Feb. 20, 1951 A. W. RANGER 2,542,705

FLAT-BED PRINTING MACHINE

Filed March 8, 1946 6 Sheets-Sheet 1

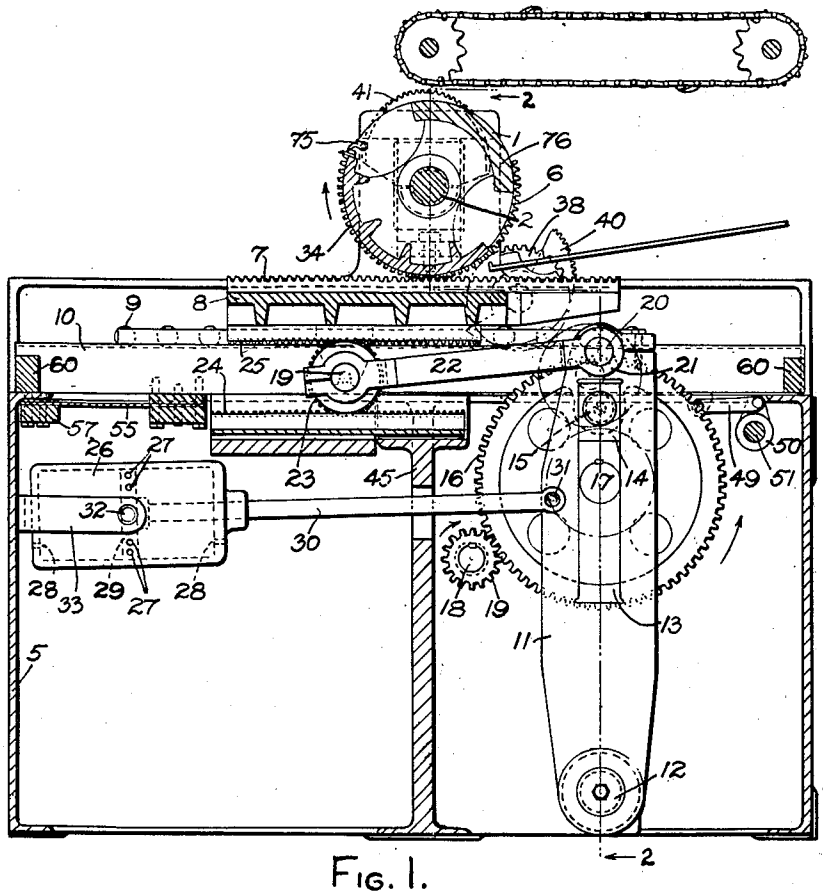


FIG. 1.

FIG. 7.

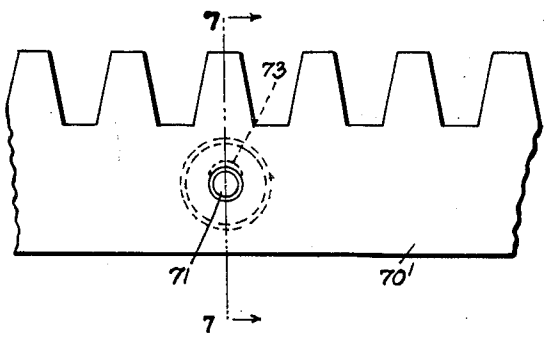
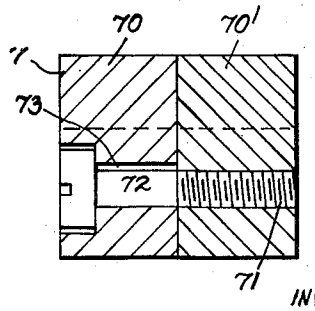


FIG. 6.



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FLAT-BED PRINTING MACHINE

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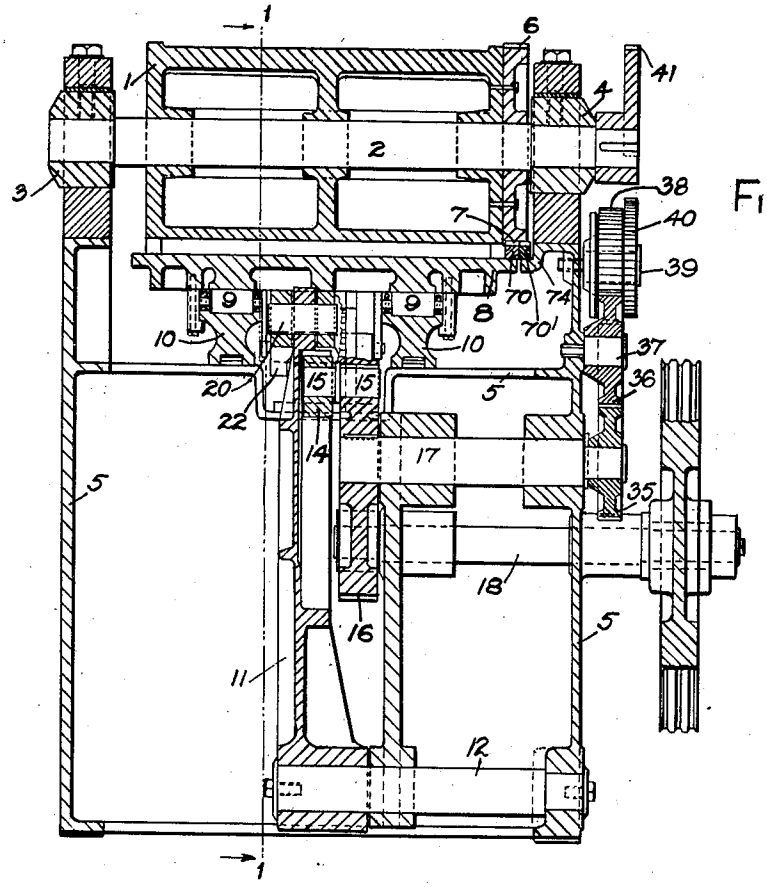


