Aug. 30, 1960 W. P. McCORMICK 2,950,673

PRINTING MACHINES

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FIG. 1.

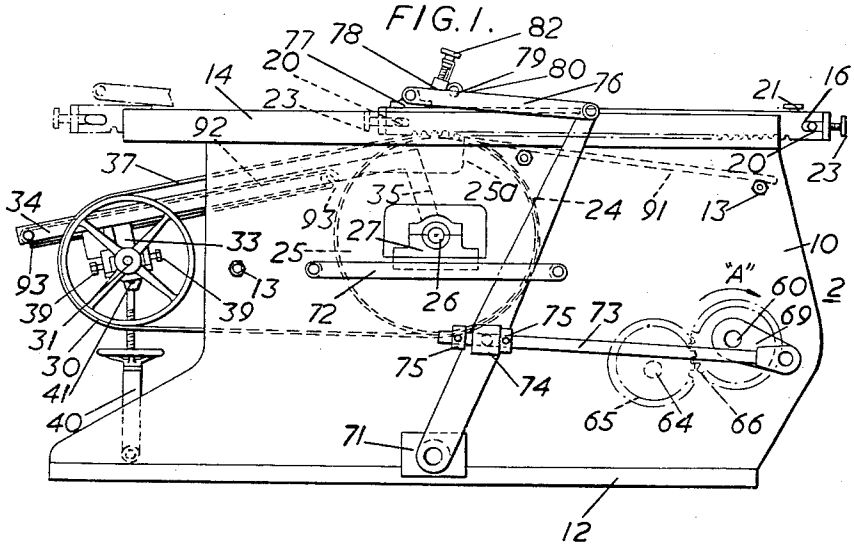
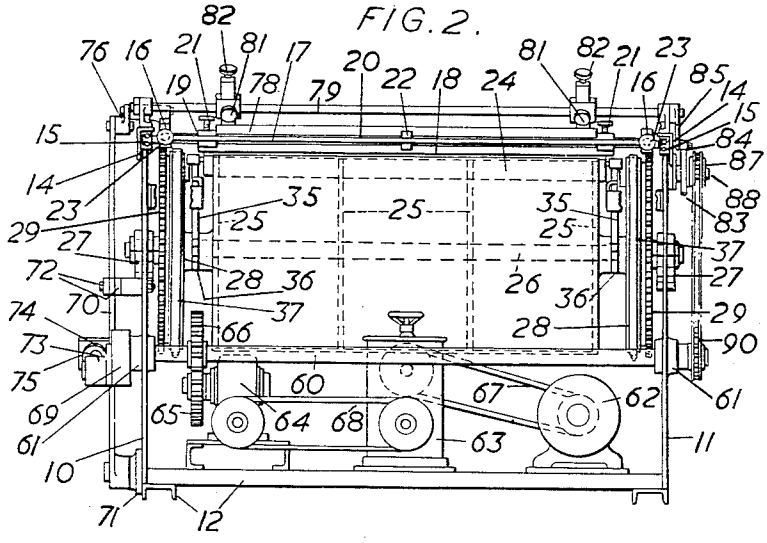


FIG. 2.



Inventor:
WILLIAM PHILIP McCORMICK

By
Richardson, Davis and Virdon
Attorneys.

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PRINTING MACHINES

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FIG. 3.

