

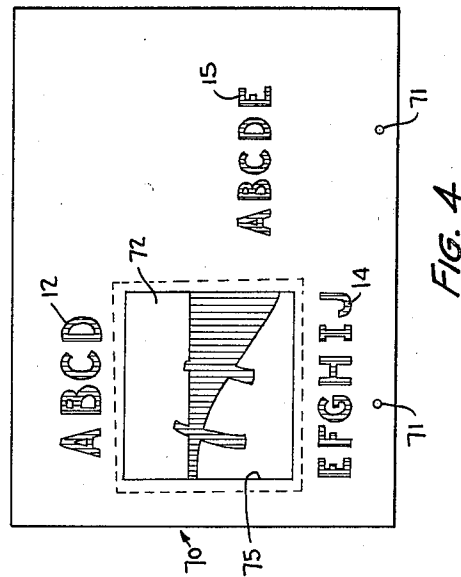
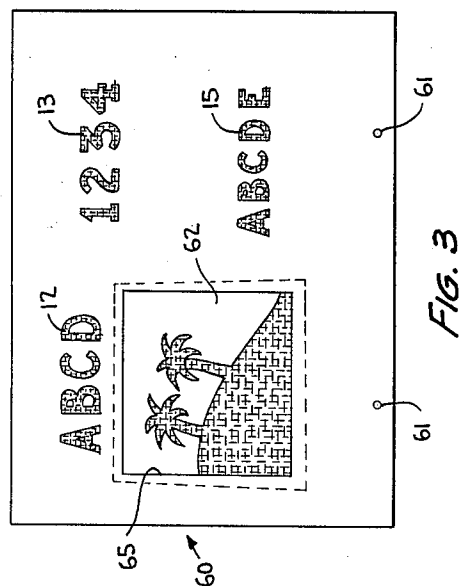
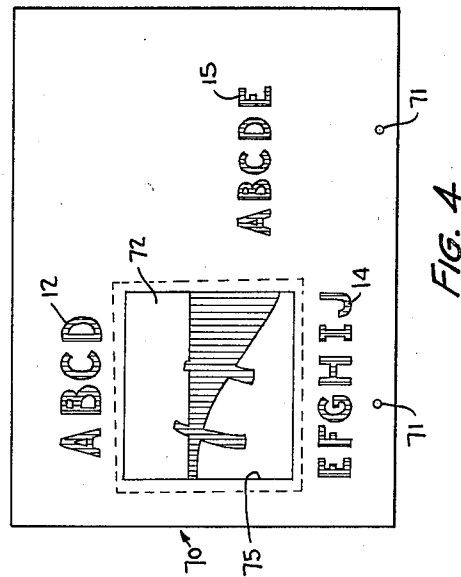
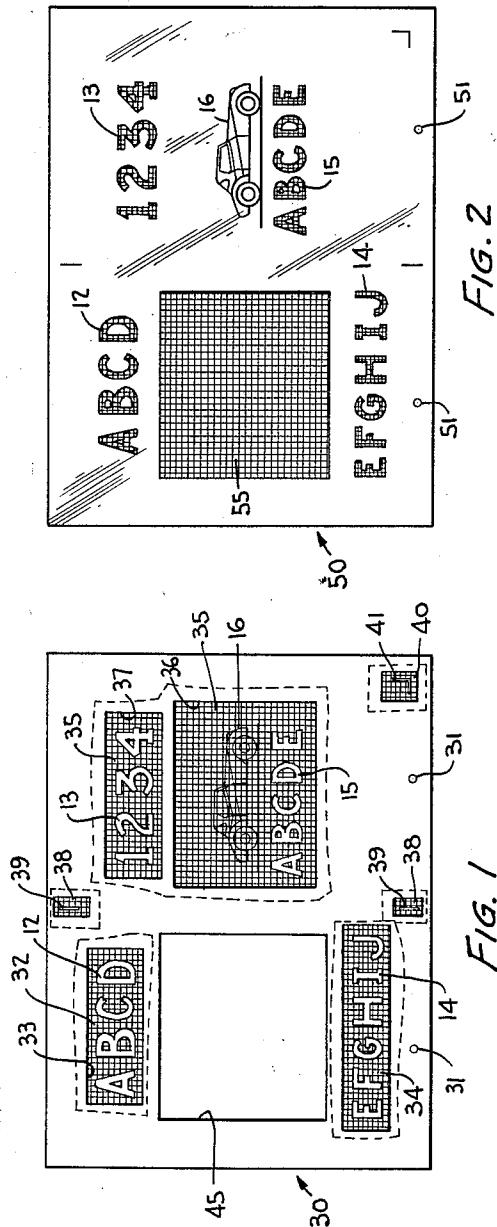
Sept. 17, 1963

D. E. SANFORD ETAL
MULTI-COLOR PRINTING SYSTEM

3,103,880

Filed March 11, 1960

7 Sheets-Sheet 1



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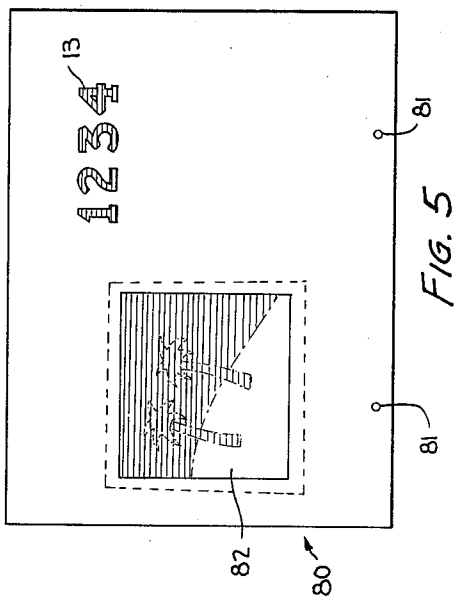
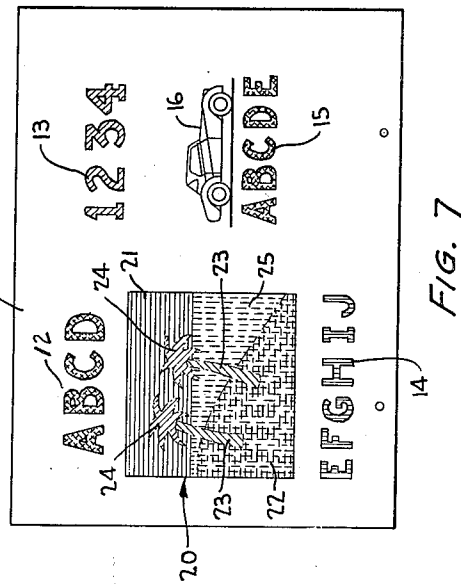
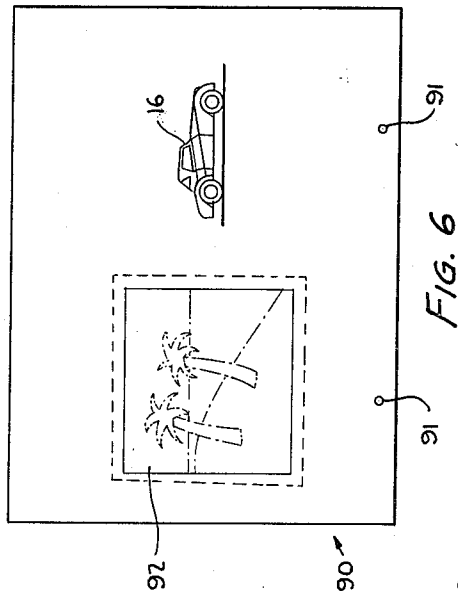
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7 Sheets-Sheet 2



