Dec. 2, 1952 C. W. HARROLD 2,619,901

IMPRESSION LENGTH VARYING MEANS FOR ROTARY OFFSET PRINTING MACHINES

Filed Aug. 28, 1946 8 Sheets-Sheet 1

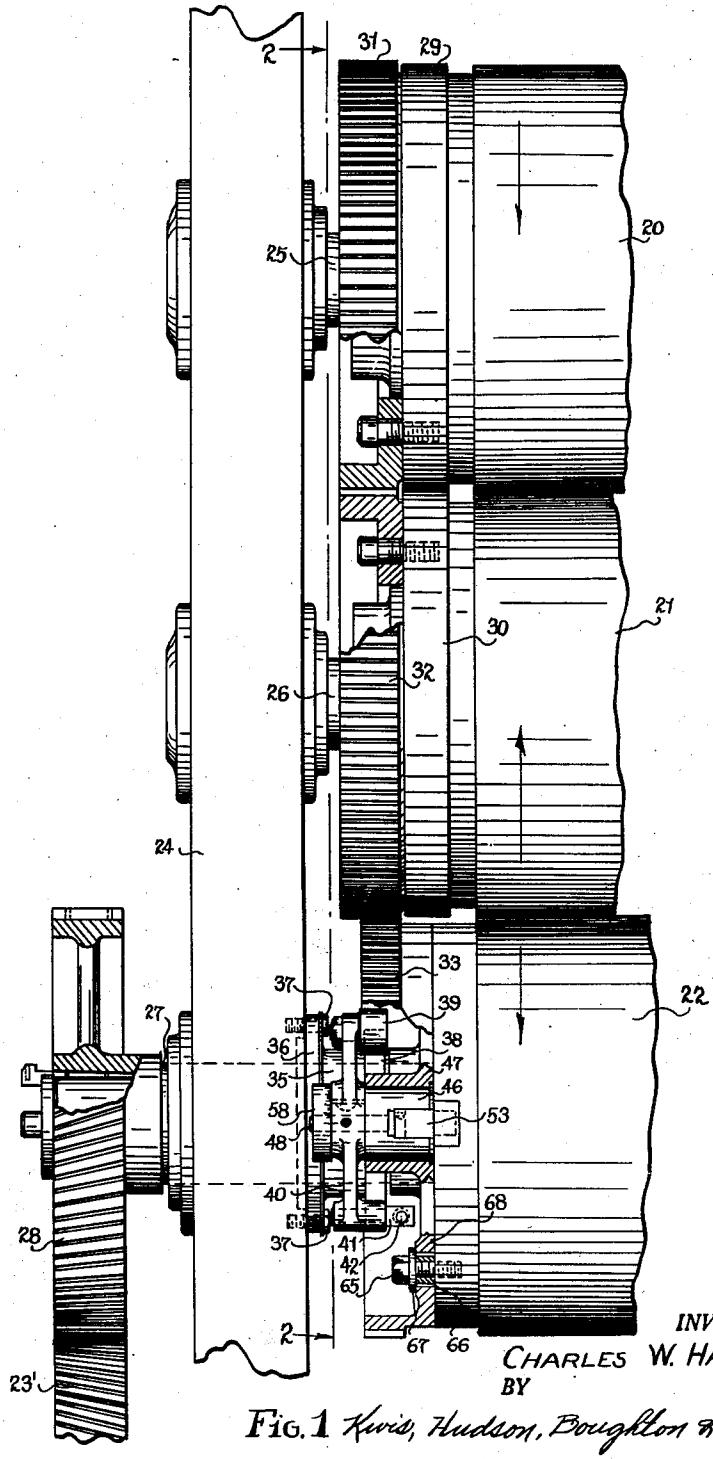

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FIG. 1 Kivis, Hudson, Boughton & Williams
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IMPRESSION LENGTH VARYING MEANS FOR ROTARY OFFSET PRINTING MACHINES

