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(54) **Web-fed offset printing press for production of business forms or the like**

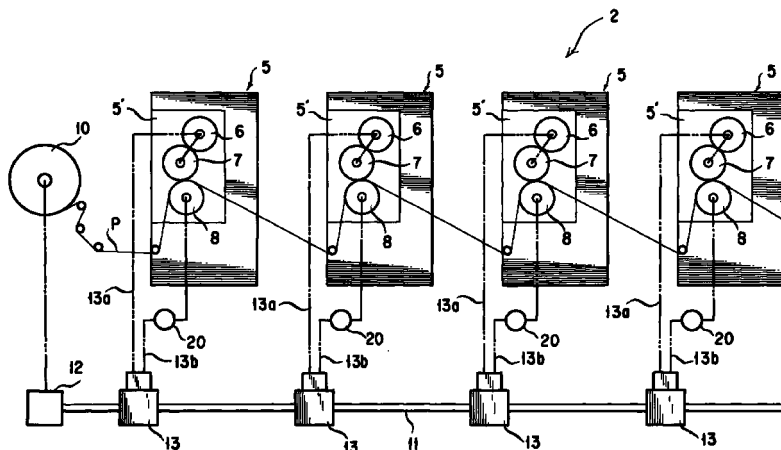
(57) A web-fed offset printing press suitable for production of business forms, having a series of printing stations (5) in each of which an inked image is printed from a plate cylinder (6) to a blanket cylinder (7) and thence offset to a web (P) running against an impression cylinder (8).

In order to realize fine adjustment of the rotational speed of the impression cylinder and hence to cause the web to be fed under proper tension by the impression cylinder despite possible variations in paper thickness, cylinder diameter, etc., two separate drive

linkages (e.g. gear trains) are provided, one (13a)

for driving the plate cylinder (6) and blanket cylinder (7), and the other (13b or 13b') for driving the impression cylinder (8). The drive linkage (13b) for the impression cylinder has a speed changer (20) coupled thereto. The two drive linkages are coupled to a common drive source in one embodiment and to separate drive sources in another.

FIG. 2



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Description

[0001] This invention relates generally to printing presses, and more particularly to an apparatus for production of business forms including a printing station having one or more offset printing units in series, in each of which the inked image is printed from a plate cylinder to a blanket cylinder and thence offset or transferred to the web running against an impression cylinder. Still more particularly, the invention deals with a drive system for the cylinders of each such printing unit, including provisions for adjustably varying the speed at which the web is fed through the unit by the impression cylinder.

[0002] The machine for production of business forms has been known which takes the form of a streamlined series of a paper supply station, a printing station, a punching station, a perforating station, and so forth. Successful operation of the business form machine depends on a large measure on proper speed control of the pertinent cylinders and rollers so that the paper web may travel through the successive stations under constantly correct tension. The web will meander if the tension is insufficient, and become elongated if the tension is too much. In both cases the business forms produced will be unsatisfactory, or even defective, in the registration and alignment, in both top-to-bottom and lateral directions, of the printings and other operations.

[0003] There have been problems, however, left unsolved in controlling roller and cylinder speeds and web tension in business form machines. One of the problems arises from the fact that the traveling speed of the web around the rollers or cylinders is subject to change with the thickness of the paper in use. Consequently, when a paper web of greater or less thickness is fed into the machine, as in the event of a change from one printing job to another, the web tension will grow or drop between the rollers or cylinders, depending upon their relative diameters, if these rollers or cylinders are driven at the same peripheral speeds as before the paper change.

[0004] For an understanding of how the web tension alterations occur, let us first define the traveling speed of a paper web around a roller or cylinder as:

$$V = N (d + t)$$

where

V = traveling speed of the web

N = revolutions of the roller or cylinder per unit time

d = diameter of the roller or cylinder

t = thickness of the web.

[0005] Hence, the greater the web thickness t, the higher is the web speed V. It will also be seen that the web speed V becomes progressively higher with the web thickness t as the roller or cylinder grows less in

diameter d. Consider a roller that is less in diameter than the one on its upstream side. When the paper is changed to that of greater thickness, but with both rollers driven at the same speeds as before, the smaller diameter downstream roller will tend to feed the thicker web faster than the larger diameter upstream roller does, with the consequent development of greater web tension between the two rollers. Conversely, if the upstream roller is less in diameter than the downstream one, the upstream web will feed the web faster than the downstream one, causing a slack in the web.

[0006] Some known business form machines come with a set of interchangeable printing cylinder assemblies each comprised of a plate cylinder, blanket cylinder, and impression cylinder in the case of offset lithography. These cylinder assemblies are selectively installed in the respective printing units of the machine according to the required top-to-bottom dimensions of the business forms to be produced. A trouble with such cylinder assemblies is that they have tended to feed the web at different speeds because of some unavoidable fluctuations in the diameter of the impression cylinders around which the web is wrapped through a certain substantial angle in order to be thereby fed toward the next printing unit or toward the next processing station. Consequently, each time a different cylinder assembly is installed in any of the printing units, web tension has often changed between the impression cylinders of this cylinder assembly and the upstream or downstream one.

[0007] Web tension control has been made still more difficult in machines using moistening water, which causes web elongation. Just as the web elongates when wetted, so it contracts upon drying. Web tension has therefore had to be individually adjusted in each printing unit, made lower in printing units that do not require moistening water than in the units that do.

[0008] Japanese Patent Publication No. 4-51456 represents a solution to the foregoing difficulties, suggesting the provision of a speed changer in each offset printing unit for adjustably varying the speed of the impression cylinder independently of the plate cylinder and the blanket cylinder. In a business form machine equipped with a set of interchangeable printing cylinder assemblies, however, this known solution requires that all the cylinder assemblies for different business form sizes and different color printings be individually furnished with their own speed changers.

[0009] Take for example a business form machine having five offset printing units for printing in as many different colors, and ten kinds of cylinder assemblies to be selectively installed in each printing unit for production of business forms of as many different sizes. This machine, which is commonplace in the industry, encompasses as many as fifty cylinder assemblies, each and every one of which must be equipped with a speed changer for the impression cylinder according to the Japanese patent cited above.

[0010] Another problem has existed with the drive systems for the offset printing units of the prior art business form machines. The impression cylinder of each printing unit has been driven via the plate cylinder and the blanket cylinders, all these cylinders being serially geared to each other and to the drive shaft common to all the printing units. The final element of the elongate drive linkage, the impression cylinder has been most seriously affected by the resultant of the backlashes of all the intermeshing gears, adversely affecting in turn the accuracy of the printings on the web traveling between the impression cylinder and the blanket cylinder.

SUMMARY OF THE INVENTION

[0011] In consideration of the foregoing difficulties heretofore encountered in the art, the present invention seeks, in an offset printing press for making business forms in particular, to make the speed of rotation of the impression cylinder variable independently of the plate cylinder and blanket cylinder and hence to make adjustable the speed at which the paper web is fed by the impression cylinder for proper web tension despite variations in paper thickness, impression cylinder diameter, and other printing conditions.

[0012] The invention also seeks to make it possible to set the plate cylinder and blanket cylinder out of rotation while the impression cylinder remains in rotation, in order to change the printing plate on the plate cylinder without stopping the web.

[0013] The invention also seeks to attain the foregoing objects in a printing machine having a series of printing units each designed for use with a set of interchangeable printing cylinder assemblies for production of different size business forms or the like.

