

(No Model.)

3 Sheets—Sheet 1.

F. H. RICHARDS.
GEARING.

No. 573,620.

Patented Dec. 22, 1896.

Fig. 1.

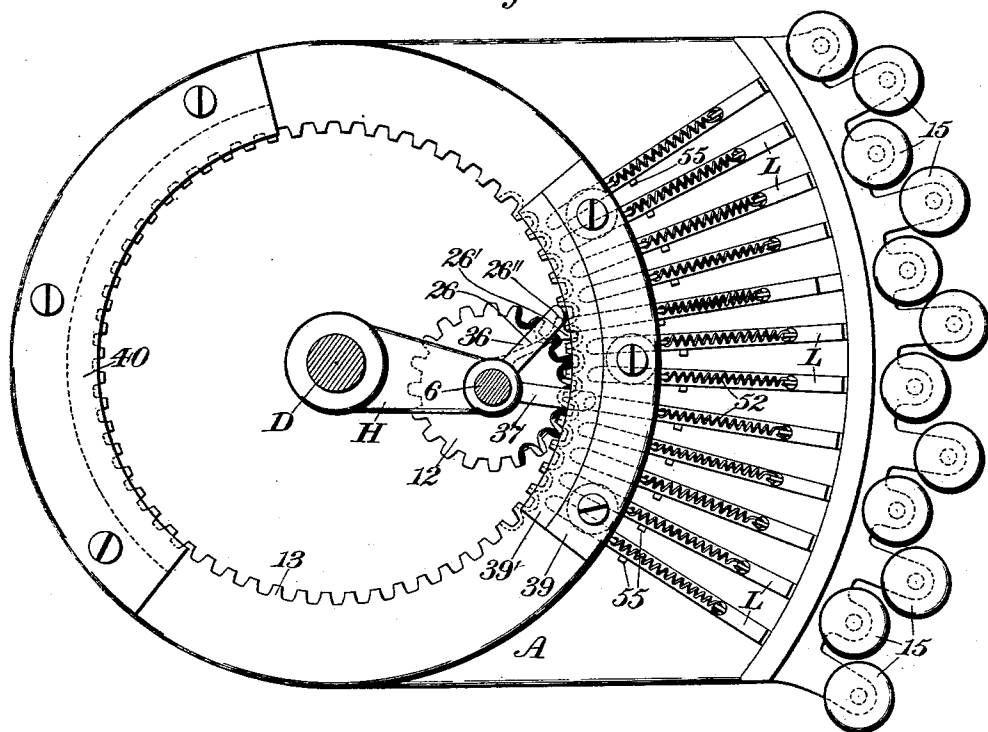
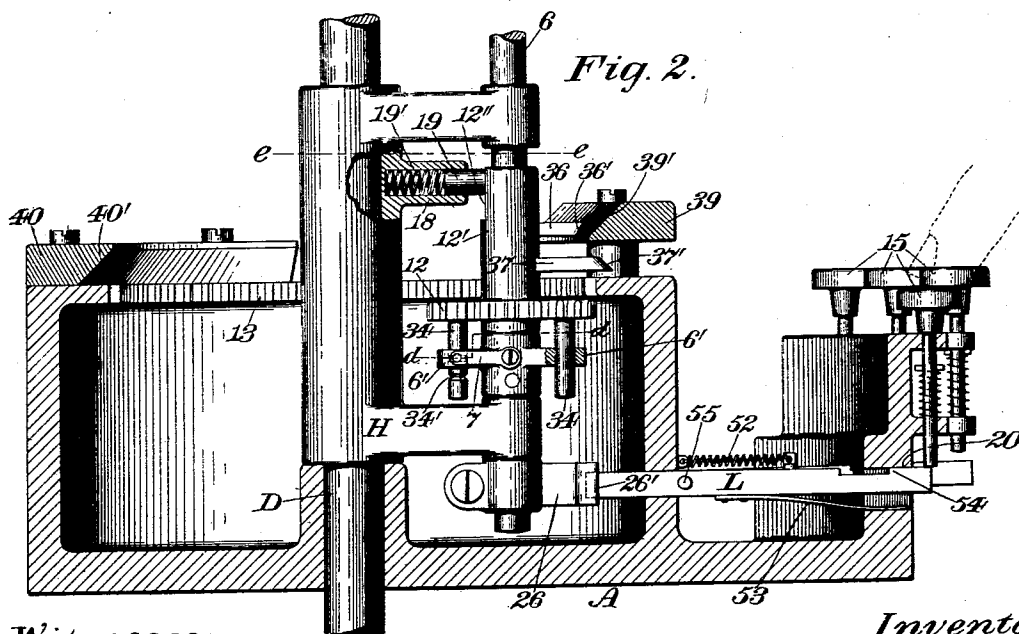


Fig. 2.



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Fig. 3.

