

Nov. 23, 1965

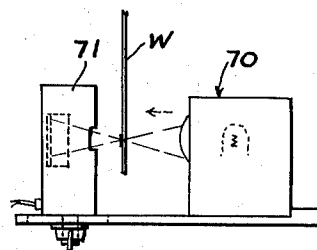
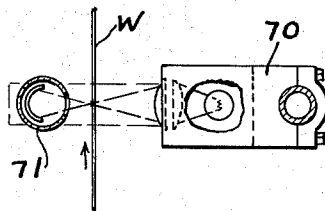
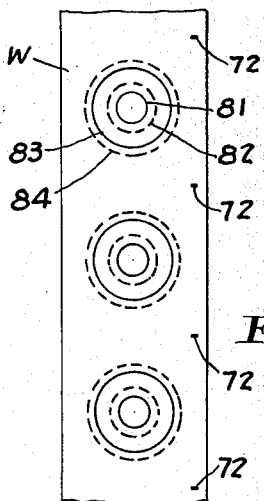
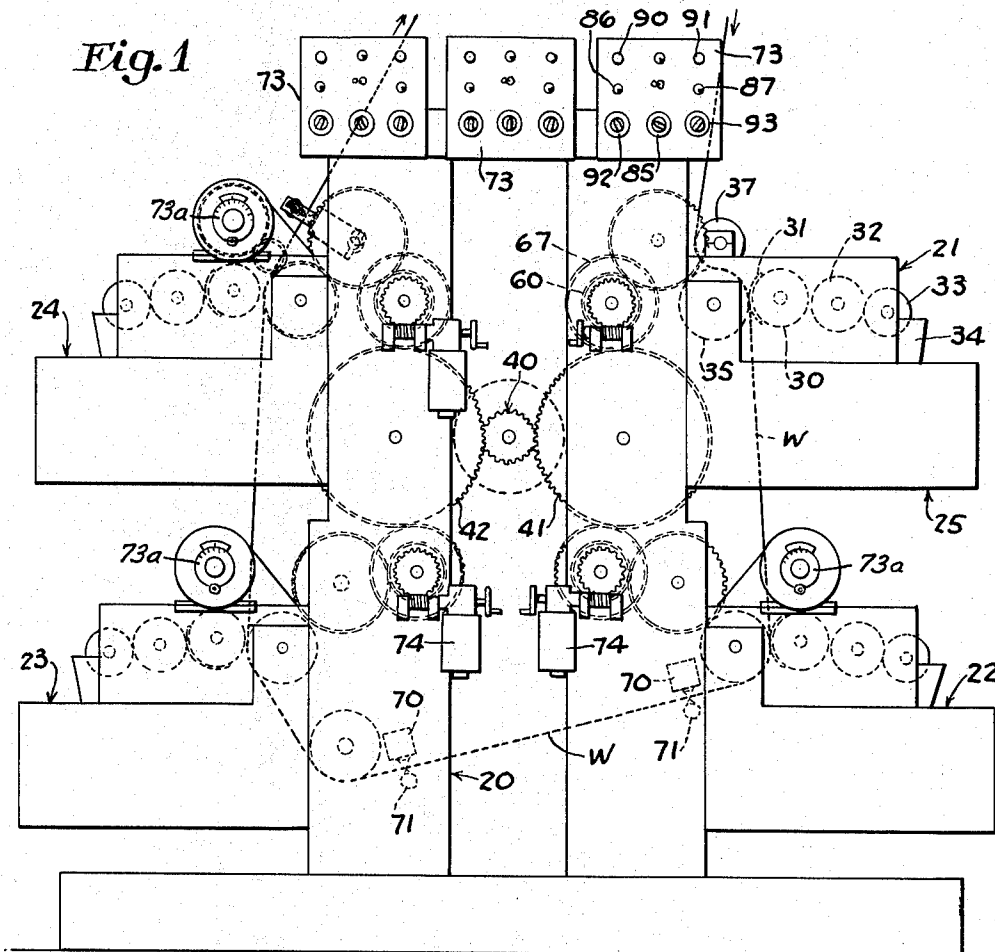
H. NAGEL