Filed Aug. 28, 1946 8 Sheets-Sheet 2

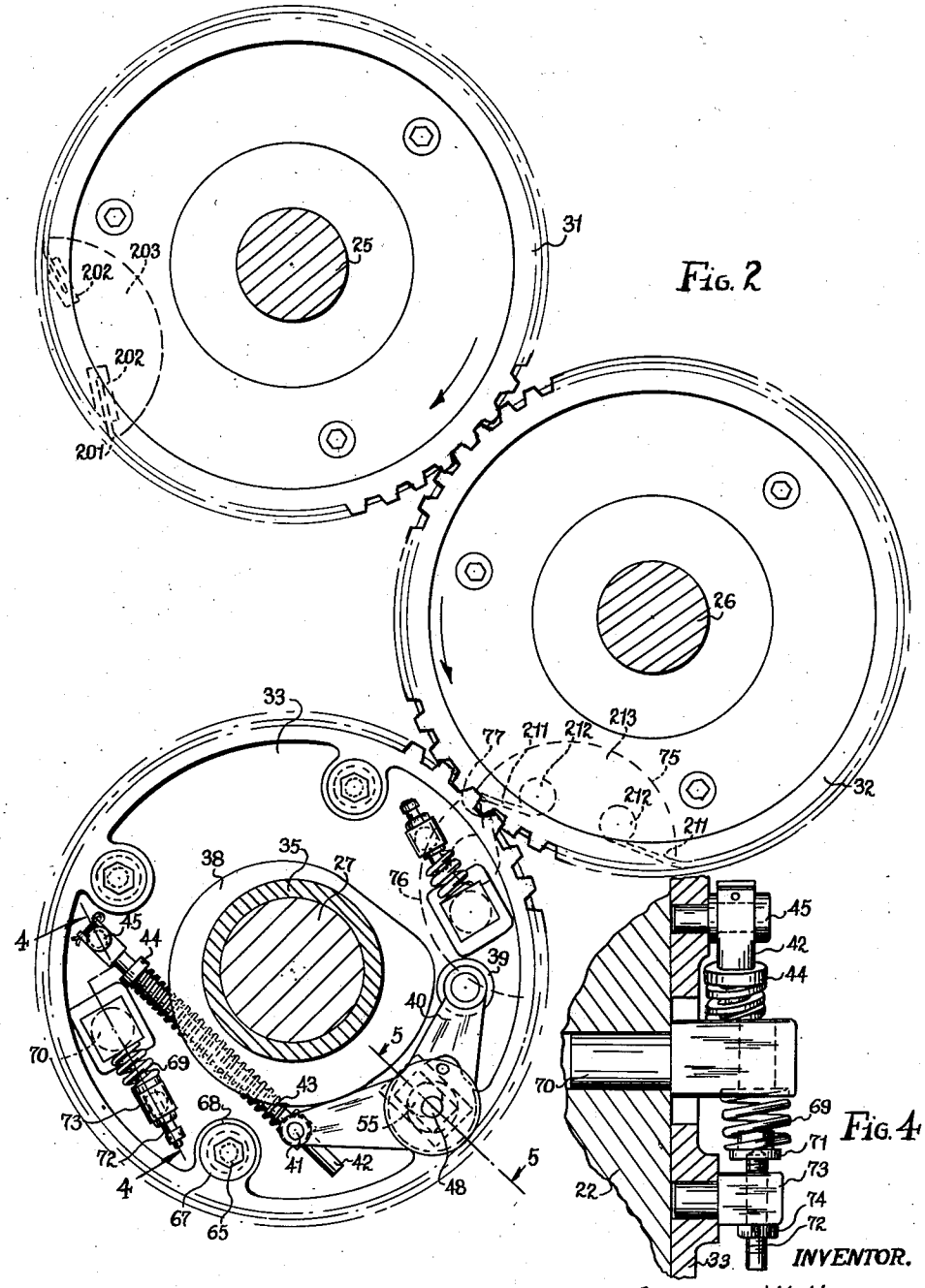

Fig. 2

Fig. 4

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IMPRESSION LENGTH VARYING MEANS FOR ROTARY OFFSET PRINTING MACHINES

Filed Aug. 28, 1946 8 Sheets-Sheet 3

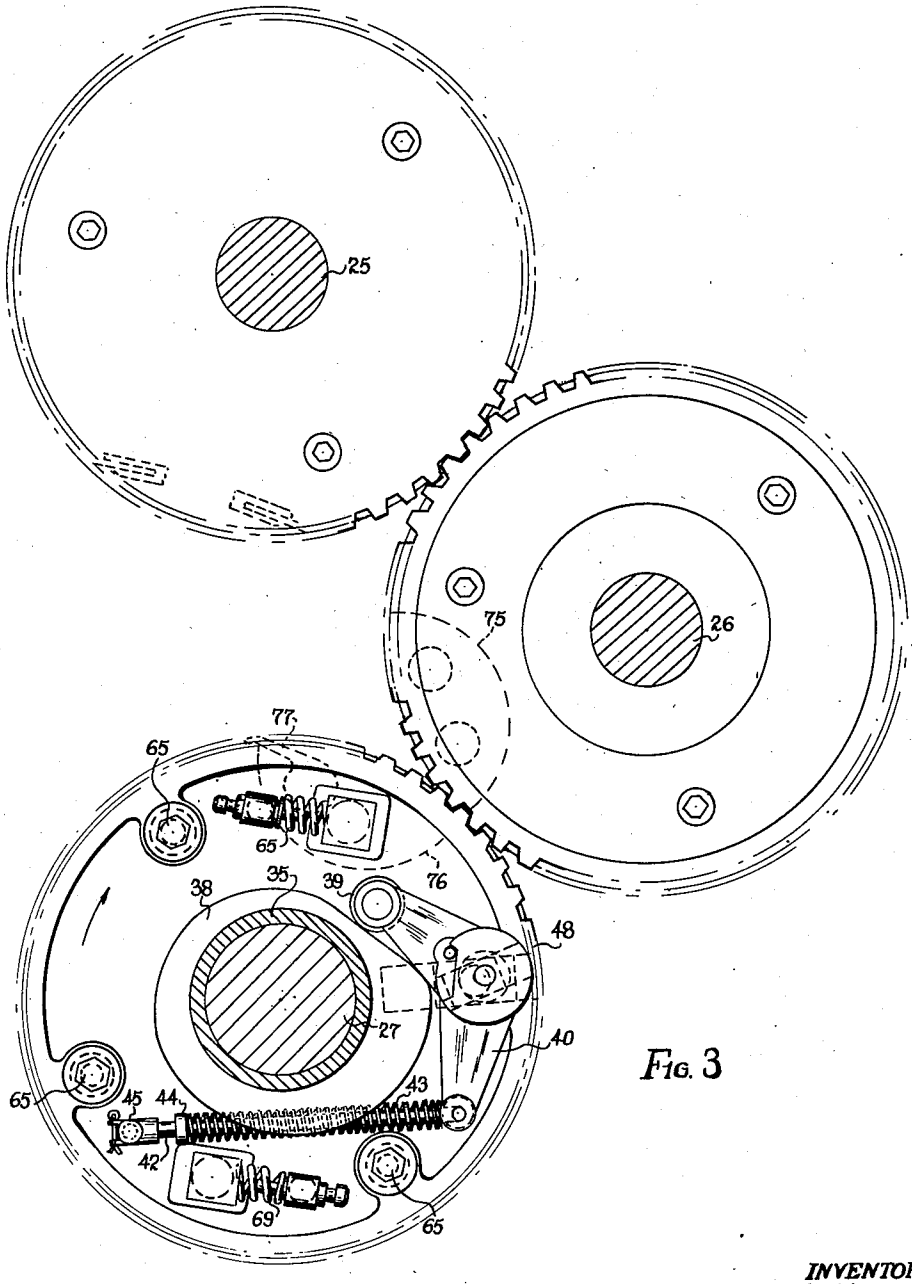

FIG. 3

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IMPRESSION LENGTH VARYING MEANS FOR ROTARY OFFSET PRINTING MACHINES

Filed Aug. 28, 1946 8 Sheets-Sheet 4

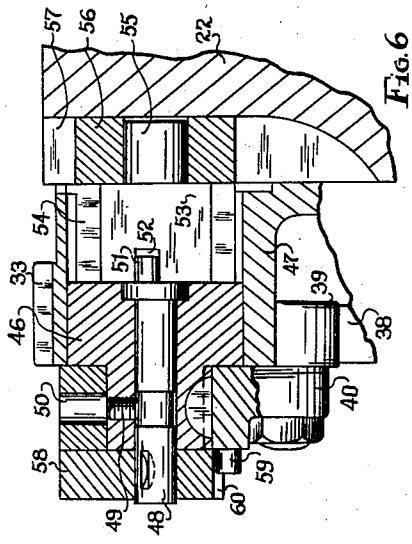

FIG. 6

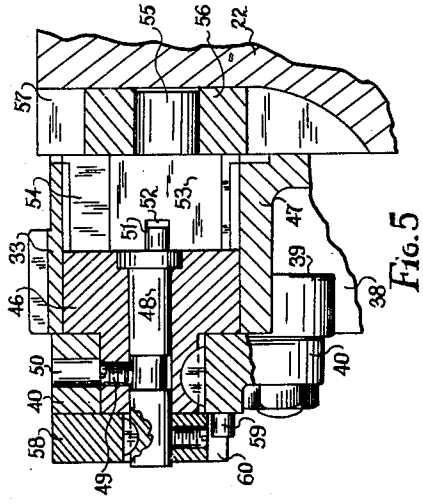

FIG. 5

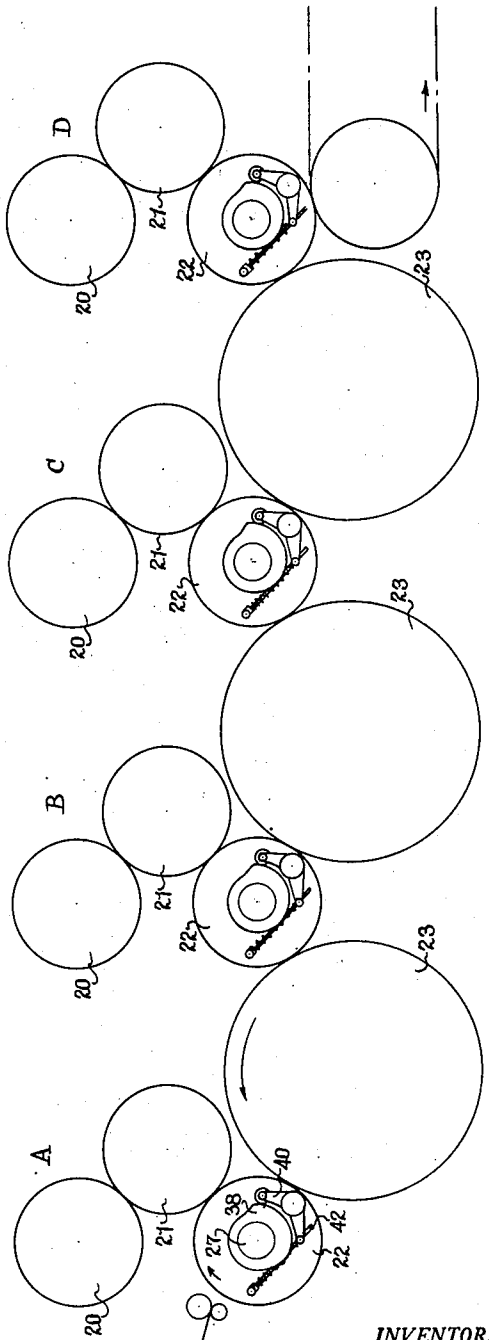

FIG. 7

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IMPRESSION LENGTH VARYING MEANS FOR ROTARY OFFSET PRINTING MACHINES

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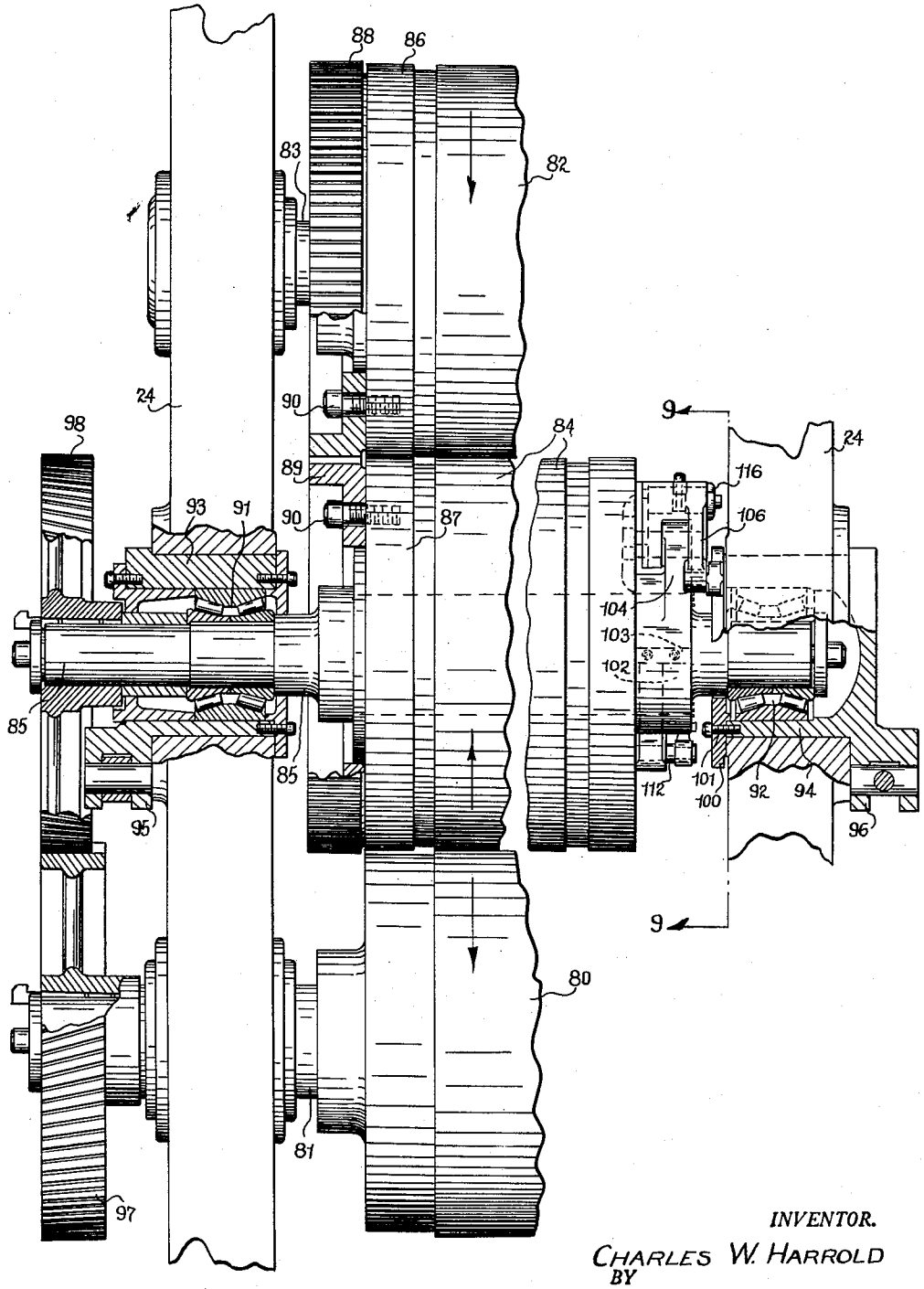

