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REGISTER COMPENSATING MEANS FOR ROTARY MEMBERS IN WEB PROCESSING APPARATUS

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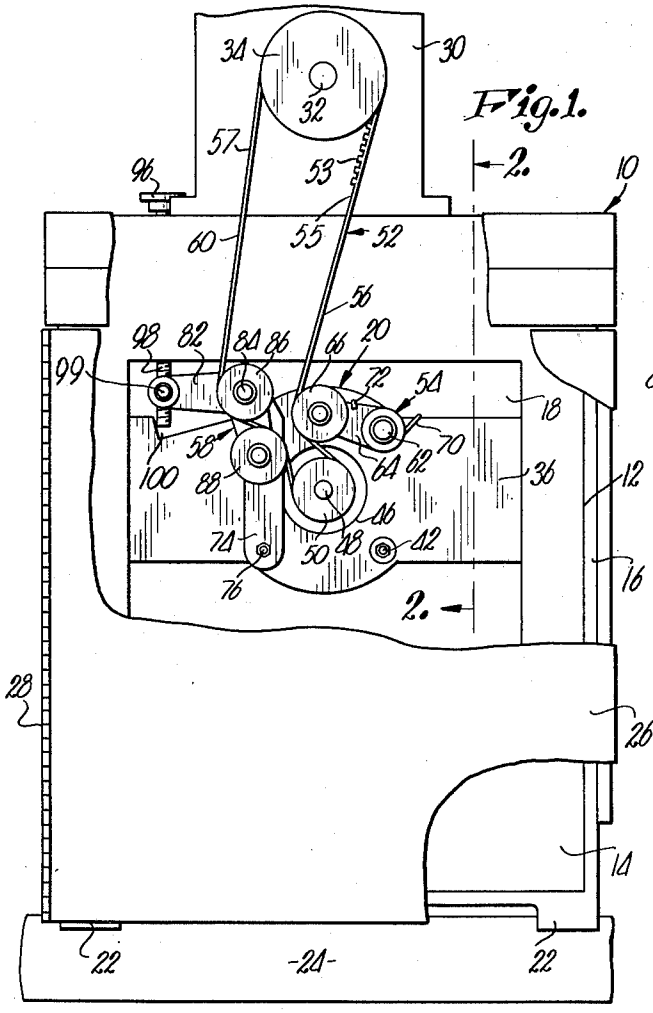


Fig. 1.

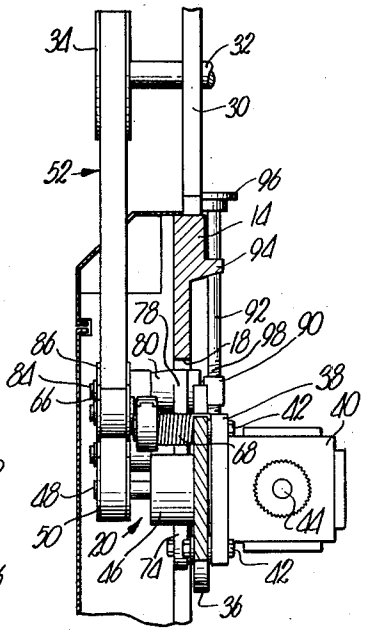


Fig. 2.

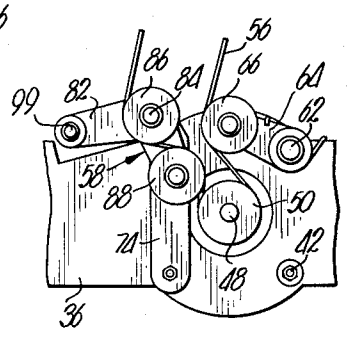


Fig. 3.

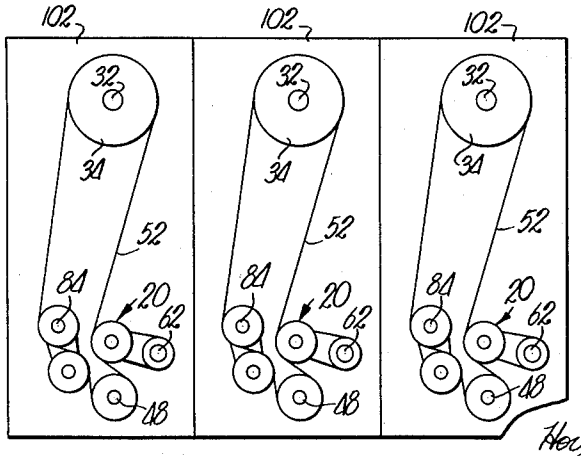


Fig. 4.