3,218,969

LONGITUDINAL REGISTRY MEANS FOR FLEXOGRAPHIC PRESS

Filed Nov. 6, 1962

2 Sheets-Sheet 1



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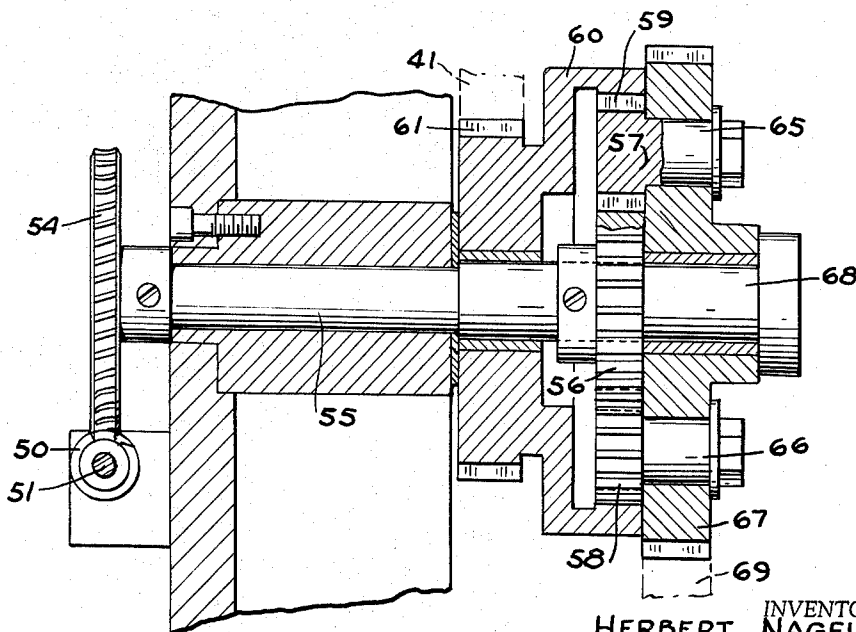
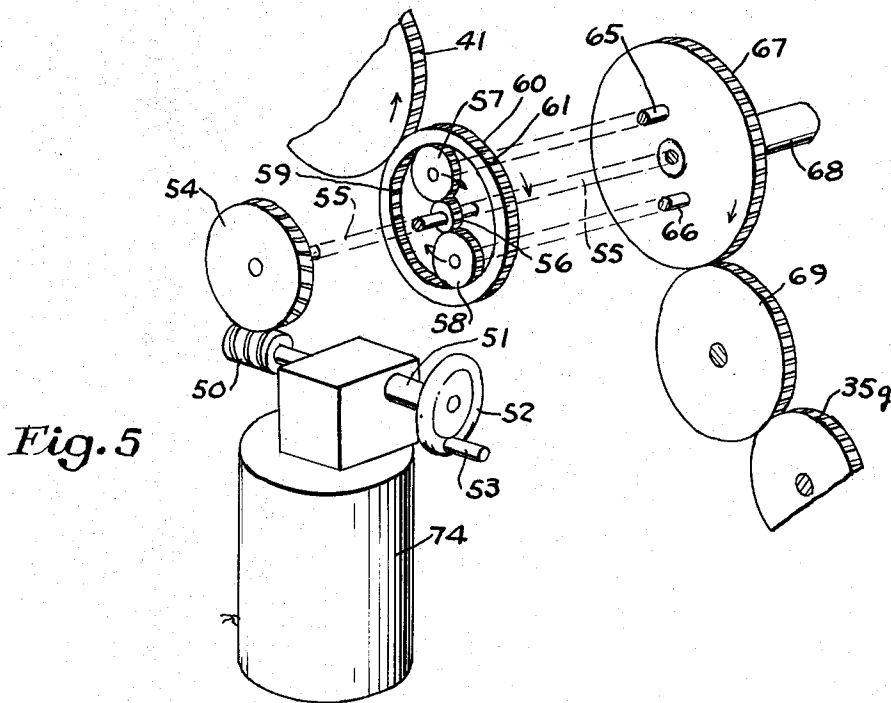
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LONGITUDINAL REGISTRY MEANS FOR FLEXOGRAPHIC PRESS

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2 Sheets-Sheet 2



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LONGITUDINAL REGISTRY MEANS FOR
FLEXOGRAPHIC PRESS

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Filed Nov. 6, 1962, Ser. No. 235,614

7 Claims. (Cl. 101—181)

This application is a continuation-in-part of my co-
pending application Serial No. 202,460, filed June 14,
1962, now abandoned.

This invention relates to printing, and more particular-
ly to the branch thereof called "flexography," and to
flexographic presses.

Flexographic presses are usually presses of the rotary
type used for printing in one or more colors on a strip
of material wound into a roll, which roll in unwound
as the material passes through the press and is wound
again after the printing thereon is completed. Printing
plates of such presses are usually made of rubber. Vari-
ous materials may be printed with the use of such presses,
particularly thin cardboard, paper, plastic film and the
like, either in a single roll layer or in the form of a
flattened tube presenting a two layer strip. The strip on
which the printing is done is usually termed a "web."