Fig. 8

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IMPRESSION LENGTH VARYING MEANS FOR
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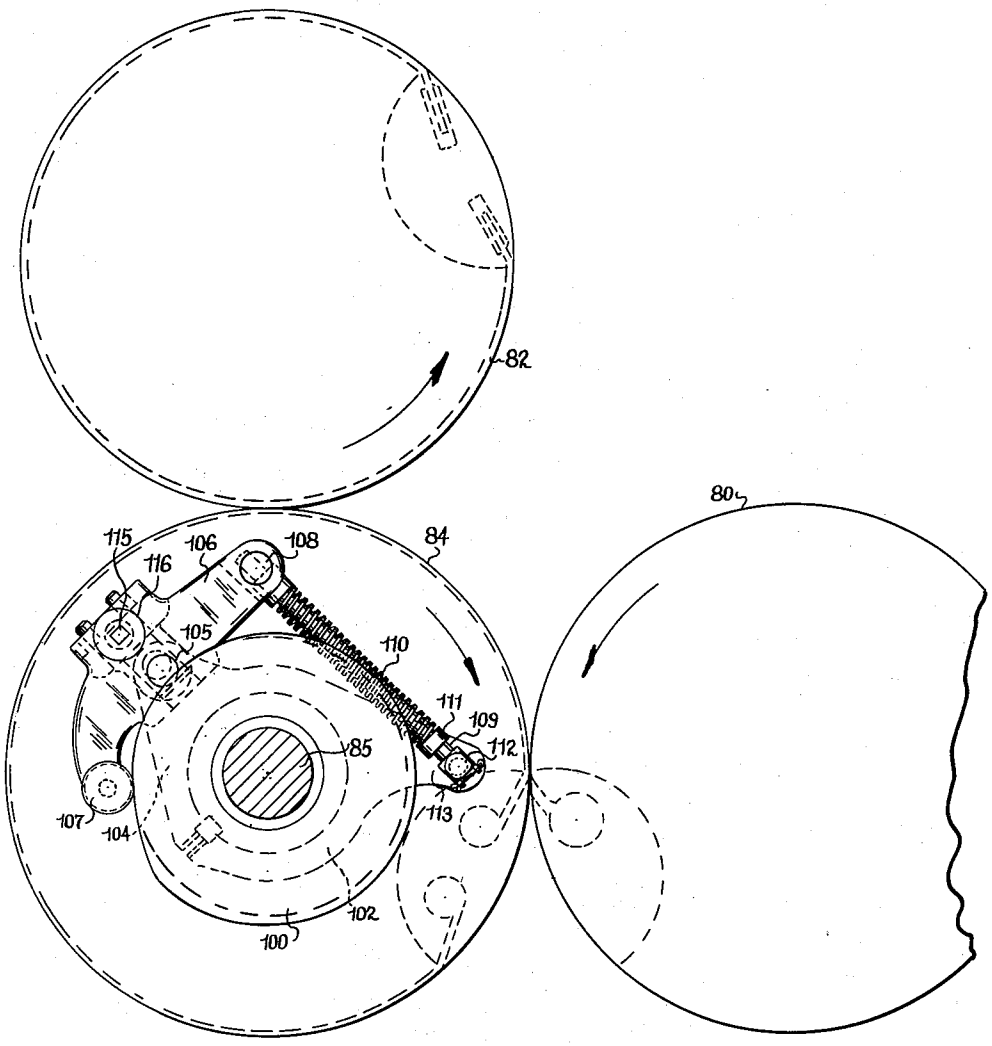

