No. 705,209. Patented July 22, 1902.

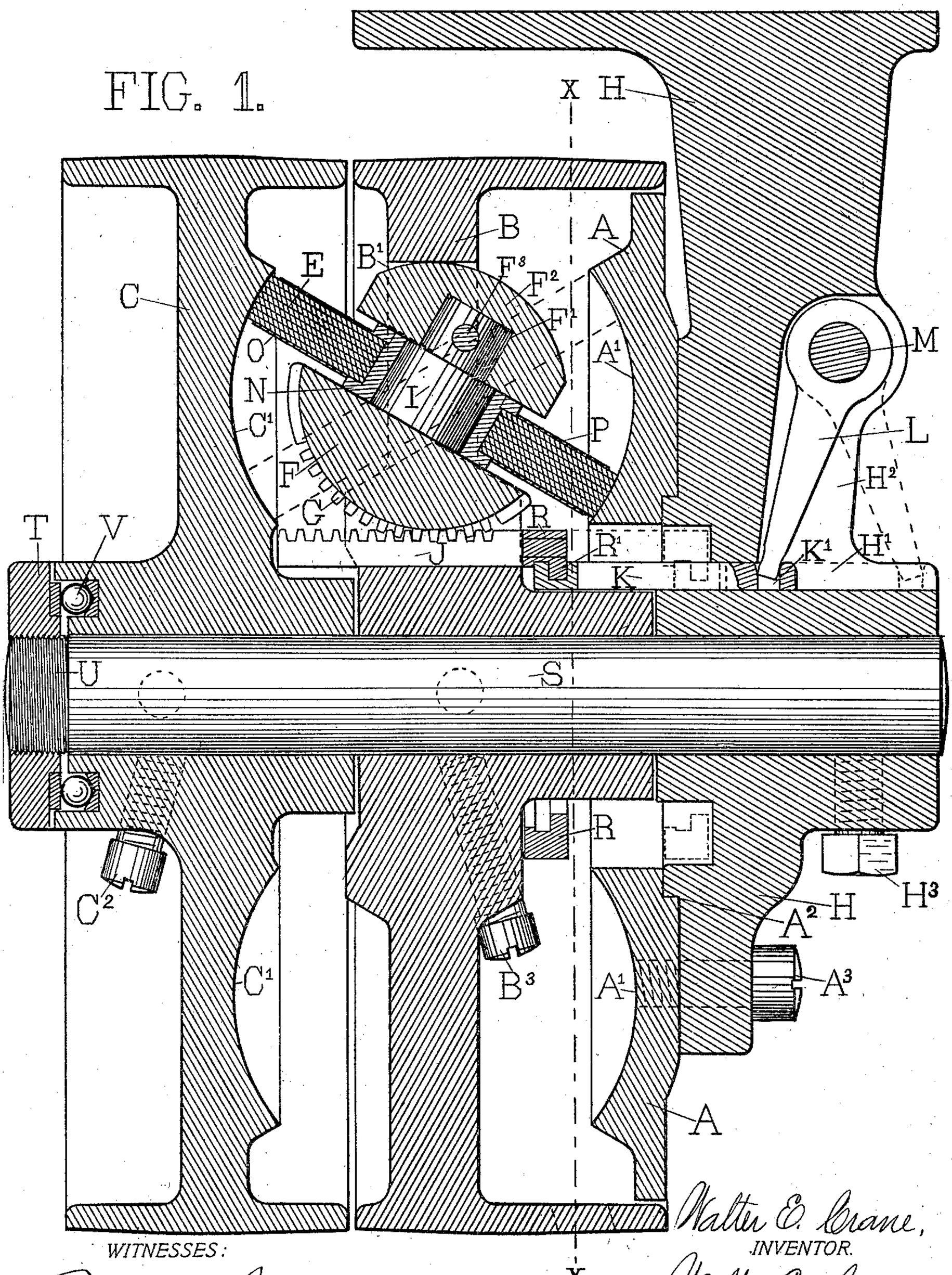
W. E. CRANE.

