June 1, 1937. O. H. SATHER 2,082,262

FOLDING MECHANISM

Filed April 26, 1935

Fig. 4

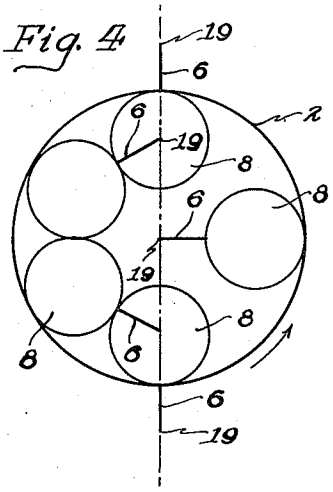


Fig. 1

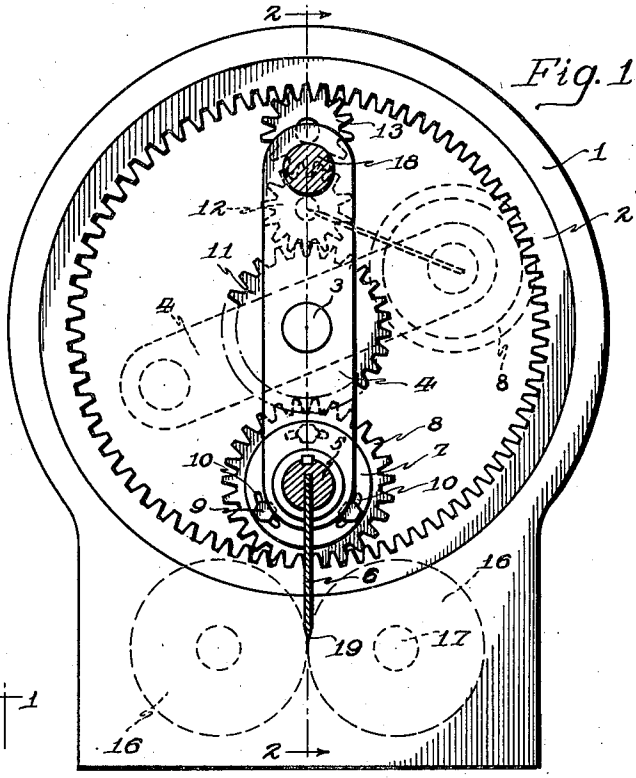


Fig. 2

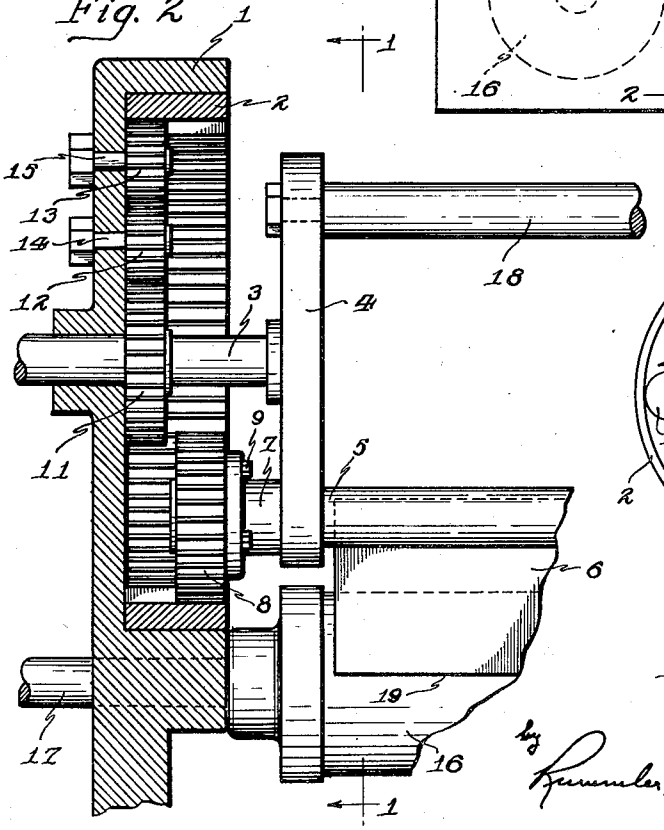
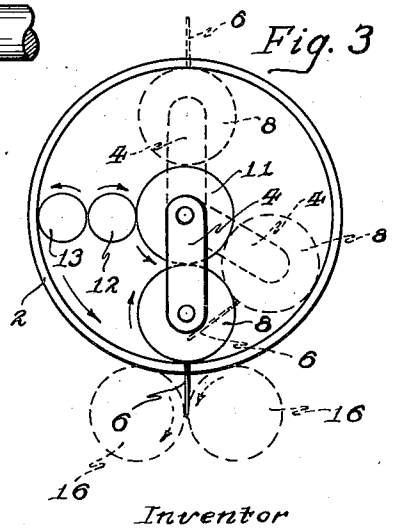