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REGISTER COMPENSATING MEANS FOR ROTARY MEMBERS IN WEB PROCESSING APPARATUS

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This invention relates to means for adjustably indexing a register point in rotary mechanisms.

It is common practice to process elongated material by unreeling it from a roll and performing operations on it with rotary equipment. Examples of this type of operation are printing, scoring, manifolding, folding, slitting, and the like. In all of these processes, the rotary equipment periodically performs operations on the material at precisely spaced-apart locations. Because a plurality of operations must often be performed sequentially on the same regions or at the same points on the material, it is essential that some register point in all of the rotary mechanisms coincide at unique points on the material. Accordingly, it is necessary to finely adjust the relative rotational orientation of the rotary mechanisms so that their operative portions are where they ought to be when a particular portion of the material on which the operations are to be performed are in position to be processed.

A familiar example which illustrates, but does not limit the invention, is in the printing of a plurality of colors on a web of paper. It is common to print as many as four colors in one area, with as many individual blanket cylinders operating to lay down a respective color at successive positions along the web. In order for the resulting composite printing to be correct, all of the blanket cylinders must be in correct register relative to each other. Indexing or register points are frequently used to make certain that this relationship exists. Such rolls must be very closely adjusted. Accordingly, they are often set up to within ¼" to 1/32" more or less by the eye of a skillful operator, and thereafter they are finely adjusted by examination of the work produced by the mechanism.

It is an object of this invention to provide a register point indexing means which is simple in construction and operation, and which can readily adjust the rotational orientation of a rotary mechanism, for example a blanket cylinder, even while the mechanism is running.

A related object of the invention is to provide an adjusting means which is effective to adjust only its own respective rotary mechanism, without affecting the path length of material between successive mechanisms, and without affecting the settings of prior and successive mechanisms.

Inasmuch as the invention essentially relates to making a fine rotational adjustment between two rotary shafts, it is to be understood that it is useful not only in printing, but also in any type of rotary apparatus wherein repetitive operations are performed on a web. The term "web" as used herein refers to material of indefinite length, and encompasses not only wide rolls of paper, but also ribbon, strip, tubing and wire.

A device according to this invention includes a drive shaft adapted to be connected to a source of power, and a driven shaft operably connected to a rotary element whose rotational position relative to the drive shaft is to be indexed. A rotatable belt driven means is attached to the driven shaft, and a rotatable belt drive means is attached to the drive shaft. The axes of revolution of the means are parallel.

A substantially inelastic endless belt is trained over

the said means, forming two belt reaches, both of which reaches are longer than their respective lines of tangents. Belt forcing means is provided for each of the reaches for inversely varying the lengths of the reaches, thereby changing the rotational relationship between the shafts, and rotationally adjusting an index point carried by a member such as a blanket cylinder.

According to a preferred but optional feature of the invention, the belt drive and belt driven means are sprockets, and the belt is a toothed timer belt, whereby errors of slippage are eliminated, and the indexed belt setting is reliably maintained.

According to still another preferred but optional feature of the invention, the belt-forcing means at one of the sides comprises a spring-loaded mechanism adapted to take up slack in the belt, and the other belt-forcing means comprises a pair of spaced-apart wheels mounted to a pivotable member, and oppositely engaged to the belt to adjustably vary the angular position of the line of tangents between them relative to the line of tangents between the belt drive means and belt driven means, thereby varying the belt path length of the respective reach.

This invention will be fully understood from the following detailed description and the accompanying drawings in which:

FIGURE 1 is a side elevational view of a web-processing unit utilizing a rotary member required to be placed in register with a moving web and illustrating the register compensation means which forms the subject of the present invention, parts being broken away to illustrate details of construction;

FIG. 2 is a cross-sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a fragmentary view of the register compensation means removed from the unit; and

FIG. 4 is a schematic, elevational view of the drive means for a number of modular web-processing units, each utilizing register compensation means.

