Sept. 25, 1962

F. NEAL ETAL

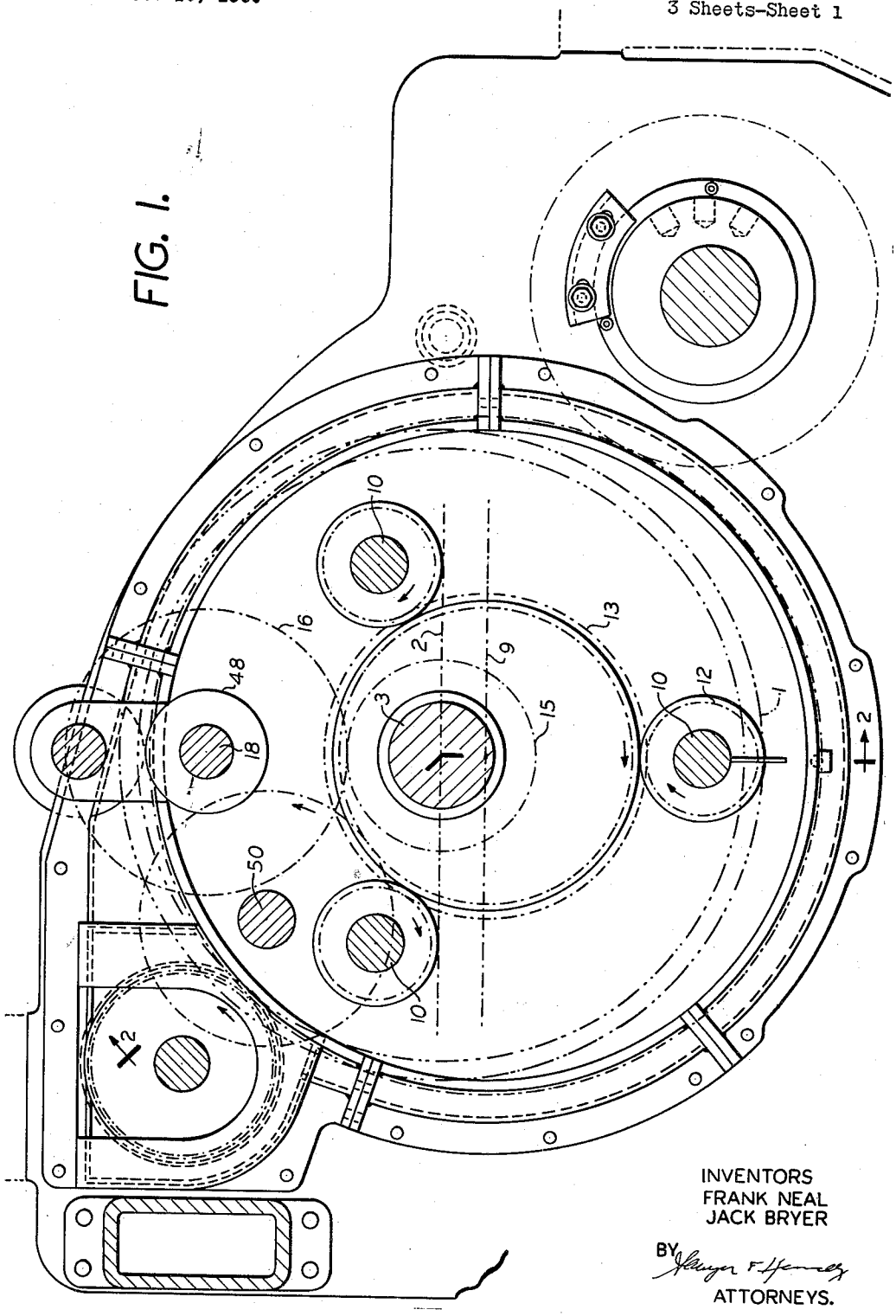
3,055,657

FOLDING MECHANISMS

Filed Dec. 16, 1960

3 Sheets-Sheet 1

FIG. 1.



