(No Model.) 3 Sheets—Sheet 1.

L. C. CROWELL.

FOLDING MECHANISM.

No. 453,395. Patented June 2, 1891.

Fig. 2.

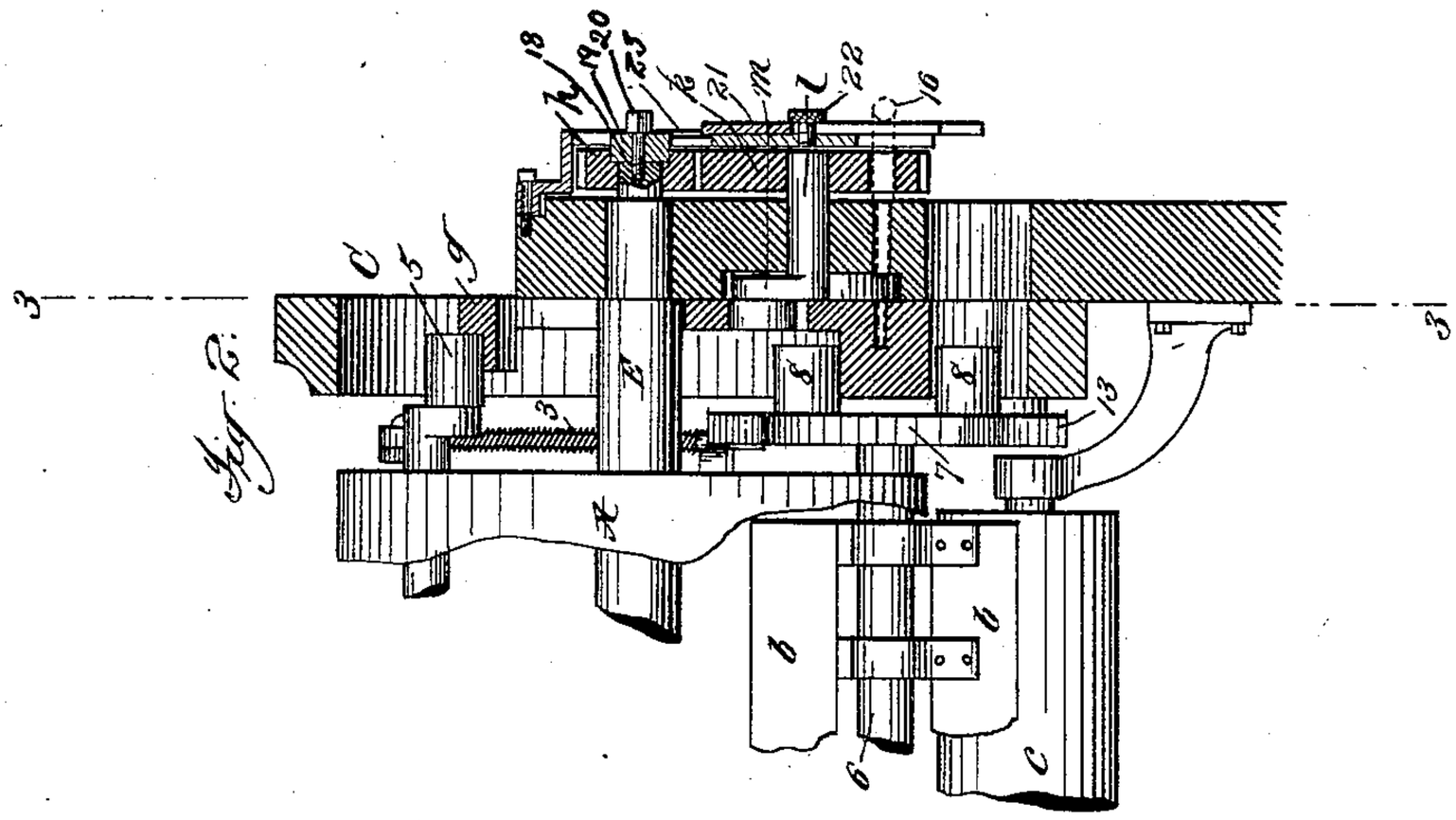

Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

L. C. CROWELL.
FOLDING MECHANISM.

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Fig. 3.