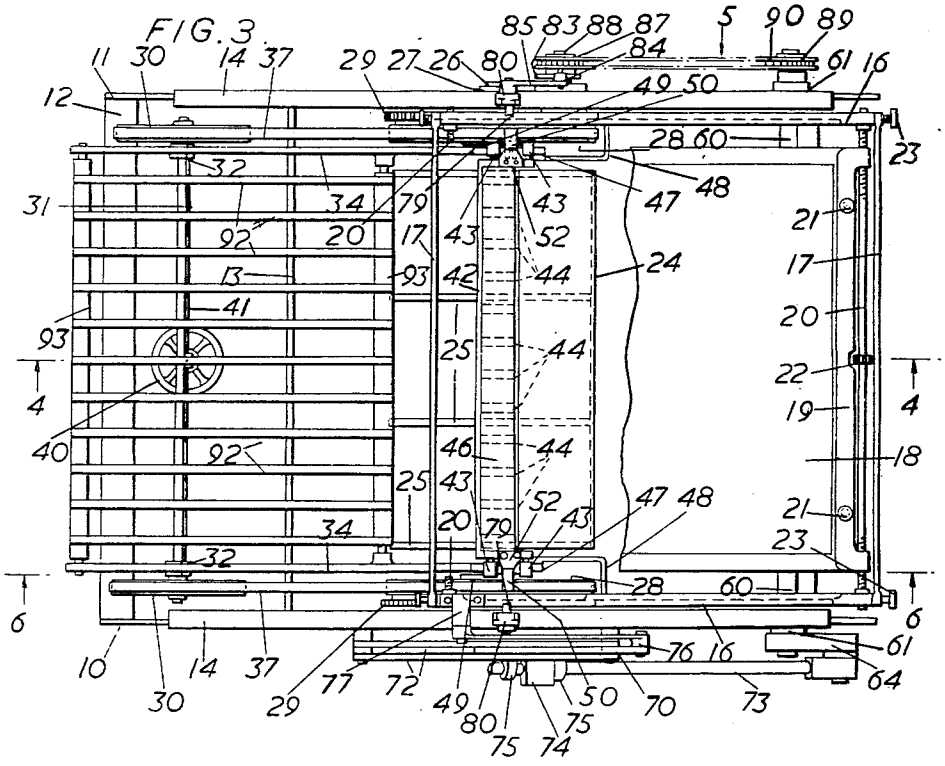
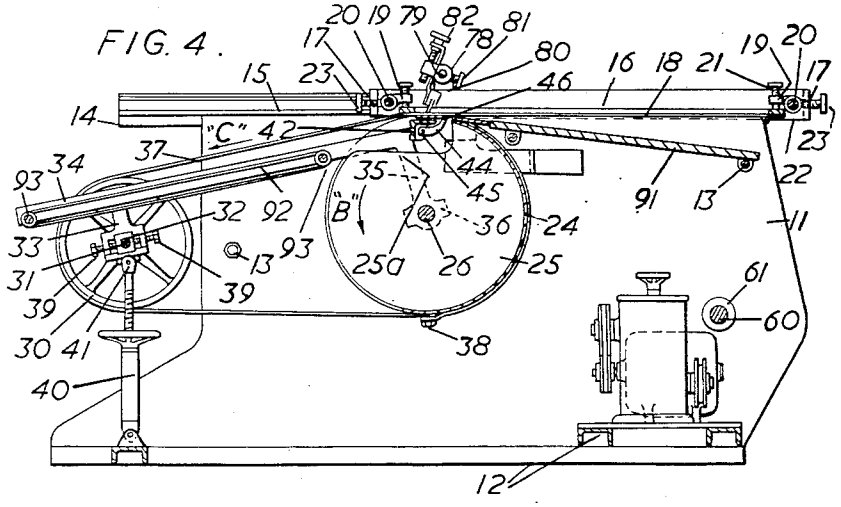


FIG. 4.



Inventor:
WILLIAM PHILIP McCORMICK

By
Richardson, Davis and Verdon
Attorneys.

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FIG. 5.

