F. SNOW.

DRIVING AND REVERSING MECHANISM.

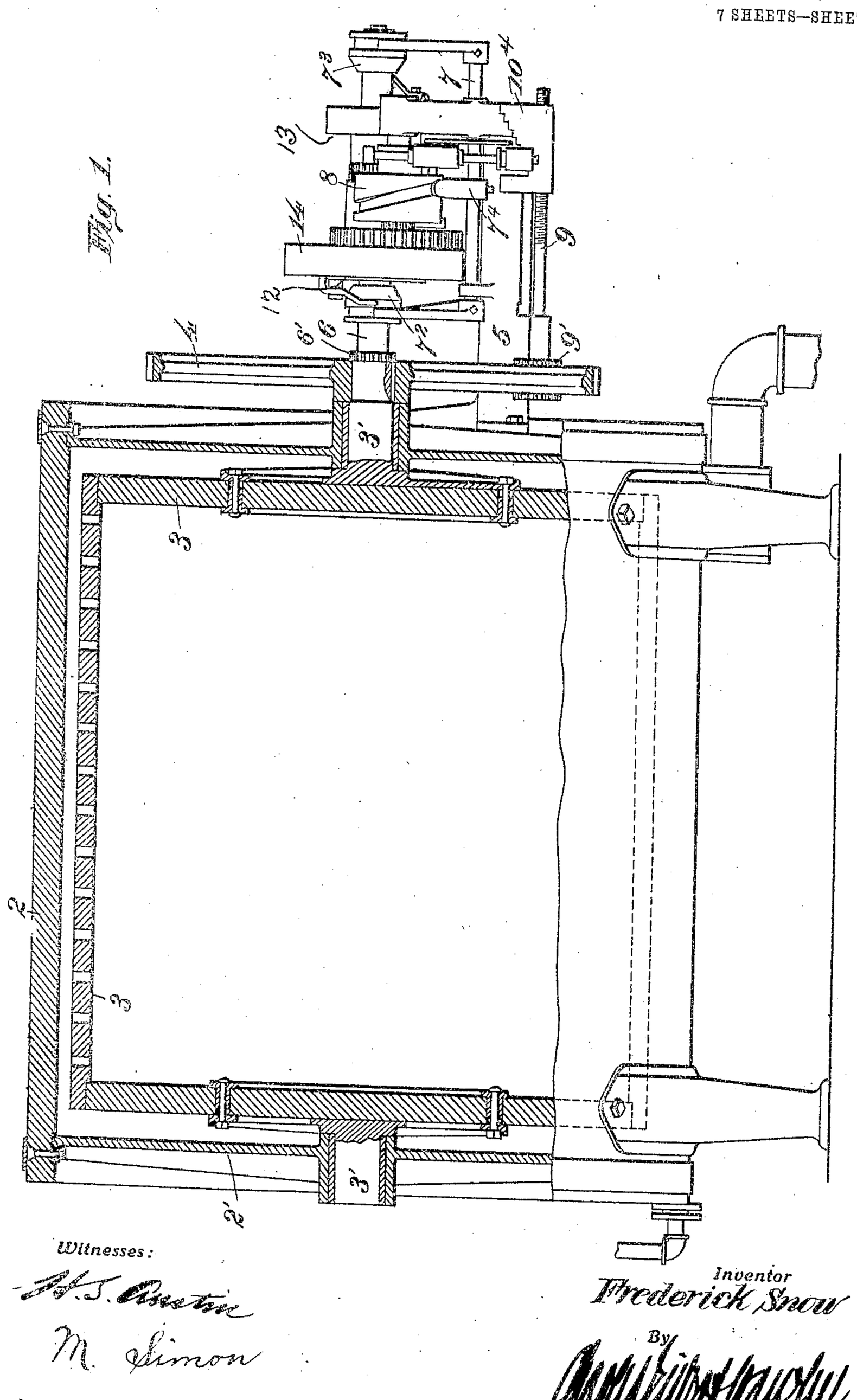
APPLICATION FILED APR. 27, 1906.

912,044.

Patented Feb. 9, 1909.

7 SHEETS—SHEET 1.

Fig. 1.



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7 SHEETS—SHEET 2.

Fig. 2

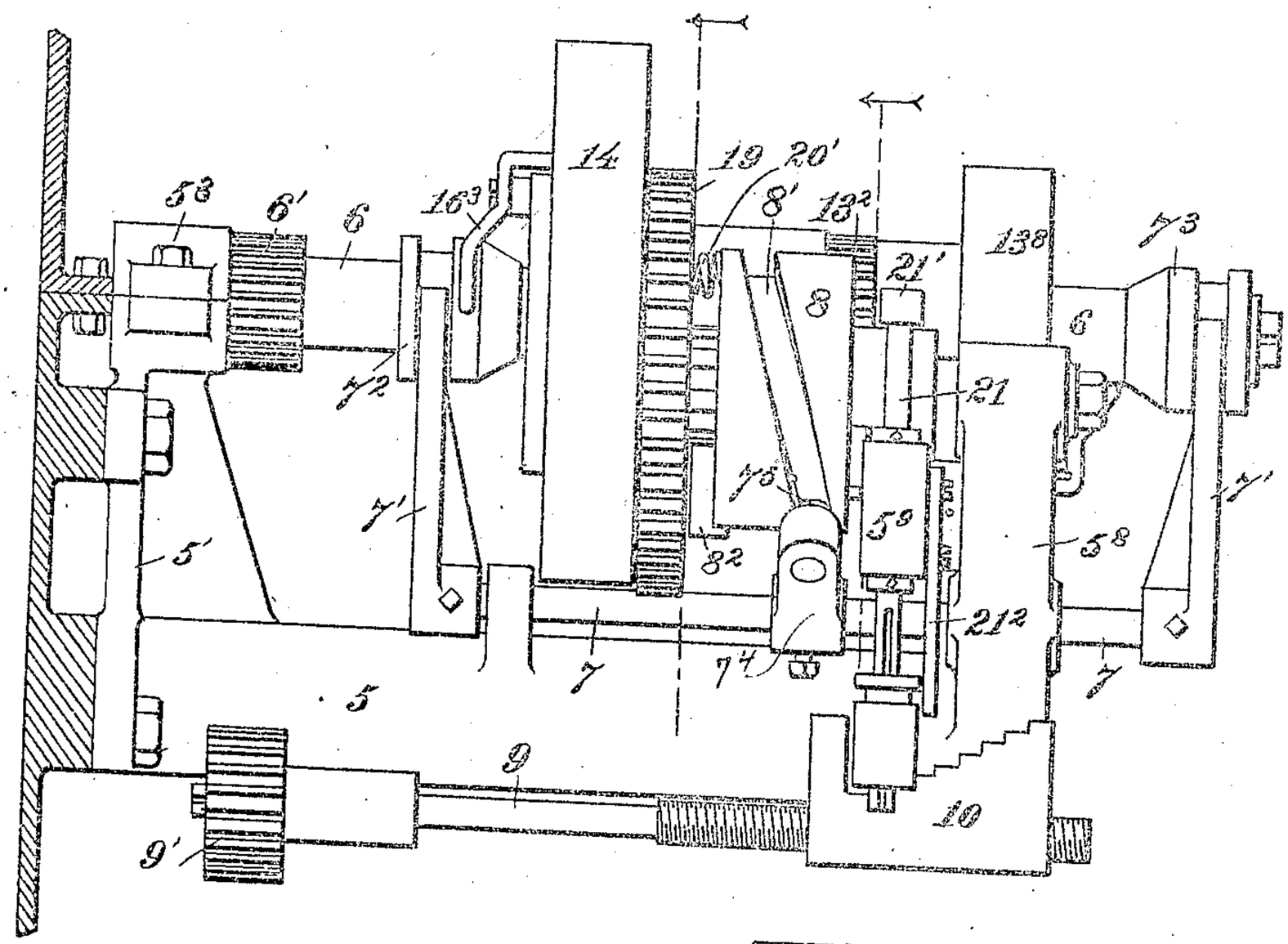
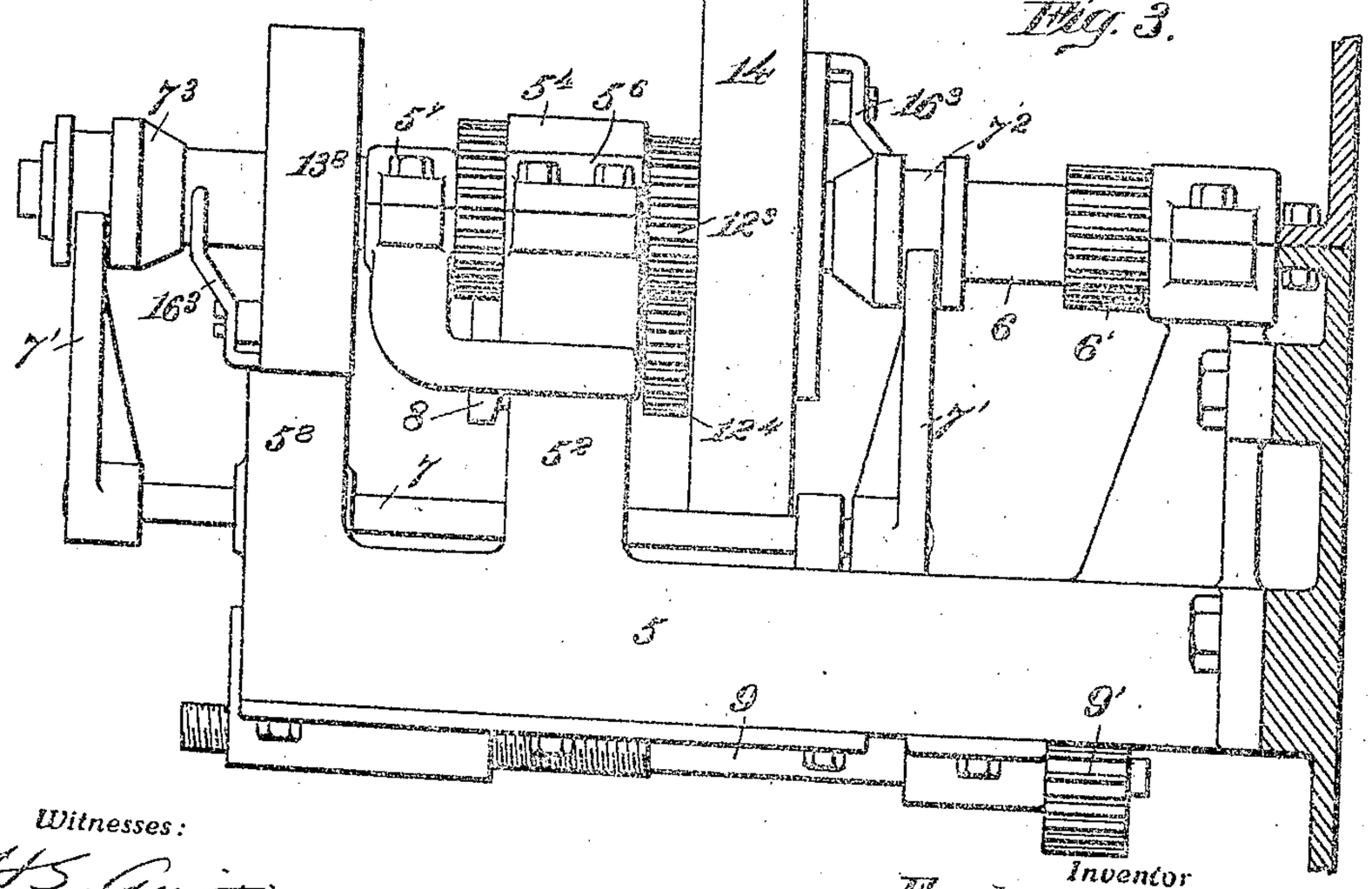


Fig. 3.