[0014] Summarized briefly, the invention concerns a web-fed offset printing press suitable for production of business forms, among other applications, wherein an inked image is printed from a plate cylinder to a blanket cylinder and thence offset to a web running against an impression cylinder. Characteristically, two drive linkages are provided, one for driving the plate cylinder and the blanket cylinder, and the other for driving the impression cylinder. A speed changer means is coupled to the second drive linkage for adjustably varying the rotational speed of the impression cylinder.

[0015] Thus the rotational speed of the impression cylinder is adjustably variable by the speed changer means with a minimum of errors and totally independently of the plate cylinder or the blanket cylinder. With the rotational speed of the impression cylinder so adjusted, the paper web to be printed upon may be fed under optimum tension in the face of likely variations in paper thickness, impression cylinder diameter, and other printing conditions.

[0016] In a preferable embodiment of the invention the two drive linkages take the form of gear trains, both

coupled to a common drive source such as a gearbox on a drive shaft common to all the serial printing units of the machine. The speed changer means is inserted between two selected gears of the second drive linkage.

[0017] As has been stated, it is the impression cylinder that largely determines the traveling speed of the web. Since this impression cylinder is driven through a gear train different from that for driving the plate cylinder and blanket cylinder, the gear train for the impression cylinder can be much shorter than in the prior art case where the impression cylinder is driven through the plate cylinder and blanket cylinder. Driven through a smaller number of gears, therefore, the impression cylinder is subject to the correspondingly reduced resultant of the backlashes of the intermeshing gears. The rotational speed of the impression cylinder is therefore controllable more accurately than heretofore, affording the production of higher quality printings.

[0018] An additional, and perhaps no less pronounced, advantage of the invention as summarized above arises in its applications where a set of interchangeable cylinder assemblies, each including a plate cylinder, a blanket cylinder and an impression cylinder, are to be selectively mounted to and dismounted from the printing press. Such cylinder assemblies are intended for production of different size business forms or the like by use of essentially one machine. Upon installation in the press, each cylinder assembly comes into driven engagement with the final gears of the two drive linkages built into the machine. Each cylinder assembly need not include the speed changer means as such means are contained in the machine, typically inserted as aforesaid in the gear trains of the second drive linkage, for common use by all the cylinder assemblies. Thus the impression cylinders of all the interchangeable cylinder assemblies can have their speed of rotation adjusted far more inexpensively than if speed changer means are fitted to each cylinder assembly according to the prior art.

[0019] It will be desirable, from the viewpoint of greater utility and applicability of the instant invention, that the cylinder assemblies having no speed changer means, as suggested by the invention, be put to use with conventional machines having no second drive linkage in addition to those having both first and second drive linkages according to the invention. Provisions are made in consideration of this possibility for making the plate cylinder of each cylinder assembly drivable not only from the second drive linkage but via the plate cylinder and blanket cylinder of that cylinder assembly as well. For use of the cylinder assemblies with machines having no second drive linkage, the blanket cylinder of each assembly may be drivingly coupled to the impression cylinder preparatory to mounting the cylinder assembly to the machine. The speed of the impression cylinder will then be conventionally adjusted via the plate cylinder and the blanket cylinder.

[0020] A further consideration that must be made in

applying the invention particularly to business form machines for use with interchangeable cylinder assemblies is that, upon installation of each cylinder assembly in the machine, its impression cylinder occupies a different position relative to stationary parts of the machine. The final gear of the second drive linkage is therefore movable into and out of driving engagement with the impression cylinder of each cylinder assembly.

[0021] There will also be hereby presented another preferable embodiment of the invention in which printing plates are made changeable without stopping the web. In this alternate embodiment the first drive linkage is connected to a first drive source, and the second drive linkage connected to a second drive source which serves also as the speed changer means, an example of the second drive source being a servomotor. A clutch is provided for connecting and disconnecting the first drive source to and from the first drive linkage and hence from the plate cylinder and the blanket cylinder. Further the blanket cylinder and the impression cylinder of each cylinder assembly are relatively movable into and out of contact with each other, as by being rotatably mounted to frame means via eccentric bearings.

[0022] Thus only the impression cylinder may be held in rotation in order to keep the web running whereas the blanket cylinder is held out of contact with the impression cylinder and, together with the plate cylinder, out of rotation. The plate on the plate cylinder may be changed while the web continues traveling.

[0023] The above outlined construction of the alternate embodiment is currently believed to be of particular advantage when applied to those machines having a series of printing units two of which are to be put to alternate use for printing different images (e.g. shop names) on the continuously running web. These two printing units may be each configured as in the foregoing. During operation of either of the two units, printing, for instance, a certain shop name on the running web, the plate on the printing plate of the other printing unit may be changed with that bearing some other shop name. When the first shop name has been printed a preassigned number of times, said other printing unit may be set in operation for printing a second shop name on the web. During operation of this second printing unit, of course, the first recited printing unit may be held out of operation for changing, as necessary, its printing plate with that bearing still another shop name.

[0024] It will be appreciated that such plate changes demand no downtime for the machine. Drastic curtailment of downtime will be realized in particular in applications that necessitate frequent plate changes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The present invention will now be described more specifically in terms of some preferable embodiments thereof, with reference had to the attached drawings in which:

Figure 1 is a diagrammatic illustration of a complete business form making machine including a printing station to which the present invention finds application;

Figure 2 is an enlarged, diagrammatic illustration of the printing station of the Figure 1 machine, the printing station having a series of offset printing units each constructed according to the novel concepts of this invention;

Figure 3 is a still more enlarged, elevational view showing one of the Figure 2 printing units in more detail;

Figure 4 is a section, with parts shown partly broken away, through the showing of Figure 3;

Figure 5 is a view similar to Figure 3 but showing an alternate embodiment of the invention;

Figure 6 is a view similar to Figure 4 but showing the Figure 5 embodiment; and

Figure 7 is a diagram explanatory of one possible application of the Figures 5 and 6 embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0026] The present invention is believed to be best applicable to multi-color business form making machines such as that diagrammed in Figure 1. The representative business form machine takes the form of a streamlined series of a paper supply station 1, a printing station 2, a post-printing processing station 3, and a folding station 4. The printing station 2 is subdivided into a series of offset printing units 5 for printing different color images on the paper web supplied from the supply station 1. Although only three printing units are drawn in Figure 1 for space limitations, there may be provided more printing units if printing is to be done in more colors than three.

[0027] All the printing units are alike in mechanical design, each conventionally comprising a plate cylinder 6, a blanket cylinder 7, and an impression cylinder 8 for printing by the familiar offset lithographic method. The invention particularly pertains to the printing station 2, or to each of its constituent printing units 5, and more particularly to the drive system, not shown in Figure 1, for the cylinders 6, 7 and 8 of each offset printing unit.

[0028] The illustrated machine is further designed for production of business forms in several different sizes. For this end, as indicated in Figure 2, the printing cylinders 6, 7 and 8 come in the form of interchangeable cylinder assemblies 5', each complete with a pair of subframes, which are to be selectively mounted to, and dismounted from, the frames of each offset printing unit 5. (The number of the printing units disagrees in Figures 1 and 2 because of lack of space in Figure 1; moreover, the number does not matter.)

[0029] Figure 2 is also explanatory of the drive system for the printing station 2. At 10 in this figure is shown an infeed roll from which a paper web P is fed into the machine. The infeed roll 10 is driven from a

drive shaft 11 via a gearbox 12. Itself coupled to a drive source such as, typically, an electric motor, not shown, the drive shaft 11 extends past all the printing units 5 for driving them via additional gearboxes 13.

