May 21, 1968 J. COTTERELL 3,384,010

SCREEN PRINTING MACHINE

Filed Feb. 6, 1967 3 Sheets-Sheet 1

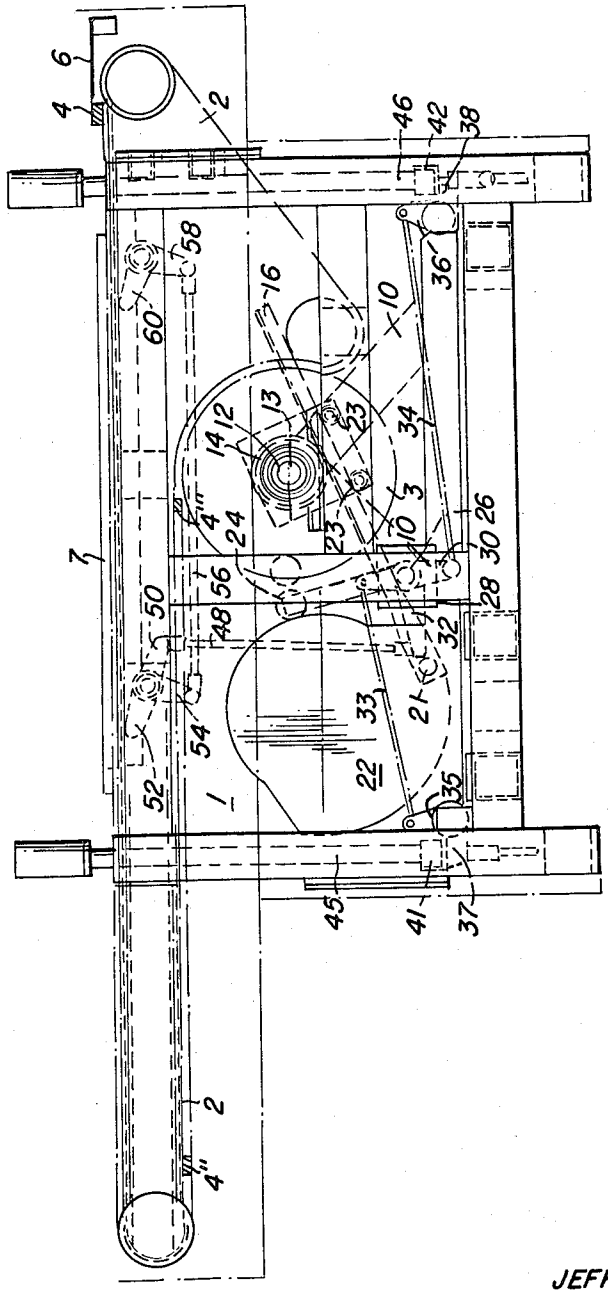


FIG. 1

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JEFFREY COTTERELL

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FIG. 2

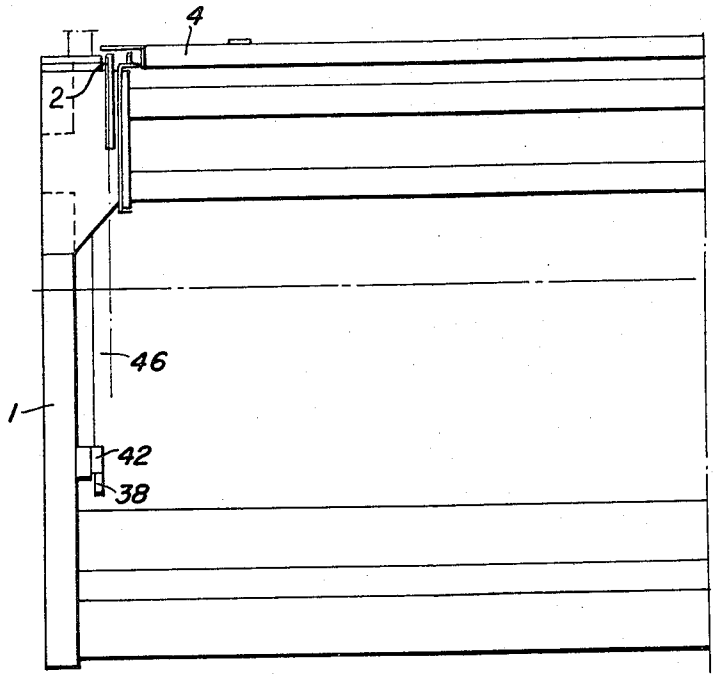
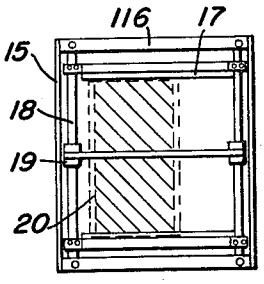


