Dec. 20, 1938. L. V. DEARING 2,140,986

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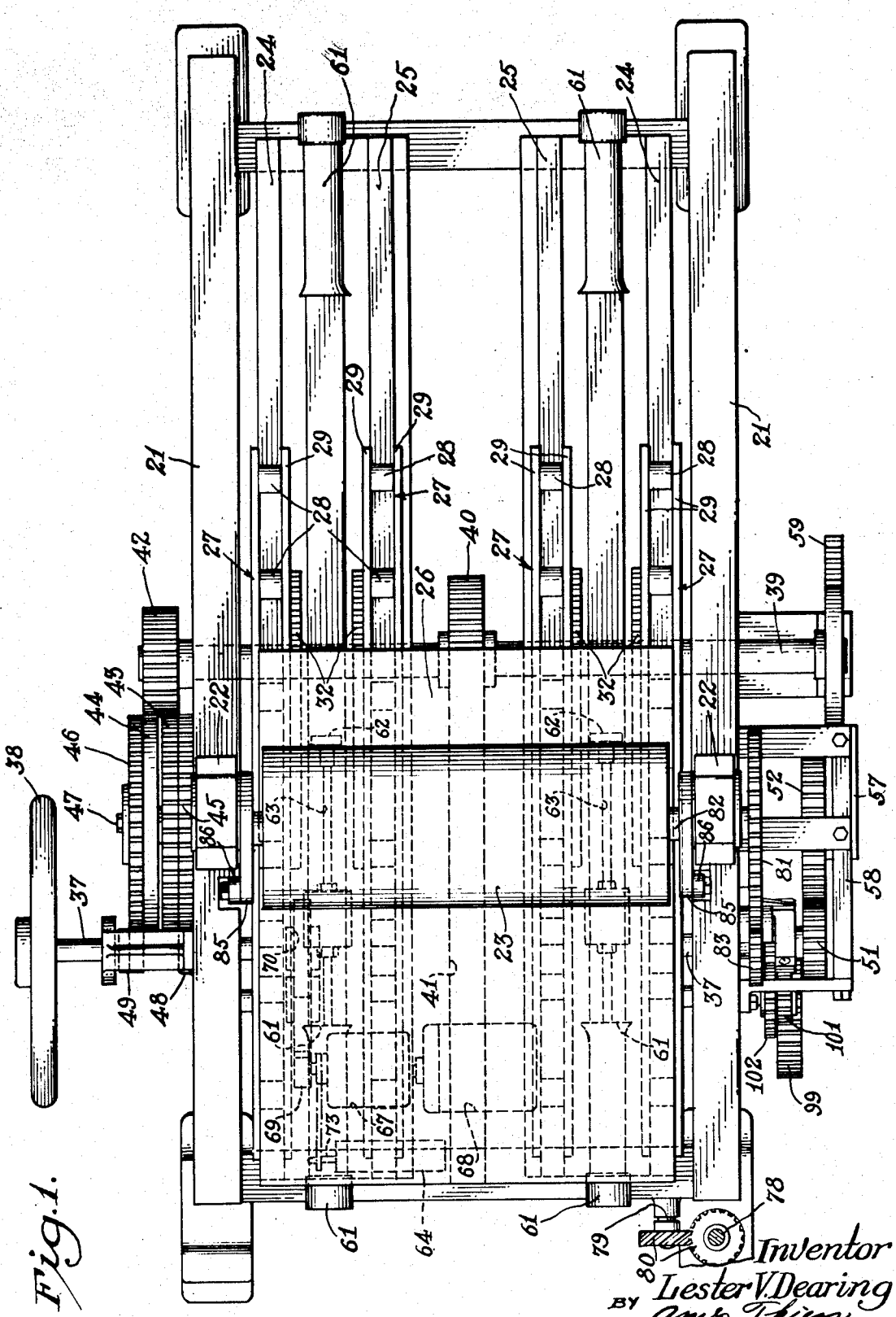


Fig. 1.

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Fig. 2.

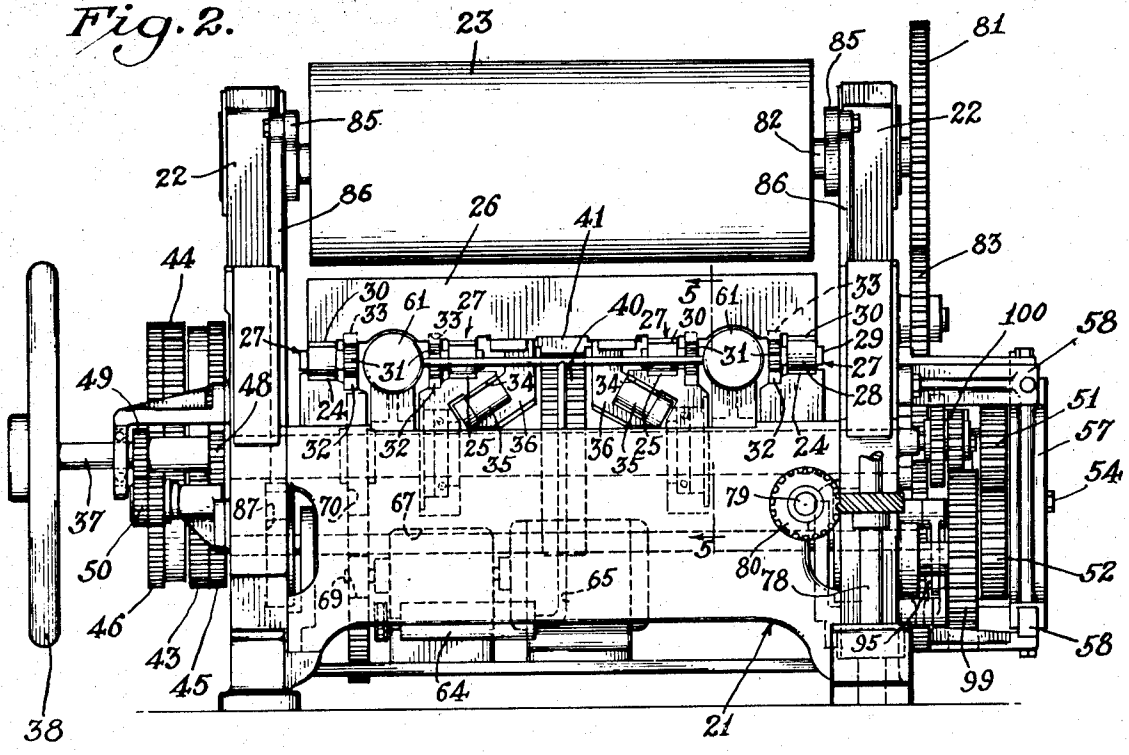
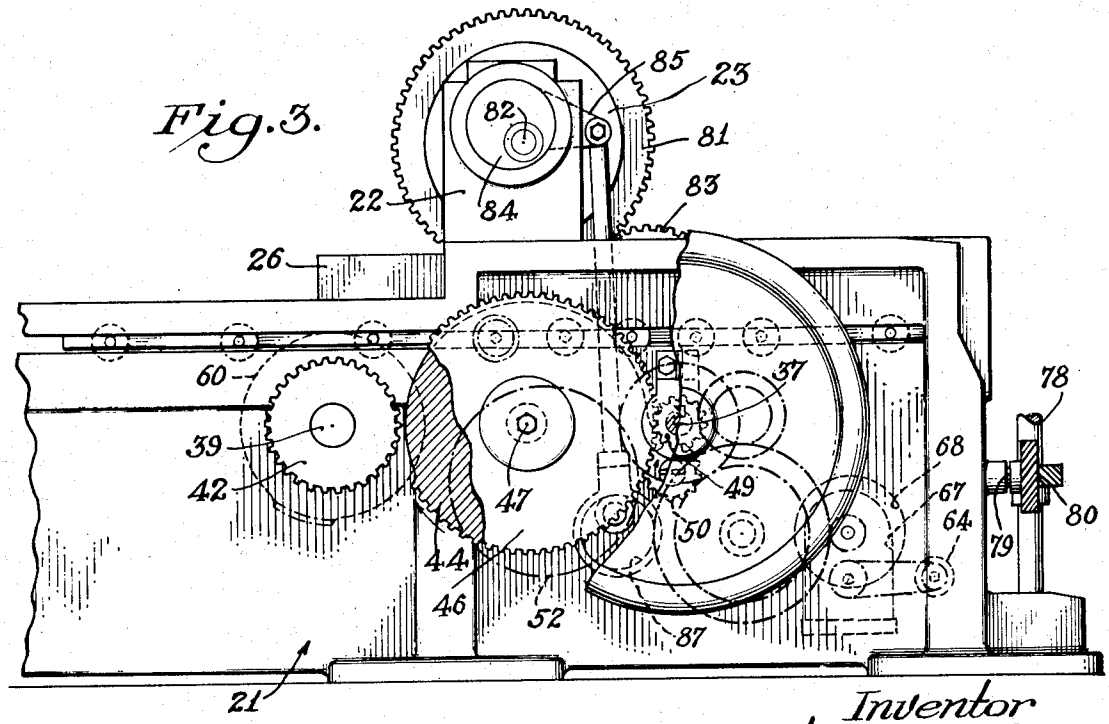