VARIABLE SPEED DEVICE.

(Application filed Nov. 24, 1900.)

(No Model.) 2 Sheets—Sheet 1.

FIG. 1.



WITNESSES:

Frank Lanzin

Fred Burroughs

Walter E. Crane,

INVENTOR.

BY Walter E. Crane.

ATTORNEY.

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FIG. 2.

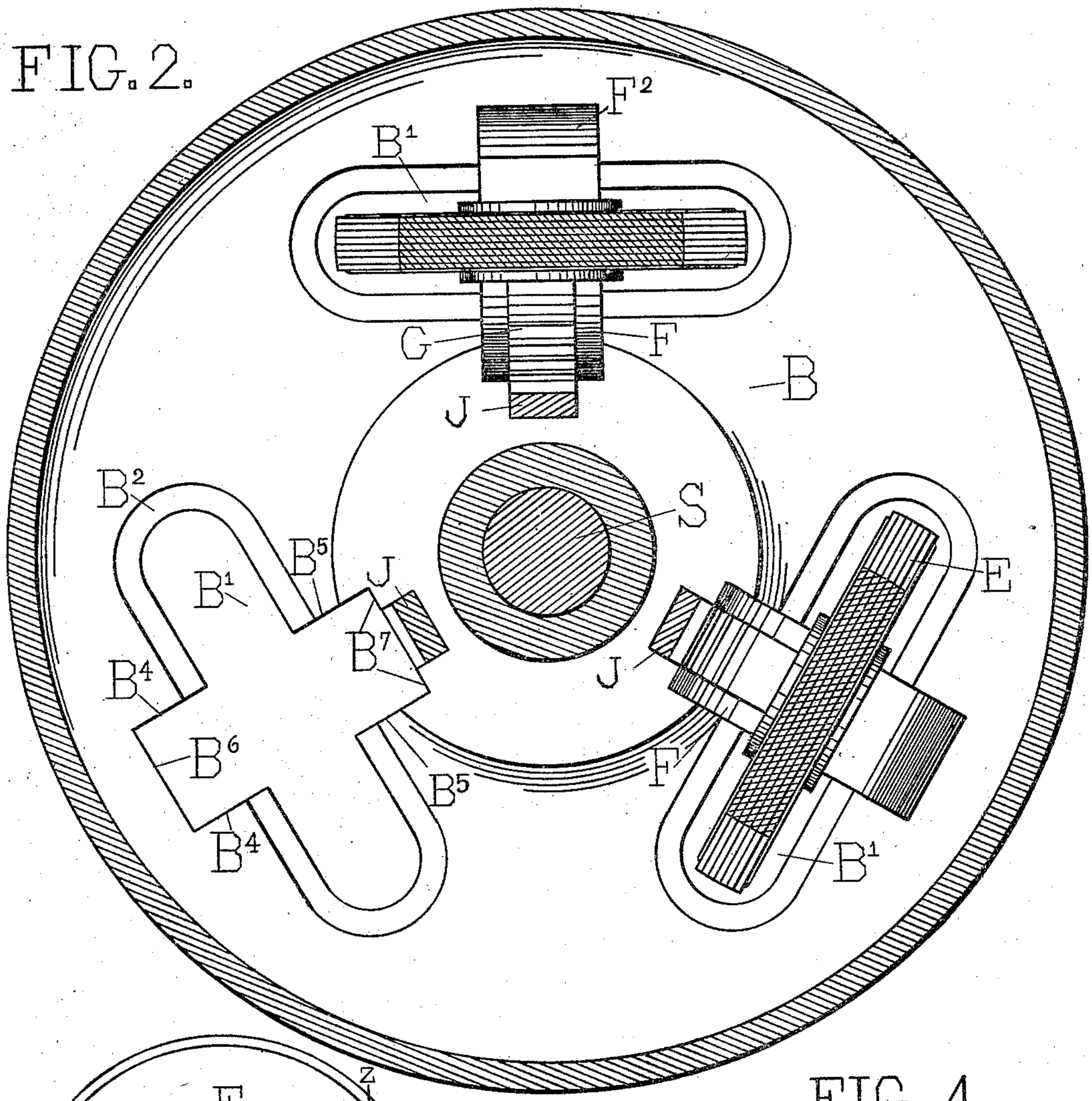
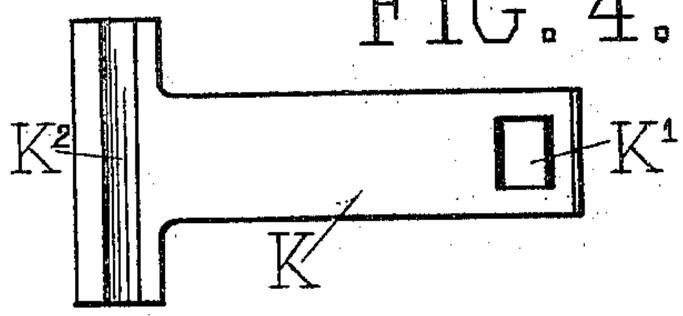