FIG. 3



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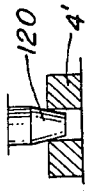


FIG. 4a

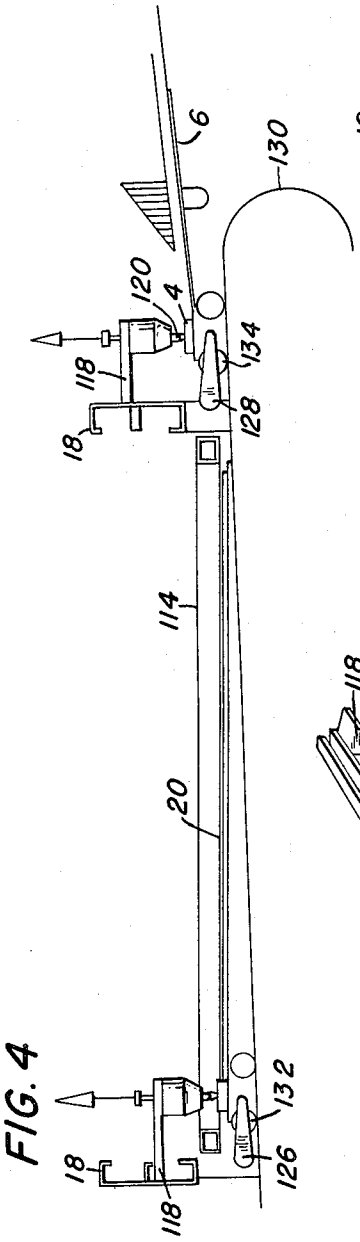


FIG. 4

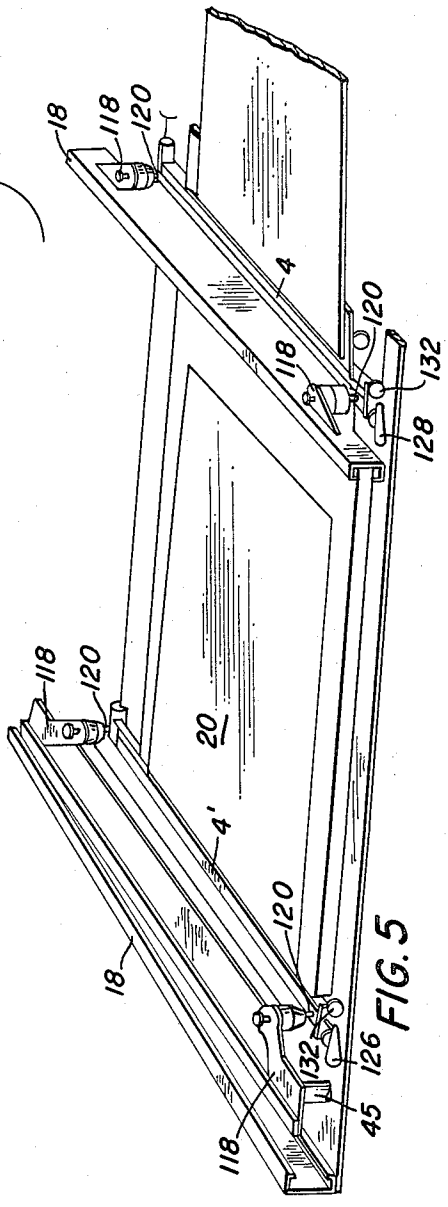


FIG. 5

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3,384,010

SCREEN PRINTING MACHINE

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Claims priority, application Great Britain, Feb. 14, 1966, 6,425/66
8 Claims. (Cl. 101—123)

ABSTRACT OF THE DISCLOSURE

A screen printing machine having a printing bed and a printing frame carrying a silk screen and provided with a squeegee adapted for reciprocal traversing movement across said frame; said printing bed and said printing frame being adapted for movement toward each other into operative position and movement away from each other into inoperative position; there being an endless chain for movement past each side of said bed with gripper bars being suitably supported by said chain for movement across said bed. Said gripper bars having means for engaging work pieces for presenting same upon said bed and for withdrawal therefrom subsequent to printing operation. Said machine is equipped with positive registering means including apertures formed in the gripper bars for receiving locking pins carried on the said frame so as to assure proper location of the work piece.