Fig. 3.



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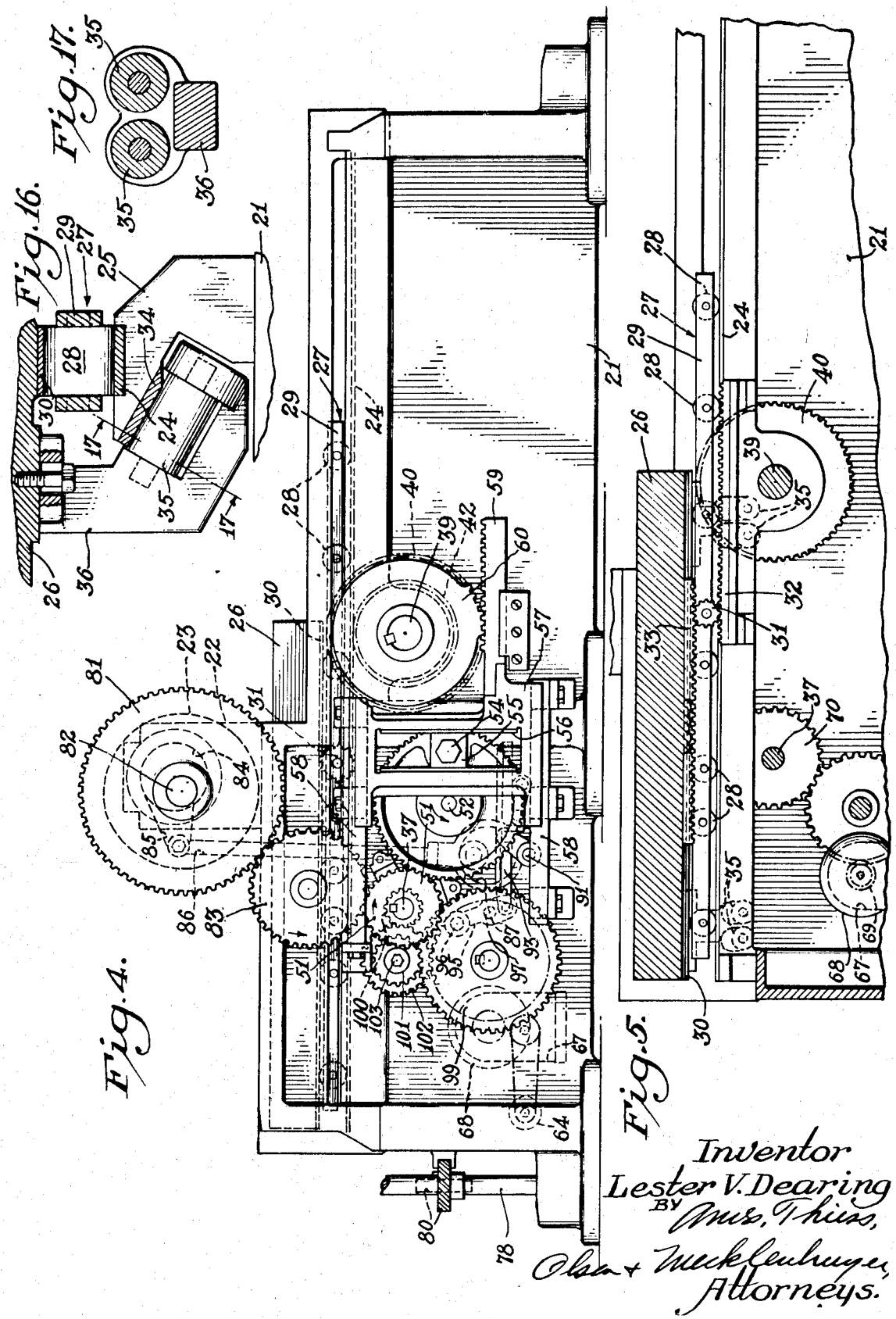


Fig. 4.

Fig. 5.

Fig. 16.

Fig. 17.

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Fig. 6.

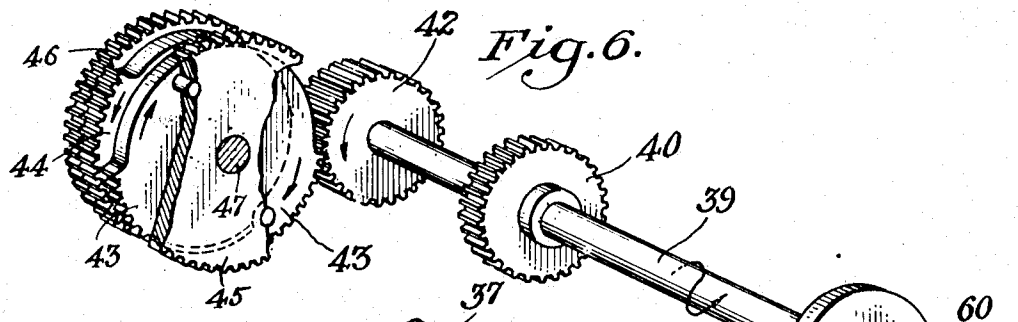


Fig. 7.

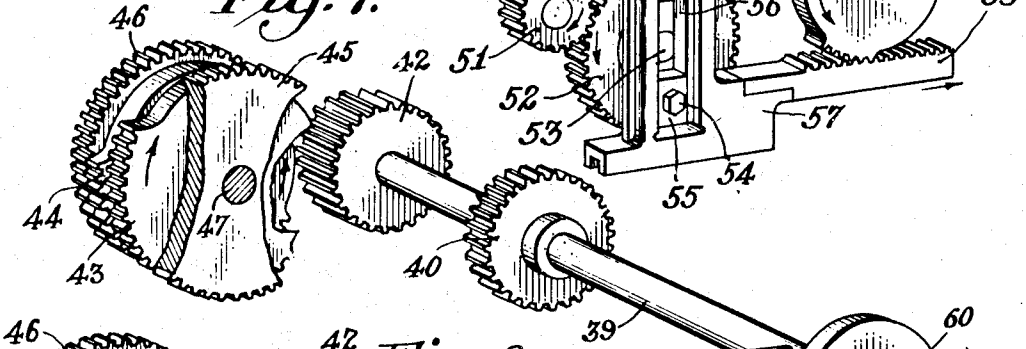


Fig. 8.