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7 SHEETS—SHEET 3.

Fig. 4.

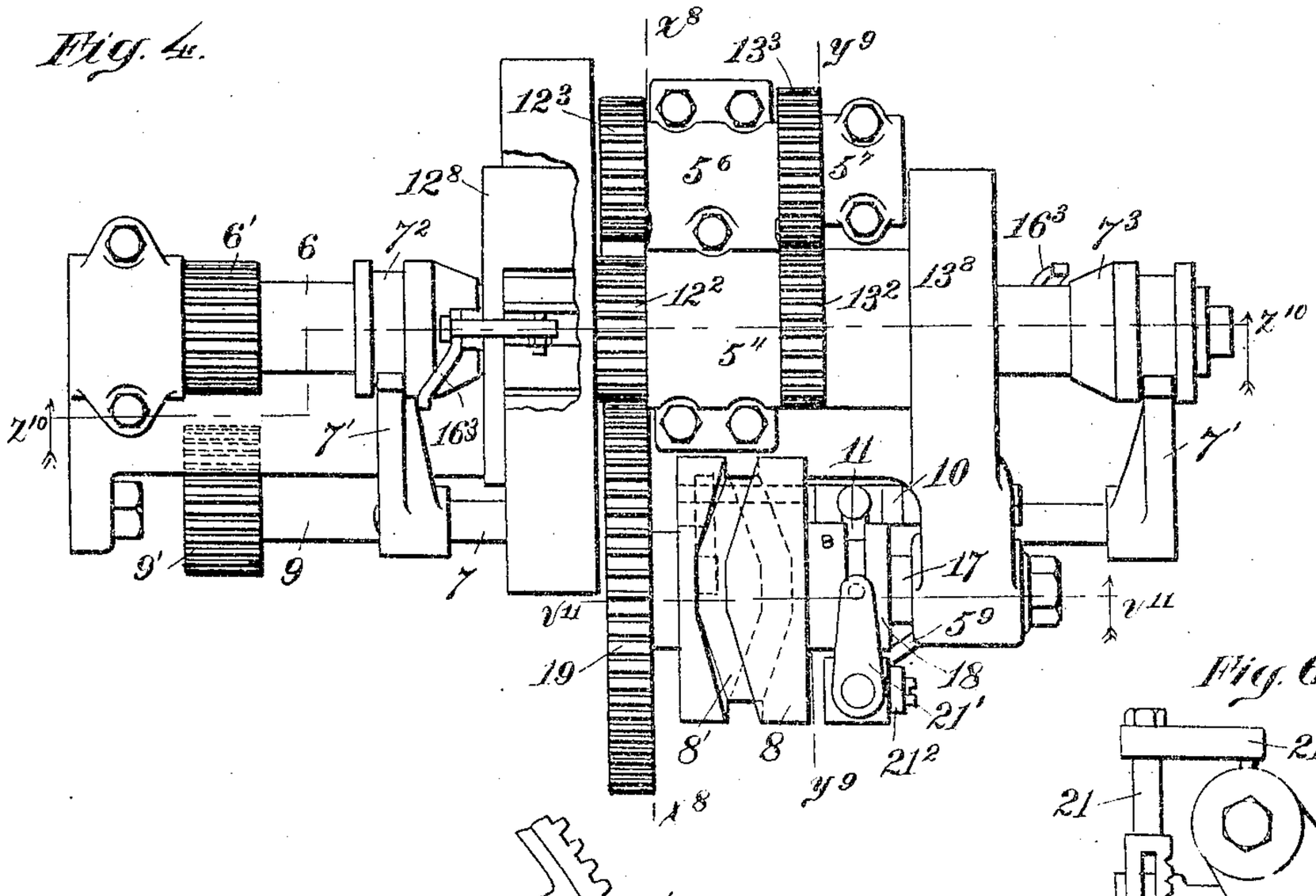


Fig. 5.

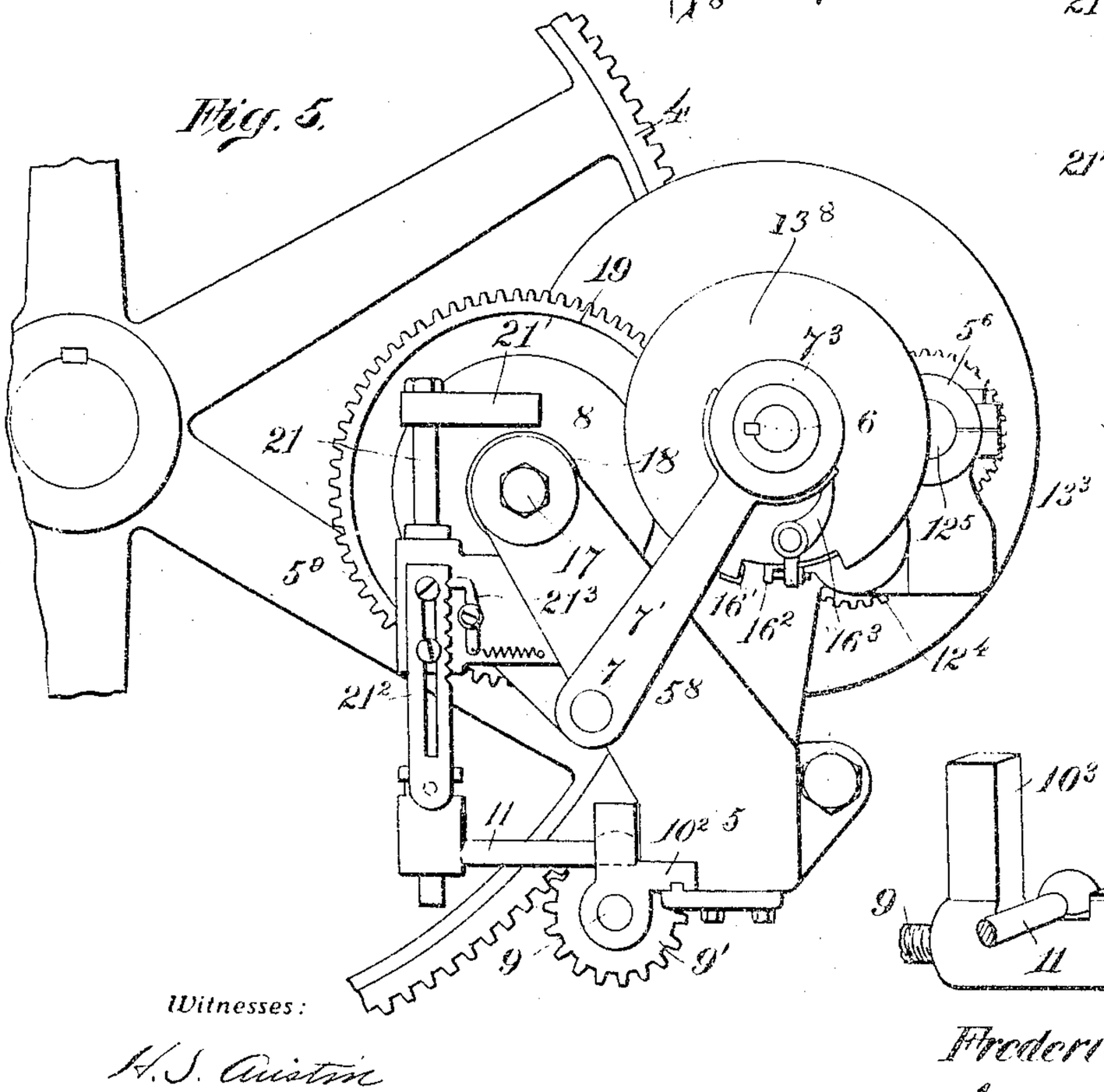


Fig. 6.

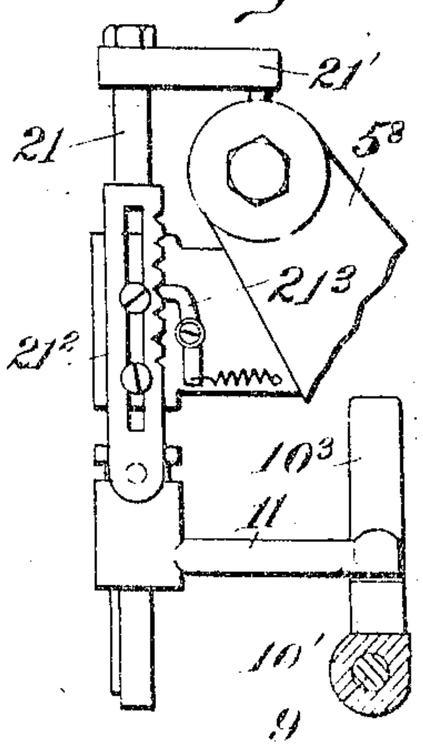
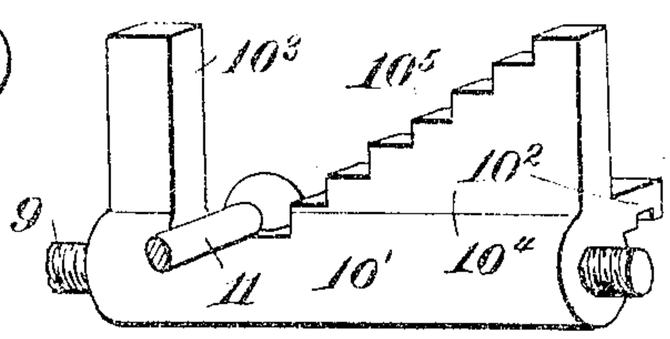


Fig. 7.



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7 SHEETS—SHEET 4.

Fig. 8.

