will be carried into such relation to the strand from holder Q and to the tying-hook N that both strands may be engaged thereby for tying. This holding-hook is arranged to release its hold at the proper time during the tying of the knot and to catch the strand anew beyond the tying-hook toward the arm F, so as to hold it for another band. A tying device is used consisting of the knotter-hook N, which projects axially from the end of a rotary and reciprocating shaft N′ and is provided with a pivotal latch similar to that of a knitting-machine needle. The hook and latch are operated in a peculiar way to catch and form a loop from the two ends of the cord and to catch them again beyond the loop and draw them through it by means of the latch, as in the action of a knitting-machine needle, to tie a solid knot to hold the band, and suitable means, as shown, are used to give these peculiar operations. The hook N is provided with a sheath N′, in which its shaft is held and carried. This sheath is formed as a hollow cylinder, in which the tying-hook is carried and fitted to move endwise as both move sidewise. The shaft of the tying-hook carries a pin n^9, which engages with the camway n^{14} as the shaft is carried back and forth sidewise by the tying-frame M, so as to reciprocate the tying-hook in the sheath. The sheath is also rotated with the tying-hook as it sweeps back and forth by a pinion-wheel on its end, which comes in contact with a cog-rack at certain points. The sheath is peculiarly fitted to assist the tying action of the hook and act as a stripper to clear it from pieces of cord, &c., and has a socket q to receive the latch when open and to hold it open.

The tying and holding hooks are mounted and borne in a peculiar way in a tying-frame which carries them up and down, so as to move up with the binder and compressor arms F F^5 and the grain as it is being bound and down for a new bundle. This tying-frame M is moved by a reciprocating segment-rack m^5, which turns a shaft m^2 by a wheel m^4 on its end, which runs on a fixed segment-rack m^3, so as to run up and down as the rack m^5 moves forward and back, which it does with the movement of the shaft F′, bearing the binder and compressor arms F F^5. The shaft m^2 as moved in this way carries the tying-frame with it. This frame in its turn carries the pinion n^2 to turn hook N, arranged to engage with a rack as it moves up and down, and a guide-pin n^9 moves this shaft endwise to reciprocate the hook, which pin is arranged to engage with a peculiar-shaped camway n^{14}, cut in the shield back of and adjoining the course of the tying-frame as the frame moves up and down to give the motion. The binder and compressor arms F F^5 and the tying-frame, with its tying and holding hooks, are arranged to move together and act in concert on opposite sides of the grain-passage to lift and bind the grain into sheaves. A stationary knife V is used to cut the cord from the band of the bound sheaf when the tying-frame has brought the parts to their highest point and after the holding-hook Q has properly engaged it, and various other accessory parts and arrangements are used to promote the actions of the tying parts. A compressing-cord H is used to assist in compressing the grain. This cord or strip is held by the compressor-arm F^5 and passes through an eye

provided with a friction-roller in the binder-arm F and over an elevated stationary bearing to a weight or spring which enables it to adjust itself and to be adjusted to bundles of different sizes and to different desired tensions. The rake brings the grain into the bottom of the grain-passage, where the binder and the compressor arms grasp and force it upward against the sheaves above while it is being bound, and the barbs hold it up while the arms descend and engage another bundle below. The sheaves as they rise above the sides of the grain-passage cant and fall over against a sheaf-holder, which retains them until released by the driver, when they are discharged onto the ground.

The binder-arm F is carried by shaft F′ directly. Compressor-arm F^5 is pivoted to arm F at f^5, so as to be operated by it. Elevator-arm U is pivoted to the bracket F^6 at u^4 and is provided with a slotted stock u^2, through which passes the shaft F′, so as to be worked by it. Elevator-arm S is carried by shaft F′ directly at another point to lift the butts of the grain, while arm F lifts the sheaf at the point of binding. These arms are operated by shaft F′ by their connection with peculiar motions adapted to the particular office of each in the operation of binding, elevating, compressing, and discharging the grain. The arm F^5 is provided with a lever-like extension f^6, bearing a guide-pin which acts within a cam-like opening f^7 on the frame back of the shaft F′ and controls its movements by turning it on its pivot as the pivot is moved by the shaft F′ to give it its peculiar motions. The shaft F′ is carried by a rocking cam F^2 and is given a peculiar rocking motion by a cam and mechanism at its front end, which will be fully set forth hereinafter. The arm U acts to hold up one sheaf, while the arms F and S grasp another. The arm S is mounted on a shaft F′ at one side of the binder-arm toward the butt-ends of the grain and acts to carry up that end of the sheaves, so that when bound they are canted over the passes between the holder T and the wall O′ and fall against the sheaf-retainer, so as to be held by it. This sheaf holder or retainer W is used to hold the sheaves as bound and drop them in bunches of three or more in line with previous bunches for shocking. This holder is made of any suitable form, as a gate, cradle, or otherwise, and is arranged to suit the binder-delivery.

It is convenient to deliver the bound sheaves in lots each containing three or more sheaves. In order to effect this, a sheaf-holder is combined with the binding mechanism, and both are combined with mechanism for elevating the grain. This sheaf-holder may be of any approved construction. In the machine represented in the drawings it consists of a curved grating W, Figs. 1 and 2, which is connected at one edge by hinges w' with the frame of the machine and is held at the opposite side by a strap w^2, which can be engaged with a stud w^3 upon the frame or otherwise held.

