No. 680,765. Patented Aug. 20, 1901.

C. P. COTTRELL.

MECHANICAL MOVEMENT.

(Application filed Apr. 9, 1897.)

(No Model.) 2 Sheets—Sheet 1.

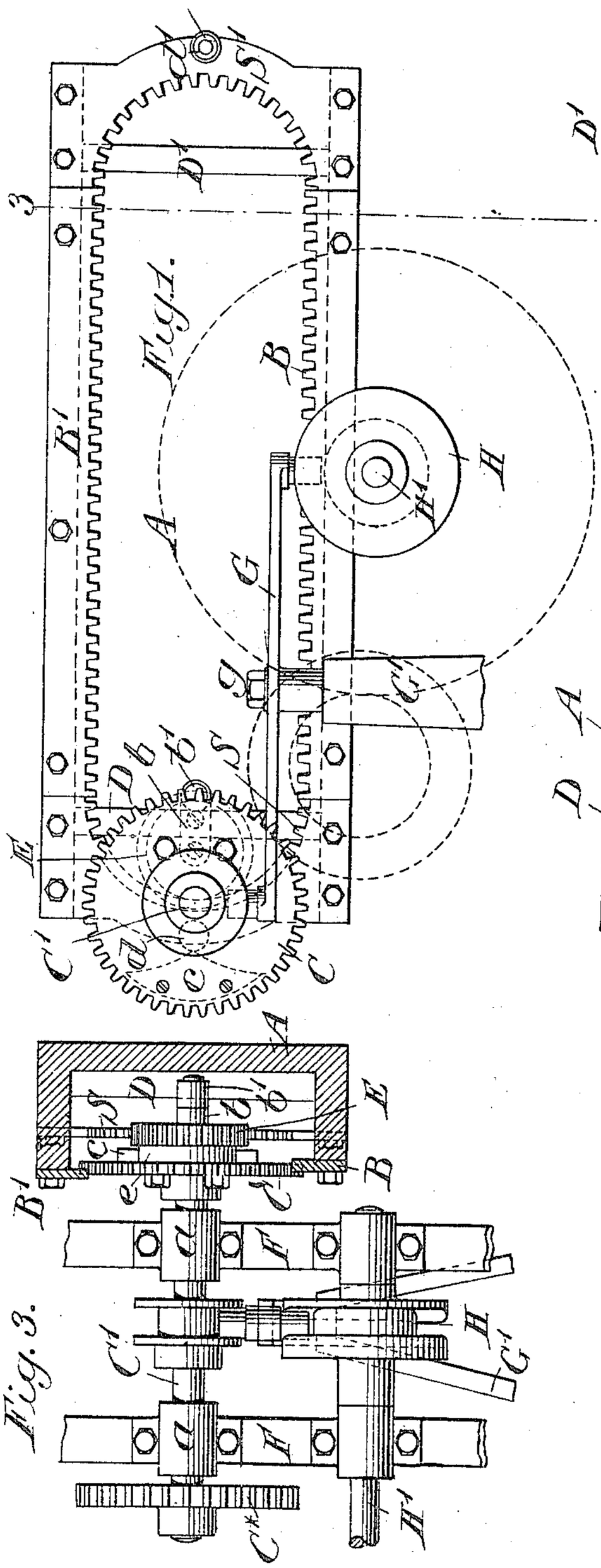

Fig. 1.