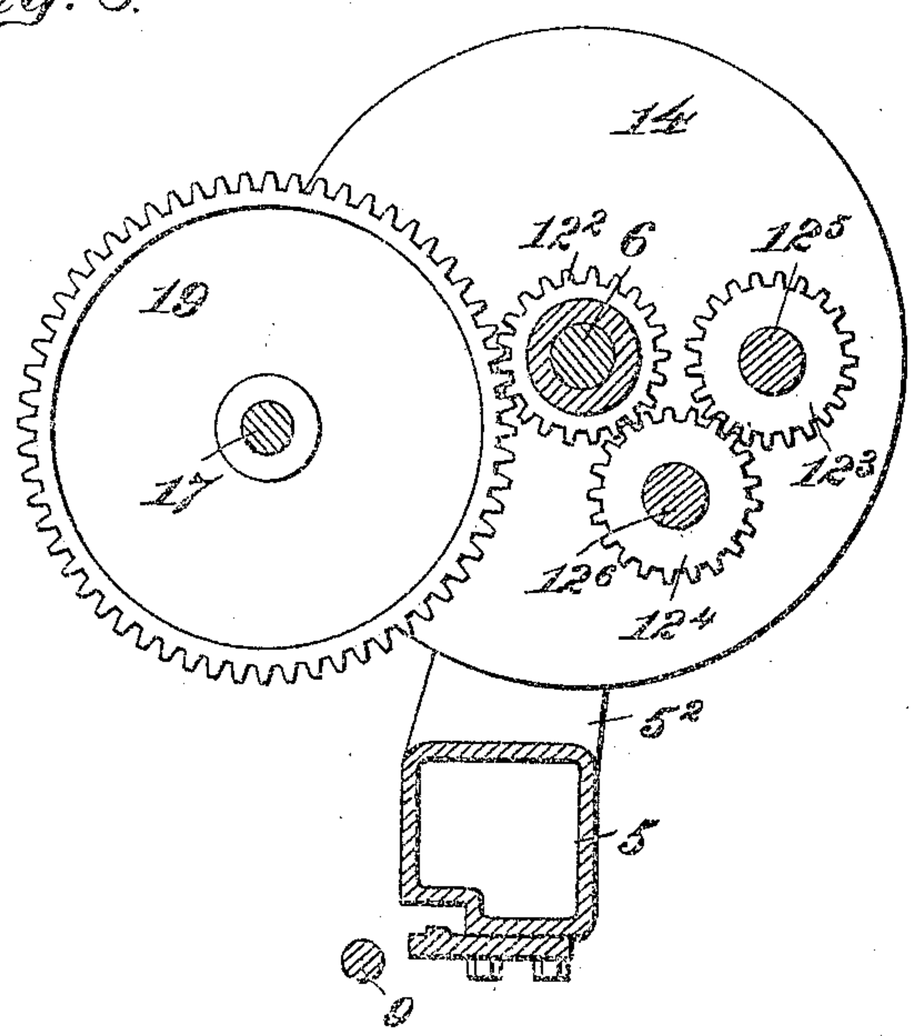
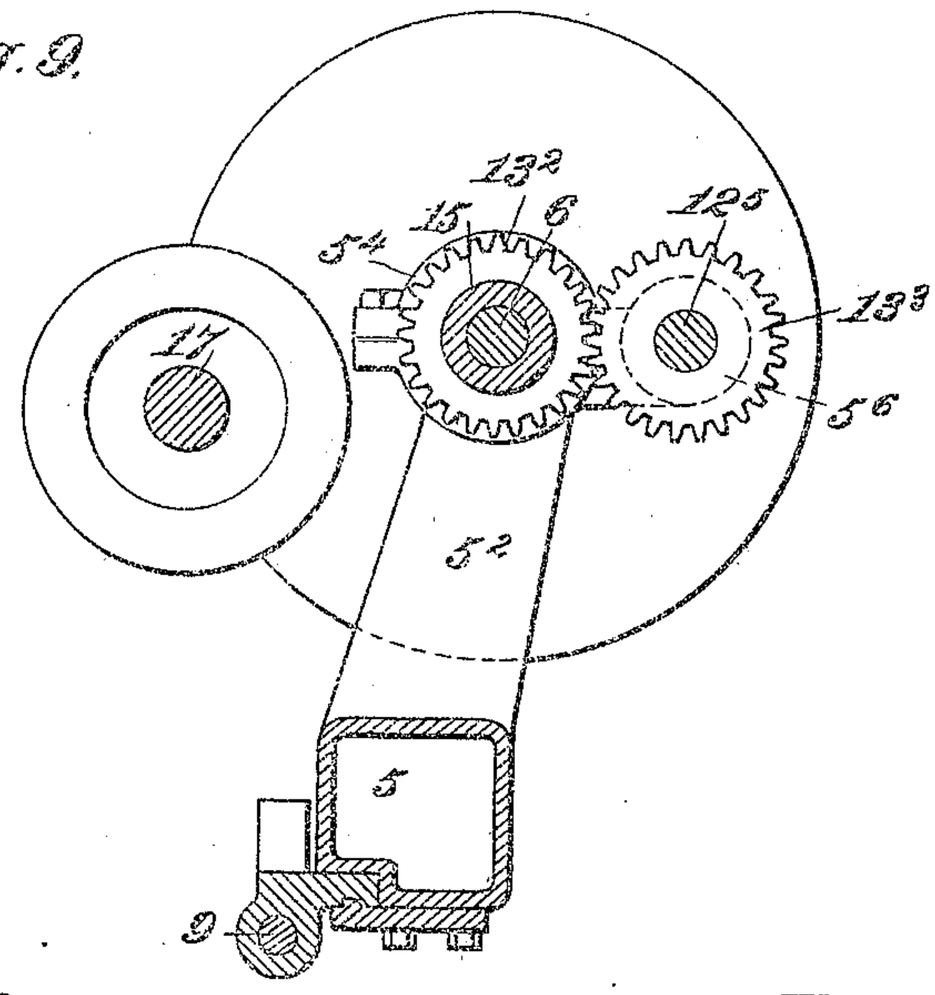


Fig. 9.



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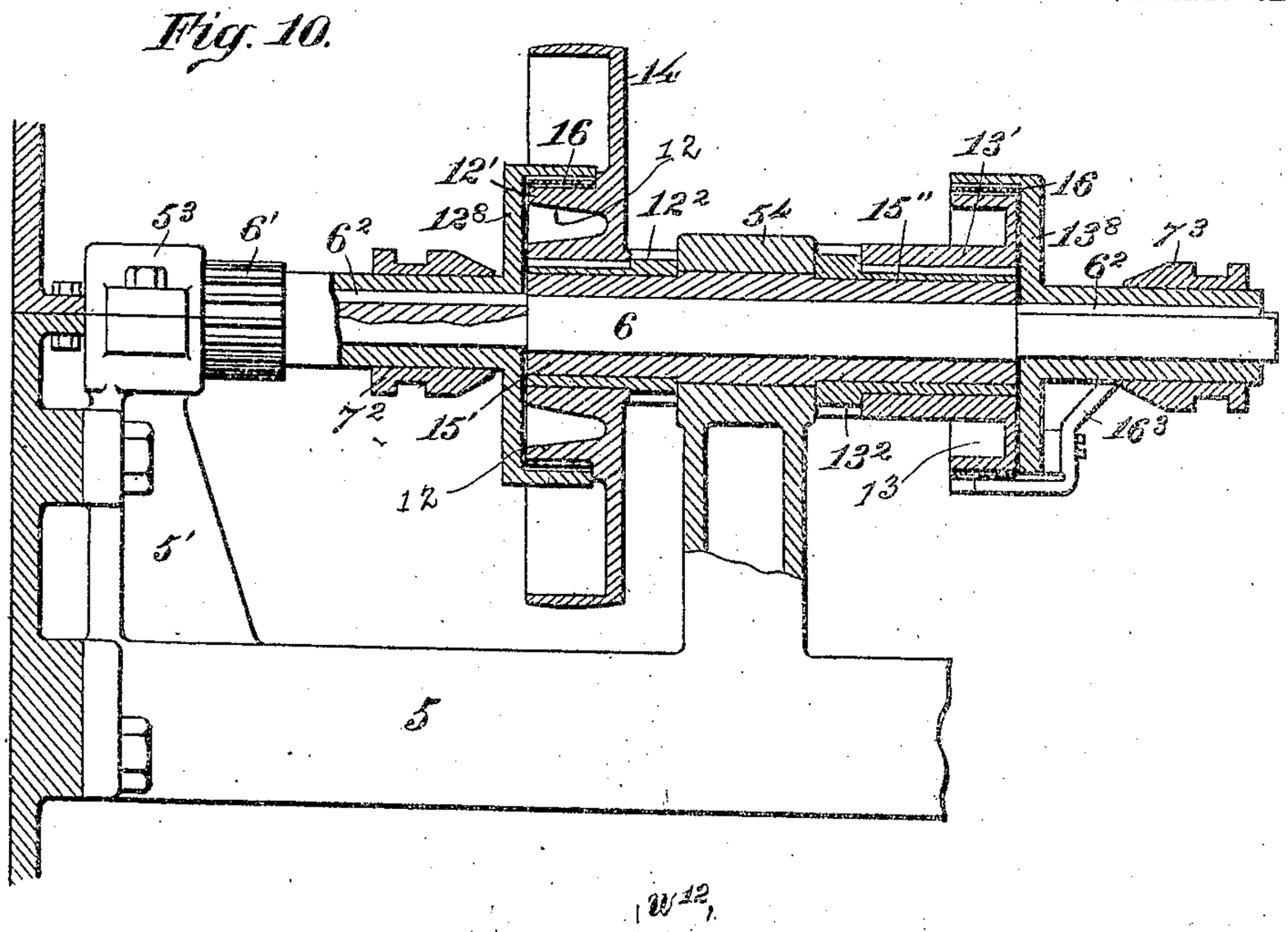
7 SHEETS—SHEET 5

Fig. 10.



W12

Fig. 12.

