No. 624,032. Patented May 2, 1899.

C. C. HILL.

BALL GRINDING MACHINE.

(Application filed May 23, 1898.)

(No Model.) 3 Sheets—Sheet 1.

FIG. 1.

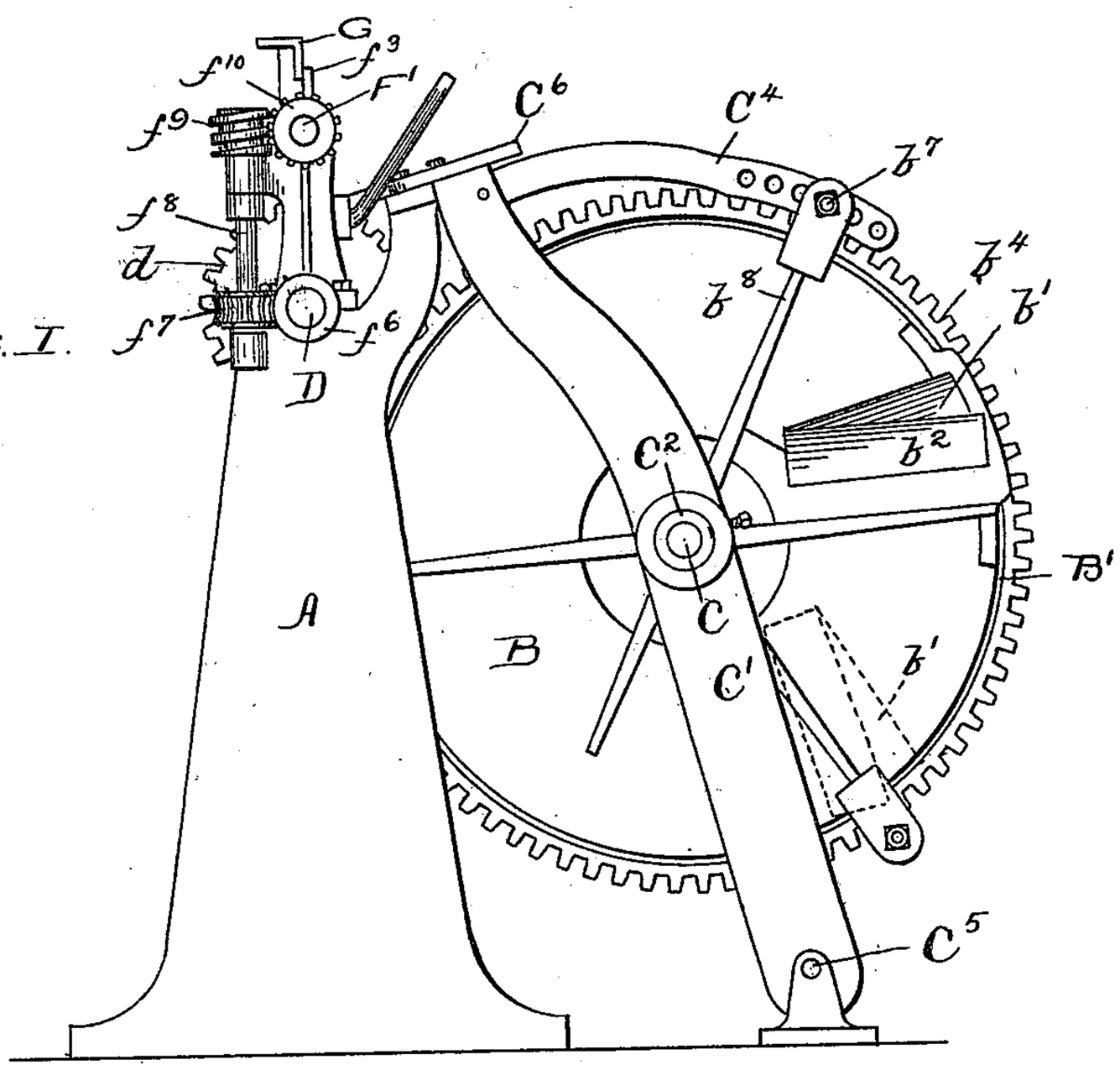

FIG. 2.