FIG. 9

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IMPRESSION LENGTH VARYING MEANS FOR ROTARY OFFSET PRINTING MACHINES

Filed Aug. 28, 1946 8 Sheets-Sheet 7

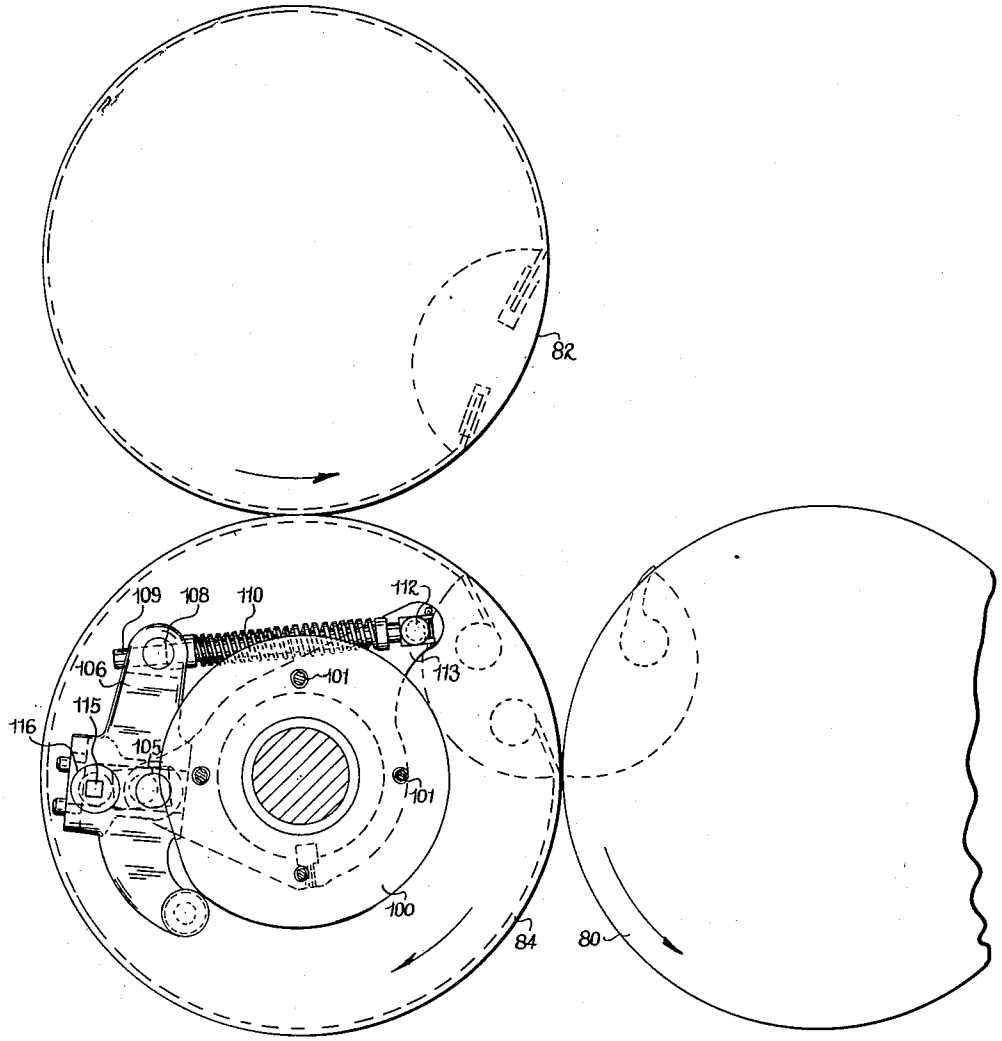

Fig. 10

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IMPRESSION LENGTH VARYING MEANS FOR ROTARY OFFSET PRINTING MACHINES

Filed Aug. 28, 1946 8 Sheets-Sheet 8

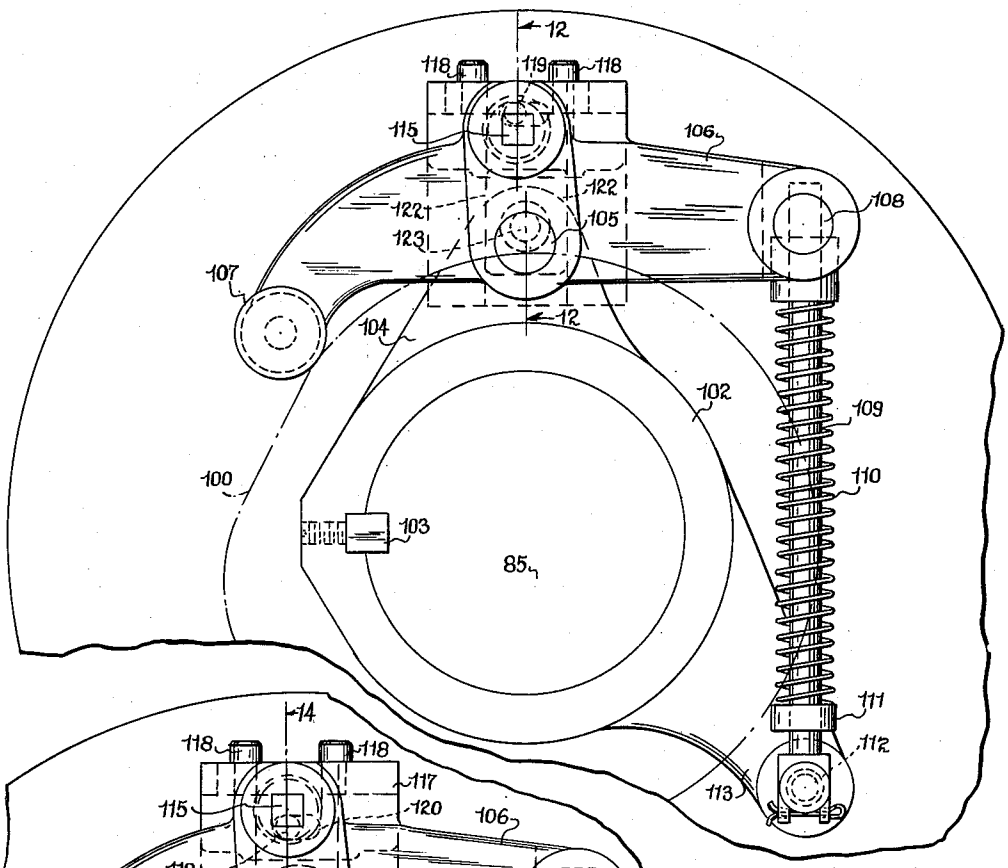

Fig. 11

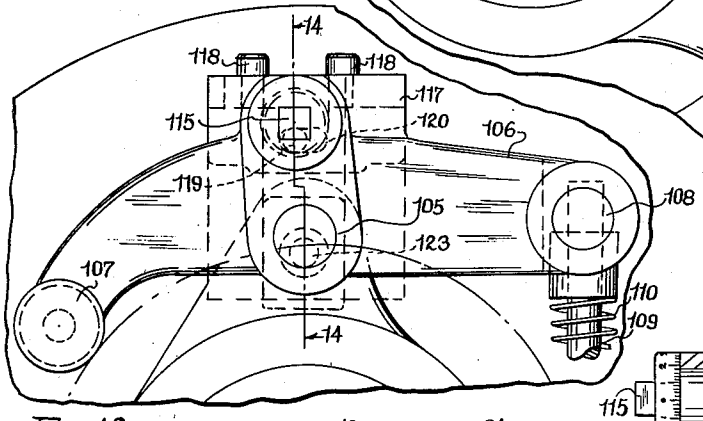

Fig. 13

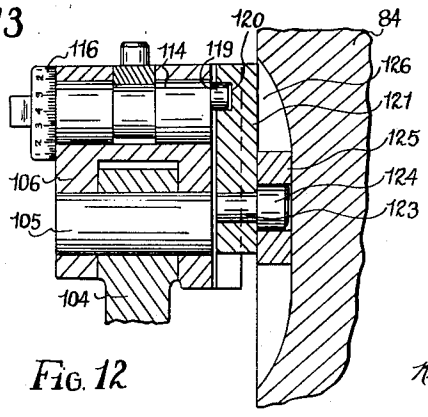

Fig. 12

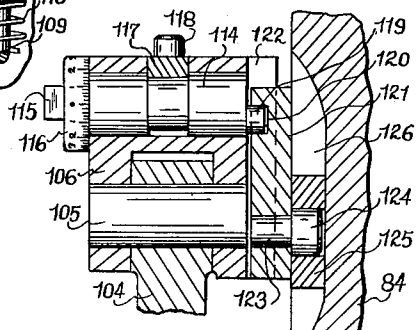

Fig. 14

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Patented Dec. 2, 1952

2,619,901

UNITED STATES PATENT OFFICE

2,619,901

IMPRESSION LENGTH VARYING MEANS FOR ROTARY OFFSET PRINTING MACHINES

Charles W. Harrold, University Heights, Ohio, assignor to Harris-Seybold Company, Cleveland, Ohio, a corporation of Delaware

Application August 28, 1946, Serial No. 693,554

26 Claims. (Cl. 101—177)

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This invention relates to offset lithographic printing presses and more particularly to means for controlling the length of the printed reproduction produced by such a press in relation to the length of the image carried by the printing plate.

In some kinds of printing it is essential that the printed reproduction be of precisely the same dimensions as the original copy. In multicolor printing, especially four-color process printing, it is very important that the reproduction of all the different colors shall be of the same size on the finished sheet although it may not be essential that this size be exactly the same as that of the original copy.

Provided that the printing forms are properly made and the paper grain runs in the proper direction, it is not especially difficult in practice to maintain accurate size or accurate registration of colors in the lateral direction, that is, crosswise of the direction of sheet travel through the press, but much difficulty is experienced and much time spent in adjusting the printing conditions in order to achieve accurate size or registration of colors in the longitudinal direction, that is, the direction of sheet travel around the press cylinders. Numerous factors are responsible for this condition some of which will now be discussed.

Modern offset presses employ plate, blanket and impression cylinders which are geared together to rotate in synchronism with each other and at uniform speed during operation of the press. A thin metal plate bearing the image to be printed is wrapped around the plate cylinder, several sheets of packing material such as paper being placed under the plate to compensate for differences in the thickness of different plates and to bring the surface of the plate to the desired height on the cylinder. The blanket cylinder, in accordance with general practice in the lithographic industry, is provided with a resilient surface usually in the form of a rubber blanket wrapped around the body of the cylinder. Several sheets of packing material are ordinarily placed under the blanket to bring the blanket to the desired height on the cylinder. The term "blanket cylinder" as used herein is to be understood as including the resilient surfacing material unless the context indicates otherwise.

Both the plate and the blanket cylinders are provided with bearers at their ends whose diameters are substantially the same as the pitch diameters of the gears on the cylinders so that a true rolling action exists between the bearers

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when the cylinders are rotated by their gears. If both the plate and the blanket were packed exactly to the height of their respective bearers, they would roll together in light contact but there would not be sufficient pressure between them to give a good transfer of ink from the plate to the blanket. Therefore, one or both of them must be packed higher than the corresponding bearers to get satisfactory printing. The normal manner of working is to pack the plate even with the plate cylinder bearers and to pack the blanket several thousandths of an inch above the blanket cylinder bearers (called over-packing) to get printing pressure.

In this kind of press, one of the factors which affects the length of print obtained is the fact that the image on the plate is longer when the plate is curved around the cylinder than when the plate is flat, as it is at the time of impressing the image upon it.

Another factor is the thickness of the paper being run. As the paper passes around the impression cylinder, it becomes a part of that cylinder, its thickness being added to the radius of the cylinder. Thus a thick sheet has the effect of increasing the impression cylinder diameter by a greater amount than a thin sheet. The result is that the print on a thick sheet is longer than the print on a thin sheet, other things being equal.

Perhaps the most troublesome and important factor in obtaining accurate register of colors in multicolor lithographic printing is dimensional change of the paper sheets between successive printings. A press may be arranged to produce prints of the different colors having exactly the same length at the time of printing, but owing to changes in the sheet length these prints will be of different lengths on the completed sheet.