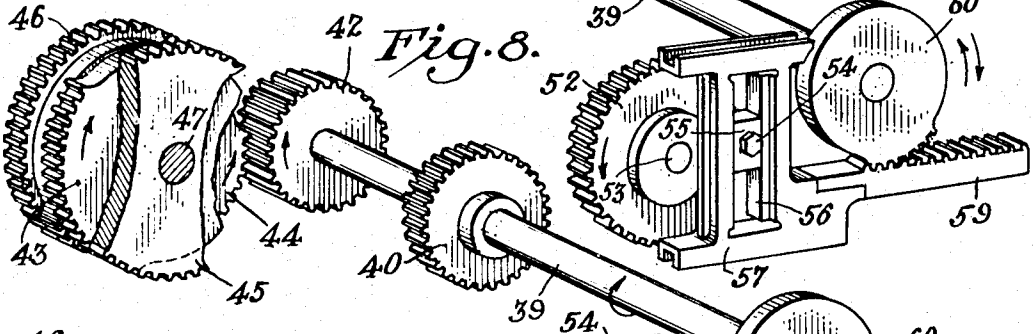


Fig. 9.

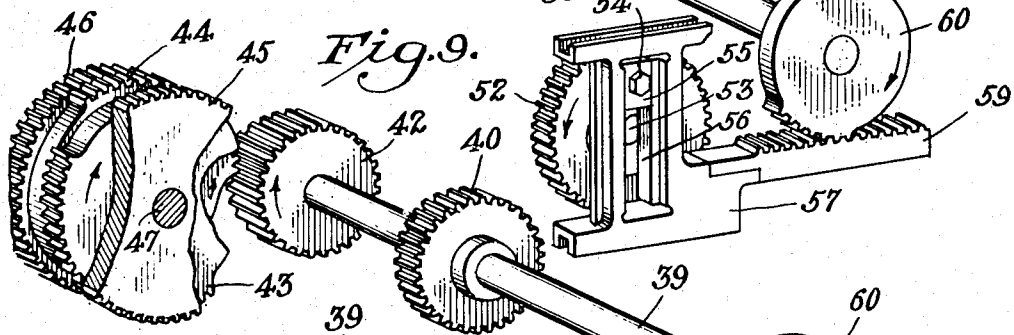
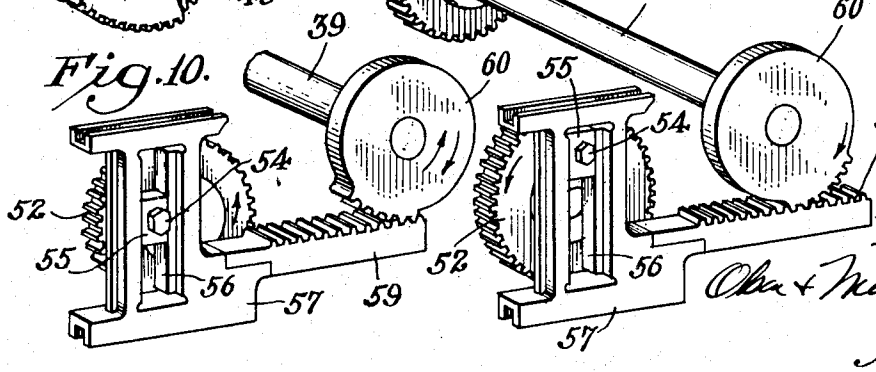


Fig. 10.



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Fig. 11.

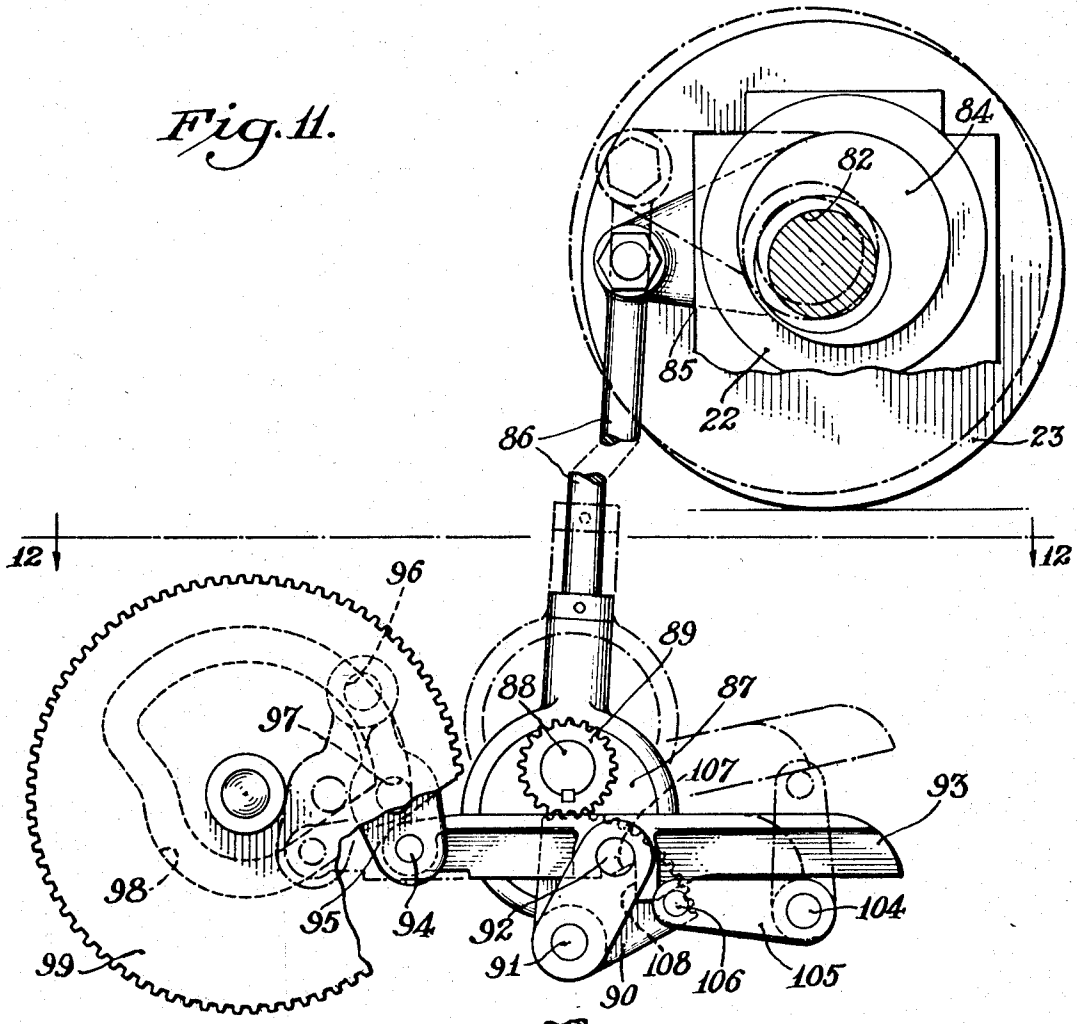
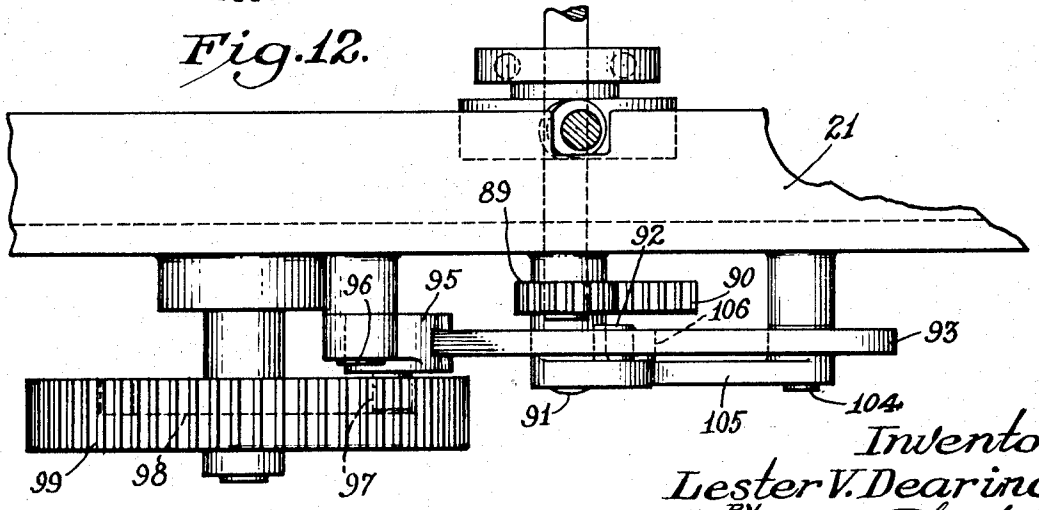


Fig. 12.