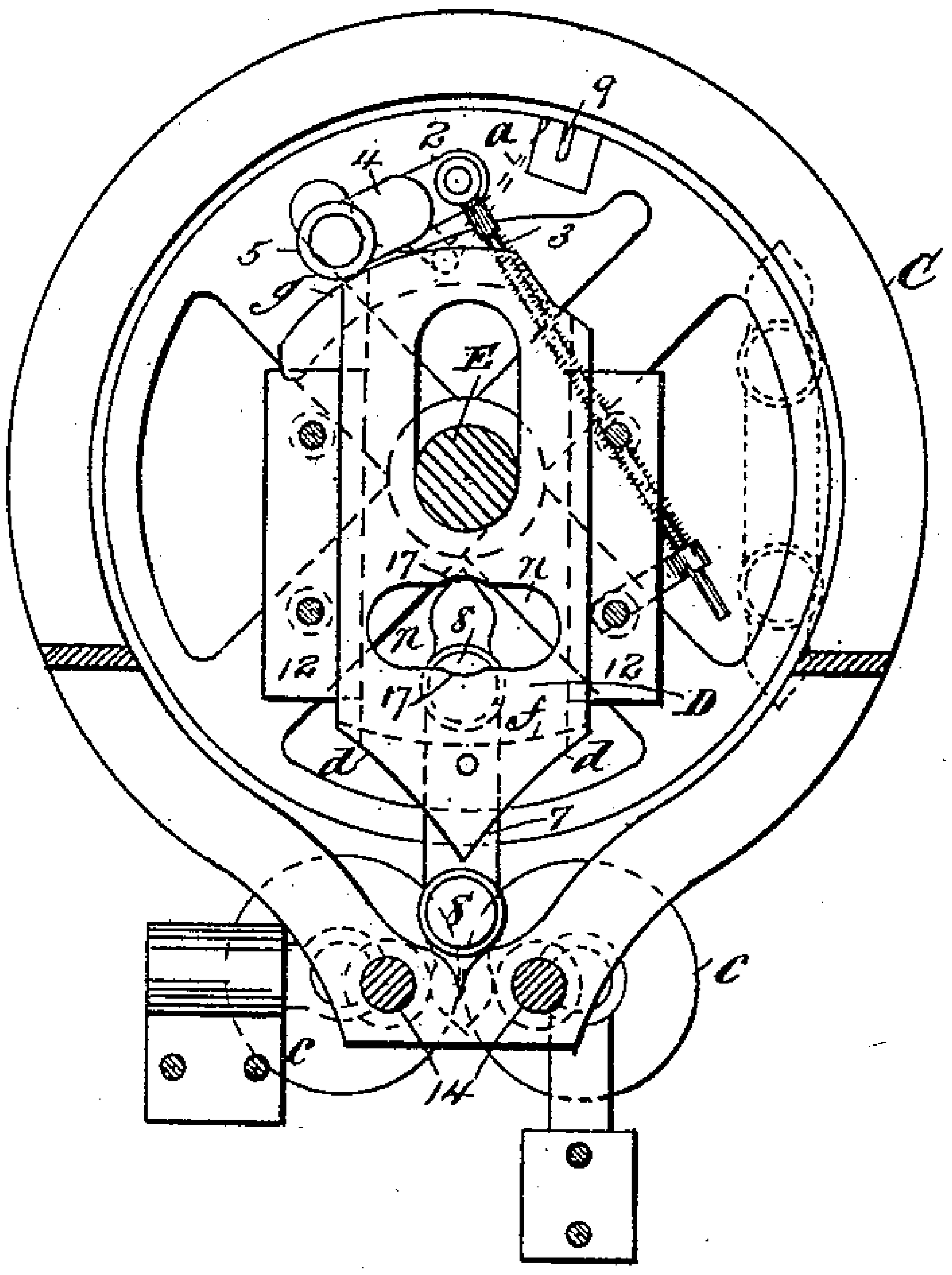


Fig. 4.

