(No Model.)

4 Sheets—Sheet 1.

# L. D. HARDING.

## GRINDING MILL.

No. 475,859. Patented May 31, 1892.

Fig. 1.

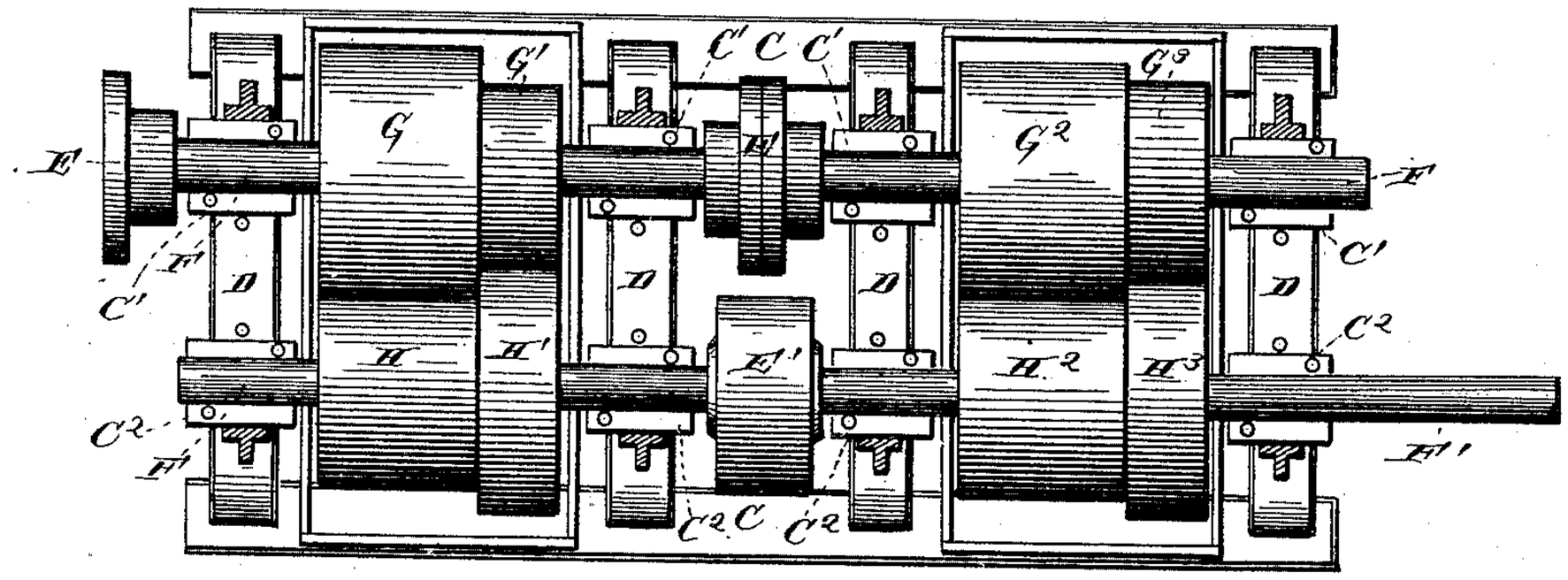
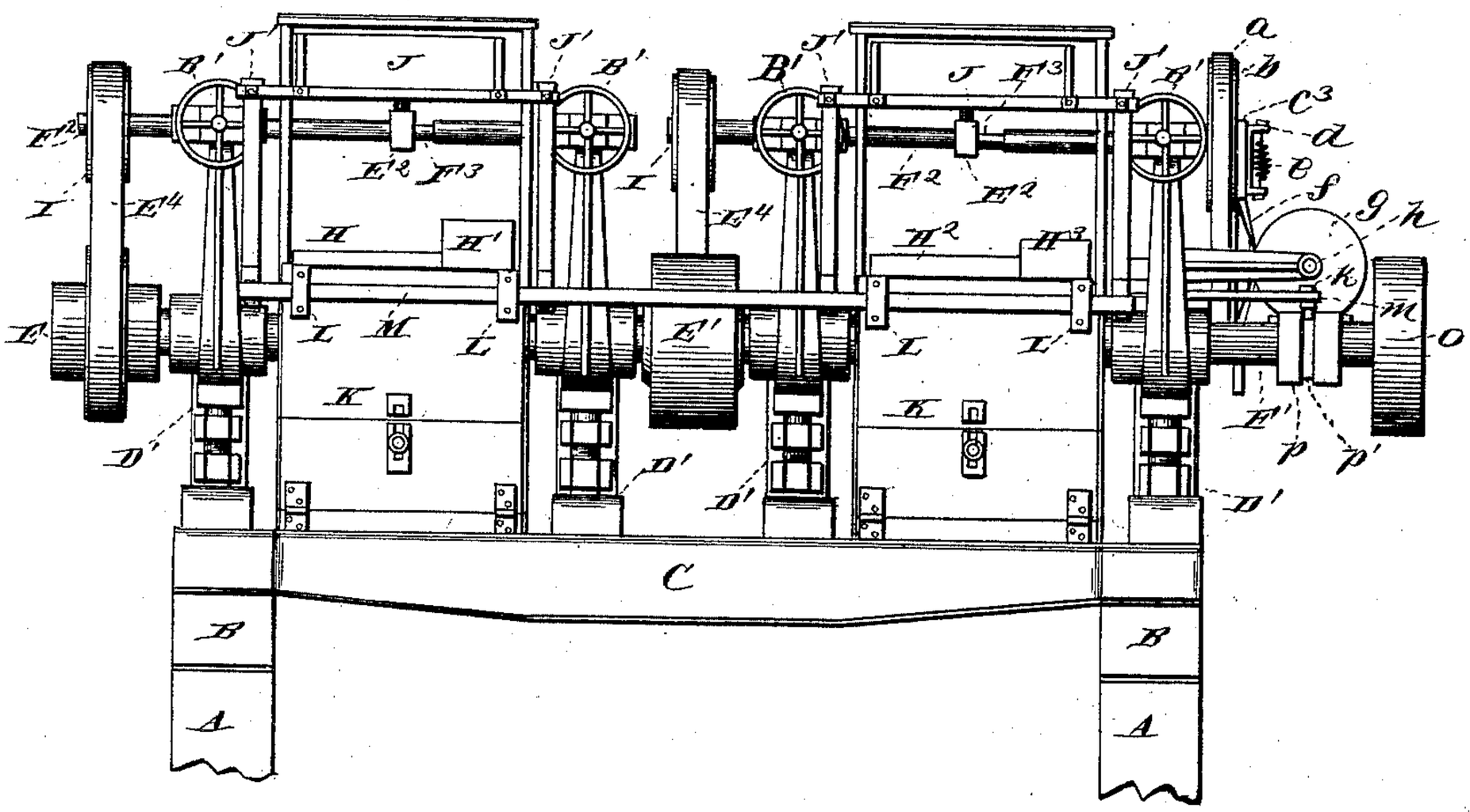