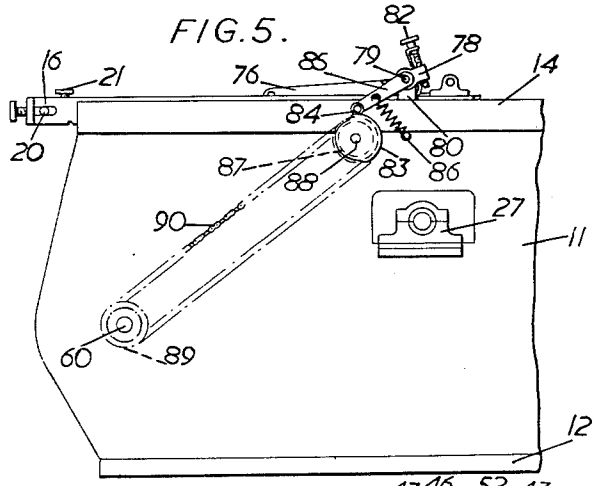


FIG. 6.

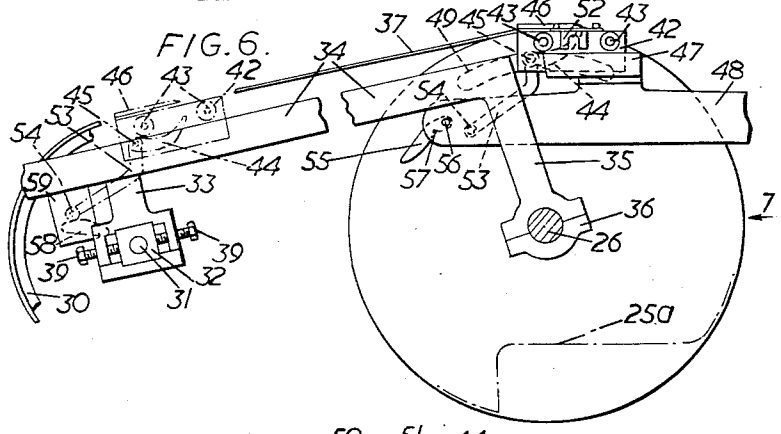
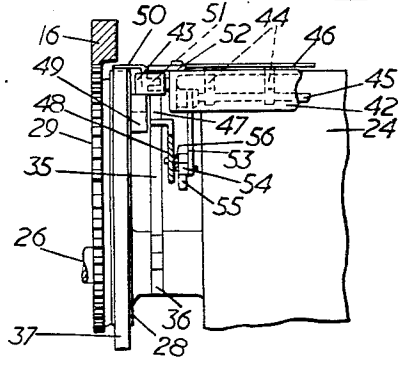


FIG. 7.



Inventor:
WILLIAM PHILIP McCORMICK

By
Richardson, Davis and Hendon
Attorneys

United States Patent Office

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PRINTING MACHINES

William Philip McCormick, 115 Birkhall Ave., Glasgow, Scotland

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9 Claims. (Cl. 101—118)

This invention relates to printing machines of the type comprising a reciprocable screen composed of silk or other textile or imperforate material, which is patterned for use as a stencil in the work of printing the pattern upon sheets fed in succession between the screen and a cylindrically arcuate impression surface movable underneath, and in unison with, the screen.

An object of the invention is to make provision in a printing machine of the type stated to ensure precise unison from day to day between the movement of the sheets to be printed and the movement of the screen and impression surface.

The invention is a printing machine of the type stated having a pair of circular side surfaces for flexible unstretchable members with means for gripping the leading edge of each sheet to be printed, guides for said members extending rearwards from the side surfaces, a pair of power-driven gearwheels associated respectively with the side surfaces and with the impression surface, and a pair of toothed racks on the screen carrier meshing with the gearwheels, the arrangement being such that said members are anchored in relation to the side surfaces and are reciprocated in paths defined by the side surfaces and guides and also such that said members, where flexed around the side surfaces, are co-axial with the gearwheels and have the same radius as the pitch circles of their teeth.

The term "unstretchable" is used herein as meaning that the members are not stretched by the forces applied to them in the operation of the machine.

It will be manifest that the said members, gearwheels and screen must all move in precise unison. Moreover, the precision is not affected by variation in the length of the bands such as stretching and shrinking caused by changes in temperature or stretching due to wear.