I will now describe more fully the details of construction.

The main frame A is carried on the drive-wheel B and the grain-wheel B′, so that it may be tipped or rocked on the axes of said wheels. This main frame supports the grain-platform C, the raking mechanism, and the binding mechanism, the last being arranged between the grain-platform C and the drive-wheel B. The cutting apparatus is connected with the front beam *a*, supporting the front side of the grain-platform, so that the cut grain falls upon the platform and is raked along it in the direction of the arrow *c*, Fig. 1, to the binding mechanism. The cutting apparatus may be of any approved construction.

In order to gather the cut grain in a gavel and deliver it to the binding mechanism, I make use of one or more rakes D, whose rake heads or stocks *d* extend crosswise beneath the grain-platform C and whose teeth *d′* while raking protrude upward through longitudinal slots *c′* in said platform. In practice I find it expedient to employ three such rakes, which are caused to travel from the grain end of the platform to the binding mechanism and then to return to the said grain end by means of two endless chains d^2, Figs. 3, 3^a, 3^b, and 4, each of which runs upon two sprocket-wheels d^3 d^4. The sprocket-wheels d^3, which are nearest the binding mechanism, are secured upon the rake-shaft d^5, which extends crosswise beneath the platform and is constructed to turn in bearings formed in the frame of the machine. The outer sprocket-wheels d^4 are each mounted on a stud secured to the inner side of the frame outside of the sprocket-wheels, so that the space between them is open for the movement of the rake-teeth. The endless chains are caused to move by turning the sprocket-wheels d^3 by their shaft d^5, which thus constitutes the driving-shaft of the rake mechanism, and is connected with the main drive-wheel B by means of gearing, so as to be revolved continuously as the machine is moved forward over the ground. The gearing is not represented in some of the figures, as it would render them more complex. That which I prefer is represented in Figs. 6 and 7, and consists of a rack *b* in the rim of drive-wheel B, which turns wheel *b′* on shaft b^2 and bevel-wheel b^3 thereon, driving-wheel b^4 on shaft b^5, bearing sprocket-wheel b^6, and drive-chain b^8, which turns wheel b^7 on shaft d^5, which carries the rake-driving wheels d^3 d^3.

During the movement of the rake toward the binding mechanism the rake-teeth are held erect. As the rake-head is carried by its chains d^2 around the rack-shaft d^5 the rake-teeth are drawn downward through the slots of the raking-platform. During the return movement of the rake toward the divider end of the platform the rake-teeth occupy, by

preference, a horizontal position with their teeth pointing toward the binding end of the platform, and when the rake-head is carried around the outer sprocket-wheels d^4 the rake-teeth are caused to protrude upward through the slots in the platform with their points at first inclining toward the grain-guard C at that end of the platform, so as to insinuate themselves between that guard and whatever grain may be upon the platform. In order that the rake-teeth may occupy in succession these various positions, the rake-head d is pivoted to the rake-chains, so that it may turn on its longitudinal axis, and means are provided to cause it to turn as required. To this end each rake-head is fitted at one end with a directing-arm d^6, which when the rake-head is gathering grain projects forward in the direction in which it is moving. The directing-arm is by preference fitted at its outer end with a wheel d^7, which may be termed the "leading" wheel, and which; or the cranked end of the directing-arm, runs upon a rail d^8 and beneath the platform while the rake is being carried toward the binding mechanism, and thus holds the rake-teeth erect. When the rake-teeth reach the binder end of the platform-slots in which they move, the rake-head is drawn downward by the passage of the rake-chain around the sprocket-wheels d^3 and the leading wheel leaves the upper rail d^8, thus permitting the rake-head to turn on its axis. The continued movement of the rake around the sprocket-wheels carries the rake-teeth beneath the rake-driving shaft d^5. At the binder end of the platform the rake-teeth engage the platform at the end of the slots, which by obstructing their passage in the erect position compels the rake-head and rake-teeth to turn downward. While in this downward position, the leading wheel d^7 runs beneath the rail d^8, secured to the platform-frame. As the rake approaches the grain end of the platform the leading wheel is brought in contact with a rising cam-track d^9, the passage over which turns the points of the rake-teeth upward toward the guard C'. As the rake-head is then carried upward around the outer sprocket-wheels d^4 a second arm d^{10}, secured to the rake-head, is borne against the curved track d^{11}, while the leading wheel runs upon an inclined track d^{12}, and the action of this track and grade upon the directing-arm and second arm of the rake-head causes the rake-teeth to point toward the grain-guard C' as they protrude through the slots of the platform until they are raised to nearly their full extent. Then the leading wheel enters between the platform and rail d^8, and the rake-head is carried forward by the rake-chains, turning until the rake-teeth stand erect. The slots of the platform stop a little short of the position to which the rake-head is carried when moving toward the binding end of the platform. Hence the ends of these slots prevent the rake-teeth from moving forward while the rake-head is still moving in that direction. Consequently the rake-teeth while being drawn downward are caused to incline or slip backward and thus free themselves readily from the gavel which they have collected and delivered to the binding mechanism.

