No. 804,495. PATENTED NOV. 14, 1905.

J. G. O'KELLY.

DIFFERENTIAL GEARING.

APPLICATION FILED FEB. 13, 1902.

4 SHEETS—SHEET 1.

Fig. 2.

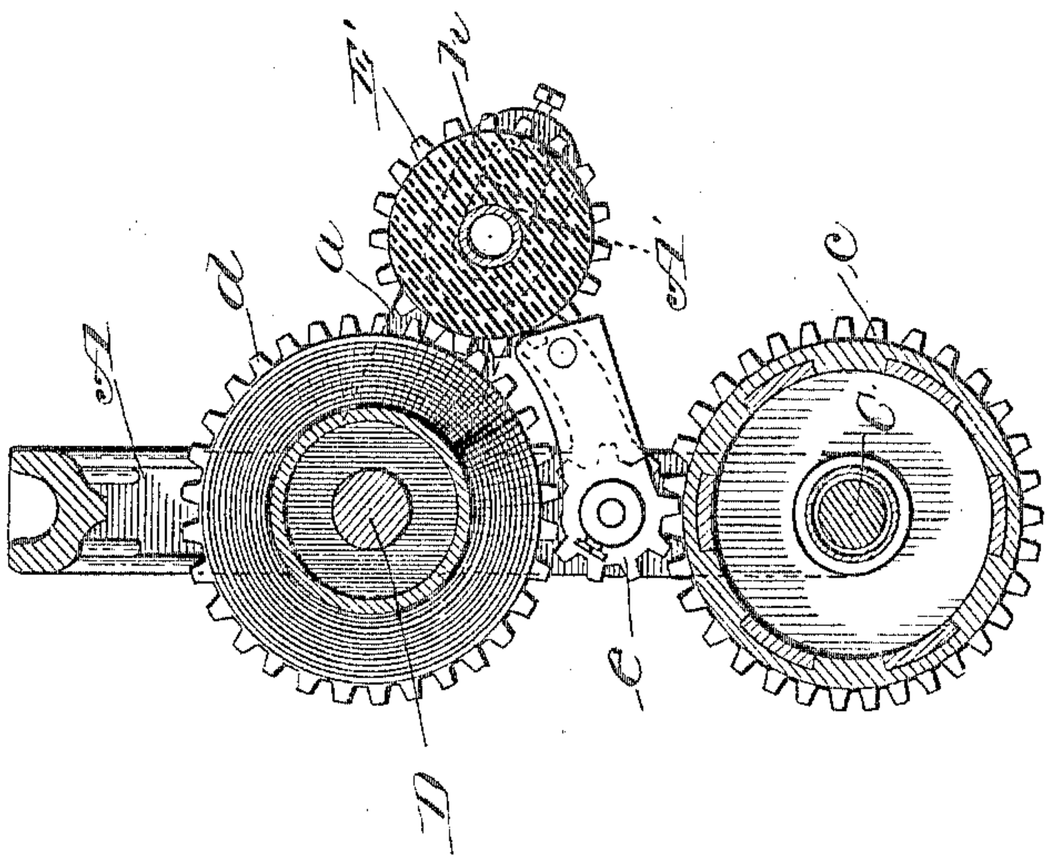
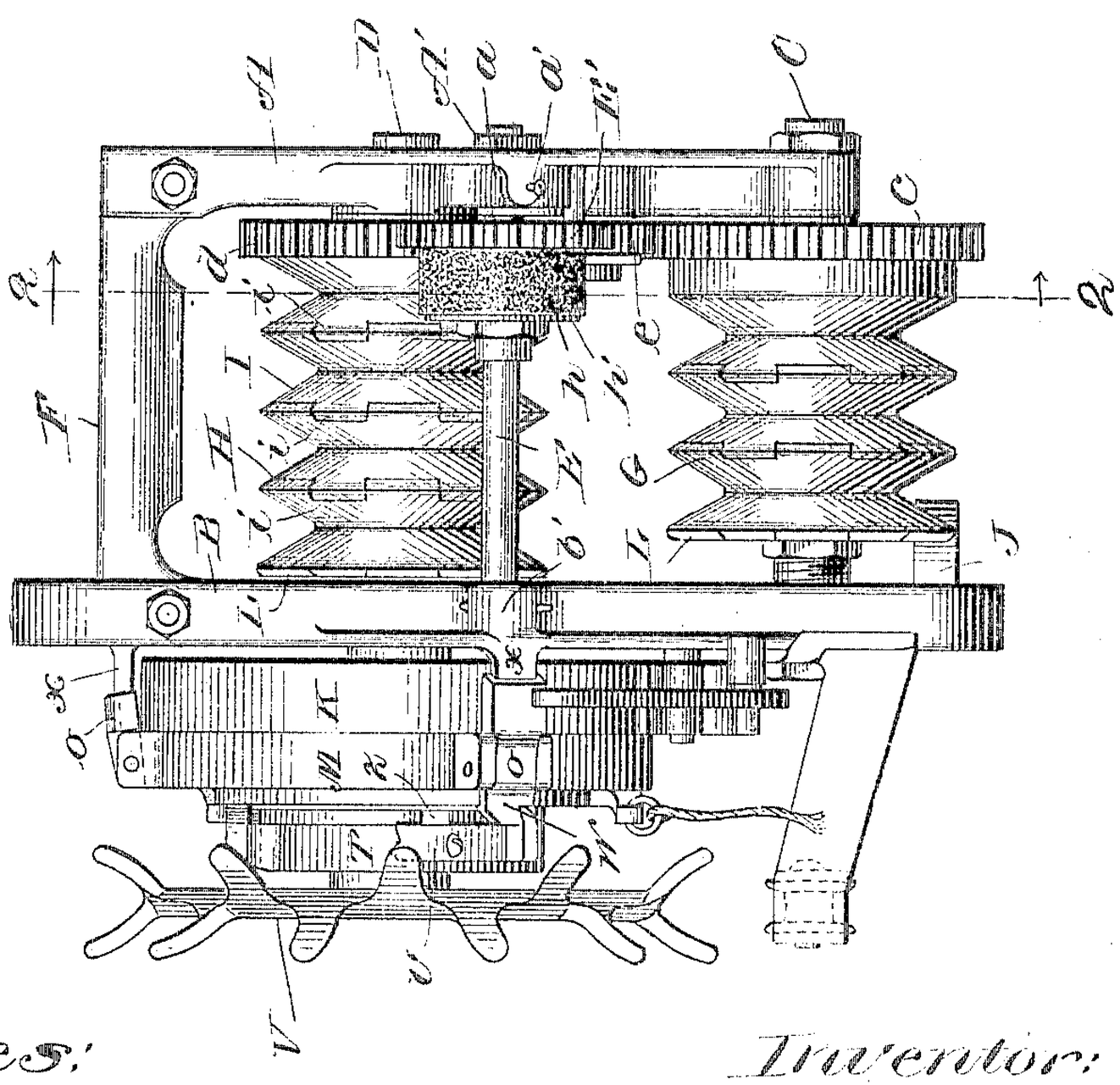