FIG. 4.



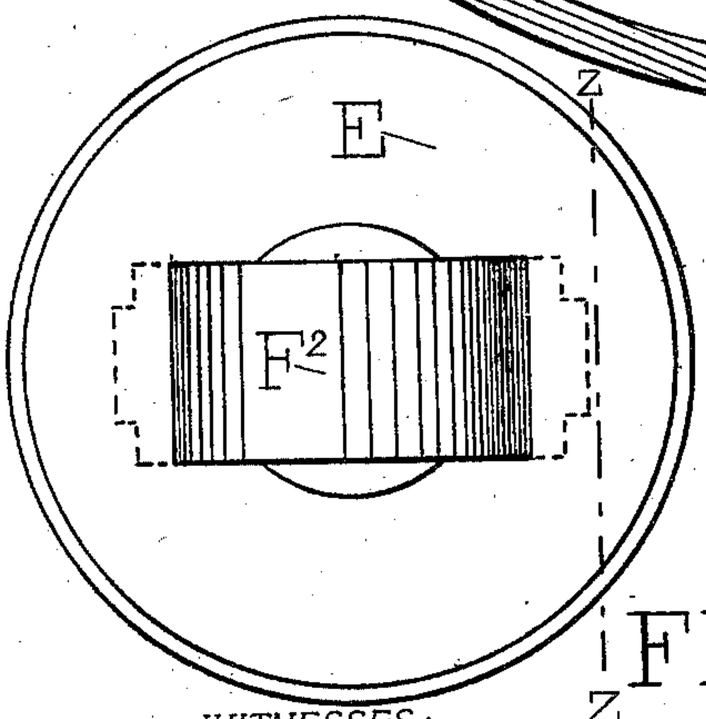


FIG. 3.

WITNESSES:

Frank Sarzin

Fred Burroughs

Walter E. Crane,
INVENTOR.

BY Walter E. Crane
ATTORNEY.

UNITED STATES PATENT OFFICE.

WALTER E. CRANE, OF DENVER, COLORADO.

VARIABLE-SPEED DEVICE.

SPECIFICATION forming part of Letters Patent No. 705,209, dated July 22, 1902.

Application filed November 24, 1900. Serial No. 37,595. (No model.)

To all whom it may concern:

Be it known that I, WALTER E. CRANE, a citizen of the United States, residing at Denver, county of Arapahoe, and State of Colorado, (whose post-office address is No. 1661 Lincoln avenue,) have invented a new and useful Variable-Speed Device, of which the following is a specification.