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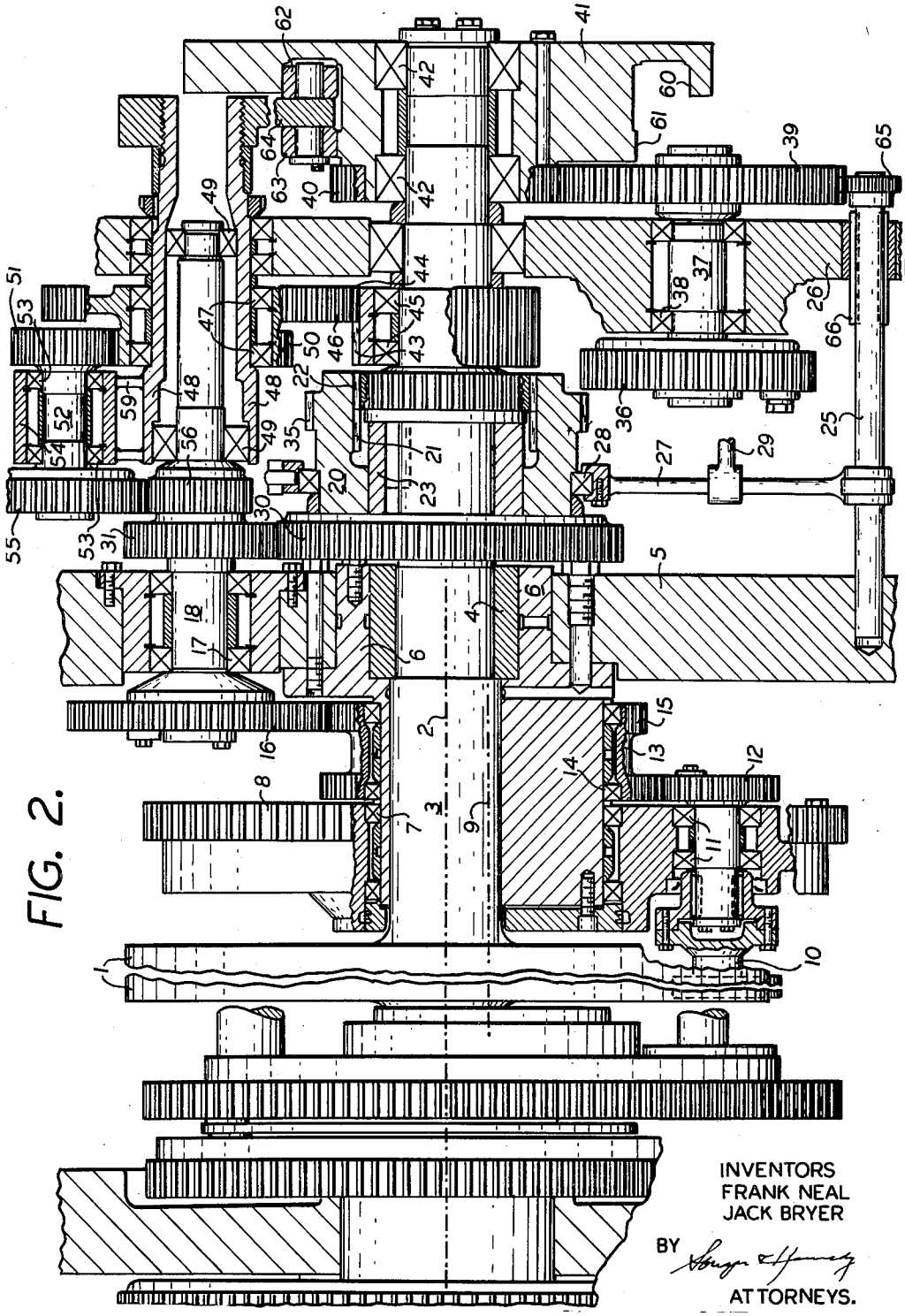

FIG. 2.