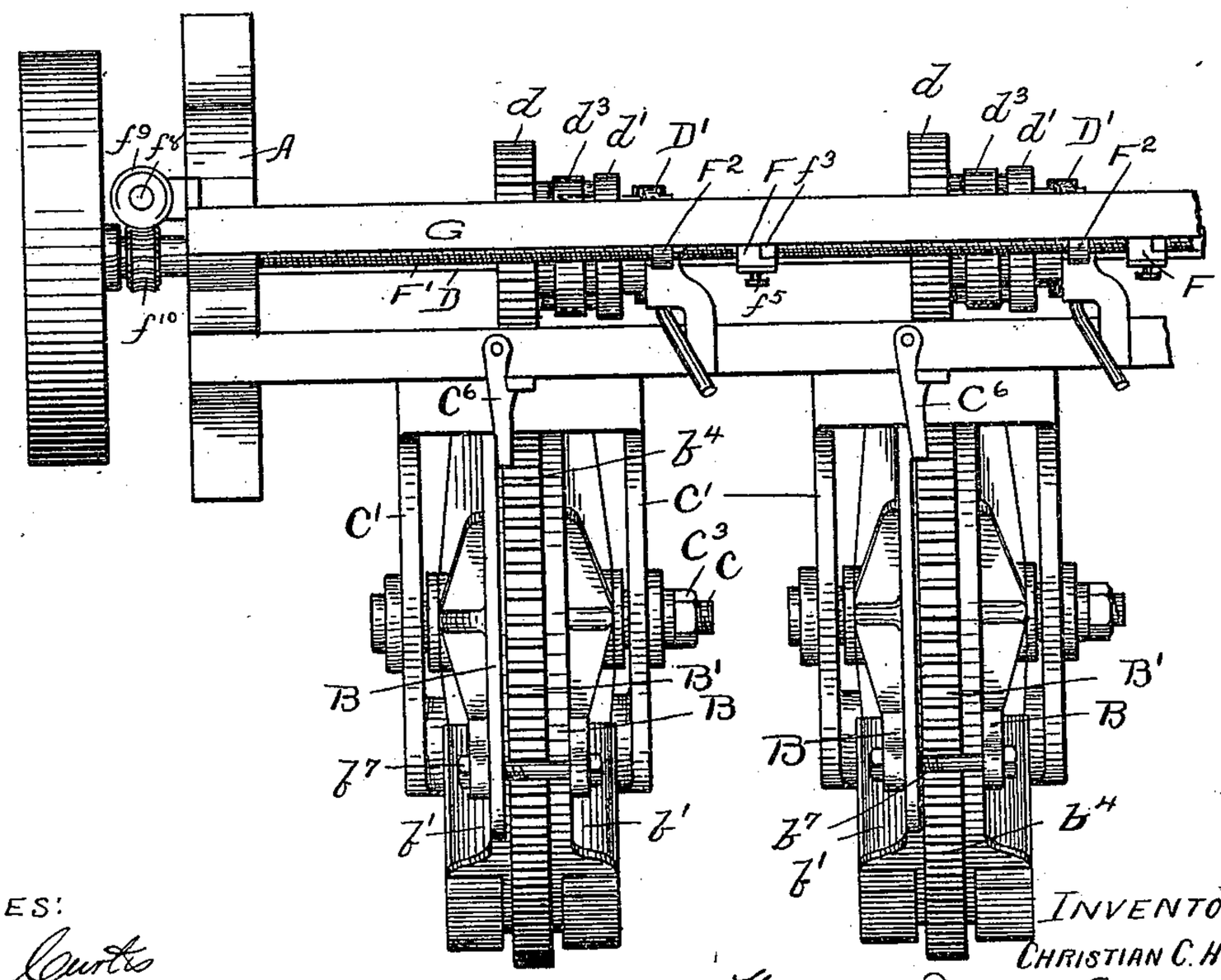

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FIG. 3

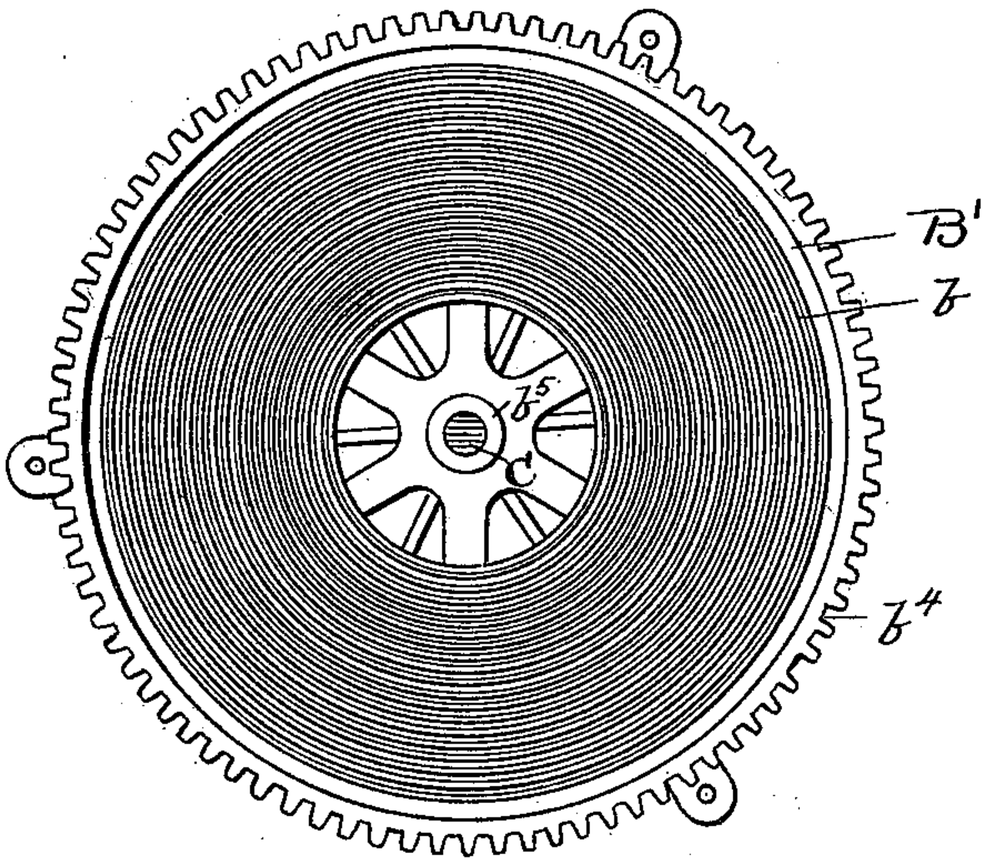

