(No Model.) 2 Sheets—Sheet 1.

G. HUMPHRIES.

MECHANISM FOR CONVERTING MOTION.

No. 508,387. Patented Nov. 7, 1893.

Fig. 1.

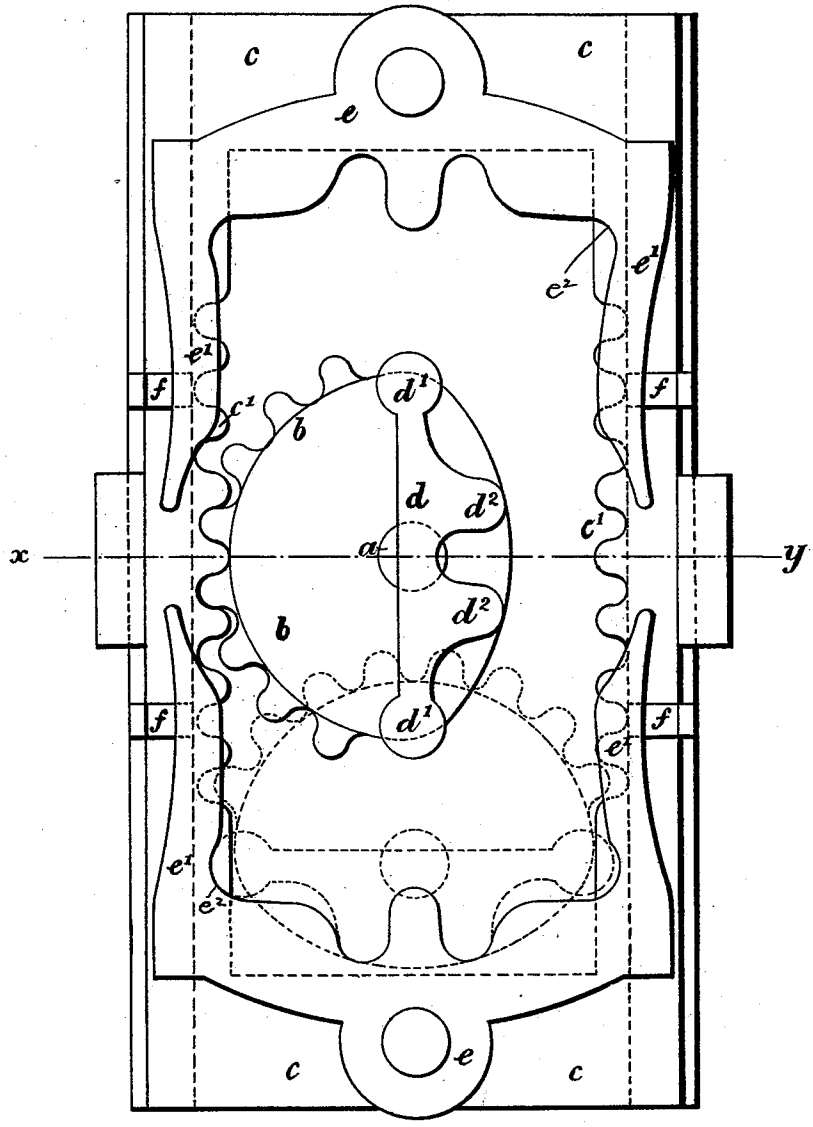
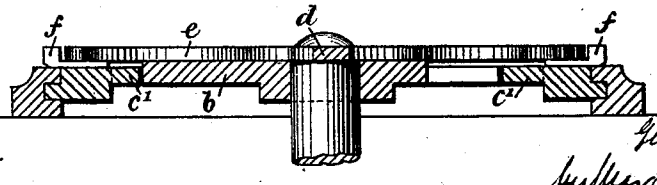