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MULTI-COLOR PRINTING SYSTEM

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7 Sheets-Sheet 3

FIG. 8

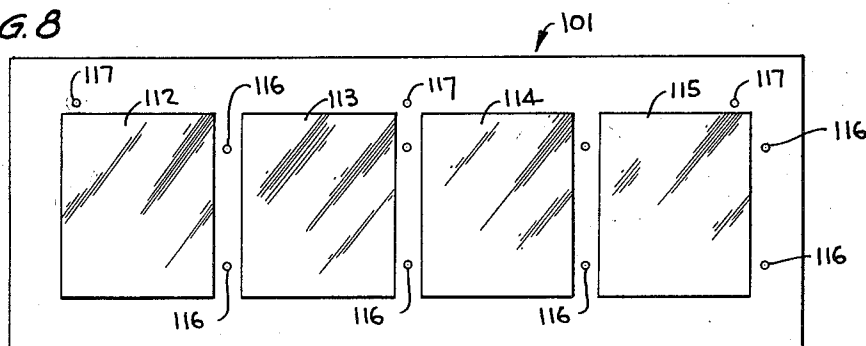


FIG. 9

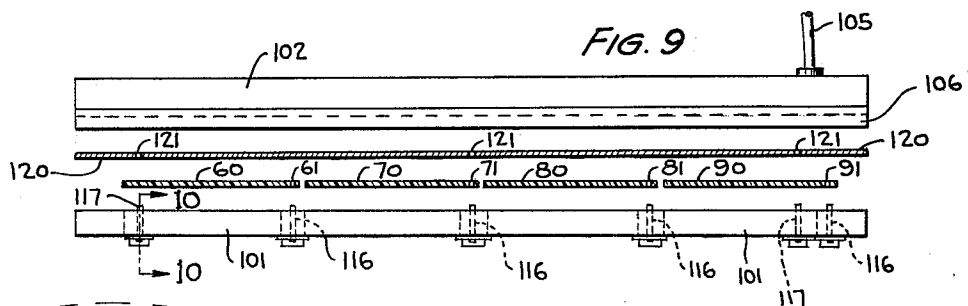


FIG. 10

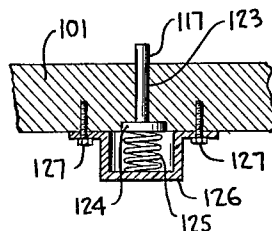
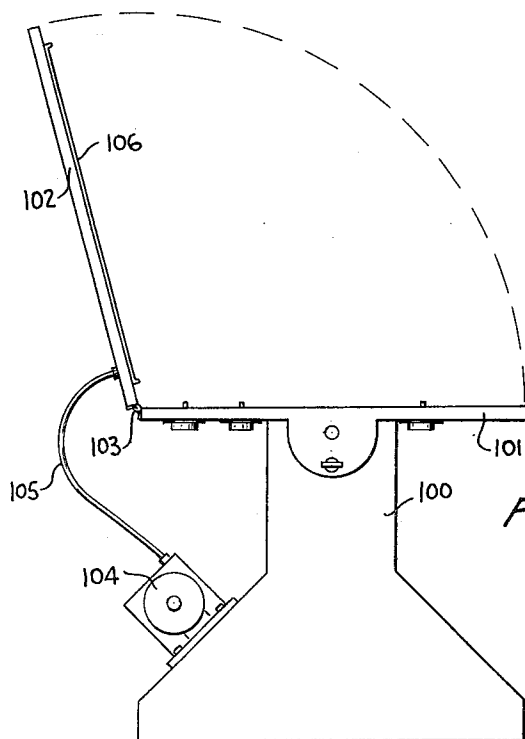