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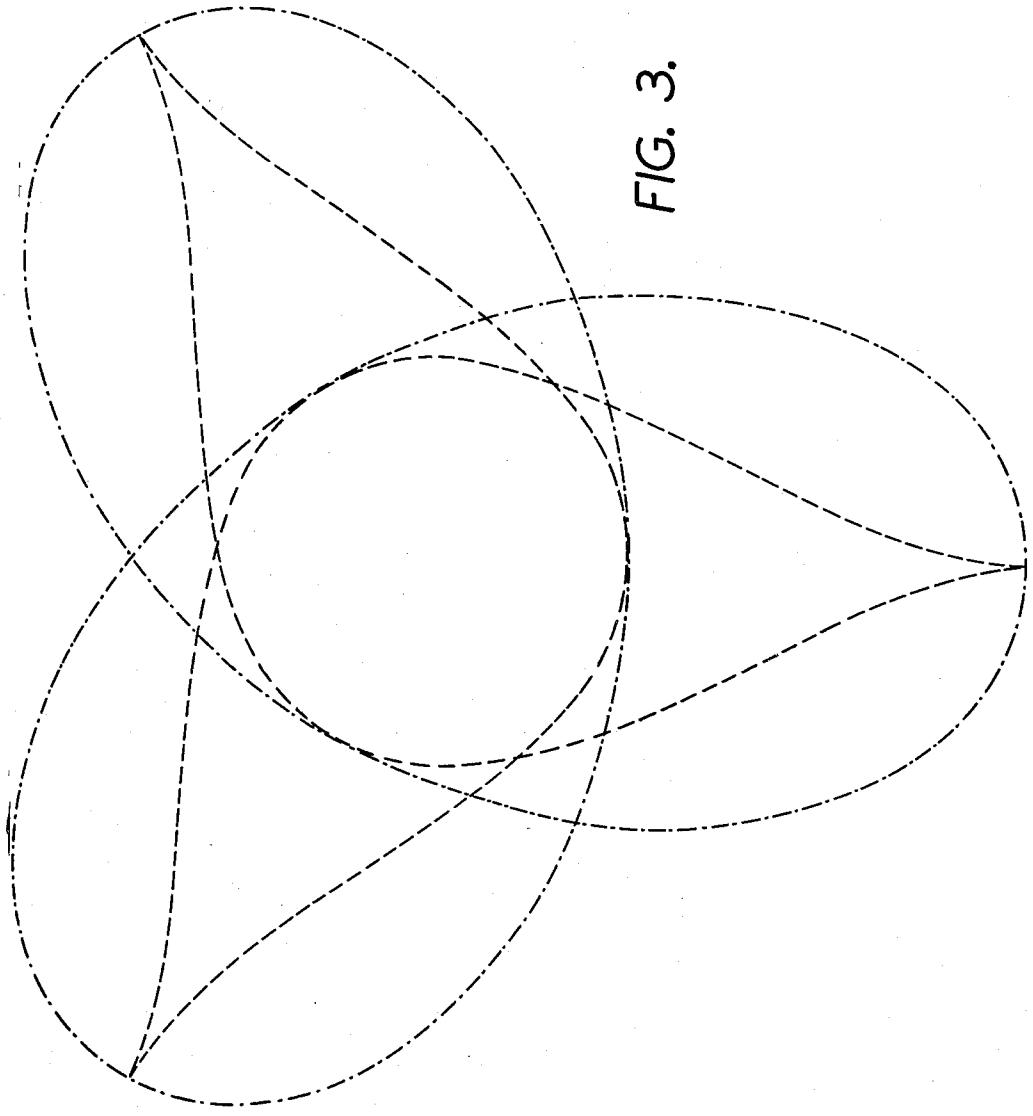

FIG. 3.

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FOLDING MECHANISMS

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7 Claims. (Cl. 270—77)

This invention relates to folding mechanisms, and more particularly to such folding mechanisms as used in connection with rotary printing presses.

A folding apparatus comprising a collecting cylinder having three sets of operating elements and cooperating with a cutting cylinder with two sets of cutting members is known, this being generally known as a 3:2 folder and it is known to provide in a mechanism of this character for either straight or collect run by modifying in a suitable manner the rotation of the folding blades.

It is an object of the present invention to provide an improved mechanism in a folder of this type by means of which the shift from straight run to collect run operation may be readily accomplished.

