(Model.) 10 Sheets—Sheet 1.

W. M. CLARK.

GRAIN BINDER.

No. 379,365. Patented Mar. 13, 1888.

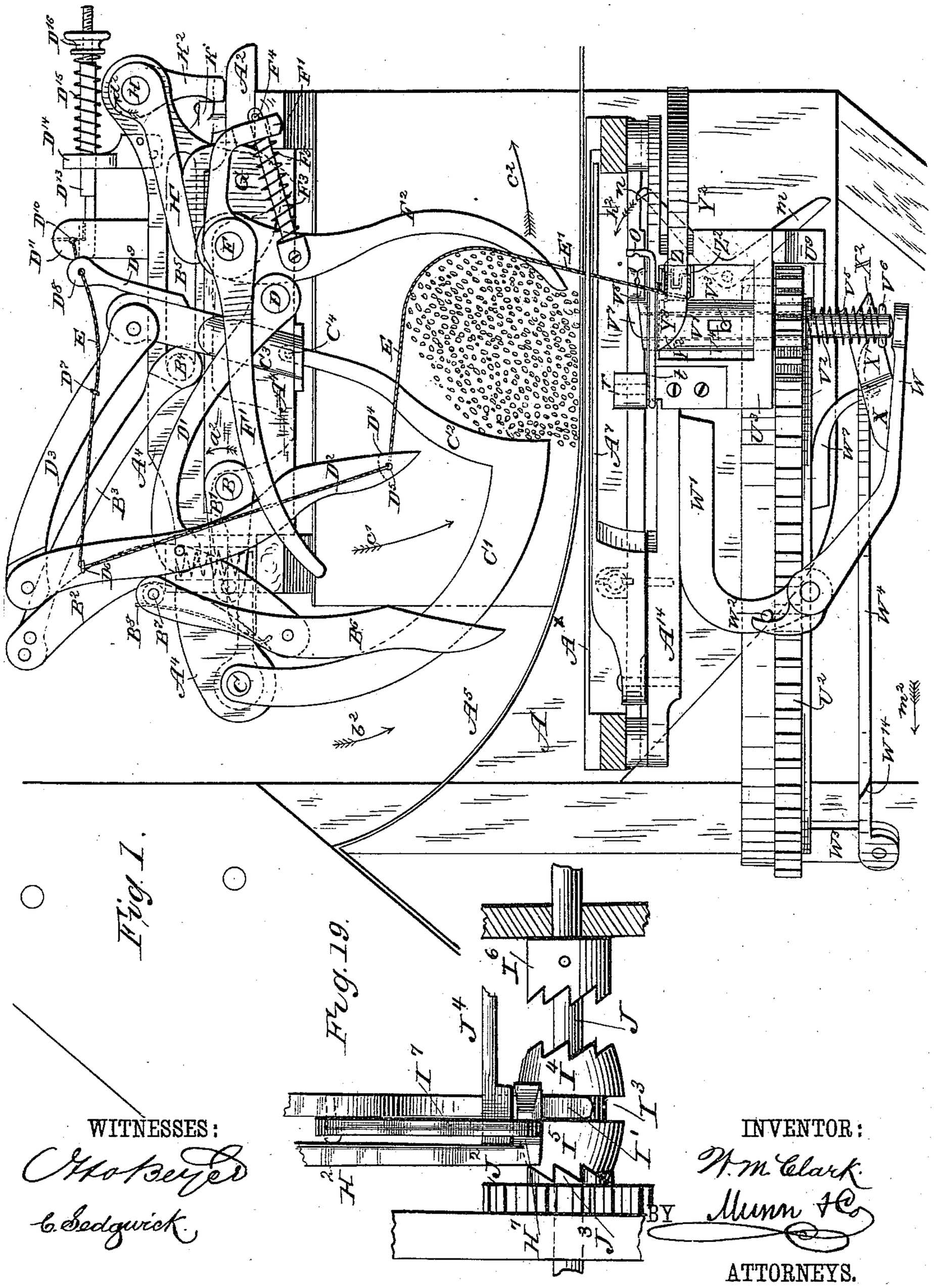

Fig. 1.

Fig. 19.

WITNESSES:

H. Hopkins

C. Sedgwick.

INVENTOR:

W. M. Clark.

BY Munn & Co

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(Model.)

10 Sheets—Sheet 2.

W. M. CLARK.

GRAIN BINDER.

No. 379,365. Patented Mar. 13, 1888.

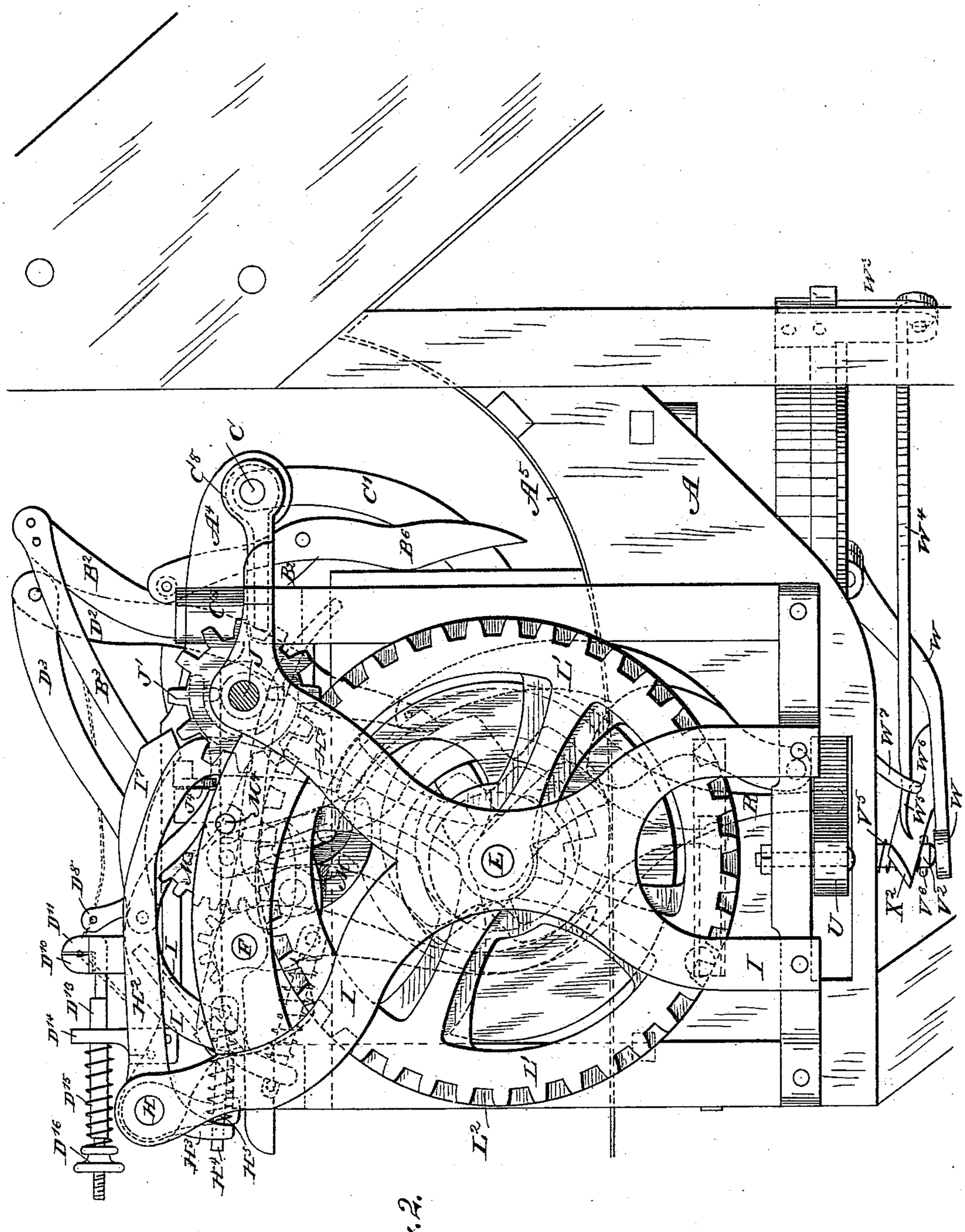


Fig. 2.

WITNESSES:

H. Hopkins

C. Sedgwick.

INVENTOR:

W. M. Clark.

BY Munn & Co

ATTORNEYS.

(Model.)

10 Sheets—Sheet 3.

W. M. CLARK.

GRAIN BINDER.

No. 379,365. Patented Mar. 13, 1888.

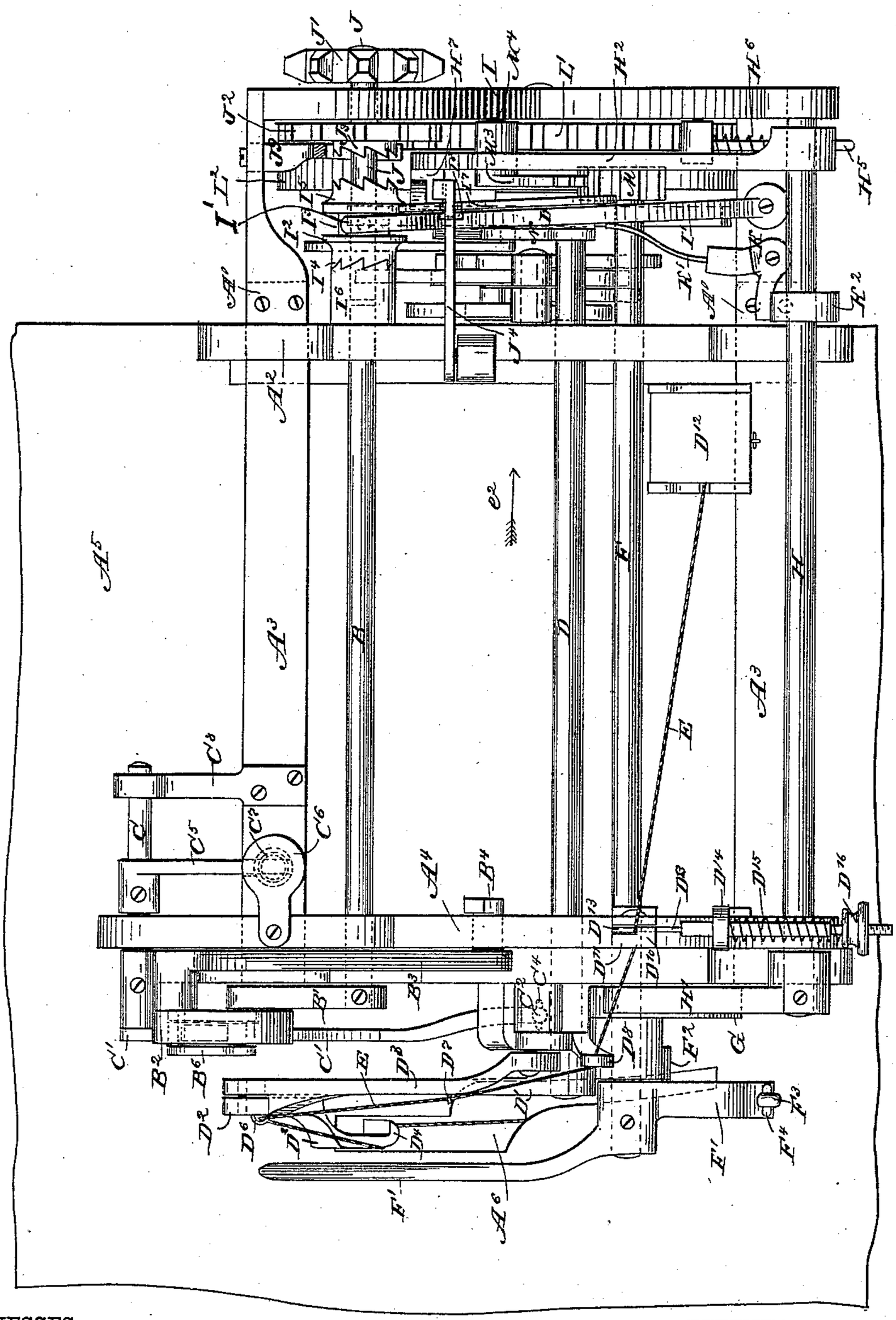


Fig. 3.

