

[54] **PRECISION DRIVE FOR PRINTING CYLINDER**

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[51] Int. Cl. **F16g 1/100**

[58] Field of Search **74/219, 221, 224, 74/225, 231 C, 231 R, 234; 346/75**

[56] **References Cited**

UNITED STATES PATENTS

3,400,540 9/1968 Cresswell et al. **74/221 X**

3,238,802 3/1966 Budzyn **74/219**
3,588,906 6/1971 Van Brimer **346/75 X**

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[57] **ABSTRACT**

A precision rotary drive for a printing cylinder includes a toothed belt having outer and inner teeth, the outer teeth engaging a toothed driven wheel to the printing cylinder, with the wheel having the same number of teeth as the outer teeth on the belt, and a power driven smaller toothed wheel engaging the teeth on the interior of the belt. The belt is constructed initially of one piece, and split longitudinally and the parts moved longitudinally with respect to each other in order to have teeth formed from like parts of material spaced longitudinally from each other in the separate sections.

4 Claims, 6 Drawing Figures

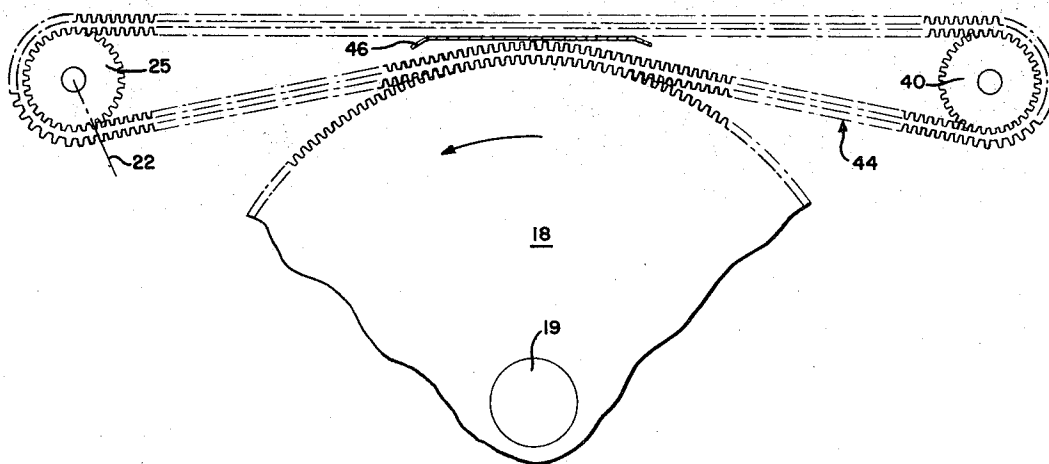


FIG-1

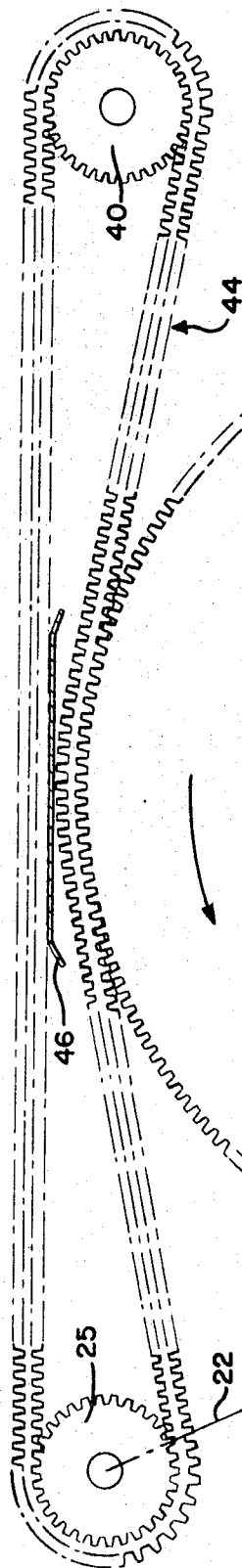


FIG-4



FIG-5

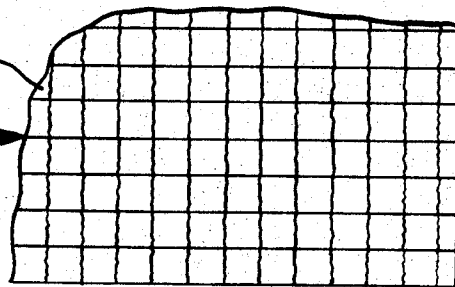


FIG-6

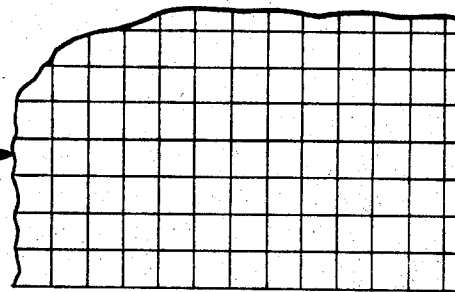


FIG-2

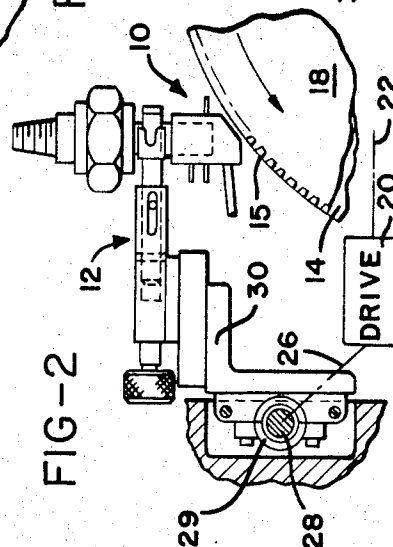
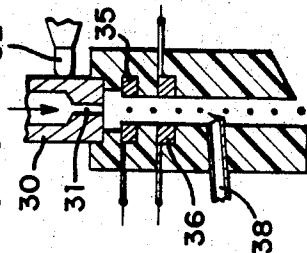


FIG-3



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PRECISION DRIVE FOR PRINTING CYLINDER

BACKGROUND OF THE INVENTION

This invention relates to drives for precision printing equipment which constructs images by placement of individual small drops on a receiving member. A typical device of this kind is disclosed in U. S. Pat. No. 3,588,906 which issued June 28, 1971 to the assignee of the present application. In such a system a receiving member in the form of a sheet of paper or the like is carried on a rotating cylinder. One or more drop generators are positioned around the cylinder, and move lengthwise of the cylinder, thereby to scan over the entire surface of the receiving member. Individual drops are either withdrawn from the system or allowed to deposit on the receiving member, thus creating a plurality of small drops which in total define the desired image.