A further object of the invention is to provide means controlling the path of movement of the folding blade device in the case of collect runs to make it unnecessary to remove the folding blade which actually is not used in the collect run.

Another object of the invention is to provide a mechanism of the type indicated in which the alternative drive elements and shiftable members involved in the change from straight to collect run may all be located separate from and axially spaced from the cylinder body and folding blade carrier. The advantages obtained by this location include facility of housing and lubrication, facility of shift from straight to collect run and avoidance of reduplication of drive mechanism for the individual blades.

With the foregoing and other objects which will appear in the following full description in mind, the invention consists in the combinations and arrangements of parts and details of construction which will now first be fully described with reference to the accompanying drawing, and the features forming the invention will then be pointed out in the appended claims.

In the drawing:

FIG. 1 is an end view of a folding cylinder and associated mechanism;

FIG. 2 is a section on the line 2—2 of FIG. 1 showing the drive structure at one end of the cylinder of FIG. 1; and

FIG. 3 is a diagram showing the path of movement of the folding blade tip.

The folding cylinder arrangement of the invention is of a generally known type, such as shown, for example, in prior Jordhoy Patent 1,900,288 and in Tomlin Patent 2,026,443 and Harless Patent No. 2,919,914 and Harless application Serial No. 729,729, now U.S. Patent No. 2,981,540. In such devices, the folding cylinder body and folding blade carrier are mounted eccentrically with relation to each other and driven in timed relation, by gearing which may be conveniently located at one end of the cylinder structure, while the folding blade shafts are driven by suitable gearing located at the other end of the cylinder. Provision is made for collect and for straight runs and for modifying the rotary movement of the folding blades accordingly, the required modification being to double the rotary speed of the folding blades as compared to the folding blade carrier and also to introduce small modifications or adjustments in the generally epicyclic path traced by the folding blade, with a view to securing the desired folding action. The mechanism used for this purpose has taken a variety of forms, as, for example, differential drives to the folding blade

shafts for combining the planetary drive movement with an oscillating drive, and the general object of the present invention (as above indicated) is to provide an improved mechanism of this general type which permits the required change in drive speed ratio and also provides for an accurate and controllable modification of the folding blade path as required by the operating conditions for which the particular folder may be designed.

Referring now to FIGS. 1 and 2, there is indicated in these figures a folding cylinder body 1 which may be generally of conventional construction, which is rotatable about the axis 2 and supported by means of a shaft 3 in bearings 4 by the main frame 5. Surrounding bearings 4 is an eccentric bushing which, in turn, supports by means of bearings 7 the folding blade carrier 8 which element rotates about the axis 9 eccentric to the axis 2, as indicated. As will be understood, the blade carrier 8 and cylinder body 1 are rotated in timed relation to each other as usual in structures of this character by means of gearing located at the other end of the cylinder structure and the paper holding pins and other elements, not shown herein, may be of any desired conventional structure.

The carrier 8 supports the folding blade shafts 10 by means of anti-friction bearings 11 and each of these shafts 10 is driven by a planet pinion 12 which meshes with a sun gear 13 rotatably supported on the bushing 6 by bearings 14 for rotation concentrically with the folding blade carrier about the axis 9. A major difference between the folder of the present invention and prior folders of this general type is that the change from straight to collect runs is accomplished by suitable gearing connected to the sun gear 13 and the desired modification of path is also accomplished by timed modifying movements imparted to this sun gear, so that differential gearing and other mechanisms carried by the folding blade carrier and cylinder themselves are eliminated, placing the necessary elements in an axial separated position from the folding blade carrier so as to permit enclosure and convenient lubrication and also locating any adjusting members on relatively stationary parts to permit ready adjustment. In addition, a single mechanism suffices to accomplish the desired change in rotary movement for all three folding blades instead of requiring three sets of mechanism, as in prior devices.