FIG. 2.

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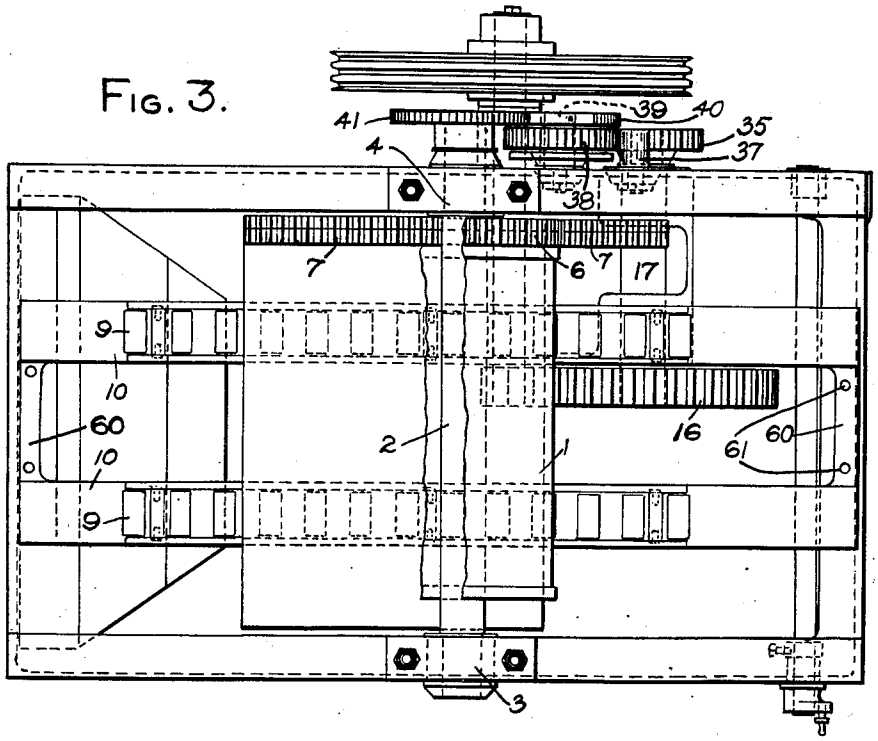
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Feb. 20, 1951 A. W. RANGER 2,542,705

FLAT-BED PRINTING MACHINE

Filed March 8, 1946 6 Sheets-Sheet 3

FIG. 3.



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Feb. 20, 1951 A. W. RANGER 2,542,705

FLAT-BED PRINTING MACHINE

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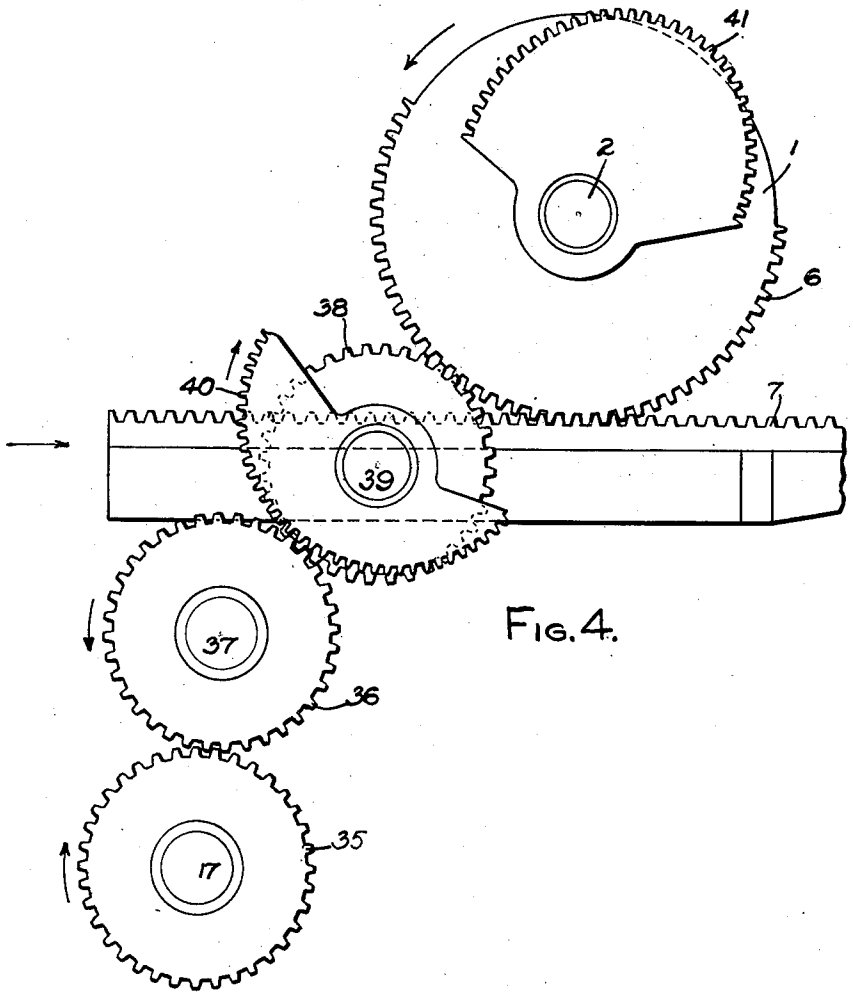