The binding devices are operated in their proper order by the revolution of one cam-wheel E, which is held by and turns upon a stud secured at the front side of the main frame. As the rake mechanism and binding mechanism operate in concert and in combination, the binding taking place immediately after a rake has delivered a gavel of grain, advantage is taken of this fact to drive the said cam-wheel through the intervention of the rake-driving shaft d^5 by means of a pinion e, Fig. 4, secured to said shaft and meshing into the gear-teeth e' upon the perimeter of the cam-wheel E.

The binder-arm F is secured to a shaft F', which is fitted to turn in a vibrating-shaft-holder frame F^2, the cross-head f of said shaft-holder having journals which turn in bearings secured to the main frame. The end of this binder-arm is caused to descend beyond the gavel delivered by the rake and between that gavel and the unraked grain on the grain-platform and to vibrate so as to compress the grain, to ascend in a curve, and to move backward above the place (d^{13}, Fig. 3) at which the rake delivers the grain and over any grain lying there by a rocking, rising, and descending movement imparted to the binder-arm shaft F' by means of the cam guides or grooves e^2 e^3 and a stud or friction-roller e^4, which are secured to the rear side of the cam-wheel E, Figs. 21 and 22. The cam-guide e^2 and stud e^4 operate on a cross-head F^3, fastened to the end of the binder-shaft F', and effect the rocking of said shaft, and the cam guide or groove e^3 operates upon the arm f' of the vibrating-shaft-holder frame F^2 to raise and depress it, the binder-shaft, and the binder-arm. Each cam guide or groove operates through the intervention of friction-rollers, one of which, f^3, is secured by a stud to the cross-head F^3 and the other, f^4, to the arm f' of the vibrating-shaft-holder frame. The downward strain upon the binder-arm F and its shaft F' is greatest while the sheaf is being compressed, which operation takes place while the shaft F' is at its lowest position. In order to support the shaft firmly at this time, a supporting-bracket F^4 is provided. This bracket has an open bearing near its outer end to admit the shaft when it descends and to permit its escape when raised, and the bracket is secured at its inner end to the breast-beam G, which is supported transversely of the grain-platform sufficiently above the same to permit the grain to be raked beneath it to the binding mechanism.

The compressing-arm F^5 is connected with the binder-arm by means of a pivot f^5 near the binder-shaft F'. This compressor-arm is constructed with a projecting shank f^6, whose

end is fitted with a friction-wheel that protrudes into the cam-slot f^7 of a block F^6, which is secured to the breast-beam G. As the compressing-arm is carried by the binder-arm it partakes of the rising and descending movements of the latter; but it is compelled by the action of the cam-slot f^7 upon the end of its shank to vibrate at one time toward the binder-arm for the purpose of compressing the gavel and at a subsequent time away from the said arm to release the bound sheaf. A stud or pin f^8 is secured to the compressor-arm F^5 in a position to prevent the accidental excessive divergence of the binder and compressing arms.

The compressing strap or cord H is carried by the binder-arm F and the compressing-arm F^5, one of its ends being secured to the end of the latter. This strap when not encircling a bundle extends from this arm across the space between the two arms to a pulley or sheave h on the binder-arm, thence under the sheave h^5 on the frame, and upward to a second sheave h', Fig. 3, on the post H', secured to the breast-beam G, and from the last pulley in a downward direction, its descending end having a weight H^2 or a spring secured to it. The weight produces a strain upon the compressing strap or cord, which yields when the parts of the strap between the arms is borne against the gavel and permits the strap to yield and be curved around the gavel by the downward movement of the two arms, but draws back the strap when the arms close upon the gavel, and thus enables the strap to embrace the gavel closely, whether its size be large or small. The weight is guided by guides secured to the pulley-post H' and to the breast-beam G. As the compressing strap or cord is carried by the binder-arm F, this strap is introduced thereby behind the gavel delivered by the rake.