WITNESSES:

A. Bruce Beyer

C. Sedgwick.

INVENTOR:

W. M. Clark.

BY Munn & Co.

ATTORNEYS.

(Model.) 10 Sheets—Sheet 4.

W. M. CLARK.

GRAIN BINDER.

No. 379,365. Patented Mar. 13, 1888.

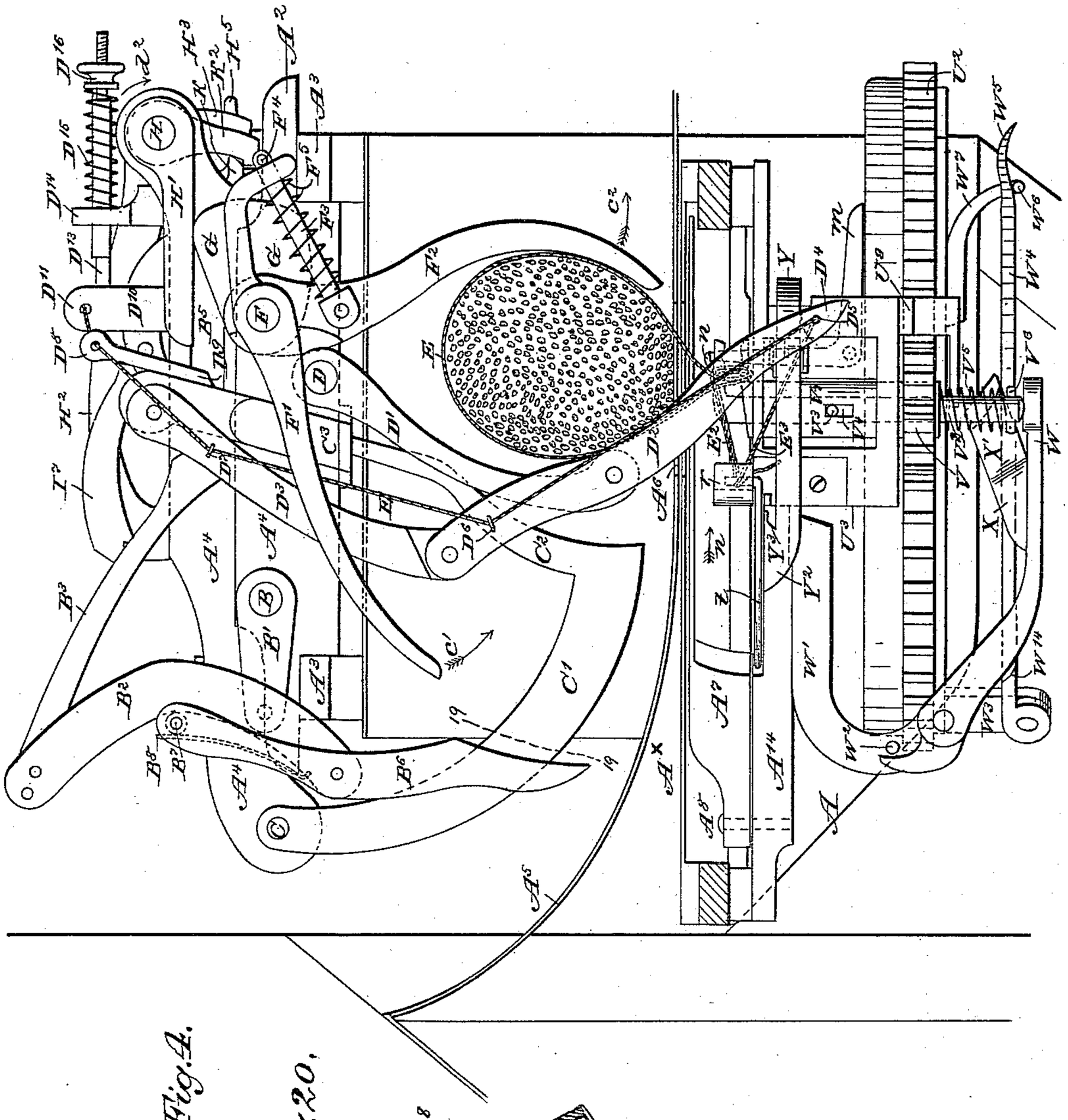


Fig. 4.

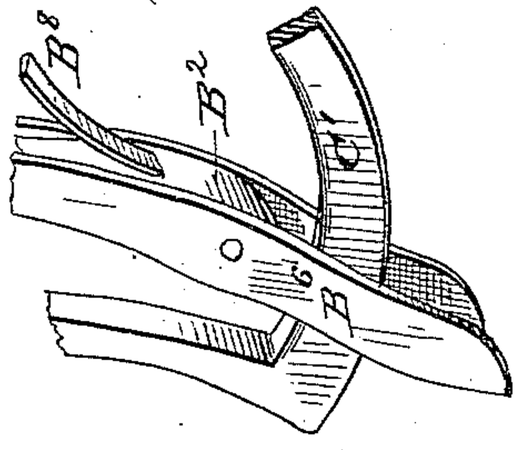


Fig. 2.

WITNESSES:

Otto Beyer

C. Sedgwick.

INVENTOR:

W. M. Clark.

BY Munn & Co.

ATTORNEYS.

(Model.) 10 Sheets—Sheet 5.

W. M. CLARK.

GRAIN BINDER.

No. 379,365. Patented Mar. 13, 1888.

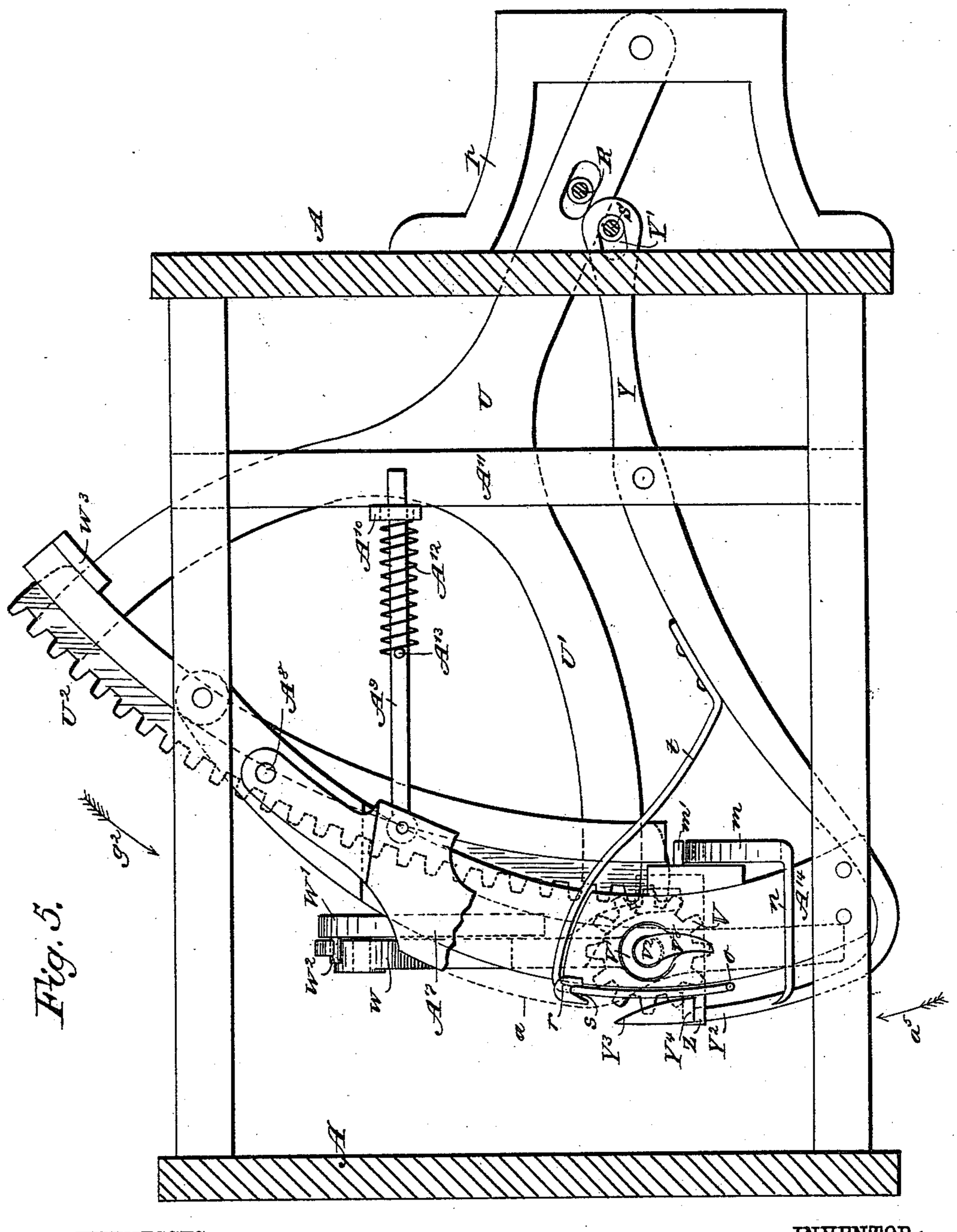


Fig. 5.

WITNESSES:

Fred Beyer

C. Sedgwick.

INVENTOR:

W. M. Clark.

BY Munn & Co

ATTORNEYS.

(Model.) 10 Sheets—Sheet 6.

W. M. CLARK.

GRAIN BINDER.

No. 379,365. Patented Mar. 13, 1888.

Fig. 2.

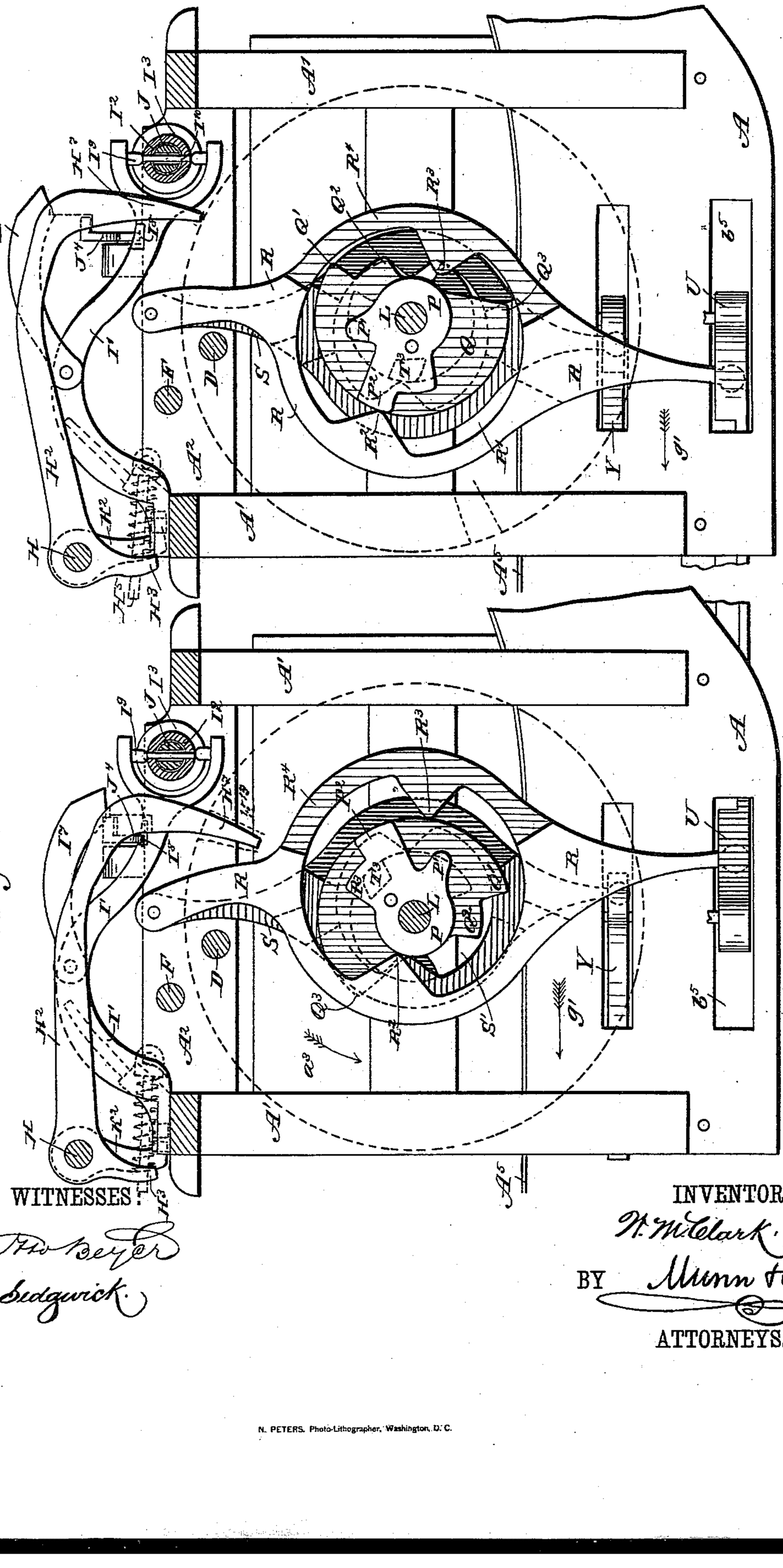


Fig. 6.

