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BED AND CYLINDER PRINTING MACHINE OF THE TWO-REVOLUTION TYPE

Filed Dec. 17, 1958 11 Sheets-Sheet 1

Fig.1

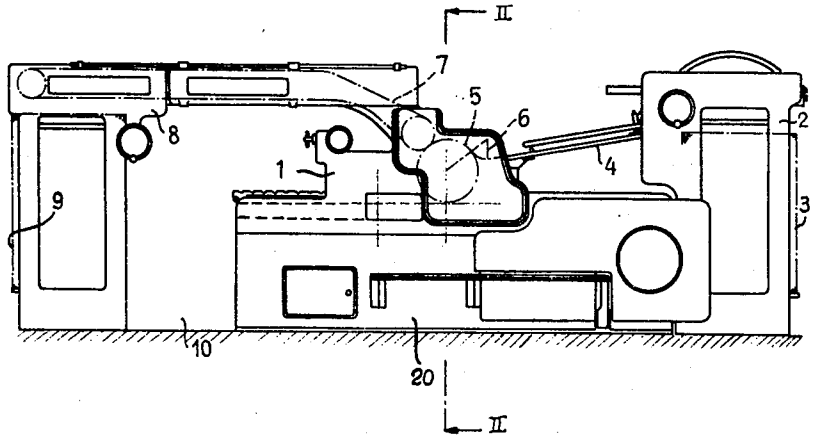
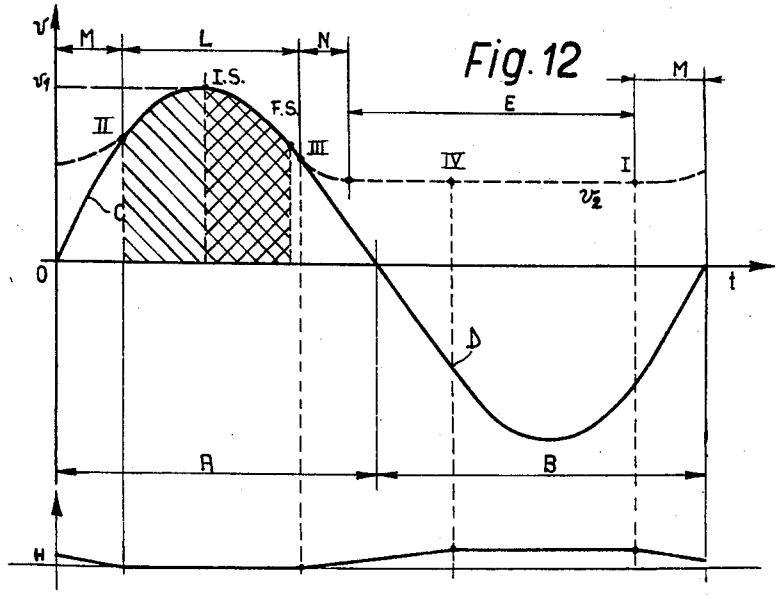