FIG. 4.

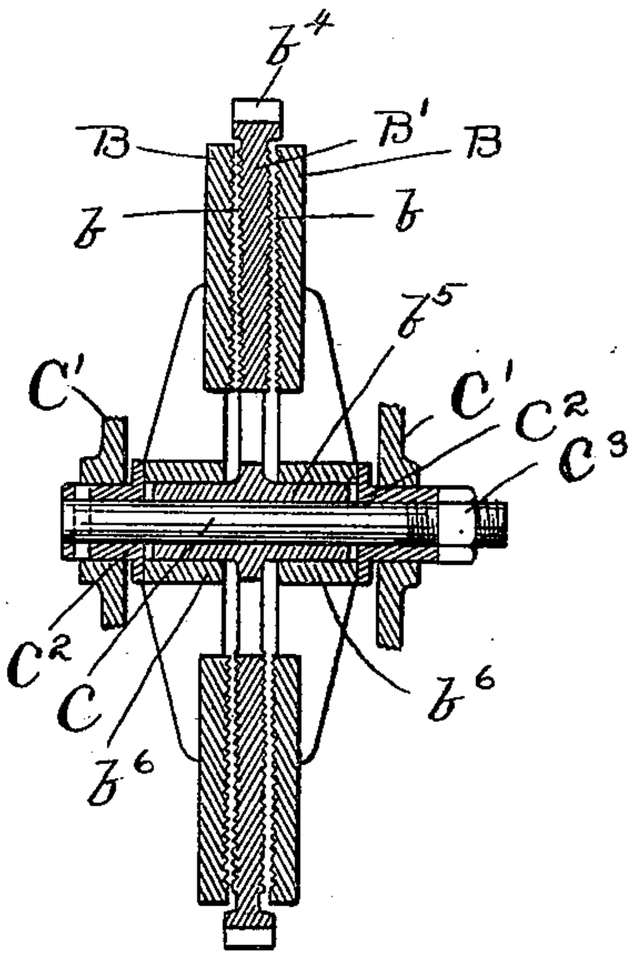

FIG. 6

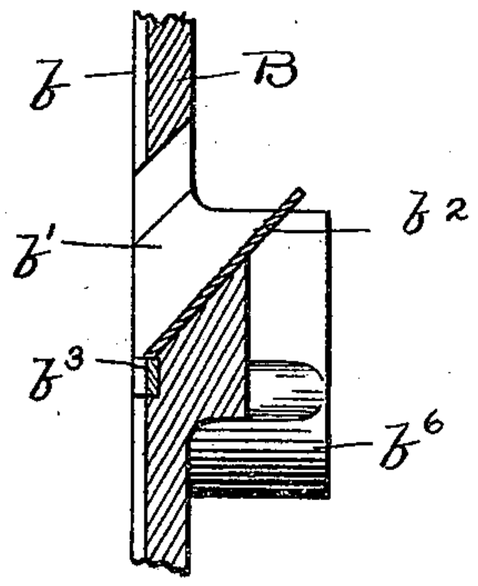

FIG. 5.