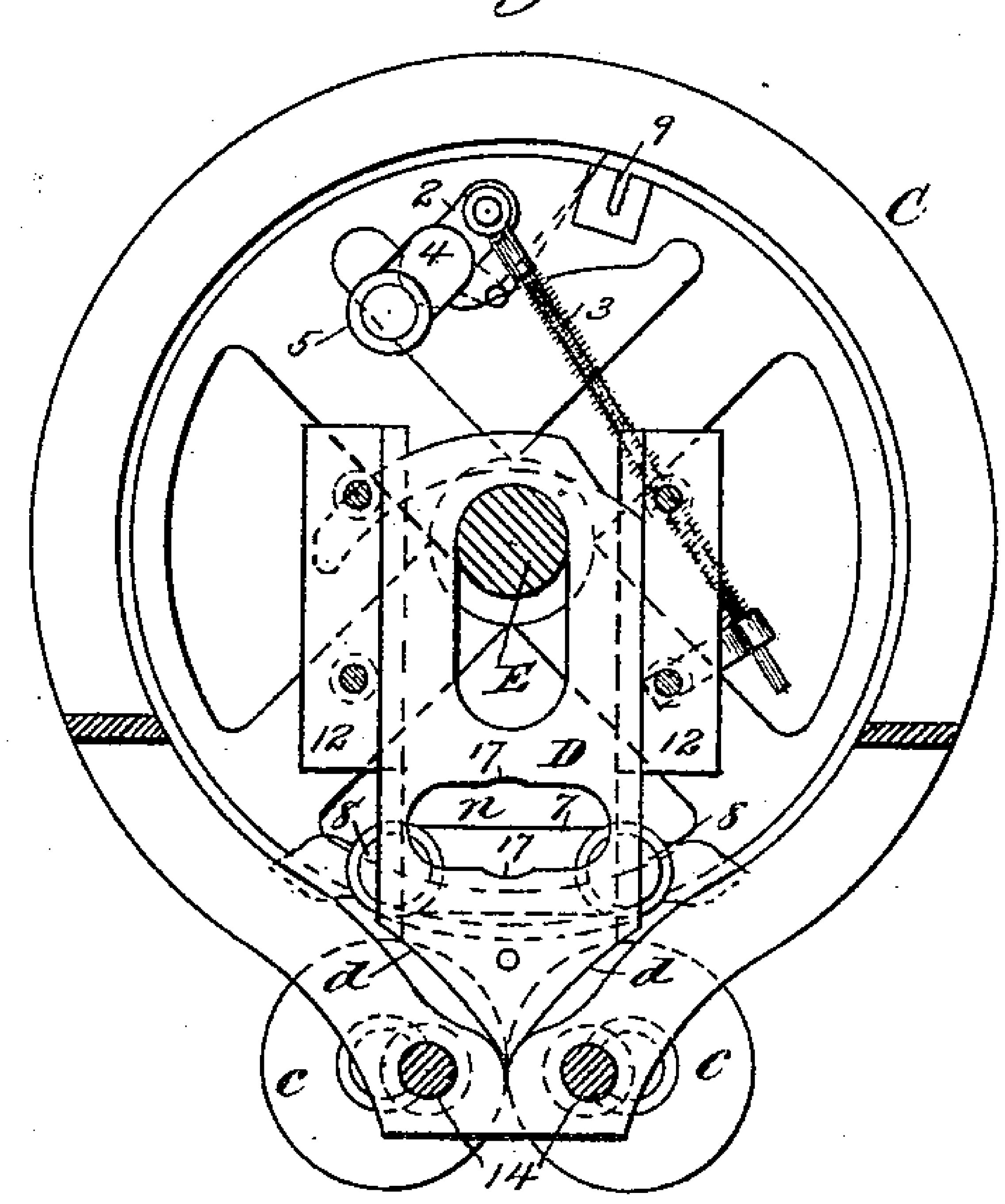


Fig. 5.

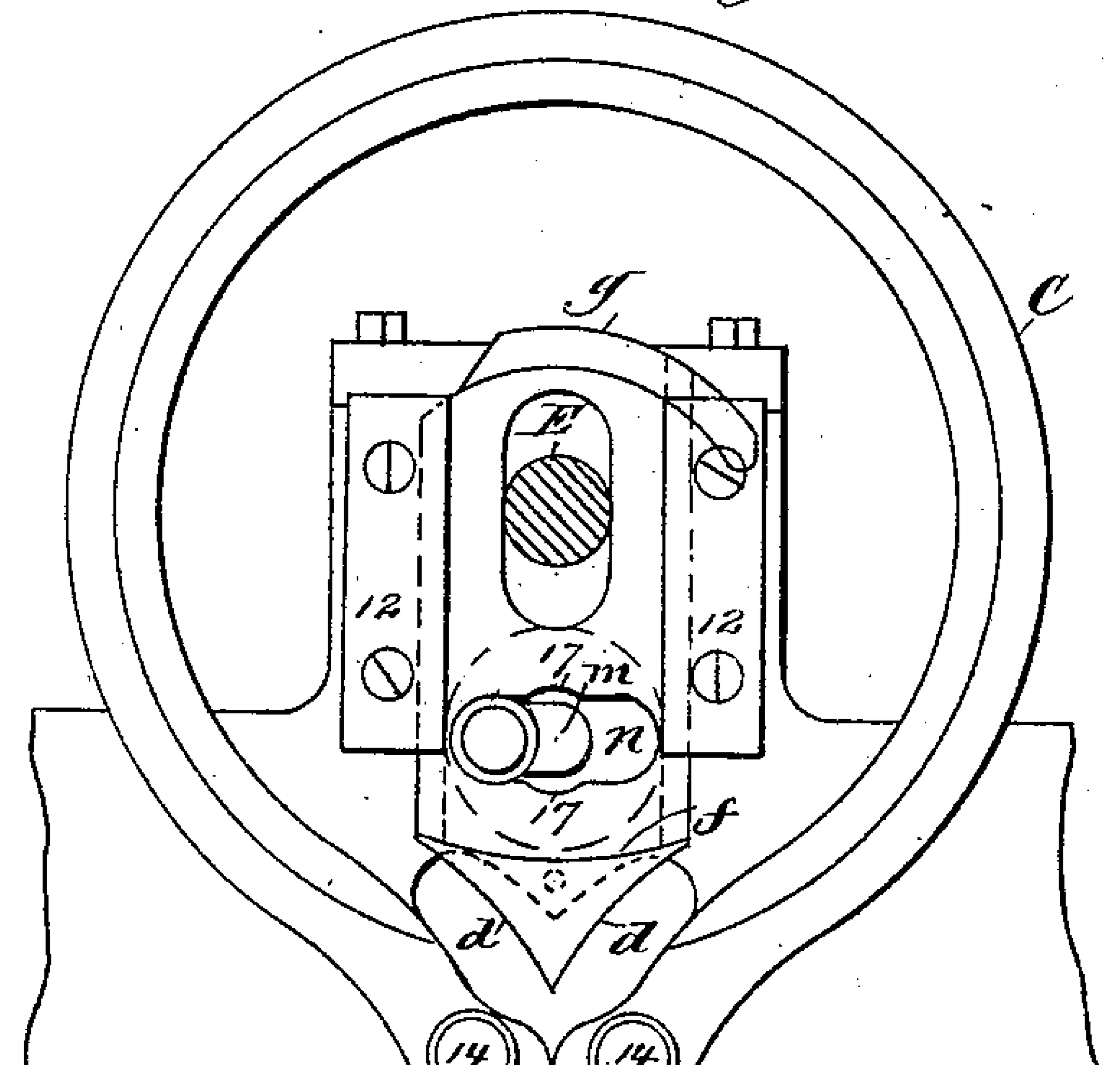
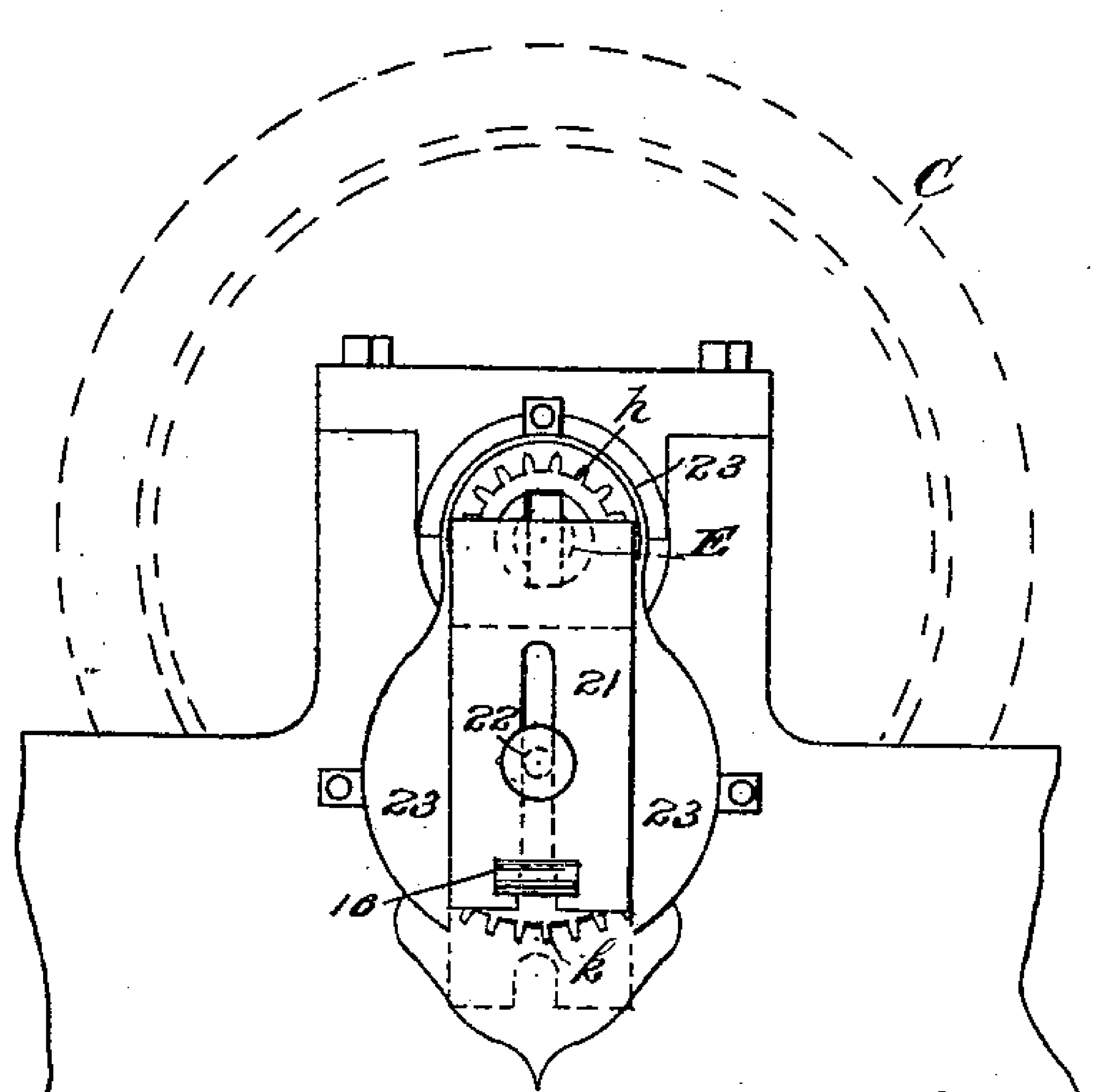