The rotary position and movement of sun gear 13 is controlled through a gear wheel 15 integral with the sun gear 13 and in mesh with a drive pinion 16 which is rotatably mounted by means of anti-friction bearing 17, in the press frame 5 already referred to. The shift from straight to collect run involves essentially a shift from a direct coupling of the shaft 18 to which gear 16 is secured to the shaft 3 of the cylinder body to an indirect coupling through a differential gear mechanism which also modifies the rotary movement in a predetermined manner by means of a cam. The change from one condition of operation to the other is accomplished by shifting a sleeve 20 which is slidable along shaft 3 but rotatably coupled thereto by splined teeth 21, 22, the latter teeth being formed on a fixed sleeve 23 secured to the shaft 3, and by also shifting (axially) along with the member 20 a shaft 25 which is slidably mounted in the main frame 5 and auxiliary stationary frame or housing member 26, the parts 20 and 25 being coupled together and moved simultaneously by a fork 27 of usual construction connected to element 20 by an anti-friction bearing 28 and operated in any convenient manner, as, for example, by an externally accessible handle 29.

Considering now the parts in the position of FIG. 2, it will be observed that element 20 has fixed to it a gear wheel 30, which gear wheel is rotatably coupled to

the shaft 3 and which drives the gear wheel 31 fixed to the shaft 18. The ratios between gears 30 and 31 and gears 16 and 15 are selected so as to drive the gear 15, and, hence, the sun gear 13 at a desired speed of rotation in relation to the rotation of the cylinder body 2. In the case selected for purposes of illustration, gear 30 is connected by compound gearing to gear 15 in such a way that sun gear 13 rotates in the same direction as shaft 3 and the cylinder body but at twice the speed. Pitch diameters in the proportion of 14:6 and 6:7 for the respective gear couples 30—31 and 16—15 are suitable. The ratio between sun gear 13 and the planets 12 being 3:1, and the sun gear rotating at twice the angular speed of the cylinder body and, hence, also at twice the angular speed of the folding blade carrier 8, it will be apparent that a proper rotary movement for a straight run is imparted to the folding blade shafts 10. It will be noted that in the construction of the invention, where the sun gear rotates in the same direction and at twice the speed of the folding blade carrier, intermediate gearing for reversing the direction of rotation of the folding blade shafts by comparison with the planet pinions is unnecessary, so that the pinions may be mounted direct on the folding blade shafts, which cannot be done in the usual structure with stationary planet gear. As will appear from the position of FIG. 2, the axially shiftable shaft 25 has an action with relation to certain gears which are involved in the collect run, but description of this action will be postponed until operation for collect run has been described. The shift from straight to collect run involves a change of folding blade paths essentially similar to that shown in the Harless application above referred to, and is accomplished by the shifting of fork 27, as previously mentioned. This moves the element 20 so as to uncouple gears 30 and 31, and bring gear 35 also formed on the member 20 into mesh with a gear 36 carried on shaft 37 rotatably supported in the stationary frame structure 26 by bearings 38. The shaft 37 also carries a gear wheel 39 which meshes with a gear 40 fixed to a cam element 41 which is rotatably mounted on the shaft 3 by means of bearings 42. This is the main modifying cam previously referred to and the operation of which will later be described in connection with the differential drive arrangement by which its movement is communicated to the sun gear 13.

The shifting of element 20 also brings the spline teeth 21 (still in engagement with the teeth 22 on member 23) into coupling relation with spline gear teeth 43 formed on a sleeve 44 which is axially fixed but rotatably mounted on the shaft 3 by means of bearings 45. A gear wheel 46 also meshes with the gear teeth 43 and this gear wheel is rotatably carried by means of bearings 47 on a tubular shaft 48 which, in turn, is rotatably supported on the shaft 18 by means of bearings 49. A further gear 50 integral with the wheel 46 meshes with a gear 51, the shaft 52 of which is rotatably carried by bearings 53 in a bracket extension 54 secured to the hollow shaft 48 previously mentioned. This shaft 52 carries a gear 55 which meshes with gear 56 concentric and formed integral with the gear 41 previously referred to.

