Jan. 18, 1966 E. P. POLLITT 3,229,627

MULTICOLOR SCREEN PRINTING PRESS

Filed Aug. 19, 1963 9 Sheets-Sheet 1

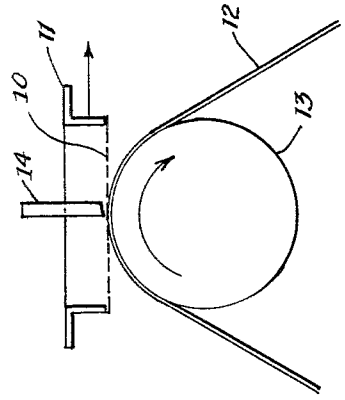


Fig. 1

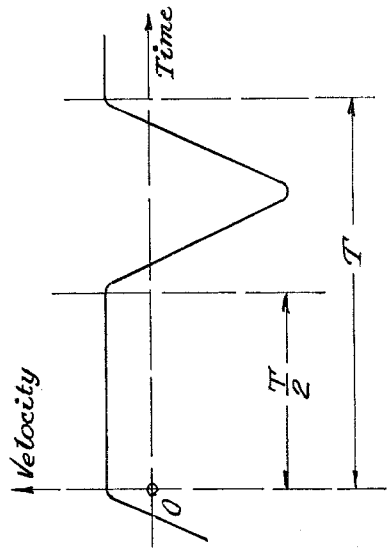


Fig. 2

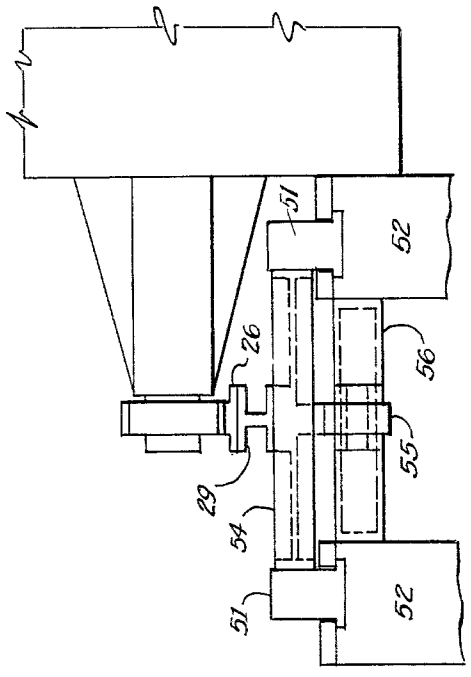


Fig. 11

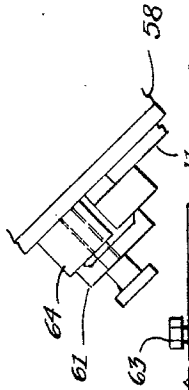


Fig. 12c

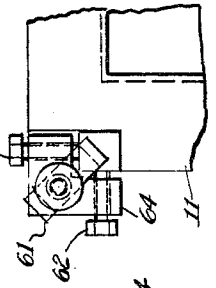


Fig. 12a

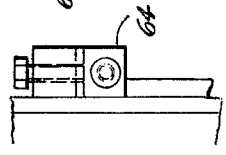


Fig. 12b

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MULTICOLOR SCREEN PRINTING PRESS

Filed Aug. 19, 1963 9 Sheets-Sheet 2

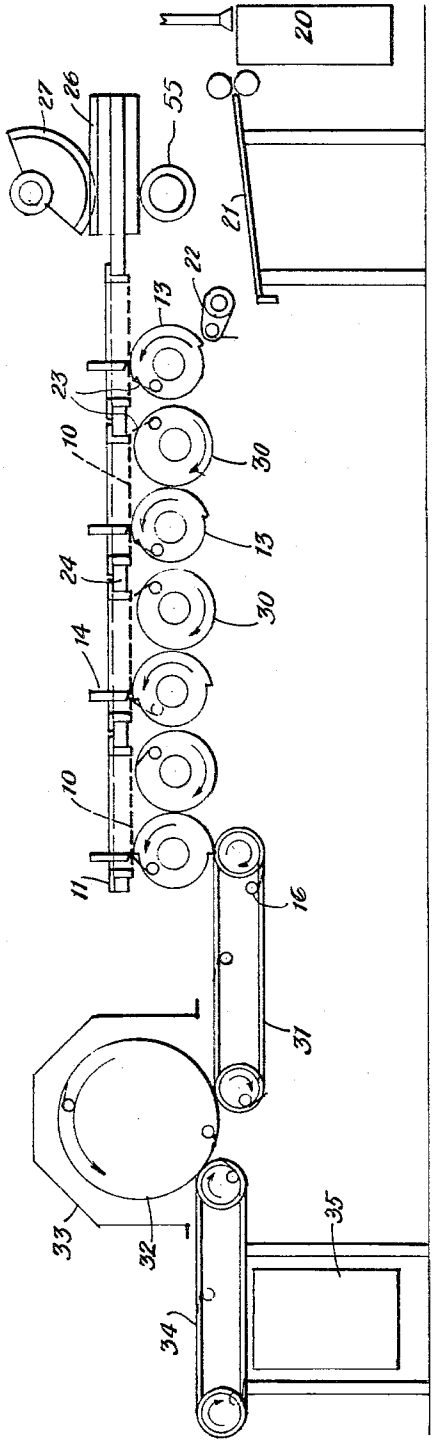


Fig. 3

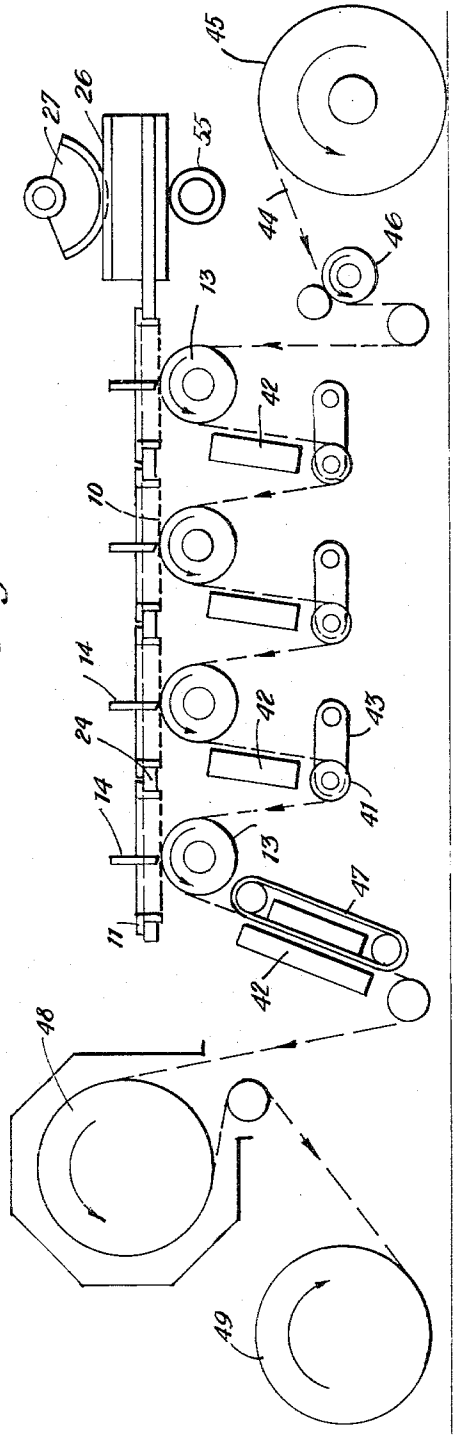


Fig. 4

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MULTICOLOR SCREEN PRINTING PRESS