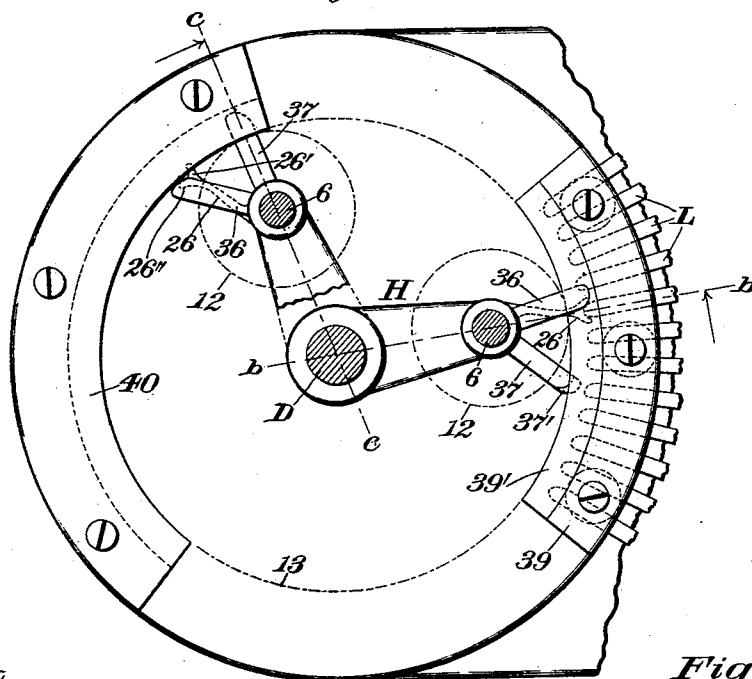


Fig. 4.

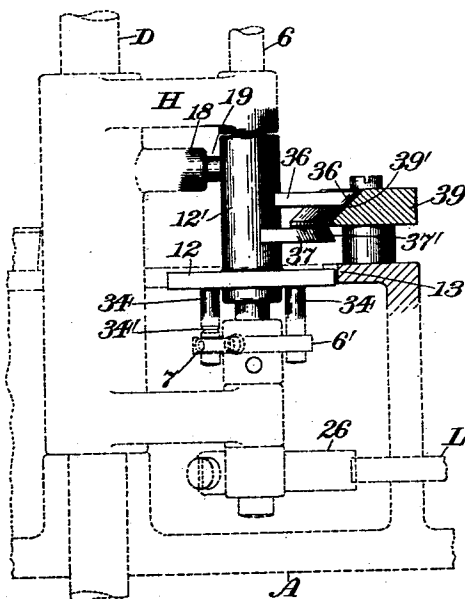
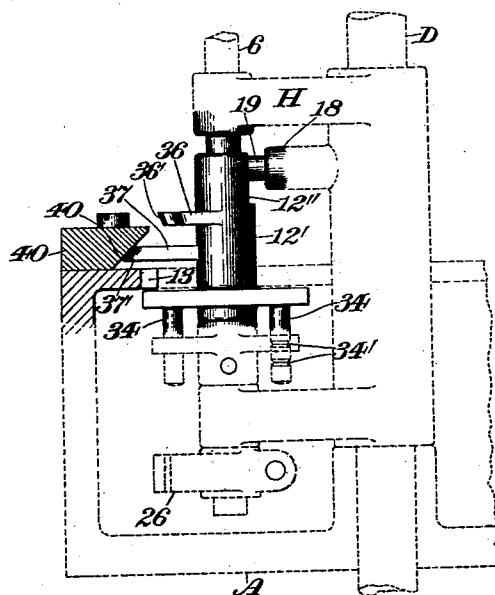


Fig. 5.



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Fig. 6.

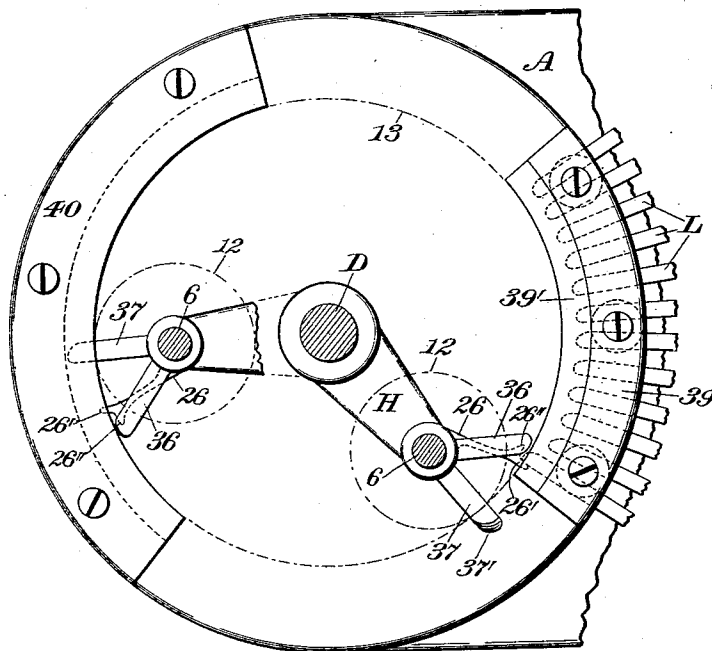


Fig. 7.