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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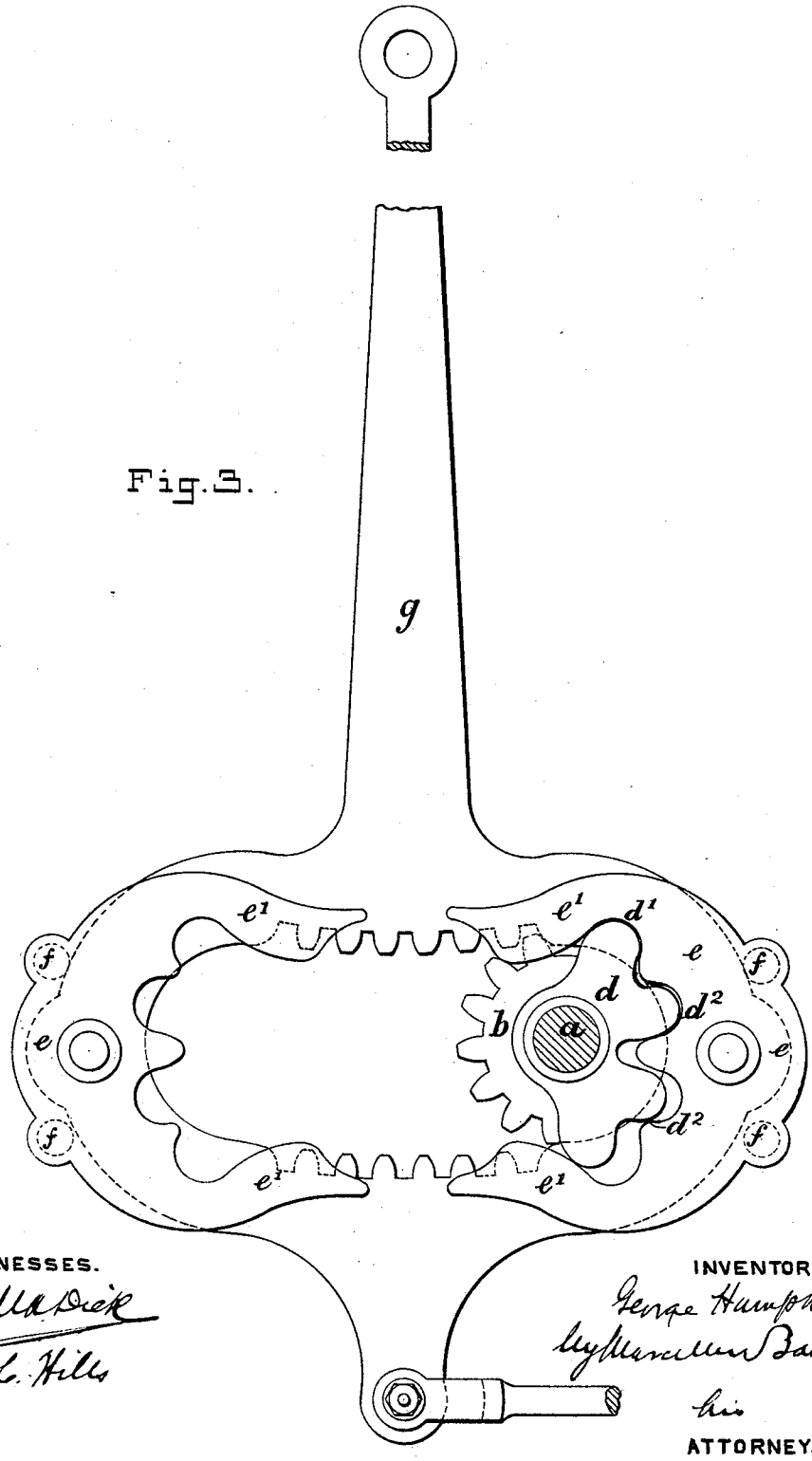
Fig. 3.



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UNITED STATES PATENT OFFICE.

GEORGE HUMPHRIES, OF LONDON, ENGLAND.

MECHANISM FOR CONVERTING MOTION.

SPECIFICATION forming part of Letters Patent No. 508,387, dated November 7, 1893.

Application filed August 28, 1893. Serial No. 484,204. (No model.) Patented in England April 5, 1893, No. 7,055.

To all whom it may concern:

Be it known that I, GEORGE HUMPHRIES, wood-carver, a subject of the Queen of Great Britain, residing at 28 Richmond Road, Barnsbury, London, in the county of Middlesex, England, have invented a new and useful Improved Mechanism for Converting Reciprocating Motion into Rotary Motion and Rotary Motion into Reciprocating Motion, (for which British Patent No. 7,055, dated April 5, 1893, has been obtained,) of which the following is a specification.