WITNESSES:

Fred Beyer

C. Sedgwick.

INVENTOR:

W. M. Clark.

BY Munn & Co

ATTORNEYS.

(Model.) 10 Sheets—Sheet 7.

W. M. CLARK.

GRAIN BINDER.

No. 379,365. Patented Mar. 13, 1888.

Fig. 9.

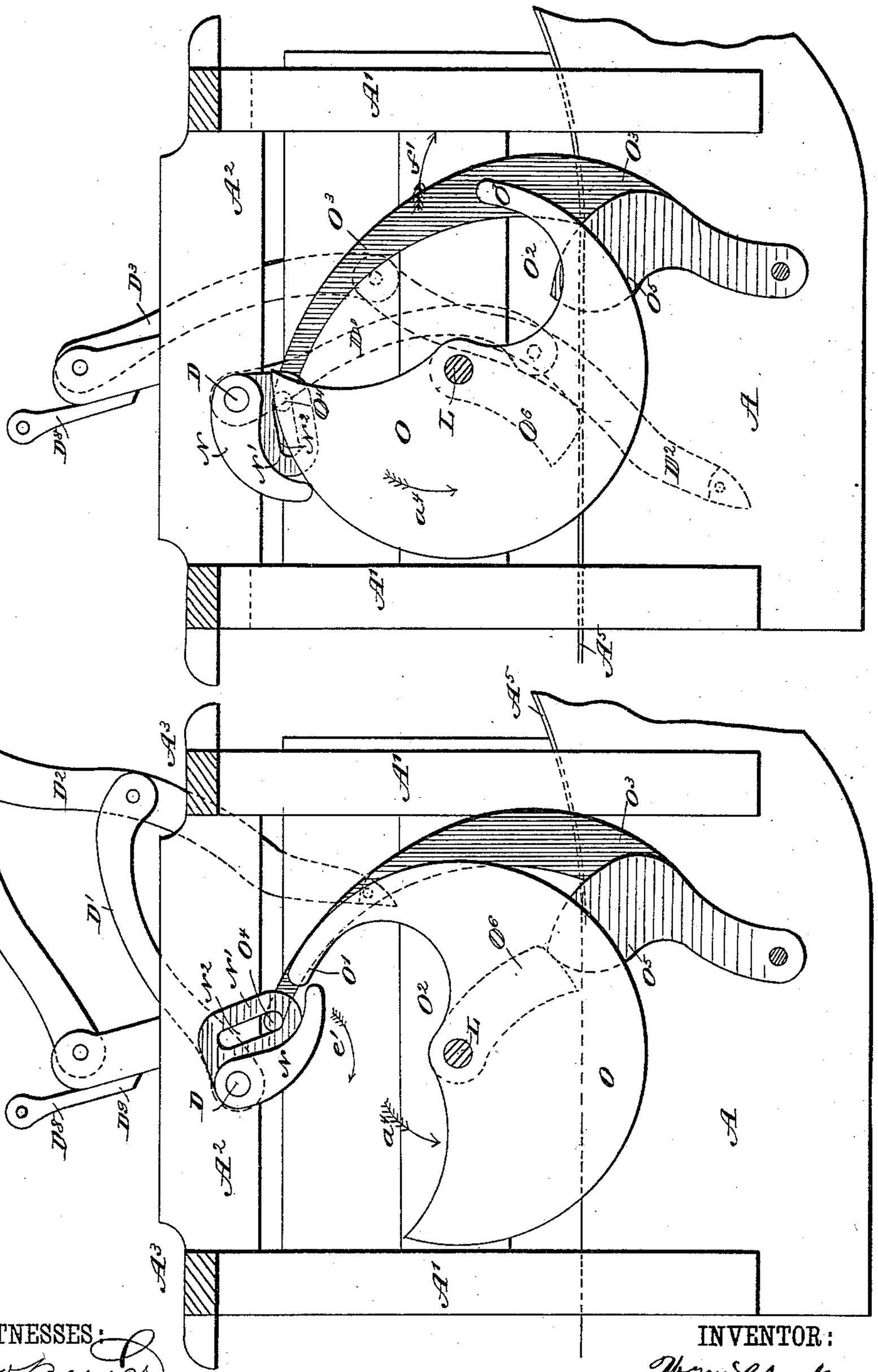


Fig. 8.

WITNESSES:

A. D. Beyer

C. Sedgwick.

INVENTOR:

W. M. Clark.

BY Munn & Co

ATTORNEYS.

(Model.) 10 Sheets—Sheet 8.

W. M. CLARK.

GRAIN BINDER.

No. 379,365. Patented Mar. 13, 1888.

Fig. 11.

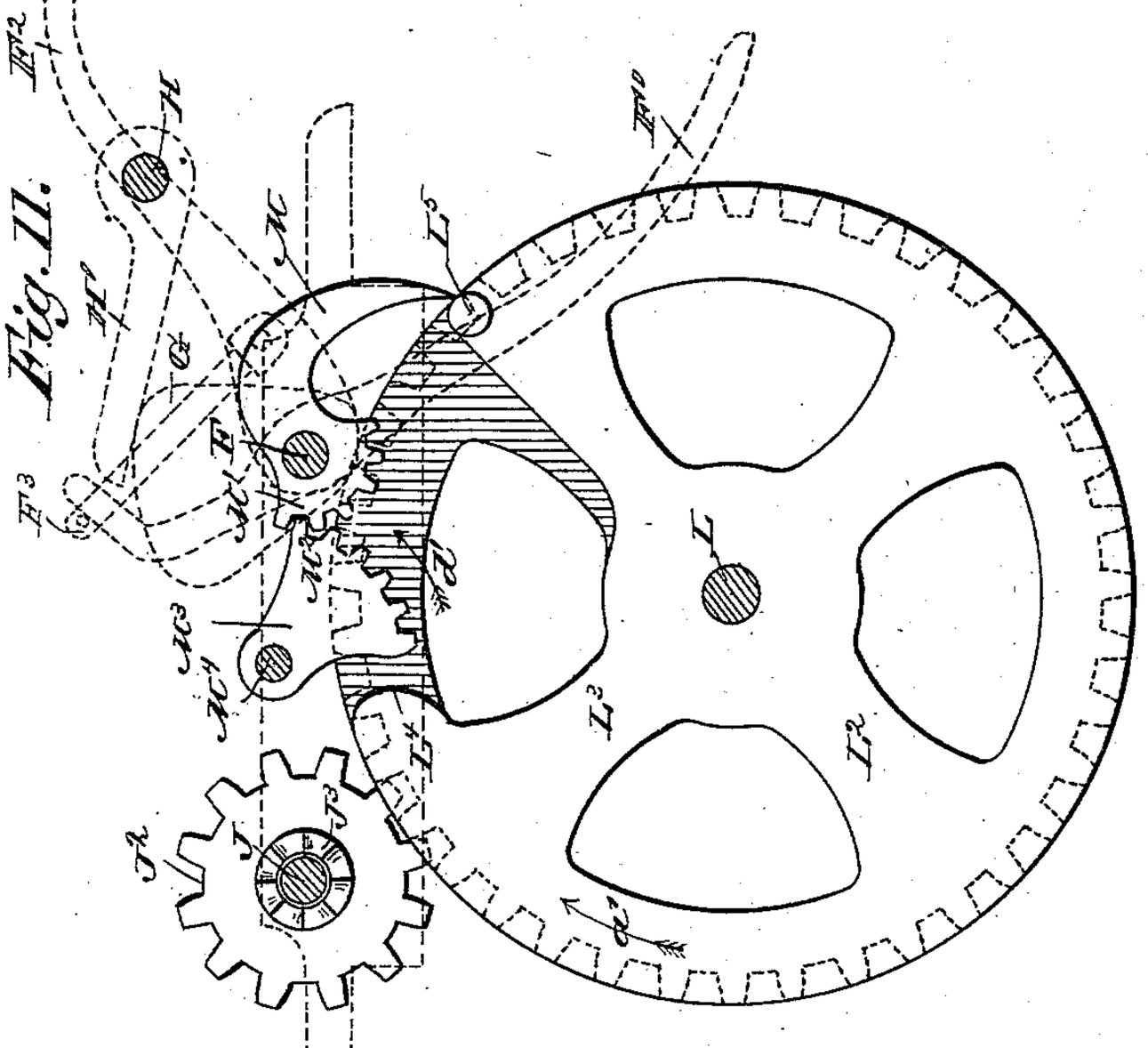
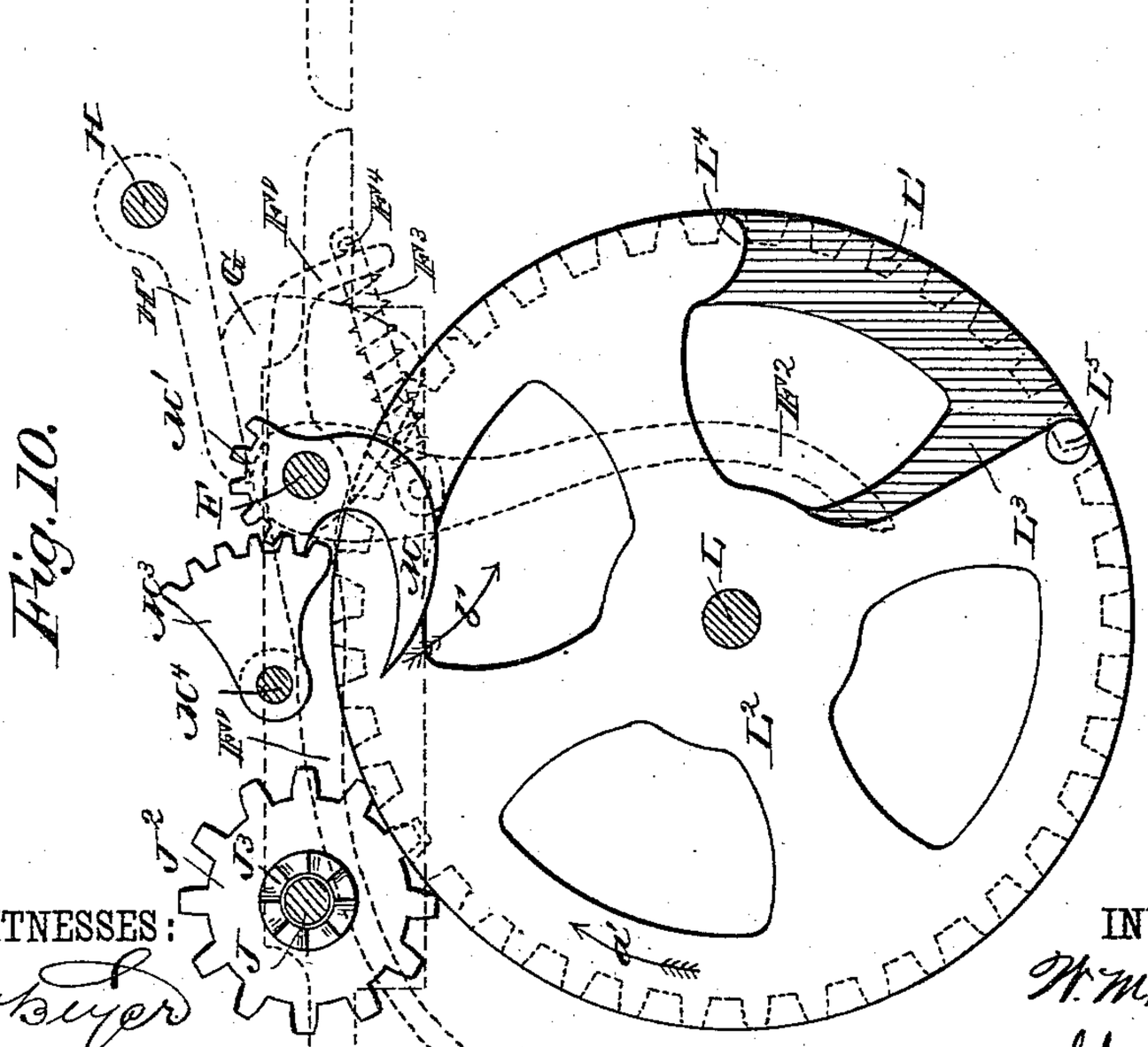