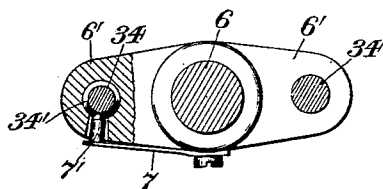
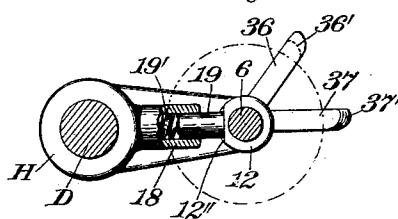


Fig. 8.



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UNITED STATES PATENT OFFICE.

FRANCIS H. RICHARDS, OF HARTFORD, CONNECTICUT.

GEARING.

SPECIFICATION forming part of Letters Patent No. 573,620, dated December 22, 1896.

Application filed April 6, 1896. Serial No. 586,345. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS H. RICHARDS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Gearing, of which the following is a specification.

This invention relates to gearing of the class especially adapted for starting and stopping the rotation about its axis of an orbitally-movable wheel—such, for instance, as a type-wheel—and is especially adapted for use in connection with a certain class of key-operated mechanisms—such, for instance, as that described in my Patent No. 401,371, granted April 16, 1889.

One of the main objects of my present invention is to provide an improved coupling mechanism by means of which a rotative driven gear may be carried into and out of engagement with a driving-gear, the orbit of which corresponds to the orbit of movement of the driven gear, the coupling and uncoupling of the driven gear being effected at predetermined points in its orbital movement.

Another important object of my invention consists in the provision of means for so regulating the number of rotations of the driven gear, occurring during the period beginning with the coupling of such driven gear with the driving-gear and its uncoupling therefrom, that the driven gear may be rotated a determined number of times when such rotation commences at one point in the orbital movement of this gear and a different number of times when the rotation begins at another point in such orbital movement.

In the drawings accompanying and forming part of this application, Figure 1 is a sectional plan of a key-operated mechanism embodying my present invention. Fig. 2 is a vertical longitudinal sectional elevation of the same. Fig. 3 is a sectional plan of a portion of the mechanism illustrated in Fig. 1 and shows two positions of the gear-shifting mechanism for permitting one rotation of the driven gear. Fig. 4 is a sectional elevation, in full and dotted lines, of a portion of the mechanism shown in Fig. 3, the section being taken in line *b b* thereof and illustrating the coupling of the driven gear with the driving-gear. Fig. 5 is a similar view illustrating

the uncoupling of the driven gear from the driving-gear, the section being taken in line *c c*, Fig. 3. Fig. 6 is a sectional plan similar to Fig. 3 and shows two positions of the gear-shifting mechanism for permitting two rotations of the driven gear. Fig. 7 is a detail longitudinal section, on an enlarged scale, of a detent device, hereinafter described, for holding the driven gear in either of its extreme positions, the section being taken in line *d d*, Fig. 2; and Fig. 8 is a similar view of brake mechanism for stopping the rotation of the driven gear and holding the same in its normal position, the section being taken in line *e e*, Fig. 2.

Similar characters represent like parts in all the figures of the drawings.

My present invention comprises, in combination with a driving-gear and with a rotatable driven gear shiftable from one to the other of two extreme positions into and out of gear with such driving-gear, and in combination also with means for carrying the driven gear in an orbit corresponding with the driving-gear, of gear-shifting means controlled by the rotation of the driven gear and operative for shifting the driven gear from one of the aforesaid positions to the other at a predetermined point in the orbit thereof.

I prefer to employ a circular driving-gear and a driven gear normally out of gear with such driving member and having means for revolving the driven gear about the driving-gear, together with means for starting the rotation of the driven gear while in its normal position, the gear-shifting means operative by such rotation being, preferably, in the nature of gear-coupling means adapted for effecting the coupling of the two gears to thereby continue the rotation of the driven gear during its revolution.

A framework suitable for carrying the several operative parts of the mechanism is shown herein at A, having a main shaft, such as D, carrying a rotary turret or frame, such as H, which in turn is illustrated as supporting for rotation relatively thereto a driven gear, such as 12, which driven gear is adapted to be rotated when in gear therewith by means of a driving-gear—such, for instance, as that shown at 13. This driving-gear is represented in the present case in the form of a

circular internal gear; but it will be obvious that it might be an external gear and have an orbit other than a circular orbit. Normally the driven gear is preferably out of mesh with the driving-gear and is shiftable transversely of the plane of the driving-gear into mesh therewith. As is usual in mechanisms of this type, the driven gear is illustrated carrying, for rotation and revolution in unison therewith, a starting-arm, such as 26, which is operative in the present case for commencing the rotation of this gear, the rotation of the starting-arm being shown as effected, in a manner substantially similar to that described in my patent hereinbefore referred to, by means of a suitable gear-starter interposable in the path of said arm.