Fig.12



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BED AND CYLINDER PRINTING MACHINE OF THE TWO-REVOLUTION TYPE

Filed Dec. 17, 1958 11 Sheets-Sheet 2

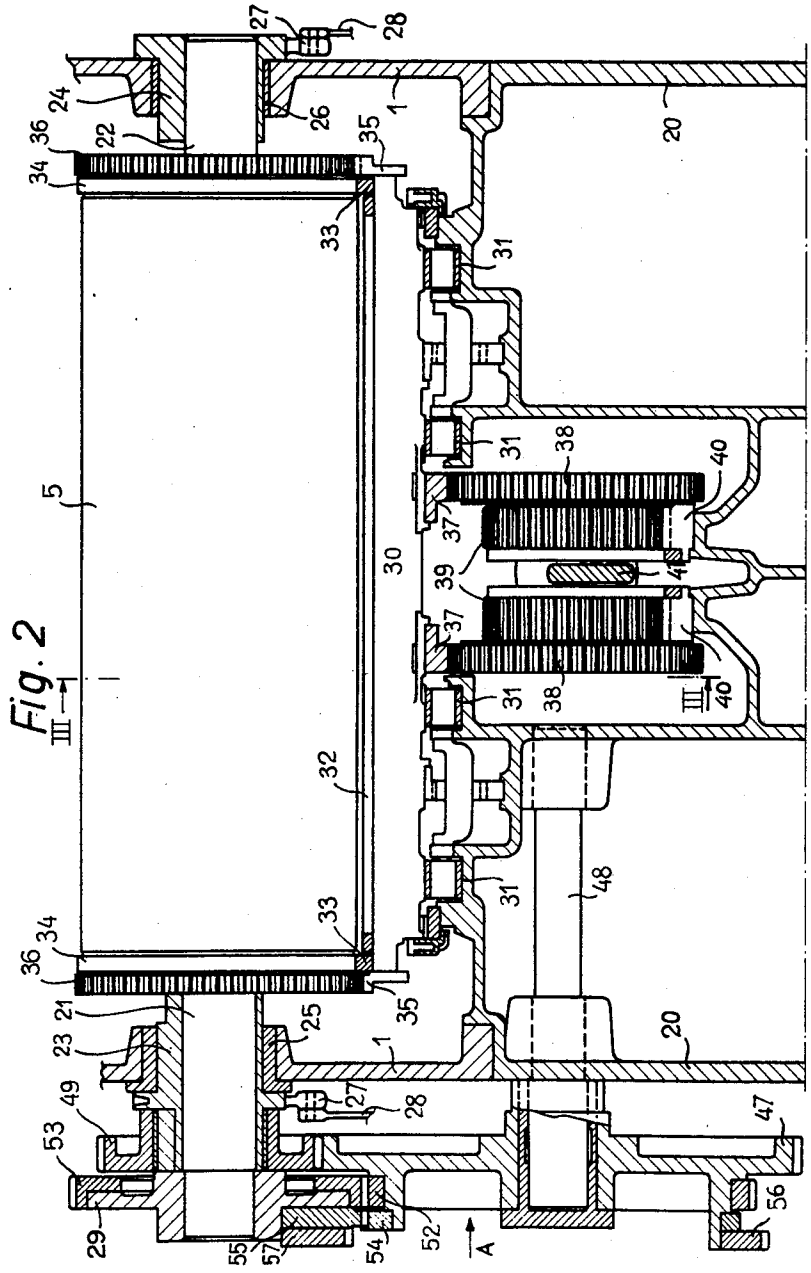

Fig. 2

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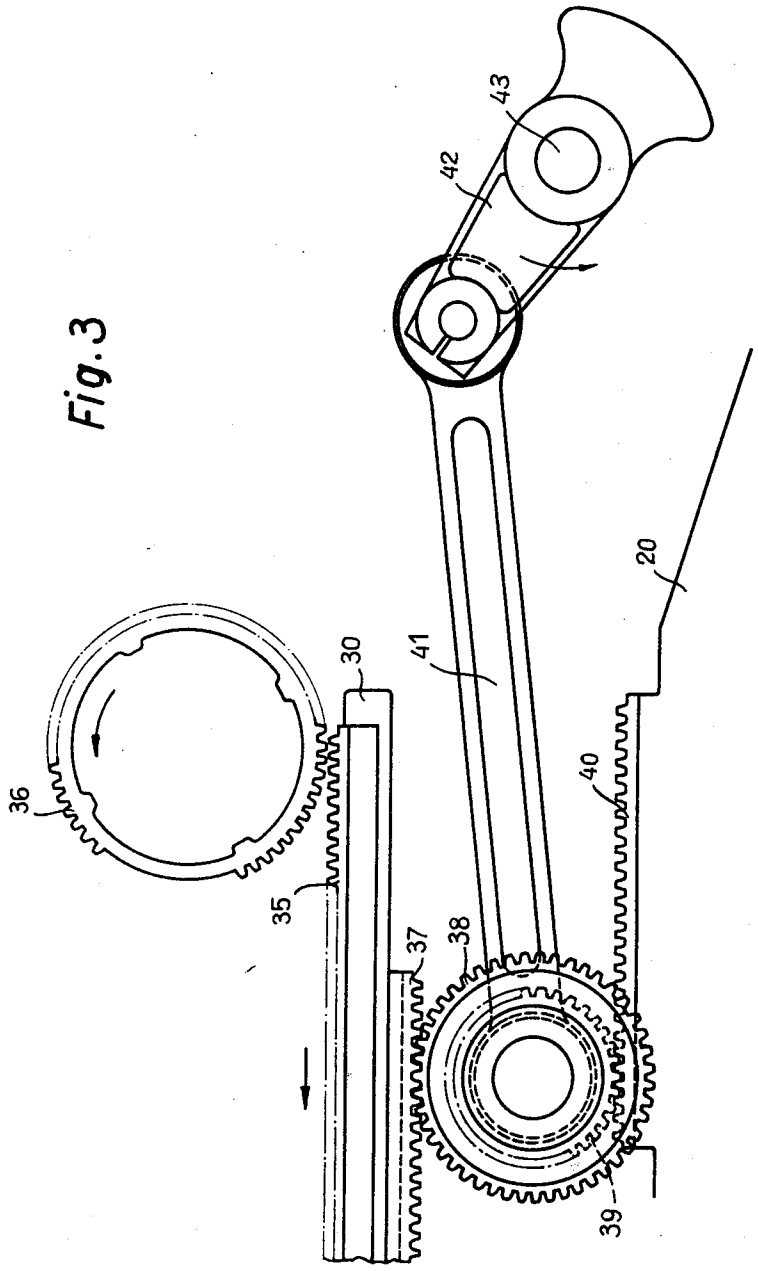
BED AND CYLINDER PRINTING MACHINE OF THE TWO-REVOLUTION TYPE

Filed Dec. 17, 1958 11 Sheets-Sheet 3

Fig. 3



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BED AND CYLINDER PRINTING MACHINE OF THE TWO-REVOLUTION TYPE

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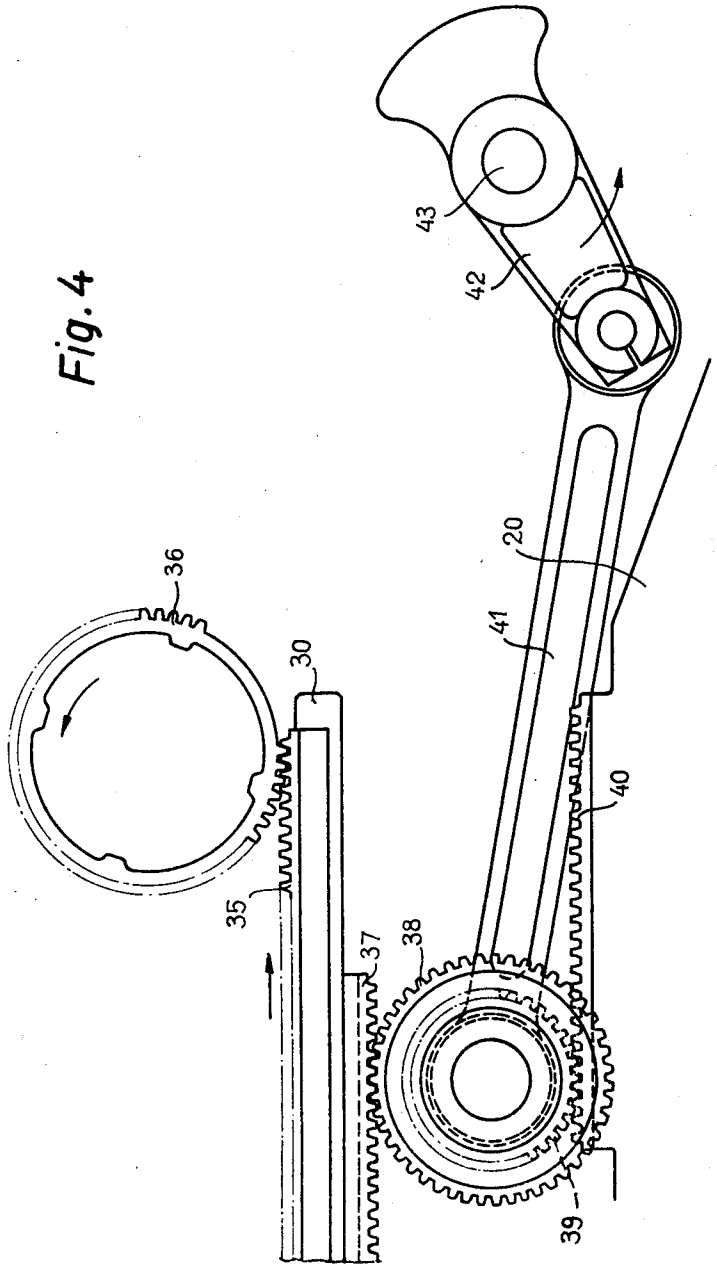
Fig. 4