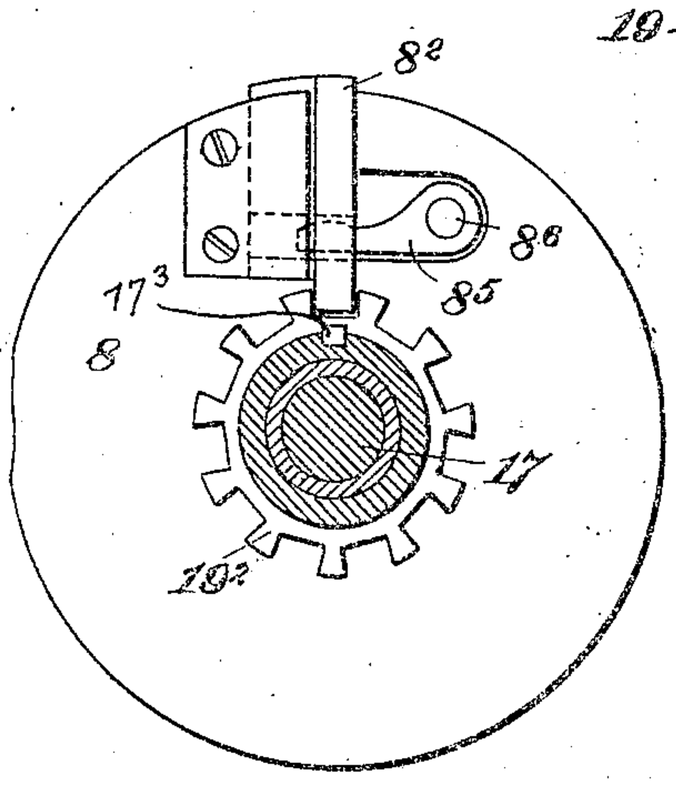
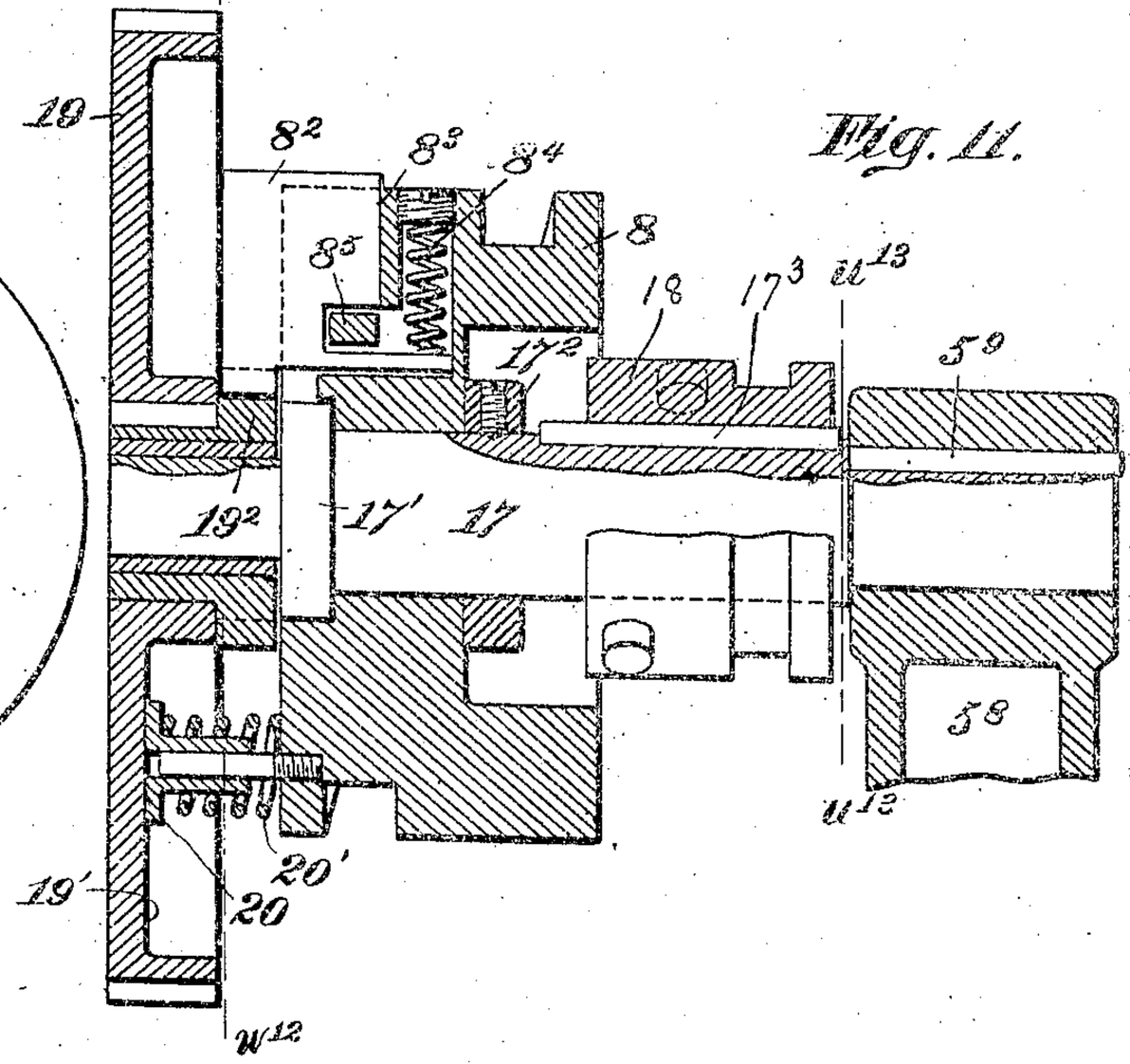


Fig. 11.



W12

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APPLICATION FILED APR. 27, 1906.

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7 SHEETS—SHEET 6.

Fig. 13.

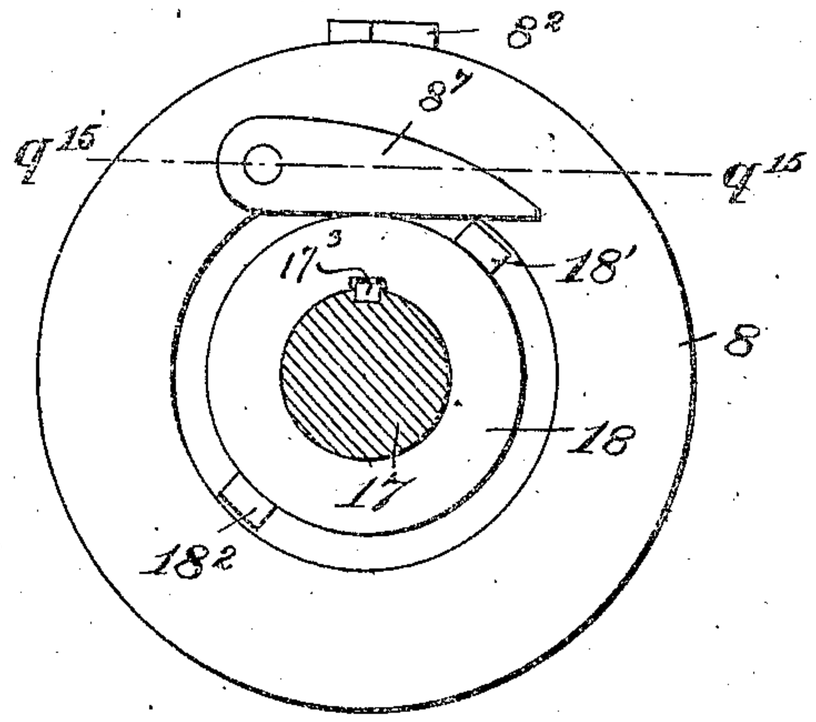


Fig. 14.

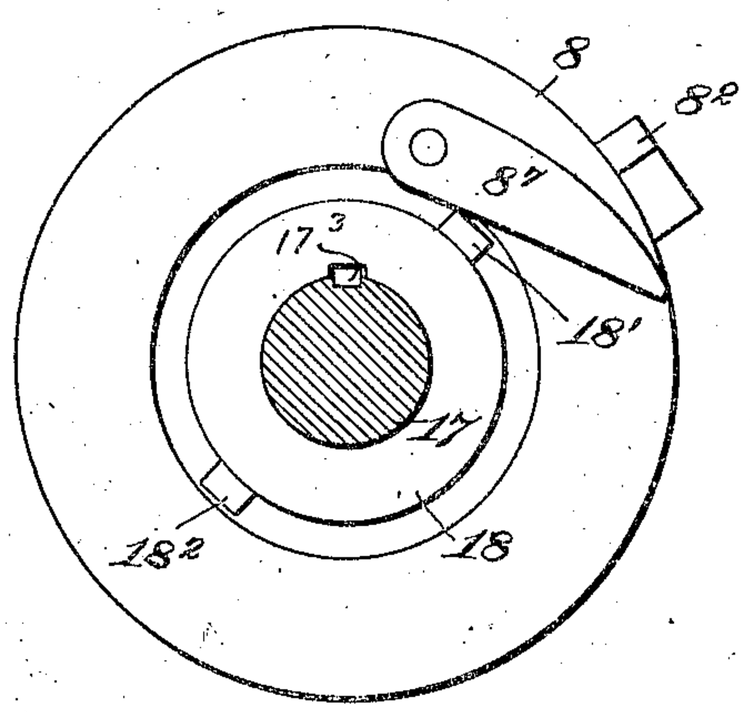


Fig. 15.

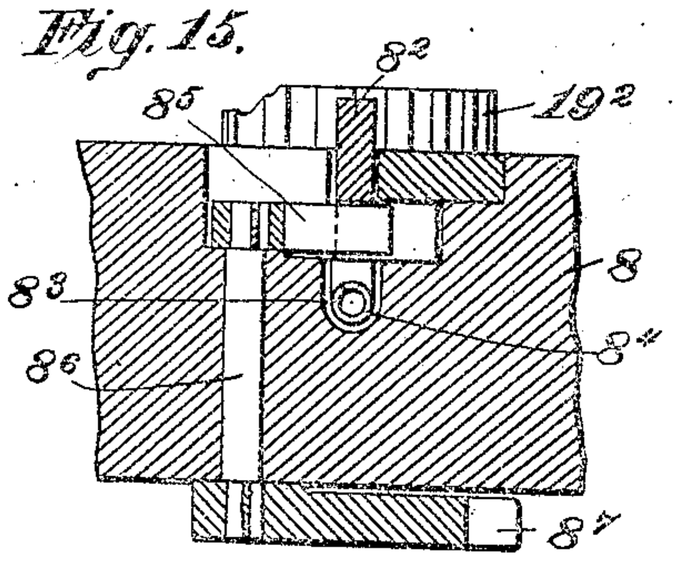
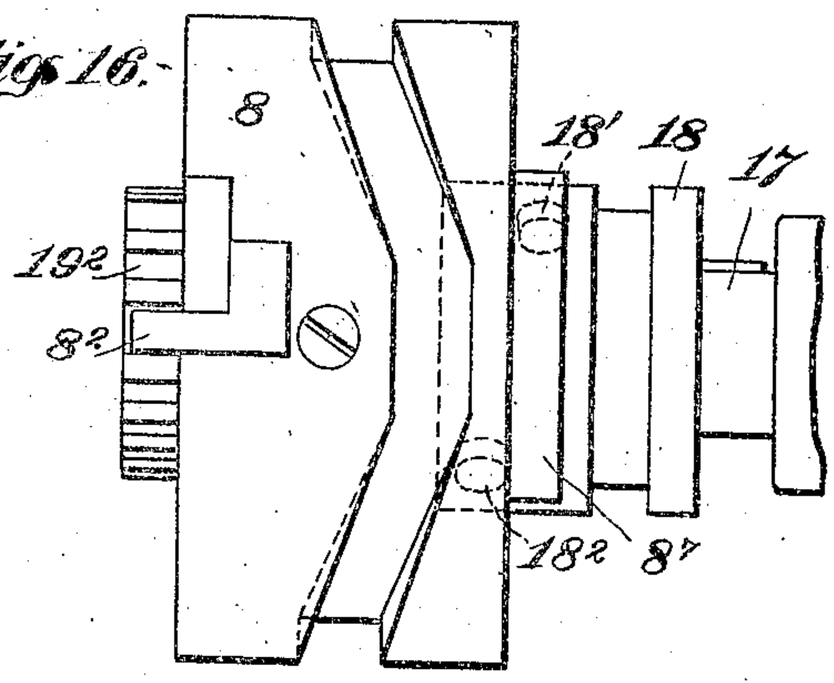


Fig. 16.