Fig. 3



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FOLDING MECHANISM

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7 Claims. (Cl. 270—77)

This invention relates to rotary folding mechanisms of the type disclosed in my copending patent application Serial No. 723,070, filed April 30, 1934, arranged to tuck sheets of paper between opposed pressing surfaces, whereby the said sheets are folded on a predetermined line, and particularly to the actuating means for such mechanism.

The main objects of this invention are to control the path of the leading edge of a tucker blade in a rotary folding mechanism by the use of gears only so that the said leading edge will reciprocate on a straight line between two predetermined radially spaced points and at a predetermined number of angular positions during each cycle of operation; to provide an improved folding mechanism wherein the leading edge of the tucking blade travels constantly along a straight line; to provide a constant straight line movement of the leading edge of the tucking blade in a rotary folding mechanism; to provide an improved high-speed rotary folding mechanism in which fanning by the tucking blade is obviated; and to provide an improved arrangement of planetary gear driving mechanism for rotary folding devices.

An illustrative embodiment of this invention is shown in the accompanying drawing, in which:

Figure 1 is a view showing the driving mechanism of a rotary folding device.

Fig. 2 is a sectional view of the same taken on line 2—2 of Figure 1.

Fig. 3 is a diagrammatic view showing the relationship of the driving gears and their relative direction of travel.

Fig. 4 is a diagrammatic view showing the relative positions of the tucking blade at several points in a complete cycle of its movement.

In the form shown in the drawing, the improved folding mechanism comprises a planet gear traveling on the inner periphery of an internal gear and carrying a tucking blade which extends beyond the pitch circle of the planet gear, so arranged that the mechanism driving the planet gear also rotates the internal gear in the same angular direction, whereby the leading edge of the tucking blade is caused to travel in a plane that diametrically intersects the internal gear at right angles thereto.

As shown in the drawing, the folding mechanism comprises an end housing 1 within which an internal gear 2 is rotatably mounted and through which a drive shaft 3 extends concentric with the said internal gear 2. Mounted on the inner end of the drive shaft 3 is an arbor or crank arm 4 which is fixed to the shaft 3 and extends at right angles thereto in opposite directions from the shaft axis.

Journaled in one end of the arbor 4 is a tucking blade shaft 5 on which is mounted a tucking or tucker blade 6, the blade 6 extending radially from the shaft 5. On the end of the shaft 5, adjacent the internal gear 2 is a flanged hub 7 to which is secured a planet gear 8 arranged to mesh with the internal gear 2. The planet gear 8 is secured to the flanged hub 7 by means of bolts 9 which extend through slots 10 in the flange of the hub 7 whereby the gear 8 may be adjusted angularly relative to the axis of the shaft 5.

Fixedly mounted on the drive shaft 3 is a gear 11 which, through a pair of idler gears 12 and 13, drives the internal gear 2, the idler gears 12 and 13 being journaled on stub shafts 14 and 15 which are mounted in the end frame or housing 1.

Pressing or folding rollers 16 are mounted on rotatable shafts 17 which extend through the end housing 1 below the internal gear 2. Two rollers 16 are provided, one on each side of the center line of the driving mechanism. However, in usual practice only one of these rollers is driven, the other being merely an idler.

In the form shown, the arbor or crank arm 4 is a cross bar which extends equi-distant in an opposite direction from the shaft 3, one side carrying the tucking blade shaft 5 and the opposite side carrying a tiebar 18 which serves to balance the shaft 5 and tucking blade 6. The opposite ends of the shaft 5 and tiebar 18, which are not shown, are connected by a second crank arm or arbor, also not shown, which is suitably journaled and supported.

The driving mechanism shown is all arranged with the purpose of driving the tucking blade so that its leading edge will travel in a single plane which will necessarily include a diameter of the internal gear 2. Thus the leading edge of the tucker blade will be traveling in a straight line as it engages the sheet to be folded and will continue in the same straight line as it carries the sheet between the folding or pressing rollers.