FIG. 11



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7 Sheets-Sheet 4

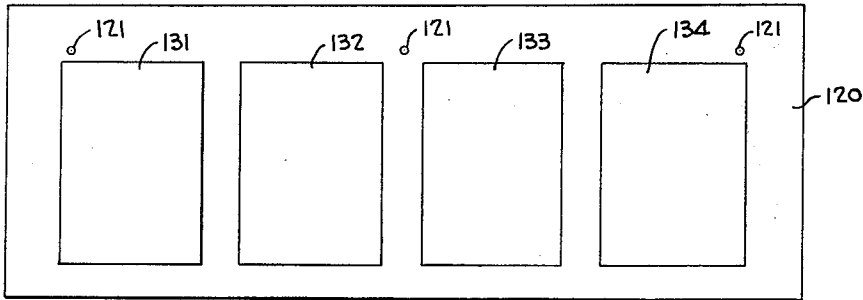


FIG. 12

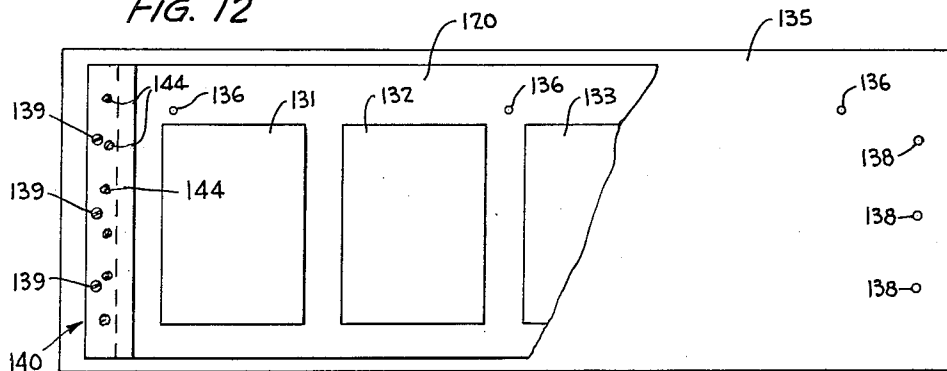


FIG. 13

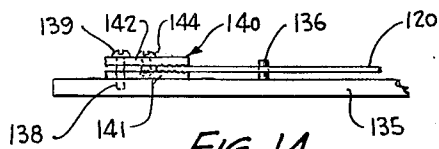


FIG. 14

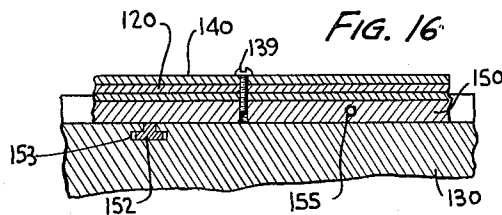


FIG. 16

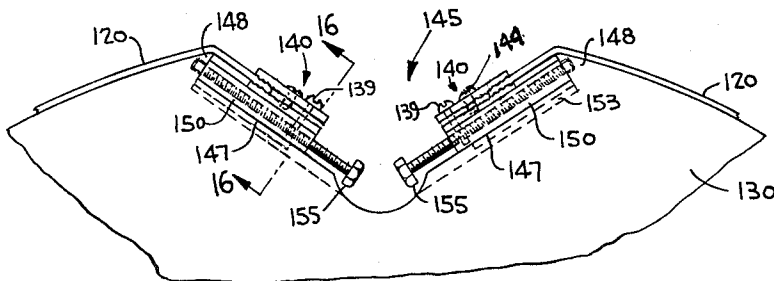


FIG. 15

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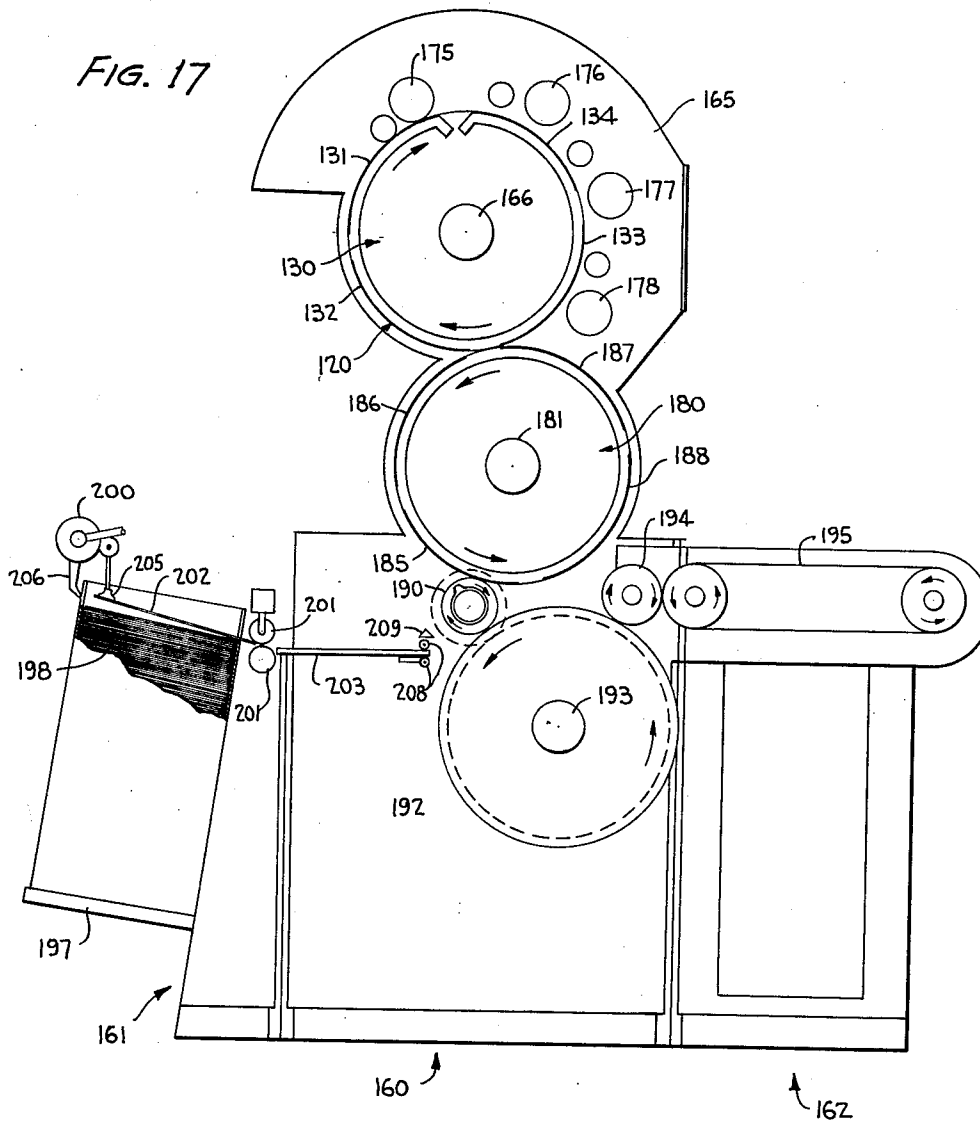
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7 Sheets-Sheet 5