Preferably, the flexible unstretchable members are bands composed of steel or equivalent material.

The flexible unstretchable members might instead be chains, preferably roller chains of the bicycle type.

An example of the printing machine will now be described with reference to the accompanying drawings in which:

Fig. 1 is a side elevation of a silk screen printing machine.

Fig. 2 is an end elevation corresponding to Fig. 1, looking in the direction of arrow "2," Fig. 1.

Fig. 3 is a plan corresponding to Fig. 1.

Fig. 4 is a sectional elevation taken on the line "4—4" of Fig. 3.

Fig. 5 is a part elevation, looking in the direction of arrow "5," Fig. 3.

Fig. 6 is a view of part of the mechanism of the machine, to a larger scale than the foregoing figures and taken on the line "6—6," Fig. 3.

Fig. 7 is an end view substantially corresponding to Fig. 6, looking in the direction of arrow "7," Fig. 6.

The printing machine shown comprises a framework including side components **10** and **11** arranged on a base

of channel-section members **12** and transversely supported by tie-rods **13**. The side components are provided along their tops with horizontal members **14** of angle-section within which longitudinal ball-bearing slides **15** are fitted. These slides are connected to two racks **16** which are disposed adjacent and parallel to the slides and are interconnected at their ends by transverse ties **17** to form a carrier for the printing screen **18**.

The printing screen is attached to its carrier by means of two end fittments **19**, each of which is mounted on a screwed spindle **20** adjustably journalled in the ends of the racks. The fitments **19** are each provided with two hand-screws **21** for adjusting the height of the screen, each spindle **20** is provided with a hand-wheel **22** for adjusting the transverse position of each end of the screen, and each rack-end is provided with a hand-screw **23** connected to the journals of the spindles **20** for adjusting the alignment of the screen.

In Fig. 3 part only of the printing screen and one fitment **19** are shown, but it will be understood that the arrangement is the same at both ends of the screen.

The arrangement of the foregoing is such that the carrier, with the printing screen, is reciprocal in a horizontal plane from end to end of the framework.

The machine includes a cylindrical assembly of components, which are co-axial and rotatable in unison. The main component of this assembly is an impression cylinder comprising a semi-cylindrical shell **24** mounted on co-axial discs **25** spaced along the length of the shell and carried on the main shaft **26** of the machine. These discs are rebated at *25a* to allow access of the gripper mechanism (hereinafter described) to the leading edge of the sheets to be printed. The shaft **26** is journalled in bearings **27** fitted to the side components of the framework of the machine.

The other components of the cylindrical assembly comprise a pair of pulleys **28** and a pair of gearwheels **29** mounted on the main shaft, a pulley and gear wheel being arranged beside each other and adjacent each end of the cylinder, and the gear wheels being arranged to mesh with the racks **16** of the screen carrier.

The machine also includes, at its rear end, a pair of guide pulleys **30** disposed in alignment with the pulleys **28** and carried by an axle **31** which is journalled in slidably adjustable bearings **32** fitted to brackets **33**. These brackets are provided on, and near the rear ends of, a pair of guide rails **34**, so that the pulleys are rotatable about an axis that is fixed in relation to the rails. These rails extend rearwards from the cylindrical assembly and are formed with downturned arms **35**, the lower ends of which are provided with pivotal bearings **36** embracing the main shaft **26** and located between the cylinder and the pulleys **28**.

A pair of narrow thin steel flexible bands, or tapes, **37** are led around and between the pulleys **28** and guide pulleys **30**, the ends of the bands being overlapped and anchored by clamping screws **38** (Fig. 4) to the faces of the respective pulleys **28** so that, in effect, the bands become endless bands positively driven by the pulleys **28**. Adjusting screws **39**, acting on the bearings **32** associated with the guide pulleys are provided on the brackets **33** for setting the steel bands under light tension. The clamping screws **38** are positioned on the pulleys **28** substantially at the lowermost part thereof when the machine is set to start a working stroke, i.e. a printing stroke.