The cord by which the gavel is bound into a sheaf is carried in cord-cups I I, mounted upon a bracket I' at the head of the post H. The cord is most conveniently wound in balls and is by preference drawn out from the interior of one of the balls and is conducted upward to a cord-guide i. Two or more cord-cups I I are provided for this one cord-guide, so that a spare ball of cord may be put into one cord-cup while the other ball is being used, and the fag end of the one in use may be tied to the leading end of another ball before the old ball in use is wholly exhausted. The two cord-cups thus permit the balls of cord to be renewed and the cord for binding to be furnished continuously to the cord-guide without the necessity of stopping the binding. Each cord-cup is by preference made expansible to suit balls of different dimensions and to hold them snugly, so that they may not be displaced by the jolting of the machine, the expansible feature being attained by constructing the upright wall of the cord-cup (see Fig. 1) in the form of an envelop, made out of a strip of elastic sheet metal bent into a volute and secured rigidly at one end only to the bracket I', which forms the bottoms of the cord-cups. The free end of the volute strip laps over the fixed end and is fitted with a perforated lug i', so that the cup may be held in a more or less expanded condition by inserting a movable pin through the perforation and into one of a series of holes formed in the bracket I'. The fixed end of the expansible wall also has at its upper edge a lip i^2, which laps over the overlapping end of the wall and holds the two close together. From the stationary cord-guide i the cord is conducted down to the tension device J, Fig. 4. The form of tension device which I prefer to use consists of two sets or rows of hooks or guides, one of which sets is fixed and the other movable. The fixed hooks j' are secured to the under side of the bracket-head I', which supports the cord-boxes. The movable hooks j^2 are attached to the upper side of a swinging bar j^3, which is pivoted at one end to a hanger from the said head. The hooks of the two rows alternate with each other and the cord is passed from the hooks of one row to the hooks of the other in alternate succession. The friction incident to passing through the hooks produces the requisite tension, which may be adjusted by using more or less hooks, and the opening at the side of each hook permits this adjustment to be readily made by applying the cord sidewise to the hooks. The swinging of the tension-bar j^3, to which the movable hooks are secured, enables it to act as a take-up, yielding to an unusual demand for cord by rising, so as to shorten the loops of cord between the hooks, and descending to take up any slack cord which may possibly be given back during the compression of the sheaf. As the force required to hold the lower set of hooks from remaining in permanently-raised positions should be varied with the number of hooks in use and with the greater or less rigidity of the cord, a shifting weight j^5 is provided to vary the strain upon the tension-bar. This weight j^5 is fitted with a hook, by means of which it may be applied to any one of a series of holes at a greater or less distance from the pivot of the tension-bar, so that it may operate with greater or less force upon the cord. An adjustable spring may be substituted for a movable weight.

From the tension device the cord is conducted downward to a second cord-guide i^3, Figs. 3 and 25, and thence to the binder-arm, which applies the cord to the gavel of grain.

In order to keep the cord in its place relatively to this arm, the outer edge thereof has a V-shaped groove formed in it to receive the cord, and an eye-guide i^4, Figs. 2^a and 2^b, is formed upon the arm at about the middle of its length to guide the cord to this groove. The cord passing through the end of the binder-arm F is conducted across the space, where the sheaf is bound, and its end is held by the holding-hook, hereinafter described.

The cord I^2, Figs. 4 and 25, is passed be-

tween its holder I and the binder-arm through a cup L, containing a liquid, so as to wet, soften, and lubricate and make it work well in the binding apparatus. This liquid may be water alone or with carbolic acid or other substance therein, or may be petroleum or fluid paint or other preservative or fluid compound adapted to soften and lubricate the cord as it passes through the binding apparatus and to strengthen and protect the band afterward. The saturating-cup L is secured to the breast-beam G, and the cord-guide i^3 is provided to hold the cord down in this cup, so that it may pass through the liquid therein. This cord-guide i^3 is by preference constructed with a sliding shank, so that it may be pushed down in the cup and secured there by means of a clamp-screw acting upon the sliding shank. The binder-arm F is employed to do a part of the work of elevating the bundle of grain, and advantage is taken of this mode of proceeding to tie the knot of the band during such elevation. Hence the cord-tying and cord-holding devices are arranged to move with the binder-arm while it elevates the bundle, and consequently the tying-frame M, with its appurtenances, is constructed to move upward during the tying and to descend after the band is tied. To this end the movable tying-frame M is constructed to slide up and down in curved ways $m\,m$, whose curvature corresponds with the curvature of the path of movement of the end of the binder-arm F. The frame is held by connecting-hooks m' with the shaft m^2, having at its ends pinions m^4, which engage in segment-racks m^3, which are secured to the main frame and conform in curvature with that of the curved ways $m\,m$, in which the tying-frame slides. The turning of this shaft m^2 in the direction indicated by the arrow in Fig. 5 causes its pinions m^4 to run up the segment-racks m^3 and to draw the tying-frame upward by means of the connecting-arm m', while the turning of the elevating-shaft in the reverse direction permits the tying-frame to descend or causes its descent. The elevating-shaft m^2 is turned by means of an oscillating lever M′, which is pivoted to a bearing secured to the main frame, and has at the end of its longer arm a segment-rack m^5, which engages with one of the pinions m^4. The raising of the segment end of the elevating-lever causes the elevating-shaft to turn and move upward and draw with it the tying-frame, and the descent of the segment effects or permits the backward turning of the elevating-shaft and the descent of the tying-frame. The oscillating lever is operated for raising the tying-frame by means of a stud or friction-wheel m^6, Figs. 8 and 23, secured to the front side of the cam-wheel E and which operates upon the heel extension of the oscillating lever. The lever is controlled in its descent by a cam guide or groove m^7, which is formed at the front side of the cam-wheel E and which operates upon a stud or a friction-wheel m^8, Figs. 8 and 23, secured to the adjacent face of the heel extension of the lever M′.

The tying-frame carries the knotter-hook by which the knot is tied and the cord-holder by which the end of the cord is held in the vicinity of the knotter-hook for the formation of a new band. The knotter-hook or fixed jaw N consists of a hook-ended piece of metal (tempered steel by preference) having a small latch-jaw n pivoted to its shank n', so that it may swing to and fro and form a clasp. The outer end of this latch n is made like the bowl of a small spoon, so that it can cover the point of the hook sufficiently to guide the loop of cord freely over the hook while passing from the shank. In order that this tying-hook may tie the knot, two kinds of motion must be imparted to it. Hence it is combined with devices which cause it to turn axially, so as to form and twist the cord into a loop upon itself and to move longitudinally for the purpose of seizing the cord to form the loop, of passing the latch through the loop on it, of seizing the ends of the band, and of drawing the latch and these ends through the loop, so as to complete the knot. The latch in this operation prevents the loop from collapsing until the ends of the band are drawn through it. As the tying-frame with the knotter-hook is caused to rise and descend advantage is taken of this fact to combine the knotter-hook with stationary devices, along which it is moved and which by their action impart the proper movements to the knotter-hook.

