FOLDING BLADE CARRIER WITH TUBULAR, DOUBLE SUN GEARING

Hans-Bernhard Bolza-Schunemann, Wurzburg, Germany, assignor by license to Messenfabrik Koenig & Bauer Aktiengesellschaft, Wurzburg, Germany, a corporation of Germany

Filed Apr. 13, 1965, Ser. No. 447,706

6 Claims. (Cl. 270—77)

ABSTRACT OF THE DISCLOSURE

This is a printing machine folding mechanism of the 3-2 folder type having a folding and collecting cylinder with three folding blades. Each blade is fixed to a planetary gear that is driven through an intermediate gear meshing with one of a double sun gear drive that is arranged coaxially about the axis of the cylinder. The drive for the double sun gears are driven through a common drive gear mounted eccentrically to the axis of the cylinder which is driven at half the rate of revolution of the cylinder and in the opposite direction. There is a crank arm drive mechanism symmetrically arranged about the cylinder axis and it has three first crank arms fixed to rotate with the common drive gear about the drive gear axis. There are three intermediate gears rotatably mounted on the outer portion of the first crank arms and these mesh with the common drive gear and orbit about it. There are two second crank arms mounted on the same rotatable mounting of the intermediate gears and on the outer ends of these second arms are mounted pinions which mesh respectively with the swinging intermediate gears and fixed to these last mentioned pinions are gears that mesh with and rotate the double sun gears respectively so that one of the three folding blades is positioned in its immersing into the folding off rollers.

This invention relates to printing machine folding mechanisms as used in connection with rotary printing machines, and more particularly to so-called 3:2 faders, that is to so-called "3:2" type folders, in which a folding and collecting cylinder, having three sets of operation elements arranged to carry three sheets, partially folded products, around its periphery, cooperates with a cutting cylinder mechanism producing two such products for each rotation, whereby either straight, non-collecting, or collect run can be obtained in a mechanism of this character by modifying the rotation of the folding blades in a suitable manner.

Of these general type mechanisms particularly two different types are known which will be explained hereafter.

One folding cylinder arrangement is shown for example, in prior Harless U.S. Patent 2,981,540 and in Neal et al. U.S. Patent 3,055,657. In such devices, the folding cylinder body respectively collecting cylinder body and folding blade carrier are mounted eccentrically with relation to each other and driven in relation. The folding cylinder body and the folding blade carrier have therefore no common axis and are not rigidly connected with each other. The folding and collecting cylinder has therefore also a special folding cylinder body besides the folding blade carrier, this folding cylinder body having a hollow cylindrical outer shell which has to be relatively thin-walled.

Another well-known type of the aforementioned category of folding mechanisms is shown in the published specification No. 1,126,412 of a German patent application, which is the type the invention at hand is concerned with. The remarkable feature of this system is the folding cylinder body respectively collecting cylinder body and the folding blade carrier being rigidly connected with each other, therefore having a common rotation axis and are integral with each other on a common shaft. The folding blade carrier serves also as collecting cylinder and has a cylindrical surface shell, the circumference of which is equal to 15 times the plate cylinder circumference. The three rotating folding blades are not carried in a particular folding blade carrier but in the collecting cylinder, that is the folding cylinder itself. As for all folding mechanisms of the aforementioned general type, suitable means exist to modify the rotation of the folding blades, that is the folding blade path for shifting from operation for straight run to operation for collect run and vice versa.

It is an object of the present invention to provide an improved drive for the folding blade elements, which utilizes planetary gear members.

Another object of the invention is an improved drive for the folding blade elements suitable for variable modifies and predetermining the path of movement such as the three-lobe epicyclic curve of the folding blade.

With these and other objects which will appear in mind, a folding mechanism will now first be described with reference to the accompanying drawings illustrating the case by way of example, and the feature forming the invention will then be pointed out in the appended claims.