Fig. 10.



WITNESSES:

R. F. Bayer

C. Sedgwick.

INVENTOR:

W. M. Clark.

BY Munn & Co

ATTORNEYS.

(Model.)

10 Sheets—Sheet 9.

W. M. CLARK.

GRAIN BINDER.

No. 379,365. Patented Mar. 13, 1888.

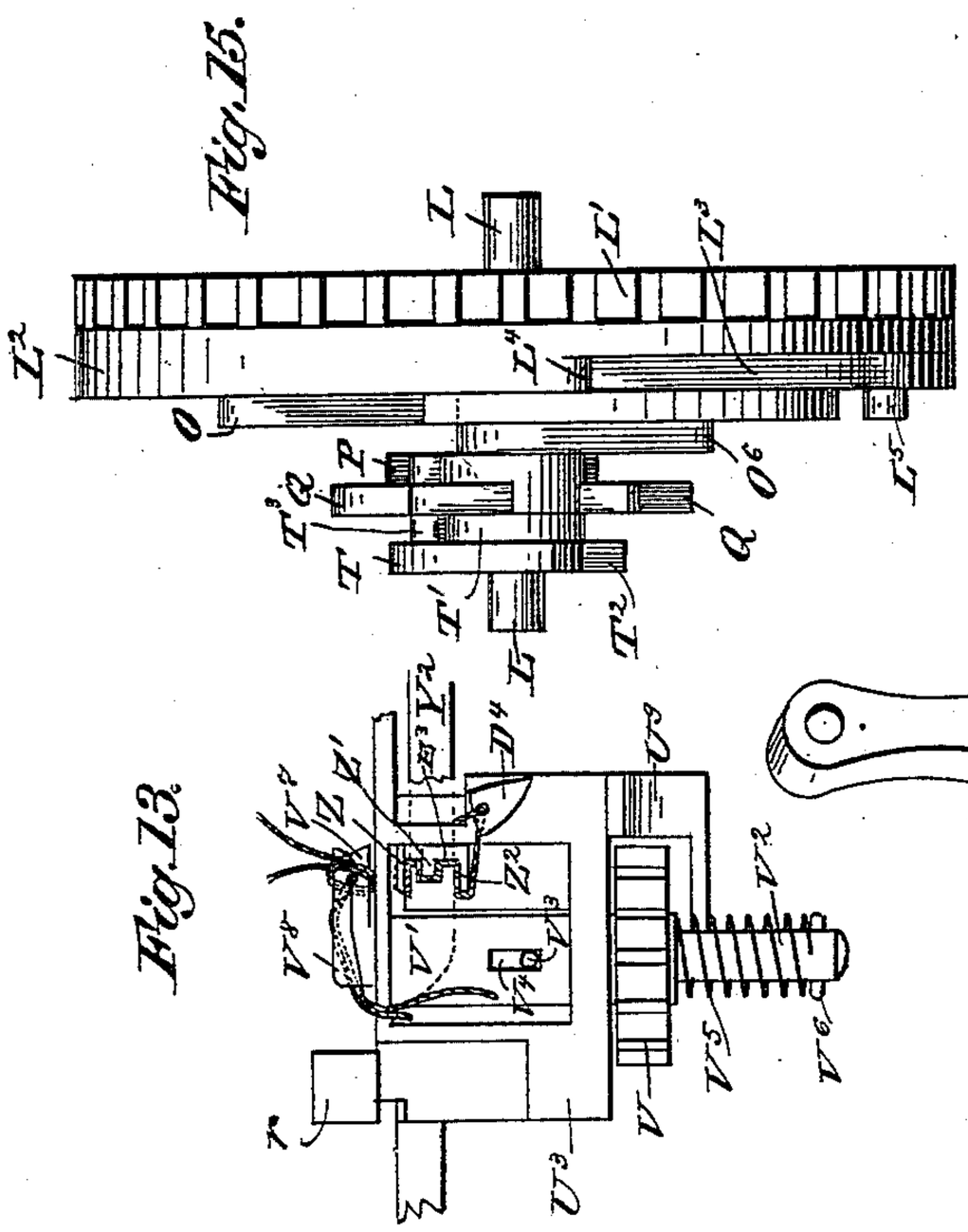


Fig. 13.

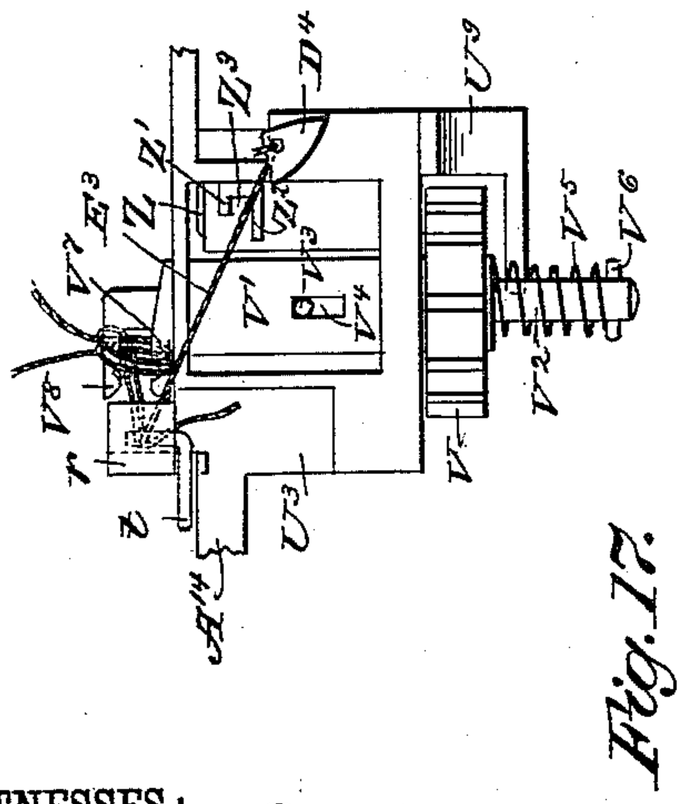


Fig. 12.

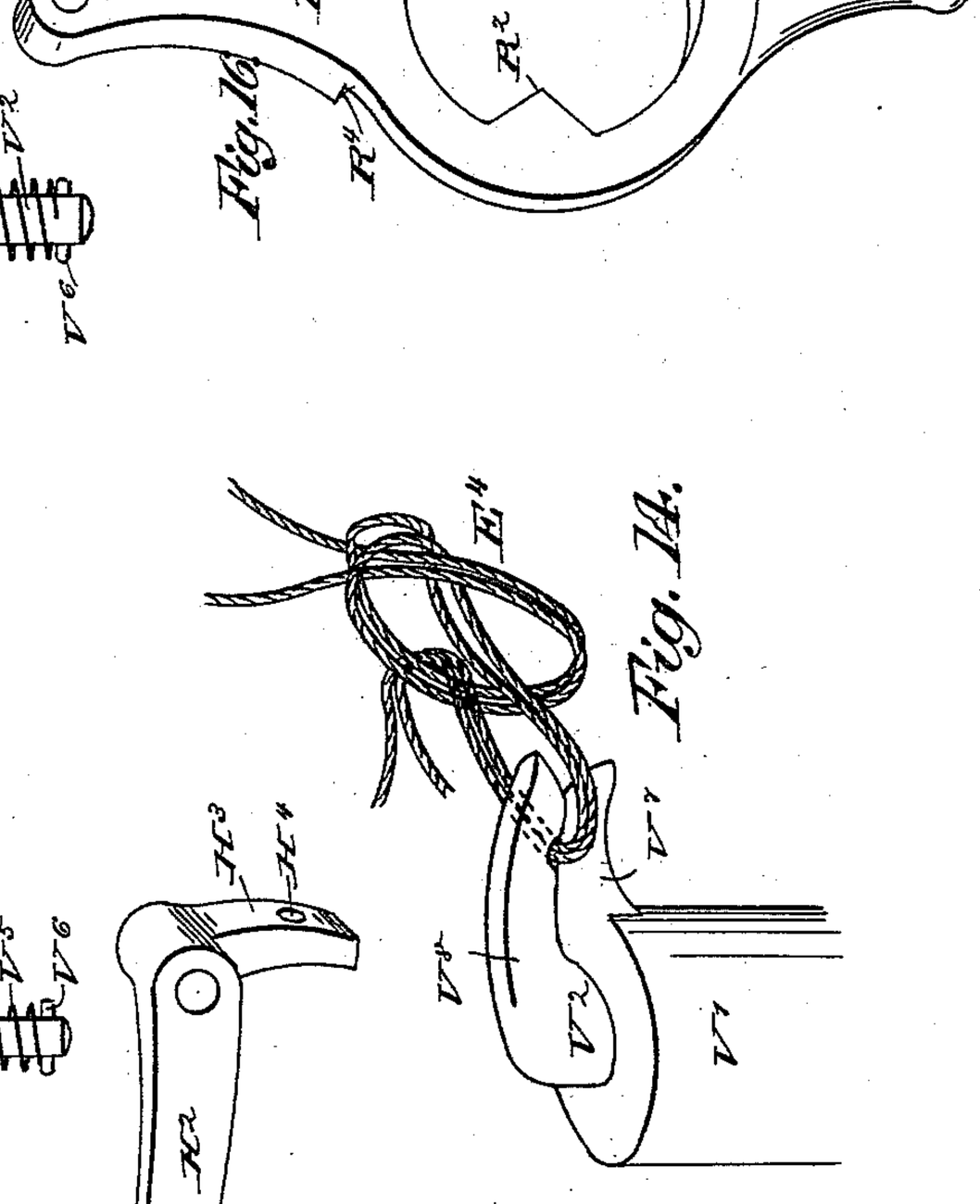


Fig. 16.

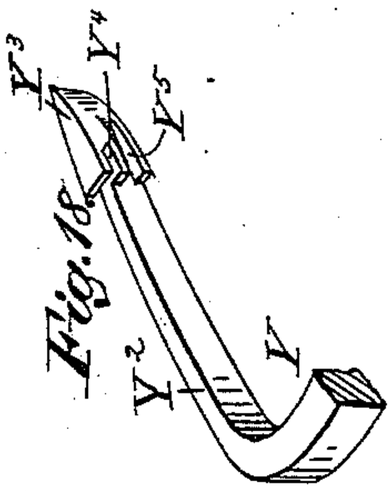


Fig. 18.