FIG. 17



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MULTI-COLOR PRINTING SYSTEM

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7 Sheets-Sheet 6

FIG. 18

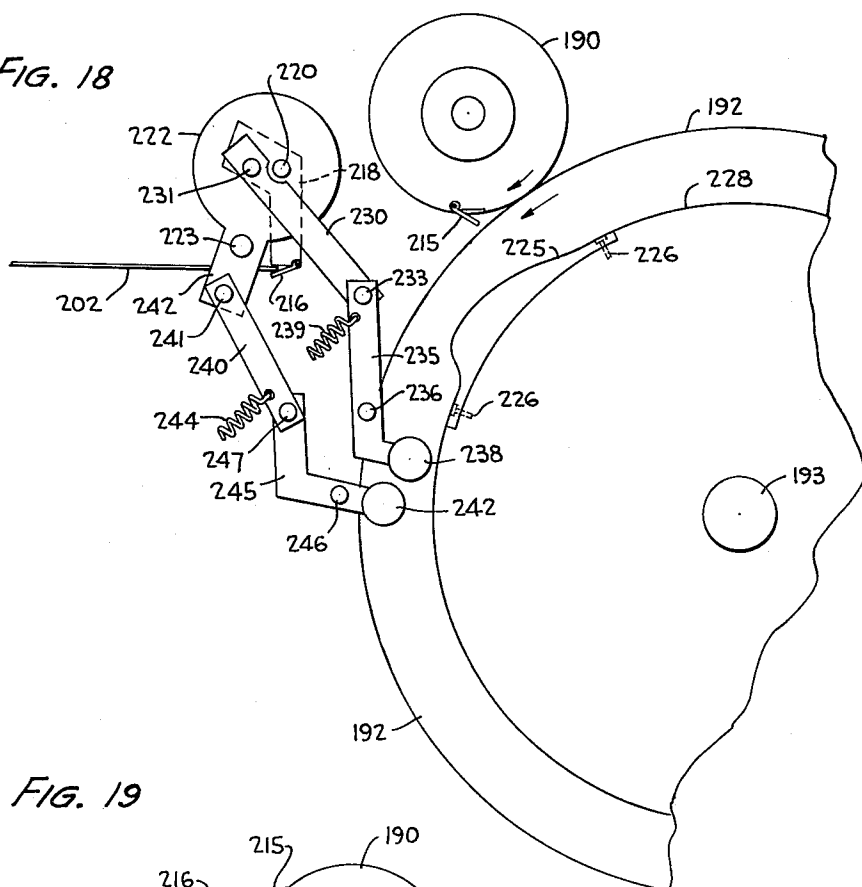
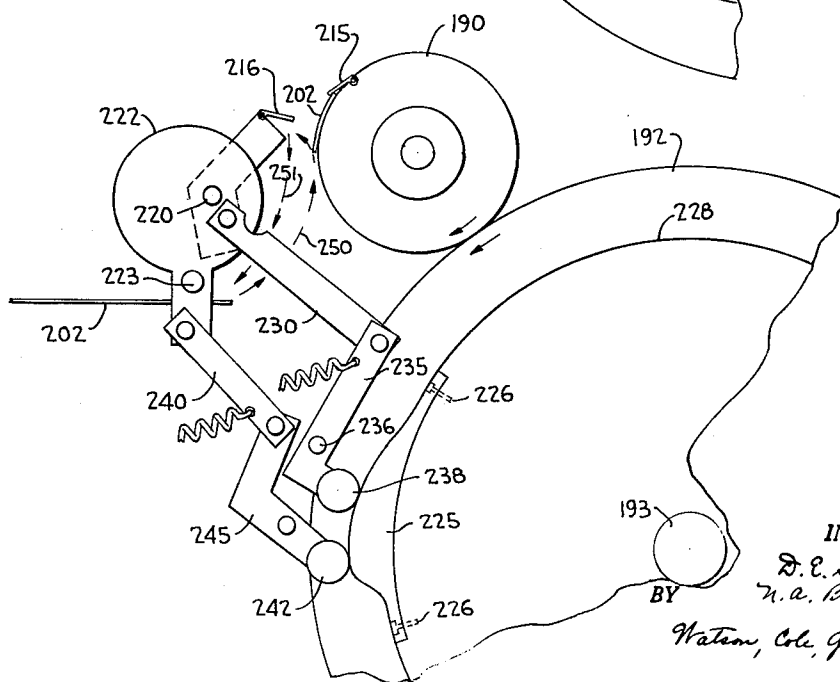


FIG. 19



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3,103,880

MULTI-COLOR PRINTING SYSTEM

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Filed Mar. 11, 1960, Ser. No. 14,284

9 Claims. (Cl. 101-136)

This invention relates to multi-color printing systems and has for its general object the provision of novel and improved processes and apparatus for preparing the plates and applying them to the press for perfect registry, and more particularly the provision of a novel printing press for effecting multi-color printing or lithography utilizing but a single plate in conjunction with a multiple revolution impression cylinder.

This application is a continuation-in-part of our co-pending application Serial No. 751,442, filed July 28, 1958, now abandoned.

The primary object of the invention is to attain perfect registry of impressions in preparing multi-color work, either of photographic or textual display matter, by unique photographic processes which involve setting up all of the involved images on a single plate, and in then producing copies of the multi-color work by means of a rotary press which comprises a unit composed only of a plate cylinder, a blanket cylinder, and an impression cylinder, together with their usual inking, moistening, and sheet handling accessories.

In its preferred embodiment, the invention contemplates the provision of basic gauge or reference devices whereby various art or display flats, positive films, and color separation negatives are made with the respective images in perfect registry, and means for maintaining such registry in the subsequent transfer of images to the printing plate.

Novel means are also provided for clamping the plate in proper position on the plate cylinder with the separately carried color images spaced precisely to transfer the inked image to the blanket cylinder and thence in superposed perfectly registering impressions on the sheet carried by the impression cylinder.

The plate and blanket cylinders are of diameters as many times larger than that of the impression cylinder as there are color impressions to be made. In the illustrative embodiment the standard number of color impressions are provided for, namely yellow, red, blue and black; therefore, the impression cylinder is one-fourth the size of the blanket and plate cylinders.

Any suitable sheet moving means may be provided for bringing successive sheets into the proximity of the impression cylinder, and a transfer or delivery cylinder is associated with the impression cylinder for taking the sheets after four revolutions on the impression cylinder and carrying them to a duplicate printing couple for perfecting, or to a delivery point if only one side of the sheet is to be printed.

Quite novel and ingenious means are provided for synchronizing the actuation of the feeding grippers, the impression cylinder grippers, and the transfer grippers; and in the ideal embodiment of the invention, these actuations are effected by means associated with or driven by the transfer cylinder.

Other objects and features of novelty will be apparent from the following specification when read in connection with the accompanying drawings in which certain embodiments of the invention are illustrated by way of example.

In the drawings:

FIGURE 1 is a diagrammatic plan view of a composite

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paper and film flat, bearing the textual and non-photographic artwork in negative film form and provided with a cut-out window where photographic copy is to appear in the finished product;

FIGURE 2 is a plan view of a film positive made from the flat shown in FIGURE 1 showing the artwork in positive form and the area for photographic reproduction in solid black;

FIGURE 3 is a plan view of a negative contact flat prepared from the positive flat of FIGURE 2 with textual or art matter not containing yellow masked out and the yellow separation halftone negative of the four-color photographic insertion in place in the window area;

FIGURE 4 is a plan view of a similar contact negative flat with textual or artwork which does not include red masked out, and a red separation negative precisely positioned in the window area in exact registry with the yellow negative shown in FIGURE 3;

FIGURE 5 is a plan view of a similar blue negative flat;

FIGURE 6 is a plan view of the negative flat exhibiting the black images of both photographic and art work;

FIGURE 7 is a plan view of the finished printed product;

FIGURE 8 is a plan view of the table of a vacuum frame for printing the plate from the prepared flats;

FIGURE 9 is an exploded elevational view of the vacuum frame;

FIGURE 10 is a detail sectional view taken on line 10-10 of FIGURE 9;

FIGURE 11 is a somewhat diagrammatic view in end elevation of the vacuum frame;

FIGURE 12 is a plan view of a prepared plate;

FIGURE 13 is a similar view of the bed of a plate clamping jig with fragmentary showings of the plate and one clamping member;

FIGURE 14 is a fragmentary view in side elevation of the left-hand end of the arrangement shown in FIGURE 13;

FIGURE 15 is a fragmentary end view of a plate cylinder showing the mounting of the plate clamps within the gap thereof;

FIGURE 16 is a fragmentary sectional view taken on line 16-16 of FIGURE 15;

FIGURE 17 is a diagrammatic view in side elevation of a multi-color printing press embodying the principles of the invention, including diagrammatic showings of the press feed and delivery;

FIGURE 18 is a fragmentary view in side elevation of the mechanism for feeding the sheets to the impression cylinder, which mechanism is actuated by a cam on the transfer cylinder;

FIGURE 19 is a similar view showing the sheet feeding means in another operative position;

FIGURE 20 is a somewhat diagrammatic view in end elevation of the press showing the impression cylinder with the associated transfer cylinder and gripper driving and synchronizing means; and

FIGURE 21 comprises a series of diagrams showing the relative positions of the impression cylinder grippers and the actuating cam during one printing cycle.