Fig. 2.




Witnesses:
J. J. Casserly.
Herbert. Warner.

Inventor:
Legrand. D. Harding.

(No Model.) 4 Sheets—Sheet 2.

# L. D. HARDING.

## GRINDING MILL.

No. 475,859. Patented May 31, 1892.

Fig. 6.

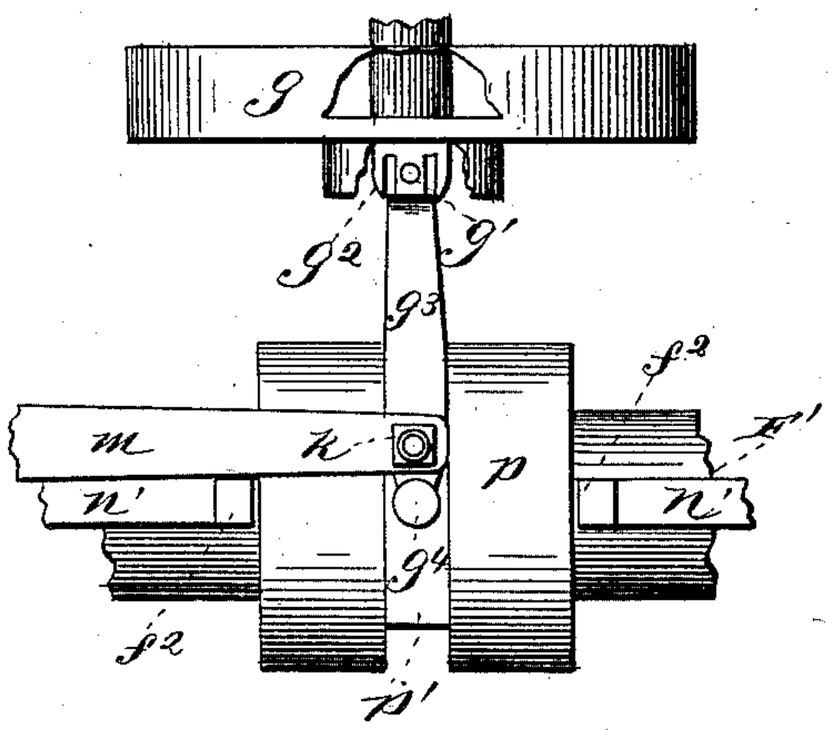



Fig. 3.