[0030] According to the novel concepts of this invention, the plate cylinder 6 of each printing unit 5 is driven from one gearbox 13 via a first drive linkage 13a, and the impression cylinder 8 of each printing unit from the same gearbox via a second drive linkage 13b including speed changer means 20. The blanket cylinder 7 is directly geared to the plate cylinder 6 thereby to be driven. In short there are two parallel drive linkages 13a and 13b from one and the same gearbox 13 to the cylinders 6-8 of each printing unit 5. This gearbox may therefore be considered a source of rotary driving motion as far as the printing unit under consideration is concerned.

[0031] The two drive linkages 13a and 13b are both illustrated in detail and on an enlarged scale in Figures 3 and 4. The gear box 13 has an output shaft 26a on which there is fixedly mounted a gear 26 in mesh with another gear 27. Still another gear 28 is mounted on the same shaft as the gear 27 and constrained to joint rotation therewith. Both drive linkages 13a and 13b are gear trains in constant mesh with the gear 28.

[0032] More specifically, the first drive linkage 13a comprises a train of gears 33, 34, 35, 36, 37 and 38. The gear 33 is in mesh with the gear 28. The gear 38 is in mesh with a gear 14 on an extension of one of the trunnions 6a of the plate cylinder 6. This plate cylinder gear 14 is in mesh with a gear 15 on an extension of one of the trunnions 7a of the blanket cylinder 7. The plate cylinder gear 14 and blanket cylinder gear 15 are the same in diameter and number of gear teeth. Thus, with the rotation of the drive shaft 11, the plate cylinder 6 and blanket cylinder 7 are to be driven at the same peripheral speed in opposite directions via the train of gears 26-28, 33-38, and 14 and 15.

[0033] The position of the plate cylinder gear 14 relative to the final gear 38 of the gear train is unchanged from one cylinder assembly 5' to another. The plate cylinder gear 14 should therefore come automatically into, and out of, driven engagement with the gear 38 when any of the interchangeable cylinder assemblies 5' of this printing unit 5 is mounted to, and dismounted from, the printing unit.

[0034] The second drive linkage 13b comprises a train of gears 29, 30, 22, 23, 24 and 25. The gear 29 is in mesh with the gear 28. The gear 25 is in mesh with a gear 17 on an extension of one of the trunnions 8a of the impression cylinder 8. The impression cylinder gear 17 is the same in diameter and number of gear teeth with the plate cylinder gear 14 and blanket cylinder gear 15.

[0035] The final gear 25 of the second drive linkage 13b is, together with the immediately upstream gear 24, rotatably supported between a pair of swing arms 21 which are jointly pivotable about the same axis as the

gear 23. This gear 23 is in mesh with the gear 24 which is coaxial with the final gear 25 and rotatable jointly therewith. A linear actuator such as a fluid actuated cylinder, preferably an air cylinder 19, is operatively coupled between one of the swing arms 21 and a stationary part of the machine for swinging the swing arms so as to move the gear 25 into and out of positive engagement with the impression cylinder gear 17. Seen at 17a and 25a are bearers fastened to the gears 17 and 25 for restricting them against relative axial displacement and maintaining them in mesh with each other.

[0036] It is considered desirable that the impression cylinder 8 be made drivable not only via the second drive linkage 13b but via the first drive linkage 13a as well, that is, via the plate cylinder gear 14 and blanket cylinder gear 15. Thus, as an ancillary feature of the invention,, a second impression cylinder gear 16, better seen in Figure 4, is mounted via bearings 16a on the same impression cylinder trunnion extension as the first recited impression cylinder gear 17. The second impression cylinder gear 16 is therefore rotatable relative to the impression cylinder 8 whereas the first impression cylinder gear 17 is not, so that the second gear 16 will be hereinafter referred to as the rotatable impression cylinder gear, and the first gear 17 as the nonrotatable impression cylinder gear. The rotatable impression cylinder gear 16 is in mesh with the blanket cylinder gear 15, although the rotation of this gear 15 is not normally transmitted to the impression cylinder 8. Both impression cylinder gears 16 and 17 are the same in diameter and number of teeth.

[0037] Threadedly extending eccentrically through the nonrotatable impression cylinder gear 17, a lockpin 18 is movable into and out of positive engagement in a depression 16b cut eccentrically in the rotatable impression cylinder gear 16. Thus the impression cylinder 8 is driven from the blanket cylinder gear 15 when the lockpin 18 is engaged in the depression 16b, and from the second drive linkage 13b when the lockpin is disengaged from the depression. Speaking generally, however, the rotatable impression cylinder gear 16 need not necessarily be locked to the nonrotatable impression cylinder gear 17 to transmit the rotation of the blanket cylinder gear 15 to the impression cylinder 8, all that is required to this end being that the rotatable impression cylinder gear be locked against rotation relative to the impression cylinder.

[0038] With particular reference to Figure 4 the speed changer means 20 include a harmonic speed changer 20a of conventional design trademarked "Harmonic Drive", which is installed between the coaxial gears 20 and 23 of the second drive linkage 13b. The Harmonic Drive speed changer 20a has what is known as a web generator gear 31 which is in mesh with a pinion 32a on the armature shaft of an electric speed control motor 32, an additional component of the speed changer means 20. The speed of the gear 23, which is on the output side of the Harmonic Drive 20a, is variable

by changing the speed of the "web generator gear" 31 through adjustment of the speed of the motor 32.

[0039] In use of the multi-color offset printing press of the foregoing preferred construction, appropriate cylinder assemblies 5' may be chosen according to the size of business forms to be made and installed one in each printing unit 5. As will be understood from Figure 3, the plate cylinder gear 14 of each cylinder assembly 5' will come into mesh with the final gear 38 of the first drive linkage 13a upon installation of that cylinder assembly in one printing unit 5. It is understood that the lockpin 18 on the nonrotatable impression cylinder gear 17 is now disengaged from the eccentric hole 16b in the rotatable impression cylinder gear 16, permitting its rotation relative to the impression cylinder 8. Consequently, although the rotation of the plate cylinder gear 14 is imparted to the blanket cylinder gear 15 and thence to the rotatable impression cylinder gear 16, there is no torque transmission from this gear 16 to the impression cylinder 8.

[0040] The position of the plate cylinder gear 14 relative to the first drive linkage 13a is unchanged as aforesaid from one cylinder assembly 5' to another, so that the plate cylinder gear 14 will automatically come into mesh with the final gear 38 of the first drive linkage. The nonrotatable impression cylinder gears 17 of the various cylinder assemblies 5 are to occupy different positions according to the size of the business forms to be made. The final gear 25 of the second drive linkage 13b is therefore mounted to the pair of swing arms 21 for angular displacement therewith. These swing arms are movable by the air cylinder 19 for bringing the final gear 25 into engagement with the nonrotatable impression cylinder gear 17 regardless of its variable position. Power flow to the final gear 25 is not interrupted despite such angular displacement thereof because the swing arms 21 pivot about the axis of the gear 23, with which the final gear remains in mesh via the gear 24.

[0041] Upon engagement, as above, of the plate cylinder gear 14 and nonrotatable impression cylinder gear 17 with the respective drive linkage gears 25 and 38, the rotation of the output member of the gearbox 13 will be transmitted to the plate cylinder 6, and thence to the blanket cylinder 7, via the first drive linkage 13a, and to the impression cylinder 8 via the second drive linkage 13b. As required, the Harmonic Drive speed changer 20a may be operated via the speed control motor 32 in order to cause the impression cylinder 8 to rotate at an optimum speed for feeding the paper web P under proper tension.

[0042] It will be appreciated that the rotational speed of the impression cylinder 8 is variable totally independently of that of the plate cylinder 6 and blanket cylinder 7. Since the speed changer means 20 are compactly incorporated in the second drive linkage 13b, moreover, none of the interchangeable cylinder assemblies 5' needs to include such means as the second drive linkage 13b, as well as the first 13a, is perma-

nently mounted in each printing unit for common use by all the cylinder assemblies.