FIG. 4.

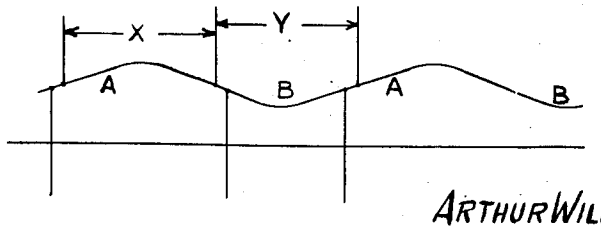


FIG. 5.

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Feb. 20, 1951 A. W. RANGER 2,542,705

FLAT-BED PRINTING MACHINE

Filed March 8, 1946 6 Sheets-Sheet 5

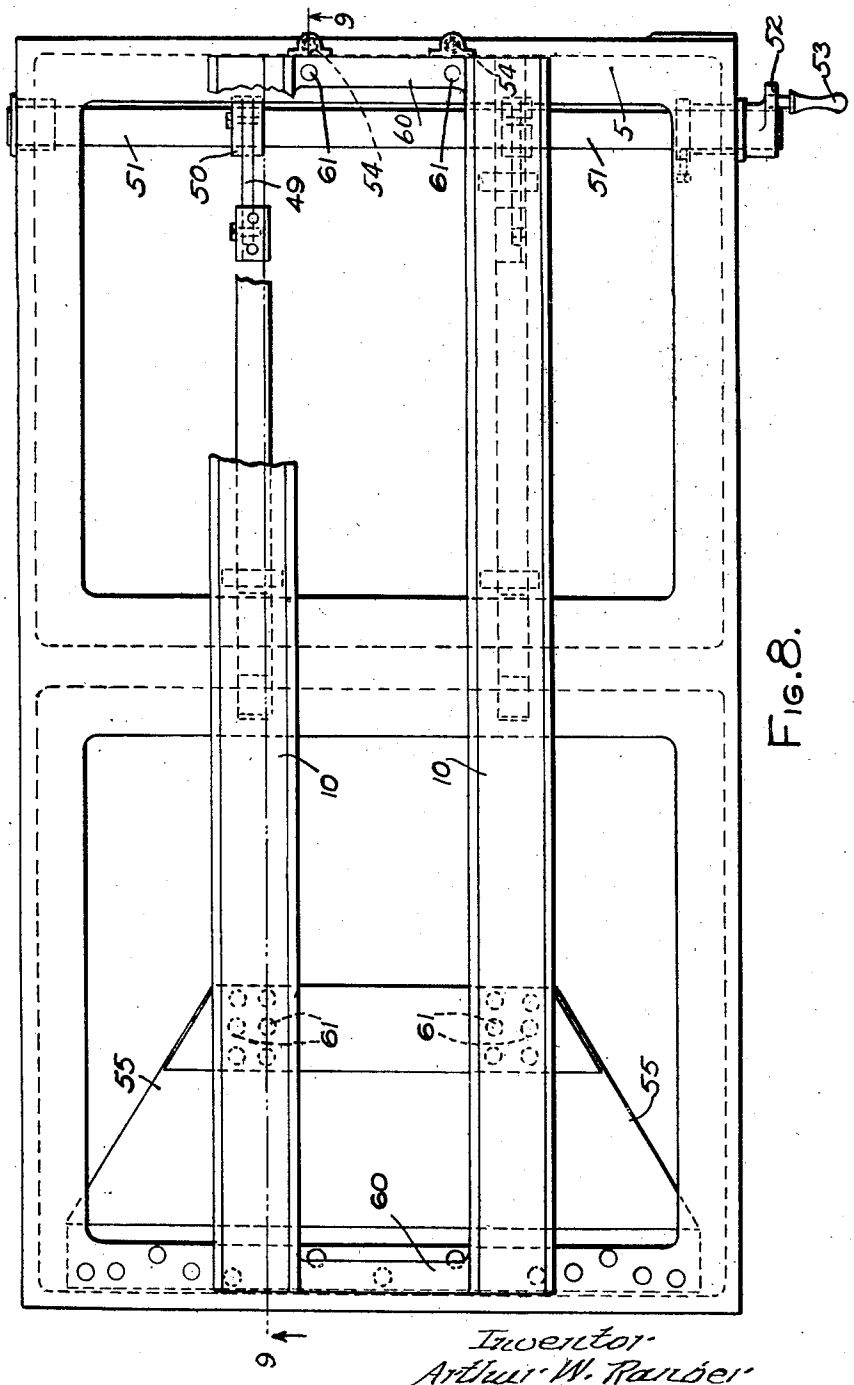


FIG. 8.