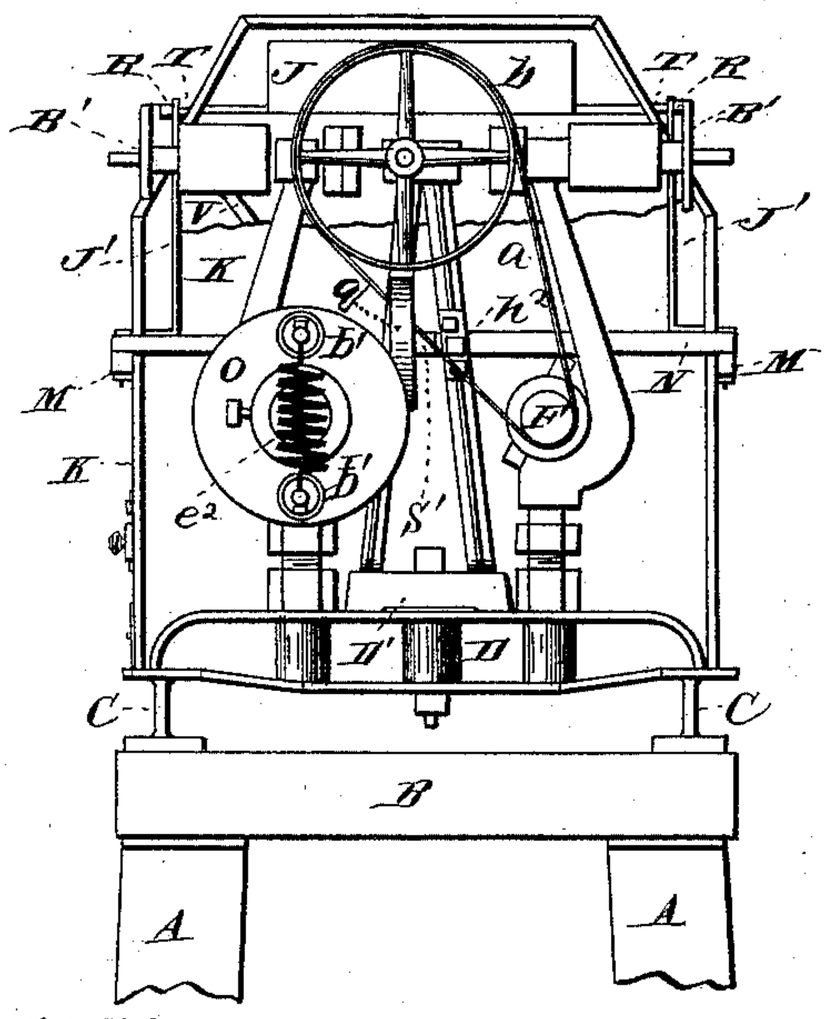



Fig. 7.