Fig. 1.



Witnesses:
H. S. Gaither
M. Friel.

Inventor:
Joseph G. O'Kelly.
by Frank D. Thomason
Attorney

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4 SHEETS—SHEET 2.

Fig. 4.

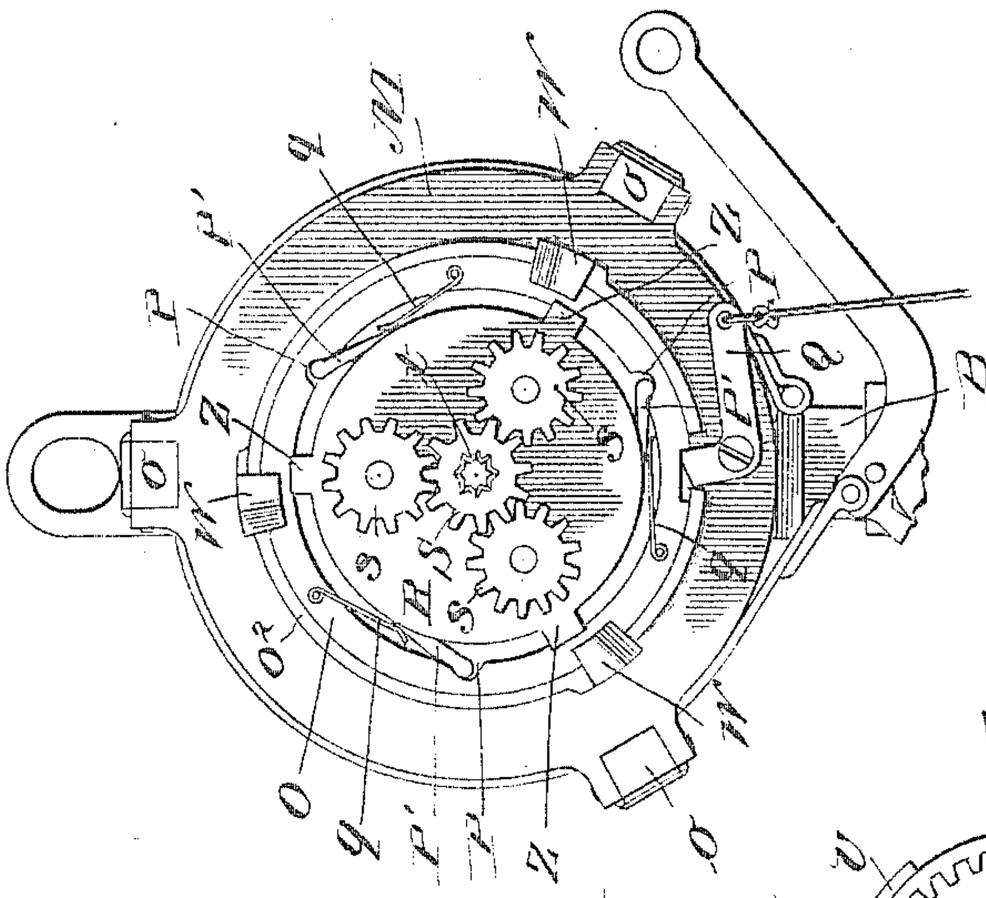


Fig. 5.