A series of gear-starters or latches, constructed for interposition in the path of the starting-arm in the manner just described, is illustrated at L, operated, respectively, in the well-known manner by means of corresponding keys—such, for example, as are illustrated at 15. These keys for operating the latches may be of any desired construction and are represented in the drawings as simple spring-retracted plungers working in suitable vertical apertures in the forward part of the main frame A and adapted, when depressed, to engage the rear ends of their respective latches. These latches are also illustrated as of well-known construction, having springs 52 for carrying them to their forward or projected positions when released by the keys; springs, such as 53, for holding them latched in their retracted positions; stops, such as 55, for limiting the forward movements of the latches, and catches, such as 54, for engaging corresponding catches 20 on the main frame.

The starting-arm (illustrated at 26) is preferably of the type described in my hereinbefore-mentioned patent, and is shown in position and adapted to push back the gear-starter or latch after being operated thereby, this starting-arm being represented in the present instance as having a starting-finger 26', which when engaged by the gear-starter or latch is rotated, and thus rotates the arm and the driven gear, and as also having a resetting-finger 26'', which when the starting-arm is in line with the gear-starter exerts a toggling action upon the latch and forces the same back to its normal position, thus resetting the same before being disengaged therefrom.

The driven gear is illustrated in the drawings carried for rotation in unison with a shaft 6, journaled in the frame or turret H, and is also represented mounted for vertical reciprocation thereon. In the present instance this gear is shown having a plurality of pins, such as 34, rigidly secured thereto and passing through apertures in a pair of arms 6' in fixed relation with the shaft 6. The driven gear

is also illustrated fixedly secured to a long sleeve 12', journaled upon the shaft 6 so as to have a vertical movement thereon.

It will be apparent that both the driven gear and its sleeve will rotate in unison with the shaft, owing to the positive engagement of the guide-pins 34 with the fixed arms 6', and that the driven gear will have its shifting or reciprocatory movement independently of the movement of the shaft, so as to permit the engagement and disengagement of the driving and driven gears, the starting-arm 26 and the fixed arms 6' being shown having stop-shoulders at opposite sides, respectively, of the lower arm of the turret or frame H to maintain the shaft and its connected parts in their proper vertical positions.

The driving-gear 13 is preferably disposed so as to have its pitch-line concentric with the axis of the driving-shaft D, and is shown herein as supporting a pair of cam-segments, such as 39 and 40, each of which is illustrated provided with a cam-face inclined to the plane of the driving-gear and having its longitudinal edges defined by arcs having their centers in the axis of the main driving-shaft, these cam-faces being designated, respectively, by 39' and 40', located in adjacent parallel planes. Each of the cam-segments 39 and 40 may be considered as comprising a plurality of gear-shifting members or cams, one for each of the latches or keys of the mechanism. As the cam-segment 39 is in the nature of a coupling-segment and that at 40 an uncoupling-segment, it will be apparent that the gear-shifting members of the former constitute coupling members or cams, while those of the latter are in the nature of uncoupling cams or members.

Two gear-shifting members adapted to cooperate with the cam-segments just described are illustrated at 36 and 37, carried for rotation and revolution in unison with the driven gear, the former constituting a gear-shifting coupling member or cam and the latter a gear-shifting uncoupling member or cam, these two arms being illustrated herein mounted in fixed relation with the driven gear. The arm 36 is shown herein having a cam-face 36', inclined at an angle corresponding to that of the face 39', and the arm 37 is preferably provided with a similar cam-face 37' for cooperating with that at 40'.

It will be obvious that either arm, operating in conjunction with its proper cam-segment or portion thereof, forms therewith gear-shifting means operative for carrying the driven gear from one of its extreme positions to the other, the arm 36 and the segment 39, or proper portion thereof, forming gear-coupling means controlled by the rotation of the driven gear when operated by the starting-arm, and the arm 37 and the segment 40, or proper portion thereof, constituting gear-uncoupling means, operative, as will be herein-

after more particularly pointed out, by the continued rotation of the driven gear after a predetermined number of rotations thereof.

As is well understood in the art, when a gear-starter or latch is interposed in the path of the starting-arm the driven gear will be partially rotated in unison with said arm. The coupling-arm 36 is so located that as the starting-arm is engaged by the gear-starter and said arm begins to rotate the cam-face 36' will be forced up the corresponding cam-face of its coöperative coupling member or cam of the cam-segment 39 and will thereby cause the driven gear to be shifted from its normal position out of engagement with the driving-gear, Fig. 2, into gear with said driving-gear, as shown in Fig. 4, the shifting movement taking place in a direction transversely of the driving or internal gear.

