

Oct. 31, 1939.

R. F. G. HOLNESS

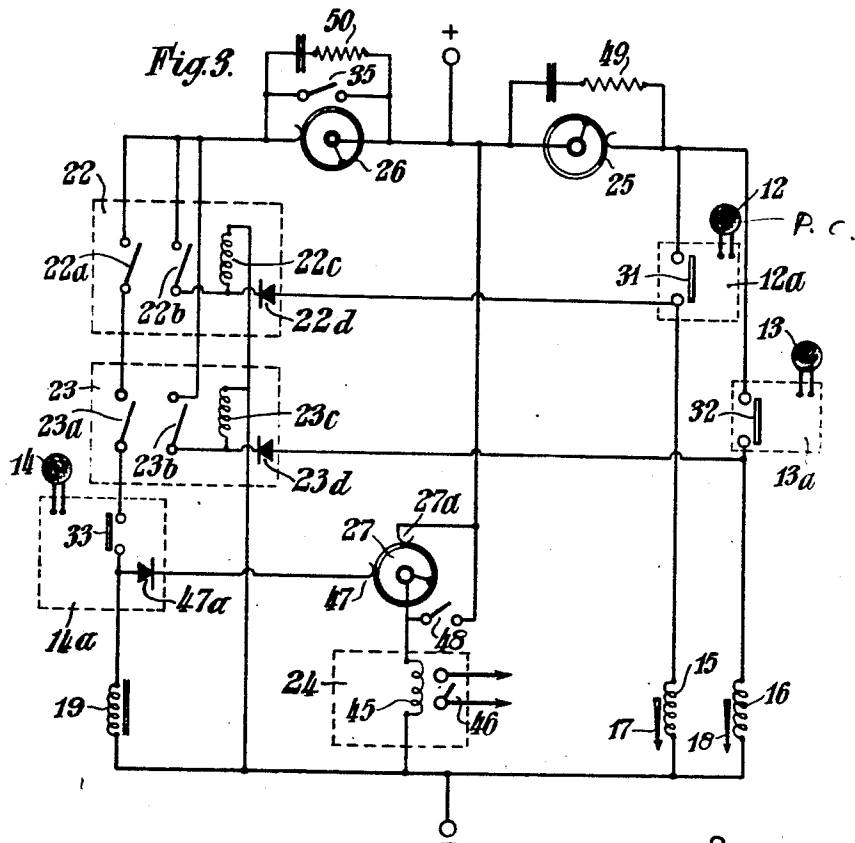
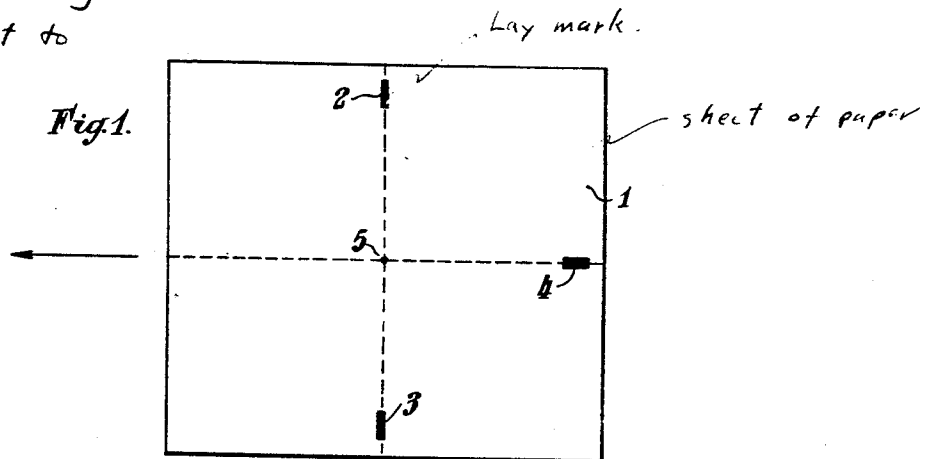
2,178,304

FEEDING OF SHEETS

Filed July 19, 1938

3 Sheets-Sheet 1

For color printing.  
Registers sheet to  
lay marks.



Inventor:  
Reginald Frederick George Holness,  
By Potter, Pierce & Scheffler,  
Attorneys.