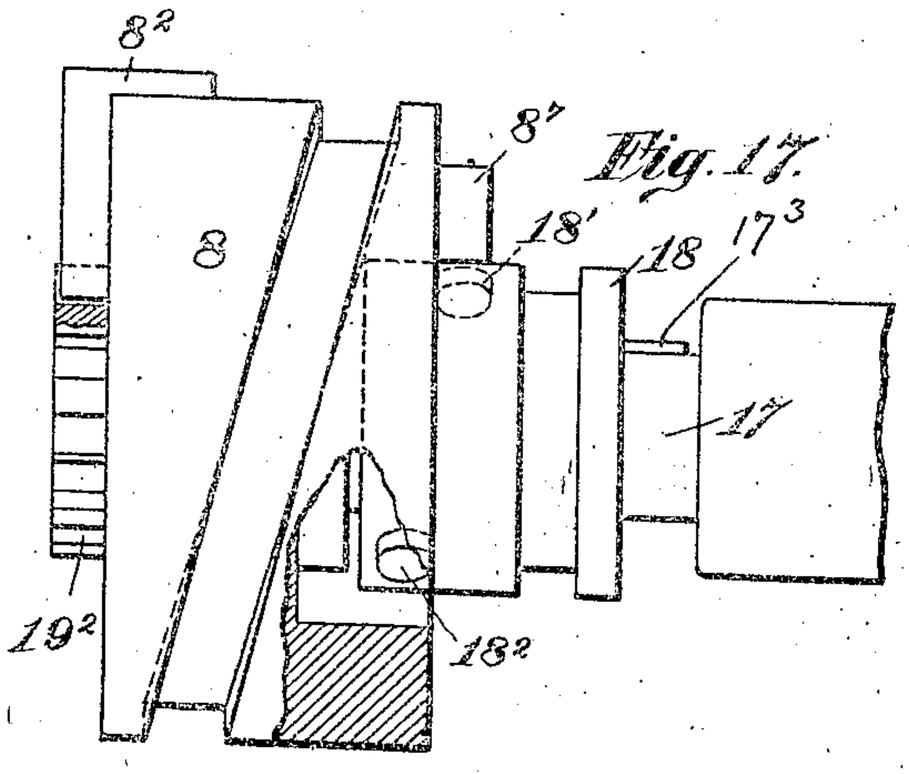
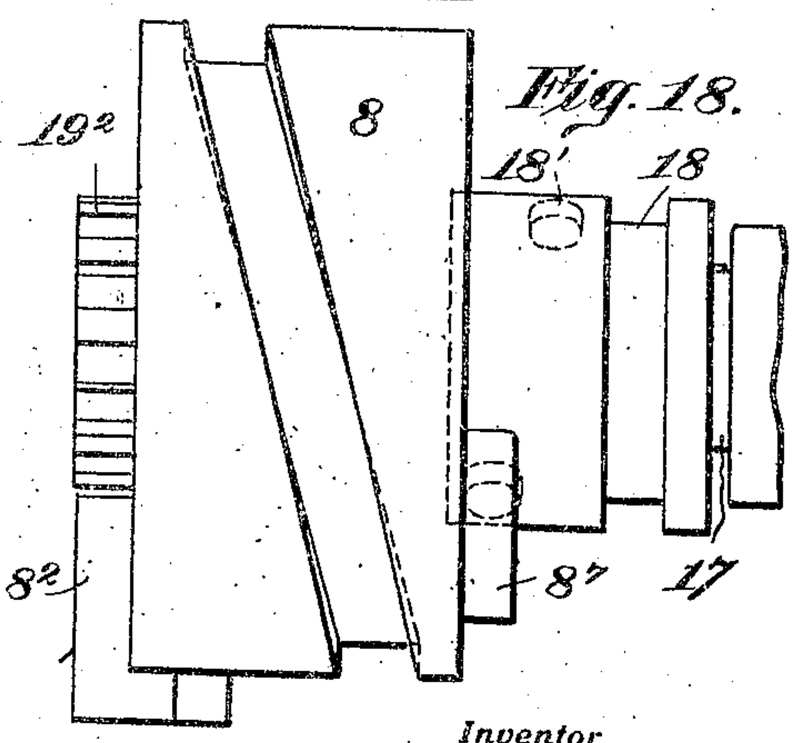


Fig. 17.

Fig. 18.



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7 SHEETS—SHEET 7.

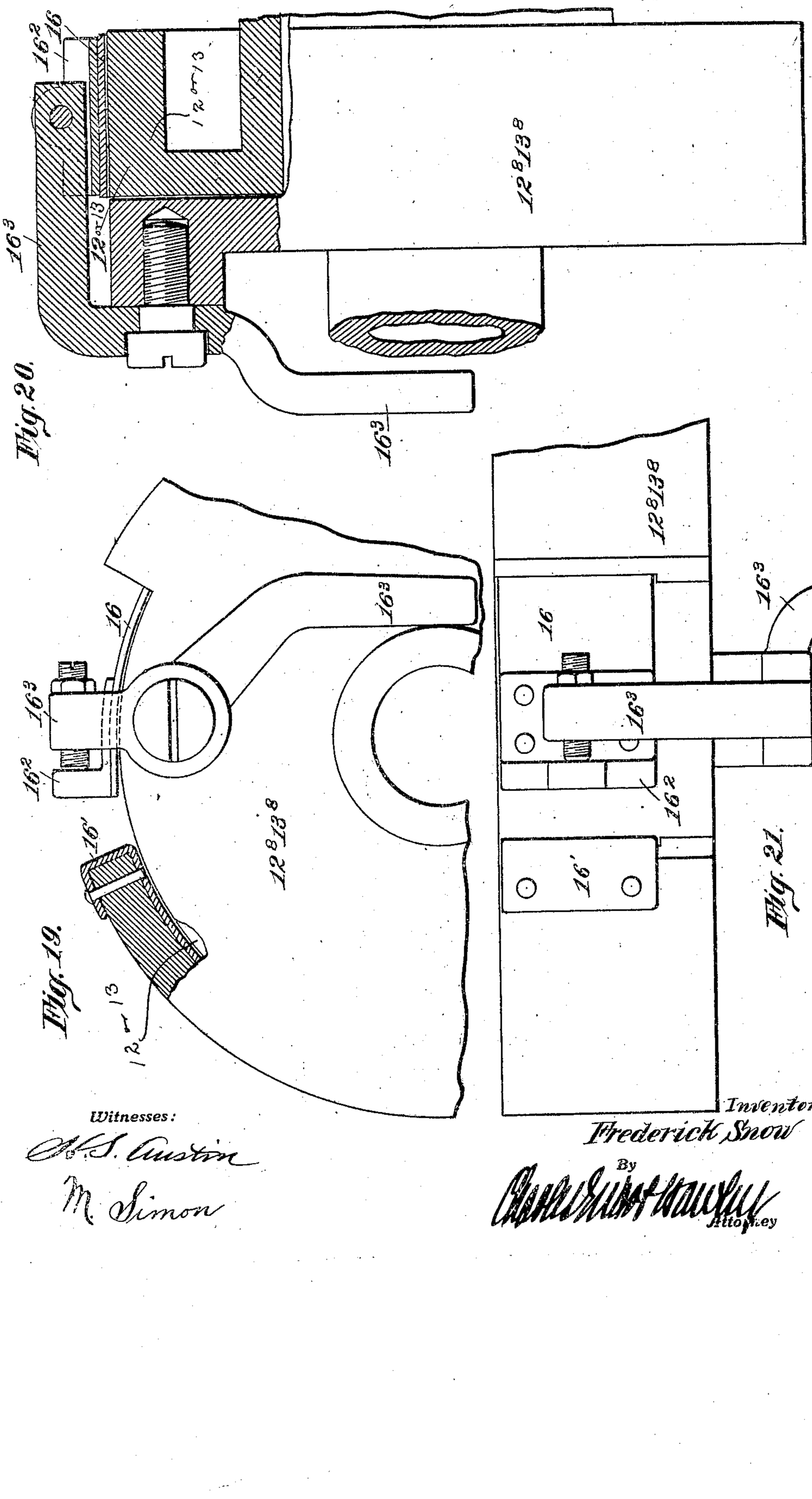

Fig. 20.

Fig. 19.

Fig. 21.

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UNITED STATES PATENT OFFICE.

FREDERICK SNOW, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO CONKLING COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

DRIVING AND REVERSING MECHANISM.

No. 912,044. Specification of Letters Patent. Patented Feb. 9, 1909.

Application filed April 27, 1906. Serial No. 314,056.

To all whom it may concern:

Be it known that I, FREDERICK SNOW, a citizen of the United States, residing in the city of Chicago, in the county of Cook and State of Illinois, have invented a certain new, useful, and Improved Driving and Reversing Mechanism, of which the following is a specification.

My invention relates to driving and reversing mechanisms, and has particular reference to a mechanism intended for and especially adapted to rotary washing-machines. For this reason, and for the better understanding of the peculiar use, function and operation of the mechanism, I shall describe my invention in connection with such a washing-machine.

A rotary washing-machine comprises a shell or tub, to contain the washing-fluid or suds, and a rotary cylinder in which are placed the garments to be washed. This cylinder is driven first in one direction and then in the other, to thoroughly agitate the garments and subject them to the washing action of the fluid. To obtain the best results, the cylinder revolutions must be equal in the two directions; otherwise, the garments will be rolled or balled into masses and will not receive the full benefit of the washing operations.

The mechanisms now used upon washing-machines are objectionable because they are inexact in operation, which results in causing unequal alternations of the cylinder, with attendant loss of efficiency.

The object of my invention is to provide a driving and reversing mechanism, for washing-machines and the like, which shall automatically limit the rotation of the cylinder to an exact peripheral travel, equal in both directions. I conceive, further, that, to a great extent, the usefulness of a washing-machine depends upon the suddenness with which the cylinder reversals are accomplished; that the pressure and driving force of the washing-fluid is inversely proportional to the time occupied in changing the rotative direction of the cylinder; and that, as this reversal moment is shortened, the pressure and flow of the fluid through the garments confined in the cylinder will be increased, and the time required for their cleansing decreased.

A further and particular object of my invention is, therefore, to provide a driving and reversing mechanism by which quick or sudden reversals of the washer-cylinder may be accomplished, with a view to increasing the practical efficiency of such machines.