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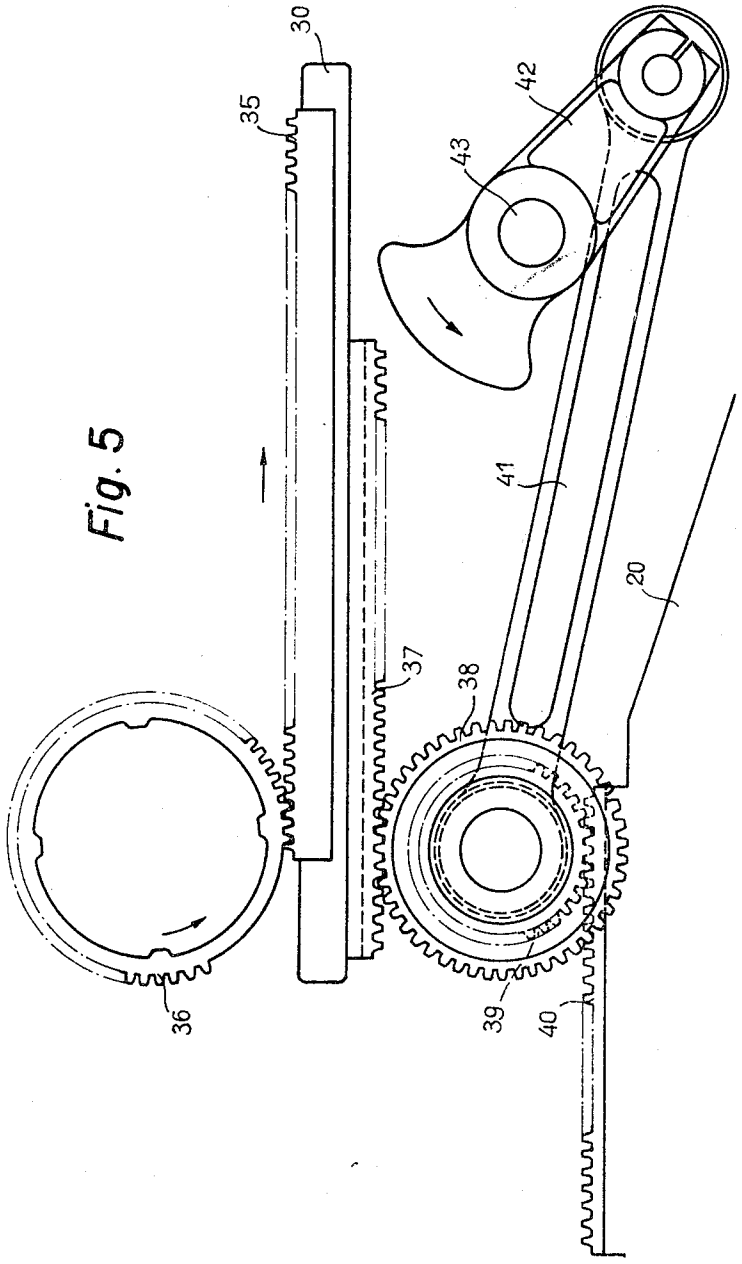
BED AND CYLINDER PRINTING MACHINE OF THE TWO-REVOLUTION TYPE

Filed Dec. 17, 1958 11 Sheets-Sheet 5

Fig. 5



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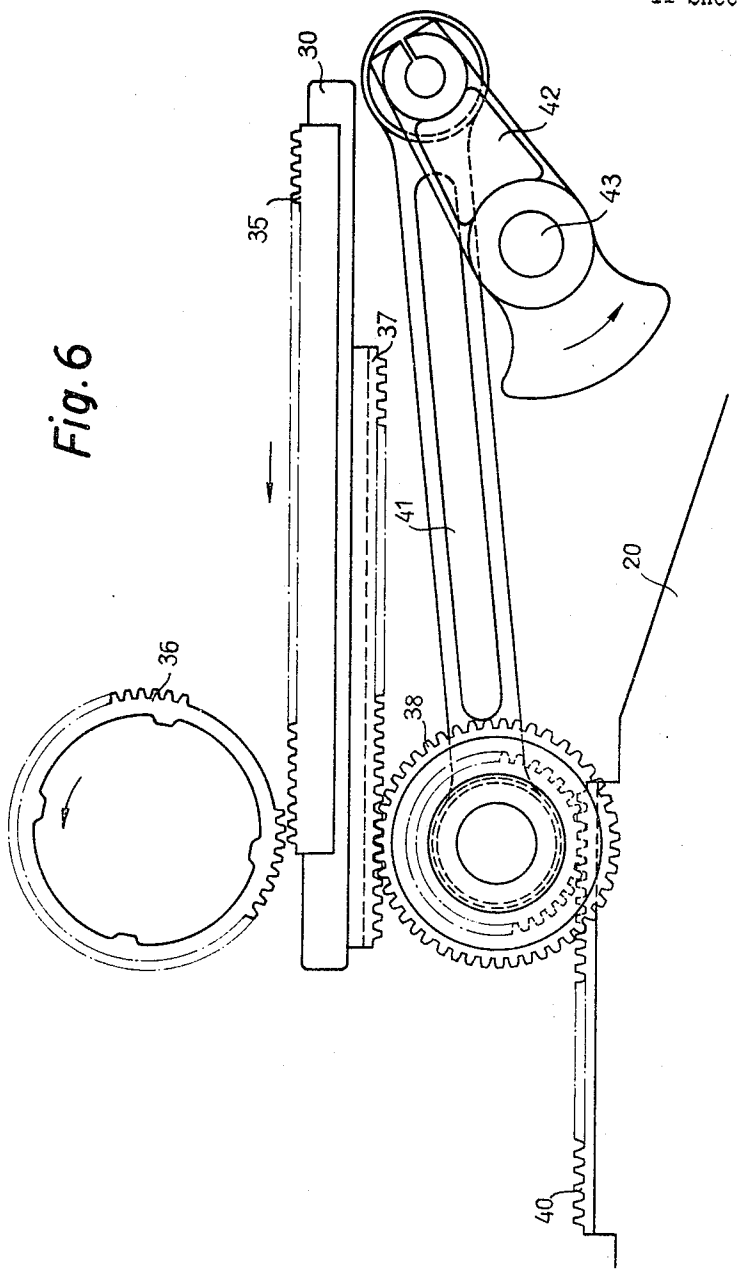
BED AND CYLINDER PRINTING MACHINE OF THE TWO-REVOLUTION TYPE

Filed Dec. 17, 1958 11 Sheets-Sheet 6

Fig. 6



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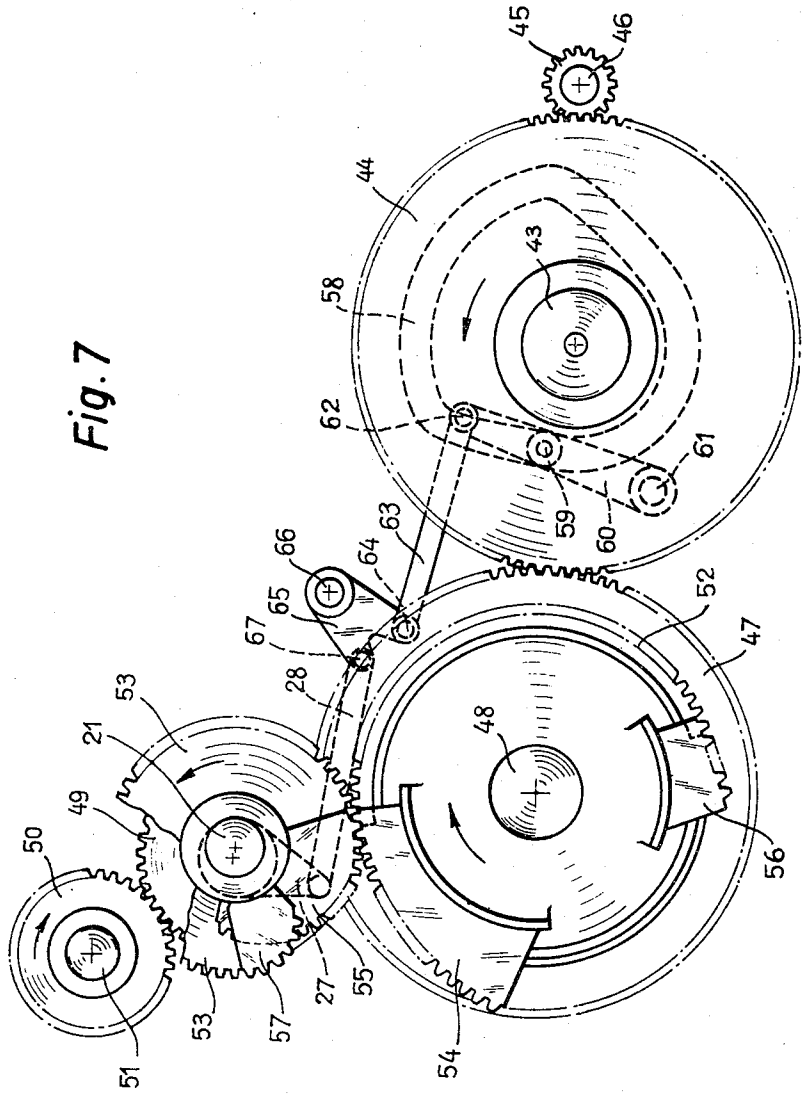
BED AND CYLINDER PRINTING MACHINE OF THE TWO-REVOLUTION TYPE