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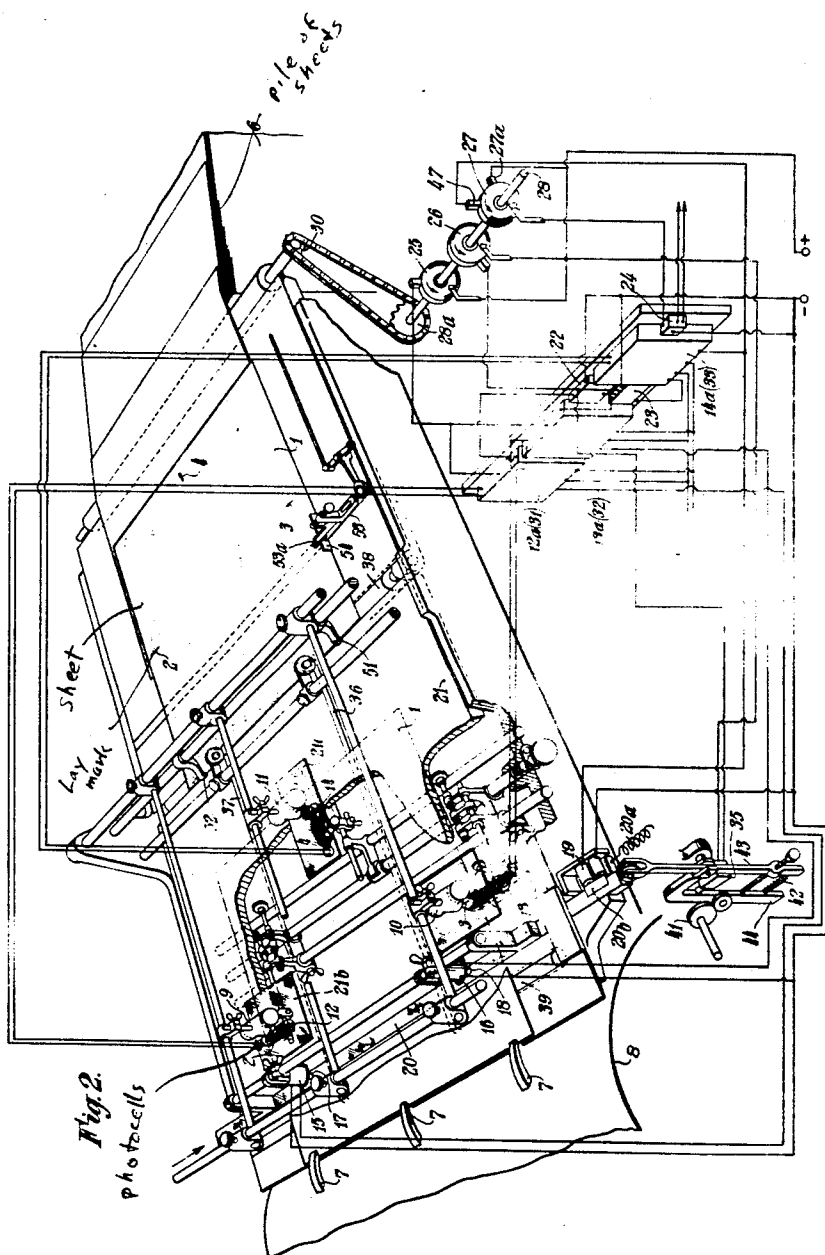
R. F. G. HOLNESS

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FEEDING OF SHEETS

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3 Sheets-Sheet 2

Fig. 2.  
photo cells

Inventor:  
Reginald Frederick George Holness,  
By Potter, Pierce & Scheffler,  
Attorneys.

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R. F. G. HOLNESS

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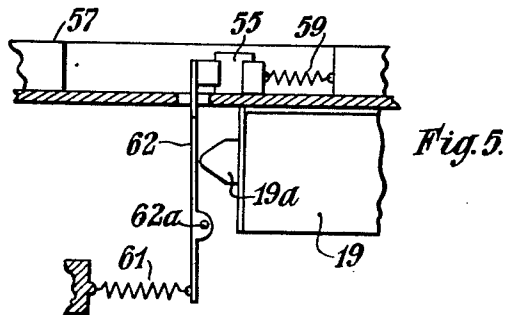
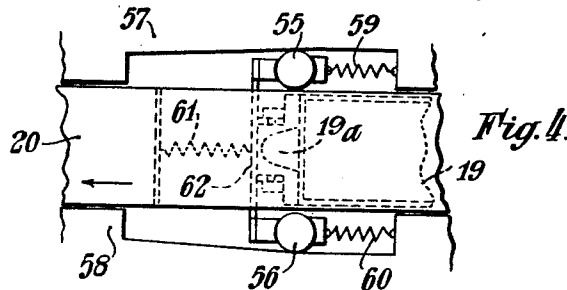
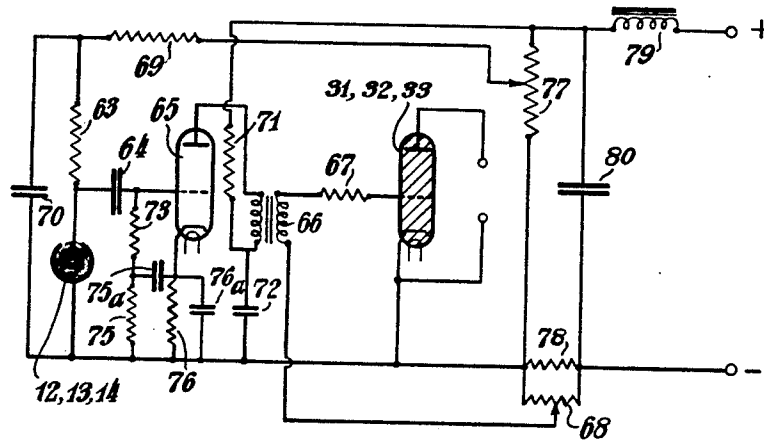
FEEDING OF SHEETS

Filed July 19, 1938

3 Sheets-Sheet 3

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Fig. 6.



