Feb. 24, 1970 H. FISCHER 3,496,865

REGISTER MAINTAINING DRIVE FOR MULTICOLOR SHEET-FED ROTARY PRINTING PRESSES

Filed April 28, 1967 2 Sheets-Sheet 1

FIG. 1.

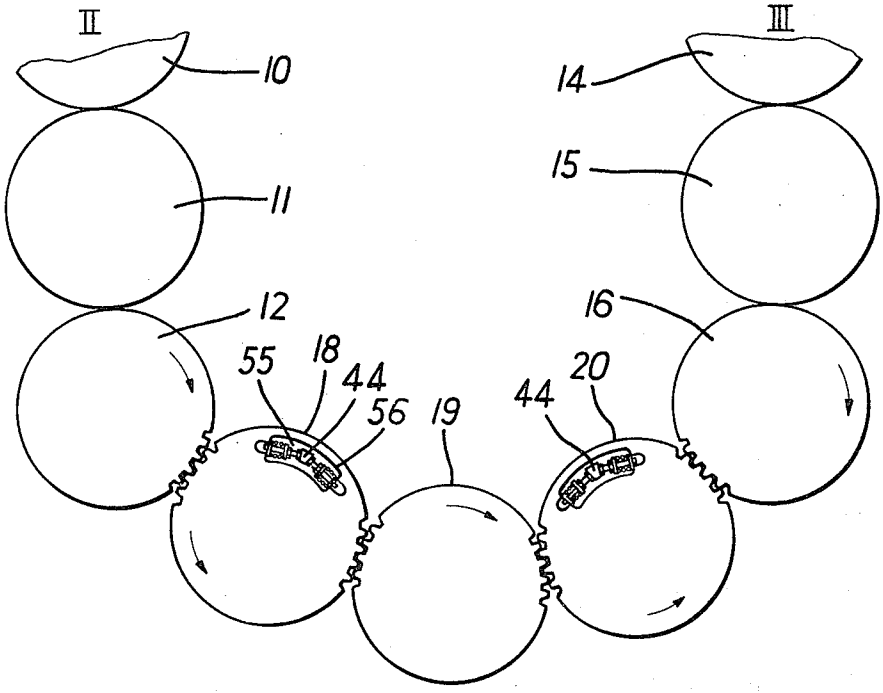
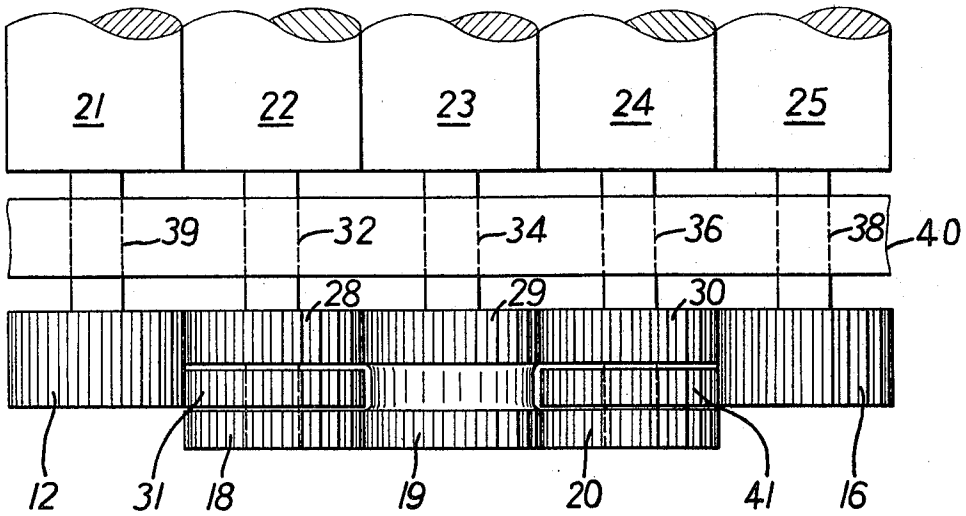


FIG. 2.



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FIG. 3.