Filed Dec. 17, 1958 11 Sheets-Sheet 7

Fig. 7



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BED AND CYLINDER PRINTING MACHINE OF THE TWO-REVOLUTION TYPE

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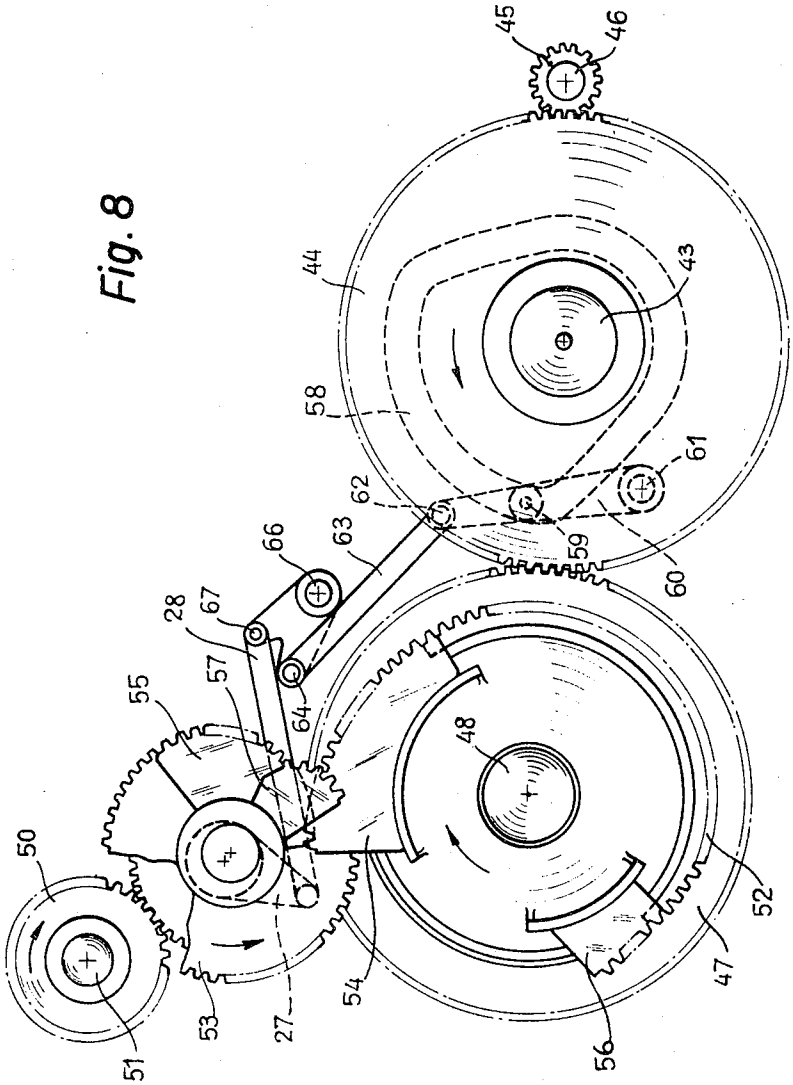
Fig. 8



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BED AND CYLINDER PRINTING MACHINE OF THE TWO-REVOLUTION TYPE

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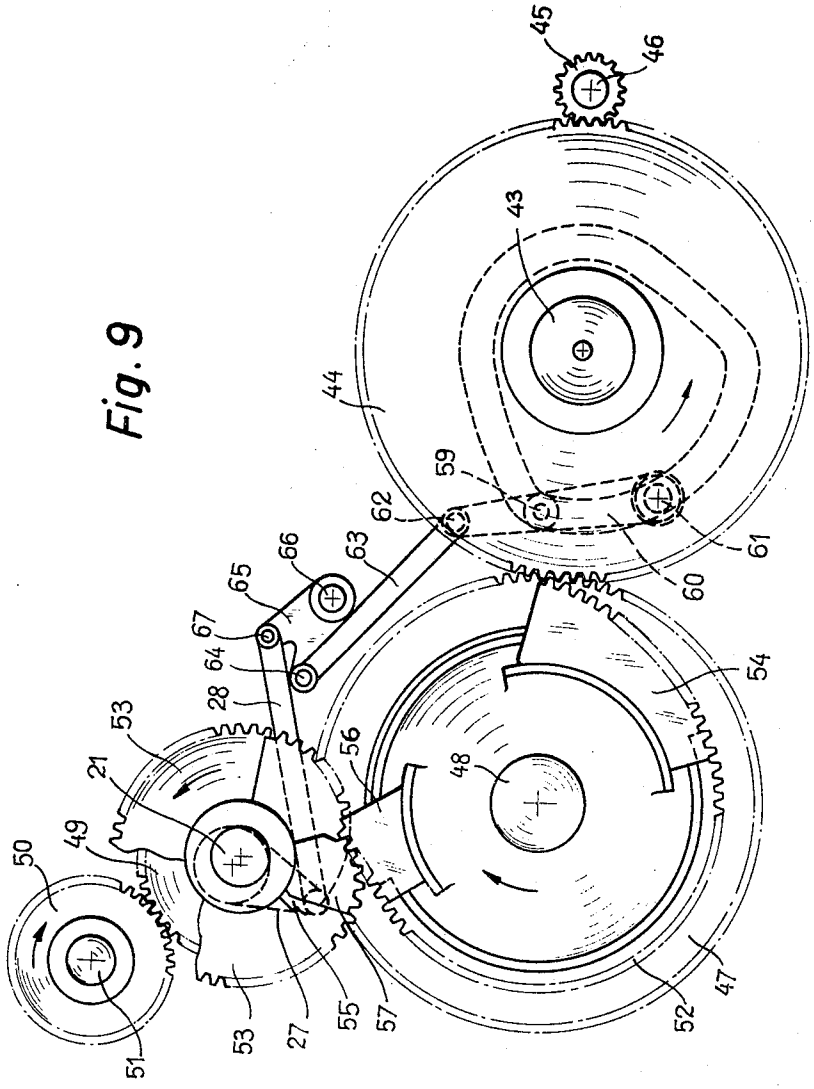
11 Sheets-Sheet 9