Inventor:  
 Reginald Frederick George Holness,  
 By Potter, Pines & Schaffler,  
 Attorneys.

## UNITED STATES PATENT OFFICE

2,178,304

## FEEDING OF SHEETS

Reginald Frederick George Holness, London,  
England, assignor to Waterlow and Sons Limited, London, England, a British company

Application July 19, 1938, Serial No. 220,118  
In Great Britain July 30, 1937

22 Claims. (Cl. 271—58)

This invention relates to the feeding of sheets, for multi-colour printing and other purposes in which a sheet has to be positioned accurately for feeding.

5 In the known automatic sheet-feeding devices, correct positioning of the sheet is accomplished by bringing two contiguous edges of the sheet up to stops. It is usual to trim these two edges previous to use so that they are exactly at right angles. 10 By this means satisfactory register is obtained in multi-colour printing involving more than one printing operation provided that the humidity of the paper remains fairly constant.

15 In certain processes the humidity of the paper varies and this is particularly so in forms of intaglio printing in which the paper is deliberately damped before use. This results in a marked dimensional change for which allowance is made when making the printing surfaces. Unfortunately this change of dimension varies somewhat from sheet to sheet, making exact register by the 20 ordinary mechanical means impossible. If the sheet were registered by mechanical front and side lays in the usual manner, the variations of register would increase progressively from the junction of the trimmed sides to the opposite 25 corner and thus, for this particular purpose the known type of automatic sheet feeder is useless.

30 Heretofore in practice these damped sheets have had to be fed by hand. They are provided with lay marks near to the centre of the sheet and the machine is provided with an equal number, usually two, of reference points to which the sheets are set by eye. By this means the variation 35 in dimensions between any sheet and the standard is distributed evenly about the centre of the sheet, thus reducing the maximum amount by which two printings fail to register to under one half of that which would result if the sheets were 40 positioned by their edges.

Up to the present no automatic method of feeding sheets to lay marks and not edges has been used.

45 The present invention has for its object to provide an improved method and means for accurately positioning sheets to lay marks instead of edges whereby the greater accuracy in registration secured by the usual hand-feed method referred to may be attained in a fully automatic 50 manner enabling a higher rate of output to be achieved in any process in which feeding of the sheets to lay marks is necessary in order to secure effective results.

55 The term "colour printing" used herein includes any process in which a sheet receives more

than one impression other than on a multi-colour machine employing a single impression cylinder.

According to the present invention, in a method of feeding sheets wherein the sheets are registered to lay marks thereon so that any error in registration due to humidity or other cause is distributed about a predetermined point on the sheet, the registration of the sheets is effected by automatically positioning the sheet to lay marks thereon by means under the control of photo-sensitive devices influenced by the said lay marks. 5 10

The invention also includes a method of feeding sheets provided with lay marks from a pile to an impression cylinder for colour printing, wherein during feeding of the sheets into position for engagement by the impression cylinder grippers, each sheet is positioned by means controlled by photo-sensitive devices influenced by the said lay marks. 15

The invention furthermore includes a method of feeding sheets in register to an impression cylinder for colour printing which comprises providing the sheets with lay marks arranged in two lines that intersect at registration points centrally located on the sheets, and operating sheet-shifting and positioning means under the control of photo-sensitive devices influenced by the said lay marks. The registration point need not be at the geometrical center of the sheet, and the term "centrally located" is to be understood as 20 25 30 applying generally to any position that is substantially spaced from the edges of the sheet.

The invention furthermore includes a method of feeding sheets from a pile which comprises effecting pre-registration of the sheets to an edge or edges by usual mechanical means including front and/or side lays and thereafter automatically registering the sheets to lay marks thereon by the use of mechanism under the control of photo-sensitive devices arranged to be influenced by the said lay marks. 35 40

Preferably each sheet is provided with three lay marks in two intersecting lines substantially at right angles to the edges of the sheet, two of such lay marks being in one line transverse to the direction of travel of the sheet, and the third lay mark being arranged in a line disposed in the said direction of travel, and automatic registration is effected under the control of three photo-sensitive devices positioned for operation by the said lay marks. 45 50

The invention also includes apparatus for carrying out the methods referred to comprising photo-sensitive devices, sheet-shifting and positioning mechanism, and means including elec- 55

trical relays under the control of said photo-sensitive devices for operating said sheet-shifting and positioning mechanism.

The invention is hereinafter described by way of example with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a plan view of a sheet provided with lay marks;

Figure 2 is a perspective view illustrating feeding and registration apparatus according to the invention;

Figure 3 is a diagram of the electrical circuit for the apparatus shown in Figure 2;

Figure 4 is a fragmentary plan view illustrating an alternative means for arresting movement of a lay bar under control of a photo-sensitive device;

Figure 5 is a fragmentary side elevation corresponding to Figure 4; and

Figure 6 is a diagram showing the circuit arrangement of the photo-sensitive device and its associated equipment.