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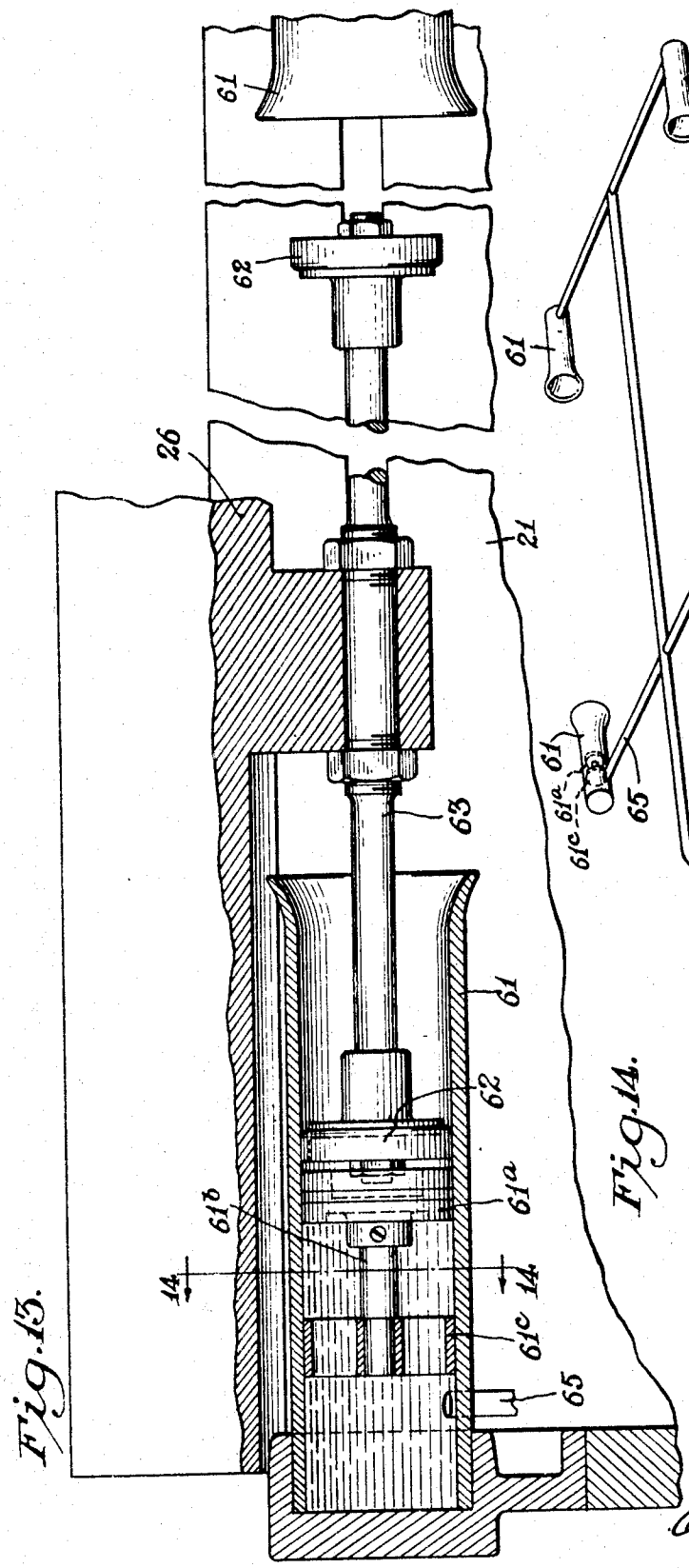


Fig. 15.

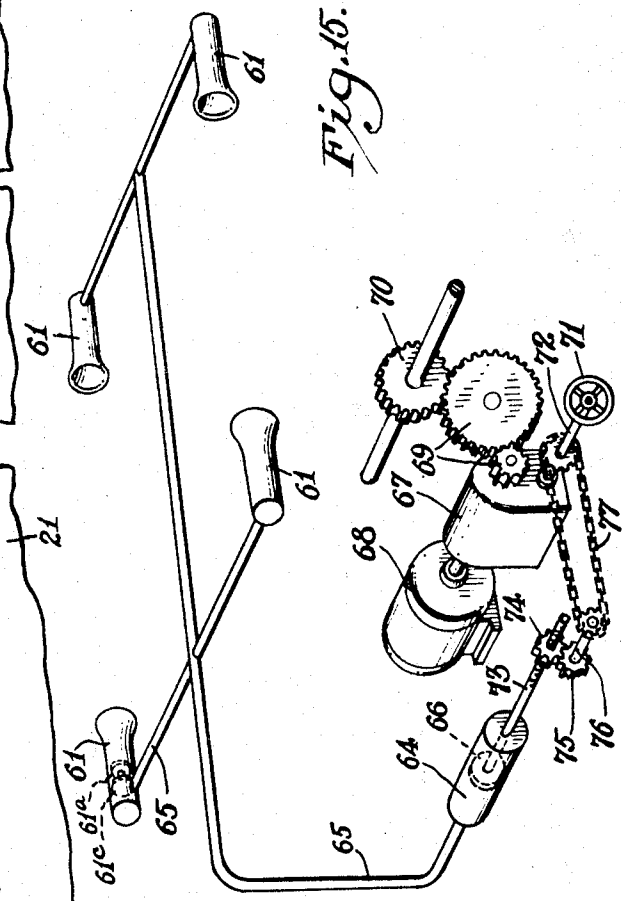


Fig. 15.

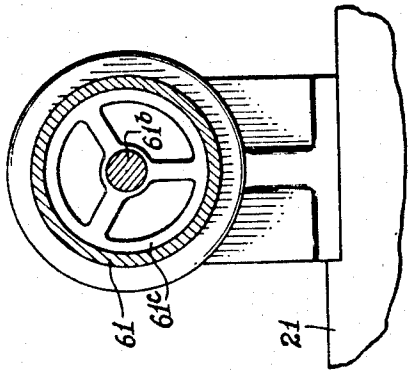


Fig. 14.

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Patented Dec. 20, 1938 2,140,986

UNITED STATES PATENT OFFICE

2,140,986

PRINTING PRESS

Lester V. Dearing, Milwaukee, Wis., assignor to Automatic Unit Corporation, Milwaukee, Wis., a corporation of Wisconsin

Application August 16, 1938, Serial No. 225,129

14 Claims. (Cl. 101—282)

This invention relates to printing presses and more particularly to cylinder presses having a rotating impression cylinder for carrying the paper and a reciprocating bed or platen which carries type matter or plates under the cylinder for printing on the paper.

The present invention is particularly adapted for use with any type of reciprocating bed press. However, it is especially adaptable in connection with so-called two-revolution cylinder presses which are often used for multi-color printing and in which the registration in successive printing operations must be very accurate. Furthermore, it is desirable to operate these presses at very high speed for quantity production and still maintain the necessary accuracy in registration, particularly for multiple printing operations. In presses of this type it is, of course, necessary to provide a comparatively heavy, rigid bed which must be reciprocated over a comparatively long cycle of movement, and it is desirable to maintain a constant high speed over that portion of the cycle during which the printing operation takes place and during the return of the table after the printing stroke. The bed is heavy in order to provide the necessary rigidity and maintain the required printing contact, and therefore the reversal of bed motion at each end of the stroke presents a serious problem, as it is desirable to accomplish the reversal as smoothly and quietly as possible and with a minimum amount of lost motion in the transmission at the reversing ends of the stroke.

