Feb. 20, 1968 R. M. LOASE 3,369,436

APPARATUS FOR PROCESSING A WEB OF MATERIAL

Filed March 30, 1966

FIG-1

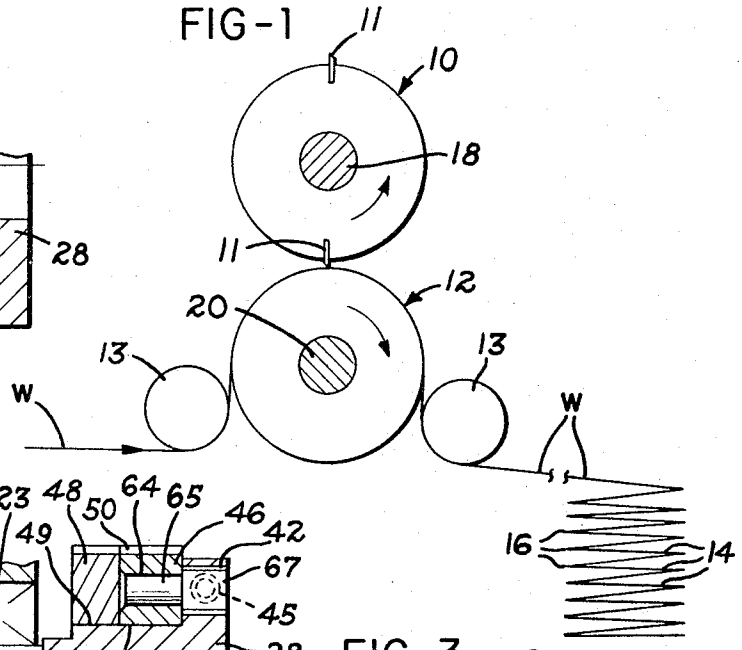


FIG-4

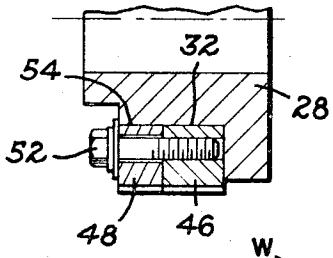


FIG-2

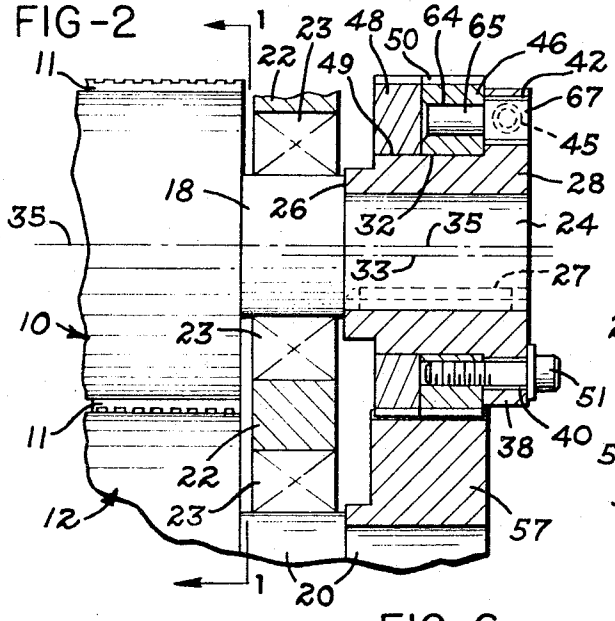


FIG-3

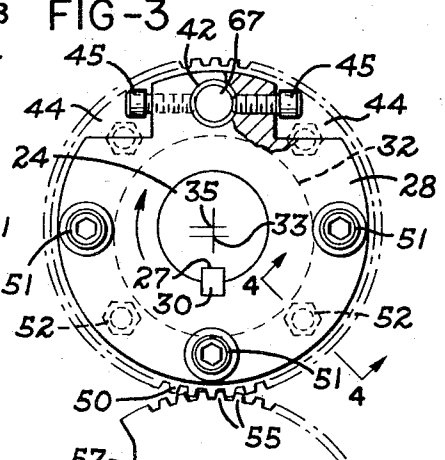


FIG-5

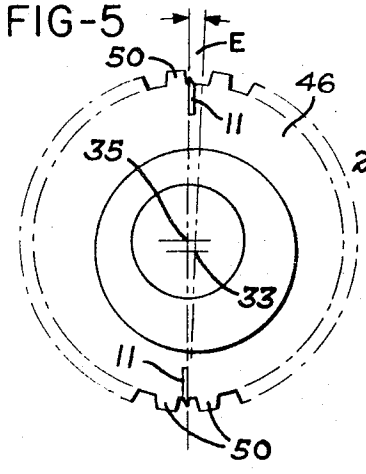
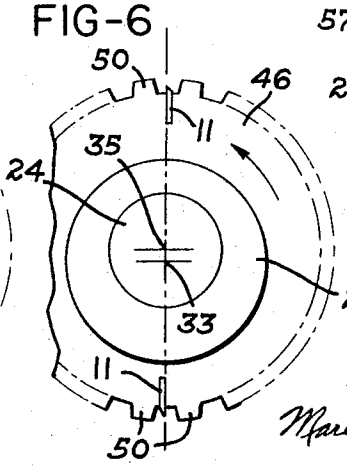
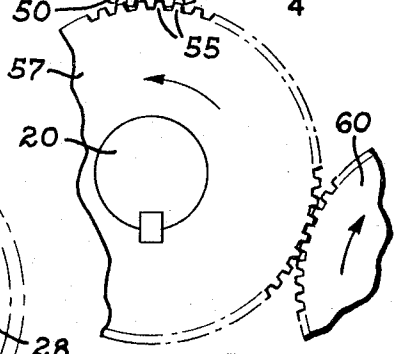


FIG-6





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APPARATUS FOR PROCESSING A WEB OF MATERIAL

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This invention relates to apparatus for performing successive operations on a moving web of material such as a web of successively connected business forms at intervals along the length thereof, and specifically to an improved drive mechanism for such apparatus to provide precisely uniform spacing between the operations on the web.

In the manufacture of machinery for performing successive operations on a web of paper, it has always been difficult to provide extremely accurate registration or spacing between the successive operations. For example, in the forming of successive rows of cross perforations along a paper web traveling within a printing press by a pair of perforation knives mounted on a rotating cylinder, there is a problem of maintaining precise spacing between the successive rows of cross perforations. This problem is usually presented by the difficulty in mounting the pair of perforation knives precisely diametrically opposite on the cylinder and/or the occurrence of slight eccentricities or errors, even with extremely accurate machining, in the spacing of the teeth on the gears which drive the cylinder or connect the cylinder with other driven elements on the press, and thereby cause a slightly irregular timing or phasing of the knives relative to the web feed.

When a perforation knife or a pair of knives mounted on the cylinder do not contact the web in precise timed relationship with the movement of the web, there results an accumulation of alternately long and short spacing between the successive rows of cross perforations. Thus when the web is subsequently folded along the perforations in a zigzag manner to form a stack of business forms, a sloping stack develops which is not only objectionable from a product appearance standpoint but presents an increasingly more difficult problem to package the forms in a rectangular carton or the like without curling the forms. Thus it is highly desirable to space the rows of cross perforations precisely along the length of the web so that the subsequent zigzag folding of the web produces an erect stack of folds with vertically aligned edges.

Heretofore, when a condition of irregular spacing of the cross perforations was presented, it has been common practice to shim one of the knives or rotate the drive gears relative to each other until a position is found where the error in one gear offsets or neutralizes the error in another gear. This trial and error procedure is not only time consuming but frequently requires replacement of gears and thus necessitates maintaining a supply of extra gears on hand.