Dimensional change in sheets is influenced to a great extent by the fact that the sheet picks up moisture from the blanket during printing and this moisture causes expansion of the paper fibers. Some papers are of course more susceptible to moisture than others.

The length of time between printings also influences the extent to which the applied moisture may cause the sheet to lengthen. Other factors which affect the rate and extent of dimensional change in sheets between printings, are the humidity and temperature of the room in which the sheets are stored between printings, the amount of pressure employed in print-

ing, and the force required to pull the sheet off the blanket after impression.

From the above considerations it will be apparent that the amount of change will vary widely with existing conditions, but an idea of its extent may be gained from the fact that under average conditions on a four-color press, a sheet, say 42 inches long, frequently lengthens approximately 3/32nd of an inch for each impression.

A common way of compensating for paper growth, or of getting a desired length of print for whatever the reason, on single or multicolor presses, has been to alter the packing under the plate and blanket. To get a longer print some of the packing is removed from beneath the plate and added to the packing under the blanket. To get a shorter print the reverse procedure is followed. In addition to the inconvenience involved, this method has the disadvantage that the plate and blanket surfaces travel at different speeds with the result that the plate becomes worn and its useful life shortened.

A more recent practice in multicolor presses has been to provide each succeeding printing unit with an impression cylinder of larger diameter than the preceding unit, the last cylinder being of such diameter as will give approximately the desired length of print under normal or standard conditions of plate and blanket packing. Such construction only approximately compensates for changes in length of the sheet and it is therefore necessary even on such presses to change the packing of the plate and blanket in order to obtain accurate registration.

It is obvious that the task of making a press ready for printing by the methods described above is tedious and time consuming inasmuch as it is first necessary to make test printings, then unclamp one end of the plate, lift the plate, remove or add packing, reclamp the plate, unclamp and lift the blanket, add or remove packing, reclamp the blanket, and make a further test printing to determine whether the proper adjustment of packing has been made. If the result is unsatisfactory, the process must be repeated.

One of the principal objects of this invention is to provide an offset lithographic press whose make-ready time is substantially less than that of previous presses.

Another object is to provide an offset press which may be readily adjusted to produce prints of different length without changing the packing of the cylinders.

Another object is to provide a printing unit comprising a cylinder having a resilient covering and a drive for the printing unit adapted to produce a predetermined difference in speed with accompanying angular displacement between said cylinder and another cylinder of the unit with which it cooperates during printing.

Another object is to provide a printing unit comprising a cylinder having a resilient covering and a drive for the printing unit adapted to turn said cylinder at irregular speed while turning another cylinder of the unit at uniform angular speed.

Another object is to provide a multicolor press having means to readily adjust the length of print on at least all but one of the printing units.

Another object is to provide a multicolor offset press in which the impression cylinders of different units are different in diameter for producing prints of different lengths from similarly packed plate cylinders and blanket cylinders and in which means is provided in at least all but one of the printing units for adjusting the length of print to the exact length desired for each such unit.

Another object is to provide simple, rugged and efficient means for imparting variable speed to a printing cylinder from constant speed driving means.

Other objects and advantages will appear as I proceed with the description of those embodiments of the invention which, for the purposes of the present application, I have illustrated in the accompanying drawings in which,

Fig. 1 is a fragmental elevational view of one unit of a rotary offset press showing the gear side of the machine, the cylinders being swung into alignment for better illustrating the invention.

Fig. 2 is a view in section along the line **2—2** of Fig. 1 with the cylinders in their true position relative to each other, and the printing portion of the cycle about to begin.

Fig. 3 is a view similar to Fig. 2 with the parts in the position they occupy at the end of the printing portion of the cycle and the gaps in the impression and blanket cylinders beginning to come into register.

Fig. 4 is a detail sectional view on a larger scale taken substantially on the line **4—4** of Fig. 2.

Fig. 5 is a detail sectional view taken substantially along the line **5—5** of Fig. 2, showing the control parts set for lengthening the printing image.

Fig. 6 is a view similar to Fig. 5 with the control parts set for uniform motion of the plate and blanket cylinders.

Fig. 7 is a diagrammatic view of a four-color offset printing press embodying the invention.

Fig. 8 is an elevational view similar to Fig. 1 showing a modification of the control means of the invention.

Fig. 9 is an elevational view, partly in section on the line **9—9** of Fig. 8, with the cylinders in their true positions relative to each other and about to begin the printing portion of the cycle, the control parts being set for shortening the printed image.

Fig. 10 is a view similar to Fig. 9 with the parts in the positions they occupy at the end of the printing portion of the cycle and the cylinder gaps beginning to come into register.

Fig. 11 is a fragmental view on a larger scale showing the control parts in the print shortening position, as in Fig. 9.

Fig. 12 is a detail sectional view taken substantially on the line **12—12** of Fig. 11.

Fig. 13 is a view similar to Fig. 11 but with the control parts set for lengthening the image, and

Fig. 14 is a detail sectional view taken substantially on the line **14—14** of Fig. 13.

In the form of the invention illustrated in Figs. 1 to 7 inclusive the control means serves to lengthen the image to a greater or lesser extent. It cannot be employed to decrease the length of the image below that which is produced by the normal uniform travel of the cylinders. In a four-color press such as that of Fig. 7 the forms on the plate cylinders **20** of the various units may be all of the same length. Unit A may be set to cause that unit to print an image of a given length. In unit B the control means

may be set to produce an image slightly longer than the image printed by unit A. The control means of the succeeding units C and D may then be set in each case to print slightly longer images than in the preceding unit. In this manner the growth of the print as it proceeds through the machine is compensated and accurate registration is maintained, the rate of growth from one unit to the next being dependent upon the factors previously enumerated.

In each unit there is a plate cylinder 20, which carries a lithographic plate 201 secured by clamps 202 located in cylinder gap 203, and an impression cylinder 22 which carries the sheet of material to be printed. Between each plate and impression cylinder is a blanket cylinder 21 provided with a resilient smooth-surfaced blanket 211 held on the cylinder by rods 212 located in the gap 213, whose function is to take an impression from the plate 201 and transfer it to the sheet on impression cylinder 22. The smooth resilient character of the blanket 211 and the interposition of a cylinder carrying such a blanket between the impression and plate cylinders are important considerations in the present invention. Sheets may be carried from one unit to the next by transfer cylinders 23 of double size or by other suitable means. The plate and impression cylinders of each unit are preferably mounted in fixed bearings in the frame 24 of the machine, one side only of the frame being illustrated herein. The shafts for the three cylinders are shown at 25, 26 and 27. In order to simplify the illustration shaft 26 is shown herein as mounted in fixed bearings, although it is usual in machines of this type to mount the blanket cylinder shaft in bearings which are movable for throwoff purposes.

Shaft 27 projects through the gear side of the frame where it has keyed thereto a driving gear 28 driven in any convenient manner, as by gear 23' on the adjacent transfer cylinder 23, and turning once for each cycle of the press. The impression cylinder 22 therefore turns at constant speed during the operation of the press. Cylinders 20 and 21 have bearers 29 and 30 at both ends thereof which are finished to substantially the same diameter as the pitch diameter of gears 31 and 32, the latter gears being fixed to their respective cylinders inside the frame member 24. A gear 33 is mounted to have limited rotation on shaft 27, and thus is capable of a small movement independently of cylinder 22, but inasmuch as it meshes with gear 32 any variable motion imparted to gear 33 is transmitted to the blanket and plate cylinders. It is to be noted that the impression cylinder 22 has no bearers, that portion of the cylinder opposite bearers 30 of the blanket cylinder being of reduced diameter, as illustrated in Fig. 1, so that only the bodies of the two cylinders come into engagement.

A collar 35 surrounding shaft 27 is provided with a flange 36 that is secured to the frame 24 by means of screws 37 of the like. On the inner end of this collar there is a fixed cam 38 upon which runs a roller follower 39. This follower is carried by one arm of a double armed lever 40, the other arm of which carries a noddle pin 41 that is perforated to slidably receive a rod 42. A coil spring 43 surrounds rod 42 between pin 41 and a collar 44 fixed to the rod. Beyond collar 44, rod 42 is pivotally connected with a pin 45 that is mounted in a hole in the web part of gear 33. The hub of double armed lever 40 surrounds and is keyed to a rock shaft 46 that is mounted to turn in a hollow boss 47 integrally formed upon the web portion of gear 33 at a point near the perimeter of the gear.

Rock shaft 46 is hollow and has mounted therein a solid shaft 48 which may be locked in a selected angular position by a setscrew 49 which is accessible through an opening 50 in the hub of lever 40. On the inner end of shaft 48 there is an eccentric stud 51 which extends into a transverse slot 52 in a block 53 that is mounted to slide in a slot 54 in shaft 46. Integral with block 53 there is a cylindrical pin 55 which takes into a hole in a slide 56 that is mounted in a radial groove 57 in the adjacent end of cylinder 22. The position of block 53 in its slot 54 is adjustable by turning shaft 48, this being accomplished by means of a knurled disk 58 keyed to the extremity of shaft 48 and bearing gauge marks on its periphery, as indicated in Fig. 1. A stop pin 59 in lever 40 cooperating with an arcuate groove 60 in the disk serves to limit the extent of rotation of shaft 48 with respect to lever 40. Setscrew 49 is loosened before an adjustment is made and then tightened down to hold the parts in adjustment.