An important feature of flexographic presses, determin-
ing in large degree their construction and methods of
printing practiced therewith, is the fact that flexographic
presses use extremely fast drying ink, usually of the al-
cohol base type. This fact necessitates having inking
rollers of the press run continuously in order to prevent
the printing ink from drying on such rollers. After the
ink dries on the rollers, which may occur within 2-3
minutes, washing such rollers to remove the dry ink be-
comes necessary in order to prevent spoilage of a con-
siderable amount of material when printing is resumed.
It may take as much as 100 feet of printing for the rollers
to dissolve the dried ink before acceptable printing is
reached.

Within recent years great changes have occurred in
packaging various materials because of the development
of polyethylene film. Polyethylene sleeve or "layflat
tube" is now widely used for making various bags for
packaging therein a very great variety of products. To
be fully effective for their intended purpose without carry-
ing separately made and cemented labels, such bags or
packages have to carry their own printing, such as vari-
ous pictures, trademarks, instructions for use, advertis-
ing messages, etc., and such printing is often required
to be in more than one color. When applied to flexo-
graphic presses, multi-color printing presents in a much
greater degree one of the difficult problems of multi-
color printing, namely, that of registry. While this prob-
lem is ever present in multicolor printing even in flat
bed presses, as well as in conventional rotary presses,
when printing on paper with slow drying oil base inks
penetrating the porous material of the paper, flexographic
multicolor presses present this problem in an extremely
difficult manner.

The polyethylene film which is one of the most fre-
quently printed materials is very slippery. It also stretches
in a very appreciable manner. In addition, printing is
done with the web running at very high speeds, such as
200 feet per minute. Under such conditions maintenance
of longitudinal registry between two printed colors is
very difficult. The occurrence of longitudinal misregistry
is virtually impossible to prevent, and because of the
high speed at which the web runs in the press, its oc-
currence is very difficult to detect by the eye. There-
fore, a constant and close watch on the rapidly run-

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ning web must be maintained, requiring a special person
of high skill. Watching such web for misregistry imposes
severe eye strain, causing severe headaches and fatigue.
When misregistry is detected, its correction must be done
immediately and without stopping the press. It should
be understood at this point that "transverse misregistry,"
i.e. misplacement of one color with respect to the other
in a direction transversely of the web is relatively easy
to prevent and to correct by the use of guides, and such
misregistry does not present a serious problem. There-
fore, the problem of misregistry to the solution of which
the present invention relates is primarily longitudinal
misregistry.

Because of the necessity to control misregistry to the
occurrence of which flexographic presses are particu-
larly susceptible, numerous devices have been offered for the
purpose of detecting and correcting such misregistry.
However, the effectiveness of said devices varies greatly,
and conventional devices of this nature have not yet
satisfactorily solved the problems involved. Some of
such devices successful at slower speeds, or with some
materials, proved to be inapplicable at higher speeds and
with other materials, particularly with the use of slippery
strip material, such as polyethylene. Still others are
satisfactory where requirements of registry are not very
precise, such as in printing colors disposed adjacently but
at a certain distance from each other, i.e. without actually
touching each other; still others are adequate for cutting
the web where control of the length of the pieces is
desired.

One of the objects of the present invention is to pro-
vide a flexographic press having improved means for de-
tecting and correcting misregistry between images print-
ed in different colors bordering on each other and, there-
fore, requiring exceedingly precise registry without over-
lapping or occurrence of gaps therebetween.

Another object of the present invention is to provide
a flexographic press having improved registry control
means in which detection and correction of the mis-
registry is done automatically, i.e. without human par-
ticipation, and without stopping or slowing down the
press.

A further object of the present invention is to provide
a flexographic press having improved registry control
means whereby the registry can be properly set manually
before printing, and correction of misregistry done on the
running press selectively, either automatically or with
the use of manual means.

A still further object of the present invention is to
provide a flexographic press having improved registry
control means whereby correction of misregistry can be
done either manually or automatically throughout the
entire range of 360° of rotation of the printing cylinder.

A still further object of the invention is to provide a
flexographic press of the character specified in the pre-
ceding paragraph, in which correction of misregistry is
done by advancing or retarding the printing cylinder with
respect to the web and without applying pressure on the
web, as is done for the purpose of controlling registry
by way of a swinging idler roller.