In the drawings:

FIG. 1 is a schematic end view of a 3:2 folding mechanism operating in non-collect, straight run;
FIG. 2 is a diagram showing an example of the path of movement of the folding blades in operation for a collect run;
FIG. 3 is an end view of the planetary gear members for the movement of the folding blades;
FIG. 4 is a schematic end view of an improved gear crank device, i.e. gear crank mechanism, for driving the planetary gear members for a collect run operation;
FIG. 5 is a longitudinal section of a folded form of a folding and collecting cylinder and associated mechanism;
FIG. 6 is a section of members, driving the gear crank drive, and
FIG. 7 is a schematic end view of FIG. 6 as viewed from the right side.

FIG. 1 shows a web 1 fed via the former 2 and various drag rollers 3 into the folding cylinder group. By means of the cutting cylinder 4 with two sets of cutting members 5 and 6 the web is cut to sheet size against the folding and collecting cylinder 7. The folding and collecting cylinder 7 is 1½ times the size of the plate cylinder making a sheet supporting surface for three sheet lengths and comprising 3 rotatably journaled, not moving except for orbital rotation, folding blades 8, 9 and 10. The folding blade edges describe in a non-collect run, when looking toward the stationary system at double production, straight run, the known three-lobe epicyclic curve 11 immersing in the folding off rollers 12 and folding the cut sheets in the usual way. Known fan delivery 13 and conveyors 14 of the tape type, for example, delivery tapes 14 deliver the folded products from the folder.
Referring to the invention, FIG. 2 as a schematic view shows by way of example curve 15 traced by a folding blade edge during a collect run. Only the lower cusp of the three-lobe cycloidal curve 11 is left for immersing into the folding off rollers 12 at double production, straight run, as is shown in FIG. 1.

The rotating folding plates complete on their path 15 the hypocycloidal cusp necessary for the folding process only with superimposing upon the rotation of the respective planetary gear members appropriate incremental velocity as compared with the basic speed of the revolving folding and collecting cylinder. The left cusp already seems a semi-circular shaped curve and the right cusp of path 11, see FIG. 1, has completely disappeared. The three rotating folding plates in this example are controlled in such a way that each folding blade emerges twice from the cylinder surface upon the first rotation of the folding and collecting cylinder, but not at all upon the second rotation. This makes it possible that the cylinder 7 on its second revolution rotates with one sheet for more than one revolution from the cutting cylinder on the cutting cylinder onto the fold off rollers 12 without the respective folding blade raising from the cylinder surface. As there are three folding blades 8 to 10 operating in the same cycle at every two folding and collecting cylinder revolu-
tions, the three blades are folding in a skipping sequence. FIG. 3 shows the folding and collecting cylinder 7 sup-
ported by its shaft 17 in bearing by the main frame 16, as seen in FIG. 5, and itself carrying the three rotatable folding blades 8, 9 and 10. Each folding blade has on its shaft 18 a planet pinion 21, 22 or 23 which is connected with a sun gear 24, 25 or 26 via an intermediate gear such as at 71 so that one of the three sun gears is associated with each planet pinion shaft 18 and therefore to each folding blade. The three sun gears 24, 25, 26 have an equal pitch line diameter and are, as will be further explained later, integral with a second wheel 34, 35 or 36 having the same or a different pitch line diameter, which is larger for the example, and meshing with the drive connection output shaft of a gear crank drive.

If the three sun gears 24 to 26 at straight run operation remain constantly stationary, all three planet pinions as well as all three folding blades 8, 9, 10 perform an evenly revolving rotary motion in the folding and collecting cylinder. Each folding blade therefor performs the three-lobe cycloidal curve 11 having three cusps, as is shown in FIG. 1. For each cylinder revolution each folding blade appears three times on the cylinder surface or six times per two cylinder revolutions.