My invention relates to improvements in variable-speed devices in which a pulley, gear, or equivalent or shaft is given a variable speed with reference to the driving source of the device, the variations including all possible speeds within the limits of the device and the speed rate being controllable at will by the attendant. As the device is used for the transmission of power or motion, it may be appropriately termed a "variable-motion-transmission device" or a "variable-speed power-transmitter."

The objects of my present invention are, first, to provide a means of imparting motion from a source of power to any desired machine at exactly the rate of speed desired and suitable for the work to be performed and to suit the variations in the work or the varying conditions affecting the same; second, to provide a device which shall make it possible to secure very slight changes and any possible speed within the range covered by the device; third, to provide a convenient means of either speeding up from the driving source to the machine to be operated or of reducing from the driving source to the machine; fourth, to provide a very compact form of speed-changing device which can readily be placed in a very limited space directly upon the machine to be operated or upon the ceiling above, the wall, or the floor, as desired, and, fifth, to provide a variable-speed device which shall be easily operable in adjustment by simply one control movement and its reverse and while the device is running at full speed and under a load. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a vertical longitudinal sectional view of the device. Fig. 2 is a vertical transverse sectional view of the same, upon a slightly-reduced scale, upon line X X of Fig. 1 and looking to the left therein. Fig. 3 is an exterior or top view of one of the friction-wheels and the carrier for the same, and Fig. 4 is a top view of the controlling-slide. In Fig. 2 one of the friction-wheels and its carrier are omitted to more clearly show the opening in which they are inserted, and the two friction-wheels shown are represented in their central position of adjustment or with their axes at right angles with the central shaft of the device. Fig. 2 is on line Z Z of Fig. 4.

This variable-speed device consists, essentially, of four principal elements, as follows: first, the stationary or non-revoluble parts, consisting of the support or hanger-bearing, the retarding device, and in some cases the central shaft; second, the variation-wheel, including the transmission-wheels mounted in the same; third, the speed wheel or pulley, and, fourth, the adjusting device for the transmission-wheel carriers.

The motive power may be applied to the variation-wheel either at its periphery or by means of securing the wheel to the central shaft as a drive-shaft, and the power or motion will then be delivered by the speed wheel or pulley to the machine it is desired to drive. This will be the manner of operation when it is desired to increase the speed above the motive source. In case of desiring to reduce the speed below that of the motive source, then the power or motion will be applied to the speed-wheel to drive the device and will be delivered from the variation-wheel to the machine to be driven. The device is represented in the preferred form with the shaft S stationary, being secured in the hanger-bearing by the set-screw shown. If, however, it is desired that it be the drive-shaft or the driven shaft, it may readily be secured either in the variation-wheel or in the speed-wheel by means of the set-screws shown, in which case it may be desirable to provide a ball-bearing at the outer end of the hanger-bearing, as well as to extend the shaft. It will, however, generally be deemed preferable to transmit the power to the rim of one of the wheels, as by a belt, gearing, or chain, and to deliver the power from the other wheel-rim in like manner and to leave the shaft fixed in the hanger-bearing. The central shaft S of the device is mounted either revolubly or fixedly in the hanger-bearing H,

which is preferably the support for the entire device and is fixedly secured to the building or to the machine to be operated in the usual manner for hanger-bearings. Mounted fixedly upon the side of the hanger-bearing and concentric with shaft S is the retarding-disk A, which is secured to the hanger in any desired manner, as by a series of screws A^3, and the disk is preferably held in a central position by means of a shoulder A^2, as shown. The face opposite to the hanger is formed into an annular concave surface A′, for a purpose to be hereinafter described.

Mounted preferably loosely upon the shaft S, slightly remote from disk A and revoluble in a plane parallel with the said disk, is the variation-wheel B, which terminates, preferably, in the pulley-rim, as shown. The wheel B is formed with a series of openings, preferably three in number, through the web portion and designated by B′, and the side portions of these openings are beveled away, as at B^2 and as shown by dotted lines in Fig. 1. When desired, the wheel B may be secured to the shaft S by means of the set-screw B^3.