Still another object of the invention is to provide an alternative driving mechanism which may be adjusted to automatically reverse the washer-cylinder at the end of each first, second, third or fourth revolution, or fractions thereof, to adapt the washer to different classes of work, and thus to provide for a saving of time when only short revolutions are required.

A further object of the invention is to provide a driving and reversing mechanism that shall be operatively self-contained; in other words, one whose operations and reversals shall in no wise be dependent upon the washer-cylinder or other driven element or member, so far as concerns the forces necessary to accomplish such reversals.

With these objects in view, my invention consists, generally, in a driving and reversing mechanism comprising a reversible driving-shaft, in combination with the member to be driven and reversed, means for driving said shaft in either direction, and a device driven from such shaft and controlling the operation of said means, whereby the peripheral alternations or rotary reciprocations of the shaft are accomplished; and my invention consists, further, in various details of construction and in combinations of parts, all as hereinafter described and particularly pointed out in the claims.

My invention will be more readily understood by reference to the accompanying drawings, forming a part of this specification, and in which:—

Figure 1, is a sectional elevation of a rotary washing-machine, showing, detailed throughout, a mechanism embodying my invention; Fig. 2, is an enlarged side view of the driving and reversing mechanism, taken from Fig. 1; Fig. 3, is an elevation of the opposite side of the mechanism; Fig. 4, is a plan view of the mechanism; Fig. 5, is an end view thereof; Fig. 6, is a detailed view of the device for changing and fixing the peripheral travel of the driving-shaft, and the cylinder or member driven thereby; Fig. 7, is an enlarged detailed view of the controlling block of the travel-varying device; Fig. 8, is a transverse vertical section on the line x^8—x^8 of Fig. 4; Fig. 9, is a similar

section on the line y^9—y^9 of Fig. 4; Fig. 10, is a vertical, longitudinal section on the line z^{10}—z^{10} of Fig. 4; Fig. 11, is an enlarged vertical, longitudinal section on the line v^{11}—v^{11} of Fig. 4; Fig. 12, is a sectional view on the line w^{12}—w^{12} of Fig. 11; Fig. 13, is a detailed view of the shifter-operating cam as viewed from the line w^{13}—w^{13} of Fig. 11; showing the cam about to be stopped by one of the pins of the non-rotative timing sleeve; Fig. 14, is a similar view, showing the cam in its stopped position; Fig. 15, is a detailed section on the line q^{15}—q^{15} of Fig. 13; Fig. 16, is a plan view taken from Fig. 13; Fig. 17, is a side view taken from the same figure; Fig. 18, is a similar side view, showing the cam as it appears in the position opposite that which is shown in Fig. 14; Figs. 19, 20 and 21, are detailed views of one of the friction clutches.

As shown in the drawings, 2 represents the shell of a rotary washing-machine. This is cylindrical in form and contains the perforated washer-cylinder, 3, the gudgeons, 3′, 3′, of which are held in bearings in the heads or ends, 2′, 2′, of the shell. A large gear-wheel, 4, is attached to the outer end of one of these gudgeons, and it is to this gear-wheel that my invention is applied.

The mechanism involving my invention is preferably arranged upon a single bracket, 5, attached to the head of the washer-shell. The manner of attaching the bracket to the washer-shell is shown in Fig. 10, wherein it will be seen that the head is provided with flats, to receive corresponding parts and bolts on the bracket. The bracket proper is provided with several extensions that terminate in bearings, which will be described in connection with the parts that are held therein. These parts may be generally indicated and named as follows:—the driving means, including the driving shaft, 6, the oppositely rotating parts upon said shaft, and the idlers that join them; the shifter, whereof 7 is the main rod;—the shifter-motor, whereof the intermittently rotated cam, 8, and a tripping device are the principal members:—and, the timing mechanism, whereto the threaded shaft, 9, the block 10, and the adjuster, 11, in some form, are essential. The driving-shaft, 6, and the threaded shaft, 9, are provided with pinions, 6′ and 9′, that mesh with the large gear-wheel, 4. They, therefore, rotate simultaneously, the latter being driven by the former, through the medium of the gear-wheel, 4. It will be noted that there are two clutches, 12 and 13, upon the driving shaft, 6, and that these, through the medium of the idlers, are driven in opposite directions, the power being derived from the belt-pulley, 14. During the normal operation of the machine, one or the other of the clutches is always engaged with the driving shaft, 6, except during the brief moment of change from one clutch to the other. The office of the shaft or spindle, 9, and associated parts, is to measure the travel of the gear-wheel, 4; hence, of the washer-cylinder. When the wheel, 4, has moved the proper distance, the part, 11, is operated. The movement of 11 frees the shifter-operating cam or motor, 8, which is normally stationary. The cam, 8, then moves a predetermined distance, preferably a half revolution, and in doing so operates the shifter to release one clutch upon the driving shaft and tighten the other clutch; thereby causing the driving-shaft to rotate in the opposite direction and cause the reverse rotation of the washer cylinder. The timing shaft, 9, thereupon immediately takes up its function of accomplishing the reverse rotation of the gear-wheel, 4 (by the pinion, 6) and ultimately causes another reversal of the driven gear, 4, and the cylinder; and further, the timing mechanism not only determines the moments of reversal, but is capable of adjustment to alter the frequency of such reversals, this capability following upon the employment of the stepped block, 10, and the adjuster, 11, or equivalent devices.

Having briefly outlined the construction, assemblage and functions of the principal members or parts of a mechanism involving my invention, I will now describe these elements or parts in detail.

The driving mechanism.—This term embraces the driving shaft, 6, and the parts upon or in connection with it, including the non-concentrically mounted gear connectors or idlers. The bracket, 5, is provided with extensions, 5′, 5². The former has the bearing, 5³, for the inner end of the shaft, 6. The latter is provided with the box, 5⁴, and the bearing 5⁶ (see Figs. 4 and 5). The box, 5⁴, contains the fixed sleeve, 15, which is firmly bound therein by the tightening of the box thereon. The sleeve is hollow and provides a long bearing for the shaft, 6. Its ends, 15′, 15″, are finished to receive the hubs of the clutch parts, 12′, 13′, the former of which is preferably integral with the single belt-pulley, 14.

12² and 13² are pinions formed upon or secured to the clutch parts 12′ 13′ respectively. These pinions or their hubs form bushings within the hubs of the clutch parts and rotate freely upon the finished ends of the stationary bearing sleeve, 15. The pulley, 14, is driven continuously in one direction, and in order to drive the clutch part 13′ in the opposite direction I employ the idlers 12³, 12⁴ and 13³. The idlers 12³ and 13³ are secured on the short shaft 12⁵ which is journaled in the bearings 5⁶ and 5⁷. The pinion, 13³, meshes with the clutch pinion 13², but the pinion 12³, does not mesh with the opposite pinion 12². Instead, it is connected therewith by the reverse motion idler

12^4 arranged on the stud-shaft 12^6 which extends from the bracket part 5^2. The shaft, 6, carries the opposed clutch parts 12^8 and 13^8, which are cup-shaped and inclose the parts $12'$ and $13'$. The hubs of 12^8 and 13^8 are secured to the shaft by keys 6^2, 6^2, and the rotation of the shaft, 6, will depend upon which of the two clutch members 12^8, 13^8 is connected with its complementary clutch part. The clutches are identical in form and are completed by straps or bands, 16. A description of one will serve for both:—On referring to Figs. 10, 19, 20 and 21, it will be seen that the band, 16, has its end 16′ attached to the part, 12^8, or 13^8, of the clutch. It encircles the inner, continuously driven, part of the clutch. The opposite end of the band is provided with an angle piece or block, 16^2 engaged by the clutch tightening arm 16^3. The arm 16^3 is pivoted on said clutch members 12^8, or 13^8, and the free or arm end of this lever extends to a position at the side of the hub of said part 12^8 13^8, for engagement by and with the sliding cone or collar of the shifter. When the inner or free end of the clutch arm is forced outwardly the short arm of the lever is moved to force the ends of the band more nearly together and tighten said band upon the inner end of the clutch. This being done the outer clutch part will rotate with the inner clutch part, and the shaft, 6, for the time being, will be positively connected to said inner part. A set screw in the clutch arm 16^3 provides means for taking up wear between the parts. It will be obvious that by connecting first one clutch and then the other to the shaft, 6, said shaft, and the washer cylinder geared thereto, will be caused to rotate first in one direction and then the other.

The shifter.—The shifter for operating the clutches includes the shaft, 7, the arms, $7'$, at the ends of the shaft, and the cones or collars 7^2 and 7^3, before mentioned, on the hubs or sleeves of the clutch parts 12^8 and 13^8. The cones may or may not rotate with said clutch parts, but are always slidable upon said hubs. When the shaft or rod, 7, is moved longitudinally one cone will be moved out of engagement with its clutch arm while the other will be moved into engagement with the arm of the opposite clutch. The shaft, 7, is arranged to slide in the bearings on the bracket, and is provided with an arm, 7^4, having a pin, 7^5, that engages the cam groove 8′ of the shifter motor, 8. The rotation of the motor cam, 8, will cause longitudinal movement of shaft, 7, and the two cones, 7^2 and 7^3 that are connected with it. Thus each partial revolution of the cam or motor, 8, operates to change the clutches upon the driving shaft 6.

The shifter motor.—The shifter motor of necessity includes more than the cam, 8, it being necessary to provide means for releasing and driving said cam at intervals. It would not be practicable to employ a cam that rotated continuously, inasmuch as the movement of the clutches must occur within a fraction of the time during which the driving shaft is in rotation in either of its directions. Hence, my employment of a shifter motor that is normally stationary and which operates at intervals only.

5^8 is a part of the bracket, 5, which carries a large stud-shaft, 17, on which the motor cam, 8, is journaled. The stud shaft also carries a tripping collar, 18, and a gear wheel, 19. The gear, 19, meshes with the pinion 12^2 and is driven continuously. Referring to Fig. 11, it will be seen that the stud-shaft, 17, is secured in the bracket part 5^8 by means of a key 5^9 and does not rotate.

17′ and 17^2 are collars on the shaft, 17, to hold the cam, 8, against longitudinal movement thereon.

17^3 is a key that prevents the rotation of the sleeve, 18, on the shaft, 17, while permitting the longitudinal movement of said sleeve.

The gear-wheel, 19, is journaled on the reduced end of the shaft, 17, and is held between the collars, 17′ and an end collar, not shown. The inner side 19′ of the gear wheel 19 is turned smooth, and 20 represents a brake shoe that is attached to the cam, 8, and which is pressed against the gear wheel, 19, by a spring, 20′. The purpose of the brake shoe will be pointed out hereafter.