The preferred embodiment of the invention is illustrated in the figures, wherein printing apparatus broadly denoted by the numeral **10**, comprises a housing **12** formed by a pair of opposed side walls **14** and a pair of opposed end walls **16** secured to respective ends of side walls **14**. One of the side walls **14** is provided with a central, rectangular opening **18** therein for mounting register compensation drive mechanism broadly denoted by the numeral **20** therein, mechanism **20** to be hereinafter fully described. Each side wall **14** is provided with track means **22** adjacent the interconnection thereof with opposed end walls **16** which engage rail members **24** disposed on a surface above which apparatus **10** is situated. In addition, a panel **26** is swingably mounted on the side wall **14** having opening **18** therein by virtue of hinge means **28** adjacent the interconnection of the side wall **14** with one of the end walls **16**. Panel **26** is provided with fastening means (not shown) for removably securing the same in closing relationship to opening **18**.

A pair of upright standards **30** is secured in any suitable manner to the uppermost edges of the opposed side walls **14** and provide support structure for the plate cylinder associated with apparatus **10**.

An elongated shaft member **32** is journalled adjacent the ends thereof in upright standards **30** above the uppermost edges of side walls **14** and end walls **16** for rotation about a generally horizontal axis. The plate, blanket and impression cylinders of apparatus **10** may be coupled with shaft **32** through a plurality of gears. Shaft **32** extends outwardly from the standard above opening **18** and is provided with a toothed pulley or sprocket **34** suitable for use with a toothed timing belt, pulley **34** being disposed

above and outwardly of the plane of the side wall **14** having opening **18** therein.

An elongated support **36** is secured to side wall **14** having opening **18** therein, and substantially spans the distance across opening **18** so that the longitudinal axis of support **36** is normally horizontally disposed. Fastening means (not shown) is utilized for securing support **36** to the inner surface of the corresponding side wall **14** so that mechanism **20** may be mounted on the normally outermost surface of support **36** in vertical alignment with pulley **34** on shaft **32**.

The base plate **38** of a gear box **40** is secured by means of bolts **42** to the generally innermost surface of support **36** intermediate the ends of the latter. Gear box **40** is provided with a shaft **44** which extends outwardly therefrom in a direction parallel to the longitudinal axis of support **36** and shaft **44** is adapted to be operably coupled to a source of power for rotating shaft **44** about the longitudinal axis thereof.

A hub **46** forms a part of gear box **40** and extends outwardly therefrom in a direction substantially normal to the axis of rotation of shaft **44**. Hub **46** passes through an opening (not shown) in support **36** and projects outwardly therefrom substantially beneath shaft **32**. Hub **46** provides bearing means for a shaft member **48** which is operably coupled with shaft **44** by virtue of gear mechanism within gear box **40**. As shaft **44** rotates about the longitudinal axis thereof, shaft **48** is caused also to rotate about its longitudinal axis proportional to the speed of rotation of shaft **44** and it is to be noted that shaft **48** is rotatable only under the influence of shaft **44**. In the preferred embodiment of the subject invention, shaft **48** is vertically aligned with shaft **32** and is substantially centrally disposed intermediate the ends of support **36**. A toothed pulley or sprocket **50** is suitable for use with a toothed timing belt and is rigidly secured to the outermost end of shaft **48** for rotation therewith. An elongated, endless, flexible, inextensible, toothed timing belt **52** is trained over pulleys **34** and **50** in driving relationship to shaft **32** to rotate the latter responsive to the rotation by shaft **44**. Belt **52** is provided with a plurality of spaced teeth **53** on the generally innermost face **55** thereof, teeth **53** extending along the entire length of face **55**.

Mechanism **20** includes first belt forcing means **54** operably coupled with one reach **56** of belt **52**, and further includes second belt forcing means **58** operably coupled with the opposite reach **60** of belt **52**.