Inserted in the openings B′ and in guiding contact with the longitudinal surfaces B^4, B^5, B^6, and B^7 thereof are the oscillatable carriers F, with caps F^2. The segment portion F of the carrier has formed preferably integral with it the cylindrical bearing portion I and cylindrical extension of the same F′, to which is fixedly secured the segmentary cap F^2 by means of the pin F^3, and revolubly mounted upon bearing I, between F and F^2, is the transmission-wheel E, which is preferably composed of layers of friction material—as, for instance, leather—which is preferably secured between a flange extension O of the hub portion N and a mating flange P, secured in the usual manner together. The segment portion F of the carrier has a central radial rib, which is cut into a segmentary gear G, and inserted in the innermost or groove portion of the openings B′ are longitudinally-slidable racks J, each of which engages with a segment-gear G. The series of slidable racks J are fixedly secured to an annular controlling-ring R, as by a tenon of the rack passing through a hole in the ring and being riveted therein. The controlling-ring R has an interior annular projection or flange R′, which is in revoluble engagement with a controlling-slide K, having a groove K^2, which incloses the projection R′. The controlling-slide is mounted for longitudinal movement in the slot H′ of the hanger H and is preferably operated with a lever L, projecting into the opening K′, the said lever swinging in the slot H^2 and being fixedly secured upon the controlling-shaft M, which is provided with such connections (not shown) as may be desired to be in position for the operator to take hold of. If preferred, the controlling-slide K may be extended and manipulated direct by the attendant without the lever L and shaft M.

The speed-wheel C is mounted upon the shaft S in proximity to the variation-wheel B for rotation in parallel plane therewith and is preferably provided with a ball-bearing in engagement with the adjustable thrust-collar T upon the threaded portion U of the shaft S. The speed-wheel C is also provided with an annular concave surface C′, similar to and opposing the concave surface A′, the centers of the curves of the said surfaces being coincident and also coincident with the mounting and oscillation of the carriers F and transmission-wheels E in the variation-wheel B. The transmission-wheels E, of which there is one for each of the openings B′, are of sufficient diameter to be in driving engagement with the annular concave surfaces A′ and C′ at the opposite sides of the said transmission-wheels, and this driving engagement, which is preferably frictional, is maintained by the adjustment of the thrust-collar T upon the shaft S, the said shaft being secured in the hanger-bearing by means of the set-screw H^3, as stated. In case of the shaft S being secured in the speed-wheel C by means of the set-screw C^2 the shaft S may be reversed, thus bringing the thrust-collar T into engagement with the outer end of the hanger-bearing H.

The hanger H is secured to some fixed object. A drive-belt is placed upon the variation-wheel B, which, with the speed-wheel C, is loose and revoluble upon the shaft S, which is fixed in the hanger H. A belt is placed upon the speed-wheel C and upon a pulley on the machine to be operated. The revolving of the wheel B with its series of transmission-wheels E in engagement at one side with the annular friction-surface A′ of the stationary retarding-disk A will cause the opposite sides of the said transmission-wheels E to travel at a velocity corresponding to the circumference of the central point of contact of the said wheels with friction-surface A′ plus one revolution of the wheel B, and the engagement of the said transmission-wheels at their opposite sides with the annular friction-surface C′ of the wheel C will revolve the same at a correspondingly greater speed. As represented, the proportional distances from the axis of revolution are two for the center of contact of the wheels E with friction-surface A′, three for the center of oscillation of the wheels E in the wheel B, and four for the center of contact of the wheels E with the friction-surface C′, which gives one and one-half revolutions of wheel C to each revolution of wheel B. If the wheel B were given one revolution with the wheels E in engagement with the wheel C, as shown, but with the wheels E out of engagement with surface A′ and non-revoluble in the wheel B, the wheel C would then be driven one revolution; but with the wheels E revoluble in the wheel B and in engagement with a circumference on A′ equal to one-half the operative circumference on C′ the wheel C