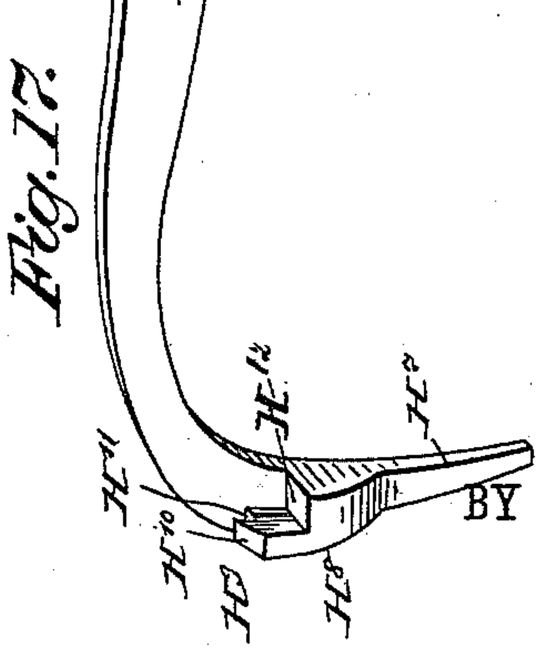


Fig. 17.

Fig. 14.

WITNESSES:

Peter Bayer.

C. Sedgwick.

INVENTOR:

W. M. Clark

BY Munn & Co

ATTORNEYS.

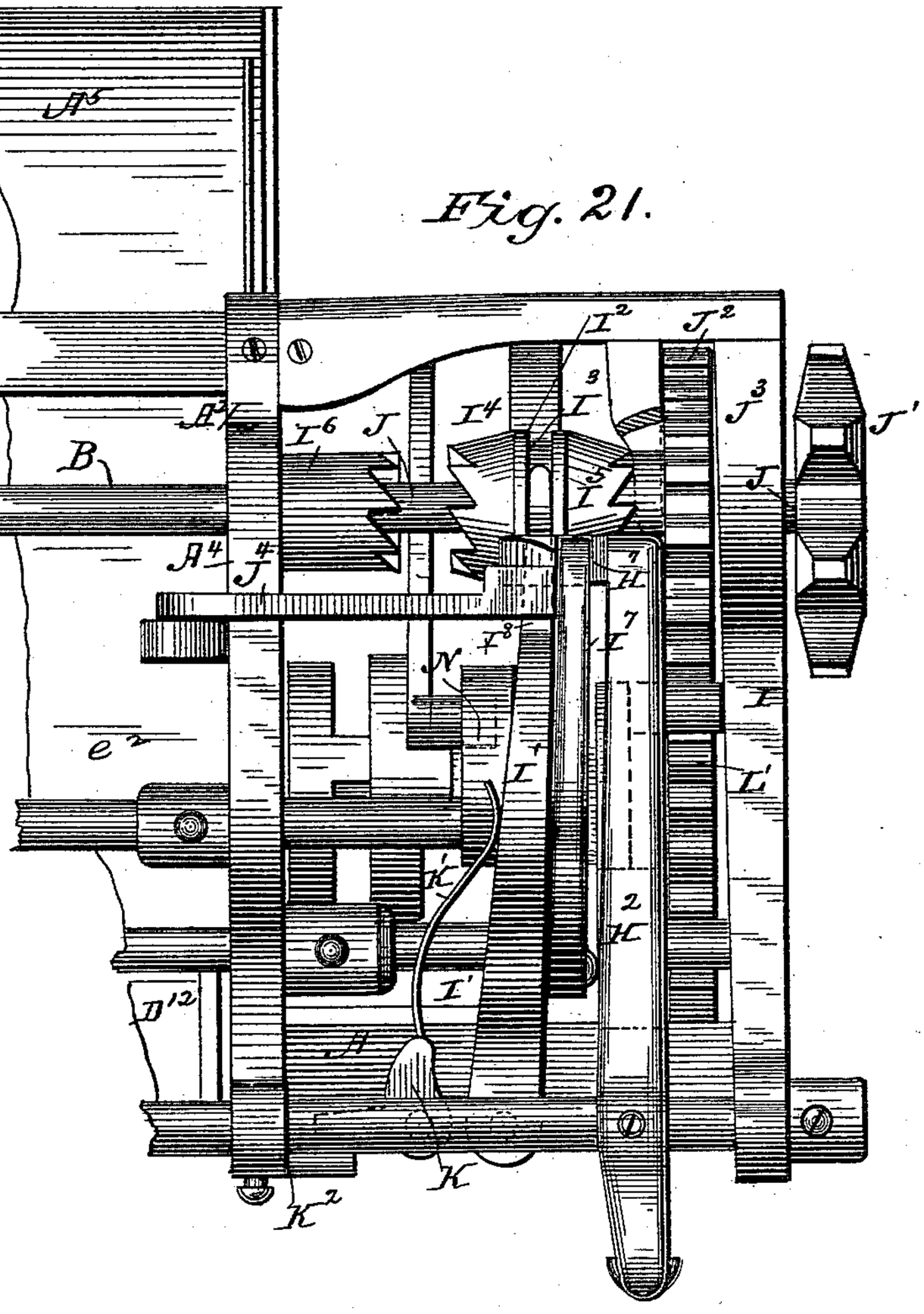
(Model.) 10 Sheets—Sheet 10

W. M. CLARK.

GRAIN BINDER.

No. 379,365. Patented Mar. 13, 1888.

Fig. 21.



WITNESSES:

C. Sedgwick.

J. M. Ritter.

INVENTOR:

W. M. Clark.

BY Munn & Co

ATTORNEYS.

UNITED STATES PATENT OFFICE.

WILLIAM M. CLARK, OF BOSCOBEL, WISCONSIN.

GRAIN-BINDER.

SPECIFICATION forming part of Letters Patent No. 379,365, dated March 13, 1888.

Application filed December 21, 1885. Serial No. 186,256. (Model.)

To all whom it may concern:

Be it known that I, WILLIAM M. CLARK, of Boscobel, in the county of Grant and State of Wisconsin, have invented a new and Improved Twine Grain-Binder, of which the following is a full, clear, and exact description.

This invention relates to certain new and useful improvements in twine grain-binders; and the object of my invention is to simplify the construction and make the machine compact and the operation more simple.

The invention consists in the construction and combination of numerous parts and details, as will be fully described and set forth hereinafter, and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a general end view of my improved grain-binder, showing the packer-needle, the ejector, and the knotter. Fig. 2 is a general view of the other end of the grain-binder, showing the mechanism for driving the different parts. Fig. 3 is a plan view of my improved grain-binder. Fig. 4 is an end view similar to Fig. 1, showing the manner in which the twine is drawn tightly around the bundle and knotted. Fig. 5 is a sectional plan view of my improved binder, showing the device for forming the loop and knot, parts being broken out. Figs. 6 and 7 are cross sectional views of my improved grain-binder at one end, showing the cams and mechanism for operating the device for forming the loop and knot. Figs. 8 and 9 are cross-sectional views of one end of the machine, showing the cams that operate the twine-carrier. Figs. 10 and 11 are cross-sectional views of my improved binder, showing the mechanism for operating the ejector. Figs. 12 and 13 are detail side views of the knotting device, showing different positions of the parts. Fig. 14 is a perspective view of the knotter-bill. Fig. 15 is a detail end elevation of the several cams at one end of the binder. Fig. 16 is a detail perspective view of one of the cam-levers for operating the knotting device. Fig. 17 is a detail perspective view of a lever forming a part of the clutch-operating mechanism. Fig. 18 is a perspective view of the twine-holder formed on the end of the angle-lever. Fig. 19 is an enlarged detailed view of the clutch mechanism. Fig. 20 is a front elevation in part of the packer-arms and their guide. Fig. 21 is a plan view of the clutching and tripping mechanism, said view being taken at the bar A^2 in Fig. 3.

The grain-binder is supported on two brackets, A, on one of which uprights A′ are secured, which are united at the top by a cross-piece, A^2, from which the bars A^3 project over the frame, uniting the brackets, which bars A^3 are united at their free ends by a cross-bar, A^4. On the base-frame a platform, A^5, is secured, which is curved, as shown in Fig. 1, and down which the grain to be bound slides, the grain being delivered upon the said platform by the reaper to which the binder is attached. The said platform A^5 has a slot, A^6, Fig. 4, through which the needle can pass. A flat cross-piece, $A^\times$, is provided below the platform A^5, and has a slot corresponding to the slot in the platform A^5. A laterally-swinging plate, A^7, (shown partly in full and partly in dotted lines in Fig. 5,) is pivoted by the pivot A^8, and is adapted to swing directly under the piece A^6 and to close the slot in the same, to prevent dirt, &c., from passing through said slot into the lower part of the machine. A rod, A^9, is pivoted to the swinging plate A^7 and guided in an eye, A^{10}, on one of the cross-bars, A^{11}, of the frame of the machine. A spiral spring, A^{12}, surrounds the rod A^9 between the guide A^{10} and a cross pin, A^{13}, on the said rod A^9. The needle, when it enters the slot in the platform, acts on the edge *a* of the laterally-swinging plate A^7 and presses the same toward the right, Fig. 5, whereby the spring A^{12} is compressed, and when the needle leaves the slot the spring A^{12} expands and throws the plate A^7 under the slot again. The said laterally-swinging plate is also shown in Figs. 1 and 4.

In the cross pieces A^2 and A^4 of the machine the four shafts B, D, F, and H are journaled. On that end of the shaft B projecting beyond the cross-piece A^4 a crank, B′, is mounted, on the free end of which a curved lever, B^2, is pivoted about one fourth of the length of said lever from its lower end. To the upper end of said curved lever B^2 an arm, B^3, is pivoted,

which carries on its free end a pin, B^4, provided with a roller which runs in a longitudinal slot, B^5, extending from side to side in the cross bar A^4. To the lower end of the curved lever B^2 two tines or teeth, B^6, are pivoted, one on each side, the said tines being pivoted at about the middle of their length. They are pointed at their lower ends, and their outer edges are concave directly above the points, and their inner edges, or the edges facing the harvester, are convex, as is shown in Figs. 1 and 4. The upper ends of the tines B^6 are united by a cross-pin and roller or spool, B^7, against which the free end of a spring, B^8, rests, which has its other end secured in the lower end of the curved lever B^2, and thereby the upper ends of the tines are pressed against the inner angle of the lever B^2.

On the outer end of the cross-piece A^4 a short shaft, C, is journaled, to the outer end of which a quadrant runner or guide, C′, is secured, which is curved from the inner end of the cross-piece A^4 downward and toward the longitudinal central plane of the machine, and is provided on its free end with an upwardly-projecting arm, C^2, which is curved more or less and passed into a pocket, C^3, on the outer side of the cross piece A^4, which pocket is open at the bottom and closed at the top. The arm C^2 is provided at its upper end with a cross-pin, C^4, within the pocket, which cross pin is of such size that when the runner or guide C′ is lowered as much as is necessary the said cross-pin C^4 strikes a stop at the bottom of the pocket C^3 and prevents the further descent of the guide C′.

On that end of the shaft C projecting from the inner side of the cross-piece A^4 the arm C^5 is mounted, which projects into an upright hollow casing, C^6, on one of the longitudinal top bars, A^3, the said casing having a vertical slot through which the end of the arm C^5 can pass. A spiral spring, C^7, is held between the top of the casing and the end of the arm C^5, and presses the end of the arm C^5 downward, thereby pressing the guide C′ downward, as said guide is rigidly mounted on the end of the shaft C. The inner end of the shaft C is preferably journaled in a bracket, C^8, projecting from the top longitudinal bar, A^3, so as to give the shaft more stability.