As it is obvious that some means must be employed in the construction shown herein for preventing the return of the driven gear and its connected parts to their normal positions on the rotation of the arm 36 out of engagement with the cam-segment 39, I have illustrated herein a detent device for holding said gear up in the position shown in Fig. 4 until the action of the uncoupling members takes place. In the form thereof herein shown this detent device preferably comprises a spring-arm, such as 7, fixedly secured to one of the arms 6' and having a detent-pin 7' working in a suitable aperture in said arm and adapted to engage the walls of either one of a pair of V-shaped or similar grooves 34' in the corresponding guide-pin 34, these grooves corresponding, respectively, to the extreme upper and lower positions of the driven gear—that is, to the geared and idle positions, respectively, of the driving and driven gears.

The driven gear is normally held against rotation in a predetermined rotative position in any suitable manner. I have illustrated herein a brake mechanism for preventing such rotation, which in the form illustrated embodies a brake member, such as 19, in the form of a sliding bolt working in the bore of a tubular boss, such as 18, on the turret or frame H, and a spring 19' held in said boss under compression and normally tending to force the bolt 19 into engagement with a flattened portion or surface 12'' of the sleeve 12', as shown in Fig. 8, this flattened surface being of sufficient length to permit reciprocation of the driven gear and its connected devices.

After the commencement of the rotation of the starting-arm and the driven gear has been effected by the gear-starter the rotation of the driven gear is continued by the driving-gear until the uncoupling-arm 37 is in position to engage the cam-surface of the proper portion of the cam-segment 40, whereupon the force of the detent-pin 7'' will be overcome by the toggling action of the cam-faces 1, and the cam-face 37', riding down the cam-

face 40', will cause the shifting of the driven gear to its normal position, as illustrated in Fig. 5.

The uncoupling of the driven gear from the driving-gear may be effected at the end of one or more rotations of such driven gear, as may be desired; but in the construction herein illustrated I have shown means for uncoupling the gears at the end of one rotation, when the coupling has been effected by the operation of any one of the series of latches, and at the end of two rotations when the coupling has been accomplished by one of the other series of gear-starters. In the present instance the cam-segment 40 is represented embodying a plurality of connected uncoupling members in fixed relation with the driving-gear, and these uncoupling members may be divided into two sets, in the first of which each uncoupling member is so located as to engage the uncoupling-arm 37 at such a distance from the corresponding starting-point—viz., the projected latch of that set—as corresponds to a determined number of rotations of the driven gear; and in the second of which each uncoupling member is located to engage such arm at a distance from the starting-point or latch of such set, corresponding to a greater number of rotations of the driven gear.

The five upper latches (shown in Fig. 1 of the drawings) are illustrated in the present case as operative to start the rotation of the driven gear at such points that said gear will have but a single rotation before it is uncoupled from the driving-gear, while the seven lower gear-starters are represented as serving to start the driven gear at such points that two rotations will be accomplished before this uncoupling is effected. This will be obvious by reference to Figs. 3 and 6, respectively, in the former of which the starting-arm is shown engaged by the lowermost one of the upper tier of latches, the cam-segment 40 being so located that the proper coupling member or portion of the segment will be operative to engage the uncoupling-arm 37 and shift the driven gear to its normal position when these uncoupling members come into operative relation with each other, while in the latter figure the lowermost one of the lower tier of gear-starters is illustrated as operative for starting the rotation of the driven gear at such a point that at the end of one of its rotations the driven gear will not be in position to carry its uncoupling-arm into engagement with the cam-segment 40, and hence said gear will continue its rotative movement until the uncoupling-arm 37 is again brought to a point where its uncoupling cam-face intercepts the arc defining the inner edge of the cam-segment 40 when the uncoupling-arm will, at the end of the second rotation of the driven gear, engage the proper uncoupling member or portion of such cam-segment and effect the uncoupling of the two gears in the manner before described.

By the proper positioning of the gear-start-

ers and the cam-segments it will be apparent that within limits any desired number of latches may be operated to start the rotation of the driven gear at such points, respectively, 5 that the uncoupling will be accomplished at the end of one or more of such rotations, and that the remainder of the latches may be actuated to start the rotation of the driven gear at such other points, respectively, that two or 10 more rotations will be completed before the uncoupling-arm of the orbitally-movable gear strikes the uncoupling cam-face of the segment 40.

While my invention is shown and described 15 as preferably operative in an orbital path, yet it is not limited thereto.

Having thus described my invention, what I claim is—

1. The combination with a driving-gear, of 20 a driven gear; means for carrying the driven gear in a path corresponding with that of the driving-gear; and means controlled by the rotation of the driven gear, and operative for 25 of engaging with the driving-gear at a predetermined point in the path thereof.

2. The combination with a driving-gear, a rotatable driven gear bodily shiftable between two extreme positions into and out of 30 gear with the driving-gear; and means for carrying the driven gear in a path corresponding with that of the driving-gear; of a starting-arm connected for rotation and movement in unison with the driven gear; a gear- 35 starter interposable in the path of said arm for starting the rotation of the driven gear; and gear-coupling means controlled by such rotation of the driven gear and operative for 40 of bodily shifting said driven gear toward and into gear with the driving-gear, to thereby continue the rotation of the driven gear.