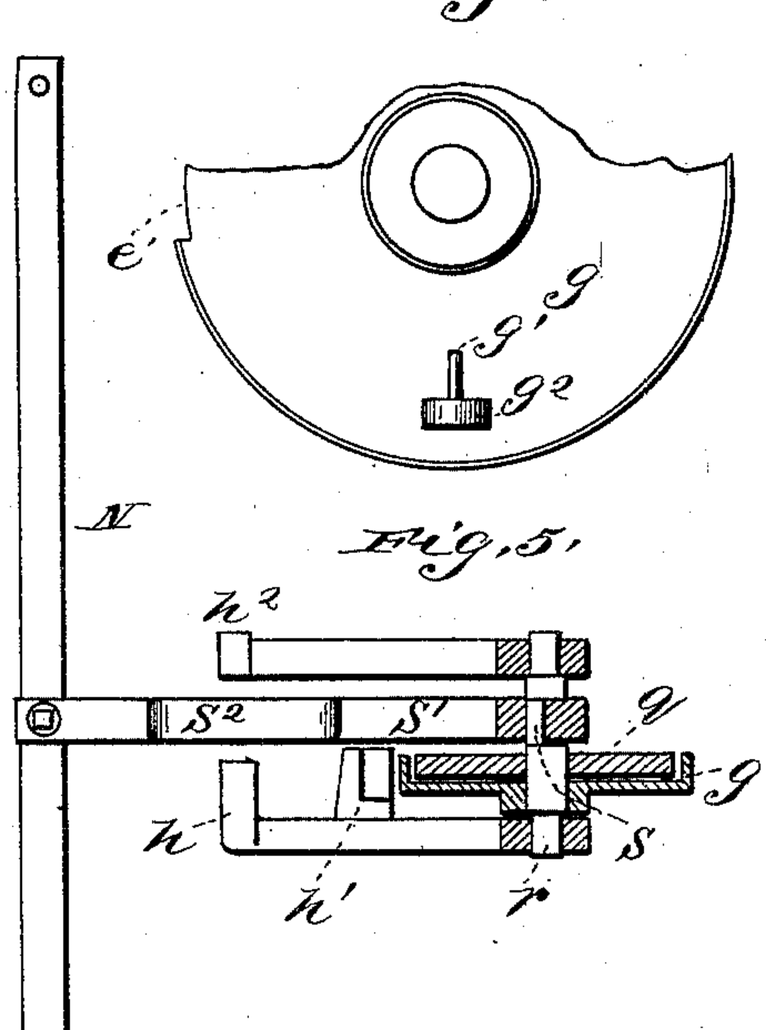


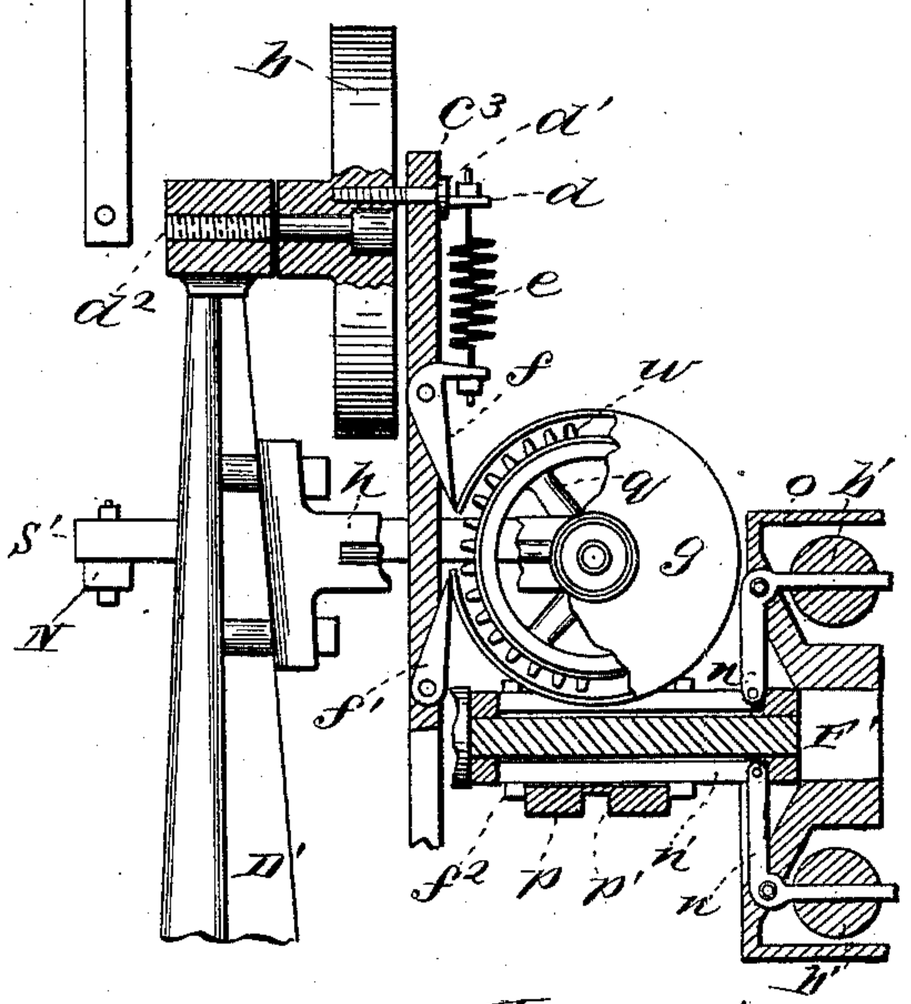

Fig. 5.







Fig. 4.




Witnesses:
T. J. Casserly.
Herbert. Warner.

Inventor:
Legrand D. Harding.

(No Model.)

4 Sheets—Sheet 3.

# L. D. HARDING.

## GRINDING MILL.

No. 475,859. Patented May 31, 1892.