A screen printing machine capable of high operating speeds owing to a new work piece being fed while the previous work piece is printed. Difficulty in registering the new work piece is avoided by keeping an indexing chain running substantially in a straight line over a printing bed making the printing bed move up and down in coordination with the printing frame. Registering may be assisted by the provision of registering means such as a tapered pin on the screen support and corresponding means on the work piece carriage.

The invention relates to a screen printing machine.

The operations in the running of a screen printing machine can be divided into two groups, the first consisting of lowering the frame, passing the squeegee across and raising the frame and the second consisting of changing the work piece, including registering a fresh work piece in the proper position. In the normal type of machine, including both the rotary type and the reciprocating bed type, these two groups of operations must be performed in sequence and the cycle time of the machine is therefore the sum of the times necessary to carry out the two groups of operations.

In order to reduce the cycle time it is desirable to carry out most of the operations of placing a new work piece in position and registering it while the machine is printing the previous work piece. In order to do this it is necessary to mount on an indexing chain or pair of chains at least two sets of grippers, one for holding the work piece being printed and the other for entering and registering the next work piece to be used. When the sequence of operations of lowering the frame, passing the squeegee and raising the frame has been completed, the chain indexes and the new work piece which has been placed in position on the second set of grippers is rapidly carried into position for printing with a minimum passage of time.

However machines employing this principle have to date not been entirely successful, largely because the problems of indexing the chain and keeping the work piece carried by it in the correct relation to the bed and the screen have not been solved. It is necessary for

the gripper bar carrying the work piece forward to be across the line of the machine so that the work piece is pulled from one end otherwise the movement of the work piece is not controllable at high speed. Having a gripper bar in this position however means that it must be arranged to hold the work piece level with the bed during printing to avoid damage to the screen. Previous attempts to solve this problem have involved the use of box cams or rollers dropping into appropriate slots to move the gripper bar down to level with the bed. The shock loadings on such cams or slots particularly at high speeds of operation are however considerable and are a severe limitation.

The present invention depends on the simple but novel idea of running the chain substantially in a straight line over a printing bed and making the bed move up and down between a position in which a work piece can be drawn over the bed and a position in which the gripper and work piece lie flush with the bed.

Preferably the bed is made to move up and down by means of rotary cams. The bed may rest on such cams and be guided so that it moves in a slight arc but remains horizontal. Alternatively the bed may be arranged to pivot about the end remote from the position of the gripper during printing as such pivoting, unlike the raising and lowering of the whole bed, makes possible a more rigid and simple construction. The end of the bed as it rises may strike the gripper if this is spring loaded in its mountings on the chain and effect the final longitudinal register of the sheet. Any slight difference or inaccuracy in the operation of the two chains on either side of the machine is thus automatically compensated for.

The main problem in the operation of such a machine is keeping a sheet work piece such as paper under control during rapid deceleration as it reaches the position at which it will be printed. This may be overcome by applying a slight continuous suction to the bed or alternatively by having the bed so that instead of being parallel to the chain while the work piece is being moved into the printing position, that is to say having the bed pivoted at the end adjacent the feed position, it is pivoted at a position part way along from that end so that the work piece as it is pulled into position is in contact with the end of the bed remote from the printing position, that is to say remote from its gripper. This may be combined with the application of slight suction. It means that for the gripper on the chain to clear the end of the bed the movement of the bed must be delayed so that the bed pivots while the gripper passes over the portion of the bed directly above the pivot point.

The invention includes printing machinery having endless chains and carriages including work piece grippers for bringing sheets to a printing station and means for registering a screen support with a carriage at the printing station. The registering of the support with the carriage ensures that the image is positioned in the same place and in the same orientation on each sheet. Sheets can be positioned in the same place with respect to successive carriages by means of grippers which engage the leading edge of a sheet and draw it through the machine. There may be more than one printing station. The preferred registering means comprises a tapered pin at or adjacent the outer edges of the screen support and corresponding holes in each carriage. A pin at each end of the leading edge of the support and a corresponding hole at each end of a gripper bar ensures positive location.