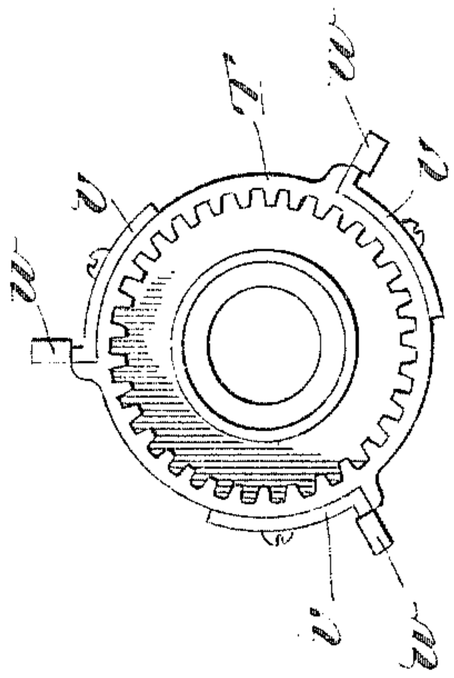
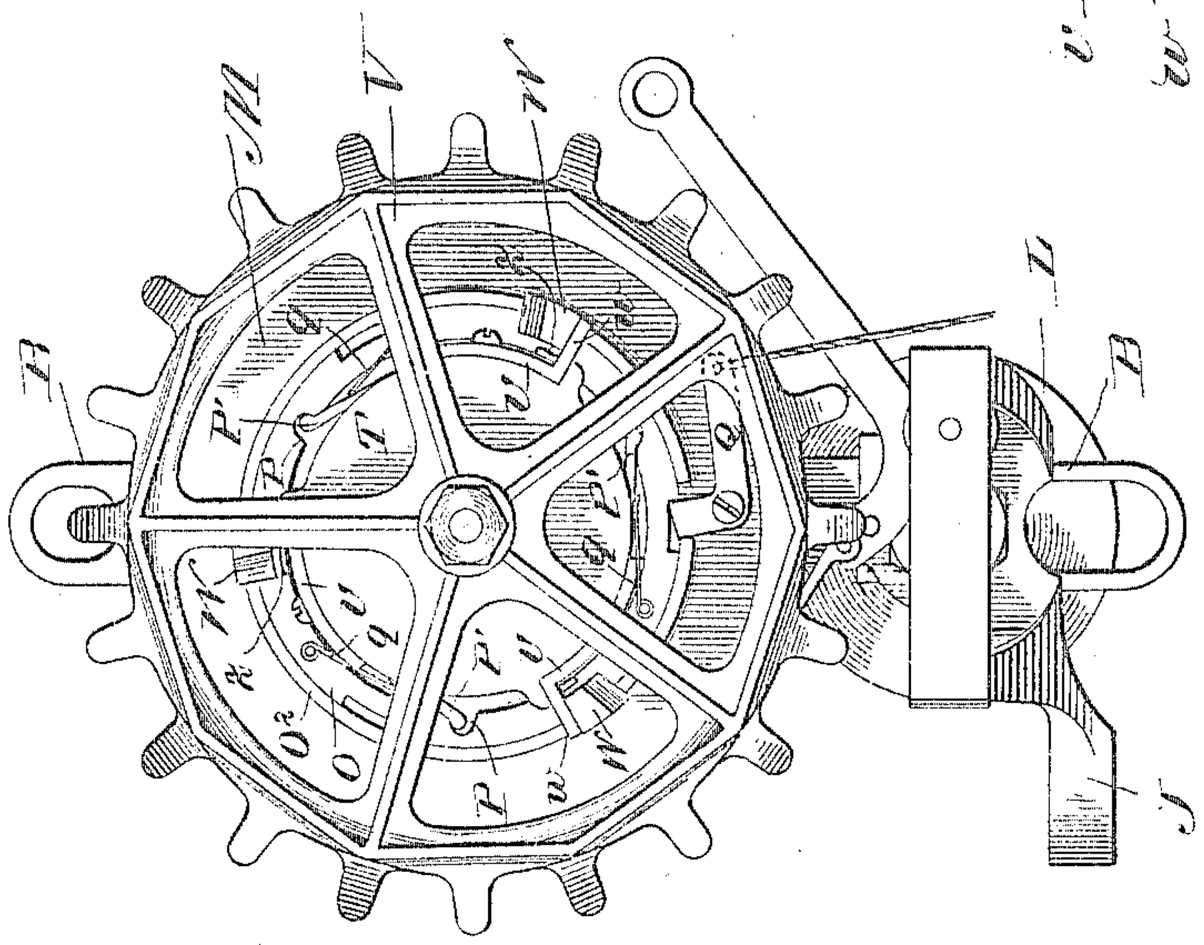


Fig. 3.



Witnesses:
H. S. Gaither
M. Friel.

Inventor:
Joseph G. O'Kelly.

By Frank D. Thomson
Attorney.

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4 SHEETS—SHEET 3.

Fig. 11.

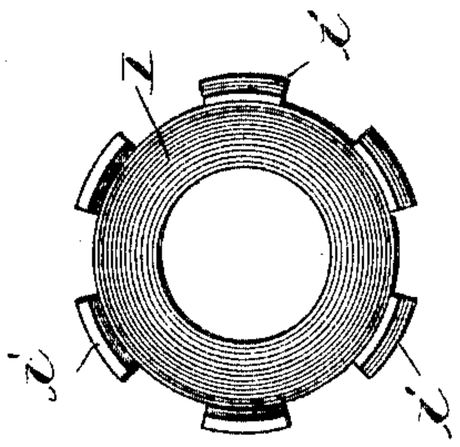


Fig. 12.