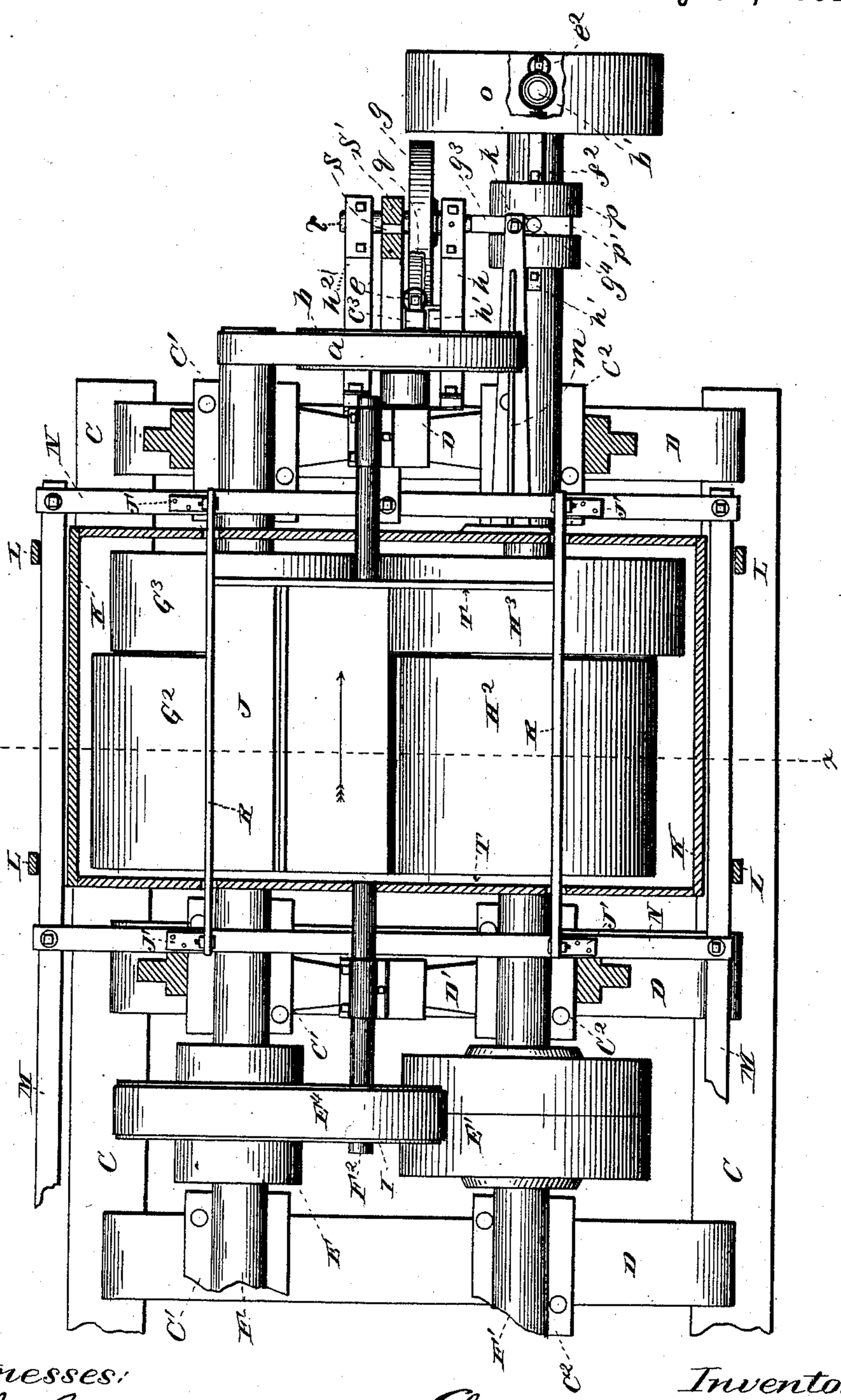


Fig. 8.

Witnesses:
J. J. Lasserly.
Herbert. Warner.

Inventor:
Legrand. D. Harding.

(No Model.) 4 Sheets—Sheet 4.

# L. D. HARDING.

## GRINDING MILL.

No. 475,859. Patented May 31, 1892.

Fig. 9.

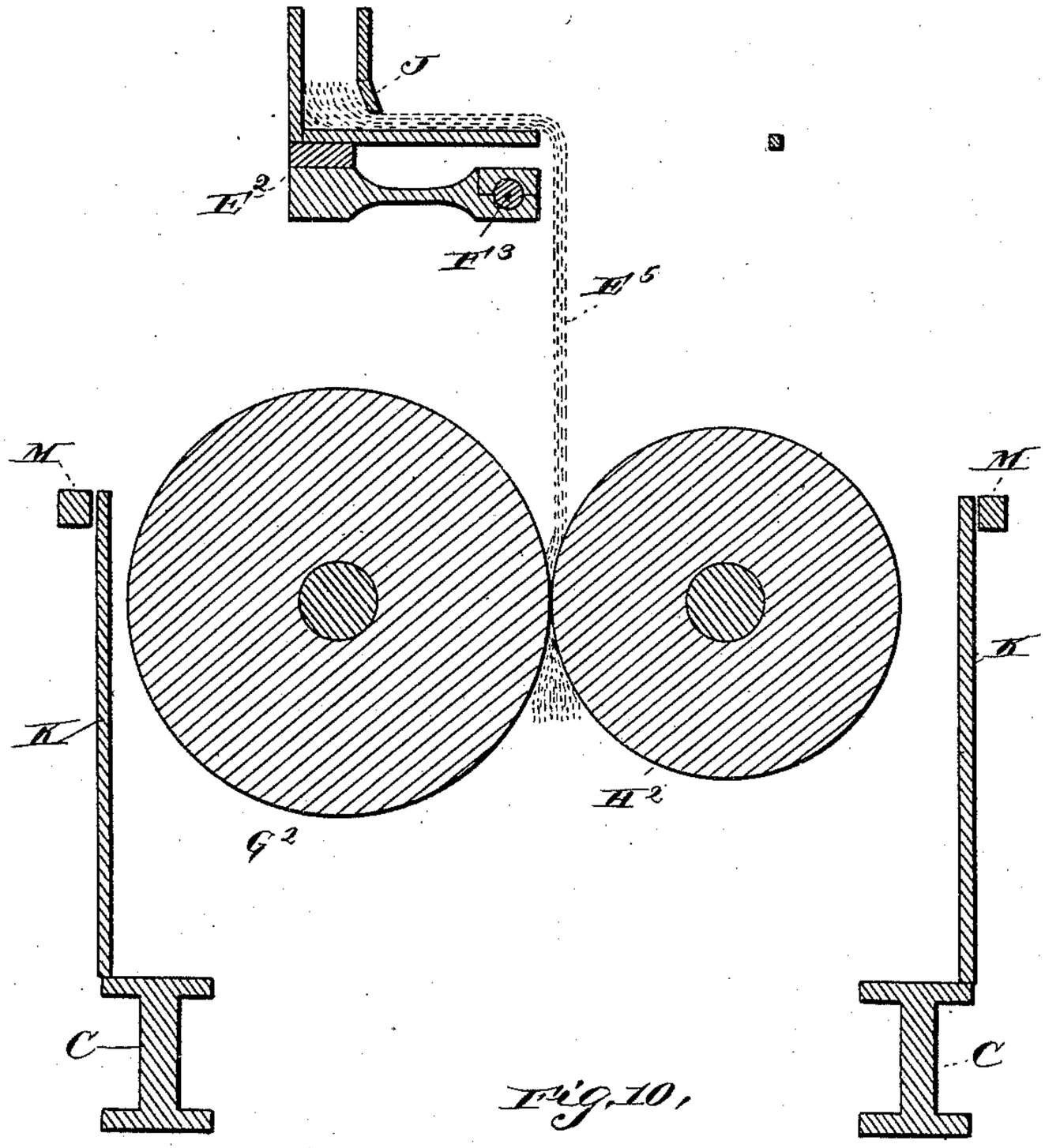
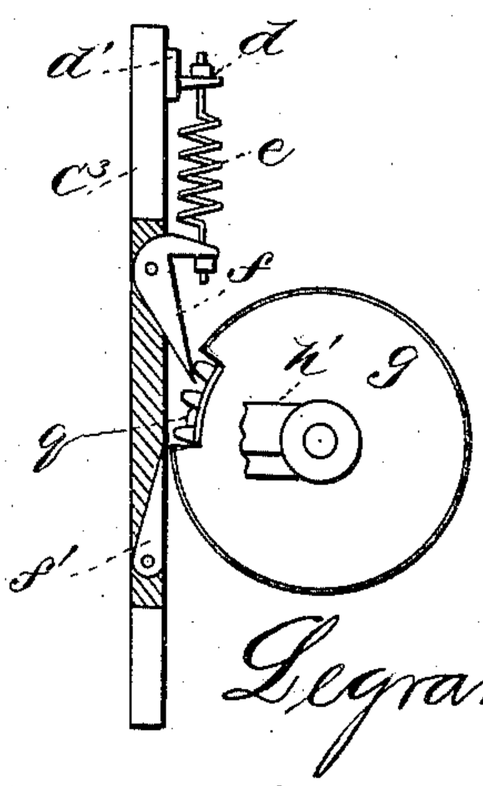