A still further object of the present invention is to
provide a flexographic press having improved registry con-
trol means whereby advancing or retarding the printing
cylinder with respect to the web for correction of mis-
registry is done in the gear drive of the printing cylinder
without affecting the positive connection of such drive
in normal printing and without interference between the
manual and the automatic registry control means.

A still further object of the present invention is to pro-
vide a flexographic press including improved registry con-
trol means whereby various corrections of misregistry

and adjustment of the registry control means can be done without stopping or slowing down the press.

A still further object of the present invention is to provide a flexographic printing press including a plurality of color printing units and having improved registry control which is capable of holding color prints in registry from the initial start-up through speed-up of the press and back down in stages to the stopping point, and thus making the operator worry-free of registry problems.

A still further object of the present invention is to provide an improved flexographic press having a plurality of color printing units and an automatic control device for correction of longitudinal misregistry, which device can be removed from the press leaving only manual means for control of misregistry, or which can be installed in a press which has only manual control of registry.

A still further object of the present invention is to provide an improved flexographic press having improved registry control means including both manual and automatic registry correcting means in all subsequent color units after the first unit, and with only manual means in the first unit, whereby in setting up a run, or resuming the same after a stop, should it be found that all subsequent colors are in registry between themselves, but not in registry with the first color, such first color can be brought to registry with the subsequent colors rather than every subsequent color brought in registry with the first, thus effecting a greatly simplified correction.

It is an added object of the present invention to provide an improved flexographic press including registry control means of the nature specified above which are simple and rugged in construction, safe and dependable in operation, easy to maintain and to service.

Further objects and advantages of this invention will be apparent from the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification, wherein like reference characters designate corresponding parts in the several views.

FIG. 1 is an elevational view of a flexographic press embodying the present invention, with the web being shown in position for printing thereon four colors all on one side thereof.

FIG. 2 shows a portion of the web with the four color print shown thereon diagrammatically, and with a printed registry mark also shown thereon in proper space relation to the print.

FIG. 3 is a view showing in greater detail the light beam projector, the photo-electric cell and the web in proper space relation thereto.

FIG. 4 is a plan view showing the construction of FIG. 3.

FIG. 5 is a fragmentary perspective view showing in a diagrammatic manner the mechanism interposed within the drive gear train of the plate cylinder for effecting correction of misregistry either manually or automatically.

FIG. 6 is a sectional view showing the construction illustrated diagrammatically in FIG. 5, with its structural details.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways within the scope of the claims. Also, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and not of limitation.

In the drawings there is shown, by way of example, a flexographic press embodying the present invention. Referring specifically to FIG. 1, the press illustrated therein comprises a frame structure 20 having four color units 21, 22, 23, and 24 mounted thereon on brackets such as the bracket 25 of the first color unit 21.

The frame 20 of the press is so constructed that it can

receive any practical number of brackets such as the bracket 25 for mounting color units thereon, such as one, two, three, or four units. Each color unit comprises a printing or plate cylinder 30 carrying a printing plate 31 which is usually made of rubber or a suitable rubber-like material and cemented on the plate cylinder 30. The thickness of rubber plates is standardized, presently at $\frac{1}{8}$ ". An ink transfer cylinder 32 is mounted adjacent the plate cylinder 30 to transfer ink in proper and even film on the rubber plate 31. The ink transferring cylinder 32 has its cylindrical working surface engraved with the use of photo-engraving process to provide a large number of small ink-retaining indentations thereon, such as 160-180 indentations per square inch. The cylinder 32 receives ink from a lower ink cylinder 33 running in an ink well 34. An impression cylinder 35 is mounted on the other side of the plate cylinder 30 in a fixed position and is driven by a gear 35g mounted on the shaft of the cylinder 35 and forming a part of the gear train from the gear 40. The gear 35g drives the cylinders of the unit in a manner described in detail in my said co-pending application Serial No. 202,460. The web W is threaded over the impression cylinder 35 which provides support for the web W pressing the same against the rubber plate with the desired pressure attained with the aid of adjusting means provided in the cylinder 30, whereby the rubber plate 31 exerts stronger or lighter pressure on the web in transferring printing ink thereto.