Fig. 7.



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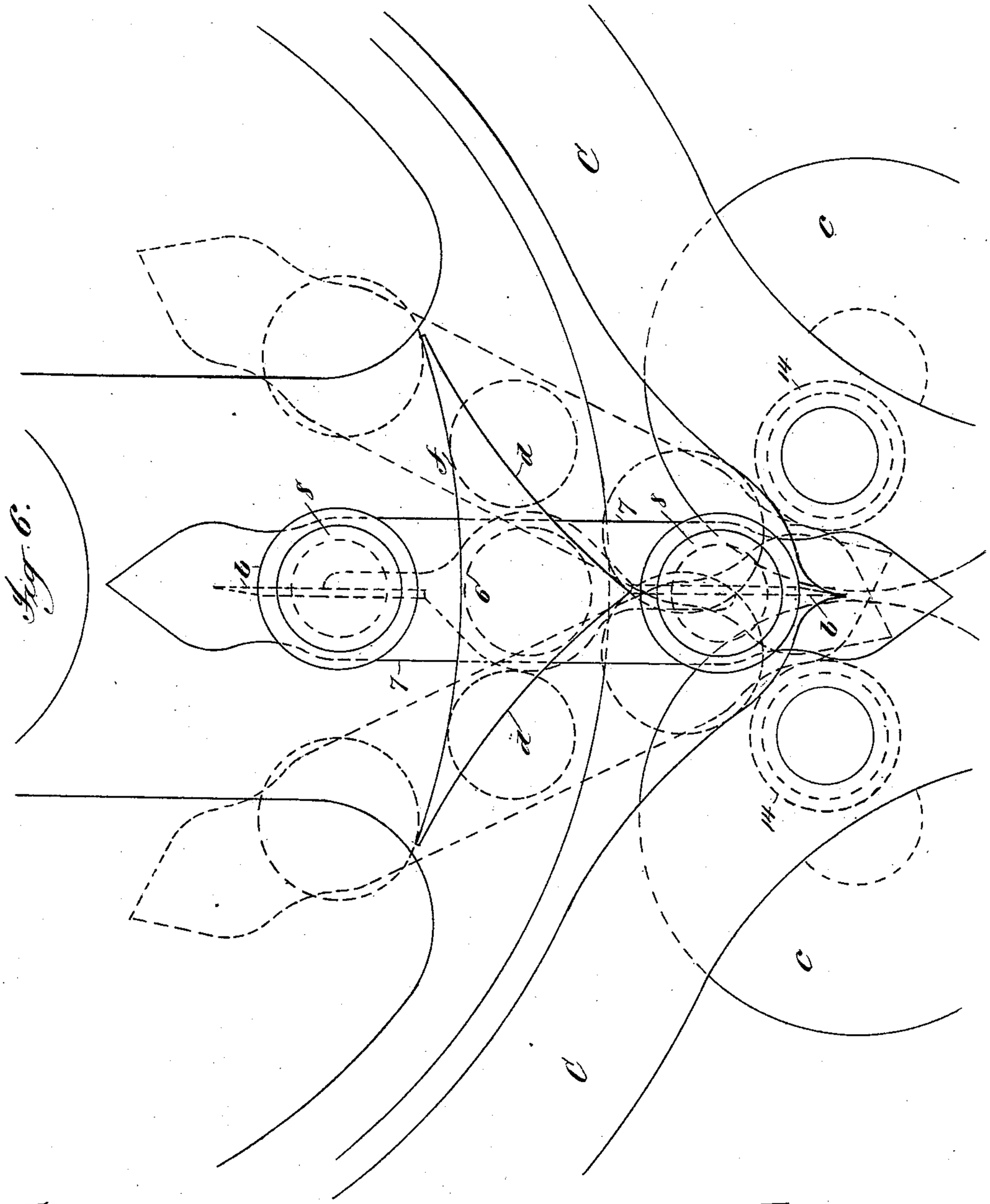
(No Model.) 3 Sheets—Sheet 3.