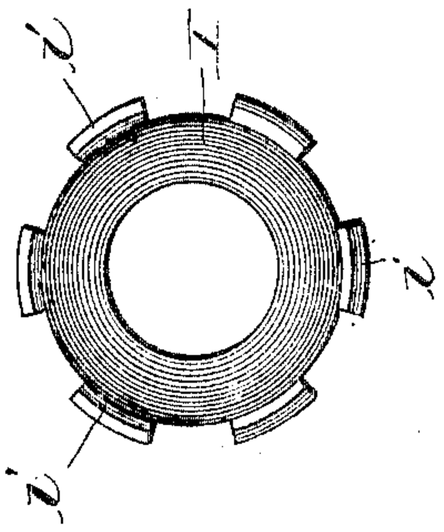


Fig. 10.

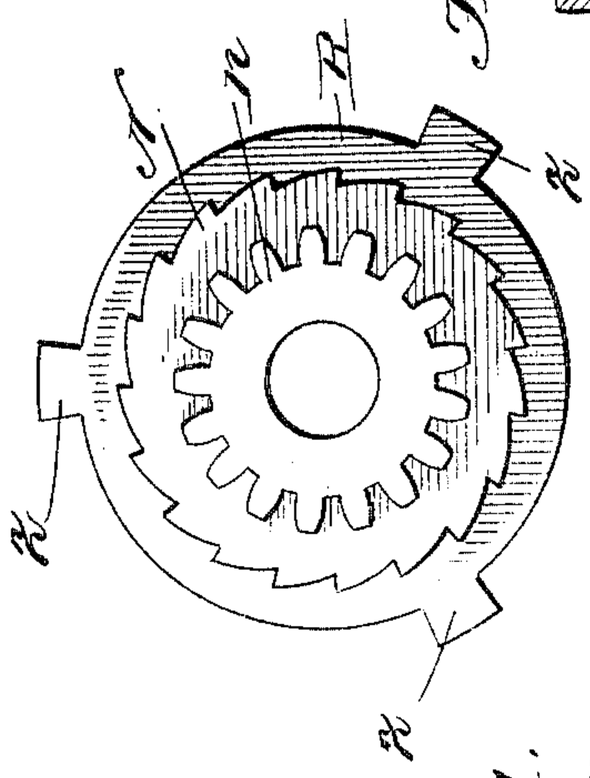


Fig. 13.

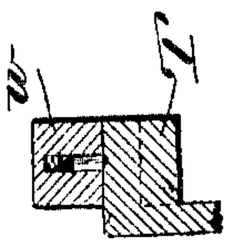


Fig. 6.

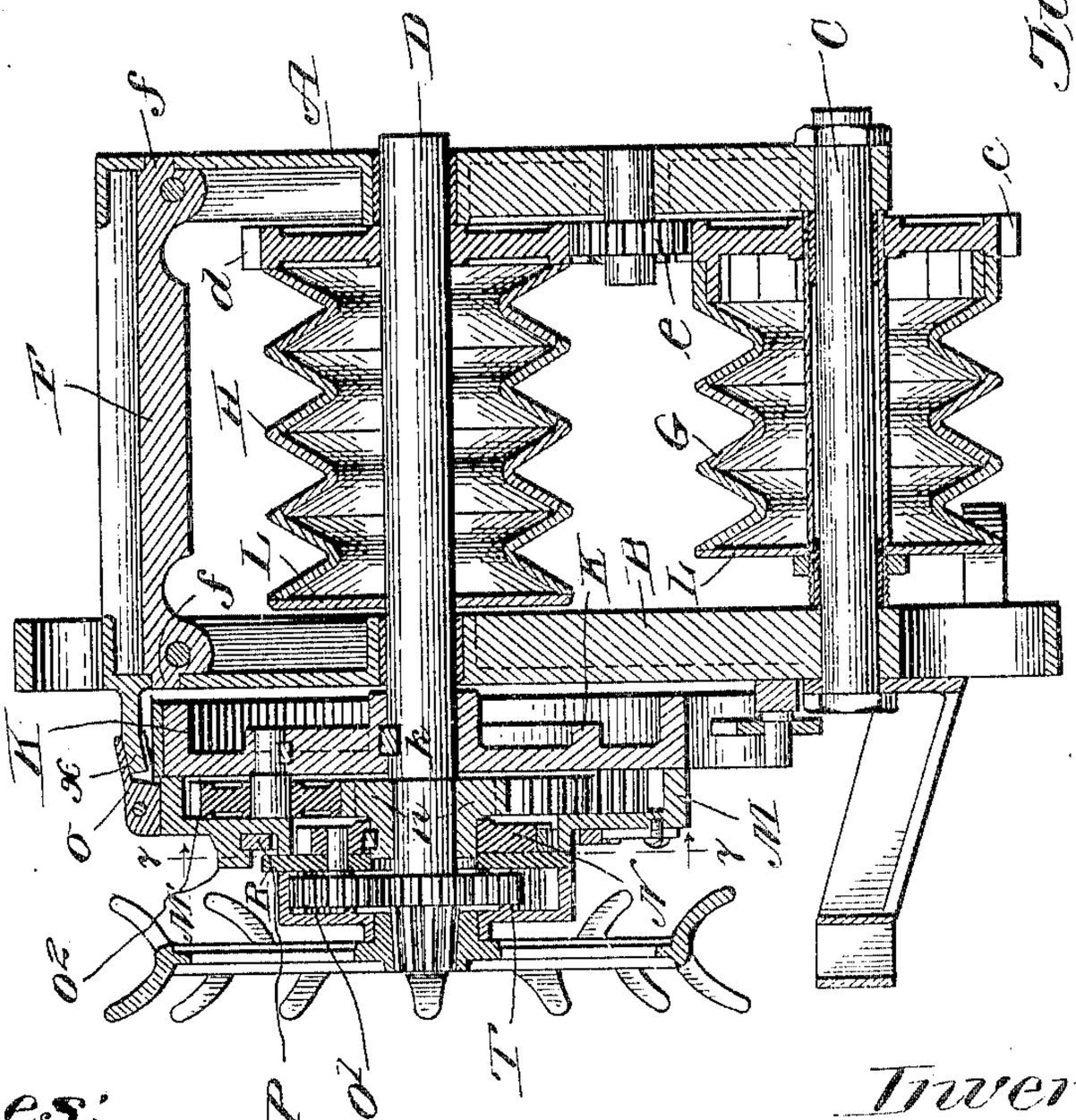
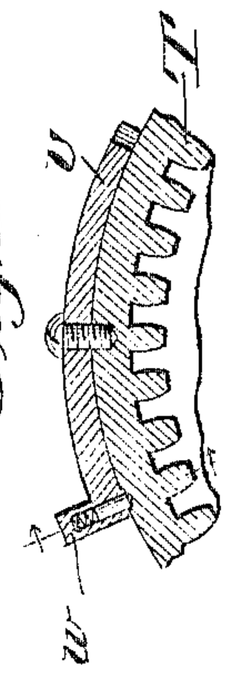