While the drive mechanism of the present invention is ideally suited for use in forming successive rows of cross perforations at intervals along the length of a web of paper, it is to be understood that it is within the scope of the invention to employ the drive mechanism for performing other successively spaced operations on a moving web of material whenever it is desirable to maintain extremely precise spacing between the successive operations. For example, the improved drive mechanism may be used for forming successive creases on a web as well as the printing of successive prints by maintaining precise positioning between the drive gears and the creasing or printing elements mounted on the driven cylinder. It is to be

further understood that the mechanism of the invention is not limited to the processing of a web of paper but may also be used for processing continuous length of other materials such as plastic film, metal foil or the like, whenever it is desirable to maintain precision spacing between the successive operations performed on the material.

Accordingly it is a primary object of the present invention to provide an improved apparatus for performing precisely spaced successive operations on a continuously moving web of material.

As another object, the present invention provides such apparatus with a drive mechanism which include conveniently located means for quickly adjusting the mechanism to achieve the precise uniform spacing.

As a more specific object, the invention provides an apparatus as outlined above including a cylinder mounted on a shaft and having a pair of diametrically opposed elements mounted thereon for performing the successive operations on the moving web of material and further including a gear for driving the cylinder support shaft, and wherein the gear is mounted for rotation on an axis offset from the axis of the shaft so that rotational adjustment of the gear relative to the shaft provides for precision alignment among the teeth of the gear, the elements mounted on the cylinder and the axis of the shaft.

As a further object, the invention provides a mechanism as outlined above wherein a plane passing through the axis of the shaft and the rotational offset axis of the gear is almost parallel or at an acute angle to a plane passing through the pair of diametrically opposed elements mounted on the cylinder so that a slight rotational adjustment of the gear on its offset axis positions the elements precisely in relation to the teeth on the gear driving cylinder.

As a more specific object, the invention provides a drive mechanism as outlined above for an apparatus which form successive rows of cross perforations on a continuously moving web of paper whereby the spacing between successive rows of perforations is precisely uniform so that the web can be subsequently folded along the perforations in a zigzag manner to produce a vertically aligned stack of folds.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawing:

FIG. 1 is a schematic elevational view of a cross perforating apparatus as generally seen along the line 1—1 of FIG. 2;

FIG. 2 is a fragmentary enlarged view partly in section, of a drive mechanism for the apparatus of FIG. 1 and constructed in accordance with the present invention;

FIG. 3 is an elevational end view of the drive mechanism shown in FIG. 2;

FIG. 4 is a fragmentary section view of a drive gear and supporting hub as viewed along the line 4—4 of FIG. 3;

FIG. 5 is a schematic view of a drive gear shown in FIG. 3 for illustrating in exaggeration a slight misalignment error which commonly occurs due to errors in the drive gears and/or in the mounting of the cross perforating knives; and

FIG. 6 is a view similar to FIG. 5 illustrating the aligned relationship between the drive gear and the knives as provided by the mechanism shown in FIGS. 2 and 3.

Referring to the drawing which illustrates a preferred embodiment of a drive mechanism constructed in accordance with the invention, the mechanism is shown and described herein for driving a pair of cylinders for a cross perforating apparatus. However, as mentioned above, it

is to be understood that it is within the scope of the invention to employ the mechanism for driving other devices, as for example, a pair of printing cylinders.

As commonly employed near the end of a web printing press, the apparatus shown in FIG. 1 generally includes a cylinder 10 having a pair of generally diametrically opposed perforating (or creasing) knives 11 which are adapted to engage alternately the surface of a hardened backup or anvil cylinder 12 as a web W of paper is directed partly around the anvil cylinder 12 by the guide rolls 13 so that the web is fed between the cylinders 10 and 12. As mentioned above, it is highly desirable to form the successive rows of cross perforations on the web W so that the spacing between the rows is uniformly precise whereby when the web is folded in a zigzag manner as illustrated in FIG. 1 (by apparatus not shown), the forms or fold 14 will produce a vertically erect stack and the corresponding folded edges 16 will be in vertical alignment.

