Nov. 11, 1969 H. FISCHER 3,477,370

REGISTER MAINTAINING DEVICE FOR MULTI-COLOR SHEET-FED ROTARY PRINTING PRESSES

Filed Feb. 28, 1967

Fig. 1.

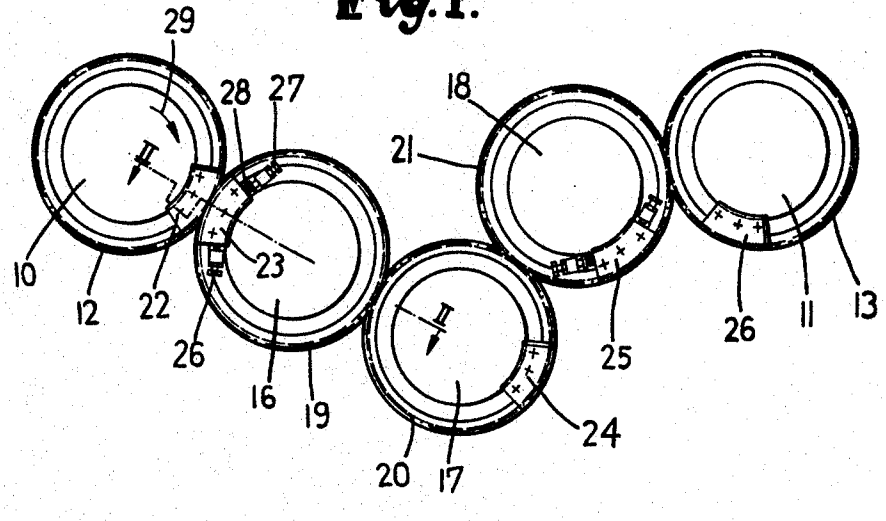


Fig. 2.

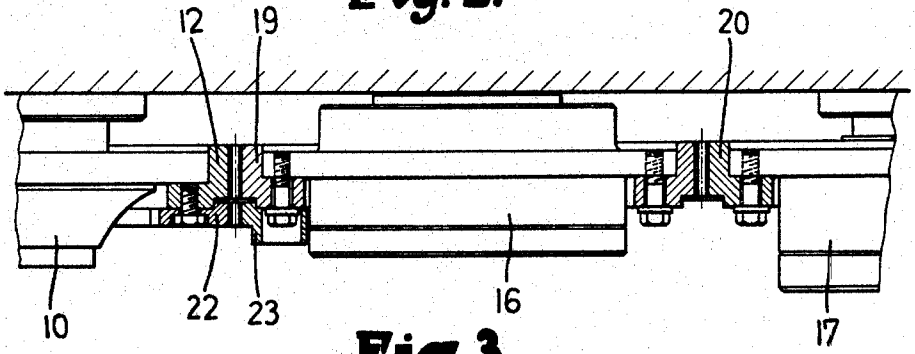
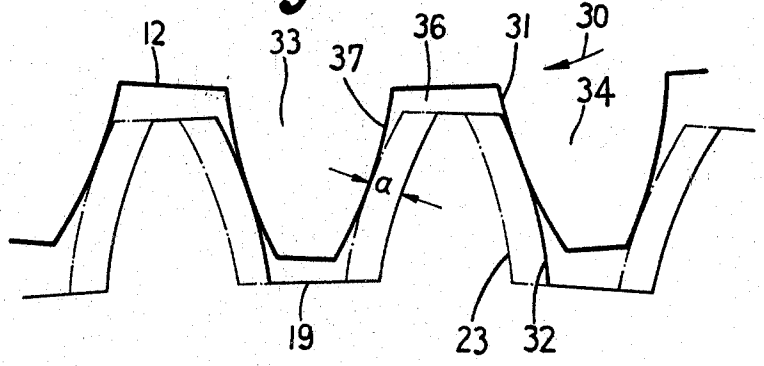


Fig. 3.



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REGISTER MAINTAINING DEVICE FOR MULTI-COLOR SHEET-FED ROTARY PRINTING PRESSES

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Int. Cl. B41f 5/16; F16h 55/18
U.S. Cl. 101—183 7 Claims

ABSTRACT OF THE DISCLOSURE

A supplemental gearing arrangement is interposed adjacent the direct drive gears of the transfer cylinders of multi-color sheet-fed rotary printing presses incorporating a resilient adjustment for accommodating the backlash in the driving gears at the place of transfer of the sheets between the various cylinders so that the sheets will not become misaligned as a result of the backlash during transfer from one station of the press to the next.

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

In multi-color printing where a final composite multi-color image is formed by the successive printing impressions 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 multi-colored image. With sheet-fed multi-color 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 plate and transfer cylinders during the printing run, as caused by the tooth play or backlash in the direct driving gears between the various cylinders.

