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PRINTING PRESS BACKLASH CONTROL MECHANISM

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2 Sheets-Sheet 1

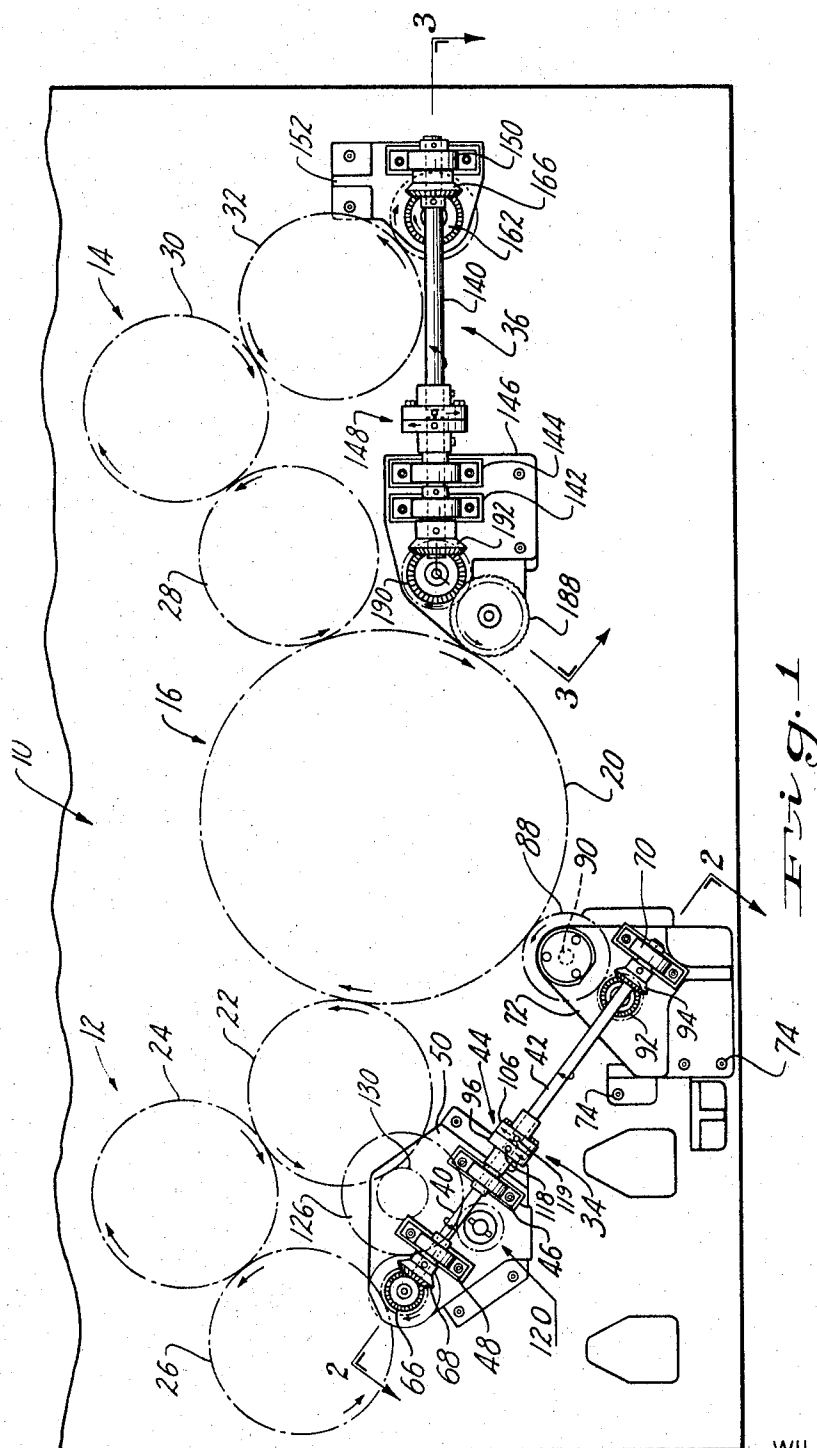


Fig. 1

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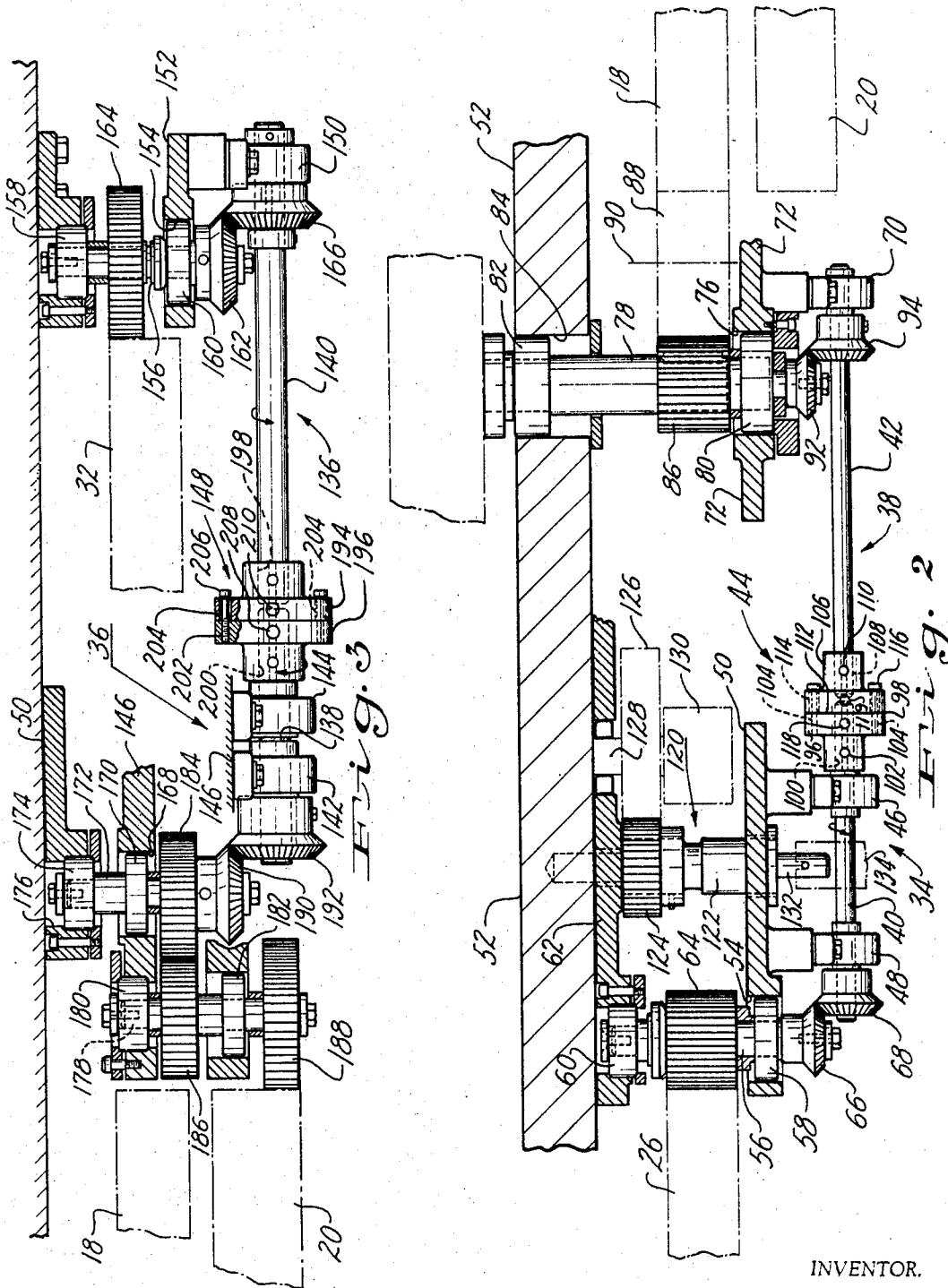
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2 Sheets-Sheet 2



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3,477,304 PRINTING PRESS BACKLASH CONTROL MECHANISM

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7 Claims

ABSTRACT OF THE DISCLOSURE

A backlash control mechanism for a rotary printing press including a shaft assembly with two axially aligned shaft members joined by a coupling device. The coupling device has two elements with faces in abutting engagement and one element secured to each shaft member. The elements are adapted to rotate relative to each other and locking means are provided to fixedly secure the elements to each other in their adjusted or rotated position. The opposite ends of the shaft assembly are connected through gearing to separate cylinder drive gears in the meshing cylinder drive gear train. A controlled amount of torque is applied to the shaft members by rotating the elements of the coupling device and locking the coupling device with the torque in the shaft members. The torque is transmitted through the connecting gearing to separate gears of the cylinder drive gear train. The torque in the shafts exerts a position pressure or load on the meshing gear teeth in the direction of gear rotation so that backlash of the gears caused by external vibrations and cyclic load variations is minimized.