Fig. 10.




Witnesses:
J. J. Casserly.
Herbert. Warner.

Inventor:
Legrand. D. Harding.

# UNITED STATES PATENT OFFICE.

LEGRAND D. HARDING, OF COLFAX, WASHINGTON.

## GRINDING-MILL.

SPECIFICATION forming part of Letters Patent No. 475,859, dated May 31, 1892.

Application filed April 8, 1891. Serial No. 388,084. (No model.)

*To all whom it may concern:*

Be it known that I, LEGRAND D. HARDING, a citizen of the United States, residing at Colfax, in the county of Whitman and State of Washington, have invented a new and useful Grinding-Mill, of which the following is a specification.

My invention relates to improvements in grinding-mills for grinding cereals, and more particularly to mills for grinding wheat for the purpose of making flour, in which rolls are used in pairs or sets, and more especially when they are coupled together to form a series or train of rolls to be driven from one point; and it consists of certain forms of rolls to be used in conjunction with certain mechanical devices and combinations of parts for acquiring fixed differentials and automatically regaining them when lost without the aid of an attendant.

The objects of my improvements are, first, to provide rolls (with offsets suitable to produce the required differentials in flour-milling) that may be more easily constructed than those shown in my patent application, Serial No. 326,010, passed and allowed April 7, 1891, and, second, to provide means for accurately and automatically regaining the differentials when lost by shifting or moving the stocks. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a plan view of two sections of my machine with all parts above the journal-bearings removed. Fig. 2 is a front elevation of two sections of the machine with the upper part of the front casing removed. Fig. 3 is an end elevation of the machine with the upper part of the casing broken away. Fig. 4 is a front elevation of a portion of the parts, partly in section, constituting the automatic stock-shifting or differential-governing device, showing its connection with a stud D′ and a roll-shaft F′. Figs. 5 and 6 are plan views of parts of the same, partly in section. Fig. 7 is a side elevation of the lower part of the shield *g*. Fig. 8 is a broken plan view showing the mechanisms from the ball-governor for automatically shifting the stock to and including the rolls and their frame-work, with the upper arms of the journal-bearings and the upper portions of the casings removed. Fig. 9 is a vertical sectional view on a line *x* *x* of Fig. 8. Fig. 10 is a detail of a portion of the ball-governor.

Similar letters refer to similar parts throughout the several views.

The posts or legs A A, the caps B B, the beams C C, the girts D, D, D, and D, and the studs D′, D′, D′, and D′ constitute the frame-work of the machine.

The journal-bearings C′, C′, C′, and C′ carry the shafts F and F, which may be coupled together, as shown at E, (see Fig. 1,) in any suitable manner and constitute the primary line.

The shafts F′ and F′ may be coupled together, as shown at E′, by any suitable elastic coupling and supported in the bearings $C^2$, $C^2$, $C^2$, and $C^2$ and adjusted in the usual way.