[0043] As an additional advantage, the cylinder assemblies 5' constructed according to the present invention may be put to use with the conventional machines not having the second drive linkages 13b but only having the first drive linkage 13a in each printing unit. The impression cylinder 8 of each cylinder assembly 5' must be driven via the first drive linkage 13a in this case. The lockpin 18 on the nonrotatable impression cylinder gear 17 may therefore be driven into the hole 16b in the rotatable impression cylinder gear 16 for locking the same against rotation relative to the impression cylinder 8. The impression cylinder 8 will then be driven by the blanket cylinder gear 15 via the locked impression cylinder gear 16.

[0044] Reference is now directed to Figures 5 and 6 for presentation of an alternative embodiment of the invention. This second embodiment also has two drive linkages, labeled 13a' and 13b', for driving the interchangeable cylinder assemblies in each offset printing unit, but, unlike the first disclosed embodiment, each drive linkage is coupled to a different drive source.

[0045] As better seen in Figure 5, the first drive linkage 13a' comprises a train of gears 26-28 and 33-38 through which driving torque is transferred from gearbox 13' to plate cylinder gear 14. The final element 38 of this gear train is to automatically engage the plate cylinder gear 14 as any of the interchangeable cylinder assemblies 5' is installed in the printing unit 5.

[0046] Unlike the gearbox 13 of the preceding embodiment the gearbox 13' has a built-in clutch 41 for on-off control of power transmission from drive shaft 11 to the plate cylinder gear 14 via the first drive linkage 13a'. A hand lever 42 is provided to the gearbox 13' for such manually performing such on-off control. Thus, although itself similar in construction to its preceding embodiment counterpart 13a, the first drive linkage 13a' differs therefrom in being disconnectable from its drive source.

[0047] With particular reference to Figure 6 the second drive linkage 13b' is greatly modified, comprising only three gears 23, 24 and 25 for power transfer from a variable speed electric motor 43 to the nonrotatable impression cylinder gear 17. This motor 43 is intended to serve not only as drive source for the impression cylinder 8 but also as speed changer for adjustably varying its rotational speed for feeding the web under proper tension in the face of such variable factors as the diameter of the impression cylinder in each cylinder assembly, the thickness of the paper in use, and the use or disuse of moistening water. The servomotor is currently recommended for use as impression cylinder drive motor 43 meeting these requirements.

[0048] Mounted directly on the armature shaft 23a of the impression cylinder drive motor 43, the gear 23 meshes with the gear 24 which is coaxially coupled to the gear 25 for joint rotation therewith. The gear 25

meshes with the nonrotatable impression cylinder gear 17. As in the first embodiment the coaxial gears 24 and 25 are both rotatably supported by the swing arm 21 for angular displacement about the axis of the gear 23. The impression cylinder 8 is provided with the rotatable impression cylinder gear 16 in addition to the nonrotatable impression cylinder gear 17. The rotatable impression cylinder gear 16 meshes with the blanket cylinder gear 15 and can be locked against rotation relative to the impression cylinder 8 by the lockpin 18.

[0049] Preferably, and as depicted in Figure 6, the trunnions 7a and 8a of the blanket cylinder 7 and impression cylinder 8 are journaled in eccentric sleeve bearings 44 and 45, respectively, which are themselves rotatably mounted to the confronting frame walls of the cylinder assembly 5'. Thus the blanket cylinder 7 and the impression cylinder 8 are movable into and out of contact with each other by revolving the eccentric bearings 44 and 45 with respect to the frame walls by any such convenient means as fluid actuated cylinders, worm gears, or rack-and-pinion mechanisms. Notwithstanding the showing of Figure 6, however, only either of the two cylinders 7 and 8 may be moved toward and away from the other.

[0050] In the operation of the Figures 5 and 6 embodiment, the hand lever 42 on the gearbox 13' may be operated to engage the clutch 41 built into the gearbox. The output torque of the gearbox 13' will then be transmitted to the plate cylinder gear 14 via the first drive linkage 13a', resulting in the joint rotation of the plate cylinder 6 and blanket cylinder 7 via the intermeshing gears 14 and 15.

[0051] The impression cylinder 8, on the other hand, is driven from the impression cylinder drive motor 43 via the modified second drive linkage 13b'. The speed of the motor 43 may be adjusted for synchronizing the rotation of the impression cylinder 8 to that of the blanket cylinder 7 and, further, for causing the paper web to be fed by the impression cylinder under proper tension.

[0052] It is understood that in this second embodiment, too, a set of interchangeable cylinder assemblies 5' are prepared for each printing unit, for selective use according to the size of business forms to be made. Since the impression cylinder 8 will occupy a different position upon installation of each such cylinder assembly, the air cylinder 19 may be extended or contracted to reposition the final gear 25 of the second drive linkage 13b' into driving engagement with the nonrotatable impression cylinder gear 17.

[0053] The plate cylinder 6 and blanket cylinder 7 will be both set out of rotation upon disengagement of the gearbox clutch 41. The impression cylinder 8 will be set out of rotation by stopping the impression cylinder motor 43.

[0054] Being driven from its own drive source 43, the impression cylinder 8 can be held in rotation while the plate cylinder 6 and blanket cylinder 7 are out of

rotation. For this end the blanket cylinder 7 and impression cylinder 8 may be moved out of contact with each other by revolving either or both of the eccentric bearings 44 and 45 relative to the frame walls of the cylinder assembly 5'. By driving only the impression cylinder 8, the paper web can be kept running while the plate cylinder 6 and blanket cylinder 7 are out of rotation, permitting the change of the printing plate 46 on the plate cylinder 6.

[0055] The utility of this embodiment will be better understood from a study of Figure 7, which shows four offset printing units 5₁, 5₂, 5₃ and 5₄ aligned for production of business forms. The first two printing units 5₁ and 5₂ are for printing two-color images, the last two printing units 5₃ and 5₄ for selectively printing different shop names. It is understood that at least these two printing units 5₃ and 5₄ are each constructed as hereinbefore described with reference to Figures 5 and 6.

[0056] Let us suppose that business forms are to be produced by this Figure 7 machine in prescribed numbers of sets each bearing a different shop name such as A, B and C. The paper web P may first be threaded through the machine as pictured in Figure 7, made to pass between blanket cylinder 7 and impression cylinder 8 in each printing unit. If a printing plate bearing the shop name A is mounted to the plate cylinder 6 of the third printing unit 5₃, the blanket cylinder 7 and impression cylinder 8 of this printing unit may be held against each other by revolving the eccentric bearings 44 and 45, Figure 6, and all the cylinders 6, 7 and 8 of the third printing unit may be driven from the two drive sources via the respective drive linkages 13a' and 13b'.

[0057] The blanket cylinder 7 and impression cylinder 8 of the fourth printing unit 5₄, on the other hand, may be held away from each other, and the impression cylinder 8 of that printing unit 5₄ may be driven from the electric motor 43 via the second drive linkage 13b' for feeding the web P toward the next processing station. Both plate cylinder 6 and blanket cylinder 7 of the fourth printing unit 5₄ may be held out of rotation by declutching the gearbox 13'.

[0058] Fed through the printing units 5₁-5₄ by all their impression cylinders 8, the web will be printed thereon the images by the first two printing units 5₁ and 5₂ and the shop name A by the third printing unit 5₃. During the progress of such printing of the business forms for the shop A, the printing plate bearing the shop name B may be mounted to the plate cylinder 6, which has been out of rotation, of the fourth printing unit 5₄ by manually revolving the same. Further, as required, the blanket on the blanket cylinder 7 of this printing unit 5₄ may be washed clean of ink and other foreign matter.