In the example, a screw-jacking mechanism **40**, for raising and lowering the rails **33**, together with the guide pulleys **30** and associated parts, is interposed between the base **12** of the machine and a bridge rod **41** interconnecting the brackets **33**. By means of this mechanism the rails can be raised to a horizontal position or lowered

to the required downward inclination to suit the kind of material to be printed.

The above-described arrangement of rails, pulleys, and steel bands is such that, whatever the angular setting of the rails, the upper stretches of the steel bands are always parallel to the rails, and, when set, the centre-distance between the pulleys **28** and **30**, and hence the tension of the bands, remain constant. Further, the radial size of the pulleys **28** and the thickness of the flexible bands are such that the outer surfaces of these bands, where they pass around these pulleys, has precisely the same radial size as the pitch circles of the teeth of the gearwheels **29**, this size being precisely the same as the radial size of the impression-surface. Consequently in the to and fro rotational movement of the impression cylinder and the reciprocation of the screen carrier, the steel bands travel at precisely the same linear speed as the impression-surface and screen.

The steel bands serve to pull a gripping mechanism to and fro underneath the path of the screen. This mechanism is designed to grip the leading end of a sheet fed to the machine for printing, to pull the sheet through the machine during the printing operation and thereafter to release the sheet.

In the example, the gripping mechanism comprises a carriage **42** arranged transversely between the rails and mounted on wheels **43** adapted to run on the rails. A series of grippers **44** are spaced along a spindle **45** journalled in the carriage. By the action of a torsion spring (not shown in the drawings) applied to the spindle **45**, the grippers press upwards against the edges of a top plate **46**, provided on the carriage, in order to grip the leading edge of a sheet about to be printed.

Fixed rail sections **47**, horizontally arranged and in line with the rails **34**, are mounted on brackets **48** secured to the side members of the machine frame. Arcuate rail sections **49**, to which the rails **34** and sections **47** are tangential, are provided on the proximal sides of the pulleys **38**. The wheels **43** are sufficiently wide to engage these arcuate sections.

The rail arrangement is such that the gripper carriage, when in its gripping position adjacent to the leading edge of the impression surface of the cylinder (as shown in Figs. 3, 4 and 7, and in full lines in Fig. 6), is always supported by the fixed rail sections. In moving to its gripping position, when the rails **34** are set in their uppermost position, the carriage runs directly from them to the rail sections **47**, the rails **34** and sections **47** then abutting flush against each other. However, when the rails **34** are set at an inclination the carriage passes by way of the interposed arcuate sections to the sections **47**.

The gripper carriage is connected to the steel bands by means of two right-angled brackets **50**, each of which is secured to one of the steel bands. Each bracket is provided with an inwardly directed horizontal pin **51** which engages within an inverted-U slot formed in an attachment **52**, there being one such attachment at each end of the carriage. The attachments **52** are adjustable on the carriage to enable the operator to adjust the position of the carriage in relation to the leading edge of the impression surface of the cylinder. The top plate **46** is height-adjustable relative to the carriage to suit various thicknesses of sheets to be printed.

Referring particularly to Figs. 6 and 7, a downwardly and rearwardly extending lever **53**, provided at its end with a roller **54**, is connected to the spindle **45** of the gripper mechanism. This roller is adapted to engage two cam devices, one at each end of the travel of this mechanism. These cam devices comprise a pivotal cam **55** mounted on a fulcrum pin **56** and normally resting on a stop pin **57**, both pins being fixed to the bracket **48** on the near side of the machine (as seen in Fig. 1); and a stationary cam **58** carried by a bracket **59** secured to the rail **34** at the near side of the machine and near the outer end thereof.