In a preferred arrangement the grippers for the sheets are attached to the endless chains by trailing links. This enables small movements of the gripper bars to be made without moving the whole of the chain. Movement of the chains resulting from inertia on stopping and chain

stretching, which tends to cause overrun, is thus readily taken into account.

The construction and operation of a particular preferred machine according to the invention is illustrated by way of example in the accompanying drawings of which:

FIGURE 1 is a composite longitudinal section;

FIGURE 2 is a half end elevation;

FIGURE 3 is a plan view of the screen and squeegee;

FIGURE 4 is a longitudinal section through the printing station;

FIGURE 4*a* is an enlarged section showing details of a register pin from FIGURE 4; and

FIGURE 5 is a schematic perspective view of the printing station as in FIGURE 4.

In FIGURE 1, particularly, the general construction of the machine can be seen. Encased side frames **1** enclose drive chains **2**. The major components from the feed end of the machine to the discharge end are a feed board **6** to which sheets can be fed for example by an automatic feeder or manually from an automatically rising pallet loader (not shown), a bed **7**, a silk screen frame **114** (FIGURE 4) and associated squeegee **19** (FIGURE 3), and tape work piece delivery unit (not shown) between the chains **2** at the discharge end. The chains **2** are driven by a wheel **3** and carry four gripper bars **4**, **4'**, **4''**, and **4'''**. The chain drive wheel **3** is supported by struts **10** on an axle **12**. Also on the axle **12** is a pinion **14** held in engagement with a rack **16** by a box **13** including wheel bearings **23**. The rack **16** is pivoted at **21** onto a combined cam and crank wheel **22** which is rotated and driven by a motor (not shown) through a gear box (not shown). The rack mechanism is linked to the indexing chain wheel **3** by means of a cam operated locking device (not shown). This ensures that when the rack is travelling one way it engages the forward drive, but at the return movement the drive is disengaged instantaneously and a fixed registering plunger comes into place to hold the wheels **3** in a positive location. This operation is, of course, repeated reciprocally at the other end of the rack stroke.

On the periphery of the wheel **22** rests a cam follower **24** rigidly connected to an axle **26** journalled in a block **28**. Rigidly mounted on the axle **26** are a toggle **30** and a projection **32**. The toggle **30** is pivoted at each end to links **33**, **34** which are pivoted at their other ends to arms of bell crank levers **35**, **36**, respectively. The other arms **37**, **38** of the bell crank levers are contactable with blocks **41**, **42** respectively on pillars **45**, **46** at the corners of the machine proper which serve to raise the printing screen and associated squeegee **19** (FIGURE 3). The projection **32** is pivoted onto one end of a link **43**, the other end of which is pivoted onto an arm **50** of a bell crank lever journalled to the machine beneath the bed **7**. Another arm **52** of the last mentioned bell crank lever is pivoted to and serves to raise the printing table **7**. Yet another arm **54** of this bell crank lever is pivoted to one end of a link **56**, the other end of which is pivoted to an arm **58** of another bell crank lever. The other arm **60** of this last mentioned bell crank lever, like the arm **52**, serves to lift the bed **7**. Thus the link **56** ensures that both ends of the bed **7** are equally raised. The whole chain drive mechanism **2**, **3**, **4** and the bed and frame raising mechanism **30** to **60** are duplicated at the other side of the machine which does not appear in the drawings.

The printing head or screen printing mechanism as shown in FIGURES 3, 4 and 5 is supported by pillars **45**, **46** and other similar pillars on the opposite side of the machine (not shown). The printing head consists essentially of two slide members **18**, connecting pillars **45** and **46** with the other similar pillars (not shown) along which the squeegee **19** is driven by a chain and reversing motor (not shown). The work piece **20** is shown in dotted outline. Beneath the squeegee **19** is adjustably mounted the silk screen frame **114** so that it can be positioned exactly in relation to the position of the gripper bar in its position of final register holding the work piece. Chain drive casings **15**, end frames **116**, and screen mounting bars **17** are also shown.