As also mentioned above, if the cutting edges of the knives 11 are not spaced precisely 180° apart from each other on the cylinder 10 in relation to its rotation axis or if the drive gears for the cylinder 10 are not perfectly constructed, the nonuniform spacing between the successive rows of cross perforations will produce alternately long and short folds 14 which will result in a sloping stack. While the spacing between successive cross perforations will not usually vary more than .010 inch, it has been found that any slight error in spacing will result in a sloping stack.

As shown in FIGS. 1 and 2, the cylinders 10 and 12 are mounted on shafts 18 and 20 respectively, each of which are rotatably supported between a pair of vertically extending frame walls 22 (only one side shown) in the bearings 23. The outer drive end portion 24 of the shaft 18 is reduced in diameter to define a shoulder 26 and has an axially extending keyway 27 formed therein. A hub 28 is mounted on the end portion 24 against the shoulder 26 and is secured thereto for positive rotation by a key 30 mounted within the keyway 27.

A cylindrical surface 32 (FIG. 2) is formed on the hub 28 and has an axis 33 which is offset or eccentric to the axis 35 of the shaft 18. A radially extending flange 38 is formed as an integral part of the hub 28 and has formed thereon a plurality of openings 40 (one shown in FIG. 2) and a somewhat larger cylindrical opening 42 which is spaced midway between a pair of notches 44 (FIG. 3) formed in the periphery of the flange 38. Extending through the flange into the opening 42 from each of the notches 44 are opposed and aligned adjusting screws 45 which are threaded in the flange.

A split gear having sections 46 and 48, each having an eccentrically formed bore 49 and teeth 50, is mounted on the cylindrical surface 32 of the hub 28. The bore 49 is formed with its axis offset from the axis of the pitch circle of the gear, which is generally concentric with the shaft axis 35, by an amount which is equal to the offset between the axes 33 and 35. The gear section 46 is secured to the flange 38 by three screws 51 which extend through the respective openings 40 and are threaded into the gear 46. The innermost gear section 48 is, in turn, secured to the gear section 46 by screws 52 (FIGS. 3 and 4) which extend through openings 54 formed in the gear section 48 and are threaded into the gear section 46. As shown in FIG. 2, the openings 40 are slightly larger than the diameter of the screws 51 so that when the screws 51 are loosened, relative rotation can occur between the gear 46 and the surface 32 about the axis 33.

Referring to FIG. 3, the teeth 50 on the gear sections 46 and 48 mesh with the teeth 55 formed on a driving gear 57, which is mounted on the shaft 20 supporting the backup cylinder 12. The gear 57 is, in turn, driven by a gear 60 which forms part of a gear train which is driven in timed relationship with the movement of the web W. The gear sections 46 and 48 are employed to prevent backlash between the teeth 55 on the driving gear 57 and the teeth 50 formed on the respective gear sections 46 and 48. This is accomplished by loosening the screws 52 and rotating the gear 48 relative to the gear 46 until any backlash is essentially eliminated, after which the screws 52 are retightened. It is to be understood, however, that the split gear construction, per se, forms no part of the present invention, but is only shown to illustrate the desirability of the combination of the antibacklash feature with the mechanism or apparatus of the invention.

Rigidly mounted in an opening 64 (FIG. 2) formed within the gear section 46 is a pin 65, having a head portion 67 which extends axially into the opening 42 formed within the flange portion 38 of the hub 28. As shown in FIGS. 2 and 3, the diameter of the opening 42 is somewhat larger than the diameter of the head 67, thus the gear 46 can be rotated relative to the flange 38 of the hub 28 by an amount equal to the difference in diameters between the opening 42 in the head 67. By loosening the screws 51, the gear section 46 can be rotated on the cylindrical surface 32 of the hub 28 by adjusting the screws 45, whereby the axis 33 of the gear bores 49 is shifted relative to the axis 35 of the shaft 18.