Upon one shaft F, I place a roll G, which is provided with a suitable annular offset G′, and opposite this roll G, I place the roll H, which is provided with a suitable annular enlargement H′, said rolls G and H, together with their offsets G′ and H′, being so proportioned in diameter as to produce the greatest differential required between their surfaces at their peripheries when their respective shafts are each revolving at the same speed.

I have shown the roll $G^2$ of smaller diameter than the roll G and its offset $G^3$ of correspondingly larger diameter than the offset G′ of the said roll G; also, its opposing roll (or mate) $H^2$ of larger diameter than the roll H, with its offset $H^3$ of correspondingly smaller diameter than the offset H′ of the said roll H. From this it is evident that a less differential would be produced between the parts of the said rolls $G^2$ and $H^2$ and their respective offsets $G^3$ and $H^3$ than that produced between the rolls G and H and their offsets G′ and H′.

I do not wish it to be understood that I confine myself to the exact proportions shown in the drawings herewith submitted, as both the relative length and the diameter of the rolls and their respective offsets may be slightly varied to adapt them to produce different differentials for the purpose of working on different stocks or to meet the views of different flour-millers without in the least departing from the letter and spirit of my said invention.

In Figs. 2 and 3 I have shown ordinary reciprocating feed-boxes J and J, which are actuated by means of the connecting-rods $E^2$ and $E^2$, forming connections with the eccentrics $F^3$ and $F^3$ on the shafts $F^2$ and $F^2$, which are driven by means of the belts $E^4$ and $E^4$, encircling the pulleys I and I, and the couplings E and E′ in the usual manner.

The feed-boxes J and J are supported by the rods T and T, which connect with bars R and R, said bars R and R being supported by springs J′, J′, J′, and J′, which are secured to transverse bars N, N, N, and N, securely attached to longitudinally-movable bars M and M. (See Figs. 2 and 3.) One of the transverse bars N (see Figs. 3 and 5) is securely fastened to the connecting-rod S′, as is plainly shown in Fig. 5. Said connecting-rod S′ is provided with a flat part forming a spring $S^2$ and is attached to the crank S of the crank-shaft *r* in the usual way. Upon the crank-shaft *r* is mounted the toothed wheel *q*, the teeth of which are nearly inclosed by the shield *g*, which is loosely fitted on the crank-shaft, the said crank-shaft *r* being supported in ordinary bearings in the end of the arms *h* and $h^2$, as is clearly shown in Fig. 5. The arms *h* and $h^2$ are securely fastened to one of the studs D′, as is shown in Fig. 4.

The pulley *b* is secured to the stud D′ by means of the screw-bolt $d^2$ and left free to turn thereon. To the pulley *b* is eccentrically attached the reciprocating rod $C^3$ by means of the screw-bolt *d′*, said rod $C^3$ carrying with it the pawl *f′*, pivoted and held in position by gravity; also, the pawl *f*, pivoted and held in position by the spring *e*, the said rod $C^3$ being held in position by a guideway *h′* on the side of the arm *h*.

Upon the shaft F′ is mounted the pulley or case *o*, to the web of which are pivoted the arms *n* and *n*, loosely pivoted to the slides *n′* and *n′*, adapted to slide in a groove in the shaft F′ and carry with them the collar *p* by means of lugs $f^2$ and $f^2$. Said collar *p* has an annular recess *p′* engaging a pin $g^4$, fixed in the end of a lever $g^3$, said lever being held in place by a bolt *k* in the end of an arm *m*. (See Fig. 6.) The opposite end of said lever $g^3$ terminates in a fork adapted to engage a pin *g′*, secured in a lug $g^2$ on the side of the shield *g*. (See Figs. 6 and 7.)

The operation is as follows: When the feed-boxes J and J are placed in proper position over the rolls, the screw-bolt *d′* being placed on a line horizontal with the screw-bolt $d^2$, the cut *e′* in the shield *g* being placed midway between the points of the pawls *f* and *f′* and the spring $e^2$ adjusted to counteract the centrifugal force of the balls *b′* and *b′* and the primary line of rolls is rotated in the usual way, reciprocating motion is imparted to the feed-boxes J and J by means of the belts $E^4$ and $E^4$, pulleys I and I, shafts $F^2$ and $F^2$, elongated eccentrics $F^3$ and $F^3$, and connecting-rods $E^2$ and $E^2$, the stock being spouted into the rear portion of the feed-boxes J and J in the usual way is actuated by the reciprocating motion of the said boxes and advances to and falls over the front edge of their bottoms, as shown in Fig. 9, and between the rolls at the proper points, and by means of the relative construction of the rolls G H and their respective offsets G′ H′, in combination with the rolls $G^2$ and $H^2$ and their respective offsets $G^3$ and $H^3$, the secondary line of shafts F′ F′ is rotated at the same speed as the primary line F F and the proper differentials are produced between the peripheries of all the roll parts.

It is well known to those skilled in the art of flour-manufacture that small accumulations of dust or foreign bodies lodge in the feed mechanism at times and obstruct the flow of the stocks, which in a grinding-mill in which the differentials are produced and maintained by use of the stock would cause the proper differentials to be lost until said obstructions are removed by the attendant.