Filed Aug. 19, 1963 9 Sheets-Sheet 3

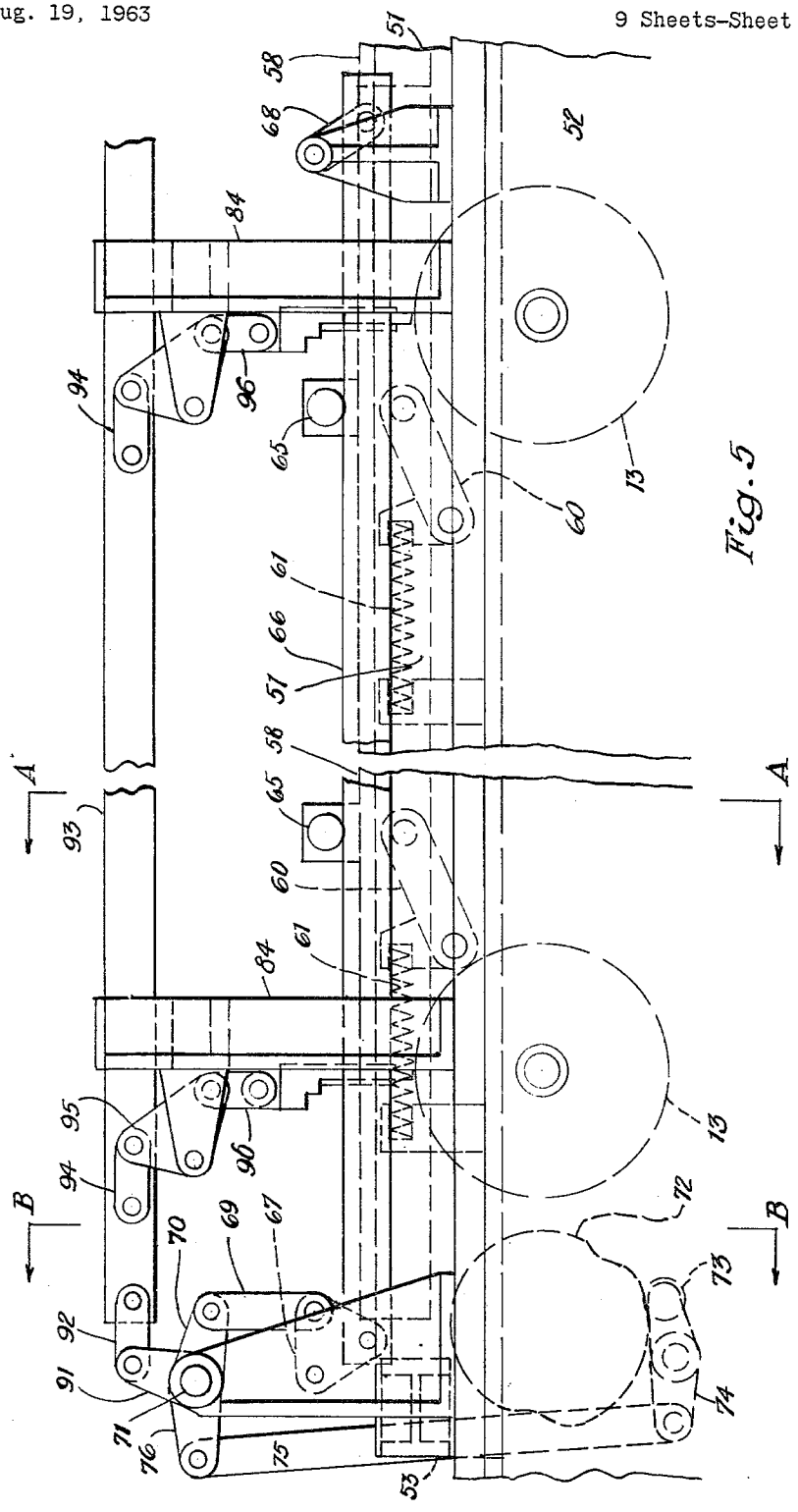
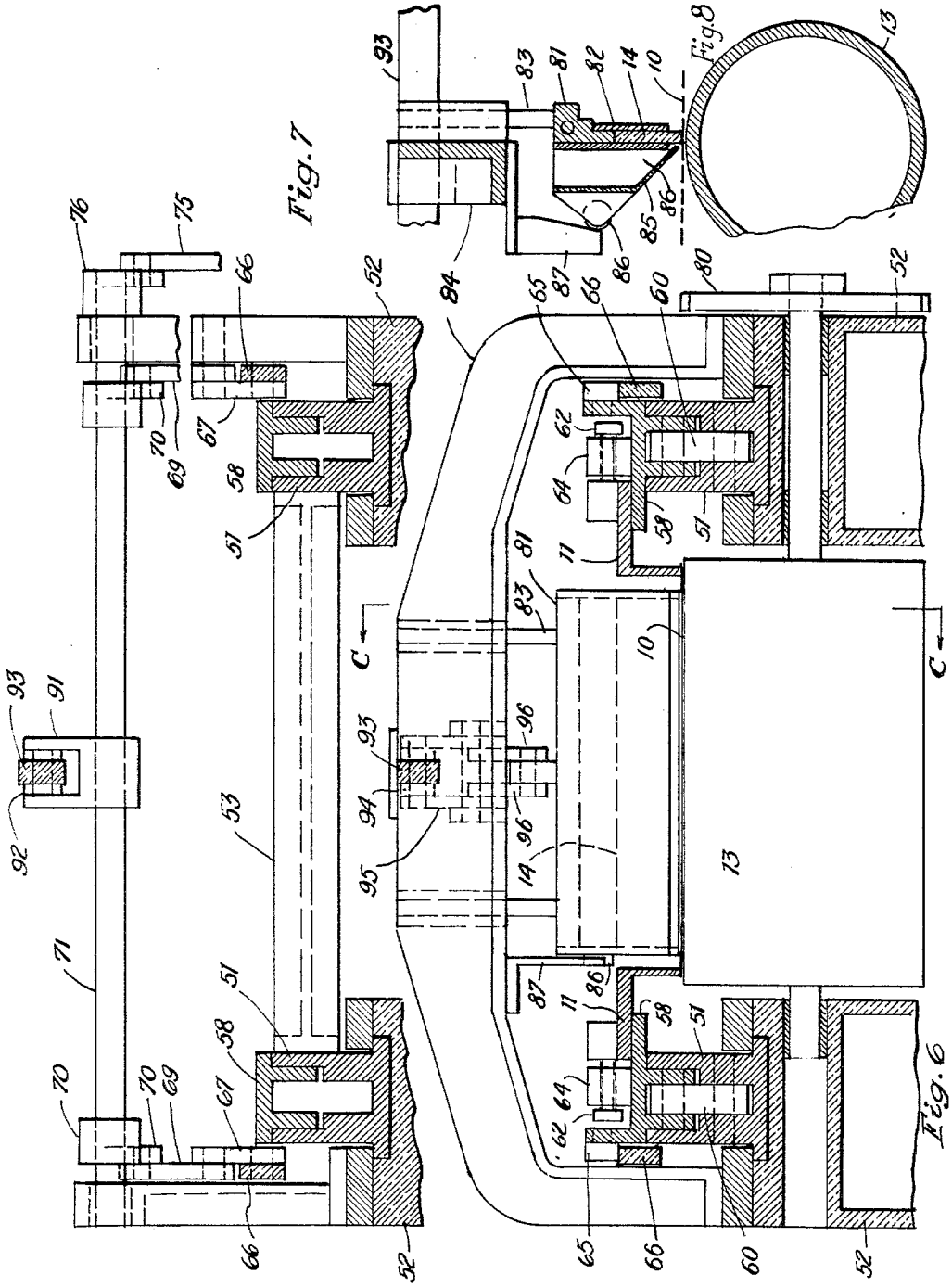


Fig. 5

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MULTICOLOR SCREEN PRINTING PRESS

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MULTICOLOR SCREEN PRINTING PRESS