[0059] Upon completion of the printing of the preassigned number of business forms with the shop name A, the blanket cylinder 7 and impression cylinder 8 of the third printing unit 5₃ may be moved away from each other, the plate cylinder 6 and blanket cylinder 7 set out of rotation, and only the impression cylinder 8 main-

tained in rotation. Further the blanket cylinder 7 and impression cylinder 8 of the fourth printing unit 5₄, in which the shop name B printing plate has been mounted as above to the plate cylinder 6, may be moved against each other via the running web. The clutch lever 42 on the gearbox 13' may be engaged for driving the plate cylinder 6 and blanket cylinder 7 via the first drive linkage 13a'.

[0060] Now, on the web P, which has been continuously fed through the machine, there will be printed the images by the first two printing units 5₁ and 5₂ and the shop name B by the fourth printing unit 5₄. During the progress of such printing, the printing plate on the plate cylinder 6 of the third printing unit 5₃, which has been kept out of rotation since the completion of the printing of the business forms with the shop name A, may be replaced by that carrying the shop name C by manually turning the cylinder. At the same time the blanket on the blanket cylinder 7 of this printing unit 5₃ may be cleaned as required.

[0061] Upon completion of the printing of the preset number of business forms with the shop name B, the fourth printing unit 5₄ may be set out of operation to discontinue printing the shop name B, and the third printing unit 5₃ set into operation again for printing the shop name C. The details of operation involved in such switching from shop name B to shop name C are akin to those set forth above in connection with switching from shop name A to shop name B.

[0062] It will now be clear why the last two 5₃ and 5₄ of the four printing units 5₁-5₄ in Figure 7 are each constructed according to the teachings of Figures 5 and 6, with the plate cylinder 6 and the impression cylinder 8 driven from the different sources 13' and 43 via the different drive linkages 13a' and 13b', and with the blanket cylinder 7 and the impression cylinder 8 made movable into and out of contact with each other. This type of multiple-color, multiple-image printing machine is greatly improved in efficiency as one or more images are made changeable without stopping the web.

[0063] Although the present invention has been shown and described very specifically and as adapted for multiple-color business form machines, it is not desired that the invention be limited by the exact details of the drawings or the description thereof. A variety of modifications, alterations and adaptations of the invention will suggest themselves to one skilled in the printing art on the basis of this disclosure. For example, while the exemplified printing presses are intended for use with replaceable cylinder assemblies, the invention may be equally well applied to machines having nonreplaceable printing cylinders. In this case, however, the final gears 38 and 25 of the drive linkages 13a or 13a' and 13b or 13b' can be in constant mesh with the plate cylinder gear 14 and the impression cylinder gear 17. The fluid actuated cylinder 19 and associated means for moving the gear 25 into mesh with the impression cylinder gear 17 may be omitted.

Claims

1. A web-fed offset printing press suitable for production of business forms, among other applications, wherein an inked image is printed from a plate cylinder (6) to a blanket cylinder (7) and thence offset to a web (P) running against an impression cylinder (8), characterized by comprising a first drive linkage (13a or 13a') for driving the plate cylinder (6) and the blanket cylinder (7), a second drive linkage (13b or 13b') for driving the impression cylinder, and speed changer means (20 or 43) coupled to the second drive linkage for adjustably varying the rotational speed of the impression cylinder.
2. A web-fed offset printing press as claimed in claim 1, characterized in that the first drive linkage (13a) and the second drive linkage (13b) are both connected to a common drive source (13).
3. A web-fed offset printing press as claimed in claim 2, characterized in that the first drive linkage (13a) and the second drive linkage (13b) are both trains of gears, and that the speed changer means (20) is inserted between two selected gears (22 and 23) of the second drive linkage.
4. A web-fed offset printing press as claimed in claim 1, wherein the plate cylinder (6), the blanket cylinder (7) and the impression cylinder (8) form parts of each of a set of interchangeable cylinder assemblies (5') which are to be selectively mounted to, and dismounted from, the printing press, characterized by comprising a plate cylinder gear (14) rotatable jointly with the plate cylinder (6) and capable of driven engagement with the first drive linkage (13a), a blanket cylinder gear (15) rotatable jointly with the blanket cylinder (7) and meshing with the plate cylinder gear, a nonrotatable impression cylinder gear (17) rotatable jointly with the impression cylinder (8) and capable of driven engagement with the second drive linkage (13b), a rotatable impression cylinder gear (16) coaxial with the impression cylinder and meshing with the blanket cylinder gear, and means (16b, 18) for locking the rotatable impression cylinder gear against rotation relative to the impression cylinder and unlocking the rotatable impression cylinder gear from the impression cylinder.
5. A web-fed offset printing press as claimed in claim 4, characterized in that the locking means comprises a lockpin (18) mounted eccentrically to the nonrotatable impression cylinder gear 17 for movement into and out of locking engagement with the rotatable impression cylinder gear (16).
6. A web-fed offset printing press as claimed in claim

4, characterized in that the second drive linkage (13b) includes a final gear (25) which is movable into and out of driving engagement with the nonrotatable impression cylinder gear (17) of each of the interchangeable cylinder assemblies (5').

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7. A web-fed offset printing press as claimed in claim 6, characterized in that the final gear (25) of the second drive linkage (13b) is mounted to support means (21) for angular displacement about the axis of another gear (23) included in the second drive linkage, and that a linear actuator (19) is mounted to the support means (21) for moving the final gear (25) into and out of driving engagement with the nonrotatable impression cylinder gear (17) of each of the interchangeable cylinder assemblies (5').
8. A web-fed offset printing press as claimed in claim 1, characterized in that at least either of the blanket cylinder (7) and the impression cylinder (8) is made movable into and out of contact with the other, and that means (41, 42) are provided for connecting and disconnecting the first drive linkage (13a') to and from a drive source (13') for the plate cylinder (6) and blanket cylinder (7).
9. A web-fed offset printing press as claimed in claim 8, characterized in that the blanket cylinder (7) and the impression cylinder (8) are rotatably mounted to frame means via eccentric bearings (44, 45) for relative movement into and out of contact with each other.
10. A web-fed offset printing press as claimed in claim 1, characterized in that the first drive linkage (13a') is connected to a first drive source (13'), and that the second drive linkage (13b') is connected to a second drive source (43) which serves also as the speed changer means.
11. A web-fed offset printing press as claimed in claim 1, characterized in that the speed changer means comprises a variable speed motor (43) connected to the second drive linkage (13b') for driving the impression cylinder.