On the end of the shaft D an arm, D′, is secured, and to the end of said arm D′ the needle D^2 is pivoted at or near the center of the length of said needle. The upper end of the needle is pivoted to a connecting-bar, D^3, which in turn is pivoted to the cross-bar A^4, or a projection of the same. The needle is provided at its lower end with a lug, D^4, projecting from the inner side, and in said lug D^4 an eye, D^5, is formed, through which the twine E is passed. A guide-eye, D^6, is formed on the side of the needle D^2, near the upper end of the same. A guide-eye, D^7, is secured on the outer side of the connecting-bar D^3, and a twine-guide, D^8, is formed on the upper end of a piece, D^9, secured on the cross-bar A^4. The twine E is held in the twine-box D^{12}, and passes from the same through an eye, D^{10}, on a standard, D^{11}, the guide-eyes D^7 and D^8, and the eye D^5. A sliding hook, D^{13}, is passed through a vertical slot in the standard D^{11} and is passed through a standard, D^{14}. A spiral spring, D^{15}, surrounds the sliding hook D^{13} between the standard D^{14} and a nut, D^{16}, screwed on the outer threaded end of the hook D^{13}, by means of which nut the tension can be regulated. The spring presses the prong of the hook against the twine E as it passes through the guide D^{10}, and thus keeps the twine at the desired tension. This tension can be regulated by regulating the spring D^{15}.

On the end of the shaft F is the ejector, which consists of an ejector-arm, F′, secured rigidly on the end of said shaft F, and a compressor and trip, F^2, is also mounted loosely on said shaft. A bar, F^3, is pivoted on the compressor and trip F^2, passes through a slot on the upper end of the ejector F′, and is provided on its end with a cross-pin, F^4. A spiral spring, F^5, is coiled around the bar F^3 between the pivotal end of said bar and the upper end of the ejector F′, which spring presses the compressor and trip F^2 toward the ejector F′. A cam, G, is loosely mounted on the shaft F, but is rigidly connected with the compressor and trip F^2, so as to move with the same, which cam is outside of the cross-bar A^4. On said cam an arm, H′, rests, which is rigidly mounted on the end of the shaft H. On the opposite end of the shaft H an angular arm, H^2, is mounted rigidly, which is provided with a downwardly-projecting lug, H^3, at its outer end, having an aperture, H^4, through which a rod, H^5, passes, which is pivoted on the end piece, I, of the machine, and is surrounded by a spiral spring, H^6, acting against the end of said lug H^3, and thereby pressing the lever H^2 downward. The arm H^2 is provided on its free end with a downwardly-projecting lug or point, H^7, at the upper end of which is formed an upwardly-projecting beveled lug, H^8, which is stepped to form a shoulder, H^{12}, and a lug, H^9, which has a beveled top, H^{10}, between the inner end of which beveled top and the said arm H^2 a recess, H^{11}, is formed, all as is shown in detail in Fig. 17.

A forked lever, I′, Figs. 3, 6, and 7, is pivoted on one of the top bars of the machine-frame to swing laterally, and in its forked end is held the clutch-sleeve I^2, having an annular groove, I^3, into which pins I^9 on the prongs of the fork pass, which clutch-sleeve also has two clutch ends, I^4 and I^5. The clutch-sleeve is mounted to slide on a shaft, J, carrying at its outer end a sprocket-wheel, J′, over which the driving-chain is passed. On said shaft J a cog-wheel, J^2, is mounted, which is provided with a clutch-collar, J^3, adapted to engage with the clutch end I^5 of the sleeve I^2. On the end of the shaft B a clutch-sleeve, I^6, is rigidly mounted, the end of which is adapted to engage with the end I^4 of the clutch-sleeve I^2, and in said clutch-sleeve I^6 the end of the shaft J is mounted to turn. A pin, I^{10}, is passed

through the sleeve I^2 and through a longitudinal slot in the shaft J, so as to permit of sliding the clutch-sleeve I^2 on the shaft J, and at the same time causing the sleeve to revolve with the shaft J. To the lever I′ a latch, I^7, is pivoted, which can drop into the notch or recess H^{11} of the arm H^2 for locking said arm in place. A latch, J^4, is pivoted on the cross-piece A^2, and is provided with a hook adapted to pass into a notch, I^8, in the inner side of the lever I′, as shown in Figs. 6 and 7, which latch also engages with the lug H^{12} of lever H^2.

An angle-lever, K, is pivoted on one of the top bars, A^3, one end of which is provided with a spring-arm, K′, which rests against the side of the lever I′, Fig. 3. An arm, K^2, is rigidly secured on the shaft H, and projects downward in such a manner that its lower end is in contact with the other arm of the angle-lever K, as shown in Fig. 1.

On the shaft L, journaled in the end piece or bracket, I, and in an intermediate cross-piece of the machine, a cog-wheel, L′, is mounted, which engages with the above-mentioned cog-wheel J^2 on the shaft J. A cam-wheel, L^2, having the same diameter as the cog-wheel L′, is rigidly mounted on the shaft L. Said cam-wheel is provided with a recess, L^3, at one end of which a projection, L^4, is formed, which, however, does not project out of the plane of the wheel L^2, and at the other end of the recess the pin L^5 projects from the inner surface of said wheel.

On that end of the shaft F opposite the one on which the ejector is mounted the cam M is mounted, on the wider end of which a segmental rack, M′, is formed, which engages with a segmental rack, M^2, formed on the edge of a short lever, M^3, pivoted on a pin, M^4, on the inner surface of the end piece, I. The pin L^5 and cam M lie in the same plane, while the projection L^4 and lever M^3 lie in a different plane from that of the former parts. The wheel L^2 revolves in the direction of the arrow *a′*, Fig. 10, the wheel L′ being revolved by the cog-wheel J^2 on the shaft J and the wheel L^2 revolving with the wheel L′. When the wheel revolves, the pin L^5 strikes the cam M and swings the same in the direction of the arrow *b′*, Fig. 10, whereby the shaft F, on which the cam M is mounted, is thrown in such a manner as to swing the arm F^2 of the ejector in the direction of the arrow *c′*, Figs. 1 and 4. The cam M is finally brought into the position shown in Fig. 11, and as the wheel L^2 continues to revolve, the projection L^4 at that end of the recess L^3 opposite the one at which the pin L^5 is located strikes the lever M^3 and swings the same in the direction of the arrow *d′*, Fig. 11, whereby the cam M is swung in the inverse direction of the arrow *b′* as the segmental rack on the end of the lever M^3, engaged with the segmental rack on the end of the cam M, and thus the cam M is brought back into the position it had, as shown in Fig. 10, in which position it remains until the cam wheel L^2 has made another revolution, when the pin L^5 again strikes the cam and the ejector is again operated, and so on.

On that end of the shaft D opposite the one on which the arm D′ is secured a cam-arm, N, is formed, which is provided with a lateral projection, N′, having a slot, N^2. On the shaft L a cam, O, is mounted, which is provided with a prong, O′, at one side of a recess, O^2, formed in the cam O. A lever, O^3, is pivoted on the frame of the machine, and is provided at its upper end with a pin, O^4, which passes into the slot N^2 of the arm N. Said lever O^3 is provided on its lower end with a cam projection, O^5, which is on the side of the lever O^3. A cam, O^6, is rigidly mounted on the shaft L adjacent to the cam O. When the cam O revolves in the direction of the arrow a^4, Fig. 8, which is the same as the direction of the arrow *a′*, Fig. 10, the prong O′ strikes the end of the cam-arm N and swings the said cam-arm in the direction of the arrow *e′*, Fig. 8, whereby the shaft D is turned in the corresponding direction, and the arm D′ and the needle D^2 are swung down and remain lowered, as shown in dotted lines in Fig. 9, until the cam-edge of the cam O runs off of the cam-arm N. The cam O^6 then begins to act on the cam O^5 of the lever O^3 and presses the said lever O^3 in the direction of the arrow *f′*, Fig. 9, causing the pin O^4 on the end of said lever O^3, which pin works in the slot N^2, to swing the cam-arm N in the reverse direction of the arrow *e′*, whereby the shaft D is turned in such a direction as to cause the arm D′ to swing upward, whereby the needle D^2 is raised.

On the shaft L cams P and Q are mounted, of which the former, P, has the prong P′, the prong P^2, and the shoulder P^3. The cam Q has the corner Q′ and the shoulder or corner Q^2 and the straight part Q^3. Cam-levers R and S are pivoted on the frame, and are provided with the circular recesses or openings R′ and S′. The lever R is provided with two diametrically opposite beveled projections, R^2 and R^3, on the inner edges of the recess, as is shown in Figs. 6, 7, and 16. The lever R is provided with a recess, R^4, in each surface, said recesses being formed in opposite faces. The recess R^4 at the right-hand edge of the lever is in the outer face, and the recess at the left-hand edge is on the inner surface, as shown in Fig. 16. The cams P and Q are also in different planes, as is shown in Fig. 15. The cam P acts on the left-hand part of the lever R; but as the right-hand part is recessed in the outer surface the cam P can swing through said recess without acting on the lever. The cam Q acts on the right-hand part of the lever R, but does not act on the left-hand part, as the cam can swing through the recess R^4 in the left-hand part. When the cams are revolved in the direction of the arrow a^3, (corresponding to the direction of the arrow a^4 in Figs. 8 and 9 and *a′* in Figs. 10 and 11,) the parts P^2 and P^3, acting on the left-hand part of the lever R, swing the same in the direction of the ar-

row g'. During this time the cam Q passes through the left-hand recess, as shown in dotted lines, without acting. As the revolution in the direction of the arrow a^3 continues, the cam Q begins to act on the right-hand part of the lever R and swings the lever R in the inverse direction of the arrow g', whereby the lever R is reciprocated. As shown in Fig. 6, the cam Q is moving the lever R' in the inverse direction of the arrow g', and is acting on the projection R^3 at the right, and the projection R^2 at the left rests against the cam P. As shown in Fig. 7, the cam P is swinging the lever R in the direction of the arrow g' and has almost completed its stroke. When the stroke is completed, the projection R^2 of the lever snaps into the recess formed between the prong P' and the projection or part P^2 of the cam P. These shoulders and projections are formed in the cams for the purpose of having positive motion at all times—that is, the lever cannot swing or play in the inverse direction of that in which it is being moved. For example, in Fig. 6 the lever cannot be moved to the right—that is, in the direction of the arrow g'—as the projection R^2 rests against the cam P, and it can be moved in the inverse direction g' the proper distance, which is governed by the cam Q, as otherwise it would conflict with the edge of the cam P. The lever S is also recessed at opposite edges and opposite sides, and is acted on by the cams T T', which reciprocate it in the same direction as the lever R is reciprocated—that is, the projection T^2 swings it to the right and the projection T^3 swings it to the left, and so on. The lower end of the lever R is passed into an aperture in a lever, U, pivoted on the bracket p on one end piece, A, of the machine, which lever U swings in the horizontal plane and passes through a slot, b^5, in the bracket or supporting-piece A. A fork, U', is formed on the swinging end of the lever U, and a segmental rack, U^2, is secured on the ends of the prongs, which rack engages with a cog-wheel, V, mounted rigidly on a tubular spindle, V', mounted in a frame, U^3, projecting downward from a cross-piece, A^{14}, of the machine. Through the tubular spindle a spindle, V^2, projects, which is provided with pins V^3, passing through longitudinal slots V^4 in the spindle V'. The spindle V^2 is surrounded by a spiral spring, V^5, between the lower end of the spindle V' and a cross-piece, V^6, on the end of the spindle V^2. On the upper end of the spindle V' the knotting hook or jaw V^7 is formed, and on the upper end of the spindle V^2 the knotting hook or jaw V^8 is formed, which is above the hook V^7. The hooks or jaws V^7 and V^8 have notches in their inner edges short distances from the ends. The lower end of the spindle V^2 rests upon a lever, W, pivoted on an arm, W', extending downward from the cross-piece A^{14}, Fig. 4, of the frame. From the arm W' a pin, W^2, projects, against which the upper end of the lever W can strike, which pin is so located that the lever W has slight play. A lug, W^3, projects downward from the rack U^2 at one end of the same, and to said lug a track-lever, W^4, is pivoted, which has its end W^5 slightly beveled. The free end of this rests upon a pin, W^6, projecting laterally from an arm, W^7, secured to and projecting downward from the rack U^2.