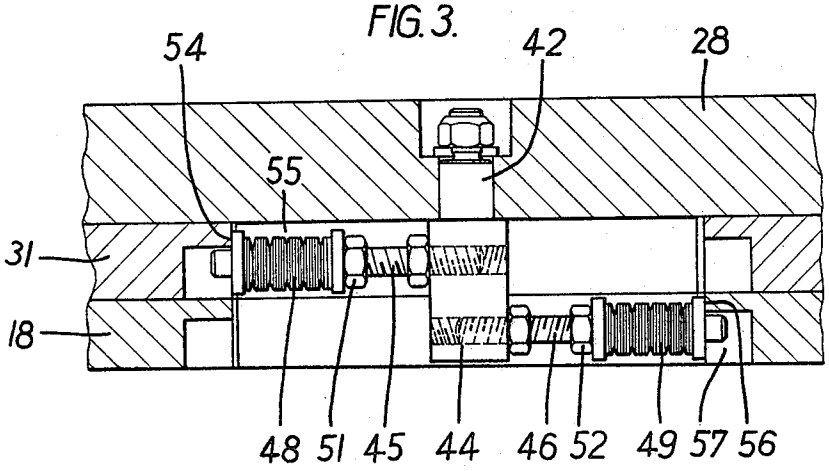
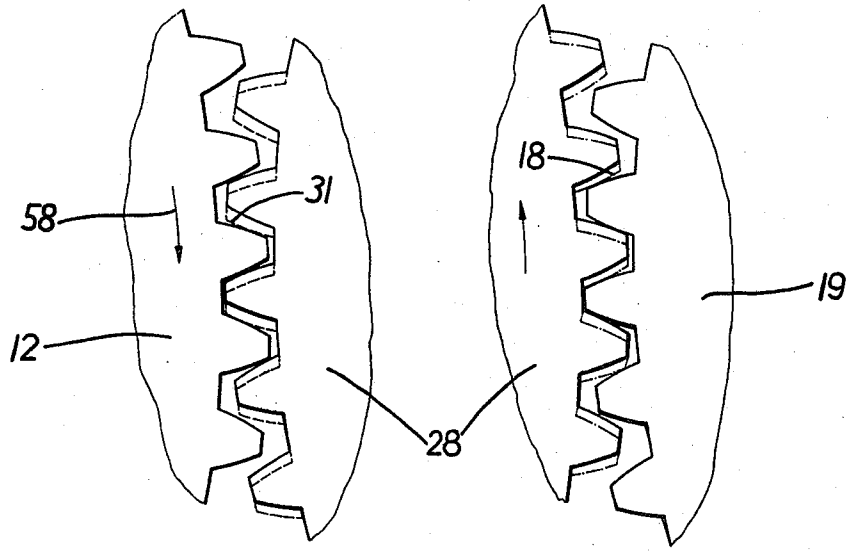


FIG. 4.



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REGISTER MAINTAINING DRIVE FOR MULTICOLOR SHEET-FED ROTARY PRINTING PRESSES

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U.S. Cl. 101—183 4 Claims

ABSTRACT OF THE DISCLOSURE

A multiple gearing arrangement is disposed adjacent the direct drive gears of the transfer cylinders of multicolor sheet-fed rotary printing presses incorporating a resilient adjustment in either direction of rotation for accommodating the backlash in the driving gears between the various cylinders so that the sheets will be properly fed through the various cylinders and between the various color stations to maintain color register notwithstanding backlash during the transfer of the sheets from one color station of the press to the next.

This invention relates to multicolor printing on a sheet-fed multicolor printing press, and, more particularly, to a register maintaining supplementary gearing arrangement adjacent the direct drive gears in the train of drive between successive stations of the press which accommodates the backlash in the direct gearing so as to compensate for the distortions caused by such backlash in the placement of sheets during the transfer thereof between each cylinder so as to effect proper registration of successive color images printed on each sheet to achieve the multicolor printed impression.

In multicolor printing, where a final composite multicolor image is formed by the successive printing impression of a plurality of superimposed single color images, the fine quality of the finished effect depends to a large extent upon the precision and accuracy with which the several successively printed individual impressions or images are registered or congruent to form the composite multicolored image. With sheet-fed multicolor presses, and especially those having a large number of separate successive printing units, however, slight variations in the placing of the paper sheets being printed may occur during the transfer thereof between the various impression and transfer cylinders during the printing run, as caused by the toothplay or backlash in the direct driving gears between the various cylinders, especially as the speed of the press is increased. At least such difficulties may occur in presses where adjacent transfer and/or impression cylinders are driven successively one from the next through a direct gear drive.

Thus, regardless of the care with which the various printing plates are positioned at the various printing stations to contact sheets of paper over precisely the same area to provide exact registration of the several superimposed color images or impressions, toothplay in such cylinder drives between the intermeshing gears leads to a change in flank at the intermesh of these gears and causes a degree of circumferential oscillation of the various cylinders so that, at the moment of transfer of the sheets from one to another of the various cylinders, distortion of the registration may result of the several superimposed impressions during the actual printing thereof.