Fig. 14.



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by Frank D. Thomason
Attorney.

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4 SHEETS—SHEET 4.

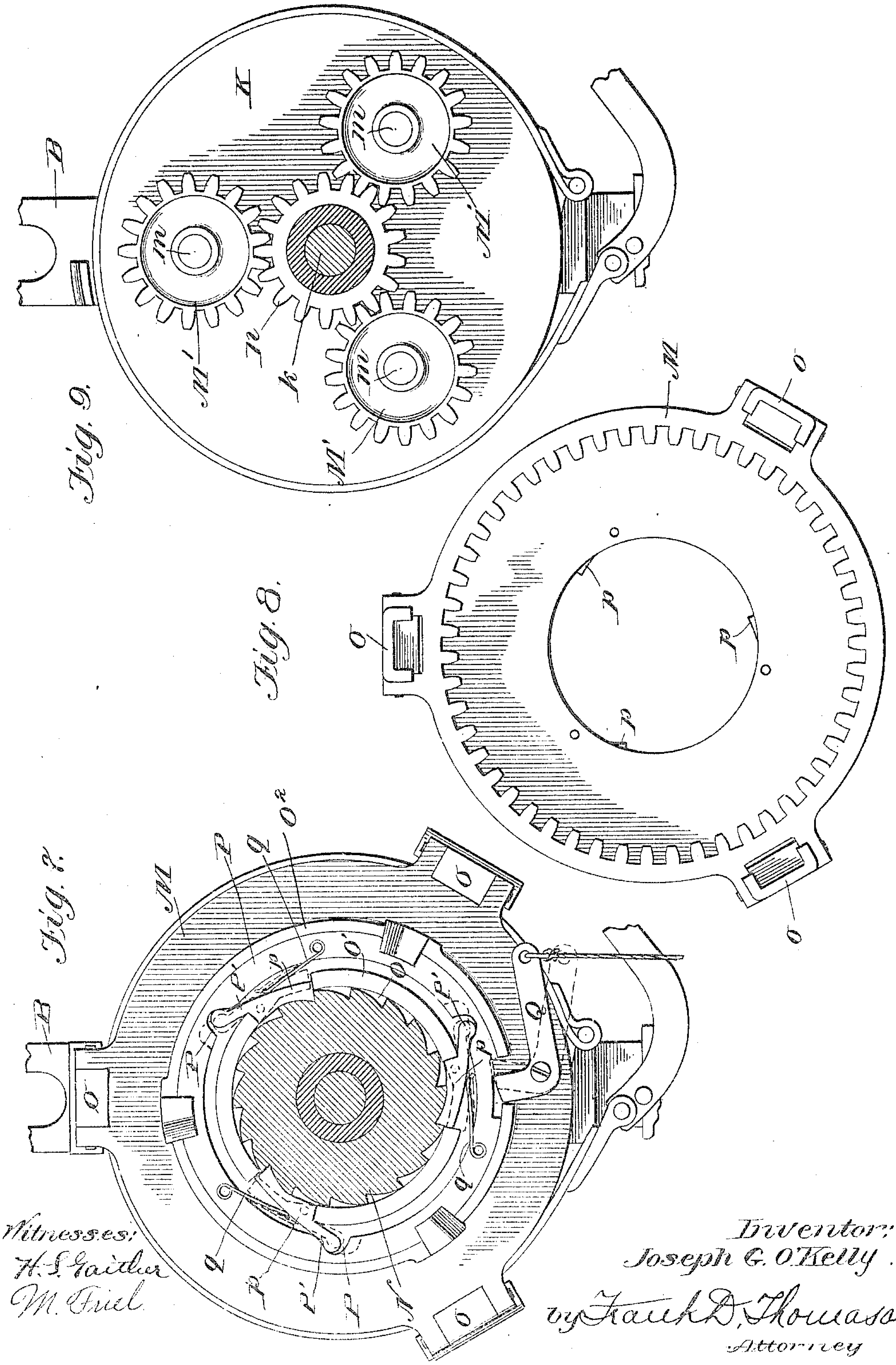

Fig. 9.