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to a backlash control mechanism connected to a pair of gears in a constantly meshing gear train that provides a positive force on the meshing gear teeth in the direction of gear rotation. More particularly, the invention relates to a backlash control shaft assembly for use in rotary printing presses connected to separate gears in the press cylinder drive gear train. The control shaft assembly is operable to exert, through a controlled amount of torque therein, a positive load or pressure on the meshing gear teeth.

Description of the prior art

The rotary printing presses, especially multicolor sheet fed printing presses include a first printing unit and a second printing unit with a transfer cylinder therebetween. In the perfecting type of sheet fed rotary printing press the first unit has a feed roll drive, an impression cylinder, and a transfer cylinder. The cylinders and the feed roll drive are connected by a constantly meshing gear train for coordinated timed rotational movement. The gear train includes a gear connected to the intermediate transfer cylinder commonly called the second transfer cylinder between the first printing unit and the second printing unit. The second printing unit similarly has an impression cylinder, a transfer cylinder and a sheet delivery mechanism. A constantly meshing gear train connects the various cylinders and the sheet delivery mechanism of the second

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printing unit to each other for coordinated timed rotational movement. The intermediate transfer cylinder includes a second gear meshing with the gear train connecting the cylinders and sheet delivery mechanism of the second printing unit. A prime mover is operatively connected to the gears on the intermediate transfer cylinder and provides a drive for the gear trains of the first printing unit and the second printing unit.