Even if very careful consideration is taken in the construction of the toothing of the various intermeshing gears,

it may not be possible with the rigid drive to prevent a slight oscillating of the gears and, therefore, of the cylinders themselves, since there is always an unavoidable load-dependent slight bending of the ends of the shafts on which the various cylinders rotate. Further, there may frequently be actually some slight deformation of the side walls in the supporting region of the shafts, especially during a high speed run. In addition, because of the high speed of such presses, the heat generated by the interplay between the gears may cause a certain degree of change in the clearance during a long period of operation, thus affecting the accuracy of the register during the transfer of the various sheets among the various cylinders of the press. Also, even a difference in ink consistency or a change in speed of operation of the press may affect the load on the press and ultimately have an unfavorable effect on the tooth-play or blacklash.

If it is attempted to correct or compensate for such variation in the placing of the sheets of paper during the transfer thereof from one cylinder to another during the press run by manufacturing one gear so that the pitch circle radius thereof is of a different size and circumference, complete compensation may not be achieved throughout the passage of the sheet through all of the subsequent printing units. In addition, the cost of manufacturing such gears with individual profiles may be prohibitive and the making of such gears is much more difficult.

Similarly, in those printing presses having series-arranged printing units with the printing units being driven from a common drive but in which the individual printing units can be disconnected from the units, if the transfer drum on which the drive is disconnected is provided in addition to the regular gear rim, with a resilient gear segment which is in mesh with the next succeeding or following drive gear, a fixed gear segment is disposed thereon which cooperates only during the transfer of a sheet with an identical tooth segment on the preceding drive gear. This arrangement serves to provide a dependable maintenance of the register on the transfer drum to separately driven printing units. It may not be appropriate, however, for the kind of press disclssed herein, where the individual printing units are all driven from a single drive.

According to this invention, however, there is provided in a press, in which the drive is connected from one printing unit thereof to the next, an arrangement of multiple supplementary gears which eliminates the peripheral oscillating of the various transfer drums between the individual units of a multiunit press. This result is obtained by providing adjacent the direct drive gears of the transfer drums or cylinders in the area of transfer between one station and the next in the press auxiliary gears which are rotatably disposed on the shafts of the direct drive gears and supported resiliently in opposite directions of rotation of the power transmiting coaxial direct drive gear. The flanks of these auxiliary gears rest simultaneously on the non-driving flanks of the adjacent intermeshing direct drive gears of both the preceding and succeeding adjacent drums or cylinders. With such an arrangement, regardless of the speed-dependent requirements of the press, the toothplay of the gears of the transfer cylinders is automatically corrected regardless of the direction of rotation of the preceding or succeeding intermeshing drive gears and even when the worm gears which effect the direct drive are in a normal position. With such an arrangement, in accordance herewith, segmental auxiliary gears and rigidly disposed auxiliary gears connected with the power-transmitting gears may be dispensed with.

With such an arrangement, in accordance herewith, the toothplay or backlash between the intermeshing gears

of the two cylinders between which a sheet is being transferred is prohibited in either direction of rotation, with the result being that the different printing units are maintained in register with respect to each other. In this way, the sheet will always be in the proper position for receiving the various colors in the multiunit press at the proper location in each unit of the press with no misalignment of a sheet during transfer thereof from one unit to the next.

With the foregoing and additonal objects in view, this invention will now be described in more detail, and other objects and advantages thereof will be apparent from the following description, the accompanying drawings, and the appended claims.

In the drawings:

FIG. 1 is a schematic side view of the gearing arrangement in the drive of a sheet-fed multicolor printing press showing two of the multiple printing units or stations arranged one behind the other with the teeth of the gears being shown for simplicity only at the transfer points between the transfer cylinders of the two units, and having this invention applied thereto;

FIG. 2 is a schematic top view of a gearing arrangement in accordance herewith;

FIG. 3 is a fragmentary view on a larger scale showing in more detail the resilient disposition of the supplemental gears in accordance herewith; and

FIG. 4 is a simplified diagrammatic enlarged fragmentary view indicating further aspects of the operation of the mechanism hereof.

Referring to the drawings, in which like reference characters refer to like parts throughout the several views thereof, an arrangement of apparatus embodying and for practising this invention is illustrated as being applied to the direct drive gear train between two printing stations of a sheet-fed printing press and preferably between the second and third stations thereof, which mechanism is for providing the driving from one unit of the press through the transfer cylinders thereof to a second unit thereof and so on. Since such successive driving and gearing mechanism in multiunit printing presses is well known and understood in this art, the drawings are primarily directed to illustrating the application of this invention to such otherwise well known or conventional printing press arrangements, and many of the constructional elements of the printing press have been omitted from the drawings for clarity and simplicity.