Fig. 8.

Fig. 7.

Witnesses:
H. S. Gaither
M. Friel

Inventor:
Joseph G. O'Kelly.
by Frank D. Thomason
Attorney

UNITED STATES PATENT OFFICE.

JOSEPH G. O'KELLY, OF CHICAGO, ILLINOIS.

DIFFERENTIAL GEARING.

No. 804,495. Specification of Letters Patent. Patented Nov. 14, 1905.

Application filed February 13, 1902. Serial No. 93,902.

To all whom it may concern:

Be it known that I, JOSEPH G. O'KELLY, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Differential Gearing, of which the following is a full, clear, and exact description.

Heretofore differential gearing has been made in which the actuating-gears revolved in planes in right angles to each other and occupied considerable space.

The object of my invention is to provide differential gearing which is more particularly adapted for windlasses, but can be used in conjunction with other mechanism, the gears of which all operate in the same or parallel planes and can be arranged in a very compact space, and is adapted to increase power and decrease speed; and a further object of my invention is to apply this improved gear to a peculiar knockdown construction of a pulley and block, the sheaves of which are so constructed as to prevent creeping and fleeting of the cable or rope used in conjunction therewith, while at the same time obtaining a much better purchase or grip on said cable or rope at a much less expenditure of friction. This I accomplish by the means hereinafter fully described and as particularly pointed out in the claims.

In the drawings, Figure 1 is a side elevation of my invention. Fig. 2 is a transverse section thereof, taken on dotted line 2 2 looking in the direction indicated by the arrows. Fig. 3 is an end elevation of the same. Fig. 4 is a similar view, but with the sprocket and revoluble interior gear removed and portions of the windlass-frame broken away. Fig. 5 is a detail view showing the reverse side of the revoluble interior gear. Fig. 6 is a longitudinal central section of the windlass and differential gearing, taken in the axial plane of the pulley-shafts. Fig. 7 is a transverse section taken on dotted line 7 7 looking in the direction indicated by the arrows. Fig. 8 is a detail view showing the reverse side of the stationary interior gear. Fig. 9 is similar to Fig. 7, but with the transmission-gear and the stationary interior gear removed to expose the circular plate to which the second train of idle gear is suitably journaled. Fig. 10 is a detail view of the transmission-plate connecting the revoluble and stationary multiple gearing, looking at it from the reverse side. Figs. 11 and 12 are detail views showing perspectively longitudinal and transverse sections of the reversing-pawl. Figs. 13 and 14 are detail views showing, respectively, opposite ends of a section of the knockdown sheave of the pulley and block to which my improvements are applied.

In the drawings, B represents a suitable frame which provides suitable bearings for the main shaft D and has projecting laterally from suitable arms radiating from its central portion in which said bearings are located lugs *x x x*, which are located at points preferably equidistant from each other and from the main shaft.

Main shaft D extends beyond its bearings in side frame B and immediately next the same has keyed to its extension *k* a circular plate K, whose diameter is such that its circumference comes within the embrace and approaches very near lugs *x*. Projecting in parallel planes to and at equal distance from the axis of the main shaft from the face of plate K opposite side frame B are three bearing-studs *m m m*, located at equal distances apart, and journaled on these studs are corresponding idle pinions M′. The teeth of these pinions nearest the drive-shaft are engaged by a loose king-gear *n*, from which they derive motion, and are engaged at points diametrically opposite gear *n* by the teeth of the interior gear M. The circumference of the interior gear M is about the same as that of the plate K, and it has suitably pivoted or otherwise secured to its periphery three laterally-reaching dogs *o*, which are located at equal distances apart and are adapted when said gear is in its proper relative position to fit over and engage lugs *x x x* of side frame B to hold said interior gear stationary. The side of this stationary interior gear M next plate K is open. Its opposite side, however, is, with the exception of an enlarged central opening therethrough, closed. The loose king-gear *n* has concentrically connected to the side thereof opposite plate K, preferably by a short neck, a ratchet N, which when in proper position is seated or comes within the enlarged central opening of the closed outer side of the stationary interior gear M, to the diameter of which its periphery nearly corresponds.

The outer marginal edge of the central opening of gear M is provided with an inner annular bead O′ and with an outer annular bead O² concentric therewith, thus forming an annular groove in which is seated a clutch-ring P.