Thus, regardless of the care with which the various printing plates are positioned at the various printing stations to contact the sheets of paper over precisely the same area to provide exact registration of the several superimposed images or impressions, tooth play 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 at the moment of transfer of the sheets between the various cylinders which may cause distortion of the registration 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, because of the high speed of such presses, the heat generated by the interplay between the gears causes a certain degree of change in tooth clearance during a long period of operation, thus affecting the accuracy of the register during the transfer of the various sheets between the various cylinders of the press. Further, even a difference in ink consistency or a change in speed of operation of the press will affect the load on the press and will ultimately have an unfavorable effect on the tooth play or backlash.

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 than the 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 is 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 other 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 of two separately driven printing units. It is not appropriate, however, for the kind of press discussed 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 supplementary gears which eliminates the peripheral oscillating of the various transfer drums between the individual units of a multi-unit press. This result is obtained by providing adjacent the various intermeshing gears in the direct drive train between the vairous units of the press alternately a supplemental adjustable rigid gearing segment or resilient gearing segment, which rigid and resilient segments between two adjacent intermeshing cylinders mesh with each other at the place of transfer of the sheets between the two intermeshing cylinders. In this manner, the tooth play 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 multi-unit press at the proper location in each unit of the press with no misalignment of the sheet during the transfer thereof from one unit to the next.

With the foregoing and additional 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 drawing, and the appended claims.

In the drawing:

FIG. 1 shows a portion of the drive of a sheet-fed multi-color printing press showing two of the multiple printing units arranged one behind the other and having this invention applied thereto;

FIG. 2 is a partial section along the line II—II of FIG. 1;

FIG. 3 is a simplified diagrammatic enlarged view in-

dicating further aspects of the operation of the mechanism of FIG. 1.

Referring to the drawing, 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, which mechanism is for providing the driving from one unit of the press through the transfer cylinders to the second unit thereof and so on. Since such driving and gearing mechanism in multi-unit 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 and the impression cylinder have been omitted from the drawings for clarity and simplicity.

Thus, FIG. 1 shows impression cylinders **10** and **11** of two succeeding units in a multi-unit rotary printing press, with spur gear **12** disposed on cylinder **10** and spur gear **13** disposed on cylinder **11**. Interposed between these two impression cylinders are transfer cylinders **16**, **17**, and **18**, with the transfer cylinders having spur gears **19**, **20**, and **21**, respectively, disposed on the shafts thereof. Impression cylinder **10** may be driven in conventional manner by worm gears disposed on the shaft thereof from a conventional power source, not shown. As will be understood, therefore, impression cylinder **10** drives transfer cylinder **16** through the intermeshing relationship of their respective spur gears **12** and **19**. Further, transfer cylinder **16** drives transfer cylinder **17** through their respective intermeshing gears **19** and **20**, and so on through the whole succession of cylinders to the next succeeding impression cylinder **11**. Also, as is well known, a sheet being fed through the press will be transferred from the impression cylinder **10** via the successive transfer cylinders **16**, **17**, and **18** to the next succeeding impression cylinder **11**. The remaining printing units or stations of the press are connected, in known manner, with each other with similar gear drives, 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.

Axially disposed adjacent the various spur gears **12**, **19**, **20**, **21**, and **13** are gear segments **22**, **23**, **24**, **25**, and **26**. These gear segments are partly rigid tooth segments and partly resilient tooth segments with the rigid and resilient segments being arranged alternately along the train of gears interconnecting the various cylinders. That is, segments **22**, **24**, and **26** are rigid tooth segments, while segments **23** and **25** are resilient. Further, these segments are arranged to intermesh with each other at the point at which a sheet is being transferred from one cylinder to another. For example, in FIG. 1, segments **22** and **23** are shown in intermesh with each other at the point where the sheet (not shown) is being transferred from the impression cylinder **10** to the transfer cylinder **16**. The rigid segments **22**, **24**, and **26** are immovably disposed axially adjacent their corresponding gear rims **12**, **20**, and **26**, as is shown in FIG. 2, with segment **22** being disposed adjacent spur gear **12**.

The resilient segments **23** and **25**, on the other hand, are disposed on their respective cylinders **16** and **18** to yield circumferentially as between two stops **26** and **27**. The resilient action is caused by an adjustable spring **28** disposed on the stop **17** which is the following stop of the segment **23** when noting the direction of rotation as indicated by the arrow **29** in FIG. 1.

The manner of operation of this device is best shown in the diagrammatic arrangement of FIG. 3. That is, with the direction of rotation noted by the arrow **30**, the front flank **31** of tooth **34** of spur gear **12** rests against the rear flank **32** of the gear **19**. As such, there is a clearance *a* present on the opposite flanks of the two intermeshing teeth. Without the arrangement described herein, this clearance *a* may allow a certain amount of play or oscillation between the intermeshing teeth. With the supplementary partial segments interposed over the standard intermeshing gears, however, the action of the spring **28** causes the corresponding tooth of resilient segment **23** to shift to the left in FIG. 3 the amount of the space *a* toward tooth **33** of the gear **12** and for the corresponding tooth of the rigid segmented portion **22** (shown in dot-dash line) so that the tooth gap **36** between the flanks **31** and **37** is filled up on both sides with no room for play between the meshing gears.