In order that the knotter-hook may be rotated, its shank is arranged to slide lengthwise in and turn with a shaft N′, which is grooved longitudinally to form a sheath for the shank, and is fitted with a pinion n^2, which, during the upward movement of the tying-frame, is caused to engage with segment-racks n^3 and n^4, formed upon one of the curved ways m. These segments are in the proper position and have teeth of the proper number to give the greater part of the required rotary motion to the clasp-hook. The teeth of the first or lower segment n^3 are sufficient in number to cause the hook to rotate about three-quarters of a revolution and the teeth of the second or upper segment N^4 are sufficient in number to rotate the hook about half a revolution. These two sets of teeth are separated by a space, and while the hook is traveling through this space it should be for a portion of the time held from turning. For another portion of the time it should be turned the remainder of the first revolution, (about one-quarter,) and it should be held again from turning, or nearly so, for the remaining portion. These actions upon the hook are effected by a stud n^5 upon the outer side of the pinion n^2 and fitted with a friction-wheel traversing a cam-slot n^6, Fig. 2, formed in a plate n^7, secured to one of the curved ways m, which carries the pinion as

it is moved up against a cogged rack, so that it will be turned at the proper time, the camway, Fig. 2, being properly formed therefor. The longitudinal movements of the knotter-hook are effected by connecting the end of its shank n' with a non-rotating collar n^8 upon the sheath N′, to which the proper movements are imparted. For this purpose the end of the shank is turned outward and is received in a ring groove formed in the collar n^8, so that the collar may not hamper the turning of the hook with the sheath N′. The collar is fitted with a stud n^9, Figs. 15, 16, and 11, which projects from its side through a zigzag cam-slot formed in a grooved plate N^3, which is secured to the frame of the machine. The collar-stud n^9 is fitted with a friction-wheel, and the cam-slot is of such shape that it imparts the proper longitudinal movements to the hook at the proper times. In order to prevent the collar from rotating with the shaft and retain its stud in engagement with the cam-slot, the stud is projected through a longitudinal slot n^{10} in the tying-frame, the length of this slot being sufficient to permit the requisite longitudimal movement of the hook n.

The tying-frame and its appurtenances are protected from the straw of the gavel by a curved casing-plate O, (which has been removed from its place to show the parts in Figs. 3 and 5,) and a corresponding curved casing-plate O′, Fig 1, is arranged in front of the position of the band upon the sheaf. The adjacent edges of these two casing-plates are separated by a narrow space or slot for the passage of the cord to the tying mechanism. The tying-hook is projected from the pressure of the straw through this slot by means of a curved guard O^2, which is secured to the tying-frame M, and is notched at its inner forward edge for the passage of the cord when the binder-arm delivers it to the cord-holder hook. When the tying-hook is in the position for first operating upon the cord end, the latch-jaw must be open. In order that it may be held in this condition, the cavity or socket m^9, Fig. 9, is formed in the tying-frame M to receive the latch and hold it open until the rotation of the hook N carries it out of this cavity. The latch should be held from closing during the turning of the hook to form the twisted loop, and this is effected in part by the front edge of the said cavity and in part by the rear edge o of the hook-guard O^2, which is shaped of the proper form for this purpose. The longitudinal movement of the hook outward from its sheath carries the point of the open latch through the loop and beyond the front end of the tying-frame, where there is room for it to swing freely on its pivot, and the drawing back of the hook for the purpose of pulling the ends of the band through the loop draws the back of the latch against the loop, which, closely embracing the sheath, enters between it and the back of the latch and compels the latter to swing forward to cover the point of the hook and to guide the loop over the same and over the ends of the band held thereby. The loop is pushed over the end of the tying-hook as the latter is withdrawn by coming in contact with the forward end of the sheath.

After the knot is completed the tie-frame with its appurtenances descends to its lowest position, and during this movement the hook reverses its longitudinal and turning movements, so that it is restored to the position for first acting upon the band. As, however, the latch is closed at the time the knot is completed it must be opened and restored to its position in the cavity m^9 of the tying-frame during the descent of the latter. In order to effect this, a projection P, Figs. 9 and 10, is secured to the tying-frame in the track of the point of the latch when the hook is moved longitudinally outward in its descent. The pushing of the latch against this projection or the latch-opener compels the latch to open or swing back from the hook-point, and as the hook turns axially the opening of the latch is completed by its movement in contact with a spur or stud p, projecting from the tying-frame, so that the latch will pass readily through the hook-guard O^2. The backward movement of the tying-hook by the action of the cam-slot in the plate N^3 brings the back of the latch-point in contact with the face of the adjacent bearing m^{10} of the sheath N′, and this face is beveled, so that the movement of the back of the latch against it causes the latch to turn outward from the hook behind the skewed rear edge of the hook-guard O^2, which during the last axial retrograde turning of the hook guides the latch into the cavity or socket m^9 of the tying-frame and into the position which it occupies during the first action of the tying-hook upon the band.