In order to avoid raising of the folding blades 6 times at collect run operation, each of the sun gears 24, 25, 26 at collect operation is stopped opposite the folding moment of its folding blade resulting in the known cycloid cusp of path 15, as is shown in FIG. 2 for folding blade 8. Afterwards the sun gears also rotate in direction of the folding cylinder rotation so that the planet pinions 21, 22, 23 rotate less often. This means for example 4 blade tips 6 per two cylinder revolutions are eliminated during running the respective sun gear, thus only two tips raising above the surface. Raising immediately after the folding process does not interfere at this point the folding and collecting cylinder is always free from sheets. In general the sun gears have to eliminate by co-running at least 3 of the 6 raised tips. In FIG. 2, for example, 4 cusps of the blade path are substracted so that two raisings remain shown for folding blades 8 and 9.

FIG. 4 shows, as an example, a schematic view of a gear for generating the sun gear motions by means of actuation via pinions 34, 35, 36 of the double pinions respectively 24, 25, 35 and 26, 36. It is imperative, however, that a progressive revolving motion is performed causing the respective sun gear to stop at the folding moment. In addition a specific turning angle of the sun gear per two folding cylinder revolutions has to be obtained, for instance 480° for a motion as per FIG. 2. Further-
more it is imperative that not only one such progressive turning motion is performed but simultaneously three similar motions, however, accordingly phased as according to the three folding blades staggered by 120° in the folding cylinder. These requirements can be fulfilled if in opposite direction to the folding and collecting cylinder an eccentric gear is rotating at half the folding and collect-
ing cylinder rate of revolution serving as driving pinion for three gear crank drives staggered by 120°.

This star motor-like constructed gear is located on the outer slider frame 16. In FIG. 4 number 37 stands for a drive pinion carried eccentrically to the folding cylinder shaft 17 and fixed on the crankpin 44, the crank axis of which is moved in arrow direction 30, i.e. revolving counterclockwise about the shaft axis 17 of the folding and collecting cylinder. Numbers 31, 32, 33 stand for three driven members carried on shafts 41, 42, 43 and staggered by 120°, i.e. mounted symmetrically about the folding and collecting cylinder axis 17. Numbers 38, 39 and 40 stand for the swinging intermediate pinolos loosely and rotatably journaled on pins 45 and in mesh with the common drive pinion 37 and one of the driven members 31, 32 or 33. Each one of these intermediate pinolos can be controlled by a connecting rod 48 hinged on a crankpin 44 and a rod 51, one per each shaft 41, 42, 43. The short shafts 41, 42, 43 of the output side driven by members 31, 32, 33 of the gear crank drive extend through the machine frame 16 and drive via pinions 27, 28, 29 one each of the sun gear drive pinions 34, 35, 36 respectively, double gears 24, 25 and 26, 25, 26.

By means of this gearing, the three sun gears operate in a collect run in such a way that each of the three sun gears 24, 25, 26 comes to a standstill once per two folding and collecting cylinder revolutions. Thus there results progressive sinusoidal oscillations with a phase shift of 240° so that always the next but one folding blade is in folding operation.

The asymmetrical folding blade motion resulting from the specified gears and through superimposing incremental velocity on the sun gears with a certain rhythm as compared with the basic speed of the folding and collecting cylinder has already been exemplified by curve 15 in FIG. 2. The path of movement 15 may be modified by selecting gear transmission ratio.

FIG. 5 is a cross section through the described fold-
ing mechanism. On the left the folding and collecting cylinder 7 with two folding blades 8 and 9 is shown whilst the third folding blade 10 and its connections with the drive are not shown. The three sun gears 24, 25 and 26 are serving for driving the planet pinions 21, 22 and 23 which are respectively 34, 35, 36 which is actuated via a separate gear crank drive each. The three hollow or tubular shafts of the three rotatable double gears 24, 25 and 26, 35 and 26, 36 are individually supported by antifriction bearings for rotation concentrically with the folding and collecting cylinder axis 17. Each sun gear is devised as a double gear, i.e. integral with a second gear respectively 34, 35, 36 which is actuated via a separate gear crank drive each. The three hollow or tubular shafts of the three rotatable double gears 24, 25 and 26, 35 and 26, 36 are individually supported by antifriction bearings and are located co-axially journaled like tubes of different diameter. Their drive pinions 34, 35, 36 are of equal size but have in the example shown a larger pitch line diameter than the three sun gears 24, 25 and 26. The three double gears respectively the three sun gears 24, 25 and 26 are in static position during straight run operation (non-collecting) whilst they are individually revolving during collect run operation.