The plate cylinder 30, the impression cylinder 35, and the ink transfer cylinder 32 have in operation equal peripheral speeds in order to produce frictionless rolling between their respective cylindrical surfaces, and to eliminate rubbing and smearing of fresh imprints. This is attained by their driving gears mounted on the shafts of the respective cylinders, having their respective pitch diameters equal to the respective diameters of the cylindrical surfaces. With respect to the plate cylinder 30, the working diameters thereof for the above purposes is taken as being that of the cylinder itself plus the double thickness of the rubber plate. On the other hand, it is desired that there be certain rubbing or wiping action between the photo-engraved surface of the cylinder 32 and the surface of the ink cylinder 33. Accordingly, the gear of the cylinder 33 is considerably larger than the pinion carried by the shaft of the cylinder 32, thus ensuring that the ink transferring cylinder 32 rotates faster than the ink cylinder 33; and, therefore, in spite of its having approximately the same diameter as the ink cylinder 33, the surface of the ink transferring cylinder 32 overruns the surface of the lower ink cylinder 33.

A pinch roller, such as indicated at 37, cooperates with the impression cylinder of the unit which is the first to receive the web from the supply roll, such as the unit 21 in FIG. 1. The purpose of the pinch roller is to provide proper grip on the web in unwinding it from the supply roll.

All of the color units of the press are driven from the center drive gear 40 and large intermediate gears 41 and 42. The gear 41 meshes with the train of gears driving the color unit 21 and with another train of gears driving the unit 22. Similarly, the intermediate gear 42 meshes with the two trains of gears driving the color units 23 and 24, respectively.

The above description is believed to be sufficient for the purposes of understanding the present invention full, and, therefore, providing further details of the press construction, which have been given in detail in my co-pending application. Serial No. 202,460, filed June 14, 1962, for Rotary Printing Press, is not believed to be necessary. It will be understood that the color units 21, 22, 23, and 24 are substantially identical in their construction so far described. The substantial difference between the color units is, of course, in their printing plates, each of which is made to print on the web a different imprint and with a different color. In order to provide a desired com-

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posite print, the separate color prints have to be printed on the web in a certain space relation with respect to each other. This space relation is particularly precise when the colors border on each other and actually touch each other to provide a composite multicolor print. Under such conditions offsetting this relationship by as much as $\frac{1}{32}$ " may cause overlapping of the colors, or gaps between them, which are objectionable, and which are usually referred to in the art as misregistry.

It should be understood that misregistry may occur in any direction, i.e. at any angle to the center line of the web. However, any such misregistry can be eliminated by making two corrections, namely, one longitudinally of the web and the other transversely of the web. However, conditions causing misregistry operate most strongly longitudinally of the web. This is due to slippage of the web, and its stretching due to building up tension therein because of the change in resistance to unwinding of the web from the supply roll due to decrease in the leverage at which the unwinding force is applied to the roll. These conditions do not affect registry in the transverse direction. Furthermore, correcting transverse misregistry may be done easily by suitable guiding means operating along the sides of the web and such corrections, therefore, do not present a particularly difficult problem. Therefore, correction of the misregistry to which the present invention is particularly directed is longitudinal misregistry.

The manual registry control means of my press are self-contained, i.e. are complete in themselves, and can be used in a press not only independently or without cooperation of automatic means but with such automatic means being completely removed from the press. A number of very important advantages are attained by such a construction. Manual control means are provided in all color units, the first, second, third, and fourth. By the first unit is meant the unit which receives the web first, i.e. for printing the first color. The second unit is the unit which receives the web for printing the second color and so on. In the embodiment illustrated, the unit 21 is the one which is considered herein to be the first, unit 22 the second, unit 23 the third, and unit 24 the fourth.

The manual registry control means of my improved flexographic press is a self-contained device which is installed at each color unit for cooperation therewith and to which automatic registry control means may be connected. By virtue of such a construction my improved registry control means can operate manually and independently of the automatic control means, and even without automatic control means being removed from the press. With the use of manual control means detection of misregistry has to be done visually by picking up a print on the long stretch of web exposed to view and following such print with the eye until it disappears.

The manual control mechanism itself is interposed in the train of gears driving the respective color unit, such as between gear 41 and the gear of the impression cylinder 35. The control mechanism illustrated in FIG. 5 may be considered as being the one associated with the color unit 22 of FIG. 1. The manual control portion of said mechanism comprises a worm 50 mounted on a shaft 51 carrying on its other end a wheel 52 with a manually operated handle 53. The worm 50 meshes with the worm gear 54 mounted on a shaft 55 carrying a sun gear 56 on its other end. The sun gear 56 meshes with two planetary gears 57 and 58 which are also in mesh with the internal gear teeth 59 of orbit gear 60. The gear 60 has on its outer periphery external gear teeth 61 meshing with the intermediate gear 41. The planetary gears 57 and 58 are mounted and rotate on shafts 65 and 66 carried by a gear 67 mounted for free rotation on a shaft 68, which shaft is journaled for rotation in suitable bearings. The gears 54 and 56 are secured to the shaft 55 and rotate therewith. On the other hand, the planetary gears 57 and 58 rotate on their respective shafts 65 and 66.