The tracks and guides for the bed must necessarily be very accurate in order to prevent any lateral motion and to maintain accurate registration and uniform pressure in printing, and any excessive jar or blow or lost motion in controlling the table at the reversing ends of the cycle tends to reduce the efficiency of the press and cause wear and inaccuracy and shorten the effective life of the machine as a whole.

It has been common practice in the past to provide dashpots at each end of the table with co-operating pistons on the bed, whereby to absorb the shock of stopping the bed at the end of the stroke as the drive gears are released and other gears are then engaged to perform the reverse stroke of the cycle. Also, certain gearing devices have been used, such as the so-called Napier bed motion, in which a rack is provided on the bed and a drive gear rotating constantly in one direction operates first on one side of the rack and then on the other, the gear being moved around the ends of the rack by means of a cam co-operating with a roller on the gear.

Certain other devices have been used in which two or more racks have been provided and the drive gear operates on first one and then another rack in order to provide a reverse drive. Also, a drive gear is sometimes shifted laterally to engage first one rack and then another. All of these mechanisms have certain objections in that more or less lost motion is always present in the flexible connections and other parts of the transmission, and particularly in the bodily movable gears, and it has been impossible to reverse the bed motion without considerable shock and jar, with consequent wear on the gears, tracks, and rollers, and other parts of the mechanism.

The present invention provides a continuous power drive throughout the entire cycle, including the reversing portions thereof, and with fixed gears so arranged that a positive drive is maintained at all times and an advantageous harmonic movement is obtained during deceleration and acceleration when reversing from the maximum constant speed in one direction to the maximum constant speed in the opposite direction.

It is an important object of the present invention to provide a simplified construction in which the rack on the bed is in constant mesh with the driving gear and is at all times positively driven from the power shaft.

A further object is the provision of a press of the class described in which the operating parts will cause no sudden shocks or jars or clashing of gears and all operating parts will maintain their accuracy over long periods of use.

Another object is the provision of a reciprocating bed press having momentum absorbing dash-pots of a compensating type which more properly may be called air springs and in which the air resistance may automatically be adjusted relative to the speed of the press and in which the air resistance may be relative to the deceleration curve of the reversing transmission to thereby assist in preventing back lash in the transmission gears.

It is a further object to provide a positively driven constant speed movement of the bed through intermediate portions of the cycle and a positively driven harmonic movement through the reversing portions. Also the invention contemplates the use of momentum resisting, energy storing means which may automatically be controlled relative to the speed of the press and will operate during the reversing portions of the cycle

to equalize the positive driving force over the reversing portion of the cycle.

It is also an object to provide a bed mounting which will provide a freedom of movement which is particularly adaptable for use in connection with the positive drive transmission and which will maintain accurate longitudinal alignment and registration throughout the cycle.

Further objects will be apparent from the specification and the appended claims.

In the drawings:

Fig. 1 is a top plan view of a cylinder press and illustrates one embodiment of the invention.

Fig. 2 is a front end elevation of the embodiment illustrated in Fig. 1.

Fig. 3 is a fragmentary side view of the embodiment illustrated in Figs. 1 and 2 and illustrates that portion of the driving mechanism on the left-hand side of the machine as shown in Fig. 2.

Fig. 4 is a side elevation of the opposite side of the press from that shown in Fig. 3.

Fig. 5 is a fragmentary sectional view through the bed and supporting frame and taken on a line substantially corresponding to line 5—5 of Fig. 2.

Fig. 6 is a perspective view of a portion of the driving and reversing transmission and illustrates the position of the gears and associated parts when the bed is at the end of its constant speed stroke in one direction and at the beginning of its decelerating movement toward the point of reversal.

Fig. 7 is a perspective view similar to Fig. 6, but illustrates the position of the gears and associated parts when the bed is at the point of reversal and at the start of the accelerating movement in the reverse direction.

Fig. 8 is a perspective view similar to Figs. 6 and 7, but illustrates the elements after reversal and acceleration and at the point of starting the constant speed stroke in the opposite direction from that shown in Fig. 6.

Fig. 9 is a similar perspective view, but illustrates the position of the elements at the start of the decelerating portion of the cycle at the opposite end of the stroke from that shown in Figs. 6, 7, and 8.

Fig. 10 is a fragmentary perspective view and illustrates the position of the rack and segment transmission at the reversing point of the movement illustrated in Fig. 9.

Fig. 11 is an enlarged side elevation of the cylinder controlling mechanism.

Fig. 12 is a top view of a portion of the cylinder controlling mechanism with the eccentric connecting rod shown in section on a line substantially corresponding to line 12—12 of Fig. 11.

Fig. 13 is a longitudinal sectional view through one of the dash-pots or so-called air springs.

Fig. 14 is a transverse sectional view through the air cylinder shown in Fig. 13 and is taken on a line substantially corresponding to line 14—14 thereof.

Fig. 15 is a diagrammatic view of the variable drive mechanism and automatic control for simultaneously controlling the speed of the bed and varying the characteristics of the air springs.

Fig. 16 is a fragmentary side elevation of the bed guide rollers and associated track.

Fig. 17 is a transverse section through the guide rollers and taken on a line substantially conforming to line 16—16 of Fig. 16.

Referring to the drawings in detail, the embodiment illustrated comprises a heavy rectangular frame 21 which is preferably formed of heavy side and end plates suitably secured together to form an extremely rigid structure, the side plates having upwardly extending bracket portions 22 with suitable bearings thereon for rotatably supporting a transversely mounted cylinder 23 in suitable printing position over the printing bed. The frame 21 is provided with outer longitudinal tracks 24 and inner longitudinal tracks 25, on which a bed or platen 26 is mounted for reciprocation. Suitable so-called sliders 27 are provided between the bed and the tracks, and these sliders comprise a plurality of spaced rollers 28 which are secured together and held in spaced relation by means of side bars 29 (Fig. 1). The rollers rest upon the tracks on the frame, and the bed 26 is provided with co-operating tracks 30 which rest upon the rollers 28. The slider members may be of the usual construction and provide the equivalent of a roller bearing for free longitudinal movement of the bed 26.

Each of the sliders 27 is provided with an idler pinion 31 mounted on one of the side bars (Figs. 2 and 5). Each pinion meshes with a fixed rack 32 mounted on the associated track member. Each pinion also meshes with a rack 33 on the table 26. The rack and pinion arrangement between the frame and bed maintains the sliders in proper relative position thereto and assures a free and easy movement of the bed during its reciprocating cycle. The rollers and tracks are, of course, hardened to prevent wear and provide the required accurate alignment.

The inner tracks 25 are provided with opposed inwardly extending and angularly disposed track surfaces 34 (Figs. 2 and 16) which are arranged to be engaged by a complemental series of angularly positioned guide rollers 35 which are mounted on suitable downwardly extending brackets 36 on the under side of the bed 26. These brackets are angularly disposed, as shown, and the rollers co-operate with the rack surfaces 34 to maintain the bed in accurate lateral alignment. A plurality of these longitudinally spaced brackets 36 are used on the bed and each bracket preferably supports two of the rollers 35, as illustrated particularly in Figs. 16 and 17. This construction is particularly desirable in that it eliminates the usual lateral guide-ways for the bed 26 and not only prevents lateral misalignment of the bed but also retains it snugly on the rollers 28 on the sliders. It has been found that this construction enables very high speed operation of the press while at the same time maintaining accurate registration of the printing surface and the cylinder.