Each sheet 1 is, as shown in Figure 1, provided with three lay marks, 2, 3, 4. In order to attain the object of laying to the centre 5 of the sheet, these lay marks are printed so as to lie in bisecting lines substantially at right angles to the sides of the sheet, two lay marks 2, 3 being in one line at right angles to the direction of travel indicated by the arrow, and the third lay mark 4 being in the other line lying in the direction of travel and preferably adjacent the rear edge of the sheet. The lay marks may be arranged in lines intersecting at any other desired point in the sheet, for instance, the centre of a design on or to be impressed on the sheet, in order to distribute any error in registration about the said point as symmetrically as possible.

For the purpose of removing the sheets one by one from a pile 6 and carrying the same towards the grippers 7 on the impression cylinder 8, any known form of mechanism may be used.

As shown in Figure 2, three illuminating systems 9, 10, 11 are associated respectively with three photo-sensitive devices 12, 13, 14 arranged to be energised by passage of the respective lay marks 2, 3, 4, in relation thereto.

When a sheet is delivered to the laying-on board, tapes or other devices used for carrying the sheet to the laying-on position, it may be travelling slightly out of square. The two photo-sensitive devices 12, 13 are placed so that when both are operated by the respective lay marks 2, 3 a sheet will be correctly positioned with regard to travel towards the laying-on position. The devices 12, 13 operate electro-magnets 15, 16 controlling grippers 17, 18 respectively, while the device 14 operates an electro-magnet 19 or other device to arrest movement of a transverse lay bar 20. Thus, when all three photo-sensitive devices 12, 13, 14 have been operated by the respective lay marks 2, 3, 4, the sheet will be correctly positioned for feeding to the impression cylinder and any error that there may be in registration due to unequal expansion or contraction of the sheets will be distributed equally about the centre 5 or other preselected point.

In the apparatus shown in Figure 2, the photo-sensitive devices 12, 13, 14 are operated by transmitted light and for this reason transparent windows or plain openings 21a, 21b, 21c respectively are arranged in the board 21. The illuminating systems 9, 10, 11 and the photo-sensitive devices 12, 13, 14 are movably mounted on rods preferably with screw or micrometer adjustment in order

that their position may be set with accuracy. Relays 22, 23, 24 and amplifiers 12a, 13a, 14a hereinafter referred to, are shown as mounted on a board which normally will be positioned under the feeder but is shown separately in the drawings for the sake of clarity. Similarly, rotary switches 25, 26 and 27, hereinafter referred to, normally would be mounted under cover beneath the feeder, but in the drawings they are shown to one side for clearness, being mounted on but insulated from the shaft 28 which is fitted with a sprocket 28a driven by chain 29 from a sprocket 30 mounted on a shaft of the feeder.

When the sheet 1 is in the correct position for feeding to the impression cylinder 8, the lay marks 2, 3, 4 will each cut off or substantially reduce the illumination incident on the respective photo-sensitive device 12, 13, 14. This change is utilised in known manner to operate the relays 31, 32, 33 (Figure 3) through amplifiers 12a, 13a, 14a respectively. For these relays 31, 32, 33, it is preferred to use grid-controlled vapour discharge tubes owing to their extremely rapid operation.

If the sheet arrives with the lay marks 2, 3 "out of square", one mark, e. g., the mark 2, arrives at the photo-sensitive device 12 first causing its associated relay 31 to close. This energises the coil 15 causing the gripper 17 to drop and hold one edge of the paper to the transverse lay pull bar 20. Simultaneously, the operating coil 22c of the relay 22 is energised closing contacts 22a, 22b. The closing of the contacts 22b supplies power to the operating coil 22c through either or both the switch 35 and the rotary contact device 26 so that if either of these is in the closed position the relay 22 remains closed despite the opening of contacts 31. At the commencement of the operation, the switch 35 is open and the contact device 26 is closed. The action of tapes, two of which 36, 37 are shown as being driven by rollers 38, 39, causes the sheet to turn about the gripper 17. When the line joining the lay marks 2 and 3 becomes parallel to the axis of the impression cylinder of the printing machine, the lay mark 3 energises the respective photo-sensitive device 13 operating relay 32 which energises the coil 16 causing the gripper 18 to hold the sheet, effectively preventing further travel with relation to the transverse lay bar 20. Simultaneously the coil 23c of the relay 23 is energised closing contacts 23a and 23b. The contacts 23b function in like manner to the contacts 22b of the relay 22 to prevent de-energising of the relay 23 on the opening of the relay 32, provided that either contacts 26 or 35 are closed. Both contacts 22a and 23a are now closed and thus power is applied to the relay 33 which previous to this had been unable to operate and thus was unaffected by the passage of any part of the design on, or the edge of, the sheet 1 over the photo-sensitive device intended to co-operate with the lay mark 4.