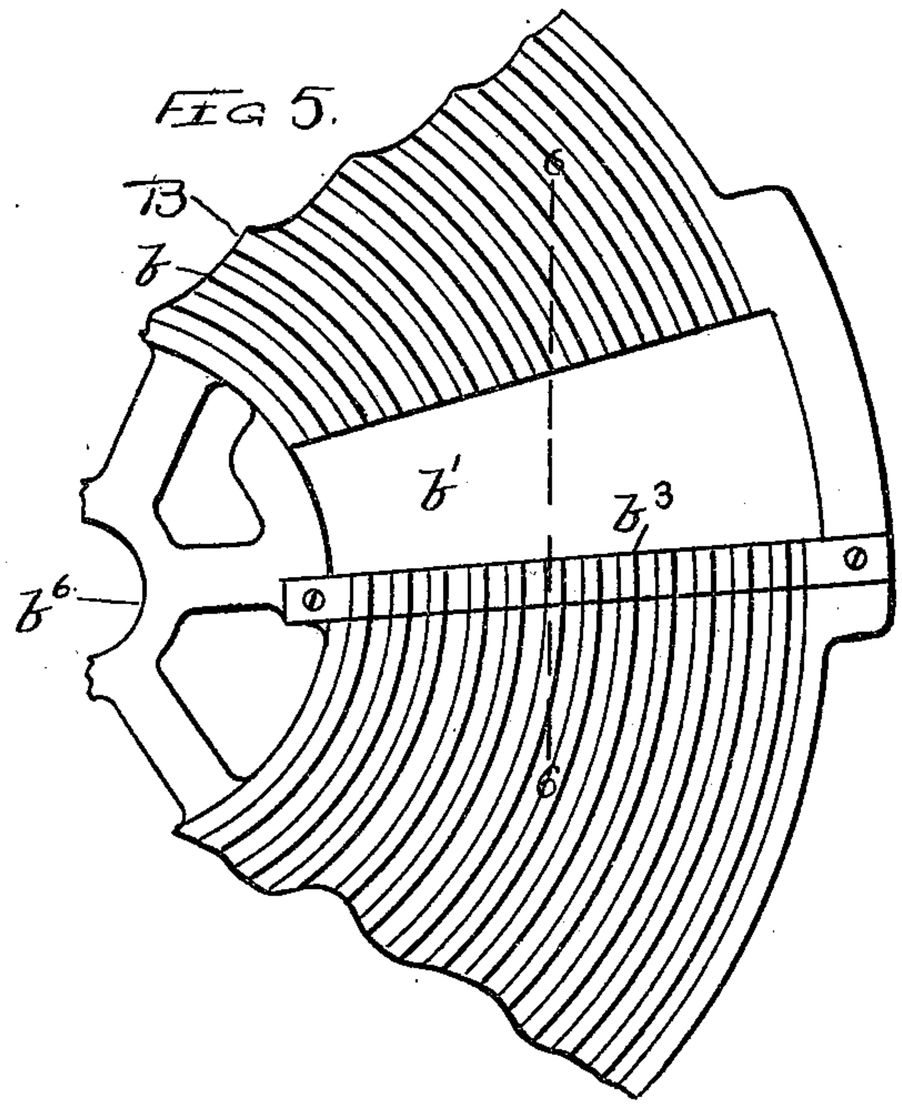

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FIG 8.

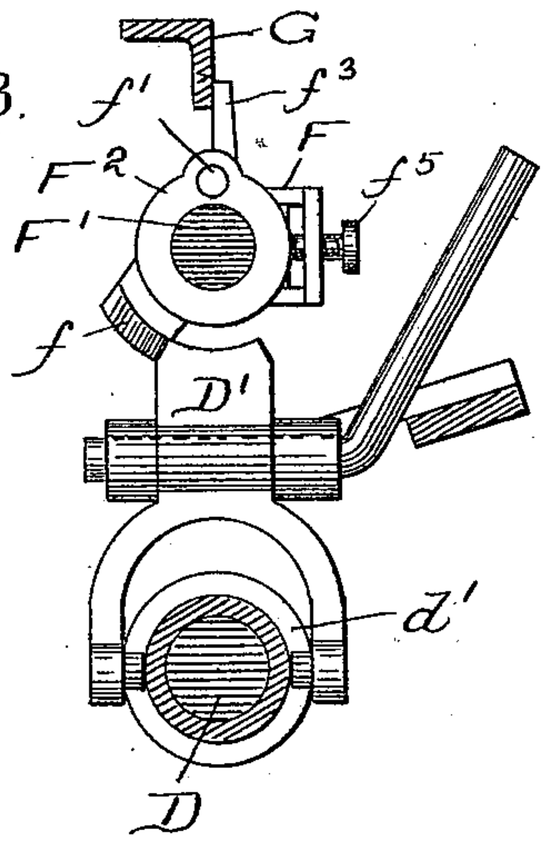


FIG 9.