will be accelerated one-half and will consequently be given one and one-half revolutions to one revolution of the wheel B. With the transmission-wheels E placed in their midway position of oscillation, as represented in Fig. 2, the wheel C will be driven at the rate of two revolutions to one revolution of the drive-wheel B. With the wheels E adjusted to their opposite position of oscillation, as represented by the dotted lines in Fig. 1, the wheel C will then be driven at three revolutions to one revolution of the drive-wheel B. It will thus be observed that the device constructed with the proportions shown has a capacity of multiplying the drive speed one and one-half times to three times, or a variation of two to one. Different degrees of variation capacity may be obtained, however, by changing the relative distances from the axes of revolution in constructing the device—as, for instance, by making the respective operative distances in proportion of one, two, and three instead of two, three, and four, as above stated. It will be noted that any intermediate speed between the extremes stated may be obtained by adjusting the wheels E to a suitable position of oscillation. In case of the speed-wheel C being the driven wheel and the wheel B the driving-wheel or wheel from which force is delivered the operation of the transmission-wheels will be the same, except that their operation will effect a reduction of speed instead of a multiplication, and the rate of speed of the driven wheel C will be divided by from one and one-half to three for rate of wheel B, according to the position of adjustment of the transmission-wheels.

From the above we deduce the following: If the device is driven by means of a belt, for instance, upon the wheel B, causing the same to revolve at the rate of one hundred revolutions per minute, the speed-wheel C would revolve at any desired speed from one hundred and fifty to three hundred revolutions per minute and as a driving-wheel. If the speed-wheel C is driven, as by a belt, at a speed of one hundred revolutions per minute, the wheel B will then revolve at any desired speed from sixty-six and two-thirds revolutions per minute to thirty-three and one-third revolutions per minute and as a driving-wheel to impart motion to the machine to be operated. By a change in the relative diameters of the speed-wheel and the variation-wheel it will be possible to get other proportions of the driving speed as a resultant of the device. For instance, if the variation-wheel terminates in a pulley twelve inches in diameter and the speed-wheel is but eight inches in diameter, then the device will be capable of delivering power, by interchanging the drive and driven belts, at a belt speed of from one-half to twice the belt speed of the belt with which the device is driven and will give all possible intermediate speeds. Likewise either or both the wheels B and C may have two sizes of pulleys, and thus be able to give out a greater variety of belt speeds without in any wise departing from my invention.

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

1. In a device of the class specified, the combination, with a support for the device, embodying a retarding means, of a drive-pulley, and a driven pulley; and means upon one of the said pulleys for varying the relative speeds of the pulleys.

2. In a device of the class specified, the combination with a support for the device, embodying a fixed supporting-shaft and a concentric fixed retarding-disk, of two adjacent pulleys revoluble on said shaft, and variably revoluble with reference to each other, from connective engagement with said retarding-disk.

3. In a device of the class specified, the combination with a support for the device, embodying a fixed supporting-shaft and a concentric fixed retarding-disk, of a speed-wheel embodying a pulley, revolubly mounted on said shaft; and an intermediate variation-wheel embodying a pulley, and variably engaging said speed-wheel and retarding-disk, to give variable relative velocities to said pulleys.

4. In a device of the class specified, the combination with a support for the device, embodying a fixed supporting-shaft and a concentric fixed retarding-disk, of a speed-pulley and a multiplying-pulley revoluble on said shaft and engaging said retarding-disk, to give multiplied speeds of said speed-pulley relative to said multiplying-pulley as a driving member, or divided speeds of said multiplying-pulley relative to said speed-pulley as a driving member.

5. In a device of the class specified, the combination with two adjacent pulley members and a supporting member, of a retarding-disk fixed to said supporting member; a central shaft fixed in one of said members and revoluble in the other said members; and means substantially as described, for varying the relative rotative speeds of the said pulley members.