Thus, FIG. 1 shows a schematic arrangement of the gearing of printing stations II and III, with printing station II having a plate cylinder with the direct drive gear thereof indicated at **10**, a rubber-blanket cylinder with the direct drive gear thereof indicated at **11**, and an impression cylinder with the direct drive gear thereof indicated at **12**. In addition, printing station III has a corresponding plate cylinder gear **14**, rubber-blanket cylinder gear **15** and impression cylinder gear **16**. The drive of the two printing stations may be effected, in known manner, through a lengthwise shaft which acts, for example, through worms (not shown) on the shaft of one of the impression cylinder gears **12** or **16**. As is clearly apparent from FIG. 2, the driving force is conducted through a spur gear **12** on impression cylinder **21** and through the spur gears **28**, **29**, and **30** on the transfer cylinders or drums **22**, **23**, and **24** to the spur gear **16** on impression cylinder **25** at the printing station III. The remaining printing units or stations of the press are connected, in known manner, with each other with a similar gear drive, and may or may not include the interposition of further worm drives which, however, will not be further described here as being a conventional arrangement, which does not form the subject matter of the present invention.

As shown in FIG. 2, auxiliary or supplemental gears **18** and **31** idle on shaft **32** of transfer cylinder **22** extending through a portion of support **40**. In addition, auxiliary or supplemental gears **20** and **41** idle on shaft **36** of transfer cylinder **24**. The auxiliary or supplemental gear **31** also engages the toothing of the spur gear **12** on shaft **39** of impression cylinder **21** while gear **41** meshes with the spur gear **16** on shaft **38** of impression cylinder **25** in the printing station III. On the other hand, gears **18** and **20** disposed on shafts **32** and **36** of transfer cylinders **22** and **24**, respectively, are in engagement with the second tooth rim **19** of gear **29** on shaft **34** of transfer cylinder **23**, with the toothed rim **19** being axially displaced from the toothed rim **29**.

As is shown in FIG. 3, each of the gears **28** and **30** has eccentrically disposed therein a bolt **42** with the axis thereof parallel to the axis of the corresponding shafts **32** and **36**. The bolts **42** have heads **44** disposed thereon which serve as stops and which have laterally bevelled surfaces. Screwed into the head **44** are oppositely directed guide pins **45** and **46** with resilient means disposed thereon such as, for example, tangential cup-spring sets **48** and **49** arranged in a row, with the spring tension thereof being adjustable by the nuts **51** and **52** respectively. The one-cup-spring set **48** lies against the lateral limitation **54** in gear **31**. Corresponding spring set **49** lies against a similar abutment or limitation **56** of gear **18**. The supporting surfaces or abutments **54** and **56** are part of peripheral grooves **55** and **57** disposed in gears **18**, **31**, and **41**, **20**, respectively.

As can be clearly seen in FIG. 4 which is on a much larger scale, with such a resilient support, when the drive gear **12** rotates in a clockwise direction as indicated by the arrow **58**, the play present between the teeth of the gears **12** and **28** will, by the movement toward the left of gear **31** under the force of the spring **48** (shown in dot-dash line), compensate for the play with respect to the gear **12**, and the gear **18** which moves toward the right with respect to the gear **28**, as a result of the action of spring **49** will fill up or compensate for the spaces between the intermeshing teeth between gear **28** and gear **29** by filling up the corresponding space between the intermeshing teeth between gear **18** and the gear rim **19** of gear **29**.

With such an arrangement, in accordance herewith, drive gears **12**, **28** and **29** are in engagement with each other without any tooth play so that no circumferential oscillation can occur between the intermeshing teeth of these gears. The same arrangement and effect is brought about at the intermesh between gears **29**, **30**, and **16**.

As is apparent in FIG. 2, the gears **12** and **16** on the impression cylinder shafts **39** and **38**, respectively, have a greater width than the power-transmitting gears **28**, **29**, and **30** of the transfer cylinders **22**, **23**, and **24**. On the other hand, the auxiliary or supplemental gears **18**, **31**, **20**, and **41** and the tooth rim **19** of gear **29** are substantially narrower, since they merely have the task of closing the tooth gaps.

If a single transfer cylinder or drum is to be arranged between printing mechanisms or stations II and III, the gears on the shafts **39** and **32** of impression cylinder **21** and transfer cylinder **22** would be arranged as described above, while the gear on the impression cylinder shaft **38** of printing station III is then arranged as a gear with two tooth rims similar to the gear **19**, **29**.