Referring to FIG. 5, to illustrate a typical condition which can be corrected with a drive mechanism constructed in accordance with the invention, opposed pairs of teeth 50 on the gear section 46 are shown angularly displaced from a plane passing through the knives 11 by a distance E which represents the error. This displacement is exaggerated for purposes of illustration since E usually does not exceed .005 inch which would result in an error of .010 inch in blade spacing.

The distance E may also represent error in the mounting of the knives 11 on the cylinder 10 whereby the knives are not disposed precisely at 180° from each other in relation to the shaft axis 35. In accordance with the invention, and because of the offset relationship between the hub axis 33 and the shaft axis 35, by adjusting the screws 45 and rotating the gear sections 46 and 48 on the hub 28, the teeth 50 on the gear sections can be precisely aligned or positioned in relation to a plane passing through both of the knives 11. This aligned relationship is shown in FIG. 6.

It should be noted, however, that due to the relatively small eccentric displacement of the axis 33 to the axis 35, rotation of the gear sections 46 and 48 on the hub 28 effectively produces displacement of an upper tooth 50 (FIG. 5) in one direction and slightly less displacement of a lower tooth 50 in an opposite direction. Thus, in effect, it is the differential displacement which produces the corrective adjustment. Furthermore, while a small eccentric displacement between the axes is preferred for providing a finely precise adjustment, it is to be understood that a more coarse adjustment could be obtained by increasing the displacement between the axes 33 and 35.

For example, by pivotally connecting a gear similar to the gear section 46 to the bottom portion of the flange 38 and laterally adjusting the gear section near the top of the flange, a coarse adjustment could be provided. Furthermore, by mounting a gear similar to gear section 46 on a cross slide member so that the gear could be adjusted laterally relative to its supporting hub member would also provide for a coarse and more direct adjustment for correcting alignment errors. In either case, however, the axis of the gear pitch circle is adjusted relative to the axis of the supporting shaft for the gear.

As shown in FIG. 5, it is desirable that the axes 33 and 35 be disposed in relation to each other to define a plane which extends almost parallel or at a small acute angle to the plane of the pair of knives 11. Thus an adjustment of the pin 65 within the opening 42 results in a minimum vertical movement of the gear 46 relative to the shaft 18 which, in turn, minimizes the change in engagement or mesh between the teeth 55 of the gear 57

and the teeth **50** of the gear section **46**. While some lateral displacement is produced when the gear section **46** is adjusted, the displacement is usually so small that the mesh is not significantly affected.

Thus a drive mechanism constructed in accordance with the present invention produces several desirable features and advantages. Basically, by providing relative rotation between the gear sections **46** and **48** on an axis offset or eccentric to the axis of the shaft **18**, the teeth **50** on the gear **46** can be precisely positioned relative to the knives **11** on the perforating cylinder **10**, and thereby compensate for machining tolerances during the forming of the teeth **50**. Furthermore, the knives **11** can thus be adjusted to be precisely positioned 180° apart in relation to the axis **35** of the shaft **18**, so that rotation of the shaft **18** through the driving engagement between the gears **60**, **57**, **46** and **48** will produce uniformly spaced rows of cross perforations in the web W.

While the drive mechanism shown in the drawing is ideally suited for use with a perforating apparatus having a cylinder with a pair of diametrically opposed perforating knives mounted thereon, it can be seen that the mechanism can also be used for other cylinders on which are mounted a pair of elements for performing successive operations at intervals along the length of a web of material. That is, the drive mechanism of the invention can be employed whenever it is desirable to provide precisely uniform spacing between the successively formed operations.