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The gear 67 meshes with an idler gear 69 which, in turn, meshes with the gear 35g of the impression cylinder 35, as mentioned. In normal operation of the press, the shaft 55 remains stationary because of the irreversibility of the worm-and-gear mechanism, while the planetary gears 57 and 58 revolve bodily because of rotation of the gear 60 by the intermediate driving gear 41. The planetary gears 57 and 58 operate to rotate the gear 67 through their shafts 65 and 66, thus driving the gear 69 and through it the gear 35g.

When correction of misregistry is to be made, the handle 53 is operated, thus turning the shaft 55 and, therefore, advancing or retarding, depending on the direction of rotation of the handle 53, the gear 67 and, therefore, the gear 69. The gear 69, in turn, drives the gear 35g, and the entire respective color unit, including its plate cylinder 30, thus rotating said cylinder with respect to the web and correcting the misregistry.

It will be understood that FIG. 5 is a diagrammatic view in which for the purpose of clarity certain features of construction have been omitted. These features appear in detail in FIG. 6. In comparing FIGS. 5 and 6, it will be noted that in actual construction shown in FIG. 6, the shafts 55 and 68 form continuations of each other. Also, that the internal and external teeth 59 and 61, respectively, of the orbit or ring gear 60 are offset axially on the gear 60 in FIG. 6 because the required ratio of the gears are such that the internal gear teeth 59 of the gear 60 have greater pitch diameter than the external gear teeth thereof.

In accordance with the invention, I incorporate into such manual control means automatic means which detect and correct misregistry automatically by acting on the shaft 51 of the worm-and-gear means. For the purpose of detection of misregistry, I provide a light beam-producing device generally designated by the numeral 70 adapted to produce a beam of light and project it on the photo-electric cell generally designated by the numeral 71. The web W, which is transparent or lightly translucent, runs between the light beam-producing device 70 and the photo-electric cell 71, as is best shown in FIGS. 3 and 4.

On the web W along one edge thereof there are printed in the first printing unit 21 timing or signal marks 72. Such marks are printed at equal distances from each other and at predetermined space relation to the first print or image 81. The marks 72 are printed simultaneously with printing the first print 81 in the first color unit 21 and, therefore, in the same color as the color of said first print 81.

In operation, the marks 72, when passing between the light beam-producing device 70 and the photo-electric cell 71, interrupt the beam of light and cause the photo-electric cell to respond to the interruption of light acting thereon and to give a signal to the control unit generally designated by the numeral 73. In case of printing opaque materials, such as paper, both the light-beam producing device and the photo-electric cell are disposed on the same side of the web, and their construction is changed to respond, in effect, to a reflected beam and its interruption by signal marks.

The control unit 73 is associated with a timer mechanism or selector switch 73a preset on the basis of the distance between the adjacent marks 72 and the speed of the web. As shown in FIG. 1, the control units 73 with their timers or selector switches 73a are provided for the units 22, 23, and 24, but no such unit and selector switch are provided for the unit 21. The control unit 73 of each of said color units is constructed in such a manner that when a signal mark 72 reaches the light beam of the unit 22 earlier than the time for which the timer or the selector switch 73a is set and, therefore, indicates that the second color unit 22 prints its image or print 82 ahead of its predetermined place and, therefore, out of registry with the first print or image 81, a relay of the control unit closes the switch of a reversible motor, arranged within the hous-

ing 74 and drivingly connected through suitable reduction gearing with the shaft 51 of the worm 50, to rotate the shaft 51 in the direction to retard the plate cylinder of the unit 22 to print the image 82 later. The switch of the reversible motor in the control unit 73 will remain closed until the correction is made and the signal mark 72 traverses the light beam exactly at the preset time. At that moment, the relay is deactivated, causing the switch to open and the reversible motor to stop.

Should the signal mark 72 begin to arrive at its predetermined destination later than is determined by the setting of the control unit 73, the electric signal from the photo-electric cell 71 will activate another relay mechanism, closing another switch, in consequence whereof the reversible motor will rotate in the opposite direction causing the worm-and-drive mechanism to rotate also in the corresponding direction to advance the plate cylinder and thus to make corresponding correction of misregistry. The numerals 83 and 84 designate the remaining two images printed by the color units 23 and 24, respectively, as mentioned before.