L. C. CROWELL.

FOLDING MECHANISM.

No. 453,395. Patented June 2, 1891.



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UNITED STATES PATENT OFFICE.

LUTHER C. CROWELL, OF BROOKLYN, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO ROBERT HOE, STEPHEN D. TUCKER, THEODORE H. MEAD, AND CHARLES W. CARPENTER, OF NEW YORK, N. Y.

FOLDING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 453,395, dated June 2, 1891.

Application filed October 15, 1889. Serial No. 327,100. (No model.)

To all whom it may concern:

Be it known that I, LUTHER C. CROWELL, a citizen of the United States, residing at Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Folding Mechanism, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to improvements in that class of folding mechanisms known as "rotary folders"—that is to say, those folders in which the sheet to be folded is carried upon a rotating cylinder and in which the folding is accomplished by means of a rotating or oscillating folding-blade, the edge of which during its rotations or oscillations is carried beyond the periphery of the cylinder and operates to fold the sheet or sheets into the bite of a pair of folding rolls or jaws. The invention relates more particularly, however, to the means for operating the rotating or oscillating folding-blade to cause it to fold the sheet or sheets from the cylinder at each revolution thereof or at each alternate revolution thereof, according as may be desired.

The invention also includes a means for operating the pins or sheet-grippers of the cylinder to conform to the operation of the folding-blade, so that the sheet or sheets will be released at the proper time to be folded, whether the blade acts at each revolution or at each alternate revolution of the cylinder.

A full understanding of the improvements constituting the present invention can only be given by an illustration and a detailed description of the mechanism embodying the same. Further preliminary description of the invention will therefore be omitted and a detailed description given, reference being had to the accompanying drawings, in which—

Figure 1 is an end view of a folding mechanism embodying the present invention, with the gear *h* loose upon its shaft and the locking parts removed. Fig. 2 is a vertical section taken on line 2 of Fig. 1 with the locking parts in place. Fig. 3 is a sectional elevation taken on the line 3 of Fig. 2, showing the blade-operating arm in two positions, at the point of folding in full lines and before reaching that point in dotted lines. Fig. 4 is a similar view showing the parts in a different position. Fig. 5 is an inside view of the cams for operating the folding-blade and sheet-retaining pins, showing the parts in a position intermediate of those shown in Figs. 3 and 4. Fig. 6 is a diagram illustrating the movement of the folding-blade. Fig. 7 illustrates an addition, which will be hereinafter referred to.

Referring to said drawings, it is to be understood that A represents a folding-cylinder of substantially an ordinary form. The cylinder, as illustrated in the present case, is of a circumference equal to the length of a sheet, and is provided with a set of sheet-retaining pins *a* or other sheet-retaining devices, by which the sheets are retained upon the cylinder until the time arrives for folding them off. The pins *a* are mounted upon arms extending from a rock-shaft in the usual manner, and this shaft is provided with an arm 2, acted upon by a spring 3, by which the pins are normally maintained in their protruded position in substantially the usual manner. The shaft which carries the pins is also provided with a second arm 4, having a bowl 5, which is acted upon by a cam to rock the shaft and retract the pins at the proper time for releasing the sheet or sheets for folding, as will be hereinafter explained. The cylinder A is also provided with a double-edged folding-blade *b*, which is mounted upon a shaft 6, journaled in the heads of the cylinder in the usual manner and operated at the proper times to fold the sheet or sheets carried by the cylinder into the bite of a pair of folding-rolls *c* in the usual manner.

The shaft 6 of the folding-blade is provided at one end with a double operating-arm 7, which is arranged parallel with the blade widthwise, and which is provided at or near its opposite ends with studs or bowls 8, acted upon by cams to operate the blade at the proper time to fold the sheet or sheets, as will presently be explained.