3. The combination with a driving-gear, a rotatable driven gear bodily movable into and out of gear with the driving-gear; and means 45 for moving the driven gear in a path corresponding with the path of the driving-gear; of gear-shifting means controlled by the rotation of the driven gear, and operative for 50 of bodily shifting said driven gear from one of its extreme positions to the other.

4. The combination with a driving-gear, and fixed cam-surfaces adjacent thereto; of a driven gear; and means controlled by the 55 rotation of said driven gear, and in intermittent engagement with said cam-faces.

5. The combination with a driving-gear; a rotatable driven gear bodily shiftable between two extreme positions into and out of 60 gear with the driving-gear; and means for carrying the driven gear in an orbit corresponding with the driving-gear; of gear-shifting means controlled by the rotation of the 65 driven gear, and operative for bodily shifting said driven gear from one of its extreme positions to the other, at a predetermined point in the orbit thereof.

6. The combination with a driving-gear; a

rotatable driven gear bodily shiftable between two extreme positions into and out of gear with the driving-gear; and means for 70 carrying the driven gear in an orbit corresponding with the driving-gear; of a starting-arm connected for rotation, and orbital movement, in unison with the driven gear; a gear- 75 starter interposable in the path of said arm for starting the rotation of the driven gear; and gear-coupling means controlled by such rotation of the driven gear, and operative for 80 of bodily shifting said driven gear toward, and into gear with, the driving-gear, to thereby continue the rotation of the driven gear.

7. The combination with a driving-gear; a rotatable driven gear bodily shiftable between two extreme positions into and out of 85 gear with the driving-gear; and means for revolving the driven gear in an orbit about the axis of the driving-gear; of gear-shifting means controlled by the rotation of the driven gear, and operative for bodily shifting said 90 driven gear from one of its extreme positions to the other, at a predetermined point in the revolution thereof.

8. The combination with a driving-gear; a rotatable driven gear normally out of gear 95 with said driving-gear, and bodily shiftable into and out of gear with the driving-gear; and means for revolving the driven gear in an orbit about the axis of the driving-gear; of means for starting the rotation of the 100 driven gear while in its normal position; and gear-coupling means controlled by such rotation of the driven gear, and operative for 105 of bodily shifting said driven gear toward, and into gear with, the driving-gear, to thereby continue the rotation of the driven gear.

9. The combination with a driving internal gear; a rotatable driven gear normally 110 out of gear with said internal gear, and bodily shiftable into and out of gear with the internal gear; and means for revolving the driven gear in an orbit about the axis of the internal 115 gear; of means for starting the rotation of the driven gear while in its normal position; and gear-coupling means controlled by such rotation of the driven gear, and operative for 120 of bodily shifting said driven gear toward, and into gear with, the internal gear, to thereby continue the rotation of the driven gear.

10. The combination with a driving internal gear; a rotatable driven gear normally 120 out of gear with said internal gear, and bodily shiftable transversely of the plane of, and into and out of gear with, the internal 125 gear; and means for revolving the driven gear in an orbit about the axis of the internal gear; of means for starting the rotation of the driven gear while in its normal position; and gear-coupling means controlled by such 130 rotation of the driven gear, and operative for bodily shifting said driven gear toward, and into gear with, the internal gear, to thereby continue the rotation of the driven gear.

11. The combination with a driving internal gear; a rotatable driven gear normally

out of gear with said internal gear, and bodily shiftable transversely of the plane of, and into and out of gear with, the internal gear; and means for revolving the driven gear in an orbit about the axis of the internal gear; of means for starting the rotation of the driven gear while in its normal position; and a pair of gear-shifting coupling members, one connected for rotation and revolution in unison with the driven gear, and the other in fixed relation with the internal gear, and located to shift the driven gear and its coupling member bodily on such rotation of the driven gear, to thereby carry said driven gear into gear with the internal gear, and continue the rotation of the driven gear.

12. The combination with a driving internal gear; a rotatable driven gear normally out of gear with said internal gear, and bodily shiftable transversely of the plane of, and into and out of gear with, the internal gear; and means for revolving the driven gear in an orbit about the axis of the internal gear; of means for starting the rotation of the driven gear while in its normal position; and a pair of gear-shifting coupling members, one connected for rotation and revolution in unison with the driven gear, and the other in fixed relation with the internal gear, and one of said coupling members having a cam-face adapted to cooperate with the other coupling member and located to shift the driven gear and its coupling member on such rotation of the driven gear, to thereby carry said driven gear into gear with the internal gear, and continue the rotation of the driven gear.