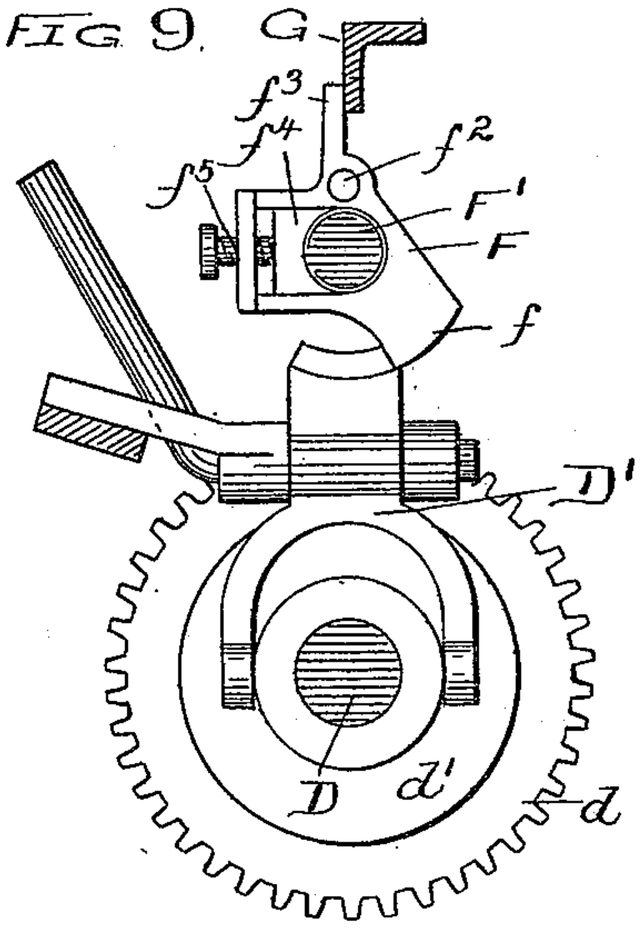
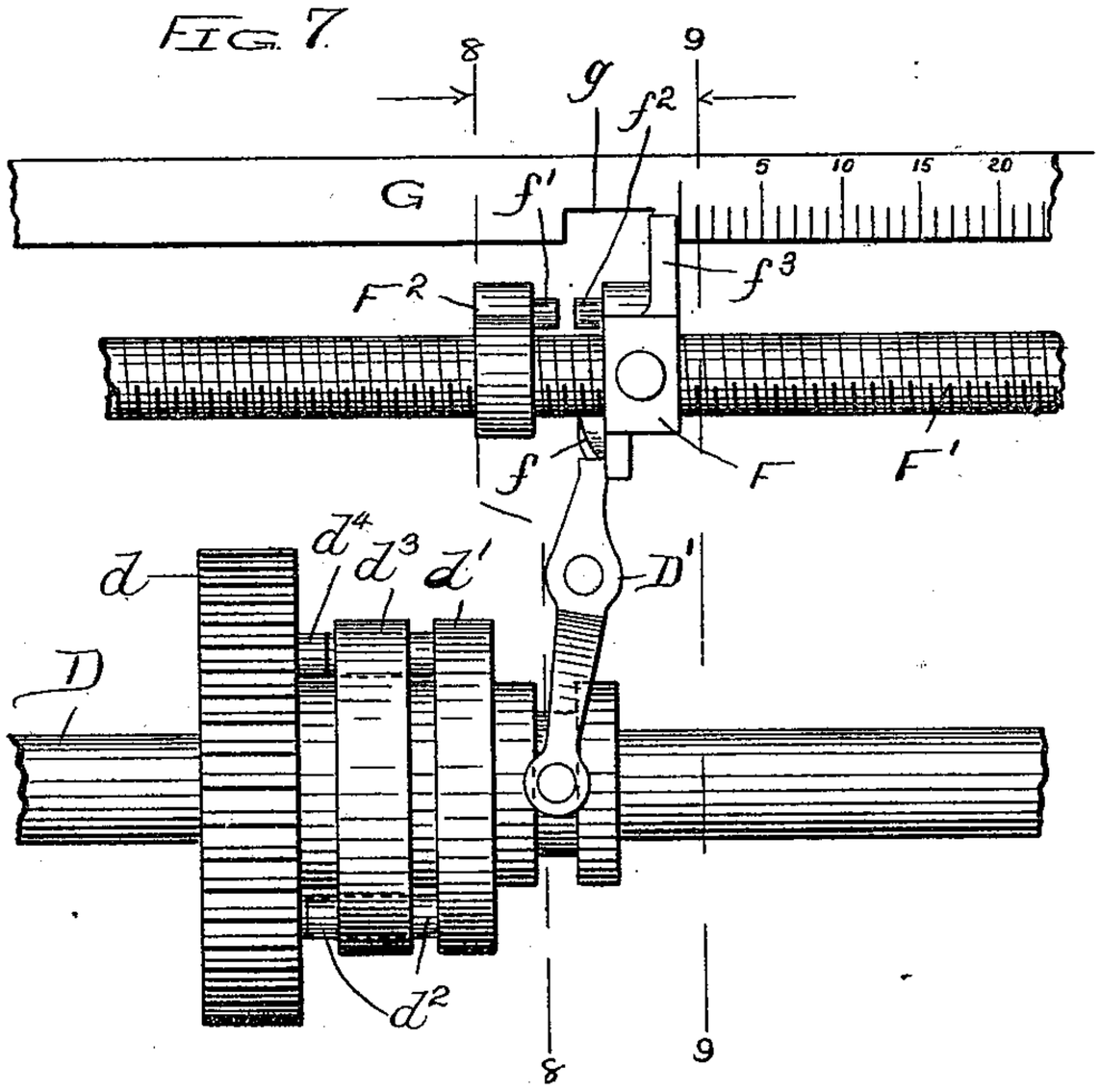