Fig. 9



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BED AND CYLINDER PRINTING MACHINE OF THE TWO-REVOLUTION TYPE

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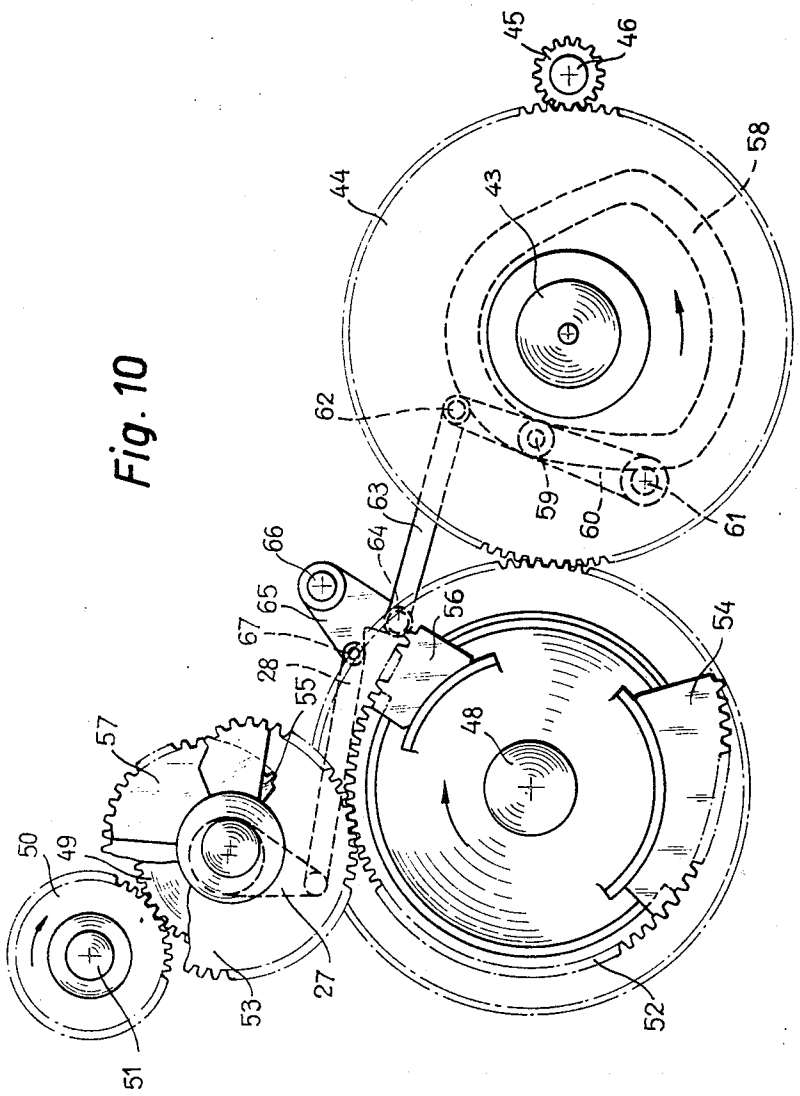
Fig. 10



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BED AND CYLINDER PRINTING MACHINE OF THE TWO-REVOLUTION TYPE

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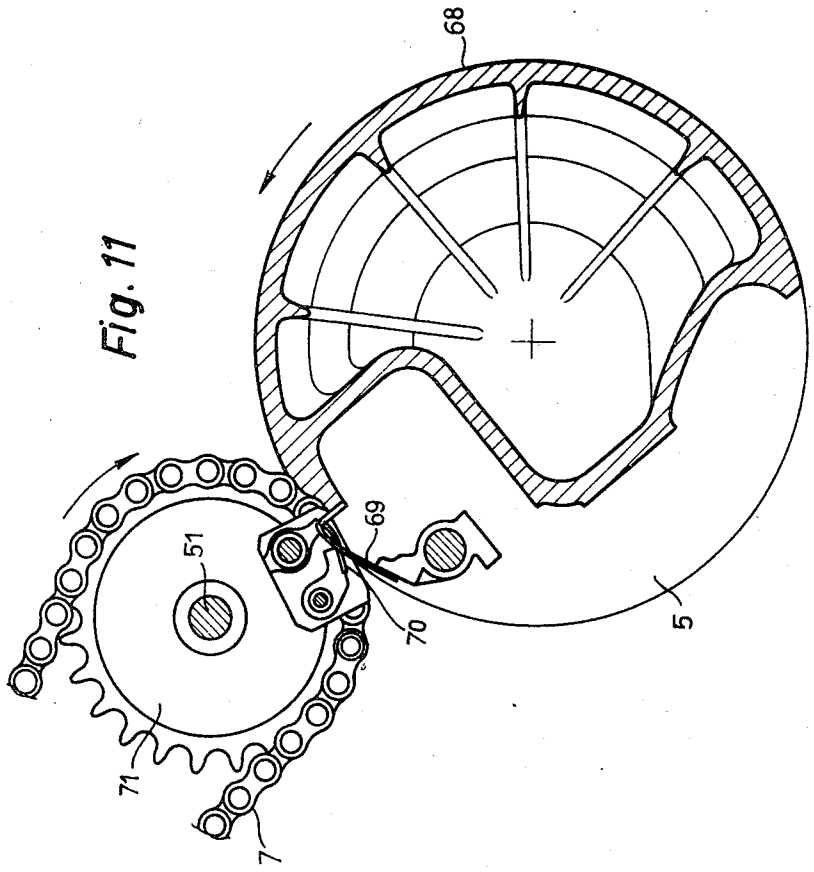
Fig. 11



United States Patent Office 2,938,457
Patented May 31, 1960

2,938,457

BED AND CYLINDER PRINTING MACHINE OF THE TWO-REVOLUTION TYPE

Paolo Papa and Federico Capetti, Turin, Italy, assignors to Nebiolo S.p.A., Turin, Italy

Filed Dec. 17, 1958, Ser. No. 781,112

Claims priority, application Italy Dec. 18, 1957

1 Claim. (Cl. 101—283)

This invention relates to a printing machine of the two-revolution cylinder type having a steadily revolving cylinder which performs two revolutions in the same direction of rotation on each reciprocation of the bed carrying the form-surface.

In known machines of this type the cylinder and bed are driven during all operational steps of the machine by two distinct drives in such manner that the bed performs a substantial part of each stroke at constant speed and undergoes a sharp acceleration and deceleration, respectively, in promixity to the points at which its motion is reversed, the cylinder revolving at a constant speed such that its peripheral speed equals the constant bed speed.

During the part printing stroke of the bed performed at constant speed the cylinder contacts the bed surface. During the remaining period of the cycle, the cylinder is slightly lifted above the said surface in order to avoid relative displacements of the bed components and cylinder due to differential directions of movement of both members and prevents the form-surface from soiling the cylinder lining. The cylinder lift is quite small, of the order of about 1 mm.