Filed Aug. 19, 1963 9 Sheets-Sheet 5

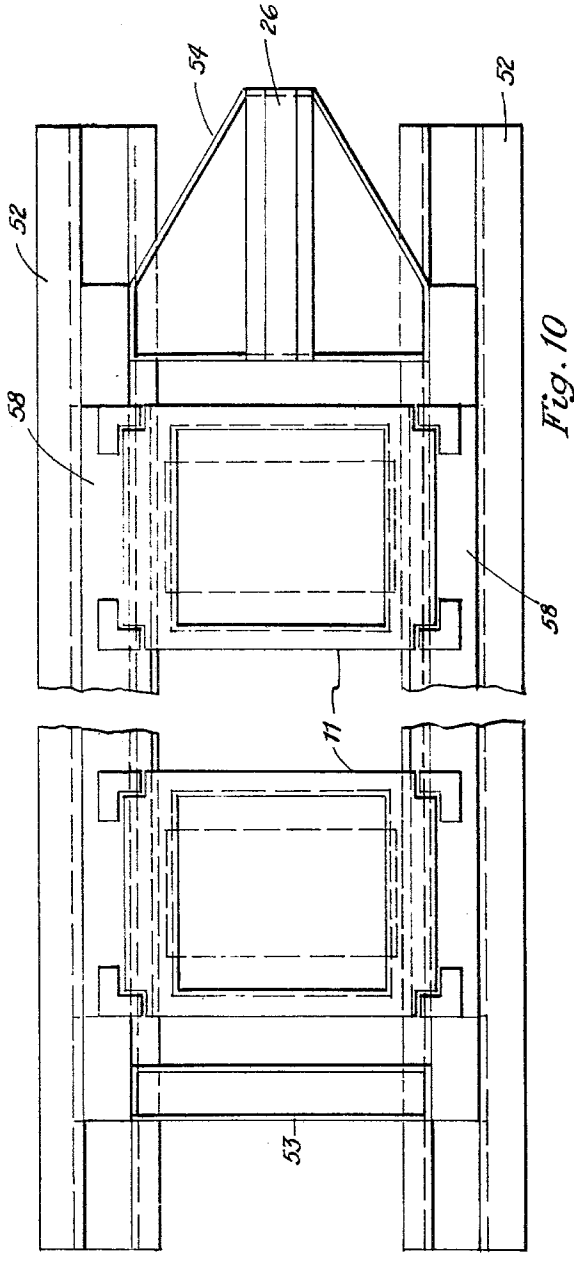


Fig. 10

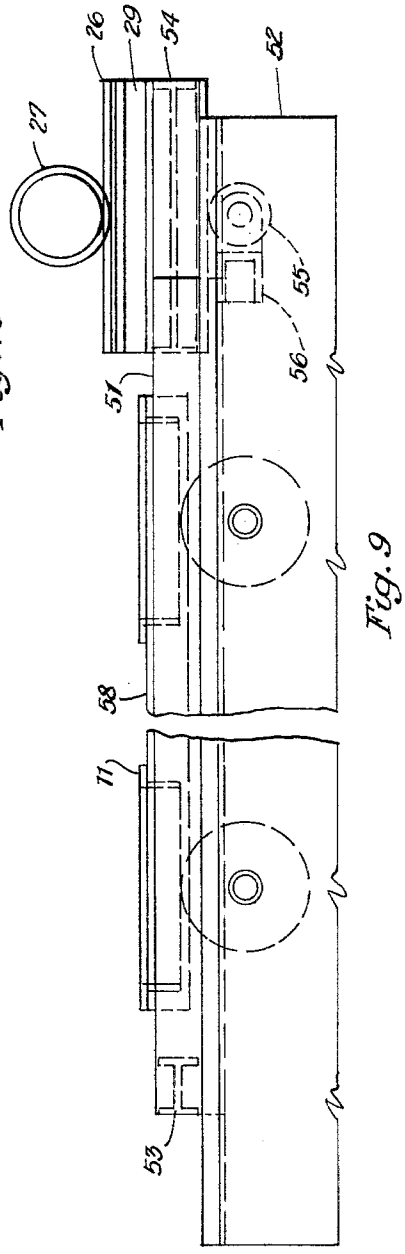


Fig. 9

MULTICOLOR SCREEN PRINTING PRESS

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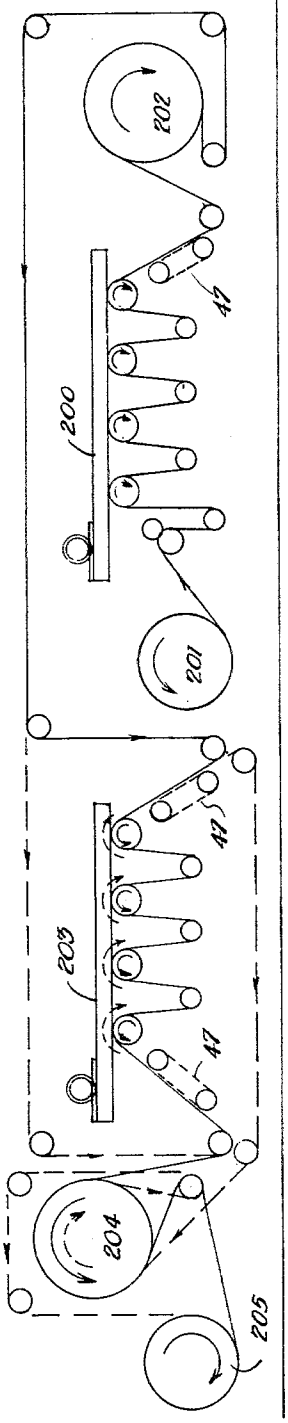


Fig. 14

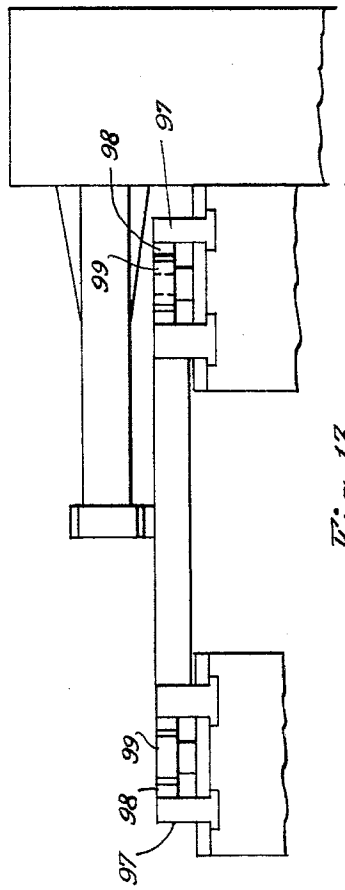


Fig. 13

MULTICOLOR SCREEN PRINTING PRESS

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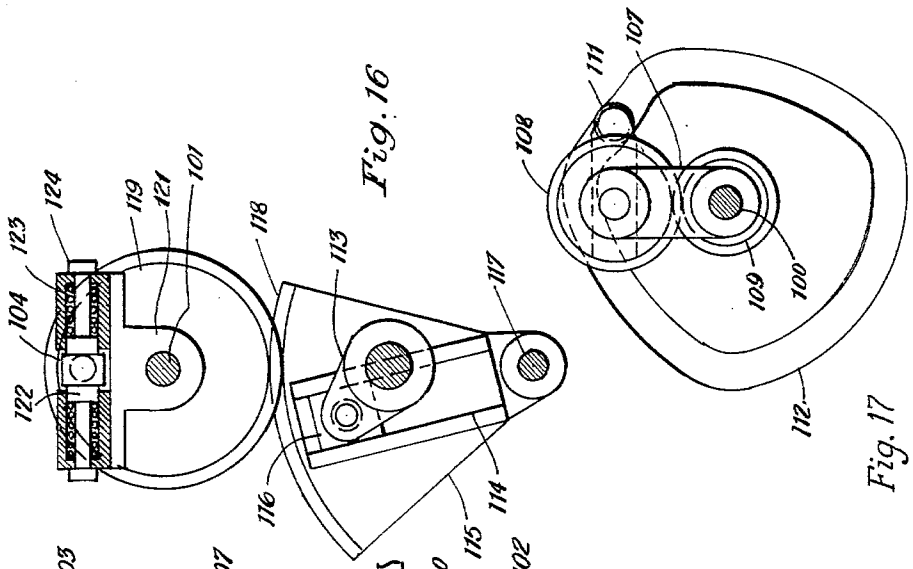