On the top of the lever W a cam-piece, X, is formed, which is inclined upward and beyond the end of said lever. In the side adjacent to the spindle V^2 it is provided with a recess, X', and on the other side it is provided with a laterally-projecting beveled lug, X^2, Fig. 1. The rack U^2 runs over a hook-lug, U^9, projecting downward from the frame U^3, for the purpose of preventing the rack from sagging.

A lever, Y, is pivoted on the cross-piece A^{11}, and is provided at one end with a slot, Y', into which the lower end of the cam-lever S passes. The free end Y^2 of the lever Y is bent over in front of the rack U^2 and terminates in a hook, Y^3, provided on its top with a recess or notch, Y^4, for receiving the knife Z, projecting from the supporting-frame U^3. Two lugs, Z' Z^2, project from the supporting-frame U^3 directly below the knife Z, the upper lug, Z', being shorter than the lower lug, Z^2, and a notch, Z^3, is formed between them. The hook Y^3 on the end of the lever Y is also provided with a groove, Y^5, in its inner side, as shown in detail in Fig. 18. A lug, r, provided with a vertical V-shaped groove, s, projects upward from the supporting-frame U^3. The lug has its bottom recessed to permit a wire or rod, t, secured on the lever, Y, to pass under said lug, as shown in Figs. 5 and 12, which wire has its end bent upward to form a hook, o. An angle-lever, m, is pivoted on the inner side of the supporting-frame U^3, which is provided with a check-pin, m', against which the said lever can strike, which prevents the said lever m from being swung back too far. The lever m is provided on the upper end of its upwardly-projecting shank with an arm, n, projecting transversely over the supporting-piece A^4. The wheel J^2 is held in place so that it cannot shift by the forked piece J^9, Fig. 3.

The operation is as follows: In order to show the operation of the machine more clearly, I will first describe the formation of the bundle, the passing of the twine around the same by the needle, the discharge of the bundle, the mechanism for performing these operations, and then the operation of the mechanism for forming the loop and knot. The shaft J, which carries the sprocket-wheel J', is continually revolved by a chain, belt, or gearing, as may be desired, and revolves the clutch-sleeve I^2, which is engaged with the clutch-sleeve I^6, whereby the shaft B is revolved in the direction of the arrow a^2, Fig. 1, whereby the tines or prongs B^6 are moved up and down on a curved line as the bent lever B^2 is reciprocated by the crank-arm B' on the end of the shaft B, and the said tines are connected with said lever B^2. The upper end of the lever is guided by the arm B^3,

the end pin of which runs in the slot B^5—that is, the tines B^6 are moved downward in the direction of the guide C′, as indicated by the arrow b^2, Fig. 1, the lower prongs of the tines being slightly below the bottom edge of the guide and short distances from the curved platform A^5. The tines catch the grain that slides down the platform A^5 and push it in the direction of the arrow b^2 beyond the arm C^2 and against the compressor and trip F^2, the ejector F′ being raised, as shown in Fig. 1. The guide C′ can give slightly—that is, it can swing upward—whereby the arm C^5 is swung upward and compresses the spring C^7 in the casing C^6. After the grain has been forced beyond the lower end of the guide, the spring in the said casing forces the arm C^5 downward again, whereby the swinging end of the guide C′ is forced downward. The twine E extends from the arm Y upward to the needle D^2, and the grain is forced against the twine, as shown in Fig. 1. This operation is continued until the quantity of grain between the arm C^2 and the compressor and trip F^2 is so great as to swing the compressor and trip F^2 in the direction of the arrow c^2, Fig. 1, whereby the cam G is rocked and raises the arm H′, whereby the shaft H is revolved in the direction of the arrow d^2, Fig. 1. During all this time the clutch-sleeve I^2 has been held engaged with the clutch I^6 by the lever I′, which in turn is locked in place by the latch J^4, the end of which catches in the recess I^8 in the forked laterally-swinging lever I′, in which fork the sleeve I^2 is held. Then as the grain is pressed against the trip-arm F^2 the arm H′ is raised by the cam G, and the point or prong of the hook H^2 slowly rises out of the notch H^{13} of the cam-wheel L′, and the arm K^2 presses back the clutch-holding lever I′ by means of the bell-crank K. When a sufficient quantity of grain is packed against the compressor and trip-arm F^2 to raise the prong H^7 of the hook H^2 entirely out of the notch of the cam-wheel L′, the spring K′ is pressed tightly against the clutch holding lever I′. At the same time the shoulder H^{12} on the hook H^2 strikes the projection of the latch J^4, beginning to lift said latch, the grain being continually packed against the compressor and trip-arm F^2 until the hook H^2 raises the latch J^4 wholly out of the notch I^8 in the clutch-holding lever I′. The latch I^7 is provided with a shoulder or pin that holds the latch the proper height to strike the bevel H^{10} on the hook H^2 and latches itself into the notch H^{11} of the said hook when the latter is at its highest point. When the hook H^2 has been lifted out of the notch in the cam-wheel or to its highest point, or nearly so, by the pressure of the grain upon the trip-arm F^2, the spring K′ is compressed against the side of the clutch-holding lever I′, so that when this is released from the latch J^4 the spring K′ throws the clutch-holding lever I′, carrying the latch I^7, from the clutch operating the packer to the clutch operating the binder, when the latch I^7 strikes and slides up on the bevel H^{10} and latches itself into the notch H^{11} in the hook H^2. The combined action of the lever I′ and the latch I^7, secured to it, holds the hook H^2 in its elevated position, the former bearing against the point or prong H^7 at its beveled side, while the latter bears oppositely against the outer side of the notch H^{11} of the hook H^2, thus holding the hook in equilibrium. The spring H^6, surrounding the rod H^5 and pressing against the lug or prong H^3 of the hook H^2, presses the prong or point H^7 of said hook upon the rim of the cam-wheel A′ now in action, so that when the notch in the cam-wheel arrives opposite the point or prong H^7 the latter will snap into the said notch, thus arresting further movement of the cam-wheel. The said point or prong H^7 is released from the latch I^7 by the action or expansion of the previously-compressed spring H^6, overcoming the friction between the latch I^7 and the side of the notch H^{11}, which has the effect of rocking the shaft H in the reverse direction of the arrow d^2, and thus depressing the hook H^2, carying its point or prong H^7 down into the notch of the cam L^2, the arm H′ of the shaft H having been liberated from the cam G. The beveled head of the hook H^2, pressing against the side of the clutch-holding lever I′, instantly throws it toward the beak of the latch J^4 and the clutch-sleeve I^2 into engagement with the clutch I^6, the beak of said latch dropping into the notch I^8 of the clutch-holding lever I′, thus effectually securing the engagement of the clutch-sleeve I^2 with the clutch I^6, which latter operation of parts, however, is preceded by the action of certain other parts, which will presently be described. Before the beveled lug H^8 of the prong or point H^7 of the hook H^2 strikes or acts in its descent upon the clutch-holding lever I′, as the said prong or point is about to enter the notch in the cam-wheel L′, said hook releases itself from the latch I^7, as above described. As the wheel J^2 is revolved it revolves the wheel L′ in the direction of the arrow a', Figs. 10 and 11, and a^4, Figs. 8 and 9, these arrows indicating the same direction, as the drawings face in different directions. The prong O′ of the cam O strikes the cam-arm N on the end of the shaft D and swings said cam in the direction of the arrow e', Fig. 8, whereby the needle D^2 is swung down in the direction of the arrow c', Fig. 1, and the twine is caught by the hook o on the end of the wire t in a manner that will be set forth hereinafter, and a loop is formed around the bundle of grain, as shown in Fig. 4. The thread is then cut in a manner that will be set forth hereinafter. The needle remains lowered as the end of the cam N runs around the greater part of the rim of the cam O. As the cam N runs over the edge of the cam O the cam O^6 strikes the cam O^5 on the lever O^3 and forces said lever O^3 in the direction of the arrow f', Fig. 9, causing the pin O^4 on the end of the lever O^3 to swing the cam N on the shaft D in the inverse direc-

tion of the arrow e', whereby the needle D^2 is raised again. During the time that the needle is lowered the pin L^5 of the wheel L^2 strikes the cam M, Fig. 10, and swings the same in the direction of the arrow b', whereby the shaft F is turned in such a manner as to throw the ejector F′ and compressor and trip F^2 in the direction of the arrow c^2, Fig. 4, causing said ejector to throw the bundle out of the machine. By the movements given to the cam M by the pin L^5 the arm M^3 is swung down to the position shown in Fig. 11. Immediately after the pin M^5 has struck the cam M the projection L^4 of the wheel L^2 strikes the arm M^3 and swings the same in the direction of the arrow d', whereby the cam M is swung in the inverse direction of the arrow b', and thereby the shaft F is turned in such a direction as to swing the ejector back into the normal position until the wheel L^2 makes another revolution, the pin L^5 strikes the cam M, and another bundle is ejected. In Fig. 10 the ejector is shown in the normal position in dotted lines, and in Fig. 11 it is shown in the position it holds after it has thrown the bundle.

The operation of forming the knot is as follows: During the time that the grain is being packed between the arm C^2 and the arm F^2 the twine E is held in the position shown in Fig. 1, the end of the twine being held below the knife Z and between the lugs Z′ and Z^2 and in the recess Z^3, between which lugs it is pressed by the hook Y^3. The angle-lever m is in the position shown in Fig. 1, and the hook o is some distance from the block r. As stated, the needle D^2 moves downward into the position shown in Fig. 4, whereby the twine is carried downward. Immediately after the needle has been lowered the rack U^2 begins to swing in the direction of the arrow g^2, Fig. 5, and strikes the lower end of the lever m, thereby swinging the upper end and the prong n of the same in the direction of the arrow h^2, Fig. 1, and throwing the part E′, Fig. 1, of the twine E in the inverse direction of the arrow c^2, so that it will be against that part of the twine which has been carried down by the needle D^2. The wheel V is now revolved by the rack U^2, whereby the two jaws V^7 and V^8 are revolved and form a loop, the twine forming the loop passing around the outside of both of said jaws. The cam-lever S now swings the lever Y in the direction of the arrow a^5, Fig. 5, whereby the hook Y^3 is moved toward the left, Fig. 1, and the rod t is moved in the same direction, and the hook o on the end of said rod catches both strands of the twine and pulls the same into the block r, as shown in Fig. 4. As soon as the rack U^2 begins to swing in the direction of the arrow g^2, Fig. 5, the beveled end of the track-lever W^4 strikes the under side of the bevel X^2 of the cam X, and thus pushes said cam X and the arm W, on which the same is held, upward, causing the arm W to press upward the spindle V^2, thereby separating the jaws V^7 and V^8. The jaws remain separated until the rack has completed its movement in the direction of the arrow g^2, when the cam X slides off of the beveled shoulder W^{14} on the end of the track-bar W^4, permitting the spring V^5 to press the spindle V^2 and the arm W downward. Then when the rack U^2 moves in the inverse direction of the arrow g^2—that is, in the direction of the arrow m^2, Fig. 1—the bevel X^2 of the cam X will be below the track-plate W^4, and the jaws will be clamped and held firmly together and will hold the twine, in a manner that will be described hereinafter. It was necessary to describe this operation of the jaws before proceeding, in order that the further formation of the knot might be fully understood. Assuming that the parts are still in the position shown in Fig. 4, we will now examine Figs. 12 and 13. The separated jaws V^7 and V^8 are revolved a second time, and the parts E^2 of the twine, Fig. 4, are passed in between said jaws, which revolve, and by the time they have completed an entire revolution and are brought into the position shown in Fig. 13 the bevel X^2 has run off of the track W^4 and off over the bevel shoulder W^{14} of the same, as mentioned above, thus permitting the spring V^5 to force the jaws together, whereby the crossed ends of the twine are securely clamped. Then the lever Y moves in the inverse direction of the arrow a^5, Fig. 5—that is, the hook o on the end of the rod t, which was in the position it had in Fig. 12, moves out of said position, and the hook Y^3 on the end of the lever Y moves in the direction of the arrow n^2, Fig. 4, and the prongs of the hook Y^3 carry the part E^3 of the twine against the lugs Z′ Z^2 and against the knife Z, as shown in Fig. 13, whereby the twine is cut. The needle brings down the twine around the bundle with the part for the band between the needle and the knotter. The knotter then starts, with the jaws open, catches both strands of the twine, draws the part to be carried to the lug r s across the hooked rod o between the upwardly-turned point that catches the twine and the lug r s, and makes one revolution and stops. The hooked rod o at once starts the hook, catches both strands, and carries them over to the lug r s and holds them. Simultaneously with the starting of the hooked rod o the holder y releases the cut end of the twine, the sharp point of the holder y passes between the needle and the twine in the needle, afterward to catch, cut, and hold the end thereof for the new band as the parts return to place. The twine is sufficiently elevated while held within the lug r s by the slightly-upturned portion of the rod o near its hook to allow the lower jaw of the knotter to pass under the twine. As soon as the twine is secured in the upright groove of the lug r s by the hooked rod o, the knotter again starts and completes its forward movement, the lower jaw passing under the twine as it is held in the lug r s by the hooked rod o, and the upper jaw passing above