As will be apparent, the rotation of shaft 18 is now determined by the driving of gear 31 (disconnected from gear 30) through the gearing 43—46, 50—51, 55—56 and by whatever rotary movement is imparted to the hollow shaft 48, it being clear that such rotary movement causes, in addition to the turning movement of gear 55 upon the axis of shaft 52, a rolling or planetary movement of this gear around the gear 56.

The planetary movement of gear 55 is accomplished by the cam 41 previously mentioned. This is a box cam having radially spaced inner and outer cam surfaces 60 and 61 which engage in respective cam follower rollers 62 and 63 rotatably carried by cam follower arm 64 which is fixed to the tubular shaft 48. It will

be apparent that as the cam 41 rotates, it will rock the shaft 48 in a predetermined manner, thus causing the above mentioned planetary movement of gear 55 and accomplishing the desired modification of the folding blade action.

The gear ratios of a collect run are selected so that gear 43 (rotating at the speed of shaft 3) has a drive ratio of 3:2 with respect to the gear 15 and, hence, the sun gear 13 so that the sun gear now rotates with respect to the frame at fifty percent greater speed than the cylinder body, the folding blade carrier thus advancing a half rotation for each rotation of the folding blade carrier and requiring two rotations of the folding blade carrier to return to any given phase relationship thereto. This is the correct condition for a collect run. As is obvious, such a variation of drive ratio taken in itself will cause the folding blade to describe a relatively blunt cusp and the modification introduced by the cam 41 corrects this condition, superimposing upon the basic 3:2 rotation of the sun gear a suitably timed acceleration or deceleration. As is apparent, this acceleration and deceleration will occur with respect to any folding blade shaft once during each rotation of the folding blade carrier. However, only the acceleration and deceleration which occur at alternate rotations will affect the folding action, as during the other rotations the blade is in an inward or inoperative position.

As will be apparent, in the straight run (parts in the position of FIG. 2), the gear 36 and, hence, cam 41 are not driven. In fact, gear 36 and cam 41 are held stationary by means of a small pinion 65 meshing with gear 39. The pinion 65 is fixed to axially slidable shaft 25 which is slidable in but keyed against rotation to the frame element 26 by means of splines 66. In the straight run operation, since cam 41 is held stationary, the hollow sleeve 48 is also held stationary by cam follower arm 64. Gear elements 56, 51, 50 and 46 and the gear element 43 rotate idly in this condition of operation, but without affecting the rotation of shaft 18 or its sun gear 13 in any way.

The path of movement of the folding blade tip is shown in FIG. 3 (broken line) in combination with the unmodified path of the folding blade tip which would be obtained by silencing the cam 62 and associated parts. As is evident from FIG. 3, the path prior to superposition of the modifying movement is a simple three-lobed epicyclic curve requiring two rotations of the folding blade carrier to be traced in its entirety, as shown in the dot-dash line of the figure. The modifying movement sharpens the operative lobe of this curve into a cusp at every second rotation of the carrier as is clearly shown by the broken line of FIG. 3, this curve also requiring two rotations of the carrier to be traced in its entirety.

What is claimed is:

1. In a folding mechanism comprising a folding cylinder body, an eccentric folding blade carrier rotatable therewith, gearing for driving the said body and carrier at the same speed, three folding blades carried on shafts rotatably mounted in the carrier and symmetrical about the carrier axis, a folding blade drive mechanism comprising a drive pinion carried by each said folding blade shaft, a sun gear in mesh with the said pinions, means rotatably mounting the sun gear for rotation about the same axis as the folding blade carrier, a set of gearing for driving the said sun gear for a straight run at twice the speed of the folding blade carrier and in the same direction, whereby each folding blade describes a tricuspidal epicyclic path, one of the cusps of the said path being located in the operative folding position of the said blade, a second set of gearing for driving the said sun gear for a collect run comprising gearing for rotating the said sun gear, still in the same direction as the carrier but at an average speed one and one-half times the speed thereof, whereby each folding blade now describes a modified epicyclic path requiring two revolutions of

the folding blade carrier and comprising a single cusp at the operative folding position of the blade and a pair of lobes in the inoperative position thereof, the average speed of rotation of each folding blade being one-half the speed of operation for the said straight run, the said second set of gearing comprising also accelerating and decelerating means operable in timed relation to the said folding blade carrier and differential gearing connecting the first mentioned collect run gearing and said accelerating and decelerating means to the said sun gear, whereby the said folding blade is accelerated in its operating position to substantially the speed of operation for a straight run and decelerated in its inoperative position to maintain an average speed of rotation one-half that for a straight run, thus sharpening the cuspidal path for a collect run to substantially the form for a straight run, and clutch means for selectively driving the said sun gear through the two said sets of gearing.