The inner annular bead O′ is at points equidistant apart cut away or recessed, and in these recesses are seated pawls *p*. The end of these pawls opposite that opposed to the teeth of the ratchet (which they are adapted to engage) is pivoted by means of lateral studs projecting therefrom and entering suitable bearings in the web forming the outer side of the stationary interior gear M. The normal position of these pawls is such that their engaging ends come within the periphery described by the ratchet and are normally in engagement with the teeth of the same. This inward movement of said engaging ends, however, is limited by the opposite pivoted ends thereof bearing against the adjacent end wall of the recess in which the pawls are seated. Projecting longitudinally from the outer angles of the pivoted end of each pawl is an extension or finger *p′*, which enter angular recesses P′ in the inner circumference of the clutch-ring P substantially as shown, and bearing outward against the portion of said pawls between their pivots and engaging ends are leaf-springs *q*, the extremities of which opposite said pawls are secured and confined in or to the inner circumference of the ring P at points near the ends of the recesses next the engaging ends of the pawl. The operation of this clutch is such that when the ring P is moved from right to left the extensions *p′* of the pawls are pushed inward, thus withdrawing the engaging ends of said pawls from the ratchet, and when the power required to again move said ring is withdrawn the action of the springs automatically return ring P to its normal position. The initial movement of the ring P is obtained by means of an L-shaped trip Q, which is pivoted at its angle to the adjacent side of the internal gear M outside of the outer annular bead O^2, through a recess into which its shorter arm extends and engages the end walls of a recess made in the outer circumference of the ring which it enters. When the end of the trip farthest from the ring is moved away from the same, said ring is given a slight rotary movement, and when the trip is released the automatic return movement of said ring restores said trip to its original position.

Secured to the side of the ratchet N opposite gear *n* is a concentric circular plate R, whose diameter corresponds to the outer circumference of the inner bead O′, against which it bears and has moving contact. Plate R is provided with three bearing-studs projecting from the side or face thereof opposite the ratchet, that are located at equal distances from the center of the plate and are arranged at equal distances apart. Journaled on these studs is a primary train of idle pinions *s*, which are engaged at points nearest the shaft by an initial king-gear S, which is loose on that portion of the extension *k* of the main shaft extending beyond plate R, where the latter is stepped to a less diameter. These idle pinions *s s s* are engaged at points diametrically opposite gear S by a revoluble interior gear T, the side of which next plate R is opened and the outer or opposite side of which is all closed excepting a central opening sufficient for the outwardly-extending serrated boss *t* of the king-gear S to pass through to an extent sufficient for the sprocket-wheel V to be slipped over the same and be retained thereon by means of a washer and nut screwed onto the end of the main shaft.

The operation of my invention is such that when the sprocket is revolved, as by a chain or rope, it imparts its motion to the drive-gear S, and the drive-gear transmits its motion to the primary train of idle pinions *s s s*. If the interior gear T was free to revolve at all times, the action of these primary idle pinions would simply cause said interior gear to revolve. In order, therefore, to communicate the power applied to the sprocket to the other parts or members of my invention and ultimately to the main shaft D, it is necessary to provide some means for holding the said revoluble interior gear stationary. This I accomplish by means of a series of dogs *v v v*, that are fulcrumed at about their centers of length to the outer circumference of the revoluble interior gear at equal intervals apart. The body of these dogs conform to the curvature of the outer circumference of said gear T and are longitudinally positioned thereon. One end of these dogs projects outwardly and toward the stationary interior gear to form hooks *w*, which are adapted to engage stop-lugs W W W, projecting from the adjacent side of the internal gear M, arranged in the circumferential plane of the outer bead O^2 thereof at equal distances apart. The side of lugs W opposing the beveled back of the hooks *w* when the internal gear T was traveling from left to right is correspondingly beveled, and the opposite side thereof is preferably slightly undercut to securely hold the said hooks and through said pawl hold and prevent interior gear M from revolving when it is attempted to move gear T from right to left. The extremities of dogs *v v v* opposite the hooked ends thereof are preferably provided with V-shaped niches therein, which are adapted to engage lugs Z, projecting radially from the circumference of circular plate R sufficient to be engaged by said dogs, and thus by connecting gear T and the king-gear *n* (through plate R and ratchet N) cause said gear T and gear *n* to move in the same direction as sprocket V when the latter moves from left to right, and the machine would then operate just the same as if sprocket V was connected directly to king-gear *n*. When the dogs *v v* are moved to thus engage lugs *z*, their hook-shaped ends are moved outward by their engagement with the beveled sides of the stop-lugs W. The operation of said

dogs is such that when being carried from right to left they will either engage stop-lugs W or lugs Z, according to the obliquity of their position to the transverse plane of the gear Γ, and when they engage lugs W they clear lugs V, and vice versa.

What I claim as new is—

1. In a differential gear, a main shaft, an interior gear loose on said shaft, a circular plate loose on said shaft and adapted to revolve with the interior gear, means coöperating with said internal gear for revolving said plate when said interior gear is disengaged therefrom, comprising idle gears carried by said plate and engaged by said interior gear, and a king-gear loose on said shaft, in combination with devices for communicating the motion of said circular plate to said shaft.

2. In a differential gear, a main shaft, a plate keyed to said shaft, idle gears carried thereby, a king-gear loose on said shaft engaging said idle gears, a ratchet and a circular plate made integrant with and concentric to said king-gear, in combination with a stationary interior gear, a pawl connected to said interior gear and adapted to engage said ratchet, and means for actuating said circular plate.

3. In a differential gear, a main shaft, a plate keyed to said shaft, idle gears carried thereby, a king-gear loose on said shaft engaging said idle gears, a ratchet and circular plate made integrant with and concentric to said king-gear, in combination with a stationary interior gear, in the central opening of the outer closed side of which said ratchet is seated, a pawl pivotally connected to said interior gear, and a surrounding spring-returnable concentric ring the movement of which actuates said pawl, and means for actuating said circular plate and said interior gear.