In order that the cord may be held so that the end may be passed around the new bundle, a holding device is combined with the tying-hook. The combination is effected by connecting both devices with the tying-frame M. The holding device consists of a sliding hook Q, Figs. 18 and 19, whose shank q is constructed to slide longitudinally in a socket on the tying-frame M. The hook is beneath the latch-opener or projection P, but is nearer the bundle than the inner edge of the binding-arm F. The open side of this holding-hook faces outward, so that when the hook is entered between the cord carried by the binder-arm and the gavel it will receive the cord in the cavity of its hook and when drawn back will draw the cord back into the socket in which it slides, thus pinching the end of the cord between the holding-hook and the sides of its socket and thereby holding it fast. In order that the cord may be seized by the holding-hook with certainty, the end of the binder-arm is constructed with the depression k', Figs. 2^a and 3, on the inner side of the eye k, this depression being secured by means of a protuberance k^2, and when the

binder-arm is caused to embrace the gavel its eye *k* is pushed forward beyond the line of travel of the holding-hook Q far enough to permit the latter to travel across the depression *k'* and engage the portion of the cord extending from the eye of the arm backward across this depression. The holding-hook is caused to traverse longitudinally of itself, but crosswise of the path of the binder-arm and the cord, by means of cam-guides, and as the tying-frame travels during the knotting of the cord advantage is taken of this feature to form the cam-grooves in a plate Q', Figs. 5 and 20, fixed to the frame, so that the holding-hook is caused to move longitudinally by being carried along these cam-guides. In order that the cam-guides in plate Q' may act upon the holding-hook, the shank of the latter is fitted with a stud q^8, Fig. 18, provided with a friction-wheel and which projects outward through said guides, so as to be acted upon as it is carried along them by the movement of the tying-frame. The forward or outward movement of the holding-hook is effected while its stud is moving backward, the cam-guide *q'* at this time acting upon the stud. The retrograde or inward movement of the holding-hook is effected partly by the guide q^2 on the side of the slot during the upward movement of the tying-frame and partly by the guide q^3 during the descent of the tying-frame. It would not be expedient to have the holding-hook protrude during the downward movement of the tying-frame, because its protrusion would loosen the end of the cord unless some other device was employed to hold it at the time. Hence the stud of the holding-hook is not permitted to retrace exactly its upward path, but is switched into the descending cam-groove during its descent. To this end the piece q^4, which forms the division between the cam-grooves, is connected with the cam-plate by a pivot q^5, so that it can swing as a switch, and a spring q^6, Figs. 5 and 20, is provided to press its upper end toward the cam-guide q^2 and its lower end in the reverse direction. This cam piece or switch q^4 does not extend the whole distance through which the holding-hook is carried by the tying-frame. Hence the stud of the holding-hook in its ascent passes beyond the point of said cam-switch and permits the spring to move it across the track of said stud in its descent, and when the stud is carried downward it passes below the lower point of the cam-piece q^4, the spring yielding for that purpose, and permits the spring to switch it across the track of the stud during its next upward movement.

While the cord is being tied, enough slack should be furnished to form the knot. To this end the holding-hook is caused to move outward in its socket as the knot-tying proceeds, thus progressively giving back the cord held by it. This progressive outward movement is effected by the form of the ascending cam-guide *q'*, which acts upon the stud of the holding-hook.

In order that the band applied to the sheaf may be severed from that held in the holder, a knife V, Fig. 5, is provided. This knife is fixed upon the frame part *m* beside the track of binder-arm F at the end of its course, Fig. 5, in such a position that the cord extending between the tying-hook and the holding-hook is carried against the knife-edge by the upward movement of the tying-frame. The knife-edge is inclined across the path of movement of the cord, so that the upward movement of the tying-frame carries the cord across the inclined edge with a drawing cut. The knife when fixed should be so adjusted that the cutting takes place before the knot is completed and while the knotter-hook and holding-hook are both drawing upon it, so that the cord is strained, and can consequently be readily cut. The knife may, if preferred, have a sickle-edge to facilitate the cutting.

The tying is effected in part by moving the knotter-hook through the loop of cord. In order that the loop may not be moved to and fro longitudinally upon the hook-shank to a greater extent than is expedient, one side n^{13} of the sheath N', Figs. 11 and 12, is extended beyond the other side thereof and has a notch R formed in it to retain in a lateral direction the cord passing around the gavel into the hook-guard O^2.

In order to insure the pulling of the knot tight, the inside of one side of the sheath is scored or roughened, as at n^{12}, Fig. 11, so that the drawing of the ends of the cord into the sheath by the backward movement of the hook jams them between the roughened face of the sheath and the side of the hook. Hence when the sheaf is elevated after binding the ends of the band hang back in the sheath, and consequently the movement of the sheaf pulls the knot tight. If any remnant of the cord tears from the ends of the band and remains in the sheath, the outward movement of the hook during its descent with the tying-frame works out such remnant. Hence the combination of the hook with devices for moving it out of its sheath and back again between the tying of one band and the commencement of tying a second band is advantageous.