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FLAT-BED PRINTING MACHINE

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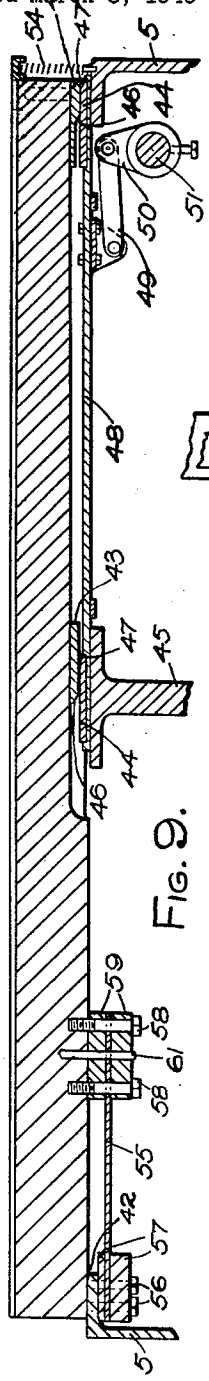


FIG. 9.

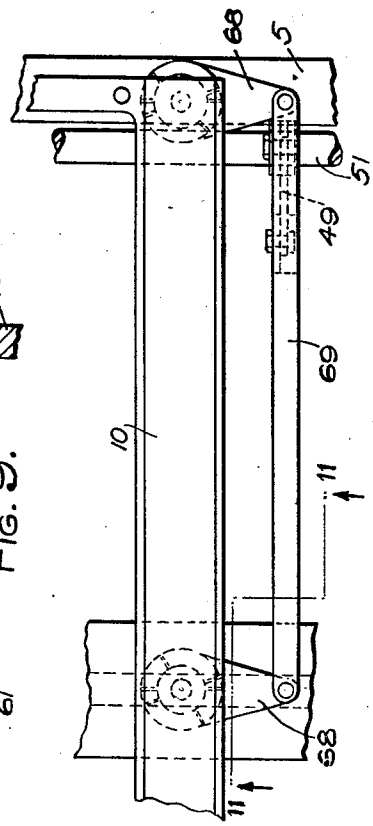


FIG. 10.

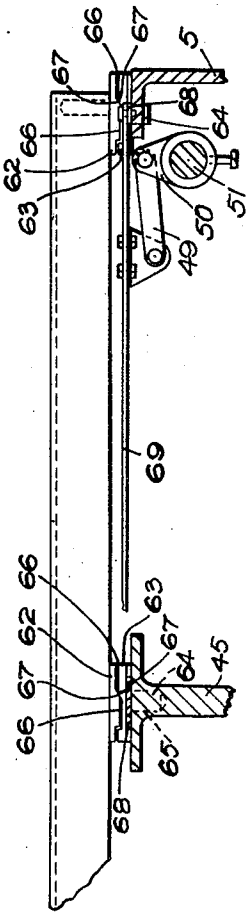


FIG. 11.

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Patented Feb. 20, 1951

2,542,705

UNITED STATES PATENT OFFICE

2,542,705

FLAT-BED PRINTING MACHINE

Arthur Willard Ranger, Brighton, England

Application March 8, 1946, Serial No. 653,068
In Great Britain March 24, 1945

6 Claims. (Cl. 101—282)

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The invention relates to letter press printing machines of the flat-bed type having a continuously rotating impression cylinder which makes one revolution only during the time that the bed makes a complete reciprocation, that is, a forward stroke and a return stroke.

Objects of the invention are to provide a machine that is capable of much faster operation than heretofore possible and to enable an impression cylinder of much less diameter to be used than has hitherto been possible with this type of machine, thereby enabling the machine to be so constructed that its parts are more accessible facilitating make-ready, and reducing cost of construction, and to ensure smooth rotation of the cylinder and reciprocation of the forme bed without shock so that the improved machine is capable of running at high speeds over long periods without needing readjustment of the bed and cylinder driving mechanism, thereby reducing cost of maintenance and ensuring good printing.

In order to attain the above objects in the machine according to the invention, the impression cylinder is rotated by two distinct driving means, each of which, however, is driven from the main driving shaft of the machine, so that each imparts its respective driving effort to the cylinder alternately, one rotating the cylinder during the greater part of the slow stroke of the forme bed and the other throughout the quick stroke thereof and also for the remaining parts of the slow stroke. Each of these two driving means includes toothed elements which are out of mesh when the respective means is not driving the cylinder, and provision is made to ensure that these toothed elements shall, at the moment of re-engagement, be moving at the same speed at the same rate of acceleration and deceleration, so that the change from one drive to the other occurs smoothly.