4. In a differential gear, a main shaft, a plate keyed to said shaft, secondary idle gears carried thereby, a king-gear loose on said shaft engaging said idle gears, a circular plate integrant with and concentric to said king-gear and a stationary interior gear engaged by said secondary idle gears, in combination with primary idle gears carried by said circular plate, a revoluble interior gear surrounding and engaging said primary idle gears, and a king-gear loose on said shaft actuating said primary idle gears, a plate and ratchet connecting said revoluble interior gear and king-gear and means for operating the same.

5. In a differential gear, a main shaft, a plate keyed to said shaft, secondary idle gears carried thereby, a king-gear loose on said shaft engaging said idle gears, a circular plate integrant with and concentric to said king-gear and a stationary interior gear engaged by said secondary idle gears, having a lug projecting from the web of its outer closed side, in combination with primary idle gears carried by said circular plate, a revoluble interior gear surrounding and engaging said primary idle gears, means for revolving said last-mentioned interior gear and a dog pivoted thereto adapted to engage said lug of said stationary interior gear, and a king-gear loose on said shaft, a plate and ratchet connecting said revoluble interior gear and king-gear and actuating said primary idle gears and means for operating the same.

6. In a differential gear, a main shaft, a plate keyed to said shaft, secondary idle gears carried thereby, a king-gear loose on said shaft engaging said idle gears, a circular plate integrant with and concentric to said king-gear, and provided with a lug projecting from the periphery, and stationary interior gear engaged by said secondary idle gears, primary idle gears carried by said circular plate, a revoluble interior gear surrounding and engaging said primary idle gears, a dog pivoted thereto and adapted to engage said lug of said circular plate and means for operating said mechanism.

7. In a differential gear, a main shaft, a plate keyed to said shaft, secondary idle gears carried thereby, a king-gear loose on said shaft engaging said idle gears, a circular plate integrant with and concentric to said king-gear and having a lug projecting from its periphery, and a stationary interior gear and having a lug projecting from the web of its closed outer side, in combination with primary idle gears carried by said circular plate, a revoluble interior gear surrounding and engaging said primary idle gears, a dog pivoted to said revoluble interior gear and adapted to operatively engage the lug of said circular plate and the lug of said stationary interior gear, and a king-gear loose on said shaft actuating said primary idle gears, and means for operating the same.

8. A differential gear for reducing the speed and increasing the power of the force applied to operate the same comprising a main shaft a revoluble interior gear loose thereon, and a revoluble circular plate also loose thereon, and means for operating the same said interior gear operatively engaging said circular plate through dogs fulcrumed upon the same which engage stops upon said plate and adapted to revolve said plate when stationary as well as when revolving therewith and means for holding the same stationary.

9. In a differential gear, a main shaft, a plate keyed to said shaft, secondary idle gears carried thereby, a king-gear loose on said shaft engaging said idle gears, a ratchet and a circular plate having a lug projecting from its periphery and both said ratchet and circular plate made integrant with and concentric to said king-gear, in combination with a stationary interior gear, pawls connected to said stationary interior gear and adapted to engage said ratchet, a revoluble interior gear loose on said main shaft operatively connected to said circular plate, and a dog connected to

said revoluble interior gear adapted to engage the lug of said circular plate, and means for actuating said gears.

10. In a differential gear, a main shaft, a plate keyed to said shaft, idle gears carried thereby, a king-gear loose on said shaft engaging said idle gears a ratchet and a circular plate made integrant with and concentric to said king-gear, and a stationary interior gear having a lug projecting from the web of its closed outer side, in combination with a clutch-ring a pawl connected to said stationary interior gear and adapted to engage said ratchet a revoluble interior gear operatively connected to said circular plate a dog connected to said revoluble interior gear adapted to engage the lug on said plate, and means for actuating said gears.

11. In a differential gear, a main shaft a plate keyed to said shaft, idle gears carried thereby, a king-gear loose on said shaft engaging said idle gears, a ratchet, a circular plate having a lug projecting from its periphery and together with said ratchet made integrant with and concentric to said king-gear, and a stationary interior gear having a stop-lug projecting from the web of its closed side, in combination with a pawl connected to said stationary interior gear and adapted to engage said ratchet, a revoluble interior gear loose on the main shaft and operatively connected to said circular plate, a dog connected thereto and adapted to engage the lug of said circular plate and a stop-lug of said stationary interior gear, and means for actuating said gears.

12. In a differential gear, a main shaft, a plate keyed to said shaft, a series of idle gears carried thereby, a king-gear loose on said shaft and engaging said idle gears, a ratchet, a circular plate, having a lug projecting from the periphery thereof and together with said ratchet made integrant with and concentric to said king-gear, in combination with a stationary gear in the central opening of the outer closed side of which said ratchet is seated and having a stop-lug projecting therefrom, a series of pawls connected to said stationary interior gear and a surrounding concentric ring engaging said pawls to effect the release movement thereof, a revoluble interior gear loose on said shaft and operatively connected to said circular plate, a dog connected to said revoluble interior gear and adapted to engage the lug of said circular plate and the stop-lug of said stationary interior gear, and means for actuating said gears.

JOSEPH G. O'KELLY.

Witnesses:
M. FRIEL,
FRANK D. THOMASON.