Folding blade 8 is actuated by planet pinion 21 rolling on sun gear 24. Sun gear 24, double gear 24, 34, is rotatable by means of pinion 27. Therefore pinion 27 is connected via shaft 41 with pinion 31 of said crank gear drive located on the outer framework. Pinion 31 is as are pinions 32 and 33 detachably mounted on shaft 41 by common means not shown; and it is connected via intermediate member 38 with drive pinion 37 eccentrically journaled and actuated by gears as will be described in.
the following paragraph and rotating at half the rate of revolution in opposite direction to the folding and collecting cylinder 7. Likewise FIG. 5 shows the drive for sun gear 26, 36 of folding blade 10 by pinion 29, the shaft 43 of which also terminates in a pinion 33 on the outer framework 16. This pinion 33 meshes via intermediate pinion 40 with the common eccentrically located drive pinion 37 of the three planetary gears and produces the same standstill motion for sun gear 26, however with a phase shift by 240° due to the staggered arrangement. As indicated in FIG. 5, the gears may advantageously be located in a housing 77 facilitating lubrication. As already said, drive pinion 37 for the gear crank drive is fixed on crankpin 44. For this purpose crankpin 44 according to FIGS. 6 and 7 is devised as a flange bolt bolted concentrically with pinion 37 by means of screws 54. Activation of pinion 37 takes place through pinion 55 acting as crank pin located on the outer framework 16 on a pivot 56 of shaft 17 of the folding and collecting cylinder 7 and is loosely and rotatably supported by anti-friction bearings 57 for rotation concentrically with the folding and collecting cylinder axis 17. Pinion 37 eccentrically located is detachably bolted with crank pinion 55 by means of four screws 55, see FIG. 7, in order that eccentricity 59 may be adjusted. To make this adjustment possible, the screw head of pinion 37 for screws 55 are slot holes 60. A setscrew 61 serves for adjustment supported on both ends radially in pinion 37 and guided in a pinhead 62 fixed in crank pin 55 and guided in a slot hole 63 of pinion sheave 37. In alignment with this slot hole 63 is another in pinion 37 diametrically located slot hole 64 serving as slot guide for an accurately fitting roll 65 for guiding pinion 37 radially adjustable to the cylinder axis 17 when adjusting eccentricity 59, see FIG. 6. The fitting roll 65 loosely rotatable and supported by anti-friction bearings, not shown, is located on a flange bolt 67 which, serving as co-axial elongation of pin 56, is bolted to the shaft 17 of cylinder 7 by means of screws 68, see FIG. 6. According to predetermined eccentricity 59 by means of setscrew 61 a modified path of movement 15, see FIG. 2, of the folding blades is obtainable; setting of eccentricity is carried out by the manufacturer; through singular and accurate adjustment it will be assured that the folding moment and speed of sun gears 24, 25, 26 and respective planet pinions 21, 22, 23 is at zero meaning that the pertinent sun gear is at a standstill. The described folding mechanism is distinguished by its simplicity despite fulfilling the difficult demand of collecting on the gear crank drive itself. The folding and collecting cylinder can be assembled with its three rotating folding blades outside the press and can be mounted as a whole on the folder.

The three planetary drive gears 21, 22 and 23 can easily be accommodated between cylinder front wall and machine frame. This outer gear crank drive can easily be produced as it is free of cam gears. When shifting from collect to non-collect operation, no folding blades have to be removed. Only the three driven shafts 41, 42, 43 of the gear crank drive are arrested by said detachment of driven members 31, 32, 33 in order to keep the three sun gears 24, 25, 26 constantly stationary in the exact folding position. It is particularly agreeable that the gear crank drive is driven only with half the folding and collecting cylinder rate of revolution so that the progressive rotary motions of the sun gears occur relatively slowly. As the folding and collecting cylinder has 1½ times the sun gear circumference, it only makes a 3½ plate cylinder rotation. This means for example for a press running speed of 30,000 plate cylinder revolutions per hour also 30,000 revolutions for the cutting cylinder, but only 20,000 for the folding and collecting cylinder and movements like 10,000 plate cylinder revolutions per hour for the gear crank drive. It is thus advantageous that three sinusoidal oscillations phased by 240° are produced so that the gears despite their progressive rotary motions with intermittent stops run dynamically smooth looking at it as a whole. The planetary collective folding cylinders and movements like the machine frame are dust-free enclosed in an oil bath.