Obviously, by adjusting the stop screws **51** and **52** of **18**, **31**, and **20**, **41**, the tooth clearances, which may be different for each set of intermeshing gears in the gear train drive and which may have different distances from cylinder to cylinder, are accommodated for in an opposite direction of rotation from the corresponding intermeshing direct drive gear, thus eliminating the objectionable oscillation of the entire spur gear drive during the transfer of a sheet from one station to another in a multiunit press. By adjusting the stop screw in each case, the spring associated therewith can be given a specific initial tension which controls the yieldability of its resilient gear.

Obviously, the invention is not limited to the field of application described above as relating to a multi-unit sheet-fed rotary printing press, but can also be used in

other applications utilizing gear drives having an objectionable oscillation or backlash and in which a correction is necessary which is both independent of the load on the drive, as well as dependent thereon.

Thus, there is provided in accordance herewith structures and arrangements in a multi-unit sheet-fed rotary printing press having a direct gear drive from one unit thereof to the next for accommodating individually objectionable backlash at the intermesh between the individual gears of the direct drive, thus eliminating the backlash and providing accurate registering of the printed sheets as they are transferred from one unit to the next in the multiunit press. With such an arrangement, each sheet is presented individually at each printing station in precise registry so that the printed image thereon coincides exactly as desired with the previously or subsequently printed area of the sheet to obtain the desired final composite multicolor printed image on the sheet notwithstanding distortions cause by a variation of the load brought about by heat acting on the individual gears of the chain of drive, or load fluctuation caused by differences in consistency of ink or differences in the loading of the individual printing units of the multiunit machine. In addition, different variations causing different amounts of oscillation between the intermesh of the individual gears in the train can be accommodate for individually without regard to different variations in the intermesh of other intermeshing gears in the train and regardless of the direction of rotation of the gears in the train at the various transfer points between the various cylinders in the chain drive so that adjustments at one point of intermesh do not affect the adjustments of a next or preceding intermeshing point in the chain of transfers of the sheet from one unit to the next.

As apparent from the foregoing, the arrangements of apparatus provided in accordance herewith are readily and simply supplied, and are similarly simply applicable, as will be understood, to any similar mechanism having a direct drive arrangement in which the individual gears thereof may have slight deviations in the teeth clearances between them which cause undesirable oscillation along the various units of the drive, and with the resilient auxiliary gears in accordance herewith providing resilient tensioning simultaneously in the direction opposite to the direction of rotation of both the preceding and succeeding direct drive gear in mesh therewith.

What is claimed is:

1. In a multicolor sheet-fed rotary printing press the combination which comprises a plurality of printing stations for imprinting sequentially a series of images on sheets fed therethrough to form a final composite multicolor image on said sheets, and having an impression cylinder at each said station with at least one transfer cylinder disposed therebetween for transferring said sheets from one said cylinder and station to another with each of said impression and transfer cylinders having a spur gear fixed on the shafts thereof and intermeshing with each other to form a direct drive gear train from a source of power through said plurality of stations, said intermeshing spur gears having clearance spaces between the driving and non-driving flanks thereof, a plurality of auxiliary gears mounted for rotation on the shaft of at least one of said transfer cylinders, connecting means resiliently connecting the direct drive spur gear on the shaft of said one of said transfer cylinders to each of said plurality of auxiliary gears, said auxiliary gears being positioned axially outward of said direct drive gear, one of said plurality of auxiliary gears being in mesh only with a respective one of the next succeeding and next preceding direct drive gears in said direct drive gear train, another of said auxiliary gears simultaneously being in mesh only with the other of said next succeeding and next preceding direct drive gears and said connecting means resiliently urging said auxiliary gears alternately in opposite directions of rotation to contact said non-driving flanks of their respectively meshed direct drive gear.

2. Apparatus as recited in claim 1 in which said plurality of stations includes at least three and the said plurality of auxiliary gears is disposed on the shaft of the transfer cylinder between the first and third stations of said press.

3. Apparatus as recited in claim 1 in which there are three transfer cylinders disposed between the said plurality of stations of the said press, in which the first and third transfer cylinders in the train of drive have two auxiliary gears disposed on the shafts thereof, and the direct drive gear of the second transfer cylinder being meshed with said direct drive gears of said first and third transfer cylinders and an auxiliary gear of said first and third transfer cylinders and having an axial extent substantially as great as the combined axial extent of said direct drive gear and one of said two auxiliary gears disposed on said shafts of said first and third transfer cylinders.

4. Apparatus as recited in claim 1 in which said resilient connecting means includes an eccentrically disposed pin disposed on said direct drive gear with the axis thereof parallel to the axis of said direct drive gear, slots disposed in each of said plurality of auxiliary gears and into which said pin extends, and spring means extending alternately in opposite directions circumferentially in said slots from said pin to the ends of said slots.

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