The gear 33 is held against the end face of cylinder 22 by means of a plurality of studs 65 which are mounted in the cylinder, extend through spacers 66 and have washers 67 thereon engaging the faces of bosses 68, the spacers 66 functioning to prevent tightening down of the studs 65 to an extent sufficient to prevent rotation of gear 33 relative to the cylinder.

Spring 43 acts to hold follower 39 against cam 38. Rotation of gear 33 relative to cylinder 22 is opposed by spring 69 which bears at one end against the flattened side of a round pin 70 that is set into a hole in the cylinder 22, the opposite end of the spring seating against a shouldered collar 71 which is backed by a screw 72 that extends through and is threaded in a noddle pin 73 mounted in a socket in the gear 33. A lock nut 74 holds the screw 72 in adjusted position to maintain the spring 69 in the desired state of compression. As the follower 39 travels around the fixed cam 38 from the high spot of Fig. 2 to the low spot of Fig. 3 springs 69 impart slight counterclockwise or backward movement to the gear 33 relative to cylinder 22, this effect taking place through a major part of the cycle corresponding to the printing operation. The shape of cam 38 is such as to produce a substantially constant angular velocity of gear 33 during the printing operation, which velocity is slightly less than the velocity of cylinder 22. Since cylinder 21 is driven by gear 33 the latter cylinder rotates slightly slower than cylinder 22 and the printed image is correspondingly lengthened as compared to the length which would be produced if the cylinders ran at the same angular speed. The increase in length is evenly distributed throughout the total length of the image, and no smearing or other deleterious effects occur owing to the smooth and resilient character of the blanket. As the follower 39 travels up from the low spot of the cam to the high spot, in other words from the position of Fig. 3 to that of Fig. 2, the lever 40 produces a clockwise or forward travel of the gear relative to the cylinder, thereby bringing the gear and cylinder back to the same relative angular relation as at the beginning of the cycle, this latter effect occurring after the printing part of the cycle is completed and while the gaps 75 and 76

in the two cylinders are passing each other. The position of the forward edge of the sheet on the impression cylinder is of course indicated by the sheet grippers 77.

In the operation of this form of the invention a setting of the control means in the position of Fig. 6 brings the axes of shaft 48 and pin 55 into alignment. The travel of follower 39 around the cam 38 rocks the lever 40 in its mounting. In other words rock shaft 46 turns in boss 47. This, however, has no effect insofar as relative rotation between gear 33 and cylinder 22 is concerned.

If, however, shaft 48 is adjusted to move block 53 radially inward to a greater or lesser extent, as for example to the position of Fig. 5, the pin 55 then becomes eccentric to the axis of rotation of rock shaft 46, so that when the lever 40 moves because of the cam action, the pin 55 swings gradually around the axis of shaft 46 producing relative rotation between the gear 32 and the cylinder 22. Since cylinder 22 is rigid with shaft 27 and gear 32 is loose upon the shaft the relative motion shifts the gear, and in the case illustrated, it shifts the gear rearwardly with respect to the direction of rotation as follower 39 travels from the high point down to the low point of cam 38. Consequently the gears on cylinders 21 and 20 which are in mesh with each other and with the gear 33, rotate those cylinders at a slightly decreased rate of speed, and the impression cylinder, which maintains rotation at a normal constant rate, consequently moves a trifle faster than the blanket cylinder, resulting in a printed image on a sheet on the impression cylinder of slightly greater length than would be printed by the transfer image on the blanket cylinder if the latter were also running at normal constant speed.

In that form of the invention illustrated in Figs. 8 to 14 inclusive, the length of the image printed may be either increased or decreased relative to the length of the offset image on the blanket cylinder. In this case the length of print control means is associated with the blanket cylinder rather than with the impression cylinder, and is disposed on the operator's side of the press rather than on the gear side.

Referring to Fig. 8, impression cylinder 80 is fixed upon shaft 81 which is mounted in fixed bearings in the frame 24. Plate cylinder 82 is likewise fixed upon shaft 83, also mounted in fixed bearings of the machine. Blanket cylinder 84 however is loose upon its shaft 85. Cylinders 82 and 84 have bearers 86 and 87 of the same diameter as the pitch diameters of gears 88 and 89 which are secured to those cylinders within the frame by machine screws 90 or other suitable means.

Shaft 85 is mounted in antifriction bearings 91 and 92 that are carried by eccentric members 93 and 94 that are adapted to be turned simultaneously and to the same extent by suitable links and levers connected to the projecting arms 95, 96 on the eccentric members. This mounting of the blanket cylinder is employed for throwoff purposes, but has no importance from the standpoint of the present invention.

A drive gear 97 keyed to impression cylinder shaft 81 meshes with any convenient driving gear on the machine, as for example the gear on a transfer cylinder as described in connection with the form of the invention shown in Figs. 1 to 7. Gear 97 in turn meshes with a gear 98 keyed to the blanket cylinder shaft 85, so that the latter shaft as well as impression cylinder shaft 81 is driven at constant speed. On the operator's side of the machine within the frame there is located the print length control mechanism which functions to produce rotation of blanket cylinder 84 during the printing period at a slightly greater or lesser speed relative to shaft 85. Because of the intermeshing gears 88 and 89 the plate cylinder 82 partakes of the same varying speed as the cylinder 84.

The speed varying mechanism for this form of the invention embodies a relatively fixed cam 100 which is attached by screws 101 or the like to the eccentric member 94. While the cam thus turns when the eccentric turns, that occurs only when the cylinder is thrown off from operative contact with the plate and impression cylinders, and the cam always returns to and remains at a given fixed position during normal operation of the press. Hence for practical purposes the cam is fixed.

Surrounding shaft 85 between the bearing 92 and the cylinder 84 there is a hub 102 secured against rotation on the shaft by a key 103. Integral with this hub there is a bracket 104 upon which is pivoted by means of a shaft 105 a double armed lever 106. In effect shaft 105, regardless of whether it is fixed in the lever or in the bracket 104 is a rock shaft and will be so referred to hereinafter. At the end of one of its arms lever 106 carries a roller follower 107 which runs upon fixed cam 100, and at the end of its other arm it carries a noddle pin 108 which is perforated to slidably receive a rod 109. A coil spring 110 surrounds rod 109 between the noddle pin and a collar 111 fixed to the rod. The opposite end of the rod is pivotally connected with a pin 112 carried in a second bracket 113 integral with hub 102.

In the lever 106 above its pivot there is a short shaft 114 having a reduced square end 115 for the reception of a wrench and a disk 116 which is graduated in convenient units. The central part of the shaft is of reduced diameter and is engaged by a clamping plate 117 which may be tightened or loosened by screws 118. A stud 119 which projects eccentrically from one end of shaft 114 takes into a slot 120 in a slide bar 121 that is mounted between guide surfaces 122 in lever 106. In the bar 121 there is mounted a pin 123 having a head 124 which is rotatable in a hole in a slide block 125 which fits within a radial groove 126 in the end face of the cylinder 84.

When the clamp 117 has been loosened, shaft 114 may be turned to cause stud 119 to move slide bar 121 radially inward or outward thereby moving pin 123, 124 relative to the axis of rock shaft 105. The clamp 117 may then be tightened to maintain the adjustment. When the adjustment is such that pin 123, 124 is in axial alignment with shaft 105, lever 106 will be rocked as the follower 107 runs upon the cam 100, without effect however upon the slide block 125. When the parts are in the adjustment illustrated in Figs. 11 and 12, the travel of the follower 107 from the low spot of the cam up to the high spot thereof, which takes place gradually throughout the printing period, will cause pin 123, 124 to swing clockwise or toward the right through a short arc, as viewed in Fig. 11, which will advance cylinder 84 slightly relative to shaft 85, thereby causing the image on the blanket cylinder to move forward somewhat more rapidly than the

sheet carried by the impression cylinder. This results in impressing an image on the sheet somewhat shorter than the image which would be impressed if the cylinders were allowed to rotate at the same angular speed. As the cam roller runs down the steep part of the cam after the printing has been completed, the cylinder 84 is restored to its original angular relation to shaft 85 by the pressure of spring 110. Additional spring means (not shown) may be provided between shaft 85 and cylinder 84 to assist in this restoring action. With the parts in the position of adjustment illustrated in Figs. 13 and 14 the opposite effect takes place, that is the swinging of the lever 106 as the roller 107 runs up the cam causes pin 123, 124 to move through a small arc again clockwise, but in this case the pin travels toward the left instead of towards the right, whereby the slide block 125 retards the cylinder 84 relative to the shaft. Hence the impression cylinder turns more rapidly than the blanket cylinder and the resulting print is lengthened accordingly.