Fig. 16

Fig. 17

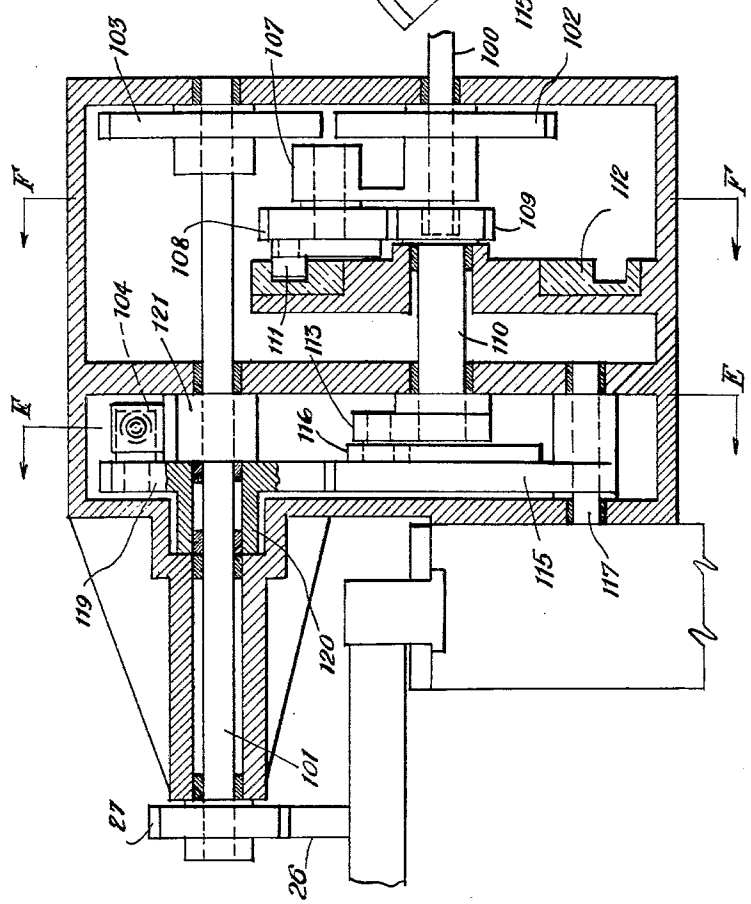


Fig. 15

MULTICOLOR SCREEN PRINTING PRESS

Filed Aug. 19, 1963 9 Sheets-Sheet 8

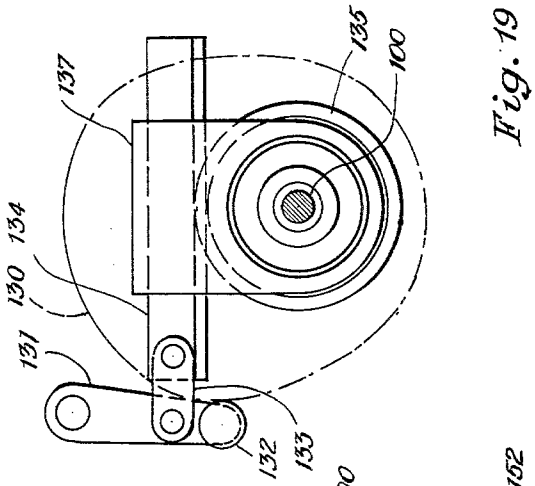


Fig. 19

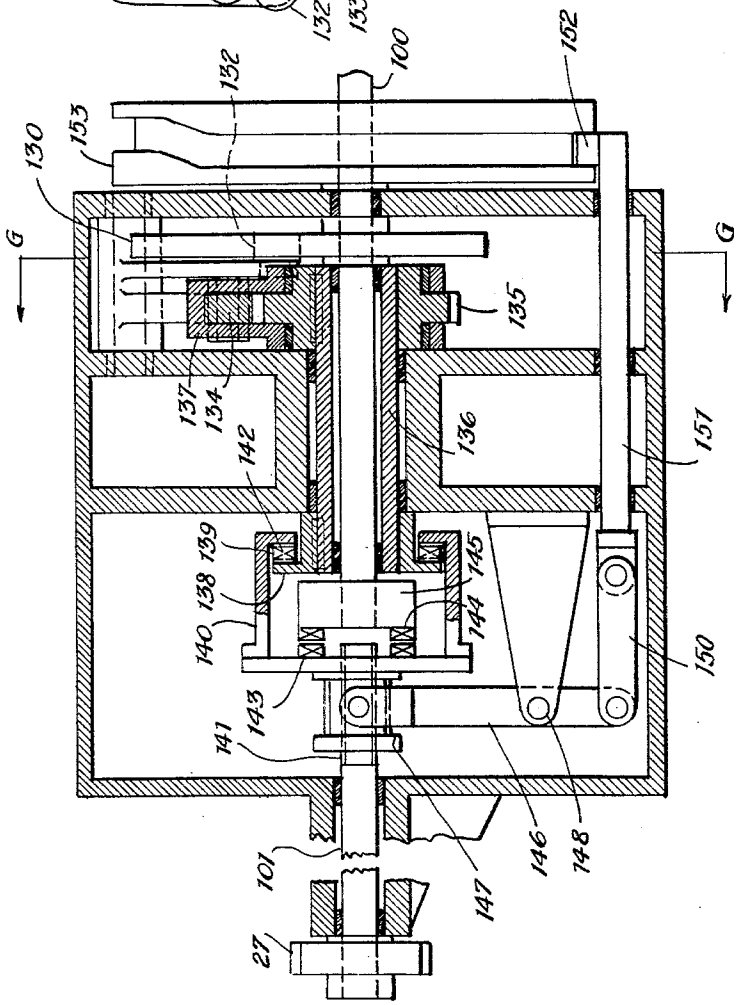


Fig. 18

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MULTICOLOR SCREEN PRINTING PRESS

Filed Aug. 19, 1963 9 Sheets-Sheet 9

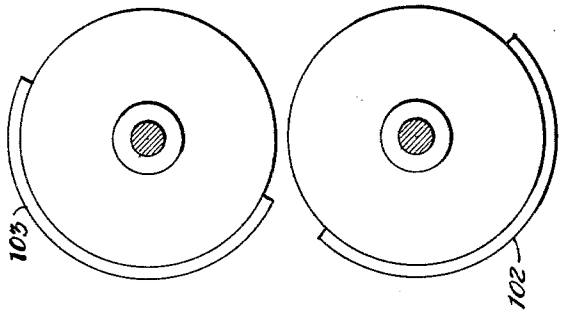


Fig. 21

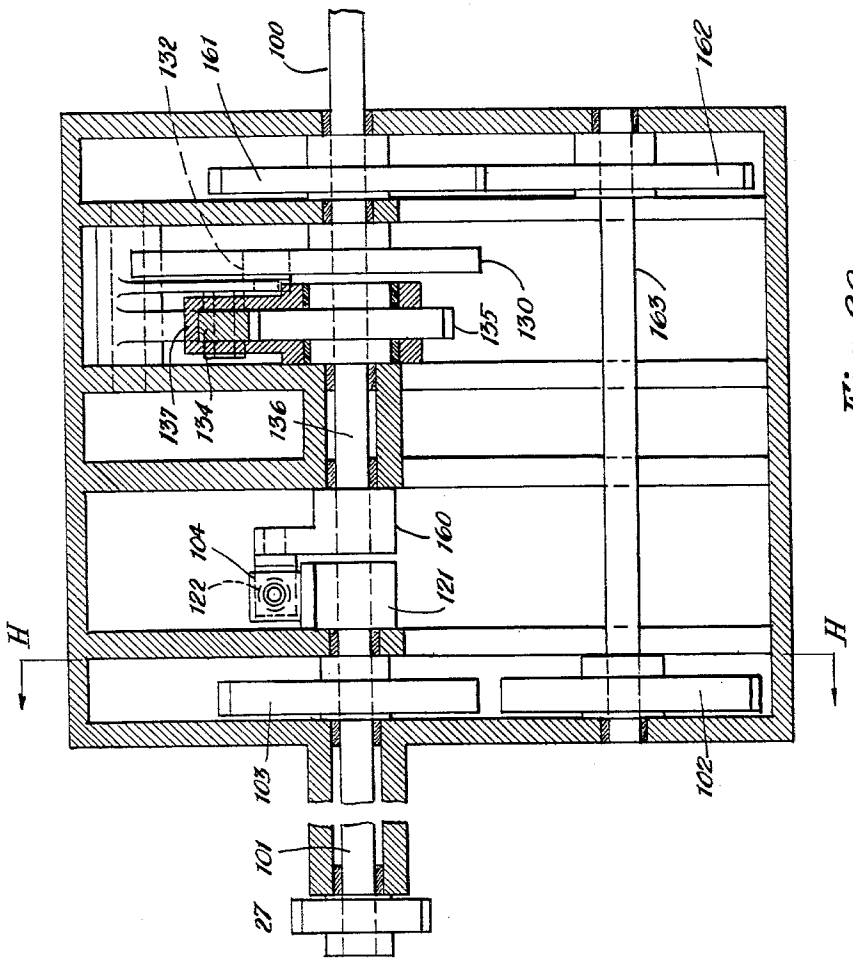


Fig. 20

United States Patent Office 3,229,627 Patented Jan. 18, 1966

3,229,627

MULTICOLOR SCREEN PRINTING PRESS

Erwin P. Pollitt, 481 Oakdale Ave., Glencoe, Ill.