The arrangement and operation of the novel system of color printing will be described in connection with a lithographic color display sheet 10, such as might appear in a travel folder or the like and which is shown somewhat diagrammatically in FIGURE 7 of the drawings.

In the finished product used as an illustrative example herein, the lettering at 12 is in an orange coloring, the characters which appear at 13 are green, the lettering at 14 is red, and the lettering at 15 is orange. The representation of the automobile at 16 is black.

The photographic representation indicated by the general reference character 20 sets forth a blue sky area 21, a yellow ground surface 22, brown tree trunks 23, green foliage 24, and a somewhat violet or purple shaded marine area 25.

The litho stripper, whose job it is to assemble all of the elements of the print work, first rules up an ordinary goldenrod paper support or flat 30 (FIGURE 1); then, either by hand or by a more precise machine method, he punches at least two registry holes 31 in a margin of the flat precisely measuring these holes from an accurately positioned center line.

Following the customer's layout which in this example is the sheet shown in FIGURE 7, the stripper tapes on the various pieces of negative film representing the textual or artwork, together with the register marks, trim marks and other delineations, cutting away the areas of the goldenrod flat to allow these various fragmentary negatives to print through.

In FIGURE 1 the negative for the typography 12 is represented at 32 as pasted or taped to the back of the flat 30, the flat being cut away as at 33 to let the negative print through the flat. A similar taped-on negative insert is shown at 34 for the typography 14, and a combined negative insert 35 contains the typography 13 and 15 and the artwork 16, the flat being cut out as at 36 and 37 for the representations to print through. Various register marks, trim marks and the like may be represented on the sheet such as suggested by the negative inserts 38 containing the center lines 39 and the insert 40 showing an angular guide mark 41.

The orange or goldenrod colored areas of this paper support or flat will not transmit light and will therefore effectively cause any area covered by this paper to be deleted during later steps.

Instead of actually taping on the halftone negative of the photographic area 20, the stripper merely cuts away an opening 45 of the exact size and shape of the desired photographic area. This opening which passes light through the flat will be designated as a window.

The flat 30 now contains all of the basic elements of the final job, whatever their individual colors are to be. For the photographic areas, there is the window 45 of the size and shape desired and all of the elements including the register and trim marks are now in exact desired position relative to the accurately punched register holes 31.

The flat 30 is then taken to the darkroom and an unexposed sheet of film is punched in the common register punch to provide openings in exact accord with those at 31 in the original flat. A vacuum frame may be provided with pins of the precise size, shape, and spacing as the holes 31 and the flat 30 placed on the pins over the unexposed film which is similarly punched. The vacuum frame is closed and exposure to light is effected. The film is developed and dried in the usual way and appears as shown at 50 in FIGURE 2 of the drawings, the accurate register holes being indicated at 51. The resulting contact film 50 now represents the original flat 30 but in positive form. The film employed should be a stable base film which will hold its size very closely.

The positive flat 50 now contains, on a stable film base, all of the elements which are to appear in the final four-color job, together with a black area 55 corresponding to the window 45 and to the photographic representation to be produced. The positive flat 50 is then taken to the darkroom and four contact negatives are made from it. Unexposed sheets of film are punched with openings corresponding to those at 31 and 51 to preserve registry and since each of these four negatives is made on the register pins of the vacuum frame and from the same original positive, it follows that when all four are placed on the register pins together or any two placed in relationship to each other on the pins, all of the elements will be in perfect register relative to similar ele-

ments in any of the negatives. The windows are now clear film transmitting light, and the edges of the windows in all negatives are exactly the same.

The stripper then places one of the four negative flats 60 (see FIGURE 3) on a light table and then tapes the halftone yellow separation negative 62 of the photo across the window onto the back of the flat 60 so that the photographic representation in yellow appears within the frame of the window area 65.

The stripper now positions the negative flat 60 bearing the yellow halftone 62 taped over the window, with the holes 61 on the pins of the supporting frame; and then he places over it on the same pins one of the other negative flats such as shown at 70 in FIGURE 4, this flat being the red flat and having accurately positioned holes 71 for entry of the pins. At this point it can be readily seen that all typography, window edges, register marks etc. are in perfect registry. All that remains to be done is to visually position the red halftone separation negative 72 over the window area 75 registering it by eye to the taped-on yellow negative 62 on the window of the yellow flat 60, and then securing the red negative to the red flat. The same procedure is followed for the remaining colors, for example, the blue flat 80 with its separation negative 82 and register holes 81, and the black flat 90 with its separation negative 92 as shown in FIGURES 5 and 6 of the drawings. Thus, all of the photographic areas are in perfect register, as referred to the basic positioning of the gauge holes and pins.

The stripper then masks out, as with goldenrod paper, or paints out with opaque paint, the elements which do not appear in or contain a particular color. For example, in the yellow flat 60 the red typography 14 will be completely masked out as will also the black representations 16, leaving only the orange lettering represented at 12 and 15, and the green lettering at 13. On the red flat 70 as shown in FIGURE 4, the green and black representations are masked out and the orange lettering 12 and 15 allowed to remain together with the red lettering 14. In the blue flat 82 all of the artwork is masked or painted out except the characters shown at 13. Similarly in the black flat 90 shown in FIGURE 6, all of the lettering is masked out leaving only the black outline artwork 16. These elements have already been registered mechanically and need only to be allowed to print.

The four color negatives 60, 70, 80 and 90 are now ready to be employed in making a plate. It will be remembered that all of them have been prepared on the basis of the accurate positioning of their register openings 61, 71, 81 and 91 on the basic gauge pins of the various frames and tables, and made from a common positive. The only human element involved is the placing of the halftones over the windows and fitting each visually to a previously positioned halftone, while both negative flats are on the register pins.

These four pre-registered negative flats are now placed on register pins in a vacuum frame, this operation being illustrated in FIGURES 8-11 of the drawings. The frame comprises a stand 100, a base plate 101, a lid member 102 hinged to the base 101 as at 103. A vacuum pump 104 is provided with a connection 105 leading to the lid 102 which is faced with a blanket element 106. These various parts are depicted in exploded form in FIGURE 9 of the drawings and the base plate 101 itself is shown in plan view in FIGURE 8.