In conclusion it may be mentioned that the inner transmission ratio of the gear members may be selected in such a way that the folding blades do not rotate at all when the sun gears are stationary. For straight or non-collecting production the sun gears will be in constant counter-rotation in order that the folding blades may obtain the speed necessary for generating the hypocycloid cusps. At collect run the sun gears will not constantly revolve but swing to and fro, which for instance can be achieved via toothed segments swinging to and fro via a crank gear. Thus the same folding blade motion would be obtained as in FIG. 2.

What is claimed is:

1. In a printing machine folding mechanism of the 3–2 folder type having a combined folding and collecting cylinder rotatable about an axial shaft, three folding blades mounted on pivot points on said cylinder for rotary movement on said cylinder axis, and said cylinder symmetrically about the cylinder axis, a folding blade drive mechanism for immersing said folding blades into two folding off rollers having a planetary gear fixed to and rotating each blade, a drive gear for each of said planetary gears, three double sun gears each having gears of a first and second pitch diameter rotatably mounted on the cylinder shaft, each gear of a first pitch diameter of said double sun gears meshing with a respective planetary drive gear meshing with the respective planetary gear to position each respective drive blade, a common drive gear mounted eccentric to the axis of said cylinder and having drive means for rotating it with half the rate of revolution of said cylinder and in the opposite direction, a crank arm mechanism arranged symmetrically about said cylinder axis and having three first crank arms having means attaching them to rotate with said common direct drive gear about the drive gear axis, three swinging intermediate gears rotatably mounted on a pivot means on the outer portion of said first crank arms and meshing with said common drive gear and orbiting thereabout, three second crank arms mounted on said pivot means on the outer portion of each of said first crank arms, a pivot means on the outer portion of each of said second crank arms, three driven pinions fixed on and driving said last pivot means and meshing with said swinging intermediate gears and three gears fixedly mounted on said respective pivot means and meshing with and each driving one of the other gears of a second pitch diameter of said double sun gears, each double sun gear having a connecting tubular shaft, said tubular shafts being arranged coaxially, whereby one of said three folding blades is positioned in its immersing into the folding off rollers.

2. In a printing machine folding mechanism according to claim 1 wherein said common drive gear has mounting means for positioning its axis to adjust its radial distance from the cylinder axis for adjusting the accurate positions of said folding blades in the moment of immersing into the folding off rollers.

3. In a printing machine folding mechanism according to claim 2 wherein said drive means for rotating the common drive gear with half the rate of revolution of said cylinder includes another rotatable gear to which said common drive gear is eccentrically attached, said gear being concentrically arranged with rotating cylinder axis and rotatable at half the rate of revolution as the cylinder.

4. In a printing machine folding mechanism according to claim 3 wherein said drive means for positioning the axis of the common drive gear at an adjusted radial distance from the cylinder axis is slot and bolt means by
which the common drive gear is eccentrically attached to said another rotatable gear.

5. In a printing machine folding mechanism according to claim 1 wherein said double sun gears have their co-axially connecting tubular shafts arranged concentrically.

6. In a printing machine folding mechanism according to claim 1 wherein the means attaching the three first crank arms to rotate with said common drive gear about the drive gear axis includes a crank pin bolted to the common drive gear at the axis and bearing means on the ends of the three first crank arms received on said crank pin.

References Cited

German printed application, 1,126,412, March 1962.

EUGENE R. CAPOZIO, Primary Examiner.
P. WILLIAMS, Assistant Examiner.