As is well known to experts in the branch, this known structure suffers from serious disadvantages. Firstly, driving of the bed and cylinder by distinct drives during the printing stroke does not safely afford a peripheral cylinder speed accurately equalling the rate of feed of the bed. The differential speed is mainly due to unavoidable plays in the drives to the cylinder and bed. This inconvenience leads to blurs in the print which generally more markedly occurs at the "tail" of the sheet being printed.

Secondly, it is not convenient for the peripheral speed of the cylinder to constantly equal the maximum speed of the bed. For this speed is very high on quick operation of the machine (which may attain 3,600 prints an hour) and feeding of the sheet from the oscillating grippers to the cylinder and from the latter to the delivery chain takes place under unfavorable conditions. The chain should be fed at a high speed equalling the peripheral speed of the cylinder, its overall development being considerable.

Finally, the driving arrangement for the bed necessitates expensive, clumsy shock absorbers for the purpose of taking up unavoidable strains on the bed driving gear on sharp deceleration at the end of each bed stroke.

Moreover, the above mentioned driving arrangement entails a considerable lengthening of the machine and increases the overall size of the latter, preventing access to the machine end at which the printed sheets are collected, in order to change, check or correct the form on the bed from a convenient position.

This unfavorably affects operation of the machine by increasing idle periods for arranging the form.

This invention provides a printing machine of the type referred to, which avoids the abovementioned drawbacks.

Consequently, the primary object of this invention is to provide a printing machine of the type referred to

ensuring a strict agreement of the peripheral speed of the impression cylinder and the speed of the bed during its printing stroke.

A further object of this invention is to provide a printing machine of the type referred to in which feeding of the sheet by the oscillating grippers to the cylinder and by the latter to the printed sheet delivery chain takes place under favourable conditions, i.e. at low speed without, however, stopping the cylinder.

A further object of this invention is to provide a printing machine of the type referred to, in which the sheet delivery chain moves at low speed resulting in a very smooth deposition of the printed sheets on the printed sheet pile, the sheet being kept against swirling or buckling as it falls on the pile, as required especially by light paper sheets.

A further object of this invention is to provide a printing machine of the type referred to, in which the bed drive is of such construction as to avoid sharp accelerations and decelerations at the ends of the bed travel, this resulting in a very noiseless operation and absence of excessive strains of the bed driving members.

According to this invention, the abovementioned objects are attained by deriving the bed motion from a crank and providing the bed with racks, the teeth of which mesh with toothed sectors coaxial with the cylinder securedly fixed to the latter during a substantial period of the bed run during which printing is effected, and by providing means adapted to revolve the cylinder at a reduced constant speed as the sheet is delivered by the oscillating grippers to the cylinder and by the latter to the sheet delivery chain while the bed performs its return stroke, and further means adapted to vary the rate of speed of the cylinder from its reduced speed to the speed at which cooperation of the teeth of the bed racks and sectors securedly fixed to the cylinder, respectively, starts, and vice versa, means being further provided for periodically lifting and lowering the cylinder with respect to the bed surface as the cylinder speed is being varied, in order to avoid any interference of the racks and sectors during the bed return stroke.

Applicants are aware that the manner of deriving the cylinder motion during the printing stroke of the bed is known per se and adopted in certain printing machines.

However, the latter machines are of the cylinder stop type, in which the cylinder is stationary during reverse movement of the bed, so that the problem of avoiding any interference of the bed rack and cylinder rim teeth, respectively, practically does not arise, and of the steadily revolving cylinder type in which the cylinder performs one revolution only during the printing and return strokes of the bed.

Further characteristic features and advantages of the invention will be understood from the appended description referring to the accompanying drawings, which show diagrammatically by way of a non-limiting example an embodiment thereof.

On the drawings:

Figure 1 is a diagrammatical elevational view of the improved machine, equipped with all accessories therefor,

Figure 2 is a part cross-sectional view of the machine on line II—II of Figure 1,

Figure 3 is a sectional view on line III—III of Figure 2, showing merely the impression cylinder and essential members controlling the bed motion,

Figures 4, 5 and 6 are further sectional views similar to Figure 3, showing further operative positions which are sequentially taken by the members shown in Figure 3,

Figure 7 is a side view in the direction of the arrow A of Figure 2 of the members controlling the cylinder motion,

Figures 8, 9 and 10 show the members according to

Figure 7 in various operative positions which are sequentially taken by said members during operation of the machine,

Figure 11 shows some constructional details of the machine on an enlarged scale,

Figure 12 is a diagram showing variations in speed of the bed and cylinder and timed variations in location of the cylinder axis with respect to the bed surface.

The printing machine shown on the drawings comprises a framing 1 and is provided at one end with a head portion 2 carrying the sheet feeding mechanism and pile 3 of blank sheets.

A feed board 4 is interposed between the sheet feeding mechanism and impression cylinder 5 on the machine. The sheet is fed from the feed board to the cylinder 5 by means of oscillating grippers diagrammatically shown at 6.

The delivery mechanism 8 is arranged at the other machine end and is provided with a sheet delivery chain 7 adapted to wipe the sheets from the impression cylinder and deposit them on a printed sheet pile 9 arranged in the head of the delivery mechanism.

A clearance 10 is left between the machine framing 1 and sheet delivery mechanism 8 to allow passage of a carriage carrying the form surface for assembly on the machine bed.

As visible from Figure 2 of the drawing, the impression cylinder 5 is rotatably carried by the machine framing 1, the framing resting on a foundation 20 supporting further essential components of the machine.

The cylinder 5 is provided at its opposite ends wtih two projecting studs 21, 22, respectively, coaxial with each other as well as with the axis of the cylinder 5. On the end of the stud 21 nearer the cylinder and on the stud 22 are fitted bushes 23, 24, respectively. The bushes are rotatably mounted in bearings 25, 26, respectively, received by suitable openings in the framing 1. The common axis of the bushes 23, 24 is offset from the axis of the cylinder and studs 21, 22. Consequently, on simultaneously and synchronously rotating the bushes 23 and 24 within the bearings 25, 26, the mutual position of the axis of the cylinder 5 and framing 1 of the machine and foundation 20 thereof may be varied. This is of considerable importance in operation of the machine, as will be explained hereafter. The bushes 23 and 24 are provided with arms 27 oriented in the same direction having hinged thereto rods 28 (compare Figures 6 to 10 too).

The foundation 20 of the machine carries the form carrying bed 30 cooperating with the cylinder 5 (compare Figures 3 to 6 too). The bed 30 is mounted for longitudinal movement on the machine and rests on four rows of rollers 31 rolling in suitable longitudinal tracks formed in the foundation 20. The bed 30 carries at the top a frame 32 in which the types for printing are set. Runners 33 are arranged on both sides of the frame 32 externally thereof, said runners being in the form of rods rectangular in cross-sectional shape having a flat top. Bands 34 roll on the runners 33 during the printing step, said bands being in the form of rings having a flat outer surface, formed on either side of the impression cylinder 5.

The bed is moreover provided on either side with racks 35 the teeth of which face upwardly. The teeth of the racks 35 are adapted to cooperate during the operational period of the machine including the printing step with sets of teeth 36 of rims secured on either side of the impression cylinder 5.