This invention relates to improvements in mechanism for converting reciprocating motion into rotary motion and rotary motion into reciprocating motion whereby the disadvantage of the varying leverage of crank mechanism is avoided.

According to this invention I place upon the shaft or spindle to be rotated a toothed sector of about one hundred and fifty degrees, or rather less than a semi-circle. On each side of the shaft is arranged a rack having the same number of teeth as the sector with which the two racks alternately engage, the one on the forward and the other on the backward stroke. These racks are connected by end pieces so as to form a rectangular frame around the sector. It is to this frame that the reciprocatory motion is given. When the parts are in such a position that the last tooth of the sector engages with the last recess in one of the said racks the other rack will not engage with the sector by reason of the latter not having teeth on more than about one hundred and fifty degrees of its periphery. It will be readily seen that the frame may be moved along in the direction to rotate the sector until it comes to the last tooth of the latter when notwithstanding the continued movement of the frame it will remain stationary by reason of there being no more teeth to engage. Any return movement given to the frame will result in the reversal of the movement of the sector which has not been rotated sufficiently in the first direction to come into gear with the other rack, and in order, to give such additional movement to the sector as will bring it into gear with the other rack, I employ the following mechanism:—To the face of the sector I attach a cross piece extending across its center, the two ends of which extend to the periphery of the sector at diametrically opposite points lying beyond the portion occupied by the teeth. These projecting ends, may for the purpose of explanation be regarded as additional teeth completing the semi-circle but lying in another plane to that occupied by the teeth already described. On the side of the cross piece farthest from the toothed edge of the sector are projecting teeth placed at equal distances from the center of the cross piece. These engage (when the rectangular frame is at the end of its stroke) with correspondingly shaped depressions formed in the side of a rocking bar pivoted centrally at each end of the rectangular frame. The ends of the said rocking bars are extended inward so as to embrace the cross bar secured to the sector when the rectangular frame is at the end of its stroke. As the frame completes its stroke one of the said inwardly projecting arms and one end of the cross bar carried by the sector come in contact with one another—the inwardly projecting arm moving toward the sector with the rectangular frame and the end of the cross bar on the sector approaching the said arm by reason of its movement about the center upon which the sector turns. The continued movement of these parts presses the inwardly projecting arm which is in engagement therewith outward and so rocks the rocking bar, of which it forms part, upon its pivot and brings the recesses into position to receive the teeth formed upon the cross bar carried by the sector. Before these parts engage with one another the opposite end of the cross bar upon the sector comes into engagement with the inner side of the angle formed by the junction of the other end of the rocking bar with its inwardly bent end. At the end of the stroke of the frame the cross piece upon the sector lies at right angles to the path of the rectangular frame and close to the inner side of the rocking bar between the bent ends of the same, which are sufficiently wide apart at their base to accommodate the cross piece on the sector. These ends incline inward however to engage with the ends of the cross piece on the sector in the manner described. On the return stroke of the rectangular frame, as the end of the cross bar on the sector at the side farthest from the rack

that was in engagement with the sector during the last stroke, is still in engagement with the inner angle of the rocking bar, the cross piece on the sector is rocked upon its pivot, turning with it the sector which is thus brought into engagement with the first tooth of the rack opposite that one which was in engagement during the previous stroke.

From the foregoing description it will be seen that the sector engages alternately with each rack so that the direction of its rotation is unchanged. This is of course only the case when the reciprocating frame accomplishes the full extent of its stroke, otherwise the sector remains in engagement with one rack and consequently oscillates upon its center. And in order that my invention may be more fully understood and carried into practice, I will now proceed to describe the same with reference to the accompanying drawings, of which—

Figure 1 is a front elevation; Fig. 2 a section on line *x*, *y*, and Fig. 3 a front elevation of a modified manner of applying my improved mechanism.

In Figs. 1 and 2 is shown an embodiment of my invention for converting rectilineal, reciprocatory, into rotary motion.