Preferably one driving means includes a rack on the reciprocatory forme bed, the rack intermittently meshing with an interrupted gear wheel on the cylinder. The other driving means includes a train of gear wheels, the last gear wheel of which intermittently meshes with a gear wheel on the cylinder shaft, and this last gear wheel and its co-operating gear wheel on the cylinder shaft are so designed as not only to permit of the intermittent drive, but to regulate the speed of the cylinder, so that the rack and its co-operating interrupted toothed wheel are moving at the same speed and at the same rate of acceleration at the moment of re-engagement,

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and so that the eccentric wheel on the shaft of the said last wheel of the train and its co-operating gear wheel on the cylinder shaft are also moving at the same speed and at the same rate of deceleration at the moment of their re-engagement.

It will be appreciated that the peripheral speed of the impression cylinder during each partial revolution, when driven by the reciprocatory rack, varies from a minimum at the start, rising to a maximum and finishing at a minimum. The last gear wheel of the train and its co-operating wheel on the cylinder shaft, being so designed as aforesaid to ensure equality of speed and rate in the re-engaging elements, therefor ensure that the speed of the cylinder, when driven by the train of gears, is co-ordinated with that imparted to it by the rack and, consequently, the change over from one drive to the other is effected smoothly and without shock, the impression cylinder being continuously rotated although not at a uniform speed.

The forme bed is preferably driven by a quick return driving mechanism of a type well known in the art, the forme bed moving at a variable relatively slow speed during the printing or impression stroke and more quickly during the return or idle stroke, the impression cylinder rotating at a speed corresponding with that of the forme bed during the impression period, and being driven by the train of gears during the remainder of its revolution at a variable slower speed that when driven from the bed.

The duration of the drive by the train of gears depends on the fraction of the revolution left to it by the rack to complete the revolution, for example, assuming that the rack imparts 210° rotation to the impression cylinder, then the train of gears effects 150° and as this is less than that effected by the rack, the speed is low in order to bring the interrupted gear into appropriate position to mesh with the rack at the moment of re-engagement.

The movement of the cylinder by the train begins with a maximum velocity, falls to a minimum and rises again to a maximum. Graphically the speed of the impression cylinder may be indicated, as hereinafter explained, by two alternating curves which smoothly merge one into the other at the parts corresponding with the periods of the change of drive from the rack to the train of gears and so on.

Another object is to enable impression contact between the impression cylinder and the forme to be broken when required by lowering the bed,

so enabling a fixed geometrical axis of rotation for the impression cylinder to be maintained, in contradistinction to the usual method of breaking contact, which consists in raising the cylinder, approximately one-eighth of an inch, by springs under the cylinder shaft bearings, which are free to slide in their housings, being held down normally by toggles or cams actuated by pedal or hand levers, or by a moving part of the machine.

The fact that the impression cylinder of the improved machine constantly rotates about a fixed geometrical axis ensures accurate engagement with the train of gears above referred to, but it also avoids other defects encountered with the old method, namely, wear and slackness in the bearing housings or holding-down mechanisms which cause irregularities in the pressure applied to the forme, necessitating re-fitting and re-adjustment. Maladjustment of the pressure control settings may result in serious breakage or strain to the cylinder and bed or to the frame of the machine.

The means by which the objects above referred to are attained will be evident from the following description with reference to the accompanying drawings illustrating an example of printing machine according to the invention.

In the drawings:

Figure 1 is a side sectional elevation of a printing machine with the improvements applied, other details of the machine well known in the art being omitted for the sake of clearness, the section being taken on 1—1, Figure 2.

Figure 2 is an end sectional elevation on 2—2, Figure 1.

Figure 3 is a plan corresponding with Figure 1.

Figure 4 is a side view of the train of gears.

Figure 5 is a diagram illustrating the varying speed and rate of rotation of the impression cylinder.

Figure 6 is a side view of part of the rack for rotating the impression cylinder.

Figure 7 is an end sectional view on 7—7, Figure 6.

Figure 8 is a plan illustrating the bed lowering and raising mechanism,

Figure 9 being a sectional elevation of the upper part thereof on 9—9, Figure 8.

Figure 10 is a plan, and

Figure 11 is a part sectional side view on the line 11—11 of Figure 10 of an alternative form of bed lowering and raising mechanism.

The printing machine illustrated has an impression cylinder 1 fixed on a shaft 2, which is mounted to rotate in bearings 3, 4, fixedly supported on the main frame 5 of the machine. The geometrical axis of the shaft 2 is, therefore, in fixed relation to the frame 5.

The impression cylinder 1 is provided with a toothed segment or what is known in the art as an interrupted gear wheel 6, which is fixed to it and meshes with a rack 7 which is fixed to a reciprocating forme bed 8. The rack 7 comprises two parts 70, 70' connected by studs 71, the screw-threaded portions of which are screwed into the part 70', but the smooth parts 72 of the studs are in slightly slotted or elongated holes 73 in the part 70 of the rack. The part 70' slides on a ledge 74, Figure 2, on the stationary frame 5, as it is carried to and fro by the part 70, which is fixed to the forme bed 8.