To accomplish this result, the planet gear can make only one revolution about its own axis while making one gyratory revolution about the axis of the driving shaft 3. It is well known that any point on the periphery of a planet gear traveling in an internal gear of twice its diameter will travel along a diameter of the internal

gear, the planet gear making only one revolution about its own axis for each gyration around the axis of the internal gear. However, the herein-described mechanism is designed to give the same effect to the edge of a tucking blade that extends beyond the periphery of the planet gear. To do so the tucking blade must extend beyond the periphery of the planet gear a distance equal to the difference between the pitch diameter of the planet gear and one-half the pitch diameter of the internal gear and the driving mechanism must be arranged to rotate the internal gear in the same direction as the direction of gyration of the planet gear at a peripheral velocity which will reduce the peripheral velocity of the planet gear to such an extent that the planet gear will make only one revolution for each cycle or complete gyration around the axis of the internal gear. The width of the tucking blade being sufficient to reach a plane including a certain predetermined diameter of the internal gear regardless of the angular position of the planet gear relative to the internal gear axis, the proper peripheral velocity of the planet gear relative to its gyratory angular velocity is maintained by proper proportioning, relative to each other of the diameters of the planet gear, the internal gear and the gear which drives the internal gear.

In the form shown, the planet gear **8** is made with a pitch diameter of one-third that of the internal gear **2** so that upon one revolution of the crank arm **4** about the axis of the shaft **3**, the planet gear **8** would make two complete revolutions relative to its own axis if the internal gear **2** were held stationary. The internal gear **2** is, however, driven by the gear **11** through the idlers **12** and **13** and the gear **11** is made with the same pitch diameter as the planet gear **8** so that upon one revolution of the shaft **3**, and since two idler gears are employed between the gear **11** and the internal gear, the internal gear is rotated one-third of a revolution or through 120° angularly and in the same direction as the direction of rotation of the shaft **3** and the crank arm **4**.

Such movement of the internal gear causes the peripheral velocity of the planet gear **8** about its own axis to be reduced an amount equal to the peripheral velocity of the internal gear. Thus, since in one complete gyration of the planet gear **8** about the axis of the shaft **3**, the internal gear is moved through one-third of a revolution, or a peripheral distance equal to the pitch circle circumference of the gear **8**, the rotation of the gear **8** about its own axis will be reduced by one revolution and, in one cycle of operation or one complete gyration of the planet gear **8** about the axis of the shaft **3**, the gear **8** will make only one revolution relative to its own axis.

The tucking blade **6** is made of such a width that it extends beyond the pitch circle of the planet gear **8** a distance equal to one-half the pitch diameter of the planet gear **8**, or the difference between the diameter of the gear **8** and one-half the diameter of the internal gear **2**. Thus, upon rotation of the shaft **3** and the crank arm **4**, the leading edge **19** of the tucking blade **6** may be confined in its travel to a single straight line which intersects both the leading edge **19** and the axis of the shaft **3**, since the distance between the edge **19** and the axis of the planet gear **8** is the same as the distance between the axes of the gear **8** and the shaft **3**.

In operation the driving mechanism is first adjusted so that the leading edge of the tucking blade is properly located in the plane in which it is intended to travel, this being done while the planet gear is in its lowermost position, as shown in Fig. 1, by loosening the bolts **9** holding the planet gear to the flanged hub **7** on the tucking blade shaft **5** and turning the shaft **5** until the blade is perfectly aligned with the plane which includes the axes of both the shafts **3** and **5**. The bolts **9** are then tightened and the apparatus is ready for the application of power.

Power is applied to the shaft **3** to drive the tucking mechanism and to one of the shafts **17** to drive the pressing rollers and as the crank arm **4** is rotated, the planet gear is carried around the periphery of the internal gear so that it will be rotated on its own axis because of its engagement with the internal gear. The internal gear is simultaneously rotated in the same angular direction as the gyratory travel of the planet gear and thus reduces the speed of rotation of the planet gear so that the edge of the blade **6** will remain in the proper plane.

It will be understood that other arrangements than that shown may be provided for rotating the planet gear on its own axis in order to accomplish the desired control of the leading edge of the tucking blade and provide a straight line reciprocating motion thereof at the tucking points.

In any case the tucking operation is to be performed at a point outside of the outer path of travel of the pitch circle of the gyrating planet gear and the dimension of this circle, which is the imaginary outer rolling circle of the planet gear and which is coincident with the pitch circle of the internal gear if such is employed to drive the planet gear, is the principal basis of all the proportions for the main elements of the mechanism since it determines the radial size and space requirements of the completed device.