On the shaft *a* to be rotated is a toothed sector or mutilated pinion *b* of about one hundred and fifty degrees or rather less than a semi-circle. On each side of shaft *a* is arranged a rack *c'* having the same number of teeth as the sector *b* with which said two racks alternately engage, one on the forward and the other on the backward stroke. These racks *c'* are connected by end pieces so as to form a rectangular frame *c* to which the reciprocating motion is given. When the parts are in such a position that the last tooth of the sector *b* engages with the last recess in one of the racks *c'* the other rack will not engage with the sector until the latter has been slightly revolved, so that any movement given to the frame in an opposite direction to that in which it had been previously traveling will result in the reversal of the movement of the sector, unless a slight forward movement be imparted to it. To give such additional movement to the sector as will bring it into gear with the other rack, I employ the following mechanism:—To the face of the sector *b* I attach a cross piece *d* the opposite ends *d'* of which extend to the periphery of the sector at points lying beyond the portion occupied by the teeth, and may be regarded as additional teeth completing the semi-circle although lying in another plane to those of the sector. On that side of the cross piece *d* farthest from the teeth of the sector *b* are formed two projecting teeth d^2 situated at an equal distance from the center of cross piece *d*, and which engage (when the frame *c* is at the end of its stroke) with corresponding depressions in the side of a bar *e*, one of which bars is pivoted at each end of the frame *c* and has its ends *e'* turned inward so as to embrace the cross piece *d* when the frame *c* is at the end of its stroke. As the frame *c* nears the end of its stroke one end *e'* of bar *e* engages with that end *d'* of cross piece *d* which is adjacent to the rack that is then engaged by the pinion *b*, so rocking the bar *e* sufficiently to allow the teeth d^2 to engage with the corresponding recesses in the bar *e*. Before however, these teeth engage with said recesses the opposite end of the cross piece *d* engages with the bar *e* in the angle e^2 formed by bending the opposite part *e'* inwardly. On the return stroke, as that end of the cross bar *d* farthest from the rack that was in engagement with the sector during the last stroke, is still in engagement with one of the parts e^2 of the bar *e*, the sector is sufficiently revolved to bring its first tooth into engagement with the opposite rack. Stops *f* are provided to regulate the movement of the rocking bars *e*. It will thus be seen that the sector engages alternately with each rack, when the frame accomplishes its full stroke, so that the direction of its rotation is unchanged.

In Fig. 3 is illustrated a form of my invention adapted to convert rotary into reciprocatory motion, and which is used to operate the pendulum *g*, the rack in this case being formed in the opposite curved faces of an opening in the lower end of said pendulum.

What I claim is—

1. In a device for converting motion, the combination of a reciprocatory frame having the opposite racks, the mutilated pinion or sector arranged between the said racks and adapted to engage therewith, a cross piece carried by the said pinion, and having the teeth *d'* arranged in a different plane from those of the pinion, and a bar carried by the said frame with which the said toothed piece engages to cause a slight turning of the pinion to carry it from engagement with one rack into engagement with the other, substantially as described.

2. In a device for converting motion, the combination of a reciprocatory frame having the two racks, the mutilated pinion arranged between the said racks and adapted to engage therewith alternately, a cross piece carried by the said pinion and having the teeth *d'*, and a rocking bar at the end of the reciprocatory frame with which the teeth of the said cross piece engage, substantially as and for the purposes set forth.

3. In a device for converting motion, the combination of a reciprocatory frame having the two racks, the mutilated pinion or segment arranged between the racks and adapted to engage therewith alternately, and having its toothed portion, *b*, less than a semi-circle in extent, the teeth *d'*, *d'* carried by the pinion and arranged at the opposite ends of the toothed part thereof, but in a different plane, and a bar at each end of the reciprocatory frame with which the said teeth *d'* engage at the completion of each stroke of the frame, in order to carry the teeth *b* from en-

gagement with one rack to engagement with the other, substantially as and for the purpose set forth.

4. In a device for converting motion, the combination of the reciprocatory frame having the racks c', c', the mutilated pinion or sector b, adapted to engage alternately with the said racks, the cross piece d carried by the pinion, and having the end teeth d', d', and the intermediate teeth d^2, d^2, and the pivoted rocking bars, e, e, one at each end of the said frame, and provided with the inward turned arms, e', e', substantially as and for the purpose set forth.

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