2. A folding blade drive mechanism according to claim 1, in which the said differential gearing comprises a first driving element and means for driving the same from the cylinder body shaft, a second driving element and means for driving the same from the said accelerating and decelerating means, a driven element driven by the two said driving elements, and means for driving the said sun gear from the said driven element.

3. A folding blade drive mechanism according to claim 2, in which the said accelerating and decelerating means comprises a cam mechanism driven by the cylinder body.

4. In a folding mechanism comprising a folding cylinder body, eccentric folding blade carrier rotatable therewith and folding blades having shafts rotatably mounted in the carrier, a folding blade drive mechanism comprising for each folding blade a drive pinion, a sun gear in mesh with the said pinions, means rotatably mounting the sun gear for rotation about the folding blade carrier axis, a set of gearing for driving the said sun gear in the same direction, a further set of gearing for driving the said sun gear in the same direction but at a three-to-two speed ratio and clutch means for selectively driving the said sun gear through the two said sets of gearing, and in which the said further set of gearing comprises a differential having a driving, driven and intermediate member, and means for oscillating the said intermediate member in timed relation to the rotation of the carrier for periodically accelerating and decelerating the said sun gear.

5. In a folding mechanism comprising a folding cylinder body, eccentric folding blade carrier rotatable therewith and folding blades having shafts rotatably mounted in the carrier, a folding blade drive mechanism comprising for each folding blade a drive pinion, a sun gear in mesh with the said pinions, means rotatably mounting the sun gear for rotation about the folding blade carrier axis, a set of gearing for driving the said sun gear in the same direction, a further set of gearing for driving the said sun gear in the same direction but at a three-to-two speed ratio and clutch means for selectively driving the said sun gear through the two said sets of gearing, and in which the said further set of gearing comprises a driving and driven gear coaxial therewith, a jack shaft spaced from the common axis of the said gears and carrying gears in mesh therewith for driving the driven gear from the driving gear through the said jack shaft, means mounting the jack shaft for planetary movement about the said common axis and means for oscillating the said shaft back and forth about the said common axis in timed relation to the said driving gear, whereby the said sun gear is periodically accelerated and decelerated in timed relation to the carrier rotation.

6. A folding blade drive mechanism according to claim 5, in which the first mentioned set of gearing comprises a gear coupled with the said driven gear and the clutch means is operated for driving the sun gear through the first said set of gearing, and comprising also means for selectively coupling and uncoupling the said oscillating drive means.

7. In a folding mechanism comprising a folding cylinder body, eccentric folding blade carrier rotatable therewith and folding blades having shafts rotatably mounted in the carrier, a folding blade drive mechanism comprising for each folding blade a drive pinion, a sun gear in mesh with the said pinions, means rotatably mounting the sun gear for rotation about the folding blade carrier axis, a set of gearing for driving the said sun gear in the same direction, a further set of gearing for driving the said sun gear in the same direction but at a three-to-two speed ratio and clutch means for selectively driving the said sun gear through the two said sets of gearing, and in which the said further set of gearing comprises a wide face gear rotatably carried on the cylinder body shaft and meshing with a gear transmitting rotation to the sun gear, and in which the said clutch means comprises a clutching member splined to the cylinder body shaft and slidable axially thereof and having internal teeth for engaging the said wide faced gear to couple the same to the cylinder body shaft.

References Cited in the file of this patent

UNITED STATES PATENTS

1,118,060	Schmidt	Nov. 24, 1914
2,016,298	Sather	Oct. 8, 1935
2,082,262	Sather	June 1, 1937
2,348,605	Carpenter	May 9, 1944