The cylinder A, also, as illustrated in the present case, forms one member of a rotary cutting mechanism, by which the sheets

which are folded off the cylinder are severed from a continuous web. For this purpose the cylinder is provided just in advance of the pins *a*, with a cutting-groove 9, which co-operates with a blade 10, carried by a companion cylinder B, the two cylinders A B being geared together, so as to revolve in unison.

The cylinder B and its cutting-groove are of the usual form, and, as they constitute no part of the present invention, need not be herein further referred to.

Located at the end of cylinder A and secured to the frame-work which supports the same, is a cam C, which is of annular form, and around the inner periphery of which travels the two bowls 8, which extend from the arm 7 upon the shaft of the folding-blade, the cam C being so shaped that the folding-blade is held in such position that neither of its edges are protruded beyond the periphery of the cylinder, as indicated by dotted lines in Fig. 3, except just at the point where the folding is to take place, at which point—that is to say, opposite the rolls *c*—the cam C is so shaped as to permit the folding-blade to make the required movement to effect the folding of the sheet or sheets.

In accomplishing the folding, the edge of the blade, which is in advance relatively to the rotation of the cylinder A, is, as it arrives at the first of the folding-rolls, caused to move outward beyond the periphery of the cylinder, and this movement is continued as the blade passes the rolls, so that its edge is projected into the bite of the two folding-rolls, thereby imparting a quarter-revolution to the blade. As the movement of the cylinder continues and the blade recedes from the rolls, its advance edge, which now becomes its rear edge, is carried back within the periphery of the cylinder, thereby completing the half-revolution of the blade. This movement of the blade to accomplish the folding is effected as follows: Located within the cam C, which forms the exterior cam for operating the folding-blade, and also supported by the frame-work of the machine, is a vertically-reciprocating plate D, which works between guides 12, secured to the frame-work. The lower end of the plate D is inclined in opposite directions, so as to form a cam *d*, which conforms in shape to the inner periphery of the cam C at that point and forms the interior cam for operating the folding-blade, and thus when the plate D is in its raised position, as will be hereinafter explained, forms a path through which the advance bowl upon the arm 7 is guided, so as to impart the half-revolution to the folding-blade, as before explained. As the folding-blade *b* necessarily reciprocates in approximately straight lines as it advances between the folding-rolls and recedes therefrom, the bowls 8, if placed opposite the edges of the folding-blade, will also move in approximately straight lines when opposite the point of the cam *d*, and will be liable to return upon the same side of the cam *d* instead of passing the point and returning upon the opposite side to complete the half-revolution. It is preferable, therefore, to place the bowls out of line with the edges of the blade in order that while the edges of the blade move in straight lines the bowls may swing sufficiently to pass the point of the cam and insure their proper return, and I prefer to place the bowls inside the edges of the blade, as shown, as this construction involves the least travel of the bowls. The blade will be controlled by the folding or nipping rolls or their equivalents, so as to secure with approximate certainty the proper return of the bowls, if the latter be placed out of line with the edges of the blade.

In order to attain greater certainty in the return of the bowls, relieve the folding-rolls from the control of the blade, and insure a positive movement of the blade at the point of its greatest protrusion, which is just as the bowl 8 passes the point of the cam *d* and temporarily out of the control of the cams C *d*, the arm 7 is preferably provided at each end with cam-surfaces, which diverge rearward from a central line, forming a wedge or heart shaped projection 13. Just before the bowl 8 leaves the point of the cam *d* this wedge-shaped projection passes between and is engaged by a pair of cam-surfaces, which are formed, preferably, by projections from the inner face of the cam C, the blade thus being positively controlled during the folding operation and until the bowl 8 has been carried past the point of the interior cam and into the control of the cam *d* upon the opposite side from that by which it advanced, thus completing the half-revolution of the blade.

It has been said that the plate D is movable and that when in its upper position the cam *d* is in position to co-operate with the cam C to operate the folding-blade, as just described. The plate D is also provided with an inwardly-projecting shoulder forming a cam *f*, which when the plate is in its depressed position, as will be hereinafter explained, forms a continuation of the annular portion of the cam C, as indicated in Fig. 4, so that the advance bowl 8 upon the arm 7 instead of being directed outward so as to carry the edge of the folding-blade outside of the periphery of the cylinder is continued onward in its annular path, so that the blade is not operated and no folding takes place, all as will be better understood when the operation of the apparatus is explained. The upper end of the plate D is also provided with a cam *g*, which when the plate is in its raised position, as shown in Fig. 3 engages with the bowl 5, which operates the pins *a*, and retracts said pins so as to release the sheet or sheets in time to permit them to be folded by the blade *b*. When the plate D is in its depressed position, so that no folding takes place, the cam *g* will be moved out of the path of the bowl 5, and as a consequence the pins will not be retracted to release the sheet. The

shaft E of the cylinder A passes through the plate D, as will be observed; but the plate is slotted vertically so as to permit it to have the required motion.

For the purpose of imparting the necessary reciprocating motion to the plate D, the shaft E is extended through the frame-work and carries a small gear *h*, which is capable of being rendered fast or loose upon the shaft, and engages with a gear *k* of twice its size, which is mounted upon the end of a shaft *l*, which passes through the frame-work, and is provided with a crank *m*, having a bowl which enters an opening *n* in the plate D. Owing to the relative sizes of the gears *h k*, the crank *m* makes one revolution to two revolutions of the cylinder A, and as a result the plate D and cams *d g* are raised upon one revolution of the cylinder and depressed at the next, the parts being so timed that the cams will be in their respective raised and lowered positions at the time the folding-blade passes the folding-rolls.