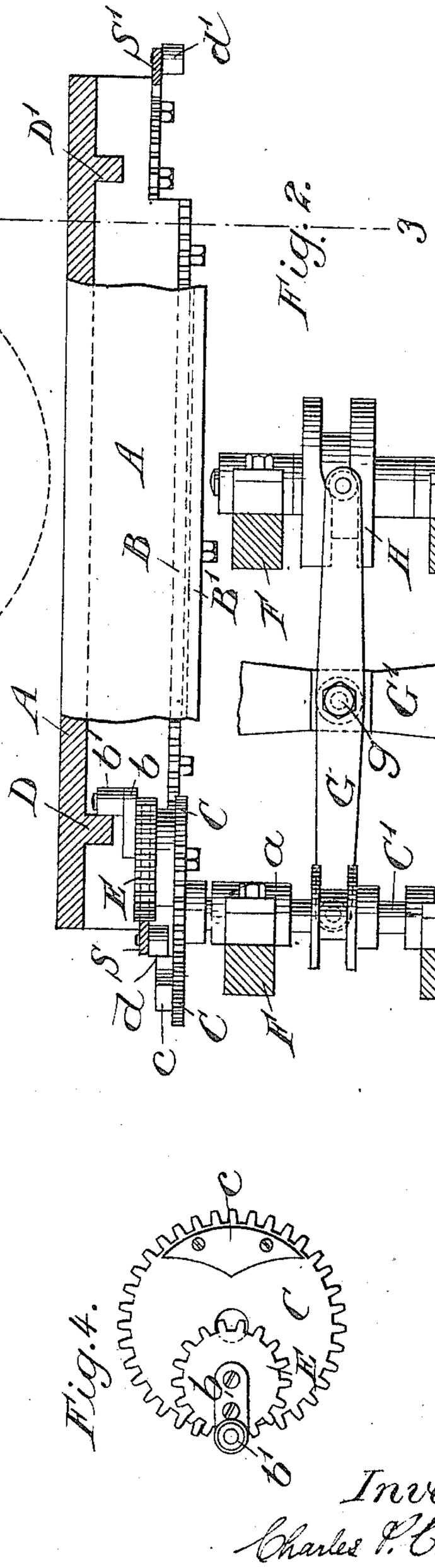

Fig. 2.

Fig. 3.

Fig. 4.

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Fig. 6.

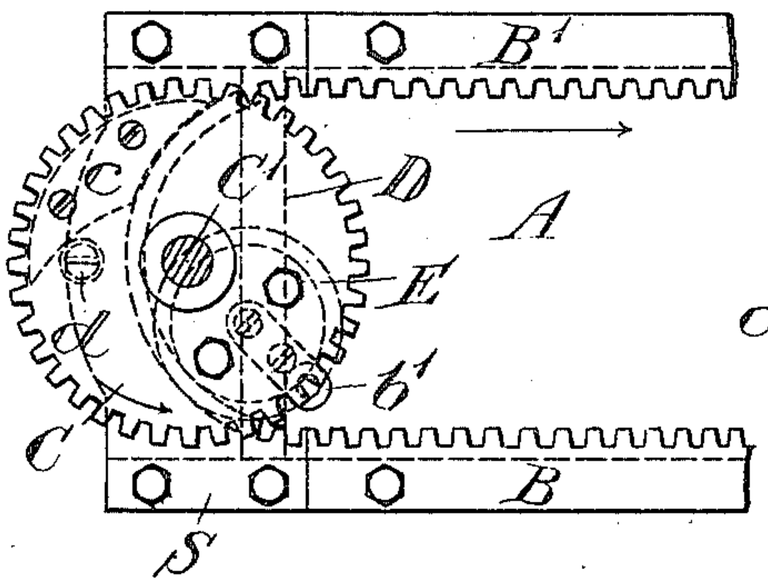


Fig. 5.

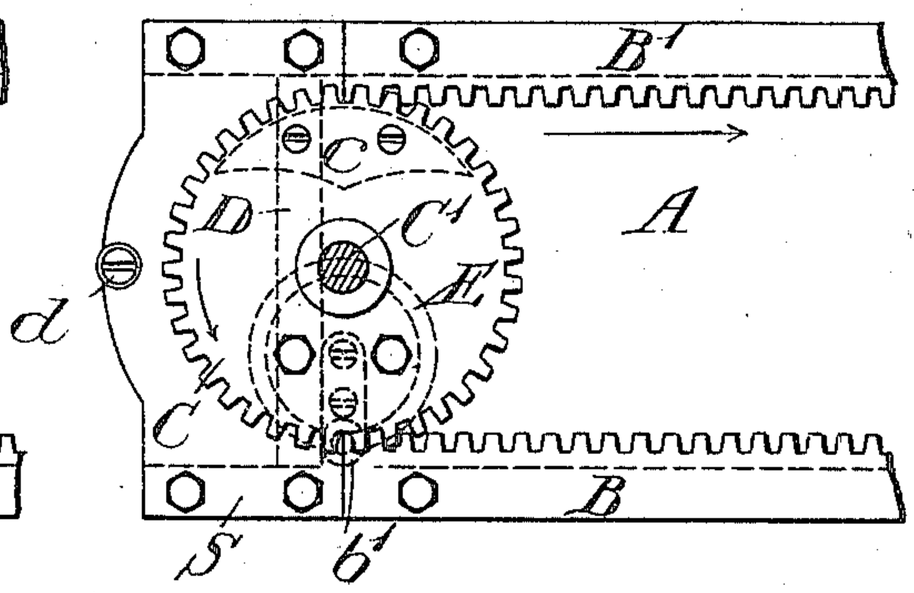


Fig. 7.