First forcing means **54** includes a stub shaft **62** secured to support **36** and extending outwardly therefrom in the direction of shaft **48**. Stub shaft **62** is disposed above and to the side of shaft **48** adjacent the generally uppermost edge of support **36**. An arm **64** is secured adjacent one end thereof to the outermost end of stub shaft **62** for movement therewith, it being noted that stub shaft **62** is journalled in support **36** for movement relative to the latter. An idler pulley **66** is rotatably mounted on the opposite end of arm **64** and normally engages the outer face **57** of belt **52** on one reach **56** thereof. A coil spring **68** is disposed in surrounding relationship to stub shaft **62** between the proximal end of arm **64** and the outer surface of support **36**. Spring **68** is provided with hook-shaped ends **70** and **72** which are hooked over proximal edges of support **36** and arm **64** to bias arm **64** in a direction to force pulley **66** into engagement with reach **56** of belt **52**. Spring **68** is placed on shaft **62** under tension so that a steady force is applied to arm **64**.

Second belt forcing means **58** comprises an elongated supporting leg **74** secured to the outermost surface of support **36** by bolts **76**. Leg **74** is generally upright and has an uppermost end **78** provided with a hub **80** projecting laterally therefrom. A bell crank **82** is pivotally mounted intermediate the ends thereof to hub **80** by virtue of a pivot pin **84**, the latter also mounting a toothed pulley or sprocket **86** thereon. An idler pulley **88** is rotatably mounted on one end of crank **82** and an internally

threaded sleeve **90** is pivotally mounted on the opposite end of crank **82**.

It is noted that pulley **88** is mounted on the outermost face of crank **82**, whereas sleeve **90** is disposed on the innermost face of crank **82**. Belt **52** is operably disposed over pulley **86** and pulley **88** normally engages outer face **57** of belt **52** on reach **60** of the latter. Since leg **74** is stationary relative to support **36**, pulley **86** is maintained in a fixed position relative to support **36**. However, pulley **88** is permitted to swing toward and away from reach **60** of belt **52** responsive to the rotation of crank **82** about pin **84**.

An elongated rod **92** is disposed within a ferrule **94** forming a part of and integral with the inner surface of side wall **14** containing opening **18**. A knob **96** is secured to the uppermost end of rod **92** for manually rotating the latter, and the lowermost end **98** of rod **92** is externally threaded and threadeably received within sleeve **90** pivotally mounted on crank **82**. It is to be noted that the axis of revolution of rod **92** is laterally spaced from the plane of crank **82**, and to this end, a connecting rod **99** interconnects and pivotally mounts sleeve **90** on the innermost face of crank **82**. A portion of support **36** is removed to provide a notch **100** directly beneath rod **99** to provide clearance for the latter as rod **99** moves downwardly responsive to the rotation of rod **92**, it being clear that the latter is journalled in ferrule **94** and generally fixed against longitudinal movement.

In operation, shaft **44**, operably coupled with a suitable source of power, is rotated to rotate shaft member **48** and thereby shaft member **32** by virtue of timing belt **52**. Since first and second forcing means **54** and **58** are between pulleys **34** and **50**, said means **54** and **58** do not interfere with the normal driving operation of shaft member **32**.

When it is desired to rotate shaft **32** through a small arc so as to place the plate cylinder associated therewith in proper register with the web passing through apparatus **10**, rod **92** is caused to be rotated by manually manipulating knob **96**. The rotation of rod **92** causes crank **82** to pivot about pin **84** so that pulley **88** moves toward or away from reach **60** of belt **52**. As pulley **88** moves toward reach **60**, it forces reach **60** inwardly or toward reach **56** and, since shaft member **48** is immovable except under the influence of shaft **44** and, since belt **52** is inextensible, a certain length of belt **52** moves inwardly and reach **60** moves downwardly as viewed in FIG. 1. Therefore, reach **56** moves upwardly a corresponding distance and pulley **66** moves outwardly or away from reach **60**. Downward movement of reach **60** rotates pulley **34** in a counterclockwise sense when viewing FIG. 1 to thereby rotate the plate cylinder coupled therewith a corresponding amount. Conversely, as pulley **88** moves outwardly of reach **60**, pulley **66** forces reach **56** inwardly toward reach **60** and a certain length of belt **52** moves inwardly to cause reach **56** to move downwardly. Simultaneously therewith, reach **60** moves upwardly a corresponding distance and pulley **34** is rotated clockwise, as viewed in FIG. 1, through an arc corresponding to the distance travelled by each of reaches **56** and **60**.