The remaining features in the construction and organization of the mechanism will be described in connection with an explanation of its operation, which is as follows: When it is desired that the folding-blade shall operate at each revolution of the cylinder A, the gear *h* will be detached from the shaft E so as to remain idle thereon without driving the gear *k*, and the plate D will be moved to its raised position, as indicated in Figs. 2 and 3, and secured in that position in any suitable manner—as, for example, by a threaded bolt 16, which is passed through an opening in the gear *k* and the frame-work and enters a threaded opening in the plate D. The plate D being secured in this position, the cam *g* will remain in the path of the bowl 5, so as to be engaged by the bowl to retract the pins *a* at each revolution of the cylinder, and the cam *d* will also remain in position to direct the bowl 8 outward at each revolution of the cylinder to commence the movement of the blade. The cams 14 will then move the blade positively as it passes the point of the cam *d* and the point of its greatest protrusion. The cams *c* and *d* will then act to complete the half-revolution of the blade. If it is desired that the folding-blade shall be operated only at each alternate revolution of the cylinder—as, for example, when it is desired to collect two or more sheets before folding—the bolt 16 will be withdrawn and the gear *h* will be made fast to the shaft E. As the folding-blade approaches the rolls *c* upon the first revolution of the cylinder the crank *m* will arrive in position to depress the plate D to the position shown in Fig. 4, so that the advance bowl 8, instead of being directed outward by the cam *d* will be directed forward in its annular path by the cam *f* and the folding-blade will not be operated. The cam *g*, being also depressed, will not be in the path of the bowl 5, and as a consequence the pins *a* will not be retracted. As the folding-blade approaches the folding-rolls upon the second revolution of the cylinder, the crank *m* will have arrived in position to raise the plate D, as indicated in Fig. 3, so that the cam *g* will be in position to be engaged by the bowl 5 to retract the pins *a*, and the cam *d* will be in position to direct the bowl 8 outward to operate the folding-blade, and so the operation will be repeated, the folding taking place at each alternate revolution of the cylinder. If from any cause it should be desired to render the folding-blade entirely inoperative, the gear *h* will be detached from the shaft E, so as to remain idle thereon without driving the gear *k*, and the plate D will be moved to its lower position, as shown in Fig. 4, where its weight will cause it to remain; or it may be secured in this position in any suitable manner.

It is important that the cams *d f* should remain in a fixed position during the time they are acting upon the bowls 8 of the folding-blade. To effect this the opening *n*, in which the bowl of the crank *m* works, is provided with curved recesses 17 upon its opposite sides, into which the bowl of the crank enters as the plate D reaches the extreme limit of its up-and-down movement, and these recesses are so shaped that after the plate has reached its extreme movement in either direction there will be a short dwell or pause before it begins its movement in the opposite direction, and this dwell is of sufficient length to permit the bowls to pass the cams *d f* while they remain stationary, the cam *d* thus being stationary relatively to the blade during the folding movement of the latter, whether the cam be locked in position for folding at every revolution or not, and the cams *d* C therefore forming in all cases a pair of stationary interior and exterior cams for operating the folding-blade.

The gear *h* may be attached to the shaft E in any suitable manner, so as to be rendered fast and loose thereon. One form of device well adapted for the purpose is shown in Figs. 1 and 2. For this purpose the face of the gear and the end of the shaft are provided with registering-recesses into which fits a rib 18, formed on a cap 19, which is secured to the end of the shaft by a bolt 20. By removing the bolt 20 and the cap the gear *h* is rendered loose upon the shaft, and can, if desired, be removed.

From the foregoing it will be seen that if, through carelessness of the attendant or for any other cause, the machine should be started when the gear *h* was fast to the shaft E and the gear *k* and plate D fast to the frame, as before explained, serious breakage and damage would be sure to result. To avoid the possibility of such an accident, there is provided a sliding plate 21, which moves upon a stud 22, projecting from a cap 23, which partly covers the gears *h k*, as shown in Fig. 7. The plate 21 is provided at its lower end with a recess to receive the bolt 16. The plate 21 is of such length that when raised

so as to permit the insertion of the bolt 16 its upper end covers or nearly covers the end of the shaft E, and as the bolt 20 projects into the path of the plate it will readily be seen that is impossible to raise the plate so as to insert the bolt 16 until the bolt 20 and cap 19 have been removed, so as to render the gear *h* loose upon its shaft, and on the other hand it is impossible to introduce the cap 19 and bolt 20 until the bolt 16 has been removed.

What I claim is—

1. The combination, with a folding-cylinder and its folding-blade having an operating-arm upon its shaft, of stationary cams for commencing and completing the partial revolution of the blade, and independent cams acting upon said arm to control the blade during the intermediate part of its movement of partial revolution, substantially as described.

2. The combination, with a folding-cylinder and its folding-blade having an operating-arm upon its shaft, of bowls located upon said arm on opposite sides of the shaft, stationary interior and exterior cams acting upon said bowls to commence and complete the partial revolution of the blade, and independent cams acting upon said arm to impart a positive movement to the blade at the point of its greatest protrusion, substantially as described.

3. The combination, with folding or nipping devices, of a folding-cylinder and its folding-blade having an operating-arm upon its shaft, bowls located upon said arm on opposite sides of the shaft and out of line with the respective edges of the blade, and interior and exterior cams acting upon said bowls to operate the blade for the folding movement, substantially as described.