the twine, the jaws then snapping together upon the twine. The hooked rod *o* and the lever *y* at once go back to place, the lever *y* carrying with it the twine in the needle back to the knife, where it is cut, and the end belonging to the needle is held for the new band, both ends of the twine being then free to be pulled from the knotter. Immediately after this the ejector is operated in the manner described above and ejects the bundle, whereby the loop E^4, Fig. 14, is pulled from off the jaws V^7 and V^8, the needle D^2 being raised immediately after the bundle has been ejected.

As stated above, the grain forced down by the tines B^6 presses the compressor and trip F^2 in the direction of the arrow c^2 after a certain quantity of grain has been forced between the arm C^2 and said compressor and trip-arm. By this movement of the ejector the cam H′ is forced upward and the entire machine is started by the shifting of the sleeve I^2, caused by the above-described movement of the cam-arm H′ and the consequent rotary motion of the shaft H. After the bundle has been ejected the cam H′ swings down, and the spring H^5 throws the lower end of the lever H^3 outward, thereby swinging the prong H^6 downward. The bevel of lug H^8 strikes the lever I′ and forces the same to the left, Fig. 3, thereby engaging the clutch-collar I^2 with the clutch-collar I^6, whereby the shaft D is revolved and the other parts are put out of operation. The tines begin to force down the grain and the other parts remain stationary until the quantity of grain forced down is sufficient to swing the compressor and trip F^2 in the direction of the arrow c^2 such a distance as to cause the cam G to raise the cam-arm H′ where the parts are brought into operation, as set forth before.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. A grain-binder constructed with a curved guide and with a shaft carrying a crank, a lever pivoted on one end of the crank, and tines pivoted midway of their length to the lever and projecting down at the sides of the guide, substantially as and for the purpose set forth.

2. A grain-binder provided with the pivoted curved guide having an upwardly-projecting arm on its free end, combined with a shaft carrying a crank, a lever pivoted on one end of the crank, and tines pivoted midway of their length to the lever and projecting down at the sides of the guide, substantially as and for the purpose set forth.

3. A grain-binder constructed with a curved guide, C′, mounted on a rocking shaft, C, an arm on the shaft, a casing into which the arm projects, a spring pressing down on said arm, which guide C′ is combined with a pocket or guide for receiving the free end of the arm on the guide, and tines operated from a revolving shaft, the said tines being at the sides of the guide, substantially as herein shown and described.

4. In a grain-binder, the combination, with a curved guide, of a shaft carrying a crank, a lever pivoted on one end of the crank, tines pivoted midway of their length to the lever and projecting down at the sides of the guide, an arm pivoted to the upper end of the lever to which the tines are pivoted, and a piece provided with a slot, into which a pin on said arm passes for the purpose of guiding the arm, substantially as herein shown and described.

5. In a grain-binder, the combination, with a shaft, J, carrying the cog-wheel J^2, of the clutch sleeve I^2, a cog-wheel, L′, operated from the cog-wheel J^2 and mounted on the main shaft, a cam mechanism on the main shaft, a trip and compressor, twine-carrier, and knotting mechanism operated from the mechanism on the main shaft, the cam G on the trip-arm, the shaft H, the cam-arm H′ on the same, the elbow-lever K, the arm K^2 on the shaft H, and the laterally swinging lever I′, connected with the clutch-sleeve I^2, said elbow-lever having a spring, K′, acting upon the lever I′, substantially as herein shown and described.

6. In a grain-binder, the combination, with a shaft, J, carrying the cog-wheel J^2, of the clutch-sleeve I^2, a cog-wheel operated from the cog-wheel J^2 and mounted on the main shaft, a cam mechanism on the main shaft, a trip-arm and compressor, twine-carrier, and knotting mechanism operated from the mechanism on main shaft, the cam G on the trip-arm, the shaft H, the cam-arm H′ on the same, the elbow-lever K, the arm K^2 on the shaft H, the laterally-swinging lever I′, connected with the clutch-sleeve I^2, the latch J^4, the lever H^2, having a pronged beveled end, and a spring acting on the short end of said lever H^2, which beveled pronged end of the lever H^2 is adjacent to and adapted to act on the laterally swinging lever I′, substantially as herein shown and described.

7. In a grain-binder, the combination, with a shaft, J, carrying the cog-wheel J^2, of the clutch sleeve I^2, the cog-wheel L′, operated from the cog-wheel J^2 and mounted on the main shaft, a cam mechanism on the main shaft, a trip-arm and compressor, twine-carrier, and knotting mechanism operated from the mechanism on main shaft, the cam G on the trip-arm, the shaft H, the cam-arm H′ on the same, the elbow-lever K, the arm K^2 on the shaft H, the laterally-swinging lever I′, connected with the sleeve I^2, the latch J^4, the angular lever H^2, mounted on the shaft H and having one end pronged and beveled, the said pronged and beveled end being adjacent to the lever I′, and the lever I^7, pivoted on the lever I′ and adapted to engage the end of the lever H^2, substantially as herein shown and described.

8. In a grain-binder, the combination, with a shaft, of an ejector on one end of the same, a cam on the other end, the short arm of which cam terminates in a segmental rack, a pivoted arm having a segmental rack on its edge engaged with the segmental rack of the cam on

the shaft, a wheel having a recess, a projection in the plane of the wheel at one end of the recess, and a pin projecting from the plane of the wheel at the other end of the recess, engaging, respectively, with the cam and pivoted arm, substantially as herein shown and described.

9. In a grain-binder, the combination, with a shaft, of an arm on one end of the same, a needle pivoted on the said arm, the cam N on the other end of the shaft, which cam has a slot, N^2, the cam O, mounted on the main shaft and provided with a prong, O′, the lever O^3, the cam projection O^5, the cam O^6 on the main shaft and adjacent to the cam O, and the pin O^4, projecting from the lever O^3, substantially as herein shown and described.

10. In a grain-binder, the combination, with a knotting device, of levers pivoted to swing in horizontal planes and serving to operate said knotting devices, levers pivoted to swing in vertical planes and connected to said horizontal levers, cams on the main shaft, cam projections on vertical levers engaged by the said cams, one of said horizontal levers carrying a rack, a lever carrying the twine against that part of the twine carried by the needle operated by said rack-arm, a wheel revolved by said rack, which wheel in turn revolves the jaws of the knotter, the other of said horizontal levers moving in an opposite direction to that in which the aforesaid horizontal lever moves, and carrying a hooked rod which catches both strands of the twine, and a fixed block into which is pulled both of said strands of twine by the said hooked rod, substantially as set forth.

11. In a grain-binder, the combination, with the levers mounted to swing in horizontal planes and the knotting devices operated by said levers, of levers mounted to swing in vertical planes and connected with said horizontal levers, said vertical levers having apertures from the edges of which cam projections extend inwardly, two cams on the main shaft for each lever, so located, substantially as described, that they cannot act on the same parts of the cam projections on said levers, one of the horizontal levers carrying a rack, a lever acted upon by said rack to carry the twine against that part of the twine carried by the needle, a wheel revolved by said rack, which wheel in turn revolves the jaws of the knotter, the other of said horizontal levers moving in an opposite direction to that in which the aforesaid horizontal lever moves, and carrying a hooked rod, and a fixed block into which is pulled both strands of the twine by the said hooked rod, substantially as set forth.

12. In a grain-binder, the combination of the levers mounted to swing in horizontal planes, the concentric tubular spindles provided with knotting-jaws, a knife, horizontally-swinging levers, one having a segmental rack engaging a cog-wheel on the outer one of said spindles, an angle-lever provided with a hook for drawing the twine taut and with an arm having a prong or hook for pressing the twine against the knife and holding the cut end of the twine, levers pivoted to swing in vertical planes and connected with said horizontal levers, and cams on the main shaft, the rack acting upon said angle-lever and the vertical levers having recesses and cam projections acted upon by the cams on the main shaft, substantially as specified.

13. In a knotter for a twine grain-binder, the combination, with two concentric spindles, each having a knotting-jaw at the upper end, the inner spindle being adapted to slide and turn within the outer spindle, of a spring for pressing the inner spindle downward, a cog-wheel on the outer spindle, a segmental rack engaging said cog-wheel, and thereby operating the spindles, mechanism for pressing the inner spindle upward, and thereby separating the knotting-jaws at proper times, which mechanism is operated by a swinging lever carrying a rack, and an additional lever provided with a hook for drawing the twine taut, and with an arm having a hook for pressing the twine against the knife and holding the cut end of the twine, substantially as herein shown and described.

14. In a grain-binder, the combination, with the frame U^3, the lugs Z′ Z^2, the knife Z above the lug Z′, and the block *r*, having a recess, of the revolving knotter, the swinging lever U, which operates the revolving knotter, the swinging lever Y, having a hook, Y^3, and the wire *t*, having a hook, *o*, substantially as and for the purpose set forth.

15. In a grain-binder, the combination, with the frame U^3, of a revolving knotter on the same, the block *r*, having a recess, which block is secured on the frame U^3, the swinging lever U, which operates the revolving knotter, the swinging lever Y, the wire *t*, having a hook, *o*, the hook Y^3 on the end of the lever Y, and the knife Z, substantially as herein shown and described.

16. In a grain-binder, the combination, with two concentric spindles, each provided at its upper end with a knotting-jaw, the inner spindle being adapted to slide in the exterior spindle, of a spring for pressing the inner spindle downward, the lever U, having a rack, U^2, engaging with a cog-wheel on the exterior spindle, the track-lever W^4, pivoted to the rack U^2, the lever W, on which the lower end of the interior spindle rests, and a cam-piece on said lever W, having a beveled lug, which beveled lug runs on the track-lever W^4, substantially as herein shown and described.

17. In a grain-binder, the combination, with two concentric spindles, each provided at its upper end with a knotting-jaw, the inner spindle being adapted to slide in the exterior spindle, of a spring for pressing the inner spindle downward, the lever U, having a rack, U^2, engaging with the cog-wheel on the exterior spindle, the track-lever W^4, pivoted to

the rack U^2 and having a bevel, W^5, on the free end, and a beveled shoulder, W^{14}, at the pivoted end, the lever W, on which the lower end of the interior spindle rests, the cam X on said lever W, having a beveled lug, X^2, which beveled lug runs on the track-lever W^4, and the arm W′, having a laterally-projecting pin, W^6, for holding the track-plate and preventing it from dropping too far, substantially as herein shown and described.

WILLIAM M. CLARK.

Witnesses:
JAMES BAILEY,
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