The driving mechanism of the machine comprises a crank shaft **60** journalled in bearings **61** on the side members of the machine frame and driven by an electric motor **62** through the medium of a variable speed gear unit **63**, a speed reduction gear **64** and a quick-return mechanism which may consist of inter-meshing eccentric or elliptic gear wheels **65** and **66** mounted respectively on the output shaft of the reduction gear and the crank-shaft. The arrangement is such that the impression cylinder and the screen perform their working motion slowly and return quickly. V-belt drives **67** and **68** respectively interconnect the motor and the variable speed unit and the last-mentioned unit and the reduction gear. A crank **69**, mounted on the end of the crank shaft on the near side of the machine is adapted to oscillate an upstanding lever **70** which has its fulcrum on a bracket **71** at the bottom of the machine frame, this lever being supported by horizontal slides **72** fixed to the frame. A connecting rod **73**, connected to the crank, is slidable in a block **74** which is pivotally fixed to the lever **70** at an appropriate distance from the lever fulcrum. The connecting rod is provided with two collars **75** so spaced apart as to introduce a degree of lost-motion between the connecting rod and the lever **70**, thereby causing the lever perceptibly to pause at the end of each movement thereof. The upper end of the lever is connected by a link **76** to a bracket **77** on the near rack at the rear end thereof. This arrangement imparts to the screen a reciprocatory motion of predetermined stroke and to the impression surface the required to-and-fro rotary motion of 180°.

In the example, a known type of squeegee **78** is provided. This squeegee is fixed to a transverse spindle **79** which is journalled in bearing **80** on top of the machine frame. The squeegee is provided with hand screws **81** and **82** respectively for adjusting its lateral position and its pressure on the screen during printing.

The squeegee is operated by a cam **83** which engages a roller **84** on a lever **85** mounted on the end of the spindle **79** at the other side of the machine from the crank (see particularly Fig. 5). The roller is held in contact with the cam by a tension spring **86**. A sprocket wheel **87** is attached co-axially to the cam and these are rotatable together on a spindle **88** fixed to the machine frame. A sprocket wheel **89**, of the same pitch diameter as the sprocket **87**, is mounted on the end of the crank shaft and both sprockets are inter-connected by a driving chain **90**. The machine would also be provided with means (not shown in the drawings) for applying printing ink or other colouring matter in front of the squeegee over the upper surface of the screen

The machine also includes at its front end a platform known as a feed-table to which the sheets to be printed are fed in succession. This feed-table is pivotally supported at its front end and is supported towards its rear end by a cam device moving with the cylindrical assembly. The arrangement is such that at the time when each sheet is to be fed into its position of registration with the screen, the feed-table lowers slightly at its rear end and provides an adequate space for insertion of the sheet. The registration position is defined by stops fixed to the framework of the machine. For simplicity since this type of feed-table is well-known per se, a table **91** is shown symbolically in the drawings (Figs. 1 and 4).

The machine is equipped at its rear end with a mechanism, known in itself, for receiving and delivering the printed sheets in succession from the machine. In the example, this mechanism comprises endless tapes **92** stretched around and between freely rotatable rollers **93** which are transversely arranged between the rails **34**.

In operation of the machine, as the driving mechanism reciprocates the screen carrier along the slides **15**, the

racks of the carrier, through the medium of the gear wheels 19, rotate the impression cylinder and pulleys 28 to and fro through 180°, so that the impression surface of the cylinder moves in unison with the screen. The pulleys cause the steel bands to travel to and fro in their endless paths and consequently to reciprocate the gripper mechanism on the rails in precisely timed relationship with the movements of the impression cylinder and screen. When the gripper mechanism approaches its gripping position towards the end of a return stroke, the roller 54 engages the upper surface of the pivotal cam 55 and causes the lever 53 to open the grippers 44. As the end of the return stroke is reached, the roller 54 leaves the pivotal cam and, under the action of the spring previously referred to, the grippers immediately close to grip the leading edges of the sheet to be printed which is located in readiness on the feed-table. During the pause in the movements of the screen, impression cylinder and gripper mechanism at the end of each return stroke, by virtue of the lost-motion hereinbefore referred to, the squeegee is brought to bear on the screen under the action of the then rotating cam 83.