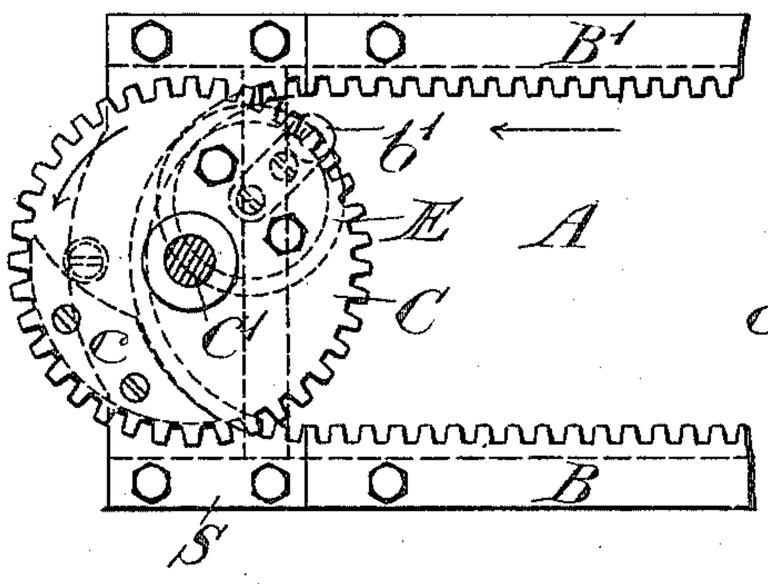
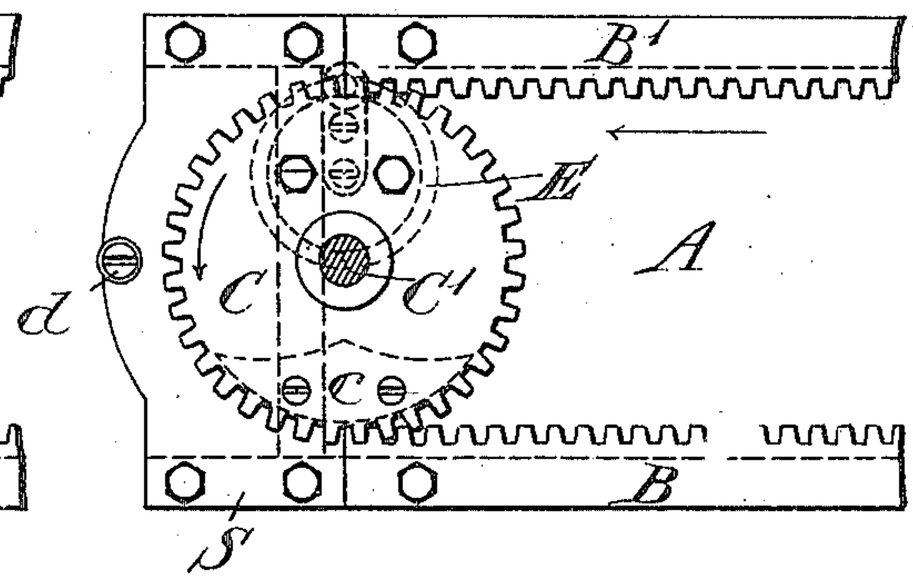


Fig. 5.



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UNITED STATES PATENT OFFICE.

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MECHANICAL MOVEMENT.

SPECIFICATION forming part of Letters Patent No. 680,765, dated August 20, 1901.

Application filed April 9, 1897. Serial No. 631,364. (No model.)

To all whom it may concern:

Be it known that I, CHARLES P. COTTRELL, of Stonington, in the county of New London and State of Connecticut, have invented a new and useful Improvement in Mechanical Movements, of which the following is a specification.

This invention relates to mechanical movements in which rotary motion is converted into reciprocating rectilinear motion by a toothed driving-wheel and two racks, with which the said wheel is brought alternately into and out of gear.

The improvement consists in the combination, with such driving-wheel and racks, of devices hereinafter described and claimed, whereby the racks and the reciprocating parts to which they are affixed are started very slowly and have their movement gradually accelerated at the commencement of their stroke in either direction and gradually retarded toward the end of each stroke.

The invention is applicable to various machines, but with particular advantage for the purpose of driving the reciprocating bed of a printing-machine.

Figure 1 in the drawings represents a side view of a mechanical movement embodying my invention. Fig. 2 is a plan view of the same, showing the frame which carries the two racks partly in section. Fig. 3 represents a transverse section taken in the line 3 3 of Figs. 1 and 2 and viewed from the right. Fig. 4 is a view of the piston and its attachments, taken on the side opposite to that shown in Fig. 1. Figs. 5, 6, 7, and 8 are side views representing the racks and driving-wheel and their directly-attached parts in different positions.

Similar letters of reference designate corresponding parts in all the figures.