13. The combination with a driving internal gear; a rotatable driven gear normally out of gear with said internal gear, and shiftable transversely of the plane of, and into and out of gear with, the internal gear; and means for revolving the driven gear in an orbit about the axis of the internal gear; of means for starting the rotation of the driven gear while in its normal position; and a pair of gear-shifting coupling-cams, one connected for rotation and revolution in unison with the driven gear, and the other in fixed relation with the internal gear and located to shift the driven gear and its coupling-cam on such rotation of the driven gear, to thereby carry said driven gear into gear with the internal gear, and continue the rotation of the driven gear.

14. The combination with a driving internal gear; a rotatable driven gear normally out of gear with said internal gear, and shiftable transversely of the plane of, and into and out of gear with, the internal gear; and means for revolving the driven gear in an orbit about the axis of the internal gear; of means for starting the rotation of the driven gear while in its normal position; and a pair of gear-shifting coupling members, one in fixed relation with the internal gear, and the other movable in unison with the driven gear and located to engage the first-mentioned coupling member by a toggling movement on the rotation of the driven gear, and one of said coupling members having its working face cam-shaped and located to shift the driven gear on the toggling movement of its coupling member, to thereby carry said driven gear into gear with the internal gear, and continue the rotation of the driven gear.

15. The combination with a driving-gear; a rotatable driven gear normally out of gear with said driving-gear, and bodily shiftable into and out of gear with the driving-gear; and means for carrying the driven gear in an orbit corresponding with the driving-gear; of means for starting the rotation of the driven gear while in its normal position; gear-coupling means controlled by such rotation of the driven gear, and operative for bodily shifting said driven gear toward, and into gear with, the driving-gear, to thereby continue the rotation of the driven gear; and gear-uncoupling means controlled by such continued rotation of the driven gear, and operative for bodily shifting said driven gear to its normal position at a predetermined point in said rotation, to thereby stop the rotation of said driven gear.

16. The combination with a driving internal gear; a rotatable driven gear normally out of gear with said internal gear, and shiftable transversely of the plane of, and into and out of gear with, the internal gear; and means for revolving the driven gear in an orbit about the axis of the internal gear; of means for starting the rotation of the driven gear while in its normal position; a pair of gear-shifting coupling members, one connected for rotation and revolution in unison with the driven gear, and the other in fixed relation with the internal gear, and located to shift the driven gear and its coupling member on such rotation of the driven gear, to thereby carry said driven gear into gear with the internal gear, and continue the rotation of the driven gear; and a pair of gear-shifting uncoupling members, one connected for rotation and revolution in unison with the driven gear, and the other in fixed relation with the internal gear and located to shift the driven gear and its uncoupling member to their normal positions at a predetermined point in said rotation, to thereby stop the rotation of said driven gear.

17. The combination with a driving internal gear; a rotatable driven gear normally out of gear with said internal gear, and shiftable transversely of the plane of, and into and out of gear with, the internal gear; and means for revolving the driven gear in an orbit about the axis of the internal gear; of means for starting the rotation of the driven gear while in its normal position; a pair of gear-shifting coupling members, one connected for rotation and revolution in unison with the driven gear, and the other in fixed relation with the internal gear, and one of said coupling members having a cam-face adapted to cooperate with the other coupling member and located

to shift the driven gear and its coupling member on such rotation of the driven gear, to thereby carry said driven gear into gear with the internal gear, and continue the rotation of the driven gear; and a pair of gear-shifting uncoupling members, one connected for rotation and revolution in unison with the driven gear, and the other in fixed relation with the internal gear and located to engage the first-mentioned uncoupling member at a predetermined point in said rotation, and one of said uncoupling members having a cam-face located to shift said driven gear and its uncoupling member to their normal positions on such engagement of the uncoupling members.

18. The combination with a driving internal gear; a rotatable driven gear normally out of gear with said internal gear, and shiftable transversely of the plane of, and into and out of gear with, the internal gear; and means for revolving the driven gear in an orbit about the axis of the internal gear; of means for starting the rotation of the driven gear while in its normal position; a pair of gear-shifting coupling-cams, one connected for rotation and revolution in unison with the driven gear, and the other in fixed relation with the internal gear and located to shift the driven gear and its coupling-cam on such rotation of the driven gear, to thereby carry said driven gear into gear with the internal gear, and continue the rotation of the driven gear; and a pair of gear-shifting uncoupling-cams, one connected for rotation and revolution in unison with the driven gear, and the other in fixed relation with the internal gear and located to shift said driven gear and its uncoupling-cam to their normal positions at a predetermined point in said rotation, to thereby stop the rotation of said driven gear.

19. The combination with a driving-gear; a rotatable driven gear normally out of gear with said driving-gear, and shiftable into and out of gear with the driving-gear; and means for revolving the driven gear in an orbit about the axis of the driving-gear; of a starting-arm and a gear-shifting coupling member, both carried for rotation and revolution in unison with the driven gear; a gear-starter interposable in the path of said arm for starting the rotation of the driven gear; and a gear-shifting coupling member in fixed relation with the driving-gear, and located to shift the driven gear and its coupling member on such rotation of the driven gear, to thereby carry said driven gear into gear with the driving-gear and continue the rotation of the driven gear.