The photo-electric cell 71, the beam-producing device 70, the control unit 73 and the timer or selector switch 73a, as well as the reversible motor may be of conventional construction. A number of such devices have now become standardized in the trade and are used for automatic controls in many industrial applications. Therefore, describing such devices in further detail is not believed necessary herein. The control knobs 92 and 93 of the unit 73 are used for adjustment of the timer in setting a run. The knob 85 is used for setting sensitivity of response of the photo-electric cell. The signal lights 86 and 87 of different colors operate to give a signal whether the web is running later or in advance of the setting and in what direction the unit is operating to make a corresponding correction.

The switches in the form of hold-in buttons 90 and 91 are operated manually to close the retard switch or the advance switch of the reversible motor in order to cause such motor to run in the corresponding direction and to effect correction of registry. By virtue of using such a construction, correction of misregistry through large distances such as several inches can be done rapidly bringing the colors into near registry, such as $\frac{1}{16}$ ", whereupon the automatic means take over and bring the colors into precise registry. It should be understood that the range of corrections in which the automatic means operate is limited and is usually approximately $\frac{1}{16}$ ".

The part-identifying numerals applied to operative parts of the color units 21 and 22 apply also to the units 23 and 24. Operation of the third and fourth color units 23 and 24, both including manual and automatic registry control means such as those of unit 22, is substantially similar to that of the above described operation of the unit 22. It will also be understood that the automatic control means of each of the units 22, 23, and 24 operate to correct misregistry by bringing it in registry with the first printed color, i.e. the color print 81 printed by the unit 21.

By virtue of the above disclosed construction, the objects of the present invention listed above and numerous additional advantages are attained.

I claim:

1. In a flexographic printing press for printing with alcohol base ink on a stretchable web a plurality of color images in predetermined registry with each other, a plurality of color printing units, a main drive shaft providing the source of power for operating the press, with each of said units including a plate cylinder carrying a printing plate, an impression cylinder adapted to maintain in repeating succession the web in printing contact with the plate, gear means drivingly connecting said main drive shaft with each color printing unit, respectively, to rotate the plate cylinder thereof, means to pass the web through the color printing units at a speed substantially equal to

the peripheral speed of the printing plate of the respective units for printing contact therewith, a device for control of registry and correction of misregistry in the direction longitudinal of the web, said device operative to set the plate cylinder of the respective color printing unit forwardly or rearwardly with respect to prior color printed on the web treaded therethrough, said control including a planetary gear mechanism operatively interposed within the driving gear means from the main drive shaft of the respective color unit, manually controlled means acting on said planetary gear mechanism to advance or to set back one of the gears of the gear train between the main drive shaft and said impression cylinder to effect advancing or setting back said plate cylinder with respect to the prior color printed on the web within full 360 degrees of rotation of said cylinders to effect a necessary correction of misregistry, photo-electric cell means adapted to detect occurrence of misregistry in the second and subsequent color units with respect to the color printed by said first unit, and driving means controlled by said photo-electric cell provided in the second and subsequent color printing units and mechanically connected to the manual control means thereof to make the correction of misregistry in response to the operation of said photo-electric cell means.

2. The flexographic press defined in claim 1, with the manually controlled means including a worm-and-gear mechanism having a shaft with the worm gear of said mechanism being secured thereto, and with the planetary gear mechanism including a sun gear secured to the shaft of the worm-and-gear mechanism and planetary gears meshing with a gear forming part of said gear train connecting the main drive shaft and the color unit, with said sun gear adapted in normal operation of the press to remain stationary and to be manually rotated through said worm-and-gear mechanism for correction of misregistry.

3. In a flexographic printing press, a plurality of color printing unit, a main drive shaft providing the source of power for operating the press, with each of said units including a plate cylinder carrying a printing plate, an impression cylinder adapted to maintain the web in repeated printing contact with the plate, a central driving gear mounted on said main drive shaft and adapted to drive said color units, a pinch roller means adapted to supply the web to the color unit receiving the same first, a gear train operatively interposed between said central driving gear and the plate cylinder of each color unit, a registry control and misregistry correcting device for each of said units interposed within said gear train to adjust within full 360 degrees of rotation of said plate cylinder registry of prints made by its respective color units, said device including a worm-and-gear mechanism, a shaft for the gear of said worm-and-gear mechanism, a planetary mechanism including a sun gear secured to said shaft for rotation therewith, and a plurality of planetary gears with shafts, the shaft of the worm-and-gear mechanism and the sun gear being adapted to remain stationary in normal operation of the press, an orbit gear arranged coaxially with said worm-and-gear mechanism shaft and having external and internal gear teeth provided thereon, the external gear teeth of said orbit gear meshing with one of the gears of said train, said planetary gears meshing with said sun gear and the internal gear teeth of said orbit gear, and a gear drivingly connected to the other gear of said train and carrying the shafts of said planetary gears for free rotation thereon, said device adapted to operate in said train as an idler gear in normal operation of the press when the gear of the worm-and-gear mechanism and the sun gear are stationary, but to advance and to set back said other gear of the train with respect to said first gear thereof when said worm-and-gear mechanism is actuated to rotate its gear in one of the two directions.