A is the rack-frame, which has rigidly attached to it the two straight racks B B′ and two curved semicircular internally-toothed sectors S S′. This rack-frame may be bolted or otherwise secured in the usual or any suitable manner to the printing-machine bed or to any other body to which reciprocating motion is to be imparted.

C is the driving-wheel, and C′ the shaft to which it is fastened, arranged in fixed bearings *a a* in a suitable frame F and furnished with a gear C*, through which it receives constant rotary motion.

The straight racks B B′ have their teeth facing each other and their pitch-lines at a distance apart equal to the pitch diameter of the wheel C, the axis of which is central between the pitch-lines of the racks. The said racks are not exactly opposite each other, but are, as shown in Figs. 2 and 3, set off laterally the one from the other, so that the driving-wheel C by being moved laterally, as hereinafter described, may be brought into gear with either one of them while it is out of gear with the other. The length of the said racks must be equal to the pitch circumference of the driving-wheel or an exact multiple of that circumference, according to the number of revolutions that the driving-wheel may be required to make during each movement of the racks back and forth. In the example represented the lengths of the racks and circumference of the pitch-lines are equal. The semicircular internally-toothed sectors S S′ have their centers approximately opposite the ends of the straight racks and have the radii of their pitch-lines equal to half the distance between the pitch-lines of the racks. The said sectors are both in the same plane, but not in the same plane with either of the racks, being set off laterally at some distance from the latter, as shown in Figs. 2 and 3.

Across the rack-frame A there are formed thereon or affixed thereto a little beyond the ends of the straight racks and the centers of the sectors two straight guides D D′, Figs. 1, 2, and 3, the edges of said guides being perpendicular to the racks and set off therefrom laterally beyond the sectors, as shown in Figs. 2 and 3.

The driving-wheel C has affixed to it eccentrically by screw-bolts a gear E for engaging with the toothed sectors during portions of the movements of the driving-wheel which take place, as hereinafter described, while the straight racks have run in either direction out of gear with the said wheel and while they so remain out of gear. This gear E is represented as having a pitch-line radius equal to half the radius of the sector and having its center midway between the cen-

ter and the pitch-line of the driving-wheel. The teeth of the said gear are of such width and the said gear is offset by its hub *e* so far from the driving-wheel that it may be in gear with the toothed sector at either end of the rack-frame while the driving-wheel is in line with either of the straight racks. To the said gear E, and consequently to the driving-wheel, there is affixed an arm *b*, to which there is pivoted a roller *b'*, which runs against the straight guide D or D' at either end of the rack-frame, while the gear E engages with the sector at the same end of the frame. The driving-wheel has also affixed to it opposite to the gear E and roller *b'* a cam *c*, which runs against a roller *d* on the toothed sector S or a roller *d'* on the sector S' during the last part of the movement of the rack-frame in either direction and the first part of its movement in the opposite direction.

In order to shift the driving-wheel laterally from a position in line with one straight rack to a position in line with the other, its shaft C' is capable of being moved longitudinally in its bearings *a* in the framing F by a horizontal lever G, which works on a fulcrum *g* in a stand G', one end of the said lever engaging with a collar C^2, fast on the driving-wheel shaft C', and the other end being engaged with and actuated by a cam H on a shaft H', which works in bearings in the frame F, to which rotary motion may be imparted in any suitable manner at such speed relatively to that of the driving-wheel C that the cam may operate to shift the driving-wheel laterally in one direction or the other near the end of the stroke of the rack-frame in either direction and while the said wheel is out of gear with both of said racks. In the example represented, in which three revolutions of the driving-wheel are required for the complete movement of the rack back and forth, the cam requires to move the lever once in each direction during every three revolutions. Therefore the cam-shaft is geared with the gear C* on the driving-shaft to make one revolution for every three revolutions of the latter. The pitch-lines of this gearing are indicated by dotted circles in Fig. 1.

Having described the construction and separate operations of the several parts of my invention, I will now describe their combined operations.

The driving-wheel C makes one revolution in gear with each of the straight racks, moving the rack-frame in one direction while in gear with one rack and in the opposite direction while in gear with the other rack, and it makes half a revolution free from the straight racks with its gear E in engagement with each of the toothed sectors. While the wheel is in gear with either of the racks, the movement in either direction is like that produced by an ordinary rack and pinion, the gear E, the sectors S S', and their attached parts being then inoperative; but as the end of the rack which has been in operation passes the center of the driving-wheel the gear E comes into engagement with the toothed sector S or S' at the corresponding end of the rack-frame and at the same time the roller *b* or *b'* runs into contact with the guide-bar D or D'. The continuance of this engagement and contact during half a revolution of the driving-wheel first produces the completion at a gradually-diminishing speed of the movement of the rack-frame in the direction in which it has just been moved by the driving-gear and straight rack and afterward starts at a gradually-increasing speed the movement in the opposite direction and continues to produce such movement until the other rack arrives in gear with the driving-wheel, the lateral shifting of the driving-wheel taking place while the gear E is in engagement with the sector and being permitted by the width of the teeth of the said gear.