During each printing stroke, as the gripper mechanism moves rearwards, withdrawing the sheet between the screen and the impression cylinder, the roller 54 simply lifts the can 55 clear of its path. As the gripper mechanism reaches its releasing position, the roller engages the fixed cam 58, so that the grippers are opened to release the printed sheet. The sheet is then deposited on the tapes 92. During the pause at the end of each printing stroke, the squeegee is moved from the screen by the action of the cam 83 and spring 86 in readiness for the next return stroke.

The pivotal cam 55, fixed cam 58 and associated parts are shown in Fig. 6, and the gripper mechanism is drawn in full lines in its gripping position and in dot-dash lines in its releasing position.

In Fig. 1 the arrow "A" indicates the direction of rotation of the crankshaft of the machine, and in Fig. 4 the arrows "B" and "C" indicate the directions of movement respectively of the impression cylinder and steel bands during the printing strokes.

By virtue of the jacking mechanism for raising and lowering the rails 34 and guide pulleys, the angularity of the gripper path in relation to the horizontal plane in which the screen works can be varied. Thus, for sheets which are stiff and heavy, the said rails can be set approximately horizontally in which case the grippers travel in a path slightly below and parallel to the screen. In this event, the weight and stiffness of the sheets ensure that they will lower from contact with the screen. On the other hand, for sheets which are lightly flexible, the rails 34 can be set at an appropriate downward inclination such that the grippers will progressively strip the sheet from adhesive attachment with the screen as the sheet is pulled from the printing zone where the squeegee functions. Furthermore, the gripping mechanism withdraws the sheets at precisely the same speed as that of the screen and impression surface, and along a plane which is tangential to the impression surface. Thus, throughout the printing operation there can be no relative movement whatever between the sheet to be printed on the one hand and the screen and impression cylinder on the other hand.

I claim:

1. A printing machine of the type comprising a screen fitted to a reciprocable screen carrier and composed of imperforate material, which is patterned for use as a stencil in the work of printing the pattern upon sheets fed in succession between the screen and a cylindrically arcuate impression surface of an impression cylinder movable underneath and in unison with the screen, the said machine comprising in combination with the reciprocable screen carrier and impression cylinder:—a pair of components incorporated in a rotatable assembly including also said impression cylinder and presenting circular side surfaces that are co-axial with the arcuate surface of the impression cylinder, flexible members respectively anchored in relation to said side surfaces and bearing around them, means connected with said members for gripping the leading edge of each sheet to be printed, guides for said members extending rearwards from the side surfaces, devices for opening and closing said gripping means at timed intervals in the printing cycle, a pair of gearwheels also included in the rotatable assembly so as to be associated with the respective side surfaces and with the impression surface, a pair of toothed racks on the screen carrier meshing with said gearwheels, and mechanism for reciprocating the screen carrier and racks so as to rotate the rotatable assembly as a unit to and fro, the arrangement being such that said members with said gripping means connected thereto are reciprocated in paths defined by the side surfaces and guides and also such that said members, where flexed around the side surfaces, are co-axial with the gearwheels and have the same linear speed as the pitch circles of their teeth.

2. A printing machine according to claim 1 in which the flexible members connecting the gripping means to the circular side surfaces are bands composed of steel.

3. A printing machine according to claim 1 in which the flexible members are roller chains.

4. A printing machine according to claim 1 in which the guides comprise pulleys for the flexible members and rails for the gripping means, the pulleys being rotatable about an axis that is fixed in relation to the rails and the rails being mounted at a constant distance from the axis of the rotatable assembly including the impression cylinder.

5. A printing machine according to claim 4 in which the gripping means includes a movable component which normally is spring-urged into its closed position and in which the gripping means is supported by a wheeled carriage, that rides along the guide rails.