The base plate 101 comprises a metal framework 111 and four inserted glass panes 112, 113, 114 and 115. The plate is also provided with a series of pairs of spring-pressed register pins 116 corresponding in size and positioning to the register openings 31, 61, 71, 81 and 91 of the various flats.

In addition to these pins 116, three additional pins 117 are provided along a longitudinal margin of the base plate 101, these pins being for the purpose of attaining

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perfect registry of the plate itself to which images are to be transferred from the flats.

The four color flats 60, 70, 80 and 90 are now placed respectively over the areas 112, 113, 114 and 115 with the registering openings receiving the pins 116. The lithographic plate 120 is next applied, this plate having three holes 121 which register precisely with the gauge pins 117 on the base 101.

In FIGURE 10 of the drawings, there is suggested one means of providing a resilient yieldable mounting for the register pins 116 and 117, the section having been taken through one of the plate registering pins 117, but a similar arrangement being provided for the flat registering pins 116. The pins pass through a bore 123 in the base 101 and are provided with heads 124, a coil spring 125 confined by a bracket 126 pressing against the head 124 and urging the pin 117 upwardly. The bracket 126 may be secured to the side of the base plate 101 as by means of the screws 127. When the flats and the superposed plate 120 are in position the lid member 102 is swung downwardly, the vacuum applied through the hose 105, and the exposure is made by the passing light through the glass panes 112-115.

Then the plate 120 is removed and processed in the usual way to bring out the images on the surface thereof.

In FIGURES 12-16 of the drawings there is illustrated in rather diagrammatic style means for mounting the plate accurately on the plate cylinder 130 of the press. The exposed and developed plate 120 is shown in FIGURE 12 of the drawings, the respective color image areas being shown at 131, 132, 133 and 134. The register openings in the plate are again indicated at 121.

A table or jig 135 is provided and this jig has pins 136 which pass through the openings 121 in the plate when it is laid upon the table as shown at the left-hand side of FIGURE 13, these pins 136 corresponding in size and position to the original pins 117 of the vacuum frame.

Also, the bed plate or jig 135 is provided with holes 138 along each end margin for the reception of the screws or bolts 139, which serve to temporarily anchor and accurately position the end plate clamps 140. These clamps comprise the lower bar 141 and the upper clamping bar 142. Preferably, the inner faces of the clamp bars are serrated where they grip the edge of the plate 120 and a series of screws or bolts 144 serve to firmly grip the plate between the bars 141 and 142. Then the temporary retaining bolts 139 are removed and the clamped plate is ready for application to the press. It is understood of course that this operation of applying the clamps may be done away from the press while a previously prepared job is being run.

Referring now to FIGURES 15 and 16 of the drawings it will be seen that the plate cylinder 130 of the press is provided with a gap 145 for receiving the locking means for the plate 120, together with the retained clamps 140. Flat areas 147 are formed on the walls of the gap 145 leaving the projections 148 around which the end portions of the plate 120 are drawn. Upon the flat surfaces 147 there are positioned the slide members 150 which extend longitudinally of the cylinder and are provided with milled keys 152 which engage in undercut slots or keyways 153 in the surface 147. The same bolts 139 which were used to position the clamps on the applying jig table 135 may now be employed to secure the plate clamps 140 to the slide members 150. Elongated headed screws 155 are threaded through the slides 150 and are socketed in the nose-like projections 148 of the cylinder 130 and it will be readily seen that by rotating the screws 155, the slides 150 may be drawn inwardly to tighten the plate 120 about the plate cylinder 130.

It will be seen that the milled slot and key arrangement prevents the slides from being drawn up out of square.

The plate cylinder, having previously been packed to

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the diameter required, is now ready to operate with no further make-ready other than inking up and loading the feeder. When the plate and the blankets on the blanket cylinder are packed to the correct height, perfect register is assured at any speed.

Now coming to the arrangement of the novel press itself, it will be seen from FIGURE 17 that the press consists essentially of a central cylinder-carrying section 160, a detachable feeder section 161, and a detachable delivery section 162. The plate cylinder 130 will be recognized as appearing at the top of the figure and supported by the superstructure 165 in which the plate cylinder shaft 166 is gudgeoned. The plate 120 as indicated diagrammatically, bears the yellow image 131, the red image 132, the blue image 133, and the black image 134. The yellow inking and dampening mechanism cluster is suggested at 175 and this is shown in operative contact with the yellow area 131. The red inking mechanism is shown at 176, the blue at 177, and the black at 178, these latter three clusters being shown in elevated or retracted positions.

The blanket cylinder is depicted at 180 and is provided with a shaft 181 gudgeoned in the frame of the central section 160 of the press. The respectively colored images from the plate 120 are transferred to the blanket cylinder as follows: the yellow image on the area 185, the red image at 186, the blue image at 187, and the black image at 188.

The direction of rotation of the various cylinders is indicated by the applied arrows.

As previously related, the impression cylinder 190 is only one-fourth of the size of the blanket or plate cylinders and makes four rotations to each single rotation of the larger cylinders. Rotating in juxtaposition to the impression cylinder 190 is the transfer cylinder 192, this cylinder being mounted upon a shaft 193 rotating in suitable bearings carried by the central portion 160 of the press frame. Delivery mechanism carried in the detachable unit 162 may comprise an intermediate gripper cylinder 194 and a travelling belt delivery device depicted diagrammatically at 195.

The detachable feeder unit 161 is provided with a pile elevator 197 which carries the pile or stack of sheets 198, a suction separator and feeder shown in purely diagrammatic style at 200, and the forward pair of feed rolls 201 by which the sheets 202 are transferred to the feed board 203.

The sheet separator and forwarding device 200 may be of conventional construction and may be provided with the suction gripper 205 and a separating air blast nozzle 206.

The view in FIGURE 17 is of a purely diagrammatic nature and the devices at the forward end of the feed board 203 are only generic or symbolic, the preferred sheet feeding features being shown in succeeding figures. For an operative suggestive showing, however, the rolls 208 and the blow-down 209 may be understood as typical.

Proceeding now to a consideration of FIGURES 18 and 19 where a preferred device is disclosed for transferring the sheets from the feed board 203 to the impression cylinder 190, it will be seen that the impression cylinder is provided with a series of sheet grippers indicated diagrammatically at 215, and transfer or feeding grippers are suggested in the same diagrammatic fashion at 216. The feed or transfer grippers are mounted on crank arms 218 which are pivoted as at 220 upon an eccentric member 222 which is in turn pivoted at 223 to a portion of the side frame of the press.

Thus the grippers 216 are subjected to a compound movement comprised of pivotal movement of the arm 218 about the point 220 and swinging movement of the eccentric mounting 222 about the point 223.