The bed is moreover formed with a pair of racks 37 extending symmetrically to the middle longitudinal plane of the machine, the rack teeth facing downwardly. The teeth of the racks 37 mesh with the teeth of two coaxial toothed wheels 38 which are each securedly fixed to a smaller diameter toothed wheel 39 bearing on a rack 40 secured to the foundation 20. The common axis of the toothed wheels 38, 39 has superposed thereon the one end of a connecting rod 41 fixed at its other end to a crank 42 fast with a shaft 43 mounted for rotation in the foundation 20 of the machine (Figures 3 to 6).

The crank shaft 43 laterally extends at one end beyond the opposite side of the foundation 20 and carries a toothed wheel 44 (Figures 7 to 10) meshing with a pinion 45 mounted on a driving shaft 46 likewise rotatably mounted in the foundation 20 rotated from a motor (not shown).

The toothed wheel 44 is situated on the left hand side of the foundation 20 (visible in Figure 2) and cooperates with a toothed wheel 47 keyed to a shaft 48 rotatably mounted on the foundation. The toothed wheel 47 transmits motion to the toothed wheel 49 rotatably mounted on the end portion extending beyond the arm 27 of the eccentric bush 23. The toothed wheel 49 meshes in turn with a toothed wheel 50 keyed to a shaft 51 having mounted thereon the pinions driving the sheet delivery chains 7 (Figure 11).

The toothed wheel 47 further carries a toothed rim 52 concentrical therewith extending through an arc of about 180°. The toothed rim 52 is adapted to cooperate with a toothed rim 53 keyed to the free end of the stud 29 extending beyond the impression cylinder 5. A toothed sector 54 is arranged beside the toothed rim 52 and at one end thereof, eccentrically to the rotational axis of the toothed wheel 47 and is adapted to cooperate with a toothed sector 55 adjacent and secured to the toothed rim 53 mounted on the stud 21. The toothed wheel 47 carries a toothed sector 56 situated at the other end of the toothed rim 52 axially offset from the sector 54 to avoid any interference with the sector 55. The sector 56 is likewise arranged eccentrically of rotational axis of the wheel 47 and is adapted to cooperate with a toothed sector 57 superposed on and fast with the sector 55.

The toothed wheel 44 (Figures 7 to 8) has formed therein facing the foundation 20 a cam groove or track 58 in which a roller 59 is slidably mounted, said roller 59 being rotatable on a lever 60 keyed to a shaft 61 carried by the foundation, and having hinged to its free end 62 a rod 63, the other end of which is pivotally attached at 64 to one arm of a bell-crank lever 65 keyed to the shaft 66 mounted on the machine framing. The other arm of the bellcrank lever 65 is hinged at 67 to the rod 28 articulated to the end of the arm 27 on the eccentric bush 23. The shaft 66 extends through the framing 1 and carries at its other end an arm having hinged thereto the lever 28 connected to the arm 27 of the bush 24.

It will be obvious that with the above structure the position of the arms 27 can be periodically varied during rotation of the toothed wheel 44, since bushes 23 and 24 are rotated simultaneously and synchronously. This results in a periodic variation of the position of the axis of the impression cylinder 5 to the plane of the bed supported by the foundation 20 in accordance with a law depending on the shape of the cam groove or track 58. This shall be described in detail when dealing with the operation of the machine.

The impression cylinder 5 is shaped at its middle portion between the bands 34 as shown in Figure 11. It will be seen from this figure that instead of being a complete drum the impression cylinder comprises a cylindrical sector extending in width somewhat beyond 180°, its outer periphery 68 receiving the paper sheet to be printed and superposing on the printing stroke of the machine on the form surface in the frame 32 carried by the bed (Figure 2).

69 denotes one of the grippers adapted to hold the leading end of the sheet to be printed against the cylinder. 70 denotes one of the grippers carried by the set of sheet delivery chains 7 which cooperate with pinions 71 provided at the opposite ends of the shaft 51 (com-

pare Figures 7 to 10 too). The mutual position of the cylinder 5 and chains 7 is selected in Figure 11 to show the offtake of the printed sheet adhering to the surface 68 of the cylinder by the sheet delivery chains.

The operation of the machine shall now be explained with reference to the figures described above and diagram shown in Figure 12.

In the diagram shown in Figure 12 the full sinusoidal line of visible in the upper portion of said figure denotes the variation in speed of the bed during its printing and return stroke corresponding to a full revolution of the crank 42 (Figures 3 to 6).

Over a part denoted by C of the bed path, the speed is positive in value during the printing stroke denoted by A, and negative in value over a further part of the path denoted by D during the return stroke denoted by B.

The area between each branch C, D respectively of the curve and the axis of the abscissae therefore denotes the length of each printing and each return stroke which are of course equal.

The dash line denotes the variation in speed of the impression cylinder. It will be seen from the diagram of Figure 12 that the rate of speed of the cylinder is kept constant during the period E, when it reaches a value which is about 40–50% of the top bed speed (v_1).

Over the period L the cylinder speed equals the bed speed. The periods L and E are connected by intermediate periods, more particularly the period N during which the cylinder speed gradually decreases from a value equalling the bed speed to a constant speed v_2, and period M during which the cylinder speed gradually increases to equal at the start of the period L the bed speed.

The lower portion of the diagram of Figure 12 shows the variation of the position H of the axis of the impression cylinder wtih respect to the bed surface, which substantially matches the spacing of the top face of the runners 34 and bands 36 of the impression cylinder (Figure 2).

It will be seen from the diagram of Figure 12 that over the full period L, during which the bed and impression cylinder equal in speed, the spacing of the runners and cylinder belts is nil. Subsequently, the cylinder is gradually lifted from the bed, which lasts a period somewhat longer than period N during which the cylinder motion slows down to the constant speed value v_2. The cylinder therefore keeps lifted at a constant height h above the bed surface, whereafter it starts lowering before period M begins during which the cylinder is accelerated from its speed v_2 to its speed v_1 which is the bed speed as period L starts. Lowering, which takes place gradually, is completed at the beginning of the period L.

The printing process actually starts at the vertical line I.S. near the top of the portion C of the speed curve of the bed and is completed at the vertical line F.S. near the beginning of period N.

The hatched area between lines I.S. and F.S. denotes the length of the path during which printing is effected.

The behaviour of the machine shall now be explained in detail referring to the four fundamental locations indicated in the diagram shown in Figure 12 by I, II, III and IV and to Figures 3 to 10 of the drawings.

The mutual position of the machine components at the beginning of the step M, i.e. at the location I on the diagram, is shown in Figures 3 and 7. It will be seen from the diagram and above mentioned figures that the cylinder starts lowering towards the bed without, however, the teeth of the cylinder rims 36 meshing with the bed racks 35. The roller 59 (Figure 7) is about to leave the constant radius part path nearer the axis of the shaft 43 of the guide 58, meshing of the last tooth of the rim 52 with the last tooth of the rim 53 being about to end and meshing of the first teeth of the sectors 54 and 55 being about to begin. Since the radius of the sector 54 gradually increases and the radius of the sector 55 gradually decreases, the rotational speed of the stud 21, hence of the impression cylinder 5, increases. The sectors are of such length and shape that their mutual engagement ceases when the peripheral speed of the cylinder equals the bed speed, i.e. at location II. Moreover, these sectors are of such construction that acceleration of the cylinder at location II accurately matches the acceleration of the bed.