When the forme bed is lowered as hereinafter described to break the impression contact between the impression cylinder 1 and the forme,

which is desirable during "make ready," namely, when the operator is preparing the machine for printing, the part 70' of the rack remains at the correct height for meshing with the interrupted gear wheel 6, but the part 70 descends with the forme bed 8. Consequently, when the forme bed 8 is again raised into its operative position, the part 70 is registered with the part 70' and correct meshing is ensured. The forme bed 8 slides to and fro on rollers 9 on guide rails 10. It is reciprocated by a quick return driving mechanism of a type well known in the art. It comprises a slotted lever 11 which is fulcrumed on a shaft 12 and has a slot 13 in which slides a block 14 pivotally mounted on a crank pin 15 on a gear wheel 16 fixed on a shaft 17. The shaft 17 is rotated from a main driving shaft 18 through a pinion 19 meshing with the gear wheel 16. The slotted lever 11 has a driving pin 20 pivotally fitted to one end 21 of a connecting rod 22, the other end forming a bearing for a pin 19 carrying a toothed wheel 23, which meshes with a rack 24 and with a rack 25 fixed to the underside of the reciprocatory bed 8.

This mechanism, as is well known in the art, imparts an increased stroke to the bed, namely, twice the movement of the wheel 23 and, moreover, the return stroke, to the right hand in Figure 1, is quicker than the forward stroke, to the left hand, which corresponds with the impression stroke.

The movement of the bed 8 during each stroke is not uniform, that is to say, the bed starts from a momentarily stationary condition, increases in speed, then decreases and ends in a stationary condition.

The reciprocating movements are cushioned by means of a dash-pot or buffer comprising a cylinder 26, Figure 1, having inlet ports 27 situated in the middle of the cylinder and outlet ports 28 at its ends.

A piston 29 slides in the cylinder 26 and is connected by a rod 30 to the slotted lever 11, the rod 30 having a pivotal connection 31 at one end with the slotted lever 11.

The cylinder 26 is closed at both ends except for the ports 28. It is pivotally mounted on trunnions 32 carried by brackets 33 which are fixed to the machine frame 5. Owing to the provision and relative disposition of the ports 27, 28, the dash-pot or buffer so constructed is double acting, that is, it cushions the mechanism at each stroke of the bed 8.

When the forme bed 8 and its rack 7 are moved to the left hand in Figure 1, the rack meshing with the interrupted wheel 6 imparts a partial rotation to the cylinder. During this stroke of the bed 8, the printing surface 34 of the cylinder is available to impress a sheet of paper against the forme on the bed 8.

In Figure 1, 75 indicates a sheet gripper at the forward edge of the printing surface 34, it being understood that the remainder of the cylinder periphery, as usual, is removed to leave a gap so that on the return stroke of the forme bed, there is no contact between the forme and the cylinder. The portion indicated by 76, Figure 1, is merely a counterweight to balance the cylinder, its peripheral surface being below the level of the printing surface.

The number of teeth in the interrupted toothed wheel 6 and the rack 7 is such that the cylinder is not driven by the bed during the whole of its stroke, the eccentric gears taking over the drive at a selected point before completion of the

printing stroke, and giving up to the rack at another selected point after commencement of the printing stroke. These points are so selected that the rack 7 is in engagement for more than the actual printing period.

After transfer from the rack 7, the impression cylinder 1 continues to rotate under the driving influence of a train of gears driven from the main driving shaft 18. This train of gears comprises a gear wheel 35, fixed to the shaft 17 which, as above explained, is driven by gears 19, 16 from the main driving shaft 18. The gear wheel 35 meshes with a gear wheel 36 freely rotating on a fixed pin 37 and meshing with a gear wheel 38 freely rotating on a fixed shaft 39.

A toothed segment or what is known in the art as an interrupted gear wheel 40 is fixed to the gear wheel 38, so that the pitch circle of its teeth is eccentric to the shaft 39. The eccentrically mounted interrupted gear wheel 40 meshes intermittently with a cam-shaped interrupted gear wheel 41, which is fixed to the shaft 2 of the impression cylinder 1.

The eccentric interrupted gear wheel 40 and the co-operating cam-shaped interrupted gear wheel 41 are so relatively disposed on their respective shafts and so designed that, when the rack 7 ceases to rotate the impression cylinder 1, near the end of the printing stroke of the forme bed 8, the gears 40 and 41 come into meshing engagement and complete a revolution of the impression cylinder 1. Moreover, at the moment of their engagement, the engaging teeth are traveling at the same speed and at the same rate of deceleration, so that they mesh without shock. As the wheels 40, 41 continue to rotate in mesh, the impression cylinder 1 is rotated at decreasing speed for a time and then at an increasing speed, so that, at the period when the gears 40, 41 cease to mesh, the cylinder is rotating at such speed that the teeth of the interrupted gear 6 which are about to re-engage with the rack 7, are moving at the same speed and at the same rate of deceleration as that of the rack teeth with which they are to re-engage. It will be understood that, while the train of gears above described is rotating the impression cylinder, the forme bed 8 and its rack 7 make their return or idle stroke, to the right hand in Figure 1, the rack 7 beginning to make its forward stroke just as the interrupted gear 6 is brought round ready for re-engagement.