4. The invention defined in claim 3, and including a single light-beam producing means in the second and each of the subsequent color units, photo-electric cell means for each one of said light-beam producing means cooperating therewith and adapted to detect occurrence of longitudinal misregistry in the second and subsequent color units, and electric driving means controlled by said photo-electric cell means and drivingly connected to the worm of the worm-and-drive mechanism to actuate the same for making correction of misregistry with respect to the image printed by said first unit in the subsequent color units in response to the operation of said photo-electric cell means.

5. The invention defined in claim 3, with the press including four color units all printing on the same side of the web, the first color unit including only manual registry control means and adapted to print a signal mark on the web, the second, third, and fourth color units having manual registry control means substantially identical to that of the first unit but also including automatic registry control means adapted to actuate automatically said manual means, with each of said four units, including the first one, being thus adapted to be brought manually both in the stationary and in running condition of the press into registry with any one of the remaining units.

6. In a flexographic printing press having a plurality of color printing units, with each of said units including a plate cylinder carrying a printing plate, an impression cylinder adapted to maintain the web in repeating printing contact with the plate, a central driving gear adapted to drive said color units, a gear train operatively interposed between said central driving gear and the plate cylinder of each color unit; a registry control and misregistry correcting device operatively interposed within the gear train of each of said units to adjust and correct manually through the full angle of 360 degrees the registry of prints made by its respective color unit, said device including a worm-and-gear mechanism, a shaft for the gear of said worm-and-gear mechanism, a sun gear secured to said shaft for rotation therewith, said shaft being adapted to remain stationary in normal operation of the press, an orbit gear arranged coaxially with said shaft and having external and internal gear teeth provided thereon, the external gear teeth thereof meshing with one of the gears of said train, a plurality of planetary gears having shafts and meshing with said sun gear and the internal gear teeth of said orbit gear, and a gear drivingly connected to the other gear of said train and carrying the shafts for said planetary gears for free rota-

tion of said gears thereon, said device adapted to operate in said train as an idler gear in normal operation of the press when the gear of the worm-and-gear mechanism and said sun gear are stationary, but to advance and to retard said other gear of the train with respect to the first gear thereof when said worm-and-gear mechanism is actuated to rotate its gear in one of two directions, a single light beam-producing device in the second and in each of the subsequent color units, a photo-electric cell for each of said light beam-producing devices adapted to respond to traversing of the light beam by signal marks on the web printed by the first unit; a control mechanism in the second and in each of the subsequent color units, said device including relay-and-switch means controlled by said photo-electric cell and having two portions with switches, one of said portions adapted to be activated by the photo-electric cell for closing its switch when the signal marks become retarded and the other portion being adapted to be actuated for closing its switch when the signal marks become advanced; a reversible motor drivingly connected to the worm of the worm-and-gear mechanism to rotate the same in one of the directions depending on which one of the switches is closed by said relay means in response to the operation of said photo-electric cell, and thus to correct misregistry automatically.

7. The invention defined in claim 6 and including two manually operated switches for said reversible motor, said switches normally remaining open but adapted to be manually and selectively closed to activate said motor for making manually coarse corrections of misregistry.

References Cited by the Examiner

UNITED STATES PATENTS

1,649,812	11/1927	Crompton	101—248 X
2,151,570	3/1939	Shoults et al.	101—181
2,283,003	5/1942	Frostad et al.	101—182
2,334,074	11/1943	Coy	101—181
2,435,791	2/1948	Luehrs	101—181 X
2,497,909	2/1950	Poole	101—181
2,500,230	3/1950	Bailey et al.	101—181
2,549,605	4/1951	Huck	101—181
2,570,045	10/1951	Bojanower et al.	101—181
2,863,387	12/1958	Huffman	101—248
3,013,519	12/1961	Wiggermann	74—675

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