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FIG. 1

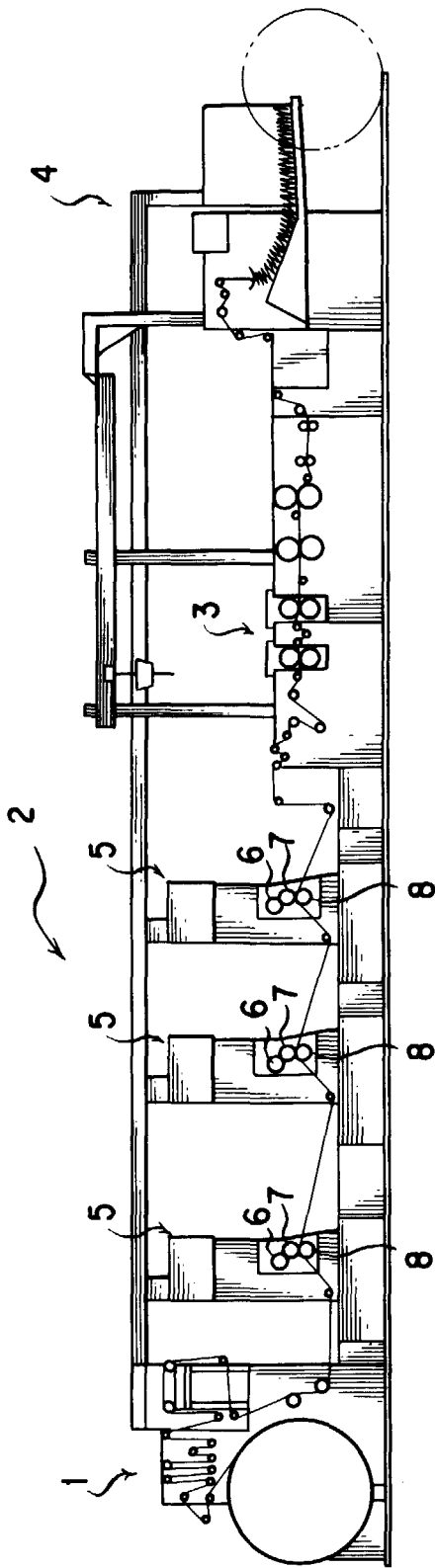


FIG. 2

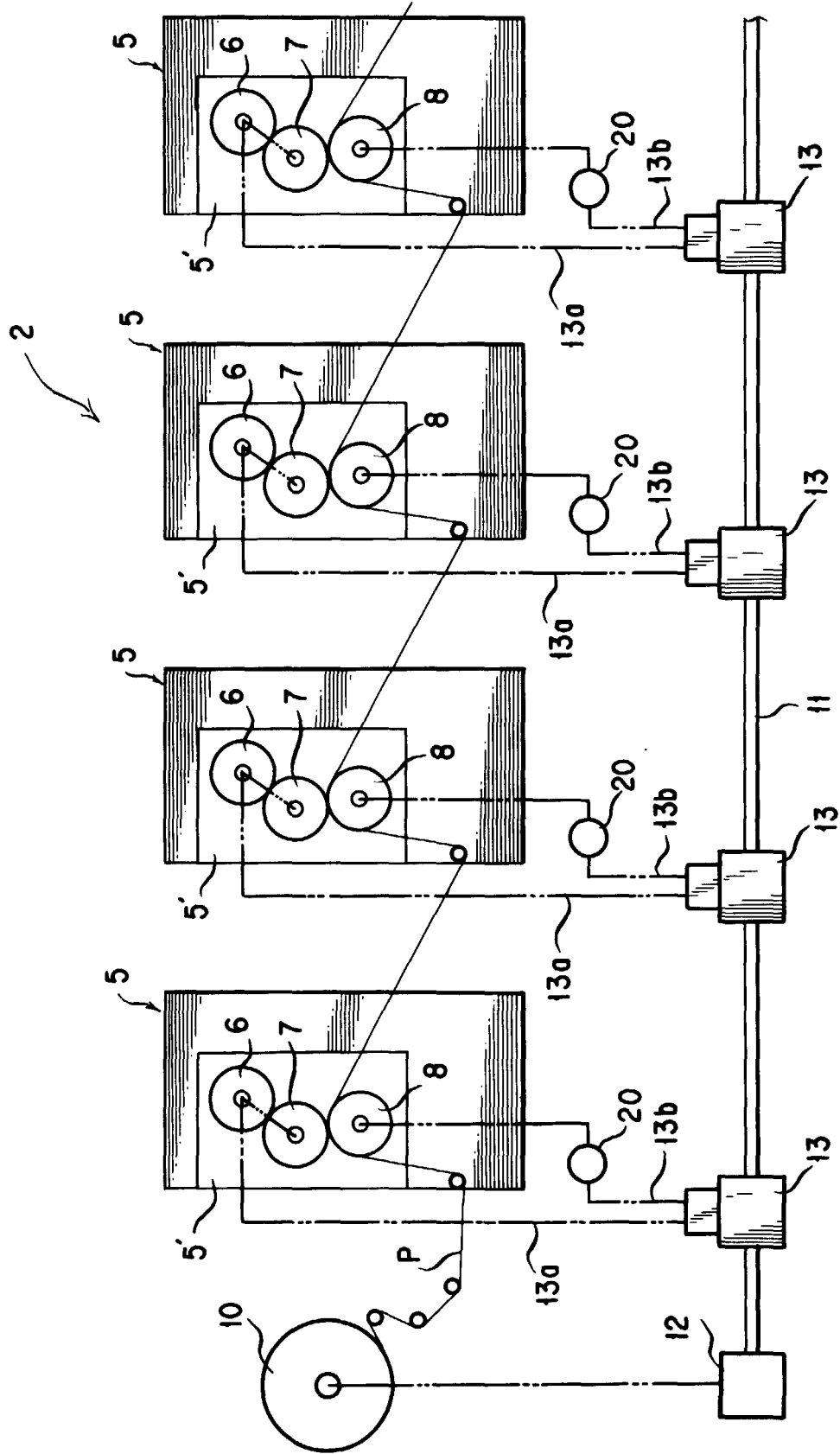


FIG. 3

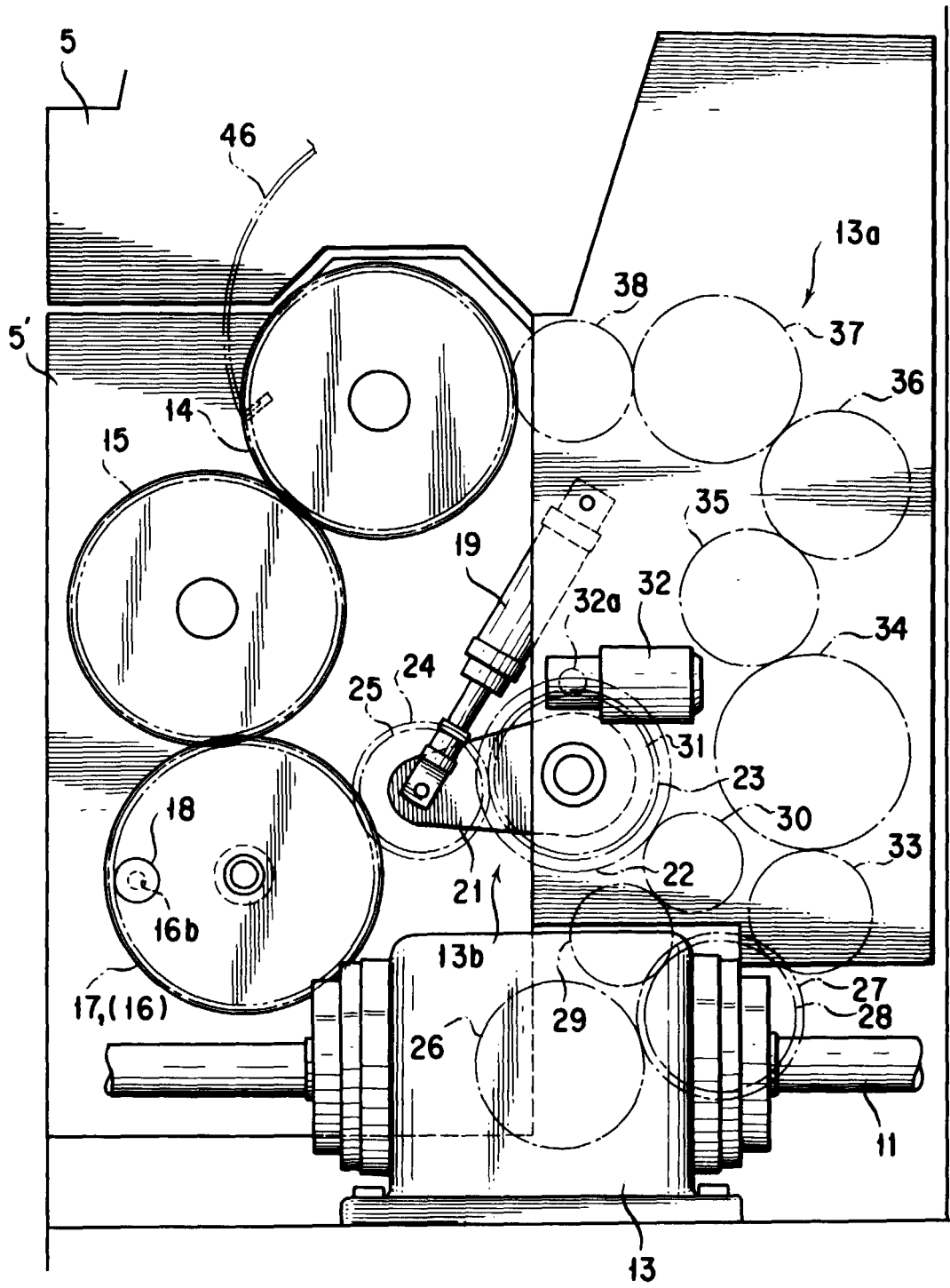


FIG. 4