The operation of a cam 41 now causes the transverse lay pull bar 20 to travel in the direction of the arrow under the influence of spring 20a, the bar 20 carrying the sheet 1 with it. When the sheet is correctly positioned for feeding, the lay mark 4 operates the photo-sensitive device 14, closing the relay 33 and energising the coil 19 to prevent further motion of the bar 20. This effect may be secured, for example, by using an insert 20b of magnetic material in the bar 20 or making the bar 20 of magnetic material to co-operate with a fixed electro-magnet with the

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coils 19 operating in the manner of the well-known magnetic chuck.

The positioning of the sheet is now complete and it is ready to be fed into the press but there will in general be a short interval of time before the impression cylinder grippers 7 are in the correct position to receive the sheet. During this period the sheet is held stationary but the cam 41, which is driven from the press, continues to travel causing "slack" in the link mechanism associated therewith, whereby a spring 42 is able to separate the lever 43 from the cam roller carrying arm 44 and thereby effect closing of the switch 35.

During the whole of the preceding operations the rotary switch 25, which, like the switches 26 and 27, is coupled mechanically to the printing mechanism, is arranged to maintain the current supply to the relays 31 and 32. At the instant that the impression cylinder 8 is ready to receive the sheet 1 the switch 25 breaks the circuit to relays 31 and 32 and their associated coils 15 and 16, raising armatures 17 and 18 and thus freeing the sheet to be gripped by the grippers 7 of the impression cylinder 8. At this time the switches 35 and 26 are closed. Thus the relays 22 and 23 are maintained closed, keeping the relay 33 and its associated coil 19 energised, thus preventing the release of the transverse lay bar 20, and obviating sudden movement of the same or of its associated mechanism and sudden stopping thereof when the "slack" previously mentioned is taken up. This motion, apart from its detrimental effect on the mechanism, would tend to move the position of the sheet while being engaged by the grippers 7 and would impair the accuracy of the "lay". Rectifying devices 22d, 23d, are inserted in the leads from the relays 31, 32 to the relay coils 22c, 23c, so that when the relays 31, 32 open, the coils 17, 18 are not maintained energised by current from the contacts 22b, 23b.

During the positioning process, the rotary switch 27 has been supplying current to the coil 45 of the relay 24, thus maintaining contacts 46 closed. The contacts 46 are arranged on opening to trip the feeder and/or press and may be, for example, in series with the "no volts" coil of the starter of the electric motor driving the printing press. At the instant of or just prior to the opening of relays 31 and 32 to allow feeding of the sheet, the rotary switch 27 breaks the circuit from the contact 27a and connects the coil 45 of relay 24 through contact 47 to the junction of the relay 33 and the coil 19. If for any reason any of the preceding operations should not have been properly performed and hence the sheet 1 not be properly registered, then one or more of the contacts 22a, 23a or 33 will be open and the current to the coil 45 of relay 24 will be interrupted causing the apparatus to stop. However, if all operations have been correctly performed, contacts 22a, 23a and 33 will be closed and will maintain the current on the relay 24 and the machine will continue to operate. Very shortly after, this switch 27 returns the coil 45 direct to the input of the power line so that the current supply to relay 24 is not interrupted when the coil 19 is de-energised. Should the trip mechanism function, a restart, after clearing the fault, can be secured by a switch 48 to short-circuit the rotary switch 27 or by a mechanical device acting to hold the contacts of relay 24 closed until normal operation is resumed. A rectifying device 47a may be inserted, as shown, to prevent any possi-

bility of the switch 27 supplying current direct from the positive lead to energise the coil 19.

The sheet 1 is now gripped by grippers 7 of the impression cylinder 8 and is taken into the printing press.

The cam 41 continues its revolution and at about the limit of its travel the rotary switch 26 opens leaving circuit continuity dependent on the switch 35. On its return half revolution when the cam 41 has taken up the slack in its associated link mechanism, the switch 35 is opened and cuts off the current to the relays 22 and 23, and thus opens the contacts 22a, 22b, 23a, 23b and relay 33, thereby resetting this part of the mechanism and releasing the grip on the bar 20 without causing jar in the mechanism and also allowing the cam 41 to restore the bar 20 to the starting end of its stroke for another operation. Shortly after the switch 35 has opened, the rotary switch 26 short-circuits it again to supply current to this part of the apparatus for the next operation.

The rotary switch 25 is arranged so as not to supply current again to the relays 31 and 32 until after the leading edge of the next sheet has passed the photo-sensitive devices 12 and 13 to eliminate any chance of faulty action due to the change in illumination on them at the instant they are passed by the edge of the sheet.

Resistance capacity absorbers 49, 50 may be inserted, as shown in Figure 3, to minimise sparking at the switch contacts.

It may be desirable to arrange for a previous mechanical alignment of the sheet, for example, to one edge, or to two adjacent edges at right angles, to reduce the extent of the movement required by the part of the apparatus controlled by the photo-sensitive devices. This mechanical alignment may be performed in known manner and is particularly advantageous when dealing with damp sheets of paper which render it difficult to secure a properly "knocked up" stack, i. e., a stack in which two adjacent edges of each sheet are in the same two intersecting vertical planes.

Previous mechanical alignment also permits simple arrangements for the feeding when desired of sheets not bearing lay marks when accurate register is not required, e. g., when so-called "waste" sheets are fed during the adjustment of the printing press.