6. In a device of the class specified, the combination with a support for the device, embodying a supporting-shaft and a concentric fixed retarding-disk, of a speed-wheel pulley revoluble about the axis of said shaft; an intermediate multiplying-wheel embodying a drive-pulley revoluble on said shaft; and a series of adjustable transmission-wheels carried by said multiplying-wheel, in engagement with opposing concave annular friction-surfaces on said retarding-disk and speed-wheel, to give a multiplied speed to said speed-wheel.

7. In a device of the class specified, the combination, with a central shaft, of a stationary retarding means concentric with, and in a plane at right angles to the said shaft; a

speed-wheel rotatably mounted upon the shaft at some distance from, and parallel with the said retarding means; and an intermediate member, rotatably mounted upon the said shaft, and carrying a series of adjustable transmission-wheels in operative engagement with the said retarding means and with the said speed-wheel.

8. In a device of the class specified, the combination with a rotatable speed means provided with an annular concave contact-surface, of a retarding means embodying an opposing similar contact-surface; a power means embodying a pulley and a series of oscillatable carriers having segment-sustaining surfaces; transmission-wheels revolubly mounted in said carriers intermediate said segment-surfaces; a fixed support for the device; and means on said support connected with said carriers to oscillate them in said power means.

9. In a device of the class specified, the combination with a support for the device, having a fixed protruding central shaft, of a retarding-disk secured to said support and having a concave annular contact-surface; a drive and a delivery wheel rotatably mounted concentric with said shaft, one of said wheels having an opposing concave annular contact-surface similar to, and with its center of curvature coincident with that of the concave surface of said retarding-disk; a series of oscillatable carriers mounted in the other of said wheels; and a like series of transmission-wheels revolubly mounted in said carriers, in position and adapted to engage at their opposite sides with different portions of said opposing concave surfaces.

10. In a device of the class specified, the combination with a revolubly-mounted drive-wheel and driven wheel, of a retarding-disk; a series of oscillatable carriers, mounted in and revoluble with one of the said wheels; transmission-wheels revolubly mounted in the said carriers, and engaging at their opposite sides with suitable contact-surfaces upon the other of said wheels and said retarding-disk; a series of slidable racks in operative engagement with the said oscillatable carriers; an annular controlling-ring secured to the said racks; and a controlling-slide in engagement with said ring.

11. In a device of the class specified, the combination, with a bodily-rotatable series of oscillatably-mounted transmission-wheels, of similar, opposing, concave surfaces in engagement with the opposite sides of said oscillatable transmission-wheels; a slidable, annular ring having longitudinal projections in operative engagement with the carriers of said oscillatable transmission-wheels; a longitudinal slide in operative engagement with said ring; and means in engagement with said slide for moving the same longitudinally, to oscillate the said transmission-wheels and bring their opposite sides into engagement with different diameters of the respective engaging surfaces.

12. In a device of the class specified, the combination with a drive-wheel and an adjacent driven wheel mounted for rotation about an axis common to both of said wheels, of a retarding-disk having an annular concave surface, a section of which has a common center or foci, with a similar surface on one of said wheels; a series of oscillatable carriers mounted in the other of said wheels, and rotatable therewith, the center of oscillation of the said carriers being coincident with the said foci; an annular controlling-ring having connections to the said oscillatable carriers; means in connection with said controlling-ring and with a controlling-shaft and lever, for the oscillation of the said carriers; and a series of transmission-wheels revolubly mounted in the said carriers, and engaging with different portions of the said concave surfaces as the carriers are oscillated.

In testimony whereof I have hereunto affixed my hand and seal, in presence of two subscribing witnesses, this 7th day of November, A. D. 1900.

WALTER E. CRANE. [L. S.]

Witnesses:
WM. BOND,
ARLINE MARSH.