FIG. 7.



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UNITED STATES PATENT OFFICE.

CHRISTIAN C. HILL, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE STEEL BALL COMPANY, OF SAME PLACE.

BALL-GRINDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 624,032, dated May 2, 1899.

Application filed May 23, 1898. Serial No. 681,431. (No model.)

To all whom it may concern:

Be it known that I, CHRISTIAN C. HILL, a citizen of the United States, residing in Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Ball-Grinding Machines, of which the following is a specification.

My invention relates to improvements in machines for grinding steel balls.

The object of my invention is to provide a machine of a simple, efficient, and durable construction by means of which steel balls for ball-bearings of bicycles and other machines may be automatically, rapidly, cheaply, and accurately ground to true spherical form and of uniform diameter and by means of which the expense and labor of operatives in tending or watching the machines and work may be materially lessened, as well as the power required to run the machine in doing a definite or fixed amount of work.

To this end a machine embodying my invention comprises, in combination, a pair of grinding-disks provided on their meeting faces with a series of parallel grinding-grooves, one of the disks being provided with a segmental open space or pocket to permit the balls to freely change from one grinding-groove to another as the balls are carried around again and again to the segmental open space or pocket, the interchange of the balls from one grinding-groove to another thus securing, as I have discovered, absolute uniformity in size of all the balls being ground in any one batch.

The invention further consists in combining the grinding-disks together in groups of three—two outer grinding-disks and an intermediate one having grinding grooves or faces on each side, so that the balls being ground between the intermediate disks and the two outer disks will themselves operate to take the pressure and entirely relieve the bearings of the rotary intermediate disk from any side pressure, thus materially reducing the friction and the power required to run the machine and also materially aiding in keeping the grinding-disks in proper adjustment.

It also consists in the combination of a series of groups of grinding-disks, the driving mechanism of each being furnished with an automatic stop capable of being suitably timed or adjusted to automatically stop the operation of each group of disks after the lapse of any given time. This materially lessens the labor of attendants or operatives required to run and watch the work of any number of grinding-disks.

My invention further consists in the novel construction of parts and devices and novel combinations of parts and devices herein shown and described, and specified in the claims.