As shown in Figure 2, the sheets fed from the pile 6 by mechanism of the usual form are brought up to front lays 51, 52 and a side lay bar 53 is then caused to move, the spring finger device 53a gripping the sheet and pulling it up to a side lay 54, thus effecting mechanical registration of the sheet by its edges. The sheet is then ready for registration to lay marks as before described and the front lays 51, 52 are caused to lift and release the sheet which travels down the board 21 on the tapes 36, 37.

An alternative method of arresting the longitudinal movement of the bar 20 makes use of the principle of the roller clutch, as shown in Figures 4 and 5. Two rollers 55 and 56 are mounted with their axes vertical one on either side of the bar 20 the guides 57, 58 of which are recessed, as shown, to provide an opening for each roller, the opening being less than the roller diameter at one end and greater at the other. Springs 59 and 60 tend to press the rollers towards the narrow end of the openings but a stronger spring 61 acting through a lever 62 pivoted at 62a prevents this occurring. Adjustable stops which are not

shown limit the travel of lever 62 to the very small amount necessary either to keep the rollers out of simultaneous contact with bar 20 and the guides 57, 58, or to release the rollers sufficiently for them to make this simultaneous contact. The energising of the coil 19 actuates the armature 19a so as to move the lever 62 to release the rollers 55, 56 which thereupon, under the influence of the springs 59, 60, grip the bar 20, which is moving in the direction of the arrow (Fig. 4).

The coil 19 is maintained energised during the travel of the cam 41 away from the bar 20 and also on the return stroke so that the release of the bar 20 is effected by the cam 41 taking up the slack in its associated link mechanism and finally applying pressure to the bar 20 when it automatically frees itself despite the fact that coil 19 is still energised. The switch 35 can be omitted in this arrangement and the rotary switch 26 arranged to break circuit continuity for a very short period at the end of the return stroke of the bar 20, thus de-energising the relays 33, 22 and 23 and resetting the mechanism for the next operation.

The photo-sensitive device and its associated equipment may be identical for each of the three sets used and the arrangement thereof is well-known per se. The arrangement shown in Figure 6 is for operation from a D. C. source which must be different from that of the rest of the apparatus. The photo-sensitive device 12, 13 or 14 may be a photo-cell of the emissive type either vacuum or gas filled and may incorporate amplification by secondary emission from target electrodes in known manner, if desired, the electrodes and subsidiary apparatus for producing this latter result not being shown. Further, the photo-sensitive device in this circuit arrangement may be of the photo-conductive type such as, for example, a thin film of selenium spread on glass between gold electrodes as described in British Patent No. 284,942. In each case the photo-sensitive device can be regarded from the point of view of circuit operation as a resistance the value of which decreases on illumination.

As normally arranged, i. e., with lay marks darker than and/or more opaque than the paper, the photo-sensitive device suffers a decrease of illumination on being acted on by its lay mark. Thus, its resistance is increased and the potential difference between the "earthy" line and the junction of the lead to the photo-sensitive device and to the resistance 63 is increased. This positive pulse is passed by the condenser 64 to the grid of the three-electrode valve 65 which amplifies it and causes it to appear in its anode circuit as a negative pulse which is passed to the primary of the transformer 66. The secondary is so connected that this is applied as a positive pulse through the resistance 67 to the grid of a grid-controlled vapour or gas discharge tube, i. e., the relay 31, 32 or 33. The resistance 67 is inserted to limit grid current during the conductive period of the relay 31, 32, 33. For the anode potential applied to it the slider of resistance 68 is adjusted so that the grid is sufficiently negative with respect to the cathode to keep the tube normally in a non-conducting state. When the positive pulse arrives, however, this negative bias is overcome and the tube becomes conducting and is no longer controllable by its grid electrode, i. e., it remains conducting until the anode circuit is interrupted. Resistance 69 and condenser 70 are for decoupling the supply to the photo-

sensitive device and the resistance 71 and condenser 72 serve the same function for the anode supply to the valve 65. The resistance 73 is the grid leak providing a conducting path from grid to cathode of the valve 65 and the resistance 76 provides negative grid bias, the resistance 75 and condensers 75a, 76a acting as decoupling devices in known manner. Resistances 77 and 78 form a potential divider across the supply, the "earthy" line being connected to their junction, thus enabling negative grid bias for relay 31, 32 or 33 to be obtained by adjustment of the slider on the resistance 68. A choke coil 79 and condenser 80 serve to remove irregularities from the supply.

It will be understood that the invention is not limited to the particular embodiment hereinbefore described and that the sheet-shifting and positioning mechanism controlled by the photo-sensitive devices may be modified in various ways. For example, at the point where the electro-magnetic grippers hold the sheet to the transverse lay bar, the said bar may be provided with rotatable parts in order to facilitate the swinging of the sheet about one or other of such grippers as herein described. Furthermore, the grippers themselves may be fitted with swivel end portions or may be otherwise rotatable.