In the above operation the roller *b'*, running against the guide D or D', has first the effect of slowing down the movement of the rack-frame, next the effect of positively stopping the rack-frame against overrunning its movement by its own momentum, and afterward the effect of starting its return movement of the rack-frame, and the cam *c* on the driving-wheel passing beyond the roller *d* or *d'* on the sector S or S' just before the termination of the movement of the rack-frame serves to confine the guide D or D' to the roller *b* or *b'* and to keep the sector in engagement with the gear E. This operation is illustrated by Figs. 1, 5, 6, 7, and 8. Referring first to Fig. 5, the rack-frame is therein represented as moving to the right, the lower rack is just leaving the driving-wheel C, and the gear E is just coming into engagement with the lower part of the sector S to continue the movement of the frame, which is gradually slowed by the action of the gear in the sector; but the slowing down is more positively effected by the action of the roller *b* against the lower part of the guide D, which latter action prevents backlash between the gear E and the sector. Referring next to Fig. 6, the rack-frame is represented as having its movement further continued in the same direction by the gear E and the sector and the roller *b'* as running up the guide, still continuing its slowing-down action, while the cam *c* is closing into operation on the roller *d* on the sector S to confine the sector to the gear E. The rack-frame continues moving in the same direction until the parts arrive in the relative positions shown in Fig. 1, the rack-frame being then positively stopped by the guide D being in contact with the roller *b*. The continued rotation of the driving-wheel, as illustrated by Fig. 7, keeps the cam *c* for some time against the roller *d* and keeps confining the sector S to the gear E while the frame is slowly started on its return movement to the left by the movement of the gear E into the upper part of the sector and by the running of the roller *b'* against the upper part

of the guide D. This action of the gear E and the sector and of the roller *b'* against the guide D are continued until, as shown in Fig. 8, the driving-wheel C strikes into the upper rack, the said wheel having now been moved laterally into line with the said rack. Precisely the same operations of the gear E, the roller *b*, and the cam *c* take place in connection with the sector S', the guide D', and the roller *d'* at the other end of the rack-bar to retard the movement of the rack-frame to the left and start its movement to the right.

I have before stated that the lengths of the straight racks correspond exactly with or are an exact multiple of the pitch circumferences of the driving-wheel. Thus, for example, if the length of the racks should be double the length of the pitch-line circumference of the wheel the rack-frame would make one movement for every five revolutions of the wheel—that is to say, two revolutions in gear with each rack and a half-revolution with the gear E in each sector.

I may here mention that a few of the teeth of the gear E may be omitted at that part of its circumference nearest the shaft C', the starting of the rack-frame being effectively provided for by the action of the roller *b'* against the guide D or D'.

The rollers *d d'* have been herein described as attached to the sectors. This is virtually an attachment to the rack-frame. It is obvious that they might be attached directly to part of the rack-frame.

What I claim as my invention is—

1. The combination of the bed-frame having two straight racks and curved end racks and vertical guides, a main driving-gear adapted to mesh alternately with said straight racks and carrying an eccentrically-arranged toothed gear, a crank-pin or roller and a cam, and a pin or roller at each end of the bed-frame to act with said cam.

2. In a mechanical movement for converting rotary into reciprocating rectilinear motion, the combination of a reciprocating rack-frame, two straight toothed racks on said frame, two toothed sectors on said frame beyond the ends of the racks, a toothed driving-wheel for gearing with the racks, a toothed gear attached eccentrically to the driving-wheel for engaging with the sectors, a cam on the driving-wheel, and rollers on the rack-frame against which said cam acts to confine the sector to the said gear, substantially as herein described.

3. In a mechanical movement for converting rotary into reciprocating rectilinear motion, the combination of a reciprocating rack-frame, two straight toothed racks on said frame, two toothed sectors on said frame beyond the ends of the racks, a toothed driving-wheel for gearing with the racks, a toothed gear attached eccentrically to the driving-wheel for engaging with the sectors, two guides on said frame located near the ends of the racks and approximately perpendicular thereto, a roller carried by the driving-wheel for running against said guides, a cam on the driving-wheel, and rollers on the frame against which said cam acts, substantially as herein described.

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