Filed Aug. 19, 1963, Ser. No. 302,789
20 Claims. (Cl. 101—115)

The invention concerns a printing press.

The object of the invention is to provide a printing press, for paper, card board, textile, or other flexible material, which is suitable for using plates made by the silk screen process (also called "screen process") where the image is formed by perforations in the coating of a fine screen through which ink is squeezed onto the surface to be printed by means of a squeegee.

In the printing press in accordance with the invention the screen is arranged in a substantially horizontal plane and is reciprocated in this plane while an impression cylinder for guiding the paper is arranged underneath the screen, and tangent to it, and a squeegee is arranged on top of the screen and held in contact with the screen at the impression line during the printing period of the cycle of the screen reciprocation; during this printing period the screen and the paper are moved at equal uniform velocity.

In a printing press of this type the paper or other flexible material may be in the form of sheets or a web; any number of colors or designs may be printed in one pass by providing a multiplicity of screens in one plane, and by providing a corresponding number of impression cylinders with their axes lying in a parallel plane.

A printing press in accordance with the invention may be designed for handling webs such that it can be adapted to different print lengths without changing impression cylinders; this can be accomplished by providing means for varying the length of the stroke of the press bed which carries the screens, and for varying the ratio of the number of revolutions of the impression cylinders to the number of reciprocations of the press bed.

Another object of the invention is to provide a drive mechanism for the press bed whose output motion has a long uniform velocity period during which printing may take place.

Other objects of the invention will appear in the text as the printing press is more fully described.

The invention is illustrated in the accompanying drawings.

FIG. 1 is a diagram of the basic elements of the printing press.

FIG. 2 is a typical velocity-time diagram of the reciprocating motion of the press bed and the screens attached to it.

FIG. 3 is a diagram of the general arrangement of the printing press adapted to sheet printing, with four impression cylinders.

FIG. 4 is a diagram of the general configuration of the printing press adapted to web printing, also provided with four impression cylinders.

FIG. 5 is a side elevation of the press bed and associated components.

FIG. 6 is a typical cross section A—A (FIG. 5).

FIG. 7 is a typical cross section B—B (FIG. 5).

FIG. 8 is a cross section C—C (FIG. 6).

FIG. 9 is a side elevation, FIG. 10 a top view, and FIG. 11 an end view of the press bed structure only.

FIG. 12*a*, *b*, and *c* show the arrangement of the clamps and register adjusting devices at one corner of the screen holder.

FIG. 13 shows diagrammatically the arrangement of balancing weights.

FIG. 14 shows the general arrangement of a perfecting press for web printing.

FIG. 15 is a sectional elevation of one type of drive unit for the press bed.

FIG. 16 is a view E—E (FIG. 15).

FIG. 17 is a view F—F (FIG. 15).

FIG. 18 is a sectional elevation of another type of drive unit for the press bed.

FIG. 19 is a view G—G (FIG. 18).

FIG. 20 is a sectional elevation of a third type of drive unit for the press bed.

FIG. 21 is a cross section H—H (FIG. 20).

The screen **10** (FIG. 1) which is attached to screen holder **11** is arranged, in the press, in a substantially horizontal plane and performs a reciprocating motion. The paper or other flexible material **12** is guided over the impression cylinder **13** and, during the printing period of the cycle of the screen reciprocation, the screen is tangent to it. The squeegee **14** is arranged vertically above the screen at the point of tangency of screen and paper, the impression line. The squeegee is in contact with the screen at this line during the printing period. During the remainder of the cycle of the reciprocation of the screen the squeegee is tripped away from the screen; if necessary the screen may also be moved out of contact with the paper during this time. During the printing period of the cycle the speed of the paper is equal to the speed of the screen, and the impression cylinder rotates at a corresponding surface speed.

During the printing period the screen and the paper move at uniform velocity which has the advantage that the paper and most of the paper handling mechanisms may also move at uniform speed throughout the whole cycle.

The velocity-time diagram of the reciprocating motion of the screen, and the press bed to which it is attached, as shown in FIG. 2, has a uniform velocity period lasting one half of the time T of the cycle. This long velocity period is of particular advantage in a press for web printing as will be demonstrated in describing the printing press shown in FIG. 4. However, the same time-velocity relationship may be used in a press bed for a sheet fed press, and the same design of the press bed may be used in a sheet fed as well as a web fed press.

The sheet fed press whose diagram is shown in FIG. 3 is suitable for printing four colors; it has four impression cylinders **13** of equal diameters all driven at the same uniform speed.

The feed mechanism may be of any suitable type. As shown it has a feed stack **20** from which the sheets are moved by suction cups or similar devices to a register table **21** provided with front and side stops which stop the sheets in correct relation to the screens. A set of oscillating or intermittently rotating swing grippers **22** transfer the sheets from the register table to the firs impression cylinder **13** which is provided with a single set of grippers **23** which, again, may be of any well known design; this transfer takes place when the speed of the sheets held by the swing grippers is approximately equal to the uniform speed of the surface of the impression cylinders.

All the screens **10** are lying in the same horizontal plane, and their screen holders **11** are attached to the press bed **24**. All impression cylinders **13** are arranged such that their axes lie in a horizontal plane parallel to the plane of the screens. The press bed is running in horizontal guides in the side frames **52** of the machine (FIGS. 6 and 7); it has attached to it a rack **26** engaged by an oscillating gear **27** which imparts to it a reciprocating motion whose time-velocity relationship may be as shown in FIG. 2. The drive unit which imparts to the gear **27** an oscillatory motion with these speed characteristics will be described later.

The squeegees **14** are supported on a frame member

84 (FIG. 6) which straddles the side frames of the machine.

The sheets are moved from impression cylinder to impression cylinder by transfer cylinders 30. These transfer cylinders have the same diameter and rotate at the same speed as the impression cylinders and are also equipped with a single set of grippers, as shown, such that the sheets move at the same speed through the whole press.

However, if more time for drying the ink between impressions is needed than can be obtained with the shown transfer cylinders, it is possible to use transfer cylinders with a larger diameter equipped with a correspondingly larger number of sets of grippers; for instance, the transfer cylinders may have twice the diameter of the impression cylinders and be provided with two sets of grippers.

From the last impression cylinder the sheets are transferred, by means of a conveyor chain 31 provided with gripper bars 16, to a dryer; this dryer may consist of a heated drum 32 provided with grippers for carrying the sheets and surrounded by a housing 33 in which hot air is circulated. From the dryer the sheets are transferred to another gripper chain 34 which carries them to the delivery stack 35 where the sheets are released.

Evidently if the transfer cylinders were arranged so that they are tangent to the screens during the printing period there is the danger that they may pick up some ink from the screens. To avoid this they may be placed lower than the impression cylinders as indicated in FIG. 3. With this arrangement the grippers of these transfer cylinders, as well as those of the impression cylinders, must be slightly phase shifted with respect to one another in order to secure proper timing of the gripper action; as a consequence, the maximum print length will be somewhat less than the length of travel of the screens during their uniform motion period.

That portion of the circumference of the impression cylinder which is not covered by a sheet of maximum print length can be recessed in order to prevent transfer of ink from the screens during the return stroke of the latter. In a printing press with impression cylinders of this design the screens can be attached directly to the press bed, using clamps and register adjustment screws similiar to those described with reference to FIGS. 12*a*, *b*, and *c*.

The tripping mechanism for the squeegees may be similar to that shown in FIG. 5, and consist of a cam 72, cam follower 73, trip bar 93 and associated linkages which will be described with reference to this figure.