Heretofore lateral and horizontal guideways have been provided between the bed and frame and, as a running clearance has been necessary in these guides, as well as constant lubrication, considerable inaccuracy has resulted in registration, particularly in multi-color work. In the present invention, the combination of a novel means for maintaining bed alignment with a positive drive mechanism of the harmonic type provides perfect registration.

A suitable transmission is provided for driving the reciprocating bed whereby a positive driving connection is maintained throughout the entire cycle, including reversal, and without lateral shifting or other bodily movement of the gears. This transmission comprises a transverse drive shaft 37 mounted in suitable fixed bearings in the frame and having a fly-wheel 38 secured thereto. A transverse shaft 39 is also mounted in suitable fixed bearings and may be parallel with the shaft

37, and is provided, preferably at the median line of the bed, with a gear 40 in constant mesh with a rack 41 secured to the bottom of the bed 26, as shown particularly in Fig. 2.

A comparatively wide-faced gear 42 is secured to the end of the shaft 39 and this gear is alternately driven in opposite directions by means of segment gears 43 and 44, respectively. These segment gears 43 and 44 are secured, respectively, to gears 45 and 46, which latter are mounted for rotation in opposite directions on a stub shaft 47. The gears 45 and 46 and the segments 43 and 44 are constantly driven in opposite directions by the main drive shaft 37, the gear 45 being constantly driven in one direction by means of a pinion 48 on the main drive shaft meshing directly therewith, and the gear 46 being constantly driven in the opposite direction at the same speed by means of a pinion 49 on the drive shaft and operating through an idler pinion 50 in mesh with the gear 46. By this means, the gears 45 and 46 and the segments thereon are constantly rotated in opposite directions at the same speed and the segments alternately mesh with the wide-faced gear 42 for driving the bed throughout the intermediate constant speed portion of the cycle in each direction. The segments 43 and 44 are less than 180 degree segments and are so positioned that they are substantially oppositely disposed at each end of the bed stroke. Therefore, during the reversing portion of the cycle at each end of the stroke these segments are out of mesh with the wide-faced gear 42 and the out-of-mesh period is utilized for the bed-reversing operation.

In order to maintain a positive drive throughout the entire cycle, including reverse, a decelerating and accelerating mechanism is provided for reversing the table while constantly maintaining a positive drive transmission from the main drive shaft 37 to the bed 26. This mechanism provides a harmonic motion and comprises a gear 51 (Figs. 4 and 6) secured to the opposite end of the main drive shaft 37 and in mesh with a gear 52 mounted on a stub shaft 53 extending from the frame 1. The gear 52 is provided with a crank pin 54 having a suitable bearing block 55 thereon, which block is slidably positioned in a vertical slot 56 in a slidable rack frame or yoke 57, which is, in turn, mounted on suitable ways 58. It will, therefore, be apparent that, with each revolution of the gear 52, the rack frame 57 will be reciprocated.

The frame or yoke 57 is provided with a rearwardly extending rack 59 arranged to mesh with a reversing segment gear 60 secured to the end of the transverse bed-driving shaft 39. The transmission gears are of such ratio that one revolution of the bed-driving shaft 39 and gear 40 thereon may be equivalent to the acceleration to constant speed; the intermediate constant speed stroke of the bed in the same direction and the deceleration in the same direction to the reversal point. In other words, a complete reciprocating cycle of the bed requires two revolutions of the shaft 39 and gear 40. The driving segments 43 and 44 are each equivalent to slightly more than the exact mathematical length of the constant speed stroke of the bed, while the meshing time of the segment 60 with the rack 59 is equivalent to slightly more than the exact mathematical length of the decelerating, reversing, and accelerating movement of the table at each end of the stroke. The meshing engagement of one of the driving segments 43 or 44 always overlaps, and is overlapped by, the meshing engagement of the reversing segment 60 and rack 59 at each end of the intermediate constant speed portion of the stroke of the bed in either direction. As soon, however, as the reversing segment 60 is operatively in mesh with the rack 59, the constant speed driving segment moves out of mesh; in other words, the reversing segment 60 meshes in the rack 59 slightly before the disengagement of one of the main driving segments and moves out of mesh slightly after meshing of the other driving segment.

Fig. 6 illustrates the position of the gears and rack when the table drive shaft is running in the direction of the arrow and the bed has reached the end of the constant speed portion of the stroke in one direction. At this moment the crank pin 54 is also moving in the direction of the arrow and, due to its position at the bottom of its stroke, and due to the ratio of gears used, the rack is travelling in the direction of the arrow at the same speed as the pitch line of the driving segment gear 43. It will, therefore, be apparent that at this point of the crank-pin stroke the rack 59 and reversing segment 60 may be in positive mesh before the driving segment 43 is completely out of mesh with the wide-faced gear 42.

The overlapping engagement of the gear teeth of the driving segments and gear and the reversing segment and rack is possible because the crank pin 54 moves laterally for a material distance at the top and bottom of its stroke at the same speed as the pitch line of all of the segments. The continued 90 degree movement of the crank pin 54 in the direction of the arrow will first decelerate the rack and the bed operated thereby to a complete stop and the succeeding 90 degree movement of the crank pin to the top of the slot 56 will reverse the direction of movement of the shaft 39 and, in this latter position of the crank pin, the shaft 39 will be rotating at the required constant speed and the driving segment 44 will mesh with the gear 42 at the intermediate constant speed rate and before the reversing segment is out of mesh with the rack 56.

In Fig. 7 the driving segments are completely out of mesh and the reversing rack 59 is at the extreme end of its stroke and the bed is in stop position ready to reverse.

In Fig. 8 the bed has been reversed, the reversing rack 59 is travelling at its highest speed, which corresponds to the constant speed of the bed, and one of the driving segments is in mesh for continuing the constant speed movement of the bed.

The gear ratio for the reversing mechanism may be designed to correspond to a predetermined length of stroke of the bed, but, in any event, at the start of the reversing portion of the cycle at one end of the bed stroke, the reversing segment 60 and rack 59 will be in the position shown in Fig. 6 and at the end of the bed stroke at the reversing point will be in the position shown in Fig. 7, in which the segment 60 is at the exact point of reversal and ready to start a complete revolution in the opposite direction.

Fig. 8 illustrates the position of the parts after acceleration to maximum constant speed in the opposite direction from that shown in Fig. 6.

In Fig. 9 the segment 60 has made a complete revolution from the position shown in Fig. 8 and has just engaged the rack 59 for another decelerating, reversing, and accelerating movement at the opposite end of the bed stroke.

Fig. 10 illustrates the position of the parts at the reversing point at the said opposite end of the bed stroke. It should be noted that, at one

end of the bed stroke, the segment 60 meshes with the teeth at one end of the rack 59, while at the opposite end of the bed stroke the segment meshes with the opposite end of the rack, and in both cases the segment starts to mesh at the center of the rack at the maximum speed and the reversal points are at opposite ends of the rack. In order to accomplish this alternate meshing at opposite ends of the rack, the gear 52 driving the rack may make at least one revolution while the segment 60 is out of mesh. The movement of the crank pin and rack may thereby be synchronized with the movement of the bed and provide advantageous deceleration and acceleration.

The mechanism just described provides a constant, positive drive transmission between the main drive shaft and the bed at all times. There is no shifting of gears and the meshing of all of the segments takes place at the maximum pitch line speed and maximum bed speed. Therefore, there is no clashing of gears at any time and the table is smoothly and easily decelerated, reversed, and accelerated without shock, and with the drive at all times comparable to a direct positive gear connection.