A typical drive previously used for such a system has been a combination of synchronous motor and toothed drive belt of conventional type to rotate the drum. This combination causes the cumulative errors of belt tooth pitch and driven pulley pitch to be added and subtracted from the mean value during successive revolutions, thus leading to an error in the true position of the drop placements. Such errors for instance show up as a wavy line instead of a straight line when a longitudinal line is desired.

SUMMARY OF THE INVENTION

In accordance with the invention, two improvements are incorporated in a toothed belt drive, thereby providing a smooth continuous rotary drive to the drum, and effectively minimizing the unevenness in lines on the print running longitudinally of the rotating cylinder. One feature of the novel drive provided by this invention is that a wide manufactured toothed belt or sleeve is split into a number of separate narrower belts, and these narrower belts are shifted longitudinally of each other and then incorporated in the drive. This distributes and minimizes any slight misalignments or manufacturing errors in the original toothed belt, to avoid this source of perturbations or unevenness when the belt is used in the drive system.

Secondly, the toothed belt employed is of a specific type in which both surfaces of the belt are provided with driving teeth. A toothed wheel is fastened to the cylinder, or to its drive shaft, and the number of teeth in the cylinder wheel is equal to the number of teeth on the exterior surface of the toothed belt. Thus, in operation the same teeth on the belt and on the wheel always contact each other. A toothed driving wheel or sprocket is located to one side of the toothed cylinder wheel, and it engages the inner teeth on the belt, and a corresponding idler toothed wheel on the other side of the cylinder guides the belt such that there is contact between the exterior teeth on the belt and the toothed cylinder wheel over a substantial number of teeth. The result is a tangential drive somewhat similar to drives as shown for instance in Roth U. S. Pat. No. 1,423,028 but with the above-mentioned one-to-one tooth ratio. Again, this minimizes any perturbations in the action of the contacting teeth of the belt and the driven toothed wheel.