The photo-sensitive devices may be operated by reflected light and the photo-sensitive devices and/or the illuminating systems may have suitable lens systems associated therewith. The lay marks, instead of being darker or more opaque than the material of the sheet, may be lighter or less opaque, in which case each lay mark will increase the illumination on the associated photo-sensitive device and the circuit connections thereof will be suitably modified.

What I claim and desire to secure by Letters Patent is:

1. In the feeding of sheets, the method of reducing those errors in registration that arise from dimensional changes in the sheets which comprises providing the sheets each with lay marks in predetermined positions with respect to a predetermined registration point intermediate the edges of the sheet, automatically controlling the advance of successive sheets photoelectrically by at least one of said lay marks to locate the registration point of the sheet in a fixed position with respect to the direction of advance of the sheets, rotating the sheet in its own plane, and automatically stopping the rotary motion of a sheet photoelectrically by another of said lay marks when the sheet is registered about its predetermined registration point.

2. In the feeding of sheets, the method of automatically registering successive sheets about similarly positioned registration points intermediate the edges of the several sheets which comprises providing each sheet with a plurality of lay marks in predetermined positions spaced from the registration point of that sheet, controlling movement of each sheet into laying-on position photoelectrically by at least one of said lay marks, rotating the sheet in its own plane, and arresting the rotation of each sheet photoelectrically in accordance with another of said lay marks.

3. In color printing, the method of feeding sheets from a pile to laying-on position for engagement by the grippers of an impression cylinder which comprises providing each sheet adjacent the border thereof with lay marks in predetermined positions with respect to a registration point within the area to be printed, controlling the advance of the successive sheets into laying-

on position photoelectrically by one of said lay marks, moving the sheet successively in two directions each at an angle to the direction of advance of the sheet, one of said movements being a rotation of the sheet in its own plane, and arresting each of said movements photoelectrically by other lay marks.

4. In colour printing, a method of feeding sheets in register to an impression cylinder, which comprises providing the sheets with lay marks arranged in two intersecting lines, said lines intersecting at a registration point centrally located on said sheets, and operating sheet-shifting and positioning means under the control of photo-sensitive devices influenced by the said lay marks.

5. A method of feeding sheets from a pile, which comprises effecting pre-registration of the sheets to at least one edge by mechanical means and thereafter automatically registering the sheets to lay marks thereon by the use of mechanism under the control of photo-sensitive devices arranged to be influenced by the said lay marks.

6. A method of feeding sheets from a pile which comprises providing each sheet with three lay marks in two intersecting lines substantially at right angles to the edges of the sheet and intersecting at a registration point centrally located on said sheets, two of said lay marks being in one line transverse to the direction of travel of the sheet, and the third lay mark being arranged on a line in said direction of travel, and effecting automatic registration under the control of three photo-sensitive devices positioned for operation by the said lay marks.

7. Apparatus for feeding sheets each provided with lay marks in predetermined positions with respect to a predetermined registration point intermediate the edges of the sheet, said apparatus comprising means for advancing a sheet into laying-on position, means for moving a sheet at an angle to the direction of its advance into laying-on position, and photo-sensitive devices responsive respectively to different lay marks for arresting the operation of said advancing means and said moving means when a sheet reaches a desired advanced position and a desired angularly moved position respectively.

8. Apparatus for feeding sheets each provided with a plurality of lay marks in predetermined positions with respect to a predetermined registration point intermediate the edges of the sheet, said apparatus comprising means for advancing a sheet towards laying-on position, photoelectric means controlled by one lay mark for arresting the operation of said advancing means, means for moving the sheet in succession in two directions at angles to the direction in which the sheet was advanced, one sheet moving means imparting a rotary motion to the sheet, and photoelectric means controlled by at least one other of said lay marks for arresting the operation of each of said sheet moving means.

9. Apparatus for feeding sheets each provided with a plurality of lay marks in predetermined position with respect to a preselected registration point intermediate the edges of the sheet, a sheet advancing and a pair of sheet moving means operative in succession to advance a sheet into laying-on position and then to impart movements to the sheet in directions at angles to the direction of the sheet advance, and photoelectric means controlled by said lay marks for arresting in succession the operation of said sheet advancing and said sheet moving means.

10. Apparatus for feeding sheets each provided with a plurality of lay marks in predetermined positions with respect to a preselected registration point intermediate the edges of the sheet, said apparatus including sheet advancing means including a pair of photoelectric devices actuated by certain of said lay marks for advancing the sheets in succession and rotating them to bring a registration line through the preselected registration point into a predetermined position, means operative thereafter to move the sheet to bring another registration line through the preselected registration point into a predetermined position.

11. Apparatus for feeding sheets provided with lay marks arranged in lines intersecting at a predetermined point intermediate the edges of the sheet, said apparatus comprising feeding means including photoelectric devices responsive to certain of said lay marks for advancing the sheets successively into laying-on position, and means including a photosensitive device responsive to another lay mark for rotating a sheet upon its arrival at laying-on position to effect registration of the sheet at its said predetermined point.

12. Apparatus as claimed in claim 11, in combination with means preventing operation of said rotating means prior to an actuation of said feeding means to advance a sheet into laying-on position.