Obviously, by adjusting the stop screws **26** and **27** on the resilient gear segment **25** in a corresponding manner exerts the same action on that segment. Therefore, 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, thus eliminating the objectionable oscillation of the entire spur gear drive during the transfer of a sheet from one station to another in a multi-unit press. By adjusting the stop screw **27** in each case, the spring **28** associated therewith can be given a specific initial tension which controls the yieldability of its respective resilient segment.

With such an arrangement, furthermore, a certain limitation of movement is imposed upon the resilient segments which acccommodates more accurately the intermesh between the resilient segments and their respective rigid segments. For example, assuming that there is a clearance of $5/100$ mm. between spur gears **12** and **19** in the transfer region between their respective cylinders and a clearance of $9/100$ mm. at the transfer point between gears **19** and **20**, then stop **26** is adjusted to the larger of the two clearances ($9/100$ mm.) with a slight reserve being made for accommodating the load-dependent operating conditions mentioned above. With such an adjustment, the spring **18** of resilient segment **23** will be compressed more at the transfer point between impression cylinder **10** and transfer cylinder **16** than will be the case at the transfer point between transfer cylinders **16** and **17**.

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 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 oscillation at the intermesh between the individual gears of the drive, thus eliminating the oscillations and providing accurate registering of the printed sheets as they are transferred from one unit to the next in the multi-unit 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 multi-color printed image on the sheet notwithstanding distortions of a variation of the load caused by heat acting on the individual gears of the chain of drive, or load fluctuations caused by differences in consistency of ink or differences in the loading of the individual printing units of the multi-unit machine. In addition, different variations causing different amounts of oscillation between the intermesh of the individual gears in the train can be accommodated for individually without regard to different variations in the intermesh of other intermeshing gears in the train so as to provide complete elimination of all oscillation at the various transfer points between the various cylinders in the chain drive so that

the adjustments at one transfer point do not affect the adjustment of a next or preceding transfer point in the chain of transfers of the sheet from one unit to the next.

As will be understood, the various rigid and resilient toothed segments may be composed of steel. Alternatively, the segments may be composed of plastic and steel disposed in alternating fashion through the gear train.

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 simillar 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.

What is claimed is:

1. In multi-color sheet-fed rotary printing press apparatus of the character described having a plurality of printing stations for imprinting sequentially a series of images on sheets fed therethrough to form a final composite multi-color 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 member disposed thereon and 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, the combination which comprises,

rigid and movable gear segments each having gear teeth corresponding to the teeth of said gear members, means mounting each of said gear segments on and for circumferential movement with a respective one of said gear members at the point of transfer of the sheets from one cylinder to the next cylinder, said rigid gear segments being rigidly mounted on respective gear members for non-relative movement therewith, said movable gear segments being mounted on their respective gear members for rotational movement therewith and circumferential limited oscillation relative thereto, said rigid and movable gear segments being mounted on alternate ones of said impression and transfer cylinders whereby a movable gear segment meshes with a rigid segment at each transfer point along said direct drive gear train from one station to the next, and resilient adjustable means between said movable gear segments and their respective gear members on which the same are mounted to adjustably position such movable gear segments on their respective gear members to selectively control the intermesh between rigid and movable gear segments.

2. Apparatus as described in claim **1** in which said rigid gear segments are mounted axially of their respective gear members.

3. Apparatus as described in claim **2** in which said movable gear segments are mounted axially and rotatably on said cylinders adjacent their respective spur gears therefor, and in which a stop is disposed adjacent each end of each of said movable gear segments with means disposed on said movable gear segments providing said adjustable predetermined tension on said segments in a direction toward the direction of rotation of the said adjacent spur gears.

4. Apparatus as described in claim **1** in which said movable gear segments are mounted axially on their respective gear members, and in which a stop is disposed on the gear member adjacent each end of each said movable gear segments with resilient means disposed between said movable gear segments and said stop providing an adjustable resilient tension on said movable segments in a direction circumferential of the direction of rotation of their respective gear members.

5. Apparatus as described in claim **3** in which said resilient means providing said adjustable resilient tension includes a spring disposed on each of said movable gear segments between one of said stops therefor and the end of the said segment adjacent thereto.

6. Apparatus as described in claims **1, 3, 4** or **5** in which said gear segments are composed of steel.

7. Apparatus as described in claims **1, 3, 4** or **5** in which said gear segments as disposed along said gear train are composed alternately of plastic and steel.

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U.S. Cl. X.R.

74—440, 443; 101—248

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(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,477,370 Dated December 3, 1969

Inventor(s) HERMANN FISCHER

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 37, after "non-relative" insert --rotative--.
Column 6, line 22, the numeral "3" should read --4--.

SIGNED AND
SEALED
FEB 24 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

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Commissioner of Patents