The main advantage of my improved folding mechanism lies in the fact that a greater speed can be had than is efficiently possible with other arrangements now in use and is the result of eliminating any fanning action of the tucking blade and driving the same so that it approaches and strikes the sheet to be folded at right angles to the sheet surface. Thus in high speed operation and with a positive, accurate sheet feed, the blade will exactly strike the desired line of fold and remain thereon while tucking the sheet between the folding rollers **16**.

Although but one specific embodiment of this invention is herein shown and described, it is to be understood that details as set forth may be altered or omitted without departing from the spirit of the invention as defined by the following claims:

I claim:

1. A folding mechanism comprising an internal gear, a planet gear meshed with said internal gear, a tucker blade connected with said planet gear and arranged to extend beyond the pitch circle thereof a distance equal to the difference between the pitch diameter of said planet gear and one-half the pitch diameter of said internal gear, means to impart angular motion of constant velocity to said planet gear, and means to rotate said internal gear in the same direction as the angular motion of said planet

gear and at peripheral velocity such that the leading edge of said tucker blade will move in a single plane diametrically intersecting said internal gear.

2. A folding mechanism comprising a drive shaft, an arm on said drive shaft, a planet gear mounted on said arm, a tucker blade mounted on said planet gear, a rotatably mounted internal gear meshing with said planet gear, said tucker blade being arranged to extend beyond the pitch circle of said planet gear a distance equal to the difference between the pitch diameter of said planet gear and one-half the pitch diameter of said internal gear, and means driven by said drive shaft for rotating said internal gear in the same direction as said drive shaft and at a peripheral velocity such that the leading edge of said tucker blade will move in a plane diametrically intersecting said internal gear at right angles thereto.

3. A folding mechanism comprising a drive shaft, an arm on said drive shaft, a planet gear mounted on said arm, a tucker blade mounted on said planet gear, a rotatable internal gear meshing with said planet gear, and means driven by said drive shaft for rotating said internal gear constantly in the same direction as said drive shaft and at one-third the angular velocity thereof, said planet gear and said internal gear having a three to one ratio and said tucker blade extending beyond the pitch circle of said planet gear a distance equal to one-half the pitch diameter thereof.

4. A folding mechanism comprising a drive shaft, an arm on said drive shaft, a planet gear mounted on said arm, a tucker blade mounted on said planet gear, a rotatable internal gear meshing with said planet gear, said planet gear having a pitch diameter of one-third the pitch diameter of said internal gear, said tucker blade being arranged to extend radially from the axis of said planet gear and beyond the pitch circle thereof a distance equal to one-half the pitch diameter of said planet gear, a driving gear on said drive shaft having a three to one ratio with said internal gear, and idler gears meshed between said driving gear and said internal gear whereby said internal gear is rotated in the same direction as said drive shaft.

5. A folding device comprising an internal gear, a planet gear meshed with said internal gear, a tucker blade connected with said planet gear and arranged to extend beyond the pitch circle thereof, means to impart angular motion of constant velocity to said planet gear, and means to rotate said internal gear in one direction and at a peripheral velocity such that the leading edge of said tucker blade will move in substantially a straight line from a position within to a point beyond the pitch circle of said internal gear.

6. A folding device comprising a planet gear arranged to gyrate around an axis and at a fixed distance therefrom, a tucker blade connected with said planet gear and arranged to extend beyond the pitch circle thereof, means to gyrate said planet gear at a constant angular velocity, and means to rotate said planet gear in one direction on its own axis and at such a constant peripheral velocity as to cause the leading edge of said tucker blade to follow a path that crosses the outer path of travel of the pitch circle of said planet gear and does not cross itself, said leading edge moving along a radial straight line beyond said outer path of travel of said planet gear.

7. A folding device comprising a planet gear arranged to gyrate around an axis and at a fixed distance therefrom, a tucker blade connected with said planet gear and arranged to extend beyond the pitch circle thereof, means to gyrate said planet gear at a constant angular velocity, and means arranged to rotate said planet gear in one direction on its own axis and at a constant peripheral velocity such that the leading edge of said tucker blade will be extended beyond the outer path of the pitch circle of said planet gear a predetermined number of times during and commensurate with one gyration of said planet gear, all proportioned such that the diameter of the outer path of the planet gear pitch circle divided by the predetermined number of times said tucker blade is extended beyond the same during one gyration of said planet gear will equal the diameter of said planet gear plus the distance said tucker blade extends beyond the pitch circle of the same.

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