20. The combination with a driving-gear; a rotatable driven gear normally out of gear with said driving-gear, and shiftable into and out of gear with the driving-gear; and means for revolving the driven gear in an orbit about the axis of the driving-gear; of a starting-arm, a gear-shifting coupling member, and a gear-shifting uncoupling member, all

carried for rotation and revolution in unison with the driven gear; a gear-starter interposable in the path of said arm for starting the rotation of the driven gear; a gear-shifting coupling member in fixed relation with the internal gear, and located to shift the driven gear and its coupling member on such rotation of the driven gear, to thereby carry said driven gear into gear with the driving-gear, and continue the rotation of the driven gear; and a gear-shifting uncoupling member in fixed relation with the driving-gear, and located to shift the driven gear and its uncoupling member to their normal positions at a predetermined point in said rotation, to thereby stop the rotation of said driven gear.

21. The combination with a driving-gear; a rotatable driven gear shiftable into and out of gear with the driving-gear; and means for revolving the driven gear in an orbit about the axis of the driving-gear; of a gear-shifting coupling member movable in unison with the driven gear; a starting-arm connected for rotation and revolution in unison with the driven gear; a gear-starter interposable in the path of said arm for starting the rotation of the driven gear; and a gear-shifting coupling member in fixed relation with the driving-gear, and located to shift the driven gear and its coupling member on such rotation of the driven gear, to thereby carry said driven gear into gear with the driving-gear, and continue the rotation of the driven gear.

22. The combination with a driving-gear; a rotatable driven gear shiftable into and out of gear with the driving-gear; and means for revolving the driven gear in an orbit about the axis of the driving-gear; of a gear-shifting coupling member in fixed relation with the driven gear; a starting-arm connected for rotation and revolution in unison with the driven gear; a gear-starter interposable in the path of said arm for starting the rotation of the driven gear; and a gear-shifting coupling member in fixed relation with the driving-gear, and located to shift the driven gear and its coupling member on such rotation of the driven gear, to thereby carry said driven gear into gear with the driving-gear, and continue the rotation of the driven gear, substantially as specified.

23. The combination with a driving-gear; a rotatable driven gear normally out of gear with said driving-gear, and bodily shiftable into and out of gear with the driving-gear; and means for carrying the driven gear in an orbit corresponding with the driving-gear; of a starting-arm connected for rotation and orbital movement in unison with the driven gear, and in position and adapted to push back the gear-starter after being operated thereby; a gear-starter interposable in the path of said arm for starting the rotation of said arm and the driven gear; and gear-shifting coupling means controlled by such rotation of the driven gear, and operative for bodily shifting said driven gear toward, and

into gear with, the driving-gear, to thereby continue the rotation of the driven gear.

24. The combination with a driving-gear; a rotatable driven gear normally out of gear with said driving-gear, and shiftable into and out of gear with the driving-gear; and means for carrying the driven gear in an orbit corresponding with the driving-gear; of means for starting the rotation of the driven gear at either of two separated points in its orbit while out of gear with the driving-gear; gear-coupling means controlled by such rotation of the driven gear, and operative for shifting said driven gear toward, and into gear with, the driving-gear, to thereby continue the rotation of the driven gear; an uncoupling-arm connected for rotation and orbital movement in unison with the driven gear; and a pair of uncoupling members in fixed relation with the driving-gear, and one located to engage said uncoupling-arm at such a distance from one starting-point as corresponds to a determined number of rotations of the driven gear and to shift the driven gear to its normal position, and the other located to engage said uncoupling-arm at such a distance from the other starting-point as corresponds to a greater number of rotations of the driven gear and to shift the driven gear to its normal position.

25. The combination with a driving-gear; a rotatable driven gear normally out of gear with said driving-gear, and shiftable into and

out of gear with the driving-gear; and means for carrying the driven gear in an orbit corresponding with the driving-gear; of a starting-arm connected for rotation and orbital movement in unison with the driven gear, and in position and adapted to push back the gear-starters, respectively, after being operated thereby; a pair of gear-starters interposable at different points, respectively, in the path of said arm for starting the rotation of said arm and the driven gear; gear-coupling means controlled by such rotation of the driven gear, and operative for shifting said driven gear toward, and into gear with, the driving-gear, to thereby continue the rotation of the driven gear; an uncoupling-arm connected for rotation and orbital movement in unison with the driven gear; and a pair of uncoupling members in fixed relation with the driving-gear, and one located to engage said uncoupling-arm at such a distance from one gear-starter as corresponds to a determined number of rotations of the driven gear and to shift the driven gear to its normal position, and the other located to engage said uncoupling-arm at such a distance from the other gear-starter as corresponds to a greater number of rotations of the driven gear and to shift the driven gear to its normal position.

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Witnesses:

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