6. A printing machine of the type comprising a screen fitted to a reciprocable screen carrier and composed of imperforate material, which is patterned for use as a stencil in the work of printing the pattern upon sheets fed in succession between the screen and an arcuate impression surface of an impression cylinder movable underneath and in unison with the screen, the said machine comprising in combination with the reciprocable screen carrier and impression cylinder: a pair of components incorporated in a rotatable assembly including said impression cylinder and presenting arcuate side surfaces that are co-axial with the arcuate surface of the impression cylinder, a pair of gearwheels associated respectively with the respective side surfaces and with the impression surface, a pair of toothed racks on the screen carrier meshing with said gearwheels, mechanism for reciprocating the screen carrier and racks so as to rotate the rotatable assembly as a unit to and fro, means constraining said racks to confine the screen to movement in a plane tangential to said arcuate surface, flexible members respectively anchored in relation to said side surfaces and bearing around them, means connected with said members for gripping the leading edge of each sheet to be printed, devices for opening and closing said gripping means at timed intervals in the printing cycle, guides for said members extending rearwards from the side surfaces, the arrangement being such that said members have the same linear speed as the pitch circles of said gearwheels and said guides constrain the flexible members to move the gripping means to and from the impression surface in a plane which is tangential to this surface and is inclined from the plane in which the screen reciprocates so that the gripping means serve to strip the printed sheet from the screen.

7. A printing machine according to claim 6 in which the said guides have adjustment mechanism for raising and lowering them angularly in relation to the plane in which the screen reciprocates.

8. A printing machine of the type comprising a screen fitted to a reciprocable screen carrier and composed of imperforate material, which is patterned for use as a stencil

in the work of printing the pattern upon sheets fed in succession between the screen and an arcuate impression surface of an impression cylinder movable underneath and in unison with the screen, the said machine comprising in combination with the reciprocable screen carrier and impression cylinder: a pair of components incorporated in a rotatable assembly including also said impression cylinder and presenting arcuate side surfaces that are coaxial with the arcuate surface of the impression cylinder, a pair of gearwheels associated respectively with the respective side surfaces and with the impression surface, a pair of toothed racks on the screen carrier meshing with said gearwheels, mechanism for reciprocating the screen carrier and racks so as to rotate the rotatable assembly as a unit to and fro, means constraining said racks to confine the screen to movement in a plane tangential to said arcuate surface, flexible members respectively anchored in relation to said side surfaces and bearing around them, means connected with said members for gripping the leading edge of each sheet to be printed, devices for opening and closing said gripping means at timed intervals in the printed cycle, guides for said members extending rearwards from the side surfaces, the arrangement being such that said members have the same linear speed as the pitch circles of said gearwheels and said guides constrain the flexible members to move the gripping means to and from the impression surface in a plane which is tangential to this surface and is parallel to the plane in which the screen reciprocates.

9. A screen printing machine comprising a screen carrier mounted to reciprocate so that a stencilled screen carried by it moves to-and-fro in a plane, rack means for reciprocating said carrier, an assembly of parts rotatable as a unit about an axis parallel to said plane, said parts including a cylindrically arcuate impression surface to which said plane is tangential, at least one gearwheel to the pitch circle of which said plane is tangential and components with circular surfaces at opposite sides of the impression surface, drive gearing applied to said rack means and gearwheel to move said carrier linearly and said assembly of parts rotatively to-and-fro in precise unison, gripper means for engaging and disengaging the leading edge of sheets fed in succession to the machine, cam means controlling the opening and closing of the gripper means, flexible side members secured to and bearing around said circular surfaces, said gripper means being operatively connected to said flexible members, and guide means constraining said gripper means to follow a predetermined path in relation to said plane, the arrangement being such that said flexible members acting through said gripper means withdraw each sheet at a linear speed precisely equal to the printing speed and thereafter return said gripper means to engage another sheet.

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