19^2 is a clutch part on the gear, 19, adapted to be engaged by a clutch slide 8^2 on the part 8. When the parts 8^2 and 19^2 are in engagement, as shown in Figs. 11 and 12, the cam, 8, will be rotated with the gear wheel, 19. As the shifter is connected with the cam, 8, by the medium of the pin, 7^5, and the cam groove, it will be obvious that the rotation of the cam will at this time operate to throw the shifter rod and change the clutches upon the main shaft. This being true, it is only necessary to provide means for intermittently operating the clutch slide, 8^2, to reliably regulate the operation of the shifter and the parts dependent upon its action.

The timing mechanism.—The means for controlling the action of the clutch slide, 8^2, will now be described. The slide is arranged in a radial groove or recess, 8^3, in the cam, 8. (See Figs. 11 and 12.) It is normally pressed into engagement with the part 19^2 by a small spring, 8^4, and it is disengaged from the part, 19^2, by means of a shifting arm, 8^5. This shifting arm is fixed to a rocking shaft, 8^6, provided in the cam wheel 8 and which extends through the opposite end thereof. (See Figs. 13 and 18.) At that point it is provided with an arm, 8^7, that overhangs the sleeve, 18. The sleeve, 18, is provided with two pins or lugs, 18′,

18², occupying different longitudinal positions on the sleeve. When the sleeve is in one position the pin, 18′, will relatively underlie the arm, 8⁷, and as shown in Fig. 14, will lift or throw the arm outwardly. This movement of the arm operates to lift the arm, 8⁵, and the slide, 8², disengaging the latter from the clutch, 19². When the parts are in these positions the gear, 19, rotates without moving the cam wheel, 8. The same condition will exist when the arm 8⁷ engages the opposite pin, 18², on the slide, 18, and such engagement will occur immediately following the movement of the sleeve, 18, on 17, to remove the point, 18′, from the path of the arm, 8⁷, whereupon said arm will drop or move inwardly to the position shown in Fig. 13, permitting the slide, 8², to engage the clutch, 19², and connect the parts 19 and 8. This connection results in a half revolution of the cam wheel, 8, to move the shifter. The revolution of the cam, 8, will be interrupted at the end of the said half revolution because of the engagement of the arm, 8⁷, with the other sleeve pin, 18². In other words, when the cam is freed from one pin and allowed to be rotated by gear, 19, the arm will be turned or moved around the sleeve, 18, and said arm will, after momentary freedom, ride upon the opposite pin thereon and be thereby lifted, to automatically retract the slide, 8². This action again liberates the cam from the gear wheel.

The motor-cam, 8, possesses considerable inertia and but for the use of the spring shoe, 20, the shock of engaging the same with the gear wheel, 19, would be severe upon the clutch parts. This shoe frictionally connects the two parts at all times and therefore tends to start the motor cam, 8, into rotation the instant said cam is released from the blocking and tripping sleeve. The slide, 8², is thus relieved from injurious shock when it engages the clutch part, 19².

Having seen that the operation of the shifter is dependent upon the action of the slide, 8², it is now seen to be in turn dependent upon the action of the sleeve, 18, as this sleeve controls the position of the slide, 8². In short, said slide, 8², operates automatically when it is freed from the sleeve, 18, and its operation is automatically stopped as soon as its arm again engages said sleeve. The sleeve may therefore be properly described as a tripping device which is periodically moved to trip or release the shifter motor.

Means for operating the motor tripping sleeve.—This portion of the mechanism comprises the vertical rocking-shaft, 21, having an arm, 21′ which engages a groove in the sleeve, 18. The shaft, 21, is held in a vertical bearing, 5⁶, extending from the bracket part, 5⁶, and the arm 21′ is always in engagement with the sleeve 18. The lower end of the shaft, 21, carries the adjustable arm, 11, which lies in the path of the stepped timing block, 10. The particular step of said block which said arm, 11, will engage, is determined by the vertical position of the arm, 11, on the shaft, 21, and for adjusting the arm, 11, I key the same to the shaft, 21, and provide the lifting and locking slide, 21², and the pawl, 21³, for securing it in any of its positions. The slide is guided by the screws in the bracket, 5⁶, and has as many notches as there are steps in the block, 10. It will be obvious that the arm, 11, may be held at any elevation desired by means of the pawl, 21³, and that the position of the arm may be readily altered at any time. The block, 10, is moved first in one direction and then in the other by the alternatively rotated screw shaft or spindle, 9. The final or last part of the movement of the block, 10, in either direction is depended upon to throw the sleeve, 18, the same operating through the medium of the adjustable arm, 11, shaft, 21, and arm, 21′. These details being understood, the complete movement, from the gear wheel, 4, to the tripping device, may now be traced. The pinions, 6′, and 9′, are both in mesh with the large gear, 4, and when the latter is driven by the pinion, 6′, the pinion, 9′, will be rotated. Hence, the screw shaft, 9, is in rotation whenever the shaft, 6, is rotated. The block, 10, which is on the screw spindle, also moves and ultimately engages and moves the arm, 11, simultaneously with which the arm, 21, and the sleeve, 18, will be moved. This movement frees the cam, 8, and permits it to make a half revolution. This in turn operates the shifter and changes the clutches upon the driving shaft, causing said shaft to rotate in the opposite direction. The cycle is thus completed at the pinion 6′ and gear wheel, 4, and the parts take up the new cycle of movement through the reverse operation of the screw spindle pinion, 9′, by said gear wheel, 4. The reverse rotation of the spindle or shaft, 9, obviously causes the return movement of the block, 10, which results in moving the arm, 11, in the opposite direction to accomplish the return shift of the sleeve 18, and permit another half revolution of the motor cam, 8, with the attendant change of clutches through the medium of the shifter.

The timing and adjusting mechanism, before referred to, comprises the stepped block, 10, and the vertically adjustable arm, 11. The threaded shaft or spindle, 9, is designed to move the block a maximum distance during the maximum number of revolutions of the gear wheel, 4, and within this limit any degree of motion may be taken from the block by adjusting the elevation of

the arm, 11, so that less movement of the block will be required to oscillate said arm, and trip the motor at more frequent intervals. The block, 10, is well shown in Figs. 2, 5, and 7. It comprises the threaded portion, 10′, that receives the spindle, 9, the two upright parts 10^3 and 10^4, and slide portion, 10^2 that is guided in a groove in the bottom of the bracket, 5. The part, 10^3, may be a simple upright lug, but the part, 10^4, is provided with a number of steps, 10^5, representing the different elevations of the adjustable tripping arm, 11. When in its lowest position the arm, 11 will cause the reversal of the clutches for every half revolution of the gear wheel 4 and the gear wheel, 4, will be permitted to rotate further as the arm, 11, is raised in the block, 10.

The operation of the mechanism having been fully described in detail, summarization thereof is deemed unnecessary.

As numerous and obvious modifications of my invention will readily suggest themselves to one skilled in the art, I do not confine the invention to the specific constructions herein shown and described.

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

1. A driving and reversing mechanism, for causing exactly equal forward and return movements of an oscillating or reciprocating mechanical element, comprising, in combination with said element, means for reciprocally driving said element and a timing mechanism positively connected with and driven by said element and from the movement of said element controlling said driving means, substantially as described.

2. A driving and reversing mechanism, in combination with a reciprocatively driven element, means whereby the operation of said mechanism is controlled by said element, said means including a variable timing mechanism, interposed between the driven element and the reversing mechanism proper, substantially as described.

3. The combination, of the element to be reciprocally driven, with a driving shaft connected therewith, means for driving the shaft in opposite directions and means positively connected with said driving means and controlling the alternations thereof, substantially as described.

4. An element to be reciprocatively driven, in combination with a rotative, reversible driver therefor, means for rotating said driver, in opposite directions and a mechanism positively connected with said means and causing said means to reciprocally rotate said driver and correspondingly actuate said element, substantially as described.

5. An element to be reciprocatively driven, in combination with a reciprocally actuated driver therefor a positively actuated motor for causing the reciprocations of said driver, means timing the operations of said motor, said means being reciprocally actuated by said driver, substantially as described.

6. An element to be reciprocatively driven, or rotated in combination with a reciprocally actuated driver therefor and means timing the reciprocations of said element, said means being geared to said element and measuring the peripheral movement thereof, and determining the moments of the reversal of said driver, substantially as described.

7. An element to be reciprocatively driven, in combination with a reciprocative driver therefor, a shifter for controlling the direction of said driver, a positively actuated shifter-motor revoluble in one direction only and means moving with and, as defined, measuring the movement of said element and controlling said motor, substantially as described.

8. An element to be reciprocatively driven, in combination with a reciprocative driver therefor, a shifter for controlling the direction of said driver, a positively actuated shifter-motor revoluble in one direction only and means moving with and measuring the movement of said element and timing the operation of said motor, substantially as described.

9. An element to be reciprocatively driven, in combination with a reciprocative driver therefor, a shifter for said driver, driving means for operating said driver, a shifter-motor revoluble in one direction only connected with said driving means for operation thereby and a mechanism actuated by said driver and timing the operation of said motor by said driving means, substantially as described.

10. An element to be reciprocatively driven, in combination with a driver therefor, a shifter for said driver, means for operating said driver, a shifter-motor connected with said means for operation thereby and mechanism connected with said element adapted to release said motor when said element has completed a predetermined movement, substantially as described.

11. An alternating or reciprocating element, in combination with a driver therefor, oppositely rotated driving parts, means for connecting either thereof with said driver, a shifter motor revoluble in one direction only and means measuring the movement of said element in both directions, and operating to momentarily connect said shifter motor with one of said driving parts upon the completion of each measured movement of said element, substantially as described.

12. A rotary driver, in combination with oppositely rotated parts for operating the driver, a shifter for determining the direction of rotation of the driver, a shifter-motor, a clutch for connecting said motor

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with one of said oppositely rotated parts and means set into operation by said driver and controlling the action of said clutch, substantially as described.

13. A rotary driver, in combination with oppositely rotated parts for operating the driver, a shifter for determining the direction of rotation of the driver, a shifter-motor, a clutch for connecting said motor with one of said oppositely rotated parts, through the medium of which said driver directly controls the action of said clutch, said means measuring and determining the rotation of said driver, substantially as described.

14. In a driving and reversing mechanism, a driving shaft, in combination with a driven element, means upon the driving shaft for rotating the same in opposite directions, a shifter-motor to be driven by said means, a clutch mechanism interposed between said means and motor and means reciprocatively rotated by said driven element and controlling the action of said clutch mechanism, substantially as described.

15. A driving shaft, in combination with means for reciprocatively rotating said shaft, a driven element, a shifter governing said means, a shifter motor, actuated from the rotating means, a traveling mechanism connected with and actuated by said driven element and a device actuated by the final movements of said traveling mechanism and controlling the operation of said motor, substantially as described.

16. A driving and reversing mechanism for causing equal, forward and return movements of a reciprocating element, comprising, in combination with said element, a driver and means for reciprocatively actuating said driver and means continuously actuated, in time and direction, with said element and operating upon the driver actuating means periodically, to reverse said driver, substantially as described.