It will be evident from the foregoing description that the impression cylinder 1 is rotated for a partial revolution alternately by two distinct driving means, namely, by the rack 7 meshing with the gear wheel 6 and by the train of gears 35, 36, 38, 40, 41, one of said driving means taking over the drive as the other ceases to drive, and at these drive transfer periods both drive means are operating at the same speed and the same rate so that the impression cylinder is continuously rotated and without shock at each period of taking over. This is graphically indicated by Figure 5, wherein X indicates the phase or period during which the rack is driving and Y the phase or period during which the train of gears is driving. The curves A, B indicate the varying speed of rotation of the cylinder during each phase, and it will be noticed how these curves gently merge into one another, indicating that there is no shock or sudden variation at the periods of taking over.

As mentioned hereinbefore, the shaft 2 of the impression cylinder 1 is mounted in bearings 3 and 4 which are fixed on the machine frame 5,

so that the geometrical axis of the shaft 2 is in fixed relation to the frame 5; consequently the axes of the gears 40, 41 have a constant or fixed relation to one another and accurate meshing engagement between them is ensured.

As under these conditions the impression cylinder cannot be raised to break the impression contact between the cylinder and the forme during "make ready," means are provided for lowering the forme bed for this purpose and for raising it into normal position for printing purposes, these means being of such a nature as to ensure a firm or practically solid support for the forme bed on the frame of the machine when impressional contact is restored. By lowering the forme bed instead of raising the cylinder, an additional advantage is obtained in that the inking rollers cannot touch the form surface which receives ink only when the forme bed is raised and during printing, so that excessive "cleaning-off" of the forme and "blacking-up" of the cylinder during "make ready" are avoided.

For the above purpose, the guide rails 10, on which the forme bed is supported and reciprocated, are fulcrumed at one end of the machine, for instance, as more clearly shown in Figure 9, their ends rest on the upper surface 42 of this end of the frame 5, the surface 42 being slightly chamfered.

The guide rails 10 are supported at their other ends and also at the middle below the impression cylinder 1, by cooperating pairs of packing blocks 43, 44, the blocks of each pair having flat surfaces where they are normally in contact with each other and with the flat undersides of the guide rails 10 or the flat upper surfaces of the cross girt 45 and the end of the frame 5, so that when the bed is in the impressional position, that is, the normal position for printing purposes, the packing blocks 43, 44 form virtually solid supports for the guide rails 10 on the cross girt 45 below the impression cylinder 1 and the end of the frame 5 on which they are situated. One block of each pair is stationary and the other movable relatively to it, for instance, the blocks 43 are fixed to the undersides of the guide rails 10 and the co-operating blocks 44 are movable. The blocks 43, 44 have co-operating wedge shaped leading edges 46 and 47, so that when the movable blocks 44 are moved in one direction to bring the wedge shaped parts 46 and 47 in contact with each other, the rails 10 are lowered slightly and, when they are moved in the opposite direction, the rails 10 are raised until the adjacent flat surfaces of the blocks are again in contact.

The movable packing blocks 44 are moved in unison, for instance, each block 44 over the cross girt 45 is connected to the aligned block 44 on the adjacent end of the frame 5 by a flat bar 48 which has recesses near its ends for the reception of the blocks 44. The flat bars 48 are connected by links 49 to levers 50 fixed on a cross shaft 51 mounted to oscillate in the frame 5 and provided with a crank 52 connected to a handle 53 or pedal by which it can be operated. Springs 54 are connected to the guide rails to assist in the raising of the rails, the springs being strong enough to take most of the weight, in order to render operation smooth and easy. The cross shaft may also be operated by movement from any suitable part of the machine engaged by a handle or pedal operated lever, as will be readily appreciated by those skilled in the art, without illustration.

In order to avoid end play of the guide rails due to reaction of the bed reciprocating mecha-

nism, the guide rails 10 near the fulcrum ends are connected to the adjacent end of the machine frame 5 by a flat spring steel plate 55 arranged as near as practicable and parallel to the plane of the forces exerted by the reciprocating mechanism, as will be more readily appreciated from Figure 1. The plate 55 is fixed by screws 56 near one edge between flat bars 57 to the machine frame 5 and firmly attached by screws 58 between flat bars 59 to the guide rails 10. The guide rails are connected at their adjacent ends by cross stays 60. Dowel pins 61 which are fixed in the rails 10 are a sliding fit in the holes in the frame 5 and a driving fit in the plates 59.