In FIG. 4, a number of individual web processing units **102** utilizing rotary members, such as plate cylinders required to be placed in register with a movable web, are shown in modular arrangement schematically and each unit **102** includes a pulley **34** operably coupled to a shaft **32** which may or may not be directly coupled to the associated rotary member or members. Each unit **102** is provided with register compensation drive mechanism **20** for rotating the shaft **32** thereof to thereby place the members associated therewith, in register with the moving web. It is evident that mechanism **20** of each unit **102**, is independent of the mechanism **20** on the adjacent unit **102** so that the registration of the rotary members of units **102** may be independently varied, depending upon the requirements for processing the web

passing through units 102 in operating relationship thereto. It is conceivable that each unit 102 is adapted to perform an operation on the web, and to this end, it is necessary that the rotary members of units 102 be properly positioned with respect to each other to correctly perform the operations on the web as the same passes through units 102.

It is evident that apparatus 10 may be in operation when rod 92 is manipulated to adjust the angular positions of pulley 34 and shaft 32. Mechanism 20 in no way interferes with the driving of shaft 32 and therefore, the latter may continue to be rotated by shafts 44 and 48 while the registration compensation process takes place. An operator standing adjacent apparatus 10 is in position to manipulate knob 96 to rotate rod 92 and thereby perform said compensation process.

The term "line of tangents" as between pulley 34 and sprocket 50, refers to straight, external tangent lines drawn between the two, which do not cross. Were the shaft 32 reversely driven by crossing the belt, then the line of tangents would cross, then being internal lines, and path length for the respective belt reaches would refer to those lines of tangents. This is to say that the length of line of tangent relates to the respective belt set-up. The line of tangents between pulleys 86 and 88 is an internal one represented by the illustrated belt path between them. Pivoting movement of bell crank 82 varies the angular orientation of the latter line of tangents relative to that between belt driven means 34 and belt driver means 50. This variation directly affects the belt path length of reach 60, and inversely varies the path length of reach 56.

It will be understood that the belt will rarely follow the straight line of tangents between means 34 and 50, which line of tangents is a theoretical one, disclosed principally for reference and definition purposes.

This invention is not to be limited to the embodiment shown in the drawings and described in the description which is given by way of example and not of limitation, but only in accordance with the scope of the appended claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. Register point indexing means for adjusting the rotational position of a rotary element comprising: a driven shaft adapted to be operably connected to the rotary element; a drive shaft adapted to be connected to a power source; rotatable belt drive means attached to the drive shaft; rotatable belt driven means attached to the driven shaft, each of said means having an axis of rotation, the said axes being parallel; a substantially inelastic, endless belt trained over the two means to form two belt reaches, each of said reaches being longer than the respective line of tangents between the means; and a pair of belt forcing means for inversely varying the relative lengths of the said reaches to adjustably vary the angular relationship between the two shafts, and thereby between the drive shaft and the rotary element, a first of said belt forcing means comprising a second member engaging a second one of said reaches, whose position relative to the lines of tangents is adjustable in order to vary the length of said second reach, and the first of said belt forcing means comprising a first member engaging the first one of said reaches, whose position relative to the lines of tangents is yieldingly adjustable in response to forces derived from the adjustment of the first belt forcing means, the first member being force-biased against said first reach, whereby the length of the second reach is adjustably determined by the second member, and the first reach is maintained in tension by the first member at a path length determined by the second member, the rotary element being adapted to be driven by the drive shaft through the belt drive means, the belt, the belt driven means, and the driven shaft.

2. Register point indexing means according to claim 1 in which the belt drive means and belt driven means are toothed sprockets, and in which the belt is a timer belt engageable with the teeth of the sprockets.

3. Register point indexing means according to claim 2 in which the second member comprises a spring-loaded idler mechanism adapted to take up belt slack.

4. Register point indexing means according to claim 3 in which the second member comprises a pair of spaced-apart wheels oppositely engaged to the belt and mounted to a pivotable member to adjustably vary the angular position of the line of tangents between them relative to the line of tangents between the belt drive means and belt driven means, whereby the belt path length of the respective side is varied.

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