The sheet fed press can handle any sheet length down from the maximum length for which it is designed. The circumference of the impression cylinder is determined by this maximum sheet length and the ratio of the actual printing period to the total time of the cycle of one reciprocation of the press bed.

A printing press with an arrangement of the screens, press bed, squeegees, drive unit, and impression cylinders which is similar to that of FIG. 3 can be used for web printing as shown in FIG. 4.

The impression cylinders 13 have a smooth circumference; they are again of equal diameter and arranged so that their axes lie in a plane parallel to the plane of the screens. Between successive impression cylinders the web 44 is guided over compensating rolls 41; if necessary a small dryer 42 may be provided between the compensating roll and the preceding impression cylinder in order to surface-dry the ink and prevent smudging of the compensator roll. These rolls are mounted on pivoted levers 43, or in slidable bearing blocks, to permit adjustment of the roll position so as to secure register in the running direction between the images printed on the web.

The web is pulled off the unwind roll 45 by feed rolls 46 from where it runs to the first impression cylinder. From the last impression cylinder the web is pulled by a suction belt 47 whose surface speed is somewhat higher than that of the feed rolls and impression cylinders in order to keep the web in tension. From the suction belt the web runs through a web dryer 48 and on to the rewind roll 49, or to a cutter and suitable delivery mechanism, or to a folder.

Since the uniform speed period during which printing takes place is only a portion of the whole cycle of the reciprocating motion of the press bed only the corresponding portion of the length of the web which passes the impression line during the cycle will be printed by one screen and one coacting impression cylinder while the remaining portion of this length will not be printed. If the uniform speed period is one half of the total time of the cycle two screens and two coacting impression cylinders are necessary for printing the whole length of the web in one color. If the press bed performs a motion of this type the printing press with four impression cylinders shown in FIG. 4 will, therefore, print the whole web in two colors, or half of the web in four colors such that a printed area alternates with an unprinted area of equal length. In the latter case the web may be passed through the press a second time for printing the gaps. To print the whole length of the web in one pass in four colors requires eight impression cylinders and screens.

The magnitude of the diameter of the impression cylinder can be chosen arbitrarily; it is only necessary to drive the impression cylinders such that the paper speed is always equal to the speed of the screens during the printing period.

The printing press can handle different print lengths without requiring changing the impression cylinders. If the press has a drive unit for the press bed where the ratio between the printing period and the total length of the cycle can not be changed (as is the case with the drive units described later) provisions must be made for varying the stroke of the press bed. But, varying this stroke has the consequence that, if the cyclic rate of the reciprocations of the press bed remains unchanged the velocity of the screen during the printing period will be varied; then, in order to have the web move at the same speed as the screens it must be possible to vary accordingly the surface speed of the impression cylinders. Thus, the printing press can be adjusted to different print lengths by two adjustment operations;

(1) The amplitude of the stroke of the press bed is varied such that the print length becomes equal to the length of travel of the screens during the printing period of the cycle, and,

(2) The ratio between the rate of the reciprocations of the press bed and the number of revolutions of the impression cylinders is varied such that the impression cylinder advances the paper web by a distance equal to the print length during the printing period of the cycle.

In the printing press described both adjustments can be performed without difficulty. The first adjustment is accomplished by selecting an oscillating gear 27 of the proper pitch diameter and by raising or lowering the rack 26 by means of changing spacers such as to maintain proper mesh between rack and gear. The second adjustment is accomplished by changing the ratio between the drive unit for the press bed and gears for driving the impression cylinders.

The image of one color can be divided up, in the running direction, into two havles, and one half image put on one screen, the other half on the other screen; this permits the use of shorter screens and of a shorter stroke.

To prevent the web from picking up ink from the screens during their return stroke the impression cylinder is preferably separated from the screen during this period. This can be accomplished by tripping the impression cylinders away from the screens. For this their bearings may be mounted in eccentric bushings in the machine frames, and these bushings may be cyclically oscillated, a method which is frequently used in printing presses; with the arrangement of the press of FIG. 4 it would be neces-

sary for the compensator rolls to simultaneously perform a similar tripping motion in order to maintain register. Instead, separation of impression cylinders and screens can be accomplished by raising the screens during their return stroke; devices for this purpose may be conveniently combined with devices for tripping the squeegees which must go out of action at the same time. Tripping of the squeegees can be accomplished by attaching the screens to the press bed in such a way that while the press bed moved horizontally during its return stroke the screens perform a vertical motion relative to the press bed structure.

The press bed, shown in FIGS. 5 to 10, has two longitudinal U-shaped bars **51** which are open at the top; these bars are guided in ways on top of the stationary side frames **52** of the press. The ends of these bars are connected with each other by tie bars **53** and **54**. Tie bar **54** at the feeder end of the press carries the rack **26** and spacer **29**. Underneath the rack, at its mesh point with gear **27**, a roll **55** is provided which is mounted on tie bar **56** connecting side frames **52** (FIG. 9).

In the web press the screen frames **11** are not attached directly to the bars **51** but to two longitudinal bars **58** which are connected to the bars **51** by parallelogram links **60** and held in contact with their top surface by springs **61** during the printing period. The screen frames **11** rest on the horizontal top surfaces of the bars **58**, and are held in contact with these surfaces by swing clamps **61** (FIGS. 12*a* to *c*) bearing down on their top. Two pairs of transversely arranged screws **62** are provided on the bars **58** whose free ends contact blocks on the longitudinal edges of screen frame **11** and allow lateral register adjustment. Two corresponding pairs of screws, **63**, contacting the transverse edges of the screen frame permit adjustment of the screen in the running direction. Rotation of the swing clamps about their vertical axis brings them out of contact with the screens and permit easily removal of the latter. The adjusting screws and the clamps are mounted in blocks **64** which are attached to the bars **58**.

Attached to each bar **58** are two rollers **65** (FIGS. 5 and 6) underneath which a horizontal trip bar **66** is provided which is connected to the side frame of the machine by two parallelogram links **67**, **68**. Link **67** which is arranged at the delivery end of the press is connected by links **69**, **70** to the trip shaft **71** which runs across the press and is oscillated by cam **72**, cam follower **73**, and links **74**, **75** and **76**, the cam performing one revolution per press bed cycle. The shape of this cam is such that at the beginning of the nonprinting period it rotates the trip shaft and the links **67** and **68**; this causes the trip bar **66** to go up and lift the bars **58** which, in turn, will then raise the screens out of contact with the paper. FIG. 6 also shows the arrangement of gear **80** for driving the impression cylinder.

In a sheet fed press where the impression cylinder is relieved over that portion of their circumference with corresponds to the non-printing period of the cycle the bars **58** and associated tripping devices are not needed; the screen frames and the blocks **64** can be attached directly to the bars **51** of the press bed.

The squeegee blade **14** (FIGS. 6 and 8) is a straight bar of rubber or a similar soft and resilient material which is held in its holder **81** by a clamp **82** which permits easy removal of the blade. The holder has two leader pins **83** by which it is vertically guided in a bracket **84** mounted on the side frames of the machine. Pivotally mounted to the holder is a transverse wall **85** of the ink trough **86** while the holder itself constitutes its other transverse wall. The lateral walls of this trough fit over the lateral end surfaces of the holder. Attached to the pivoted wall **85** is a cam follower **86** which when the squeegee is moved upward comes in contact with a cam **87** on bracket **84**. The shape of this cam is such that the upward motion of its follower roller causes the wall **85** to swing towards the squeegee blade and close off the bottom of the ink trough to prevent ink from dripping on the screen. An electric heater may be provided in the ink trough or in the holder to keep them at the proper temperature.

Trip shaft **71** also trips the squeegees. Attached to the center of this shaft is link **91** connected by link **92** to the trip rod **93** which runs through to the squeegee of the first printing screen. This rod carries links **94** which are connected to bell cranks **95** connected by links **96** to the squeegee holders. When the trip shaft is rotated the trip rod **93** is moved in the length direction of the press and, through the links and bell cranks, raises the squeegees.

The linkages which control the trip motion of the squeegees and the screens are so proportioned that the screens rise slower than the squeegees so that the squeegees separate from the screens during their tripping motion.

All the images for the different impression cylinders may be put on a single screen and registered photographically; in this only a single screen holder is necessary for multicolor printing.