As an alternative construction, the packing blocks can be cylindrical, for instance as shown in Figures 10 and 11, wherein 62 represents the blocks fixed to the guide rails 10, and 63 represents movable co-operating blocks having pins 64 rotatably fitting in holes 65 in the cross girt 45 in the frame 5. The blocks 62, 63 have co-operating faces composed of flat parts 66 and wedge shaped parts 67. The blocks 63 have lateral lever extensions 68 connected by links 69 which are connected by links 49 to levers 50 on the operating cross shaft 51, the connecting joints permitting a slight amount of lateral play. When the shaft 51 is oscillated, the blocks 63 are oscillated and the co-operating faces of the fixed and movable blocks raise and lower the rails 10. When the rails 10 are raised, the flat surfaces 66 are in contact to ensure that the blocks form firm supports. Obviously, in either form of construction, the shaft 51 can be operated by a suitable form of power drive instead of by hand or pedal.

I claim:

1. A letter press printing machine of the reciprocatory flat forme bed type having a rotating impression cylinder for co-operation with said forme bed, a shaft for said cylinder, stationary bearings for said shaft, and means for raising and lowering said bed for the purpose of bringing the form into and out of impressional contact with the impression cylinder, said means comprising guide rails for supporting the form bed, said guide rails being supported on the frame of the machine, and means including pairs of relatively movable packing blocks with parallel faces between the guide rails and the said frame, said packing blocks having co-operating wedge ends and means for effecting relative movement between the packing blocks of each pair thereof, said guide rails for the reciprocatory forme bed having fulcra on the machine frame for the purpose of permitting the packing blocks to oscillate said rails about said fulcra, said guide rails being provided with a flat spring steel plate, firmly connecting them to the machine frame near their fulcra for the purpose of resisting end play of the guide rails during the reciprocation of the forme bed.

2. A printing machine comprising, in combination, a frame, a flat forme bed mounted for reciprocation on said frame, an impression cylinder rotatably mounted on said frame above the path of said bed, drive means on said frame, quick return drive mechanism driven by said drive means for reciprocating said bed through a relatively slow variable speed impression stroke and a relatively fast variable speed return stroke, a rack carried by said bed, an interrupted gear wheel fixed with said cylinder for meshing with said rack at the relatively slowest portions of the bed movement to drive said cylinder with the bed at a variable relatively fast speed through the impression portions of the bed movement and cylinder rotation, an eccentric gear wheel journalled on said frame and driven by said drive means at a constant speed, and an interrupted cam-shaped gear wheel fixed with said cylinder for periodically meshing with said eccentric gear to drive said cylinder at a variable relatively slow speed during the periods that it is not driven by said rack and at the same speed and at the same rate of acceleration and deceleration as imparted by the drive from the rack during the engagement and disengagement between said rack and interrupted gear wheel, whereby said cylinder is continuously driven at one revolution for each cycle of bed movement and at a constantly variable rate through each revolution thereof and without abrupt changes of cylinder speed.

3. In a printing machine of the type in which an impression cylinder is journalled in fixed relation on a frame and a forme bed is reciprocal beneath said cylinder on rails that are supported by means on said frame for vertically adjusting said rails and bed relative to said cylinder, the combination with said rail supporting means of fulcra between said rails and said frame to permit tilting of said rails relative to the horizontal, means on said frame for adjustably supporting said rails relative to their fulcra, and a flat spring plate fixed to said frame and to said rails adjacent said fulcra for resisting end play of said rails during the tilting thereof.

4. In a printing machine of the type in which an impression cylinder is journalled in fixed relation on a frame and is drivingly connected by a gear meshing with a rack fixed with a forme bed which is reciprocal beneath said cylinder and suported on said frame for vertical adjustment relative to said cylinder, said rack being divided longitudinally into two coinciding parts, one of said parts being fixed with said forme bed and movable therewith relative to said cylinder and gear, the other of said parts riding on the frame to be maintained in fixed vertical relation to said gear, and means connecting said rack parts for permitting only relative vertical movement therebetween.

5. A printing machine comprising, in combination, a frame, a flat forme bed mounted for reciprocation on said frame, an impression cylinder rotatably mounted on said frame above said bed, a lever pivoted at one end to said frame and operatively connected at the other end with said bed, drive means on said frame for reciprocating said lever to reciprocate said bed, and buffer means on said frame and connected with said lever to cushion the stroke reversal during the reciprocation of said lever and bed.

6. A printing machine comprising, in combination, a frame, a flat forme bed mounted for reciprocation on said frame, an impression cylinder rotatably mounted on said frame above the path of said bed, power drive means on said frame, quick return drive mechanism driven by said drive means for reciprocating said bed through a relatively slow variable speed impression stroke and a relatively fast variable speed return stroke, means operated by bed movement for intermittently driving said cylinder starting at the relatively slowest portions of the bed movement to drive said cylinder with the bed at a variable relatively fast speed through the impression portions of the bed movement and cylinder rotation, and independent variable speed drive mechanism on said frame driven by said

power drive means and operatively connected with said cylinder to drive said cylinder at a variable relatively slow speed during the periods that it is not driven by said bed operative means and at the same speed and at the same rate of acceleration and deceleration as the drive of said bed operative means during the start and end of each intermittent drive operation of said bed, whereby said cylinder is continuously driven at one revolution for each cycle of bed movement and at a constantly variable rate through each revolution thereof and without abrupt changes of cylinder speed.

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