4. The combination, with a folding-cylinder and its folding-blade having an operating-arm upon its shaft, of bowls located upon said arm on opposite sides of the shaft and out of line with the respective edges of the blade, stationary interior and exterior cams acting upon said bowls to commence and complete the partial revolution of the blade, and independent cams acting upon said arm to impart a positive movement to the blade at the point of its greatest protrusion, substantially as described.

5. The combination, with a folding-cylinder and its folding-blade having an operating-arm upon its shaft, of bowls located upon said arm on opposite sides of the shaft and out of line with the respective edges of the blade, interior and exterior cams acting upon said bowls to commence and complete the partial revolution of the blade, and independent cams acting upon said arm to impart a positive movement to the blade at the point of its greatest protrusion, substantially as described.

6. The combination, with a folding-cylinder and its folding-blade having an operating-arm upon its shaft, of bowls located upon said arm upon opposite sides of the shaft inside the respective edges of the blade, interior and exterior cams acting upon said bowls to commence and complete the partial revolution of the blade, and independent cams acting upon said arm outside the bowls to impart a positive movement to the blade at the point of its greatest protrusion, substantially as described.

7. The combination, with a folding-cylinder and its folding-blade, of an arm mounted upon the end of the blade-shaft and having cam-surfaces diverging rearward and forming a wedge-shaped projection, means for protruding said blade for the folding operation, and two fixed surfaces between which the cam-surfaces of the wedge-shaped projection enter to impart a positive movement to the blade at the time of its greatest protrusion, substantially as described.

8. The combination, with a folding-cylinder and its folding-blade having an operating-arm upon its shaft, of bowls upon the arm, an exterior cam and an interior cam, both stationary during the folding movement of the blade, said interior cam being adjustable independently of the exterior cam, and said cams acting upon said bowls to impart a folding movement to said blade or cause it to remain idle, according to the position of said interior cam, substantially as described.

9. The combination, with a folding-cylinder and its folding-blade having an operating-arm upon its shaft, of bowls upon said arm, an exterior cam and an interior cam, both stationary during the folding movement of the blade, said cams acting upon said bowls to impart a folding movement to said blade or cause it to remain idle, according to the position of said interior cam, and means for moving said interior cam independently of the exterior cam to cause the blade to operate intermittently, substantially as described.

10. The combination, with a folding-cylinder having a folding-blade and sheet-retaining devices, of an exterior cam and a plate carrying or forming an interior cam and adjustable independently of said exterior cam, said two cams acting to impart a folding movement to said blade or cause it to remain idle, according to the position of said plate, and a cam *g*, also carried by or formed on said adjustable plate for operating the sheet-retaining devices, substantially as described.

11. The combination, with a folding-cylinder having a folding-blade and sheet-retaining devices, of an exterior cam and a plate carrying or forming an interior cam and movable independently of said exterior cam, said two cams acting to impart a folding movement to said blade or cause it to remain idle, according to the position of said plate, a cam *g*, also carried by or formed on said movable plate for operating the sheet-retaining devices, and means for imparting movement to said plate to cause the blade and sheet-retaining devices to operate intermittently, substantially as described.

12. The combination, with a folding-cylinder and its folding-blade, of an exterior cam and an interior cam for operating said blade, said interior cam being movable independently of said exterior cam to and from position to operate the blade, and means, substantially as described, for moving said interior cam with a pause during the operation of the blade, substantially as described.

13. The combination, with a folding-cylinder and its folding-blade, of an exterior cam, and a sliding plate having a cam-surface which in one position of the plate forms an interior cam co-operating with the exterior cam and having a cam-surface which in the other position of the plate forms a part of the exterior cam, and means, substantially as described, for moving said plate with a pause when either of its surfaces is in position to co-operate with the exterior cam, substantially as described.

14. A folding mechanism consisting of the cylinder carrying the folding-blade, in combination with independent co-operating cams stationary during the folding movement of the blade, but capable of being adjusted or operated to render the blade inoperative or to cause it to operate at each revolution of its carrier or to operate only at certain revolutions, substantially as described.

15. The combination of a cylinder carrying a folding-blade and interior and exterior co-operating cams, one of which is movable and adjustable transversely to the co-operating surface of the other cam, whereby the folding-blade may be rendered inoperative or operated at each revolution of the cylinder or only at certain revolutions, substantially as described.

16. The combination, with sliding cam-plate D, having the opening *n*, of the crank *m*, entering said opening for operating said plate, detachable driving connections for said crank, and means for securing the crank and plate in a fixed position when the plate is not to be operated, substantially as described.

17. The combination, with sliding cam-plate D, of crank *m* for operating said plate, gear *k* on said crank, detachable driving connections for said gear, and bolt 16, securing said gear and plate to the frame when the plate is not to be operated, substantially as described.

18. The combination, with shafts E and *l*, of gears *h* and *k* for transmitting motion between said shafts, removable cap 19 for securing the gear *h* to its shaft, bolt 16 for securing the gear *k* to the frame, and sliding safety-plate 21, substantially as described.

19. The combination, with the movable cam, of the shaft E, crank *m*, uncoupling-gear *h*, and intermediate *k* for transmitting motion to the crank, removable cap 19 for securing the gear to the shaft, bolt 16 for securing the intermediate to the frame, and the sliding safety-plate 21, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

LUTHER C. CROWELL.

Witnesses:
J. M. BORST,
GEO. H. BOTTS.