Accordingly, the primary object of this invention is to provide a precision rotary drive for a printing

cylinder, and in particular to provide such a drive for printing systems employing one or more drop generators, where images are created by precision placement of individual drops of marking liquid; to provide such a system wherein a toothed belt has teeth on its outer surface equal in number to and contacting a toothed driven wheel which in turn is connected to rotate the printing cylinder; to provide such a drive arrangement wherein the toothed belt is subdivided into a plurality of independent sections obtained by splitting an original single belt into a number of independent components of equal length, and then shifting these components longitudinally with respect to each other to align different portions of different teeth with respect to the original manufactured belt.

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

BRIEF DESCRIPTION OF THE DRAWING

In the drawing, FIG. 1 is a schematic showing of the overall arrangement of the toothed belt drive;

FIG. 2 is a drawing showing details of the mounting and arrangement of a single drop generator;

FIG. 3 is a schematic cross sectional view showing details of the drop generator;

FIG. 4 is an enlarged partial view showing the split sections of the drive belt;

FIG. 5 is the diagram showing a grid line or network constructed in accordance with a device using prior art synchronous drives; and

FIG. 6 is a diagram similar to FIG. 5 showing a grid network constructed with the printing device having the drive of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2, the drop generator 10 is shown mounted on an adjustable bracket 12 to track over the surface of a printing cylinder 14 which carries on its surface a receiving member 15, such as a sheet of paper. The cylinder rotates in the direction shown by the arrow, and at one end of the cylinder, or fastened to a shaft common with the cylinder, there is a toothed driven wheel 18 which is the driven wheel for the printing cylinder. This toothed wheel is also shown in FIG. 1, together with the shaft 19 carrying it and the cylinder. A drive is indicated schematically at 20, having a high speed output shaft 22, which extends to the driving toothed wheel 25, shown in FIG. 1. The drive also has a separate output shaft 26, which is connected to a lead screw 28 that engages a ball nut 29 carried in the slide 30, which in turn provides the mounting for the bracket 12. This forms the support for the drop generator 10, arranged to move it longitudinally of the printed cylinder, in order to scan over successive adjoining or adjacent circular paths over the surface of the receiving member 15.

The drive to shaft 26 may be either at a lower speed correlated to the speed of shaft 22, causing the head to follow a shallow helical path, or preferably the drive to shaft 26 may be intermittent to step the slide and the drop generation once for each revolution of the drum, thereby causing the generator to scan parallel lines circumferentially of the cylinder and across the moving

surface of the receiving member 15. Details of the drop generator are disclosed in the aforementioned U. S. Pat. No. 3,588,906, and for convenience some of the parts are shown in FIG. 3.

In general, these include a supply tube 30 for the marking liquid leading to an orifice 31 from which a jet filament of liquid issues and separates into drops. The drops are separated under the stimulation of a suitable stimulating device 32 causing the size and spacing of the drops to be of a desired regular pattern. The separation of drops from the filament occurs in the region of a charging electrode 35, at which point the drops are selectively electrostatically charged, and the drop path then extends past suitable deflecting electrodes 36, where the path of charged drops is shifted. A suitable catcher 38 removes unwanted drops from the stream which then continues out the end of the drop generator. The arrangement may be such that either charged or uncharged drops move into the catcher 38.

At the opposite side of the driven toothed wheel 18 there are a toothed idler wheel 40 and a toothed driving wheel 25. A toothed driving belt 44 passes over the driven wheel 18, around the driving wheel 25, and around the idler wheel 40. Due to the fact that the belt 44 has teeth on both its exterior and its interior surface, precise transmission of rotary motion from the driving wheel 25 to the driven wheel 18 is accomplished through the belt. In some arrangements the paths of the lower driving and upper return flights of the belt may be close to each other, in which case a suitable stationary shield or separator 46 can be inserted as shown.