In my improved grinding-mills as herewith illustrated, in case the flow of a stock or stocks is interrupted by an obstruction shutting off a portion of the stock flowing between the offset G′ of the roll G and the enlargement H′ of the roll H or between the offset and the opposing enlargement of any pair of rolls in the system or series of rolls in the grinding-mill, thereby increasing the motion of the secondary line of shafting F′, and consequently causing the proper differential movements between the peripheries of the opposing rolls and their respective offsets and enlargements to be lost, the balls *b′* and *b′* will recede from their position and through their connection with the shield *g* by means of the arms *n* and *n*, the slides *n′* and *n′*, the collar *p*, and the lever $g^3$ the shield *g* is moved, and as the pulley *b* is rotated by the belt *a* the connecting-rod $C^3$ is moved up and down in the guideway *h′* by means of the eccentric screw-bolt *d′*. The proper pawl *f* engages the teeth of the partially-toothed wheel *q*, as shown in Fig. 10, and rotates said wheel, which by its connection with the crank-shaft *r*, by means of the crank *s*, connecting-rod *s′*, cross-bar N, longitudinally-movable bars M and M, springs J′, J′, J′, and J′, and connecting-rods T T and T T carry the longitudnally-movable feed-boxes J and J in the right direction, as indicated by the arrow in Fig. 8, and cause the stocks to fall between the rolls and their offset at the proper points to reproduce the proper differentials. At this point the balls *b′* and *b′* resume their former position, the shield *g* is moved back to its former position, and the pawls play up and down thereon and the stock-shifting devices remain at rest and the differentials are maintained until further accident or until the said obstruction is removed by the attendant, which would cause, relatively, too large an amount of the stock to flow between the offsets and enlargement of the rolls in the system (which are the differential holdback parts) and cause the secondary line F′ to revolve too slowly

and the balls $b'$ and $b'$ to be drawn toward each other by the force of the spring $e^2$, and all the parts of the stock-shifting devices to be actuated and the feed-boxes to be thereby moved back (or in the opposite direction from that indicated by the arrow in Fig. 8) to their former position.

I do not wish to be understood as confining myself to the reciprocating feed-boxes alone, as it is evident that any of the well-known feed mechanisms may be used and longitudinally moved for the same purpose without in the least departing from the letter and spirit of my said invention.

I do not wish it to be understood that I confine myself to a grinding-mill composed of only two pairs of grinding-rolls, as it is quite evident that any number of pairs of rolls of the kind herein described may be coupled together to form a grinding-mill composed of a series or systems of rolls to be actuated and their movements automatically governed and the required differentials regained (when lost) by the longitudinal movement of all the feed-boxes of the system, as hereinbefore described, without in the least departing from the essence of my said invention.

I am aware that centrifugal balls, connected and combined with springs, arms, slides, recessed collars, forked levers, pins, shields, partly-toothed wheels, crank-shafts, and connecting-rods have been used and actuated by the movements of a rotating shaft and pawls pivoted on reciprocating rods moving in guideways in some well-known water-wheel governors. Therefore I do not claim these combinations; but,

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

1. In a roller grinding-mill, the combination, with a grinding-roller having an annular offset in its periphery at one end, of a second grinding-roller held in frictional contact with the stock passing between it and the said first-named grinding-roller and provided on its periphery with an annular enlargement at one end fitting into the annular offset on the end of the said first-named grinding-roller, substantially as herein described, and for the uses and purposes herein set forth.

2. In a grinding-mill of the character described, the combination, with the rolls and their respective offsets and enlargements and the intervening stock, of longitudinally-movable feed-boxes J J and automatic means for moving them and the stock in either direction in a line parallel with the axes of the two lines of rolls, substantially as and for the purposes herein set forth.

3. In a grinding-mill of the character described, the combination, with the supports J′ J′ J′ J′ for the feed-boxes J J, of the movable cross-bars N and N, and automatic means for moving them and the feed-boxes in either direction in a line parallel with the axes of the two lines of rolls, substantially as and for the purpose herein set forth.

4. In a grinding-mill of the character described, the combination, with the supports J′ J′ J′ J′ for the feed-boxes J J, of movable cross-bars N and N, longitudinally-movable bars M and M, attached thereto, and automatic means for moving them in either direction in a line parallel with the axes of the two lines of rolls, substantially as and for the purposes herein set forth.

5. In a roller grinding-mill of the character described, the combination, with the two lines of rolls having offsets and arranged as described and supports J′ J′ J′ J′ for the feed-boxes J J, of movable cross-bars N and N, longitudinally-movable bars M and M, attached thereto and forming one or more rectangular frames, and the connecting-rod S′ and the herein-described automatic means for actuating the same and thereby moving the feed-boxes J J in either direction in a line parallel with the axes of the two lines of rolls and carrying the stock (when necessary) in either direction in a line parallel with the axes of the two lines of rolls to the proper point over the rolls and their respective offsets and enlargements and causing it to fall between the rolls and their respective offsets and enlargements at the proper points, substantially as herein described, and for the uses and purposes herein set forth.

LEGRAND D. HARDING.

Witnesses:
E. K. HANNA,
J. T. BROWN.