In FIGURES 4 and 5, for the sake of clarity, the endless chains **2** the screen (silk frame) **114** and the squeegee **19** have been omitted. The machine is shown at that stage of printing cycle when the squeegee **19** is traversing the frame **114** and depositing ink on the work piece **20**. The squeegee slide **18** has four lugs **118** each rigidly supporting a tapered pin **120**. The pins **120** cooperate with holes in gripper bars **4'**, **4** to provide the registering means. The gripper bars **4'**, **4** are connected by trailing links **126**, **128** to the chains **2** and guided by rollers **132**, **134** engaging the top of a gripper bar track **130** and other such rollers which do not appear in the drawings engaging below the gripper bar track **130**. The engagement of each pair of register pins **120** respectively in the gripper bars **4'**, **4** positively locates the work piece **20** which is secured by the grippers on the gripper bar **4'** in relation to the frame **114** and thus ensures that the image being printed is in the same place and in the same orientation as other work pieces similarly arranged on other gripper bars.

The sequence of operations starting as a work piece finishes being printed is as follows:

As the squeegee **19** (FIGURE 3) nears the end of its transverse of the frame **114** the gripper fingers (not shown) of the gripper bar **4** are closed by a cam mechanism (not shown) to grip the next work piece for printing which is resting on the paper feed board **6**. After the completion of the traverse of the squeegee **19** and thus the printing of the work piece **20**, the squeegee slide **18**, the frame **114** and thus the register pins **120** are raised by the mechanism shown in FIGURE 1. Similarly the table **7** falls to a plane below the gripper bar track **130** so as not to obstruct the passage of the gripper bar **4**. The chains **2** are then advanced so that the gripper bars **4'**, **4** index to the left, the gripper bar **4'** withdrawing the work piece **20** just printed and releasing it outside the machine, for example onto the tape work piece delivery unit (not shown) leading to a drier or drop-off box, and the gripper bar **4** bringing the new work piece into the printing position. The next gripper bar **4'''** is brought into the waiting position in which the gripper bar **4** is shown. The table **7** rises to support the new work piece. The squeegee slide **18**, the frame **114**, and the register pins **120** enter the holes in the gripper bars which are free to move over a small range if necessary independently of the chain drive mechanism by means of the trailing links **126** and **128**. The squeegee now starts its printing traverse of the next work piece and the position shown in FIGURES 4 and 5 of the drawings is again assumed.

The time cycle in seconds is frame down ¼ sec., squeegee stroke ¾ sec., frame up ¼ sec., making a total printing time of 1¼ secs., and a chain movement time of ¾ sec. making a total cycle time of 2 secs., equivalent to a rate of 1,800 pieces per hour. The printing time of 1¼ secs. is quite sufficient for the operator to place a new sheet work piece in register at the feed position, so that exchange of work piece is possible without the passage of any time other than that necessary for the mechanical operation of the machine.

I claim:

1. A screen printing machine comprising a printing frame, means for raising and lowering said frame from and to operative position, a printing bed located beneath said printing frame for supporting a work piece, means for raising and lowering printing bed to and from operative position respectively, at least two sets of work gripper devices in spaced-apart relationship and presented for disposition transversely above said printing bed, means for causing said gripper members to travel across said printing bed, and cooperative locking means provided

on said gripper devices and said printing frame for effective positive registration of a work piece for printing thereon.

2. A screen printing machine as defined in claim 1 and further characterized by said means for causing travel of said gripper devices comprising endless chains provided laterally of each side of said printing bed, means for effecting movement of said endless chains and means for engaging said gripper devices to said chains.

3. A screen printing machine as defined in claim 2 and further characterized by said means engaging said gripper devices to said chains comprising trailing links.

4. A screen printing machine as defined in claim 1 and further characterized by said work piece gripper devices comprising elongated gripper bars.

5. A screen printing machine as defined in claim 4 and further characterized by said cooperative locking means comprising locking pins provided on said printing frame, and said gripper bars having receptacles for receiving said locking pins.

6. A screen printing machine as defined in claim 4 and further characterized by said cooperative means comprising downwardly depending locking pins fixed in their upper end portions to said printing frame, said gripper

bars having apertures for receiving said locking pins, said locking pins being tapered at their lower ends for facile reception within said apertures.

7. A screen printing machine as defined in claim 6 and further characterized by said apertures being provided adjacent each end of each gripper bar and said pins being located adjacent the outer edges of the printing frame.

8. A screen printing machine as defined in claim 1 and further characterized by said means for raising and lowering said printing bed comprising cam members engaging said bed on its undersurface at spaced-apart points thereon, and means for rocking said cams for effecting upward and downward movement of said printing bed.

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