In the accompanying drawings, forming a part of this specification, Figure 1 is an end elevation of a machine embodying my invention. Fig. 2 is a partial plan view showing two groups or sets of grinding-disks, the machine preferably having as many different sets or groups of grinding-disks combined together with a single driving-shaft as one man can conveniently attend to to diminish the labor cost as much as possible. Fig. 3 is a detail side elevation of the middle or intermediate grinding-disk of each set or group. Fig. 4 is a radial section through one set or group of grinding-disks. Fig. 5 is a detail side view of one of the outer grinding-disks, showing the pocket or open space therein which permits the balls being ground to change from one grinding-groove to another. Fig. 6 is a detail section on line 6 6 of Fig. 5. Fig. 7 is a detail elevation of the stop mechanism by which the operation of any set of grinding-disks is automatically stopped after the lapse of any given time for which the stop mechanism may be set; and Figs. 8 and 9 are sections on lines 8 8 and 9 9, respectively, of Fig. 7.

In the drawings, A represents the frame of the machine.

B B B′ are the grinding-disks composing each set or group, the same having grinding-grooves *b*, preferably circular, on their meeting faces. The intermediate grinding-disk B′ thus has grinding-grooves *b* on both of its faces or sides, while the two outer grinding-disks B B have such grinding-grooves *b* only on their inner faces. The two outer grinding-disks B B are each provided with a segmental open space or pocket *b*′, extending transversely across all the grinding-grooves *b*,

so that when each ball is carried in any particular grinding-groove around again to this open space, pocket, or cut-away portion it may next enter some other grinding-groove. This interchange of the balls from one grinding-groove to another insures absolute uniformity in size and shape of all the balls which are being ground together at any one time or batch. At the pocket or open space b' the grinders B B are also each provided, or preferably provided, with a hopper-plate b^2 to increase the capacity of the pocket or open space b' and to facilitate the feeding of the balls to be ground into the grinding-grooves b until said grooves are filled. The pocket or hopper should be large enough in capacity to hold a sufficient number of balls in excess of the number required to fill the grinding-grooves b when the grinding begins to compensate for the diminished size of the balls as the grinding proceeds so that the grinding-grooves may be filled to substantially their full capacity during the whole period of grinding any batch of balls at the end as well as at the beginning of the grinding of the batch. Each of the outer grinding-disks B B is also preferably provided at the lower margin of the pocket b' with a plate of hardened steel b^3 to prevent undue wear or abrasion at the entrance to the grinding-grooves b.

The intermediate or rotary grinding-disk B′ is provided with gear-teeth b^4 on its periphery for rotating it, and its hub b^5 is journaled on a short shaft C, mounted in the frame-arms C′ C′. The hubs b^6 of the outer disks B B surround the hub b^5 of the inner disk B′, and the outer disks B B are held or forced together, so as to produce the requisite pressure upon the balls between the disks B B′ B by caps C^2 C^2, which bear against the hubs of the outer disks B B and the adjusting-nut C^3 on the shaft C.

The proper automatic interchange of the balls being ground from one grinding-groove b to another is facilitated by having the bottom or lower edge of the pocket or open space b' at a slight angle or inclination to the horizontal, the outer end preferably being slightly higher than the inner end, as is clearly illustrated in Figs. 5 and 1, and to enable the inclination of the bottom of the pocket b' to be properly adjusted as may be required the radial position of the outer disks B B may be adjusted by placing the bolt b^7, which passes through a strengthening rib or arm b^8 on the disks B, in different holes of the arm C^4, by which the disks B are held in position and from rotation. By removing the bolt b^7 the disks B B may also be turned to bring the hopper or pocket b' into position for discharging the balls from the grinding-disks when the grinding is finished, as illustrated by the dotted lines in Fig. 1. To facilitate the removal or disconnection of each set of grinding-disks B B′ B from the machine, the frame-arms C′ are pivoted at their lower ends on the pivots C^5, and their upper ends are held or locked to the main frame A by a catch or latch C^6. This permits any set or group of grinding-disks to be swung out from the rest whenever desired for any purpose.

D is the driving-shaft. It is provided with a series of spur-gears d, which mesh with the spur-gears b^4, formed on the periphery of each of the intermediate grinding-disks B′. The gears d are loose on the shaft D and are automatically connected and disconnected therefrom by means of a sliding collar d', loose on the shaft D, and which is furnished with pins d^2, that pass through holes in a collar d^3, fast on the shaft D, and which pins engage pins d^4 on the gear d when the sliding collar d' is moved forward to make said pins so engage. The movement of the collar d' to disengage the gear d from the shaft D is automatically effected after the lapse of any required time or amount of grinding determined by experiment to be sufficient, or approximately sufficient, by means of a traveling stop F on a screw-shaft F′, which is provided with a cam f, that engages a clutch-lever D′, which is connected at its yoke end with the collar d'. The screw-shaft F′ is provided with a fixed stop F^2, secured to the screw and rotated therewith, and which is provided with a pin or projection f', that engages a pin or projection f^2 on the traveling stop F when the traveling stop has been moved by the rotation of the screw into position for such engagement. The traveling stop F has an arm f^3, that rests upon the gage-plate G and prevents the traveling stop from rotation, except when it has been advanced far enough to bring said arm f^3 into registry with the notch g in the gage-plate G. Any set or group of grinders B B′ B is set to run a greater or less length of time by the disengaging and setting or moving the traveling stop F at a greater or less distance from the notch g and again engaging it with the screw. The traveling stop F is disengaged from the screw F′, so that it may be slipped or moved to any desired point for starting by withdrawing its threaded segment f^4 from the threads of the screw, this being done by the adjusting-screw f^5.