In applying this form of control means to a four color press, various ways of setting the same may be employed. For example, the control means may be so adjusted in the first printing unit as to increase the speed of the blanket cylinder, in the second unit to give neither increase nor decrease in speed, in the third unit to cause a decrease in speed of the blanket cylinder and in the fourth unit to cause a somewhat greater decrease. By this means the length of print will be increased slightly in each successive unit so as to compensate for paper growth. Other desired combination of settings may be employed to meet other operating conditions.

In a multicolor press constructed according to the invention employing either of the illustrated forms of control means, various arrangements of cylinder diameters and packing may be employed. In one such arrangement, for example, all the plate cylinders are packed alike, that is to the same diameter, all the blanket cylinders are also packed alike, and all impression cylinders are ground alike. In such an arrangement, the entire change in the length of print desired in each unit is accomplished solely by adjustment of the control means.

In another arrangement each plate cylinder is packed to a different diameter, for example, the first cylinder may be the largest and the succeeding cylinders progressively smaller, each blanket cylinder is packed to a different diameter as required by the corresponding plate cylinder, and all the impression cylinders are ground alike. In this arrangement the desired length of print in each unit is approximated by proper selection of the diameter to which the plate cylinder of that unit is packed and the final adjustment of the print to the exact length required is made by use of the control means.

The preferred arrangement in a multicolor press, however, is one in which all plate cylinders are packed alike, preferably so that the plate surface is even with the plate cylinder bearers, all blanket cylinders are packed alike, preferably so that blanket surface is about .003 or .004 inch higher than the blanket cylinder bearers, and the impression cylinders are ground to different diameters, preferably such that the first cylinder is the smallest and the succeeding cylinders are propressively slightly larger, the very last cylinder being of such diameter as will produce a print of the desired final length and the difference between impression cylinders being such as to not quite compensate for the change in length of the sheet as it progresses through the machine. In such an arrangement, all plate cylinders and blanket cylinders may always be packed in a standard manner and the final adjustment for exact length of print may be made by minor adjustments of the control means. Under such conditions, substantially true rolling contact between plates and blankets is preserved in all units at the same time, full and convenient control of the length of print produced by each unit is attained.

While throughout the foregoing description reference has been made to speed variations as between coacting cylinders in one sense during the printing portion of a cycle and in the opposite sense during the non-printing portion thereof, it will be apparent that such variations result in an increasing difference in angular movement of one coacting cylinder with respect to the other during the printing portion of the cycle and the elimination of such difference during the non-printing portion of the cycle, with the result that the cylinders are returned to the positions which they occupied at the beginning of the cycle.

Having thus described my invention, I claim:

1. A method of rotary offset printing, comprising producing during the printing portion of each cycle of the blanket cylinder and a cooperating cylinder a predetermined gradually increasing forward angular movement of the blanket cylinder relative to the forward angular movement of said cooperating cylinder to produce a predetermined difference in the length of the printed image as compared to the length thereof which would be produced without such relative increase in angular movement, and thereafter during the non-printing portion of the same cycle eliminating said relative increase in angular movement to return said cylinders to the relative angular positions which they occupied at the beginning of the cycle.

2. A method of rotary offset printing, comprising producing in each cycle of the cooperating impression and blanket cylinders during the printing portion of the cycle a gradually increasing difference between the forward angular movements of the impression cylinder and the blanket cylinder, to produce a consequent alteration in the length of the printed image as compared to the length thereof which would be produced without such difference in angular movements, and thereafter during the non-printing portion of the same cycle eliminating said difference in angular movement to return said impression and blanket cylinders to the angular positions which they occupied at the beginning of the cycle.

3. A method of rotary offset printing to increase the length of print over that which would otherwise be produced which comprises producing in each cycle of the cooperating impression and blanket cylinders during the printing portion of the cycle, a gradually increasing forward angular movement of the impression cylinder relative to the forward angular movement of the blanket cylinder, and thereafter during the non-printing portion of the same cycle eliminating said increase in angular movement to return said cylinders to the angular positions which they occupied at the beginning of the cycle.

4. A method of rotary offset printing to decrease the length of print below that which would otherwise be produced, which comprises producing in each cycle of the cooperating impression and blanket cylinders during the printing portion of the cycle, a gradually increasing forward an-

gular movement of the blanket cylinder relative to the forward angular movement of the impression cylinder, and thereafter during the non-printing portion of the same cycle eliminating the said increase in angular movement to return said cylinders to the angular positions which they occupied at the beginning of the cycle.

5. A method of multicolor rotary offset printing in which compensation for increasing paper length is obtained by producing in each cycle of certain printing couples during the printing portion of the cycle a difference in angular speed between the members of those couples, the amount of said difference changing progressively in the same sense in each succeeding couple, to produce a length of print for each couple greater than that for the preceding couple, and during the non-printing portion of the same cycle of each such certain couple effecting an opposite difference in angular speed sufficient to bring the members of that couple into the angular relation which they occupied at the beginning of the cycle.

6. In a sheet fed rotary offset printing press, a printing unit comprising a plate cylinder, an impression cylinder and a blanket cylinder having a printing portion throughout one arc of its circumference and a non-printing portion throughout the remaining arc of its circumference, cyclically operable driving connections for rotating one of said cylinders at constant speed and a coacting cylinder at a speed differing from said constant speed in one sense during the printing portion of the cycle of the coacting cylinders and in the opposite sense during the non-printing portion thereof sufficient to restore the cylinders to their initial phase relationship at the beginning of the cycle.

7. In a sheet fed rotary offset printing press, a printing couple comprising an impression cylinder and a blanket cylinder having a printing portion throughout one arc of its circumference and a non-printing portion throughout the remaining arc of its circumference, said impression cylinder having sheet grippers for moving sheets across the printing line between said cylinders, cyclically operable driving connections for rotating one of said cylinders with varying speed relative to the other cylinder, said connections being operable to produce angular speed of one cylinder different by a predetermined amount from that of the other cylinder in one sense during printing and in the opposite sense during the non-printing portion of the cycle, and means for adjusting the amount of said difference, whereby the length of the printed image impressed by said blanket cylinder on a sheet carried by said impression cylinder may be controllably varied.

8. In a sheet fed rotary offset printing press, a printing couple comprising an impression cylinder and a blanket cylinder having a printing portion throughout one arc of its circumference and a non-printing portion throughout the remaining arc of its circumference, said impression cylinder having sheet grippers for moving sheets across the printing line between said cylinders, cyclically operable driving connections associated with said cylinders for rotating the same, said connections rotating said impression cylinder at constant speed and said blanket cylinder at varying speed in one sense during the printing portion of each cycle and in the opposite sense during the non-printing portion of the cycle, and means for adjusting the degree of variation of said varying speed, whereby the length of the printed image impressed by said blanket cylinder on a sheet carried by said impression cylinder may be controllably varied.

9. In a sheet fed rotary offset printing press, a printing couple comprising an impression cylinder and a blanket cylinder having a printing portion throughout one arc of its circumference and a non-printing portion throughout the remaining arc of its circumference, said impression cylinder having sheet grippers for moving sheets across the printing line between said cylinders, a plate cylinder cooperating with said blanket cylinder, cyclically operable driving connections associated with said cylinders for rotating the same, said connections rotating said impression cylinder at constant speed and said blanket cylinder and plate cylinder at varying speed in one sense during the printing portion of each cycle and in the opposite sense during the non-printing portion of the cycle, and means for adjusting the degree of variation of said varying speed, whereby the length of the printed image impressed by said blanket cylinder on a sheet carried by said impression cylinder may be controllably varied.

10. In a multicolor offset printing press for printing on sheets, a plurality of printing units each including a plate cylinder, a blanket cylinder and an impression cylinder, means for conveying sheets from one printing unit to the next, and means for driving said printing units and conveying means, said driving means comprising means for rotating the impression cylinder of each unit at uniform angular speed and means for rotating one of the other cylinders of at least all but one of said printing units at varying angular speed above and below the speed of the impression cylinder during each revolution of said variable speed cylinder.

11. In a multicolor offset printing press for printing on sheets, a plurality of printing units each including a plate cylinder, a blanket cylinder and an impression cylinder, means for conveying sheets from one printing unit to the next, and means for driving said printing units and sheet conveying means, said driving means comprising means for rotating the impression cylinder of each unit at uniform angular speed and means for rotating one of the other cylinders of at least all but one of said printing units at varying angular speed above and below the speed of the impression cylinder during each revolution of said variable speed cylinder, each cylinder having a gap, said speed varying means producing speed differing from the speed of the impression cylinder in one sense during printing and in the other sense during gap.