If it is desired to trip each screen and squeegee independently from one another each screen would be mounted on a pair of short bars similar to the bars **58**, and each of these bars would be connected to the press bed by links similar to the parallelogram links **60**. A trip shaft similar to shaft **71** would be provided for each screen, and each shaft actuated by its own cam which would be similar to cam **72**.

It is possible to cancel out the external inertia forces acting in the direction of and caused by the reciprocating motion of the press bed by the arrangement shown in FIG. 13. At the elevation of the center of gravity of the press bed two masses **97** are provided which are placed at equal distance from and at opposite sides of this center of gravity. The magnitude of each of these masses is equal to one half of the mass of the press bed. These masses are reciprocated, in the direction opposite to the motion of the press bed, by horizontal racks and gears **98** and **99** respectively, which gears, in turn, may be driven by racks attached to the press bed.

A printing press for a single color, for sheets, is similar to that shown in FIG. 3 except that only one impression cylinder, and no transfer cylinders, are required. The general configuration of a printing press for a single color, for web, is similar to that shown in FIG. 4 except that for printing the whole web in one pass it needs only two impression cylinders. With a single impression cylinder only half of the length of the web can be printed in one pass as was pointed out previously.

The described printing presses can also be used for perfecting as shown for the web press, FIG. 14; two printing presses of nearly identical design are arranged in series and the web is guided such that it travels through these presses in opposite directions. In the first printing unit, **200**, the paper web shown in solid lines moves from the unwind roll **201** arranged at the center between the two units from left to right and to the first dryer **202**; from the dryer it runs to the second, the perfecting unit **203** through which it passes from right to left, and on to the second dryer **204** and the rewind roll **205**.

The perfecting unit **203** can be provided with a reversing mechanism in the drive which permits reversing the direction of rotation of the impression cylinders and of the reciprocation of the press bed; suction belts are provided at both ends of the unit. In the reversed unit the web will run in the direction indicated by the dotted lines. A press of this design equipped with four impression cylinders in each unit can be used in two ways: either as a perfecting press in two colors, or for printing four colors on one side.

The drive mechanism for the impression cylinders and dryer drums may consist of spur gears in series, or of

bevel gears driven by a longitudinal shaft; in a press for web printing a conventional transmission with change gears may be provided between this main drive and the input shaft of the drive unit for the press bed to allow varying the speed ratio between the impression cylinders and the press bed reciprocation in order to permit adjustment of the press to different press lengths.

The drive unit for reciprocating the press bed consists essentially of three mechanisms, one for generating the non-uniform speed portion of the reciprocating motion of the press bed, one for driving the press bed during its uniform motion period, and one for switching the non-uniform motion drive to the uniform motion drive, and vice versa.

The mechanism for generating the non-uniform portion of the reciprocating motion of the press bed may consist essentially of non-circular gears, of a cam only, or of a linkage whose output motion is modified by a cam; in the latter case it is possible to use the cam for first converting uniform input rotation into non-uniform rotation, and then convert this rotation ino the desired oscillatory output motion.

The uniform portion of the output motion is obtained by driving the output shaft from the input shaft directly, or through plain gears, or clutches. Cyclically switching from the uniform drive to the non-uniform drive may be accomplished by resilient clutches, or by the use of interrupted gearing, or by inserting in the train of drive elements a gear engaged by a rack which is cyclically disengaged from this gear, or by a combination of these devices.

FIGS. 15 to 17 show a drive unit where the non-uniform portion of the motion of the cycle is obtained by first converting uniform input motion into non-uniform rotation, and then converting the latter into the oscillatory output motion by a linkage. Uniform output motion is obtained by interrupted gears in combination with a resilient clutch.

The input shaft **100** drives output shaft **101** during the uniform motion period through the interrupted gears **102** and **103** whose fully active teeth extend through an arc of 108 degrees. The output shaft carries at its end segment gear **27** engaging rack **26** on the press bed. Mounted on the end of shaft **100** is an arm **107** carrying a planet gear **108** which meshes with sun gear **109** mounted on the end of intermediate shaft **110** coaxial with shaft **100**. Attached to the planet gear is a cam follower **111** engaging a stationary cam **112** which surrounds the sun gear; this cam and planet gear arrangement causes non-uniform rotation of the sun gear. The sun gear drives a shaper crank linkage. Shaft **110** carries at its end the crank **113** provided with a slide block **116** which engages a slot **114** in the rocker **115** mounted on the intermediate shaft **117**. The rocker is provided with a gear segment **118** engaging a gear **119** attached to a hollow intermediate shaft **120** mounted concentric to the ouput shaft **101**, is free to rotate on it and connected to it by the resilient clutch **121**.

The shape of the cam is such that gear **119** tends to impart to gear **27** the desired non-uniform speed during the non-printing periods, and uniform motion during the printing period. Due to machining errors exact uniform motion can not be obtained in this manner; in order to have exact uniform speed the clutch **121** has resilient torque transmitting members which permit the uniform speed drive provided by the gears **102, 103**, to prevail over the motion imparted to the output shaft by the gear **119** to prevail during the uniform speed period.

Gear **119** carries block **104** engaged by two plungers **122**; these plungers are guided in recesses in the body of the clutch, and are held in engagement with the block **104** by springs **123**. Each plunger is provided with a stop **124** which prevents it from following the motion of the block **104** in one direction but permits the plunger to further compress the spring when the block moves in the opposite direction relative to the clutch body. The spring pressure is set so as to result in a torque acting on the block **104** which is higher than the maximum load torque. Consequently the shaft **120** will drive the output shaft without lag in either direction during the non-uniform velocity period of the cycle. If, during the uniform velocity period the interrupted gears will cause the block **104** to come out of contact with one or the other plunger—depending on the direction of the cam error—the only effect will be that there interrupted gears will be subjected to the spring load; however, this will not effect the output motion.

For short strokes the oscillatory motion of the output shaft may be obtained essentially by a rotating cam only.

FIG. 18 shows such a drive unit where as toothed clutch is used for switching from the cam drive to a direct drive. Input shaft **100** is coaxial to output shaft **101**. Input shaft **100** carries a cam **130**. The arm **131** to which the cam follower **132** is attached is connected, by link **133**, to rack **134** engaging a gear **135** mounted on hollow shaft **136** concentric to the input shaft. The rack is held in engagement with its gear by guide member **137** pivoting about the gear center. Shaft **136** carries the disc **138** provided with face teeth **139**. The movable clutch member **140** is connected to output shaft **101** by sliding splines **141**, and is provided with two opposite sets of face teeth **142** and **143**. Teeth **142** are adapted to engage teeth **139**, teeth **143** adapted to engage teeth **144** on a hub **145** mounted on an extension of the input shaft. The position of the movable clutch member **140** is controlled by a shifter arm **146** engaging a groove **147** in its hub. The shifter arm, pivoted at **148** to the housing, is connected through a link **150** with a slide **151** carrying the cam follower **152** which engages the groove of a drum cam **153** mounted on input shaft **100**. This drum cam has only two short lobes which cause the movable clutch member **140** to move either into engagement with disc **138** and out of engagement with disc **144** at the beginning of the non-uniform period of the cycle, or to perfom the opposite motion at the end of this period; during the uniform motion period the output shaft is directly coupled to the input shaft.

The drive unit shown in FIG. 20 is similar to that of FIG. 18 except that the face clutch **138** to **145** is replaced by a combination of a resilient clutch, which is similar to clutch **119** to **124**, and interrupted gears **102** and **103**. The input shaft **100** drives the intermediate shaft **136** through cam **130**, cam follower **132**, rack **134** and gear **135**. Shaft **136** is connected to the input shaft **101** with which it is coaxial through the resilient clutch whose driving member **160** carries the block **104** engaging the spring loaded plungers **122** mounted on the driven member **121** on output shaft **101**. During the uniform speed period the interrupted gear **102** driven from the input shaft through gears **161, 162**, and shaft **163**, engages interrupted gear **103** on the output shaft.

The described drive units are, of course, also applicablie to other machines using a reciprocating motion with a uniform velocity period.