For controlling these movements, linkages are provided which are equipped with followers adapted to be contacted by a cam member 225 secured as at 226 to an end

plate 228 of the transfer cylinder 192. A link 230 is pivotally connected as at 231 with the short arm of the crank lever 218 which carries the grippers 216 and the link 230 is in turn pivotally connected as at 233 with a lever 235 pivoted to the press frame as at 236 and provided with the follower roller 238 disposed in the path of the cam 225. A spring 239 connected to the lever 235 serves to urge the follower roller 238 into contact with the cam and indirectly to urge the grippers 216 into the position shown in FIGURE 18 where they are in readiness to grip the edge of the oncoming sheet.

A link 240 is pivotally connected as at 241 to the arm 242 of the eccentric member 222 and a lever 245 pivoted to the frame as at 246 is connected with the link 240 as at 247. A follower roller 242 is adapted to be actuated by the cam 225 and is urged toward the cam by means of the spring 244 which, like the spring 239, is connected to the respective linkages at one end and to a fixed point on the frame at the other.

In operation then, the sheet 202 is seized by the transfer or feeding gripper 216 at the front edge of the feed board 203 and when the cam 225 engages the follower roller 238 on the lever 235 the lever is swung about its pivot 236 in a clockwise direction and the gripper carrying crank arm 218 is rotated about its pivot point 220 in a counter-clockwise direction and causes the gripper 216 to follow the path 250 indicated by the arrows in FIGURE 19. This causes the sheet to be brought up to the proximity of the periphery of the impression cylinder 190 where it is grasped by the cylinder grippers 215.

While the follower roller 238 is still riding on the diminishing tail portion of the cam 225 and thus the grippers 216 are retained in an upward position, the roller 242 of the eccentric swinging linkages engages the cam, the lever 245 is swung in a clockwise direction and the eccentric 222 moved about its pivot 223 in a counter-clockwise direction. This serves to displace the grippers 216 from the periphery of the impression cylinder 190 and at the peak of the operational movement of these parts the gripper 216 will be in the position shown in FIGURE 19, where it has delivered the sheet to the cylinder grippers 215 and has been displaced from the vicinity of the cylinder. The remaining movements of the follower rollers 238 and 242 down the cam 225 will cause the sheet feeding grippers 216 to retrace their movement along the path indicated by the arrows 251 back to the starting point indicated in FIGURE 18.

It will be perceived that since the transfer cylinder 192 is four times the size of the impression cylinder 190, the cam 225 brings the feeder into actuation only during every fourth revolution of the impression cylinder, and this is in accordance with the principles underlying the four color process which is the subject of this invention.

Now the release of the cylinder grippers 215 at the end of every fourth revolution of the impression cylinder and the interchange of the sheets from the impression cylinder to the transfer cylinder 192 must be described. In this connection, reference is had to FIGURE 20 of the drawings.

The view constituting FIGURE 20 is, as in the case of the other figures, quite diagrammatic and generic and many changes can be made in the auxiliary features such as the mountings, bearings, and framing of the device to adapt the device to various types of press structures and different usages. In the present device two side frames 260 and 261 are used as typical. The impression cylinder 190 has shafts 263 and 264 which rotate in anti-friction bearings shown diagrammatically at 265. The transfer cylinder to which the general designation 192 is applied is shown diagrammatically as comprising a central cylindrical portion 267, end flanges 268 which are bolted to ultimate end plates 270 and 271, and shafts or trunnions 272 and 273 which rotate in bearings 274 and 275 in the respective side frames. The impression

cylinder grippers 215 are indicated diagrammatically as carried on a rocking shaft 277 which has an arm 278 at one end thereof which carries a follower roller 279 which is actuated by a cam to be presently described. The grippers for the transfer cylinder are diagrammatically indicated at 280 and they are carried upon a rock shaft 282 having an arm 283 carrying a follower roller 284 which is also cam actuated.

Fixed at one end of the impression cylinder 190 is the pinion 285 which meshes with a large gear 286 carried by the end plate 270 of the transfer cylinder. These gears 285 and 286 bear the same ratio to each other as the diameters of the impression and transfer cylinders, namely, 1:4.

At the opposite end of the transfer cylinder an extension 288 is provided for supporting a gear 290 which meshes with a gear or pinion 292 bolted as at 293 to a sleeve 295 which is carried by but freely rotatable upon a portion of the impression cylinder shaft 264. Anti-friction bearings 297 and 298 may be provided for facilitating the relative rotation of these parts.

The sleeve 295 carries a cam 300 which is secured thereto as by means of the bolts 301. This cam serves to contact the follower roller 279 carried by the impression cylinder gripper installation 215.

At the opposite side of the press a cam 305 is bolted to a bracket 306 which extends inwardly from the side wall 260 of the press. This cam 305 serves to trip the transfer grippers 280 by contact with the follower roller 284.

The gears 292 and 290 bear a ratio to each other of 1:3 in contrast to the ratio of 1:4 between the gears 285 and 286. It will be readily seen how this arrangement will cause the impression cylinder grippers 215 and the transfer cylinder grippers 280 to effect the removal of a sheet from the impression cylinder after every fourth revolution of the latter.

The relative movements of the impression cylinder grippers 215 and the cam 300 which trips them, as well as the transfer grippers 280, is schematically shown in FIGURE 21 of the drawings. Diagram A shows the start of the printing of a given sheet. The transfer grippers 280 have just removed the previous sheet and the gripper 215 is actuated by the cam 300 and closed upon another sheet. In diagram B the impression cylinder grippers 215 have made one revolution, but the cam 300 which runs at three-quarters of the speed of the gripper 215 has accomplished only three-quarters of a revolution. In diagram C the impression cylinder grippers 215 have completed two revolutions and the cam 300 one and one-half revolutions. In diagram D the impression cylinder grippers 215 have completed three revolutions and the cam two and one-quarter revolutions. Finally, when the transfer cylinder 192 has completed one revolution, as shown in diagram E, the impression cylinder grippers 215 have completed four revolutions, and the tripping cam 300 has completed three revolutions, and all of these instrumentalities have arrived at the original points shown in diagram A, whereupon the sheet is released from the impression cylinder, carried off by the transfer cylinder, and a new sheet gripped and carried into the printing couple for receiving its four impressions. The lengths and contours of the cams 300 and 225 are so selected that the opening and closing of the various grippers occur at the proper times.

It will be readily perceived from the foregoing disclosure that the present invention provides a novel and ingenious printing system for effecting multiple color work by making available novel steps for providing a printing plate for accomplishing the impressions in the most accurate and economical way, as well as the provision of a novel press for manipulating the plate to print the sheets with the utmost accuracy of register and ease of operation.

Various changes can be made in the illustrative em-

bodiments set forth herein without departing from the scope of the invention as determined by the subjoined claims.