It is also a feature of the invention that the gear section **46** can be conveniently adjusted on the hub **28** simply by making corresponding adjustments of the screws **45** which are located adjacent the outer end of the shaft **18** and outboard of the side frame wall **22** which supports one end of the shaft. Also the heads of the screws **51** are conveniently located for loosening the gear section **46** for adjustment.

The drawing illustrates the drive mechanism of the invention mounted on the end portion **24** of the shaft **18** which supports the perforating cylinder **10**, however, it is to be understood that as an alternative, the mechanism can also be mounted on the shaft **20** which supports the backup roll **12**. However, regardless of which shaft on which the mechanism is mounted. it is preferred that axes **33** and **35** be spaced generally in parallel relationship with the knives **11** so that when the gear **46**, **48** is rotated on the hub **28** for adjustment, there is a minimum effect on the teeth mesh or engagement between the gear sections **46** and **48** and gear **57**, especially at the point when the knives **11** engage the web W to form perforations.

While the drive mechanism shown in the drawing is mounted on the shaft supporting a cylinder having a pair of diagrammatically opposed perforating knives, it is to be understood that the mechanism may also be used with a cylinder having a single knife by mounting the mechanism including the hub **28** and adjustable gear section **46** on the shaft supporting the anvil cylinder. It has been determined, however, that it is desirable to produce effective results, for the eccentric displacement of the axis **33** and the axis of the shaft to be aligned with the knife, and also for the anvil cylinder to be double the size of the cylinder carrying the single knife.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In apparatus for performing successive operations at predetermined intervals along the length of a continuously moving web of material and including a pair of parallel spaced shafts supporting a corresponding pair of cylinders between which the web is guided, one of the cylinders having element means mounted thereon and adapted to perform the operations on the web; an improved drive mechanism for maintaining precisely uniform spacing between the successive operations on said web, comprising a gear having a plurality of teeth, means mounting said gear on one of said shafts for movement of the pitch circle axis of said gear teeth relative to the axis of said shaft, means for driving said gear in timed relationship with the movement of the web, and means for adjusting the pitch circle axis of said gear teeth relative to the axis of said shaft to provide for precision positioning of said teeth on said gear relative to said element means and said axis of said shaft.

2. Apparatus as defined in claim **1** including means mounting said gear on one of said shafts for relative rotation with respect to said shaft on an axis offset from the axis of said shaft, and means for rotatably adjusting said gear on said offset axis relative to said shaft to provide said precision positioning of said teeth relative to said element means and said shaft.

3. Apparatus as defined in claim **2** wherein said element means includes a pair of diametrically opposed elements mounted on one of said cylinders.

4. Apparatus as defined in claim **3** including means for positioning said gear on said shaft so that a plane defined by said axes is at a small acute angle to a plane defined by said pair of elements on said cylinder to provide for correction of error in either direction with minimum relative rotation between said gear and said shaft.

5. Apparatus as defined in claim **3** wherein said elements include a pair of diametrically opposed knives for forming successive rows of cross perforations on said web to facilitate folding of the web in a zigzag manner, and said adjusting means for said gear includes means for providing precision alignment of the plane defined by said knives with said teeth on said gear such that said apparatus will produce a web having precisely spaced perforations for forming a stack of folds having vertically aligned folded edges.

6. Apparatus as defined in claim **2** including a hub fixed to said shaft for rotation therewith and having a cylindrical surface with an axis offset from the axis of said shaft, said gear including means defining a cylindrical bore having an axis offset from the axis of its pitch circle by an amount corresponding to said offset axis of said surface, and means adjustably mounting said gear for rotation on said surface of said hub.

7. Apparatus as defined in claim **6**, wherein said gear is formed in two connected sections, and means for adjustably rotating said sections with respect to each other on said hub to minimize backlash between said gear and said driving means.

References Cited

UNITED STATES PATENTS

781,219	1/1905	Mills	74—395
2,879,845	3/1959	Haas	83—324 X

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