As previously stated, the bed is comparatively heavy and may be operated at high speed. It is, therefore, desirable to provide a novel type of compensating dash-pots or so-called air springs comprising energy storing devices to assist in reducing the momentum of the table and to eliminate the possibility of excessive shock and stress in the mechanism and to equalize the positive power application during deceleration and acceleration. In order to accomplish this, suitable open end air cylinders 61 are provided at each end of the frame and each cylinder is mounted on a suitable bracket on the frame and arranged to receive a piston 62, which latter is mounted on a piston rod 63 rigidly secured to the bed 26. These pistons and cylinders are so positioned that the pistons may enter the cylinders substantially at the end of each constant speed portion of a cycle and compress the air in the cylinders and are so proportioned that the momentum of the table is overcome sufficiently to enable positive drive deceleration and a smooth reversal and acceleration by the combined action of the air springs and the transmission without undesirable jars or strains.

Each cylinder 61 is provided with a floating piston 61*a* which may be provided with a short piston rod 61*b* and on which is mounted a guide member 61*c* in the form of a perforated disc arranged to maintain the floating piston in alignment. The cylinders contain oil or other liquid, preferably of a type not materially affected by temperature changes, and each of the cylinders is connected to a master oil cylinder 64 (Fig. 15) by means of a suitable conduit 65. The master cylinder 64 is provided with a piston 66, and means is provided whereby this piston may automatically be positioned relative to a corresponding bed speed. In other words, varying the position of the piston 66 in the master cylinder 64 will position the auxiliary piston 61 to vary the amount of fluid in the cylinders, so that the characteristics of the air springs will be relative to the momentum of the bed of the press and also may be relative to the decelerating rate of the reversing transmission to prevent back lash.

The main drive shaft 37 of the press may be driven from any suitable power source through a variable speed transmission. In the present embodiment, a variable speed transmission 67 (Fig. 15) is driven by means of a motor 68, and this transmission drives the main drive shaft 37 by means of suitable gears 69 and a driven gear 70 on the shaft 37. The variable speed transmission 67 may be of any suitable type, preferably of the type having belt-driven cones which are adjustable by means of a hand wheel 71 on a suitable shaft 72 which controls the disposition of the cones within the variable speed mechanism. By rotation of the hand wheel, the cones may be adjusted to vary the speed as desired.

A transmission is provided between the hand wheel shaft 72 and the piston 66 of the master cylinder 64, whereby any variation of the variable speed transmission will provide a relative variation of the piston 66 in the cylinder 64, whereby a predetermined amount of fluid is injected into or withdrawn from the cylinders to thereby determine the positions of the floating pistons therein.

In the present embodiment the automatic control comprises a threaded shaft 73 on the piston 66 and this shaft is provided with a pinion 74 in mesh with a gear 75 on a shaft 76. The shaft 76 is connected to the shaft 72 of the variable speed transmission control by means of a chain 77 and suitable sprockets. By this construction, whenever the variable speed transmission is adjusted by means of hand wheel 71, the dash-pots or air springs will automatically be adjusted, whereby the resistance of the dash-pots is always proportional to the momentum of the printing bed.

As previously stated, the present invention is more particularly concerned with a so-called two-revolution press—that is, wherein the cylinder 23 makes two revolutions for each cycle of bed operation. However, it will be apparent that the cylinder may be operated in any suitable relationship which is consistent with the functioning of the reciprocating bed. Also, one or more cylinders may be used with duplicate mechanisms properly timed to drive them and raise and lower them in proper synchronism with the movement of the bed.

In the present embodiment, the cylinder 23 performs one revolution while the bed is moving in one direction and a second revolution while the bed is returning to its original position, in which position a paper sheet may be fed to the cylinder by any suitable feeding mechanism. As shown in Figs. 1 to 5, inclusive, a vertical shaft 78 may be supported in suitable bearings adjacent the paper-feeding end of the machine, and this may provide the drive shaft for any suitable type of paper-feeding mechanism. The shaft may be driven from a horizontal shaft 79 mounted in suitable bearings on the frame of the machine and connected in driving relation to the drive shaft 78 by means of suitable spiral gears 80. The shaft 79 may be driven from any suitable power source, preferably from one of the table-driving shafts, through any suitable transmission, whereby the feeding mechanism is synchronized with the bed and cylinder movement. The particular mechanism for accomplishing this result is not shown, as it is well known in the art.

The paper-feeding mechanism is, of course, also synchronized with the cylinder 23, which latter is provided with a gear 81 (Fig. 4) secured to the projecting end 82 of the shaft on which the cylinder is mounted. The gear 81 and cylinder secured thereto is constantly driven from the

main drive shaft 37 by means of the gear 51 on the drive shaft and an intermediate gear 83, which latter is in mesh with the cylinder gear 81, these gears, of course, being of a proper ratio to produce the desired speed of the cylinder relative to the printing bed. As previously stated, the cylinder 23 is raised after every printing stroke of the bed, so that the bed may complete its cycle without further contact with the cylinder. This raising of the cylinder is accomplished by means of movable eccentric bearings which are so arranged that the transmission gears to the cylinder are always in mesh substantially at the pitch line and in any raised or lowered position of the cylinder.

The mechanism for accomplishing this result is illustrated in detail in Figs. 11 and 12. The shaft 82 of the cylinder is mounted in eccentric bearings 84 which are oscillatably supported in the upwardly extending portions 22 of the frame. These bearings 84 are provided with rearwardly extending arms 85, each arm being connected by means of a link 86 to a corresponding eccentric 87 mounted on a transverse shaft 88, which latter is supported in suitable bearings in the frame 21. The shaft 87 is provided with a pinion 89 secured thereto and in mesh with an oscillatable segment 90 pivoted on the frame at 91. If the segment 90 is moved to the left from its position shown in Fig. 11, the eccentrics will be rotated to raise the cylinder 23 and a return movement of the segment to the position shown will lower the cylinder to its printing position. The segment 90 is provided with an outwardly extending pin or roller 92 which is normally engaged by a hook or latch 93. This latch is pivoted at 94 to a link 95, which latter is, in turn, pivoted to the frame at 96. Therefore, if this latch 93 is oscillated, it will rotate the shaft 88 and through the eccentric transmission will raise and lower the cylinder 23, as indicated by dotted lines in Fig. 11, and this will be accomplished without materially affecting the pitch line relationship of the driving gears.

In order to oscillate the latch 93, the link 95 is provided with a roller 97 operating in a cam slot 98 in a gear 99. This combined gear and cam is driven from the main drive shaft 37 by means of a transmission comprising a pinion 100 (Fig. 4) on the drive shaft 37 and the intermediate gears 101 and 102 rotatably mounted on a stub shaft 103. The various mechanisms are so synchronized that the cylinder is in raised position when the paper is fed to the machine, and, if for any reason a sheet of paper is not fed to the machine at the proper time, a suitable mechanism is provided so that the latch 93 will be released from the pin 94 and the cylinder will not be lowered during at least one cycle of the printing bed.

The mechanism for releasing the latch 93 comprises an oscillatable shaft 104 (Fig. 11) having an arm 105 secured thereto and provided with a laterally extending pin 106 positioned under the latch 103. The oscillatable shaft 104 and the tripping arm thereon are normally retained in the position shown in Fig. 11 as long as the paper is consecutively fed to the printing press in the proper timed relation. The shaft and trip arm 104 thereon may be controlled from the paper-feeding mechanism by any suitable tripping device, not shown, the mechanism of which is well known, and it is believed unnecessary to describe it in detail. In order that the latch 103 may only be raised when the cylinder is in the raised position, the pin 92 on the latch is provided with a flat side 107 and the co-operating slot 108 in the latch 103 is of such dimension that the latch may only be raised and released from the pin when the pin is in the dotted-line position (Fig. 11), in which position the cylinder 23 is in raised position.

The usual paper-feed tripping mechanism is so constructed that the latch 103 will remain in lowered position as long as paper is fed consecutively in proper timed relation to the press, and whenever paper is not properly fed thereto the latch automatically will raise and will remain in the raised position until a sheet of paper is again properly fed to the machine.

Modifications may be made without departing from the spirit of the invention. It is desired, therefore, that the invention be limited only by the prior art and the scope of the appended claims.