The screw-shaft F′ is driven at a slow speed, preferably at a reduction of about two hundred to one, from the driving-shaft D by means of the worm f^6 on the shaft D engaging worm-gear f^7 on the counter-shaft f^8, said counter-shaft f^8 having a second worm f^9, engaging a worm-gear f^{10} on the screw-shaft F′.

I claim—

1. In a ball-grinding machine, the combination with a pair of grinding-disks furnished with a series of grooves on their meeting faces, one of said disks having a segmental pocket or open space to permit the balls to change from one groove to another as they are carried around again and again, substantially as specified.

2. In a ball-grinding machine, the combination with a pair of grinding-disks furnished with a series of grooves on their meeting faces,

one of said disks having a segmental pocket or open space to permit the balls to change from one groove to another as they are carried around again and again, the bottom or lower edge of said pocket or open space being inclined to the horizontal, substantially as specified.

3. In a ball-grinding machine, the combination with a pair of grinding-disks furnished with a series of grooves on their meeting faces, one of said disks having a segmental pocket or open space to permit the balls to change from one groove to another as they are carried around again and again, said pocket having an inclined plate or wall to serve as a hopper for feeding the balls into the grinding-grooves, substantially as specified.

4. In a ball-grinding machine, the combination with a pair of grooved grinding-disks, one of which is stationary and the other rotary, the stationary grinding-disk having a segmental pocket or cut-away portion and a hardened-steel grooved plate at the lower edge of said pocket or cut-away portion, substantially as specified.

5. In a ball-grinding machine, the combination with a pair of outer grinding-disks, with an intermediate grinding-disk and having a grinding-face on each of its sides, and means for clamping or holding the two outer disks against the intermediate disk, substantially as specified.

6. The combination with two outer stationary grooved grinding-disks B B, having a series of grinding-grooves on their inner faces, and a pocket, hopper or open space extending across the grinding-grooves, and an intermediate rotating grinding-disk having grinding-grooves on each of its sides, substantially as specified.

7. The combination with two outer stationary grooved grinding-disks B, B, having a series of grinding-grooves on their inner faces, and a pocket, hopper or open space extending across the grinding-grooves, and an intermediate rotating grinding-disk having grinding-grooves on each of its sides, a driving-shaft and driving-gear thereon, a clutch and a time stop mechanism for automatically stopping the operation of the grinding-disks, substantially as specified.

8. The combination with a set of grinding-disks, of a driving-shaft and connecting-gear, clutch devices, a screw, a traveling stop threaded on said screw and provided with an arm, and a notched gage engaging said arm on the traveling stop, substantially as specified.

9. The combination with a series of grinding-disks, of a driving-shaft and connecting-gear, clutch devices, a screw, a traveling stop threaded on said screw and provided with an arm, and a notched gage engaging said arm on the traveling stop, said traveling stop having a cam engaging the clutch-lever, substantially as specified.

10. The combination with a series of grinding-disks, of a driving-shaft and connecting-gear, clutch devices, a screw, a traveling stop threaded on said screw and provided with an arm, and a notched gage engaging said arm on the traveling stop, said traveling stop having a cam engaging the clutch-lever, and said screw having a fixed collar or projection adapted to engage the traveling stop and cause the same to rotate with the screw when the arm or projection on the traveling stop registers with the notch in said gage, substantially as specified.

11. The combination with a stationary grinding-disk furnished with a pocket or hopper extending across the grinding-grooves, and a rotating gringing-disk, and a shaft upon which said grinding-disks are mounted, and means for holding the stationary grinding-disk adjustably in position to adjust the inclination of the bottom of said pocket or hopper and permit the rotating grinding-disk to be turned to bring said pocket or hopper into position for discharging the balls when the grinding is finished, substantially as specified.

CHRISTIAN C. HILL.

Witnesses:
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EDW. S. EVARTS.