After the binding is completed the action of the cam guides or grooves e^2 e^3, Figs. 21 and 22, of the cam-wheel E upon the crosshead and shaft-holder of the binder-arm shaft F' causes it to rock backward and also to rise out of its bearing in the bracket F^4. The effect of this compound movement is to cause the binder and compressing arms to open from the sheaf, leaving the end of the cord leading from the binder-arm held by the holding-hook. The continued movement of the cam-wheel E causes the binder-shaft F' to descend and to introduce the end of the binder-arm

F in behind the gavel newly delivered under the breast-beam G by the rake mechanism. As before stated, the bundle of grain is partly elevated during the binding by the movement of the binder-arm. In order to relieve this arm of a portion of the strain incident to raising the bundle, a raising-arm S, Figs. 1, 2, 2ª, 3, 4, and 5, is secured to the binder-shaft F′. This raising-arm is introduced behind the freshly-gathered gavel by the descending movement of the binder-shaft F′, and it is raised with the binder-arm F, so that it aids the latter more or less in raising the bundle during binding. The number of these raising-arms may be increased, if desired, and one of them may be arranged close to the binder-arm, so as to relieve the latter of the strain of raising the grain.

When the binder and compressing arms commence to open to release the sheaf, it is prevented from falling by the wall or guide T, bearing bars, which bears against one side of the sheaf, while it is held from escaping at the opposite side by the curved casings O O′. After the arms have opened the bound sheaf is elevated farther and is canted over toward the rear of the machine. The first portion of this work is done by the elevator-arm U, Figs. 1, 2, 3, and 4, and the last part of it is done by the crowding of the next succeeding sheaf upward. The elevator-arm U may be of any approved construction, but that which I have devised has an arm u' and a stock u^2, the arm being pivoted to the stock, so as to swing freely upward, but to lock when pressed backward to the line of the rear of stock. The stock is pivoted at its butt to the side of the cam-block F^6, so that the stock and arm can vibrate together. The stock is slotted longitudinally to hold a slide u^3, Fig. 1, which is fitted as a loose collar upon the binder-arm shaft F′. Hence the ascending and descending movements of said shaft F′ cause the elevator-arm U to move up and down. The upward movement takes place when the binder and compressor arms open, so that the elevator-arm then forces the sheaf upward and attains the position shown in Fig. 2ª. The descent of the binder-arm shaft lowers the elevator-arm, leaving the sheaf held by the grain-passage walls T and O, which prevent the retrograde movement or descent of the sheaf when the elevator-arm leaves it. The continuous descent of the elevator-arm carries it backward to the position for operating upon the under or rear side of the next succeeding sheaf. In this descending movement the back edge of the elevator-arm u' is brought into contact with the next succeeding gavel of grain then in the grasp of the binder and compressor arms, but the connection of the arm u' with its stock u^2 by a pivot permits the arm to swing forward while it is drawn backward, so that it passes over the new gavel and drops down behind it.

The elevator-arm S is arranged between the front of the machine and the positions of the binder-arm F and the cord-tying devices, so that it may act under the sheaf between the band and butt of the same. Hence the butt-ends of the sheaves are pushed up highest between the walls of the grain-passage because of their greater bulk, and they are thereby canted backward as they rise, which is facilitated by the weight of heads of the grain extending backward. Each sheaf thus crowded up by that which succeeds it escapes at the upper end of the passage-way and turns over endwise to the rear, tending to fall from the machine; but it being convenient to deliver the bound sheaves in bunches of three or four for shocking, to affect this a sheaf holder or retainer W is used. This is made, as shown, Figs. 1 and 2, of a gate or cradle-like form suited to the arrangement of the binder for discharging the sheaves. This gate-like holder W is hinged at one side at w' on an axial line slanted back above, so that it may swing out backward and downward when released by the weight of the sheaves against it to drop them by automatic action. The free end of the gate is held by a strap w^2 or otherwise, which is engaged by a stud w^3, so it may be held to hold a number of sheaves as bound and when released discharge them. The slanting hinge-line w' is very important for this purpose. The holder is set across the path of the harvester and opens parallel with it when discharging. Being light it is easily returned and held when empty.

The platform C has the space under it inclosed by a bottom x to hold loose grain falling through slots c', which grain may be saved by removing it through an opening at intervals.

Having thus described my improvements, it may be proper to state some particulars of construction which experience has shown to be expedient. The tying-hook is by preference formed of steel and tempered, so that it is both strong and somewhat elastic. The point of the hook should be bent slightly forward in the direction in which the hook is rotated, Fig. 12, such bending facilitating the holding of the binding-cord. The head of the hook also should be beveled from both its rear and front edges, so as to facilitate the escape of the loop of cord over it. One of the flat sides of the hook—viz., that which slides in contact with the roughened side of the sheath—should be a plane surface, so that the hook-stem will crowd the cord strongly against the adjacent side of the sheath. The opposite side of the shank should be reduced in the vicinity of the head, so that the hook may spring or yield laterally and thus accommodate itself to variations in the size of the cord drawn in between the hook-stem and the adjacent roughened side of the sheath and may hold the cord with a yielding or spring pressure. The roughening of the side of the sheath is not essential, but is expedient. When the latch of the hook is opened or turned backward, its end should be only about far enough

out of the slot in which it is pivoted to insure its being acted upon by the loop of cord when the hook is drawn backward through the loop. The end of the hook-sheath should be rounded to facilitate the passage of the cord-loop off of it.