12. In a multicolor offset printing press, a plurality of printing units each including a plate cylinder, a blanket cylinder and an impression cylinder, each pair of associated plate and blanket cylinders having bearers adapted to run in contact under pressure, the said bearers of the cylinders of each unit being of the same diameter as the bearers of the corresponding cylinders of the other units, means for driving said printing units, said driving means comprising means for rotating the impression cylinder of each unit at uniform angular speed and means associated with at least all but one of the printing units for rotating the blanket cylinders and plate cylinders of those units in unison with each other but at varying speed above and below their average speed during each revolution thereof, the amount of variation from average speed in each variable speed unit being adjustable.

13. In a multicolor offset printing press for printing on sheets, a plurality of printing units each including a plate cylinder, a blanket cylinder and an impression cylinder, the impression cylinder of each unit having a body diameter slightly greater than the body diameter of the impression cylinder of the next preceding unit, means for driving said printing units, said driving means comprising means for rotating the impression cylinder of each unit at uniform angular speed and means associated with at least all but one of the printing units for rotating the blanket cylinder and plate cylinder of those units in unison with each other but at varying speed above and below their average speed during each revolution thereof, the amount of variation from average speed in each variable speed unit being adjustable.

14. In an offset press for printing on sheets, a plate cylinder, an impression cylinder, a blanket cylinder therebetween, said blanket cylinder and said impression cylinder having coacting printing surfaces in their peripheries and at least one of them having a gap in its periphery, cyclically operating driving means interconnecting said cylinders for rotating the same, said driving means comprising means for producing different angular speeds of rotation of said blanket and impression cylinders relative to each other in one sense during the period said printing surfaces are in contact and in the opposite sense during the period said gap is passing the other cylinder, whereby the length of printed image applied by said blanket cylinder is different from the length which would be applied by said blanket cylinder if there were no difference in the relative angular speed of said blanket and impression cylinders.

15. In an offset press for printing on sheets, a plate cylinder, an impression cylinder, a blanket cylinder therebetween, said blanket cylinder and said impression cylinder having coacting printing surfaces in their peripheries and at least one of them having a gap in its periphery, driving means interconnecting said cylinders for rotating the same, said driving means comprising means for producing different anular speeds of rotation of said blanket and impression cylinders relative to each other in one sense during the period said printing surfaces are in contact and in the opposite sense during the period said gap is passing the other cylinder, and adjustable means for controlling the degree of variation in speed whereby the lenghth of printed image applied by said blanket cylinder may be controllably varied.

16. In an offset press for printing on sheets, a plate cylinder, an impression cylinder, a blanket cylinder therebetween, said blanket cylinder and said impression cylinder having coacting printing surfaces in their peripheries and at least one of them having a gap in its periphery, driving means interconnecting said cylinders for rotating the same, said driving means comprising means for producing different angular speeds of rotation of said offset and impression cylinders relative to each other in one sense during the period said printing surfaces are in contact and in the opposite sense during the period said gap is passing the other cylinder, and adjustable means for controlling the degree of difference in angular speed between said offset and impression cylinders whereby the length of printed image applied by said blanket cylinder may be controllably varied, said driving means maintaining the plate and banket cylinders in synchronism at all times.

17. In an offset press for printing on sheets, a plate cylinder, an impression cylinder, a blanket cylinder therebetween, said blanket cylinder and said impression cylinder having coacting printing surfaces in their peripheries and at least one of them having a gap in its periphery, cyclically operating driving means interconnecting said cylinders for rotating the same, said driving means rotating said impression cylinder at constant speed and said blanket and plate cylinders at equal varying speed differing from said impression cylinder speed in one sense during the period said printing surfaces are in contact and in the opposite sense during the period said gap is passing the other cylinder, whereby the length of printed image applied by said blanket cylinder is different from the length which would be applied by said blanket cylinder if there were no difference in the relative angular speeds of said blanket and impression cylinders.

18. In an offset press for printing on sheets the combination of a plate cylinder, an impression cylinder, an offset cylinder therebetween, a resilient blanket on said offset cylinder adapted to bear against print receiving material on said impression cylinder during a part only of the press cycle to transfer a print from a plate on said plate cylinder to said print receiving material, and means for rotating said cylinders, comprising means for producing different angular speeds of rotation of said offset and impression cylinders relative to each other in one sense during that part of a cycle in which said resilient blanket bears against said print receiving material and in the opposite sense during another part of the cycle, whereby the length of print applied by said resilient blanket to the print receiving material is different from the length which would be applied if there were no difference in the relative angular speeds of said offset and impression cylinders.

19. In a sheet fed rotary offset printing press, cooperating plate, blanket, and impression cylinders, and means for rotating said cylinders comprising adjustable means for rotating one of said cooperating blanket and impression cylinders at a different angular speed than the other throughout the printing portion of each cycle of the press, and for returning said cylinders to their original angular relation during the non-printing portion of each cycle.

20. In a rotary offset printing press, a printing couple comprising an impression cylinder and a blanket cylinder, driving connections for causing changes in the speed of said blanket cylinder with respect to said impression cylinder, said connections embodying a rock shaft mounted to revolve bodily about the axis of one of said cylinders, a slide guided for radial movement in said cylinder, eccentric means moving with said rock shaft for moving said slide radially, and cam means for turning said rock shaft in one direction during the printing portion of a cycle and in the opposite direction during the non-printing portion of the same cycle for producing relative angular movement of said rock shaft and cylinder about the cylinder axis.

21. In a rotary offset printing press, a printing couple comprising an impression cylinder and a blanket cylinder, driving connections for causing changes in the speed of said blanket cylinder with respect to said impression cylinder, said connections embodying a rock shaft mounted to revolve bodily about the axis of one of said cylinders, a slide guided for radial movement in said cylinder, eccentric means on said rock shaft for moving

said slide radially, and cam means for turning said rock shaft in one direction during the printing portion of a cycle and in the opposite direction during the non-printing portion of the same cycle for producing relative angular movement of said rock shaft and cylinder about the cylinder axis, and means for varying the eccentricity of said eccentric means with respect to said rock shaft.

22. In a rotary offset printing press, a printing couple comprising an impression cylinder and a blanket cylinder, driving connections for causing changes in the speed of said blanket cylinder relative to said impression cylinder, said connections embodying a gear mounted to rotate about the axis of said impression cylinder, a rock shaft carried by said gear, an eccentric pin moving with said rock shaft operatively associated with said impression cylinder for producing relative angular movement between said gear and said impression cylinder, cam means for turning said rock shaft in one direction during the printing portion of a cycle and in the opposite direction during the non-printing portion of the same cycle and a gear on said blanket cylinder meshing with said first named gear.

23. In a rotary offset printing press, a printing couple comprising an impression cylinder and a blanket cylinder, driving connections for causing changes in the speed of said blanket cylinder relative to said impression cylinder, said connections embodying a member mounted to rotate about the axis of said blanket cylinder, a rock shaft carried by said member, an eccentric pin moving with said rock shaft operatively associated with said blanket cylinder for producing relative angular movement between said member and said blanket cylinder, cam means for turning said rock shaft in one direction during the printing portion of a cycle and in the opposite direction during the non-printing portion of the same cycle, a gear on said impression cylinder, and a gear on said member meshing with said impression cylinder gear.

24. The method of controlling the length of the print produced from a plate of given length on a rotary offset press having plate, blanket and impression cylinders, under constant conditions of plate and blanket packing, comprising producing an increase or decrease in the angular speed of one of two coacting cylinders relative to the other during that portion of the cycle when the latter cylinders are in printing relation in an amount dependent upon the length of the print to be produced, and thereafter, in that portion of the same press cycle when said two cylinders are not in printing relation, effecting an opposite change, i. e. a decrease or increase in angular speed of said one cylinder to bring said cylinders into a given angular relation prior to the start of the next cycle.

25. An offset printing press as defined in claim 14, wherein said means for producing different angular speeds of rotation of said blanket and impression cylinders relative to each other comprises a pivot mounted to move in a circular path at the same angular speed as one of said cylinders, a lever rockable about said pivot, connections between said lever and the other of said cylinders adapted to cause a change in the relative angular speed of said last named cylinder and said pivot upon rocking movement of said lever, and cam means for rocking said lever in one direction during the period said printing surfaces are in contact and in the opposite direction during the period said gap is passing the other cylinder.

26. An offset printing press as defined in claim 14, wherein said means for producing different angular speeds of rotation of said blanket and impression cylinders relative to each other comprises a pivot mounted to move in a circular path at the same angular speed as one of said cylinders, a lever rockable about said pivot, a follower and groove connection between said lever and the other of said cylinders adapted to cause a change in the relative angular speed of said last named cylinder and said pivot upon rocking movement of said lever, and cam means for rocking said lever in one direction during the period said printing surfaces are in contact and in the opposite direction during the period said gap is passing the other cylinder.

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