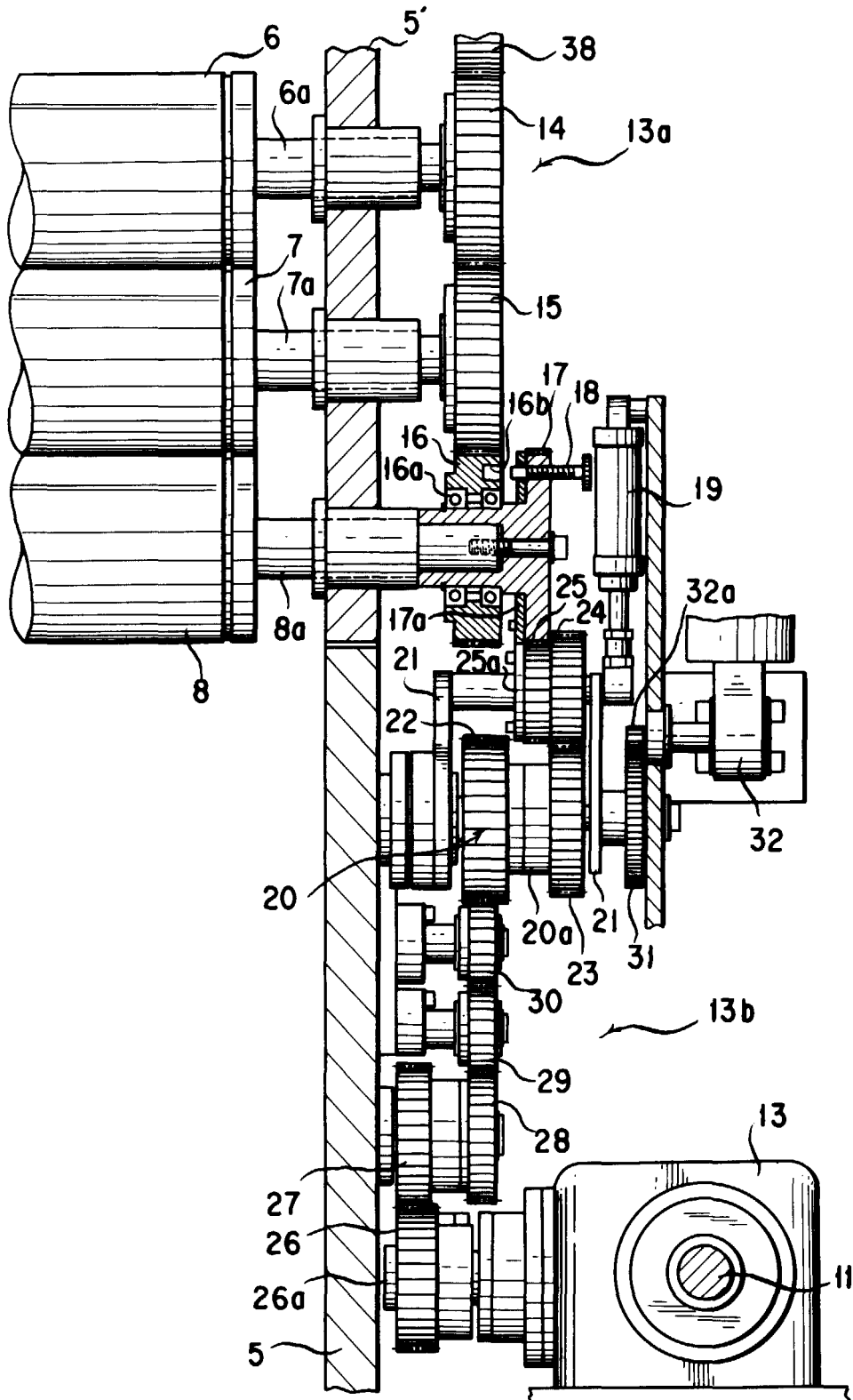


FIG. 5

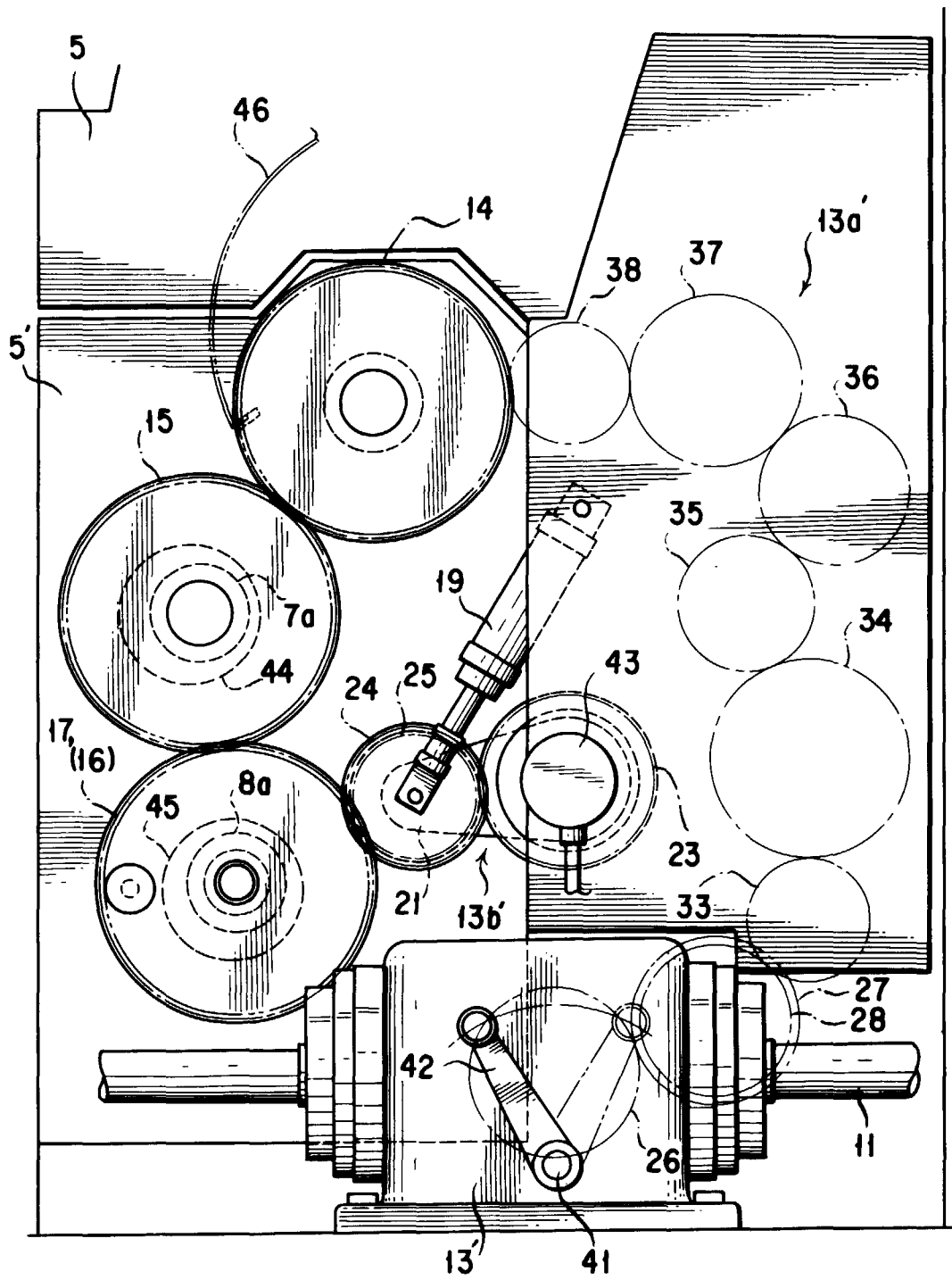


FIG. 6

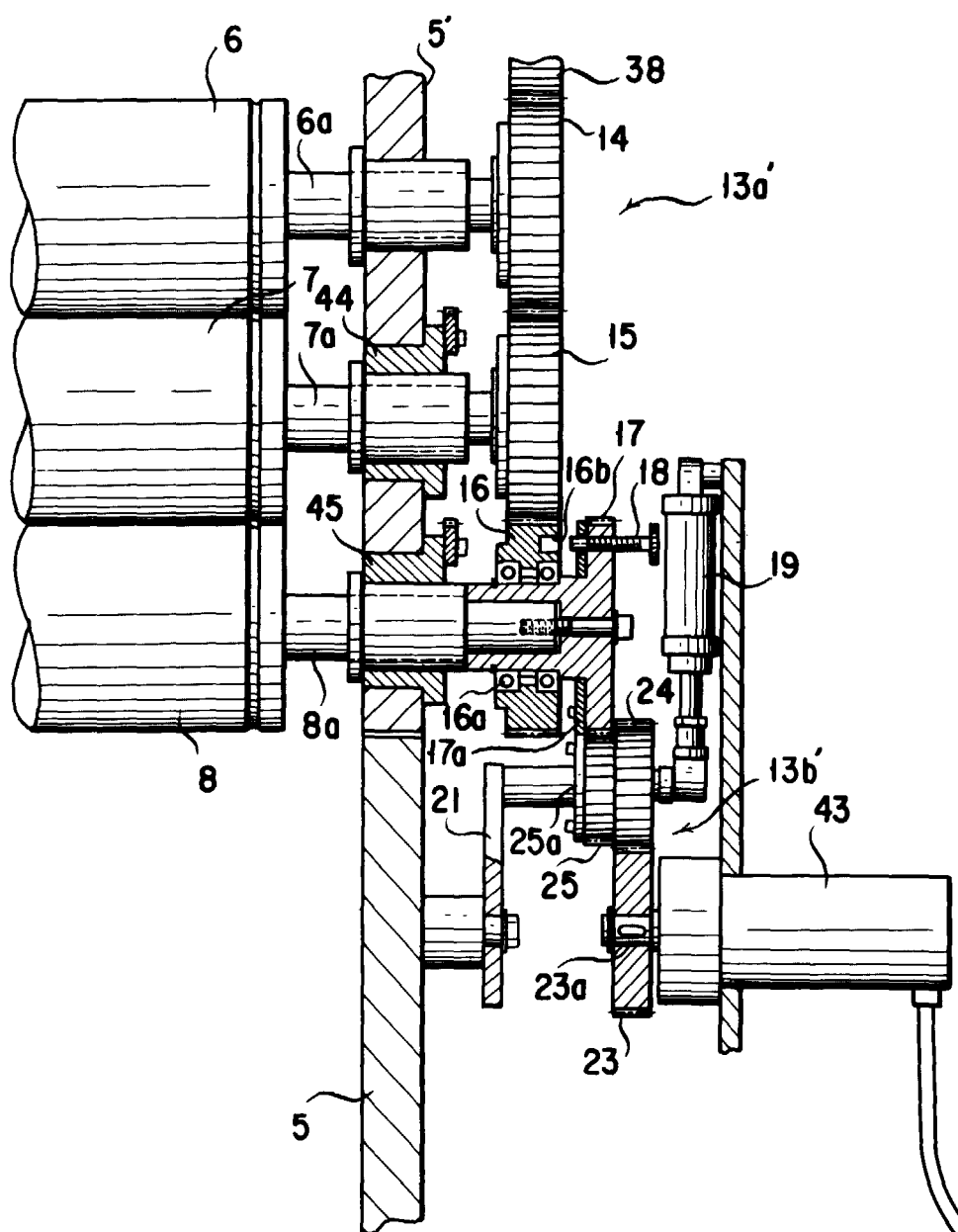
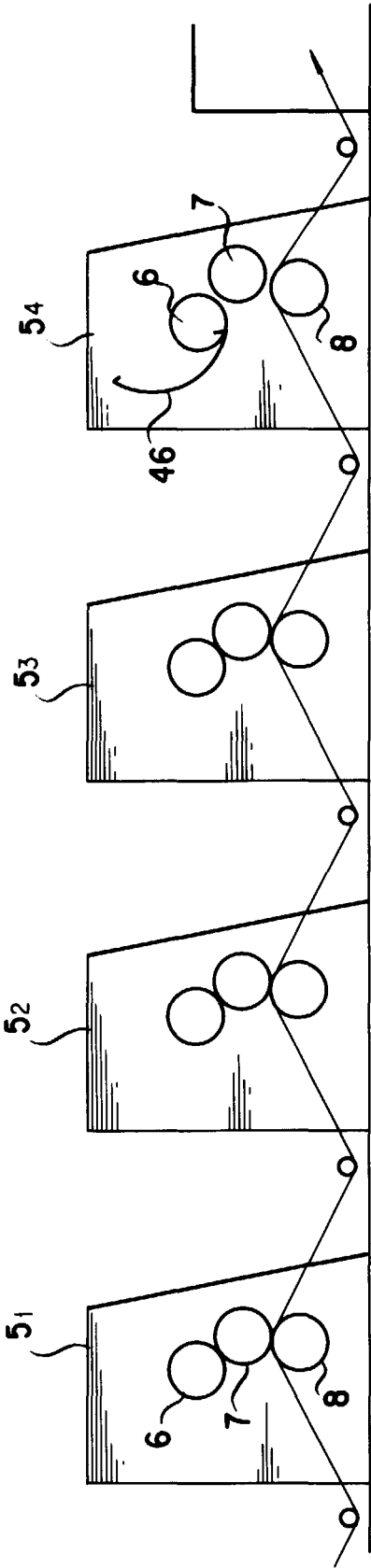


FIG. 7





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 00 10 7360

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Place of search	Date of completion of the search	Examiner	
THE HAGUE	9 August 2000	DIAZ-MAROTO, V	
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