17. A driving and reversing mechanism, and means for causing sudden reversals of a driven rotary reciprocating element,—comprising, in combination with said element, means for driving the same in opposite directions, a shifter for said means, a shifter-motor, a member geared to said element, a traveling part actuated by said member and a motor-tripping device operated by said part during the last portion of its travel in either direction, substantially as described.

18. A driving and reversing mechanism, and means for causing sudden reversals of a driven rotary reciprocating element,—comprising, in combination with said element, means for driving the same in opposite directions, a shifter, for said means, a shifter-motor, a member geared to said element, a traveling part actuated by said member and a motor tripping device variably operated by said traveling part, substantially as described.

19. A driving and reversing mechanism, comprising, an element to be reciprocatively rotated, in combination with a periodically operable driving and reversing mechanism proper, and means for changing the periods of the reversal of said mechanism, substantially as described.

20. A driving and reversing mechanism, comprising an element to be reciprocatively rotated, in combination with a two direction driving mechanism, a periodically operative reversing mechanism therefor, and means for changing the periods of the reversal of the driving mechanism by said reversing mechanism, while said element is in motion, substantially as described.

21. In a driving and reversing mechanism, the combination, of a reversible element or member, with driving and reversing mechanism therefor, and means for regulably controlling the number of rotations of said reversible member in each direction, substantially as described.

22. In a driving and reversing mechanism, the combination, of a driving shaft and an element to be driven, with reversible driving means on said shaft, clutches for engaging said means with said shaft and a clutch operating cam positively driven in one direction by said means, substantially as described.

23. In a driving and reversing mechanism, an element or member for reciprocative rotation, in combination with a shaft connected therewith, oppositely revoluble driving parts on said shaft, means for rotating said driving parts in opposite directions and operatively connecting either thereof to said shaft, a normally stationary shifting motor therefor, a clutch for periodically connecting said motor to one of said parts, and mechanism whereby the operation of said motor may be accelerated or retarded, for controlling the peripheral travel of said element, substantially as described.

24. In a driving and reversing mechanism, a gear for reciprocative rotation, in combination with a driving shaft a pinion on said shaft meshing with said gear, oppositely revoluble parts on said shaft, means for rotating said parts in opposite directions, a shifter for alternately connecting said parts to said shaft, a normally stationary shifter motor, means for driving said motor and mechanism whereby the operation of said motor may be variably timed to cause reversals of said shaft and determine the movement or travel of said element, substantially as described.

25. In a driving and reversing mechanism, a rotary working member, in combination with a driving shaft therefor, means on said shaft for rotating the same in opposite

directions, a shifter controlling the operation of said shaft, a shifter actuating cam, adapted for intermittent operation by the shaft rotating means and a variable timing mechanism which measures the movement of said working member and controls the operation of said cam, substantially as described.

26. In a driving and reversing mechanism, the combination, of a member or element for reciprocative rotation, with clutches for the periodical reversal of said member, each clutch having a movable part, a shifter for operating such parts, a clutch shifting cam engaged with said shifter, means for rotating said cam, a tripping device normally preventing the rotation of said cam and means whereby said device is operated by and from said member, substantially as described.

27. In a driving and reversing mechanism, the combination, of a member or element for reciprocative rotation, with clutches for the periodical reversal of said member, each clutch having a movable part, a shifter for operating such parts, a clutch shifting cam engaged with said shifter, means for rotating said cam, a tripping device normally preventing the rotation of said cam and a timing mechanism in geared connection with said element or member for actuating said tripping device periodically, substantially as described.

28. In a driving and reversing mechanism, the combination, of a member or element for reciprocative rotation, with clutches for the periodical reversal of said member, each clutch having a movable part, a shifter for operating such parts, a clutch shifting cam engaged with said shifter, means for rotating said cam, a tripping device normally preventing the rotation of said cam, a timing mechanism in geared connection with said element or member for actuating said tripping device periodically, and means interposed between said cam and tripping devices and adapted to vary the operating time of the latter, substantially as described.

29. In a driving and reversing mechanism, a working element for reciprocative rotation, in combination with a driving shaft connected thereto, a driving pulley mounted for rotation about said shaft, clutches oppositely rotated by said pulley, a clutch shifter, a shifter motor continuously engaged with said shifter and having a member which is continuously engaged with said pulley and means for intermittently connecting the members of the shifter motor to cause the operation of said shifter, substantially as described.

30. In a driving and reversing mechanism, a working member for reciprocative rotation, in combination with a driving shaft connected thereto, a timing shaft also connected thereto, a driving pulley and means for rotating said driving shaft therefrom in both directions, a shifter cam driven from said pulley and a cam controlling mechanism driven by said timing shaft, substantially as described.

31. In a driving and reversing mechanism, a member or element to be reciprocatively rotated, in combination with a driving shaft connected thereto, opposite direction clutches for rotation about said shaft, a shifter for operating said clutches, a shifter-motor, a constantly driven member in constant frictional engagement therewith, a clutch interposed between said member and motor, means normally holding said last named clutch in disengaged position, and a timing mechanism therefor actuated from said driving shaft, substantially as described.

32. In a driving and reversing mechanism, a member or element to be reciprocatively rotated, in combination with a driving shaft connected thereto, opposite direction clutches for rotation about said shaft, a shifter for operating said clutches, a constantly driven part, a shifter motor in constant frictional engagement therewith, a clutch arranged between said part and motor and normally disengaged, means normally preventing the rotation of said motor and means for freeing said motor and engaging its clutch to reverse said driving shaft and said working member at predetermined moments, substantially as described.

33. In a driving and reversing mechanism, a driven member or element to be reciprocatively rotated, in combination with a driving shaft connected thereto, opposite direction clutches for rotation about said shaft, a shifter for operating said clutches, a constantly driven part, a shifter motor in constant fricitional engagement therewith, a clutch arranged between said part and motor and normally disengaged, means normally preventing the rotation of said motor, and a motor tripping and clutch engaging mechanism in continuous engagement with said driven element, substantially as described.

34. In a driving and reversing mechanism, a member or element to be reciprocatively rotated, in combination with a driving shaft connected thereto, opposite direction clutches for rotation about said shaft, a shifter for operating said clutches, a constantly driven part, a shifter motor in constant frictional engagement therewith, a third clutch arranged between said part and motor and normally disengaged, means normally preventing the rotation of said motor, and means, variable as to time of operation, geared to said member or element, for periodically freeing said motor and engaging said third clutch, substantially as described.

35. In a driving and reversing mechanism,

an element, in combination with a driving shaft connected thereto, means for rotating said shaft in opposite directions, a timing device geared to said element and controlling said means and means for adjusting said timing device to accelerate or retard the operation thereof, substantially as described.

36. A driving and reversing mechanism, including driving means, a shifter and a shifter-motor for driving said shifter, in combination with the element to be reciprocatively rotated and a shifter motor controlling mechanism geared to and driven by said element, substantially as described.

37. In a driving and reversing mechanism, an element to be reciprocatively rotated, in combination with a reversible driving mechanism, a driving mechanism shifter, a shifter motor, means for driving said motor in one direction only and a motor timing mechanism variably interposed between said motor and said element, driven by said element and controlling the operation of said motor, substantially as described.

38. In a driving and reversing mechanism, a driving shaft, in combination with means for rotating the same in opposite directions, timing device reciprocatively rotated by said shaft and controlling the direction of rotation thereof by said means, and mechanism operatively interposed between said device and said means for accelerating or retarding the operation of said timing device, substantially as and for the purpose described.

39. In a driving and reversing mechanism, an element to be driven, in combination with a driving shaft, oppositely rotating clutches, a clutch shifter, a shifter motor, means normally preventing the operation of said motor, means for operating the same when released, a timing shaft driven by said element, a motor releasing device and variable operating means interposed between said device and said timing shaft, substantially as described.

40. In a driving and reversing mechanism, a working element or member, in combination with a driving shaft and a timing shaft, both connected to said working member, clutch parts revoluble about said driving shaft, in opposite directions, a block driven by said timing shaft and measuring the movement of said working element, and means interposed between said block and said clutch parts and actuating, and controlling the action of, said clutch parts, substantially as described.

41. In a driving and reversing mechanism, a working element or member, in combination with a driving shaft and a timing shaft, both connected to said working member, clutch parts revoluble about said driving shaft, in opposite directions, a block driven by said timing shaft and measuring the movement of said working element, an intermittent, positively actuated shifter, controlling the action of said parts upon said driving shaft, and a manually adjustable mechanism operatively interposed between said shifter and said block and controlling the action of said shifter, substantially as described.

42. In a driving and reversing mechanism, a working element, in combination with the support therefor, a bearing bracket extending therefrom, a driving shaft and a timing shaft arranged in said bracket and both connected to said working element, suitable clutches and a shifter, a shifter motor, a motor tripping device slidably arranged on said bracket, means for positively actuating said motor when tripped and mechanism supported on said bracket and adapted to periodically connect said timing shaft with said tripping device to operate the latter, substantially as described.

43. In a driving and reversing mechanism a bracket or frame, in combination with a reversible shaft mounted thereon, means, upon said bracket, adapted to drive said shaft, in opposite directions, a shifter motor mounted on said bracket, a timing shaft, a timing block threaded upon said timing shaft and slidable upon said bracket, and means through the medium of which said block variably controls the action of said motor, substantially as described.

44. In a driving and reversing mechanism, a frame or bracket, in combination with a long sleeve fixed in said bracket, the clutch parts rotated upon the ends of said sleeve, a driving shaft revoluble within said sleeve, complementary clutch parts upon said driving shaft, and a clutch shifter, substantially as described.

45. In a driving and reversing mechanism, a driving shaft and oppositely rotating parts thereon, for driving the same in opposite directions, in combination with a shifter, a shifter motor, a constantly driven part, a clutch for connecting the same with said motor, a clutch arm controlling such connection, a non-rotative part, having oppositely placed staggered pins or lugs, one or the other of which normally engages said arm and prevents the rotation of said motor, and means for moving said non-rotative part longitudinally, to permit the momentary rotation of said motor, substantially as described.

46. In a driving and reversing mechanism, a driving shaft, its clutches and shifter, in combination with a shifter motor, means constantly tending to rotate said motor and a non-rotative part periodically actuated to successively free and stop said shifter motor, substantially as described.

47. In a driving and reversing mechanism, a working member, in combination with a

driving shaft and its clutches, a clutch shifting motor, having a part which is continuously driven by one of the clutch members, means actuated by the working member and timing the operation of said motor and a single belt pulley connected with and adapted to drive said clutches, substantially as described.

In testimony whereof, I have hereunto set my hand this 21st day of April, 1906, at Chicago, Illinois, in the presence of two witnesses.

FREDERICK SNOW.

Witnesses:

CHARLES GILBERT HAWLEY,

JOHN R. LEFEVRE.