Having thus described this invention, what is claimed and desired to be secured by Letters Patent is:

1. In a printing press having a reciprocating bed with constant speed throughout an intermediate portion of the cycle in each direction, the combination with a pair of gear-segments positively driven in opposite directions and a positive gear connection between one of said segments and said bed during each intermediate movement of said bed comprising a single rack carried by the bed and a pinion constantly in mesh therewith, of a reciprocating rack and gear-segment transmission to said pinion for driving said pinion and consequently the bed through the decelerating, reversing, and accelerating movements, said segments being related to provide alternate positive drives throughout the entire cycle.

2. In a printing press having a reciprocating bed with constant speed throughout an intermediate portion of the cycle in each direction, a drive shaft, two gear-segments positively driven in opposite directions by said shaft, a positive gear connection successively between said segments and said bed during alternate intermediate movements of said bed comprising a single rack carried by the bed and a pinion constantly in mesh with said rack, a rack and gear-segment transmission to said pinion for the decelerating, reversing, and accelerating movements of the bed, and a positive drive transmission between said drive shaft and said rack, the meshing engagement of said segments being related to provide a positive drive from said drive shaft to the bed throughout the entire cycle.

3. In a printing press having a reciprocating bed, a power shaft, an oscillatable shaft, a constantly meshed rack and pinion connection between said oscillatable shaft and the bed, a gear secured to said oscillatable shaft, a pair of concentric segments positively driven in opposite directions from the power shaft and arranged to alternately mesh with said gear to positively drive the bed through a constant speed intermediate portion of its cycle of motion in each direction, a reversing gear-segment operatively connected to the oscillatable shaft for positively driving the bed through the reversing portions of the cycle, a reciprocating rack positively driven from the power shaft and arranged to intermittently mesh with said reversing gear-segment in such timed relation to the operation of the oppositely turning pair of segments as to positively drive the bed through the reversing portions of the cycle, the meshing of said reversing gear-segment and its

rack occurring between the periods of meshing of the concentric segments with the gear on the oscillatable shaft and having an overlapping timed relationship with the operation of said concentric segments so that at least one segment is always in positive mesh to drive the bed through the entire cycle.

4. In a printing press having a reciprocating bed, a power shaft, an oscillatable bed-driving shaft, a rack carried by the bed, a pinion fixed on the oscillatable bed-driving shaft and in mesh with said rack throughout all motion of the bed and whereby all motion of the bed is imparted thereto by the pinion on the bed-driving shaft meshing with said rack, a transmission between said power shaft and said oscillatable shaft comprising a gear secured to said oscillatable shaft, a pair of concentric gear-segments arranged to alternately mesh with said oscillatable shaft gear, a constant mesh gear transmission for driving said segments in opposite directions at the same speed for positively driving said bed through the intermediate portion of the cycle in each direction, a reversing gear-segment secured to said oscillatable shaft, a reciprocating rack for intermittent engagement with said reversing segment, and a varying speed transmission from said power shaft for reciprocating said rack in timed relationship to the movement of said reversing segment whereby the meshing of said rack and segment is initiated at the highest speed of said oscillating shaft at an intermediate point on said rack when the segment is moving in either direction, said concentric segments and said reversing segment overlapping in driving mesh whereby at least one segment is always in driving mesh throughout the entire reciprocating cycle of the bed.

5. In a printing press having a reciprocating bed with constant speed throughout an intermediate portion of the bed motion in each direction, the combination of, a single rack carried by the bed, a single pinion meshing with the rack at all times and throughout all portions of the bed motion, a power driven constant speed drive transmission to said pinion including a pair of oppositely turning gear-segments positively drivingly connected with said pinion throughout the intermediate portion of the bed motion, and a variable speed power driven drive transmission positively drivingly connected with said pinion during the end portions of the bed motion.

6. In a printing press having a reciprocating bed, an oscillatable shaft transverse to the linear motion of the bed, a single driving connection between said shaft and the bed operative continuously throughout the entire cycle of bed motion, a constant speed drive transmission to the oscillatable shaft for moving the bed at constant speed through the intermediate portion of its motion comprising a pair of gear-segments continuously driven in opposite directions and alternately positively acting on said oscillatable shaft at spaced intervals, a harmonic motion positive drive transmission acting on the oscillatable shaft during the interim between the periods of action of said pair of gear-segments to drive the bed at the ends of its motion, and a single power source permanently connected with both of said drive transmissions, said drive transmissions overlapping in their actions on the oscillatable shaft to provide an uninterrupted positive drive to said oscillatable shaft.

7. In a printing press having a reciprocating bed, an oscillatable shaft transverse to the linear motion of the bed, a single driving connection between said shaft and the bed operative continuously throughout the entire cycle of bed motion, a constant speed drive transmission to the oscillatable shaft for moving the bed at constant speed through the intermediate portion of its motion comprising a pair of gear-segments continuously driven in opposite directions and alternately positively acting on said oscillatable shaft at spaced intervals, a reversing gear-segment fixed to the oscillatable shaft, a harmonic motion positive drive transmission acting directly on said reversing gear segment during the interim between the periods of action of said pair of gear-segments to drive the bed at the ends of its motion, and a single power source permanently connected with both of said drive transmissions, said drive transmissions overlapping in their actions on the oscillatable shaft to provide an uninterrupted positive drive to said oscillatable shaft.

8. In a printing press having a reciprocating bed with constant speed throughout an intermediate portion of the bed motion in each direction, the combination of, a single rack carried by the bed, a pinion meshing with the rack at all times, a shaft to which the pinion is fixed, a gear on said shaft, a pair of power driven gear-segments operable continuously in opposite directions and alternately engageable at spaced intervals with said gear to drive the bed through an intermediate portion of its motion, a reversing gear segment fixed to said shaft, and a variable speed power driven drive transmission positively acting directly on said reversing gear-segment during the interims between intervals at which said pair of gear-segments are operative, to drive the bed at the ends of its motion.

9. In a printing press having a reciprocating bed, resilient means for resisting the momentum of said bed, and means for simultaneously varying the speed of said press and the characteristics of said momentum resisting means.

10. In a printing press having a reciprocating bed, resilient means for resisting the momentum of said bed, and a single manually operable means for varying the velocity of said bed and the resilience of said resisting means.

11. In a printing press having a reciprocating bed, a variable speed mechanism for driving said press, pneumatic springs for resisting the momentum of said bed, hydraulic means for varying the pneumatic characteristics of said springs, and a single manual control for varying said speed mechanism and said hydraulic means.

12. In a printing press having a reciprocating bed and a variable speed control mechanism, opposed air spring cylinders for opposite strokes of said bed, pistons controlled by said bed for co-operation with said cylinders to resist the momentum of said bed, means for varying the effective air capacity of said cylinders, and means for simultaneous relative adjustment of press speed and cylinder volume.

13. In a cylinder printing press having a reciprocating bed, a power source, a transmission from said power source to positively drive said bed through a constant speed intermediate portion of its stroke in each direction, a second transmission for positively driving said bed through the decelerating, reversing, and accelerating portions of its stroke whereby a positive drive is maintained throughout the entire cycle, a variable speed mechanism for said transmis-

sions, energy storing means effective to resist momentum to thereby assist deceleration and to assist acceleration after reversal, and means to automatically maintain the effective characteristics of said last means relative to the driving rate of said second transmission.

14. In a printing press having a reciprocating bed, a constant speed positive drive transmission for said bed through intermediate portions of the stroke in each direction, a harmonic motion positive drive transmission for said bed throughout the extreme portions of the cycle, the positive driving engagement of said transmissions overlapping at the constant speed rate to provide an uninterrupted positive drive throughout the entire cycle, and variable energy storing momentum resisting means operative during said extreme portions of the cycle and tending to equalize the applied energy of said harmonic transmission during its positive driving engagement.

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