Despite precautions taken in the manufacture of the flexible toothed belt 44, it has been found that slight variations may occur, for example in the height of one or more teeth, or the center-to-center spacing of the teeth. Even small variations of this type which cannot readily be detected will create minor perturbations in the rotary drive transmitted to the printing cylinder. This has been observed in the past, as indicated in FIG. 5, by printing a grid on the receiving member and observing the construction of the vertical and horizontal lines of the grid. Direction of motion of the receiving member on the rotating cylinder is indicated by the arrow at the top of FIG. 5. Hence, the vertical lines are produced by a continuous deposition of drops along a portion of the circle covering the receiving member from one edge to the other at it rotates. The horizontal lines are produced by depositing drops side by side during successive rotations of the cylinder, and the unevenness of the horizontal lines as shown in FIG. 5 is an indication of the perturbations noted in the earlier drive mechanisms.

To minimize these slight variations in the originally manufactured belt, a relatively wide belt or sleeve is marked and split longitudinally into several parts 44a, 44b, 44c, and 44d as shown in FIG. 4. After this, the parts are shifted longitudinally to bring portions of the original teeth into alignment with portions of others of the original teeth. A random re-alignment has proven satisfactory, however a predetermined pattern has also been successfully employed.

For example, in a five section belt having 225 teeth, using a 225 tooth driven wheel and 30 tooth driving and idler wheels, the following side-by-side tooth re-arrangement may be employed:

Belt Section Tooth	a	b	c	d	e
1	46	91	136	181	
2	47	92	137	182	
:	:	:	:	:	:
225	45	90	135	180	

This system has been found to operate with noticeably reduced positional errors, and it has been possible to produce grid networks as shown in FIG. 6, wherein the horizontal and vertical lines are comparable in quality. This ability is particularly significant in precision printing operations, such as the production of high precision maps.

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 a precision rotary drive for a printing cylinder or the like, the combination of
 - a driven member adapted for attachment to the cylinder and including a plurality of driven teeth,
 - a flexible drive belt having teeth on both its inside and its outside, the number of such outside teeth equalling the number of said driven teeth,
 - a pair of spaced toothed wheels engaged with the inside of said belt, one of said wheels having a power input to impart motion to said belt,
 - means supporting said wheels in spaced relation with the centers thereof aligned with opposite ends of an arcuate section of said driven member and the teeth on the outside of said belt engaging a substantial number of said teeth on said driven member to impart rotary motion to the cylinder with the same outside teeth of said belt always contacting like teeth on said driven member.
2. A rotary drive as defined in claim 1, wherein said belt comprises a plurality of independent parallel sections initially formed from the same piece of toothed belt material, severed from each other, and having teeth formed from like parts of the material spaced longitudinally from each other in the separate sections whereby irregularities in tooth contour or spacing are averaged out in the final drive construction.
3. In apparatus for precise placement of liquid drops on a receiving member, including
 - drop generator means capable of projecting individual liquid drops along a path at predetermined spacing, including an orifice receiving a flow of liquid under pressure,
 - means for stimulating flow through said orifice at a predetermined frequency to create a stream of regularly spaced drops, and
 - means for selectively charging and deflecting individual ones of the drops to allow only selected drops to pass along said path, the improvement comprising
 - a cylinder constructed and arranged to drive the receiving member past said path,
 - a driven member adapted for attachment to the cylinder and including a plurality of driven teeth,
 - a flexible drive belt having teeth on both its inside and its outside, the number of such belt teeth in each case equalling the number of said driven teeth,

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a smaller toothed drive wheel engaged with the inside of said belt and having a power input to impart motion to said belt,

means supporting said belt with a portion of its length extending along an arcuate section of said driven member and the teeth on the outside of said belt engaging a substantial number of said teeth on said driven member to impart rotary motion to the cylinder with the same outside teeth of said belt always contacting like teeth on said driven member. 5 10

4. In a precision rotary drive for a printing cylinder or the like, the combination of a driven member for attachment to the cylinder and

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including a plurality of teeth,
a plurality of toothed flexible drive belts arranged in side-by-side relationship for cooperative driving of the teeth in said driven member, and
a driving member for simultaneous common driving of all of said drive belts,
said driving belts comprising sections severed from a single toothed sleeve and relatively shifted in the driving direction to have teeth from different parts of said sleeve in side-by-side relationship whereby irregularities in tooth construction are averaged out in the resulting belt arrangement.

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