What I claim is:

1. Printing press for paper or other flexible materials comprising, in combination, a stationary frame, a press bed adapted to reciprocate in said frame in a substantially horizontal plane, one or a number of image screens attached to said press bed, an equal number of impression cylinders provided in said stationary frame and placed at right angles to the direction of reciprocation of the press bed, said impression cylinders being arranged underneath said screens, means adapted to move said image screens into and out of contact with the paper on said impression cylinders, a squegee arranged in the frame above the said impression cylinders at the impression line, means adapted to move said squeegees into and out of contact with said screens, a drive unit, an input shaft pro-

vided in said drive unit, said drive unit adapted to impart to said press bed a reciprocating motion such that at uniform rotation of said input shaft said reciprocating motion has substantially uniform speed during a portion of its cycle, means adapted to cause the screens to contact the paper on the impression cylinders and means to cause the squeegees to contact the screens during this portion of the cycle of the reciprocation of the press bed such that printing takes place during this pearíod, means adapted to drive the impression cylinders at such a speed that the paper speed is equal to the speed of the press bed during the printing period, and a common drive adapted to impart continuously uniform rotation to the input shaft of said drive unit as well as uniform rotation to the impression cylinders such that the paper moves continuously and at uniform speed during the whole cycle.

2. Printing press in accordance with claim 1 characterized in that the duration of said printing period is one half of the total time of the cycle of the reciprocation of the press bed.

3. Printing press in accordance with claim 1 characterized by means provided in the press bed adapted to hold all screens in one and the same substantially horizontal plane, and by the impression cylinders being arranged in the stationary frame such that their axes are lying in a plane parallel to the plane of the screens.

4. Printing press in accordance with claim 1 characterized by an unwind reel adapted to feed a web of paper or similar flexible materal to the impression cylinders, compensator rolls adapted to guide the web of paper between adjacent impression cylinders, and means adapted to adjust the distance of said compensator rolls from said impression cylinders.

5. Printing press in accordance with claim 1 characterized by a sheet feeding unit adapted to feed sheets of paper or similar flexible material to the impression cylinders, a sheet delivery unit adapted to receive printed sheets from the impression cylinders, transfer cylinders arranged between the impression cylinders, and grippers provided on said impression and transfer cylinders, said grippers adapted to receive, to hold and to release a sheet.

6. Printing press in accordance with claim 5 characterized in that said transfer cylinders being arranged below the impression cylinders such as to clear the screens.

7. Printing press in accordance with claim 5 characterized by the circumference of said impression cylinders being provided with recesses extending over a length of arc which corresponds to the non-printing portion of the cycle of the reciprocation of the press bed.

8. Printing press in accordance with claim 1 characterized in that said means for moving the image screens into and out of contact with the paper on the impression cylinders comprise two longitudinal bars provided on said press bed, means adapted to fasten said screens to said bars, and links connecting said bar to said press bed, said links adapted to cyclically trip said bars.

9. Printing press in accordance with claim 1 characterized by means adapted to vary the length of stroke of the reciprocation of the press bed, and by means to correspondingly vary the speed of the impression cylinders such that the paper speed remains equal to the speed of the press bed during the printing period.

10. Printing press in accordance with claim 1 characterized in that said drive unit is provided with an output shaft adapted to be in driving connection with the said press bed, an intermediate shaft, means to drive said intermediate shaft by the said input shaft at a speed proportional to the speed of the press bed during the non-printing period, and means to drive said output shaft by said input shaft at an exactly constant ratio during the printing period, and by said intermediate shaft during the non-printing period.

11. Printing press in accordance with claim 10 characterized by a gear mounted interchangeably on said output shaft, a rack mounted on said press bed engaging said gear, and means adapted to raise or lower said gear such as to keep said rack in mesh with said gear regardless of this gear's pitch diameter.

12. Printing press in accordance with claim 10 characterized by means adapted to drive said intermediate shaft at a speed closely approximating uniform speed during the printing period.

13. Printing press in accordance with claim 10 characterized by said intermediate shaft being coaxial with said output shaft.

14. Printing press in accordance with claim 10 characterized by said input shaft being coaxial with said output shaft.

15. Printing press in accordance with claim 1 characterized in that said drive unit is provided with an output shaft adapted to be in driving connection with the press bed, an intermediate shaft, means adapted to drive said intermediate shaft from the input shaft at a speed proportional to the speed of the press bed during the non-printing period, said output shaft and intermediate shaft being arranged coaxial with the input shaft, a toothed clutch disc mounted on said input shaft, a second toother clutch disc mounted on said intermediate shaft, a third clutch member adapted to slide on said output shaft and having a set of teeth adapted to engage the said first clutch disc, and another set of clutch teeth adapted to engage the said second clutch disc, and a shifter mechanism adapted to cyclically shift said third clutch member.

16. Printing press in accordance with claim 1 characterized in that said drive unit is provided with an output shaft adapted to be in driving connection with the press bed, means adapted to drive said output shaft by the input shaft at an exactly constant ratio during the printing period, an intermediate shaft, means adapted to drive said intermediate shaft by said input shaft at a speed proportional to the speed of the press bed during the whole cycle, a coupling adapted to connect said intermediate shaft with the said output shaft during the whole time of the cycle, and resilient elements provided in said coupling adapted to permit slight differences in speed between the intermediate shaft and the output shaft during the printing period.

17. Printing press in accordance with claim 1 characterized in that said drive unit is provided with an output shaft adapted to be in driving connection with said press bed, means adapted to drive said output shaft by the input shaft at an exactly constant ratio during the printing period, an intermediate shaft, means to drive said intermediate shaft by the input shaft at a speed proportional to the speed of the press bed during the whole cycle, a coupling adapted to connect said intermediate shaft with said output shaft during the whole time of the cycle, said coupling comprising a hub rigidly mounted on one of said shafts, an eccentric stud mounted on said hub, a second hub mounted on the other of said shafts, two spring loaded plungers mounted on said second hub, said plungers adapted to engage opposite sides of the said stud, a stop connected with each plunger, said stops adapted to permit simultaneous contact between said stud and both plungers with substantially equal and opposite contact forces when said stud is in its neutral position and each stop preventing its plunger from remaining in contact with said stud when the latter moves away from its neutral position.

18. Printing press in accordance with claim 1 characterized in that the drive unit is provided with an output shaft adapted to be in driving connection with the press bed, means adapted to drive said output shaft from the input shaft at an exactly constant ratio during the printing period, an intermediate shaft, means to drive said output shaft from said intermediate shaft at a speed proportional to the speed of the press bed during the non-printing period, a second intermediate shaft adapted

to drive said first intermediate shaft, means interposed between said second intermediate shaft and the input shaft adapted to convert uniform rotation of the input shaft into non-uniform rotation of the second intermediate shaft, and means interposed between said first and said second intermediate shaft adapated to convert non-uniform rotation into an oscillatory motion.

19. Printing press in accordance with claim **1** characterized in that the drive unit is provided with an output shaft adapted to be in driving connection with the press bed, means adapted to drive said output shaft by the input shaft at an exactly constant ratio during the printing period, an intermediate shaft, means adapted to drive said output shaft by said intermediate shaft at a speed proportional to the speed of the press bed during the non-printing period, a second intermediate shaft adapted to drive said first intermediate shaft, a planet carrier mounted on said input shaft, a planet gear mounted on said carrier, a cam follower attached to said planet gear, a stationary cam adapted to be engaged by said cam follower, a sun gear mounted on said second intermediate shaft, said sun gear meshing gear meshing with said planet gear, said cam, cam follower, planet gear carrier, planet gear and sun gear adapted to coact in such a way as to convert uniform rotation of the input shaft into non-uniform rotation of the second intermediate shaft, and means interposed between said first and second intermediate shaft adapted to convert non-uniform rotation into an oscillatory motion.

20. Printing press in accordance with claim **1** characterized in that the drive unit is provided with an output shaft adapted to be in driving connection with the press bed, means adapted to drive said output shaft from the input shaft at an exactly constant ratio during the printing period, an intermediate shaft coaxial with said output shaft, a cam mounted on the input shaft, a cam follower adapted to engage said cam, a rack driven by said follower, a gear adapted to engage said rack, said gear mounted on the intermediate shaft, said cam, cam follower, rack and gear adapted to coact in such a way as to impart to said intermediate shaft a speed proportional to the speed of the press bed during the non-printing period, and means adapted to drive the output shaft by the intermediate shaft during the non-printing period.

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