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

1. In a multi-color printing apparatus, a supporting frame, an impression cylinder rotatably mounted in said frame for rotation about a predetermined axis, means for rotating said cylinder; sheet grippers on said impression cylinder for seizing a sheet, holding it for a complete cycle of multiple rotations, and releasing it at the end of such cycle; a collar member sleeved onto a portion of said impression cylinder adjacent one end thereof, a tripping cam on said collar member adapted to contact and actuate the impression cylinder grippers whenever the tripping cam and said grippers coincide in their angular movement about the axis of said impression cylinder; a rotary transmission member mounted in the frame adjacent said impression cylinder and carrying a first gear and a second gear coaxial therewith, a gear fixed to said impression cylinder and coaxial with it and meshing with said first gear of the rotary member, the diameter of said first gear being an even multiple of that of the said impression cylinder gear; a gear carried by and coaxial with said collar member and meshing with said second gear of the rotary member, the ratio of said second gear to the collar-carrying gear being numerically equal to the ratio of said first gear to the impression cylinder carrying gear diminished by one, whereby the impression cylinder gripper actuating cam on the collar member coincides with the impression cylinder grippers for tripping the latter only once for each cycle of multiple color printing rotations of the impression cylinder.

2. In an apparatus for multi-color printing of the class described, a rotary multi-color offset printing press comprising a supporting frame; plate and blanket cylinders of the same diameter, and an impression cylinder rotatably mounted in said frame; the diameter of the plate and blanket cylinders being an even multiple of the diameter of the impression cylinder, and means for rotating said impression cylinder as many times faster than the plate and blanket cylinders as necessary to maintain proper rolling contact, whereby the impression cylinder is adapted to carry a sheet throughout a cycle comprising a plurality of rotations for repeated printing contact with the blanket cylinder before releasing the sheet; sheet grippers carried by said impression cylinder and adapted to receive successive sheets from feeding means and deliver them to delivery means; feeding means for the sheets comprising a support for sheets, feeding grippers, a pivoted feeding gripper carrying member adapted to move said feeding grippers in a feeding path from a point of seizure of a sheet from said support to a point of transfer of a sheet to the impression cylinder grippers, and move them through a different return path; said gripper carrying member comprising a crank lever having the feeding grippers attached to one end thereof, and pivoted at an intermediate point to a second lever which is pivoted at a point intermediate its length to a fixed point on the supporting frame of the press; a rotary transmission member supported on the press frame and of the same diameter and rate of rotation as the blanket cylinder, said rotary member carrying a cam at one point on its periphery, a pair of actuating levers pivoted on the frame and having follower rollers at their ends adapted to be contacted and moved by said cam, springs serving to urge said actuating levers in directions to maintain the follower rollers in contact with the cam, a pair of links connecting the remote ends of the actuating levers to remote points on the feeding gripper carrying lever and the supporting lever respectively, whereby movement of the supporting lever while the gripper carrying lever is swinging causes the latter to have a compound movement which accomplishes the different feed and return paths of the feeding grippers; tripping of the actuating levers by the single

cam on the transfer member occurring only after a plurality of rotations of the impression cylinder; and means also operatively connected with said rotary transfer member for synchronizing the operation of the impression cylinder grippers and the delivery means with the actuation of the feeding grippers.

3. The apparatus as set forth in claim 2 in which the actuating lever and follower roller which is operatively connected with the feeding gripper carrying lever is disposed in advance of the actuating lever and follower roller which is operatively connected with the supporting lever, in respect to the path of the cam, so that the initial portion of the path of the feeding grippers is in a substantially circular arc toward the point of transfer of the sheet to the impression cylinder grippers, whilst the return path is compounded of movements imparted by both of said actuating levers.

4. In a multi-color printing apparatus, a supporting frame, a multi-cycle impression cylinder mounted for rotation about a fixed axis in said frame, means for continuously rotating said cylinder, impression cylinder grippers carried by the impression cylinder at a fixed point on its periphery to rotate therewith, means for opening and closing said grippers, feeding gripper members disposed at a fixed point on said frame for feeding successive sheets to said cylinder grippers each time the impression cylinder completes a given number of rotations, and transfer grippers adapted to receive the sheets from the impression cylinder grippers and carry them to a delivery point, and a single unitary rotary member tangent to and driven from said impression cylinder and being of a larger diameter than said impression cylinder to make a single rotation during multiple rotations of said impression cylinder, said rotary member carrying said transfer grippers at a point on its periphery and also carrying means for effecting the actuation of all of said grippers and gripper members, said last named means including means acting between said rotary member and said grippers for effecting multi-cycle functioning of said grippers.

5. In a multi-color printing apparatus, a supporting frame, an impression cylinder supported in said frame for rotation about a horizontal axis, sheet grippers carried by said impression cylinder, and including a cam follower rotatable with the cylinder for actuating said grippers, a rotary transmission member mounted on said frame for rotation about an axis parallel to that of the impression cylinder, means interconnecting said cylinder and said member for rotation at a ratio such that the impression cylinder makes a given plurality of complete revolutions for each revolution of the said member, a cam carrying member mounted for rotation concentrically with and independently of said impression cylinder, and a gripper cam fixedly carried by said cam carrying member for operative engagement with said cam follower, means interconnecting said cam carrying member and said transmission member for rotation of the cam carrying member at a ratio equal to the ratio, diminished by one, between said impression cylinder and the transmission member, whereby said cam is positioned for operative engagement with said cam follower only once for each said given plurality of complete revolutions of the transmission member.

6. In a multi-color printing apparatus as defined in claim 5, the further improvement comprising a delivery gripper peripherally carried by said transmission member to receive the sheets from said impression cylinder grippers and transfer them to a delivery point, said delivery gripper including cam actuated tripping means, and a tripping cam fixedly mounted on said frame for operative engagement by said tripping means to actuate the latter once for each revolution of the transmission member at a time when the said cam and cam follower of claim 5 are operatively engaged.

7. The combination defined in claim 5 in which said means interconnecting said cylinder and said member

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comprise intermeshing gears fixed coaxially to the said cylinder and said member, and the said means interconnecting the cam carrying member and the transmission member comprise intermeshing gears coaxially fixed respectively to said members.

8. In a printing apparatus, a sheet feeding mechanism comprising a supporting frame, a first lever fulcrumed on said frame, a free-ended second lever fulcrumed on said first lever at a location eccentric to the fulcrum of the first lever, a feeding gripper carried at the free end of the second lever, a common control cam for said levers mounted for rotation on said frame, first and second cam followers movably supported on said frame in position for successive engagement respectively with identical surface portions of said common control cam, and linkages connecting said cam followers respectively in controlling relation to said first and second levers at locations eccentric to the fulcrums thereof, and imparting a compound motion to said grippers.

9. The combination of claim 8 in which each said linkage includes a lever medially pivoted on said sup-

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porting frame, said cam followers being each carried by one of said levers in spaced relation to its said medial pivot, together with a rigid link interconnecting one of said medially pivoted levers to one of said levers of claim 8.

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