The mutual position of the members controlling movement of the bed and cylinder at location II is shown in Figures 4 and 8. It will be seen from these figures as well as from the diagram shown in Figure 12, that the cylinder is fully lowered, so that its bands 36 bear on the top faces of the runners 33 (Figure 2).

Figure 8 shows that the roller 59 is at the beginning of a further constant curvature portion of the cam groove or guide 58. The same figure shows that the last tooth of the sector 54 is being disengaged from the teeth of the sector 55. Figure 4 shows that the toothed rims 36 of the cylinder simultaneously start meshing with the racks 35 fast with the bed. The period denoted by L in Figure 12 now starts, the cylinder and bed speed during this period being the same by virtue of the fact that motion is transmitted to the impression cylinder by the bed by effect of the mutual engagement of the racks 35 and toothed sectors 36.

This period ends at location III at which the teeth of the racks 35 in the bed and of the toothed sectors 36 in the cylinder become disengaged, the cylinder lift starting in order to prevent any interference of the teeth of the sectors 36 and racks 35 during the return stroke of the bed. The position of the various members controlling movement of the bed and cylinder at location III is shown in Figures 5 and 9. It will be seen from Figure 5 that the last tooth of each of the toothed sectors 36 leaves the teeth of the racks 35 since the laws according to which the bed and cylinder speed, respectively, should vary, are henceforth modified. At the same time the first teeth of the sectors 56, 57, respectively, start meshing together, so that the cylinder is never left to itself, but is positively driven at any moment of its revolution. The radii of the sectors 56, 57 gradually decrease and increase, respectively, said sectors being of such length and shape that their mutual engagement ceases at the end of the period N, when the cylinder takes a predetermined peripheral speed. The cylinder drive is effected henceforth by cooperation of the toothed rims 52, 53. The sectors 56, 57 are further of such shape that deceleration of the cylinder at location III is of the same rate as deceleration of the bed.

The above properties of the cooperating sectors afford a smooth engagement and disengagement of the set of teeth of the cylinder sectors 36 and bed racks 35 without any strain detrimental to operation of the machine.

Figure 9 shows that the roller 59 leaves the portion of the cam groove or guide of larger constant radius to enter the connection to the smaller constant radius portion. The cylinder now starts lifting to prevent the teeth of the toothed rims 36 from interfering with the teeth of the racks 35 in the bed during the return stroke of the latter. The position of the cylinder and bed driving members at the last characteristic location, at which the cylinder lifting step is completed (location IV in the diagram shown in Figure 12), is shown in Figures 6 and 10, respectively. It will be seen from Figure 6 that the bed had previously started its return stroke, the axis of the impression cylinder being at such height that the teeth of the sectors 36 do not interfere with the teeth of the bed racks 35.

Figure 10 shows that the cylinder drive is effected by mutual engagement of the toothed rims 52, 53, thereby affording a constant rate of revolution of the cylinder. The roller 55 enters the smaller radius constant curvature portion of the cam groove or track 58, so that the angular position of the bushes 23, 24 as well as the height of the cylinder above the bed surface keep constant.

The diagram shown in Figure 12 further shows that the bed movement takes place under favourable conditions, accelerations and decelerations at the start and end of each of its stroke being very moderate. Most of the movement of the impression cylinder, i.e. over one revolution, takes place during the bed printing stroke, the remaining portion (less than one revolution) taking place during the bed return stroke without, however, the cylinder ever stopping, and in such manner that the cylinder performs two revolutions during the period of the printing and return strokes of the bed.

The constant rate of speed of the cylinder is of the order of about 40–50% of its top speed and lasts over a sufficient period of time for utilizing it for feeding the sheet from the oscillating grippers **70** to the cylinder grippers **69**, which takes place before period M starts, at a speed lower than the printing speed. The operational conditions of the grippers are thereby improved over known machines of this type. Similarly, delivery of the sheet substantially at the end of the period N takes place at a reduced speed substantially equalling the uniform cylinder speed, whereby the noise of the sheet, delivery chain **7** is reduced and conditions under which the sheet is fed from the grippers **70** on the chain and grippers **69** on the cylinder and smoothness of deposition of the sheet on the printed sheet pile **9** are improved. With this structure the length of the sheet delivery chain **7** need not necessarily be a multiple of the circumfernce of the impression cylinder as in known machines. The sticks carrying the sheet grippers being the same in number, the chain length may be considerably reduced with respect to known machines.

According to this invention the chain comprises three sets of gripping members referred to as gripper carrier sticks, instead of two as in machines of known construction. The gripping members are spaced by an extent considerably smaller than twice the circumference of the impression cylinder, the overall length of the chain being but slightly increased over known machines. However, this arrangement leaves a clearance **10** between the head portion of the framing **1** and sheet delivery mechanism **8** to allow of passage of a carriage carrying the form to be introduced into the bed, thereby facilitating introduction without requiring removal of the printed sheet pile **9** as in known machines.

It will be understood that, the principle of the invention being left unaltered, embodiments and constructional details may be widely varied with respect to the example described and shown without departing from the scope of this invention as defined by the appended claim.

What we claim is:

A bed-and-cylinder printing machine having a frame, a bed supported for reciprocating in said frame, a crank-mechanism for driving the bed at a varying speed, means for driving said crank-mechanism, a continuously rotating cylinder rotatably supported in said frame above said bed, at least one toothed rim on the periphery of the cylinder and at least one rack on the bed for engaging said rim during a part of the printing stroke of the bed, a mechanism for rotating the cylinder independently of the bed and at a constant speed when said rim and said rack are out of engagement, said mechanism comprising a first toothed rim receiving movement at a constant speed from said means for driving said crank-mechanism and a second toothed rim fast with the cylinder and coaxial therewith meshing with said first toothed rim during a part of the time during which the rack on the bed is disengaged from said rim on the periphery of the cylinder, means for raising and lowering the cylinder after the end and before the beginning, respectively, of said part of the bed printing stroke during which said rack engages said rim on the periphery of the cylinder, and a mechanism for rotating the cylinder independently of the bed and at a variable speed during raising and lowering of the cylinder, said mechanism consisting of a pair of toothed sectors arranged eccentrically of the axis of said first toothed rim and secured at the ends of the latter and of a pair of toothed sectors arranged eccentrically of the axis of said toothed rim and secured at the ends of the latter and meshing each with one of said sectors secured at the ends of said first rim during raising and lowering, respectively, of the cylinder, said sectors providing a positive drive of the cylinder during the raising and lowering of the latter and being of a shape such that the peripheral speed of said rim on the periphery of said cylinder and its acceleration or deceleration, respectively, at the beginning and end of the engagement of said rim with said rack on the bed equal the speed and acceleration or deceleration of the bed itself.

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