The point of the holding-hook Q should form an acute angle with its stem, so as to hold the cord more securely. It is also expedient to form a small notch in the side of the head of the holding-hook, so that the cord may engage in this notch and that the retrograde movement of the binder-arm may not draw the cord over the point of the hook. As the holding-hook slides in a socket or sheath and the bight of cord is drawn into this sheath by the backward movement of the holding-hook and is thus bent sharply around the corner of the end of the socket when the binding-arm retrogrades, and is also pressed between the side of the head of the holding-hook and the side of the socket, the end of the cord is securely held, although the holding-hook is fitted to slide freely in its socket or may become worn by use.

Various modifications may be made. The clasp-tying hook N, (sometimes called the "clasp-hook,") mentioned in the foregoing description, is not every kind of hook composed of two parts which are either pivoted together or are otherwise connected, so as to move toward and from each other, but is a peculiar implement, which, as represented in the accompanying drawings, is distingushed by the following characteristics, viz: It is composed of a hook-ended piece of metal and a clasp *n*, Fig. 16. The mean line of the hook, as indicated by the dotted line n^{13}, Fig. 16, extends in the direction of the longitudinal axis upon which the device as a whole is fitted to turn and also in the direction in which the implement is constructed to move through the loop of cord or twine to be tied. The clasp *n*, Fig. 16, is pivoted to the shank of the hook-ended piece, so that the hook projects beyond the clasp-pivot, and this pivotal connection permits the clasp to swing in one direction to cover the point of the hook, close the opening thereof, and guide the loop over the hook and also permits the clasp to swing in the reverse direction to open the hook and permit it to engage with the cord. Whenever, therefore, the "clasp-tying hook" is recited in the claims hereinafter stated, it is to be understood that the implement is not every device which might be abstractly called by that name, but that it is the particular implement having all the above-named characteristics, which it is therefore useless to recite in each claim in which the clasp-tying hook is recited.

Having thus described my invention, what I claim is—

1. In a grain-binding harvester, the combination of the platform, a raking mechanism, an upwardly-inclined deck on which the grain received from the raking-platform is bound, and a binding mechanism adapted to travel with and bind the grain while moving on said deck.

2. In a grain-binding harvester, the combination of the platform, a raking mechanism, an upwardly-inclined deck on which the grain received from the raking-platform is bound, mechanism to elevate the grain on the deck, and binding mechanism adapted to travel with and bind the grain while being elevated.

3. In a grain-binding harvester, the combination of the platform, a raking mechanism, an upwardly-inclined deck on which the grain received from the raking-platform is bound, mechanism for separating and compressing the grain into bundles and elevating it on the deck, and binding mechanism adapted to travel with and bind the grain while being elevated.

4. In a binding mechanism, the combination with a cord tier or knotter, of a receptacle for holding the balls of cord, said receptacle having expansible and adjustable walls.

5. A cord-holder consisting of a receptacle to contain the ball, with means whereby its capacity can be varied by adjusting the sides to and from the center for different-sized balls.

6. In a cord-holder for grain-binders, a bottom, sides to retain the balls on the bottom, and a device whereby the sides of the holder may be adjusted to and from the center for large and small balls.

7. In combination, to form a cord-holder, a bottom or support for the balls, an envelop to retain the balls thereon, said envelop being composed of a sheet of metal attached to the bottom of the holder at its lower edge, and having its upright edges overlapping, and means whereby the meeting edges of the metal sheet may be adjusted and secured with respect to each other so as to enlarge or decrease the diameter of the holder.

8. In a cord tying or knotting mechanism, the combination of a rotary hook having a pivoted latch, with a latch-opener, the latter adapted to engage the latch forward of its pivot as the hook rotates, so as to open said latch.

9. In a harvester, the combination of the main supporting-wheel supported and adjusted in guides on the main frame, the grain-wheel, a shaft mounted in bearings on the machine-frame, said shaft having different diameters, and connections between the said shaft and the main and grain wheels, that leading to the main wheel being connected with the larger diameter of the shaft.

10. In a harvester, the combination of the main supporting-wheel, the grain-wheel, a winding-shaft mounted in bearings on the machine-frame, said shaft having winding portions or drums of different diameters, and flexible connections between said shaft and the main and grain wheels, that leading to the main wheel being connected with the larger diameter of the shaft.

11. In a harvester, the combination of the

main supporting-wheel, gear-racks on the machine-frame with which pinions on the wheel-axle engage, the grain-wheel journaled on an arm pivoted to the machine-frame, a winding-shaft having winding portions or drums of different diameters, a flexible connection extending from the larger diameter of said shaft to the main-wheel axle, and a similar connection leading from the smaller diameter of the shaft to the arm of the grain-wheel.

In witness whereof I have hereto set my hand this 25th day of April, A. D. 1879.

WILLIAM WORTH BURSON.

Witnesses:

P. W. KELLY,

L. PHILLIPS.