13. Apparatus for feeding sheets provided with lay marks arranged on lines intersecting at a predetermined point intermediate the edges of the sheet about which any error in registration is to be distributed, comprising photosensitive devices positioned to be influenced by said lay marks when a sheet is in registration position, sheet-shifting and positioning mechanism, and means including electrical relays under the control of said photosensitive devices for controlling the operation of said sheet-shifting and positioning mechanism to register the sheet with reference to the said predetermined point on the sheet.

14. Apparatus for feeding sheets each provided with a plurality of lay marks in predetermined positions with respect to a preselected registration point centrally located on the sheet, said apparatus comprising three photosensitive devices positioned to be influenced by said lay marks, means for feeding a sheet towards laying-on position, means for rotating a sheet upon its arrival in laying-on position, sheet moving means for moving a sheet into fully registered position, timing means operative to energize said sheet feeding means and thereafter in succession said sheet rotating and sheet moving means, and means controlled by said photosensitive devices for arresting in succession the operation of said sheet feeding means, said sheet rotating means and said sheet moving means.

15. Apparatus as claimed in claim 14, wherein the means controlled by the respective photosensitive devices includes electrical relays and the circuit of the electrical relay of the third photosensitive device which controls the sheet moving means is normally open, in combination with relay means in the circuits controlled by the other photosensitive devices for closing the relay circuit of the third device upon the energization of said other devices.

16. Apparatus for feeding sheets provided with lay marks arranged on lines transverse to the feed movement of the sheet and to the transverse lay of the sheet, said lines intersecting at

5 a predetermined point on the sheet about which  
any error in registration is to be distributed, said  
apparatus comprising three photosensitive de-  
vices two of which are positioned to be influenced  
10 by the lay marks located on a line transverse to  
the feed movement of the sheet, the third of said  
devices being positioned to be influenced by a lay  
mark arranged on a line transverse to the di-  
rection of transverse lay movement of the sheet,  
15 means controlled by said two first-mentioned de-  
vices for positioning the sheet with regard to  
travel towards the laying-on position, and means  
controlled by said third device for moving and  
positioning the sheet laterally.

15 17. Apparatus as claimed in claim 16, wherein  
the means controlled by said third device in-  
cludes a transverse lay bar; and the means con-  
trolled by the other devices comprises a pair of  
grippers independently controlled by the first  
20 two devices for clamping a sheet to said trans-  
verse lay bar.

18. Apparatus as claimed in claim 16, wherein  
the means controlled by said third device includes  
a transverse lay bar, a cam for controlling the  
25 movement of said transverse lay bar, and electro-  
magnetic means energized by said third device  
for arresting the cam-controlled movement of  
said transverse lay bar.

19. Apparatus for feeding sheets into a laying-  
30 on position, said sheets having lay marks for  
registration of the sheets about predetermined  
registration points intermediate the edges of the  
several sheets, said apparatus comprising feed-  
ing means and transverse displacing means op-  
35 erable in timed sequential relation to advance a  
sheet into laying-on position and to move a  
sheet into registration after arrival at laying-on  
position, means including photosensitive devices  
responsive to different lay marks for gripping a  
40 sheet upon arrival at the desired laying-on po-  
sition and registration position respectively, and  
means operable in timed relation to said feeding  
means and said moving means to release said  
gripping means.

20. In printing apparatus, the combination  
with a relay for controlling the energization of  
the driving motor of a printing press, of means  
for feeding to the printing press sheets having  
5 lay marks for determining the registration  
thereof, photosensitive means positioned for en-  
ergization by said lay marks when a sheet is  
properly registered, relay circuits energized by  
said photosensitive means for controlling said  
10 feeding means, said relay for controlling the  
driving motor being included in one of said relay  
circuits, whereby energization of said printing  
press motor is dependent upon the proper regis-  
tration of a sheet to be printed.

21. In printing apparatus as claimed in claim  
15 20, the combination with a source of current, and  
switch means for energizing said motor-con-  
trolling relay and said relay circuits in predeter-  
mined timed relation.

22. In apparatus for feeding into laying-on  
20 position sheets having lay marks for determining  
the registration of the sheets about a predeter-  
mined point on the sheets, the combination with  
means for advancing the sheets to laying-on po-  
sition, a transverse lay bar, photoelectric means  
25 responsive to certain of said lay marks for clamp-  
ing a sheet to said lay bar upon arrival at laying-  
on position, a spring tending to move said lay bar  
in one direction, a cam and lever mechanism for  
determining the displacement of said lay bar by  
30 said spring, photoelectric means controlled by  
another lay mark and means energized thereby  
for arresting the movement of said lay bar by  
said spring, whereby slack is developed in said  
35 lever mechanism upon the continued movement  
of said cam, and a switch operable by slack in  
said lever mechanism to close a holding circuit  
for said movement arresting means, whereby said  
40 holding circuit is opened by said switch only when  
the slack is eliminated from said lever mech-  
anism upon the reverse movement of the cam.

REGINALD FREDERICK GEORGE  
HOLNESS.