The various cylinders include cam actuated sheet handling devices such as sheet gripping devices and suction devices. At high printing speeds it is believed that the cam actuated devices create periodic torsional stresses in the various shafts associated with the cylinders. These torsional stresses in the shafts associated with the cylinders tend to vibrate the drive gearing and cause the meshing driving and driven teeth to momentarily separate and provide erratic drive for the printing cylinders. The separation and erratic loading of the gear teeth due to the external forces will hereinafter be referred to as gear backlash. Since the respective gears are rigidly secured to the cylinders associated therewith, the gear movement caused by the vibration produces a corresponding movement or vibration in the respective cylinders. Deviation from the desired coordinated timed rotational movement of the printing cylinders causes registry problems. It is also believed that an unbalanced loading condition of the various phases in a multiphase electric motor or an out of phase relationship between the three phases may result in erratic pulsating rotation to the gears driven by the electric motor and also cause gear backlash.

The problem of backlash caused by departures from the optimum spacing between plate and impression gears has been previously recognized. In United States Patent 2,948,215 there is an apparatus that includes a series of gears with a cup shaped ring gear having internal and external teeth. It is stated this cup shaped ring gear provides a means for reducing the backlash effects in a printing plate and impression cylinder couple that has an eccentrically mounted adjusting device.

SUMMARY OF THE INVENTION

The hereinafter described invention is directed to a backlash control mechanism that maintains the meshing teeth of the respective gears in the gear train in contact with each other so that the externally caused vibrations do not materially affect the coordinated timed rotational movement of the various cylinders. It is, therefore, an object of this invention to provide apparatus to control backlash in a series of constantly meshing gears in a printing press by providing a positive force on the meshing gear teeth in the driven direction of the gears.

Another object of this invention is to provide apparatus for the control of backlash by means of apparatus permitting controlled variation in the positive force applied to the meshing gear teeth in the gear train.

It is yet another object of this invention to provide a backlash control device by interconnecting certain gears of the gear train by means of a shaft assembly having a controlled amount of torque therein to provide the positive force on the meshing gear teeth.

These and other objects and advantages of this invention will be more completely disclosed and described in the following specification, the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIGURE 1 is a view in elevation, partially schematic, of a first printing unit and a second printing unit with the intermediate transfer cylinder and the backlash control mechanism for each printing unit.

FIGURE 2 is a sectional view taken along the line 2—2 in FIGURE 1 illustrating the backlash control apparatus for the first printing unit.

FIGURE 3 is a view in section taken along the line 3—3 of FIGURE 1 illustrating the backlash control mechanism for the second printing unit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGURE 1, the rotary printing press selected for purposes of illustration is a sheet fed offset lithographic press adapted for two color and perfecting printing. The printing press generally designated by the numeral 10 has a first printing unit 12 and a second printing unit 14 interconnected by a second or intermediate transfer cylinder 16. The gearing for the first printing unit 12, the second printing unit 14 and the intermediate transfer cylinder 16 is illustrated diagrammatically in FIGURE 1 with the direction of rotation of the respective cylinders indicated by the directional arrows.

The intermediate cylinder 16 has a pair of coaxial gears 18 and 20 (FIGURES 2 and 3) that are positioned on a common shaft and interconnect the printing units 12 and 14 with the intermediate transfer cylinder 16. The gear 20 of intermediate transfer cylinder 16 is arranged to be disconnected from its supporting shaft to permit rotation of the cylinders of the first printing unit relative to the cylinders of the second printing unit for adjustment of the press as a two color press or a perfecting press. In FIGURE 1, the gear 20 is indicated schematically as the outer gear. It should be understood, however, that gear 20 is in overlying relation with gear 18 and that gear 20 connects the intermediate transfer cylinder 16 with the second printing unit 14.

The first printing unit 12 has a gear 22 on the first transfer cylinder that meshes with the gear 18 on intermediate transfer cylinder 16. The impression cylinder of the first printing unit has a gear 24 that meshes with the gear 22 on the first transfer cylinder. A gear 26 that drives the cam actuated feed roll meshes with the gear on the impression cylinder 24 of the first printing unit 12. The gears 18, 22, 24 and 26 are arranged in substantially the same plane and form a constantly meshing gear train in the first printing unit 12.

The second printing unit 14 has a gear 28 on the third transfer cylinder meshing with the outer gear 20 on the intermediate transfer cylinder 16. Gear 30 mounted on the impression cylinder in the second printing unit 14 meshes with the gear 28 on the third transfer cylinder of the second printing unit 14. The sheet delivery mechanism has a gear 32 connected thereto that meshes with the gear 30 on the impression cylinder. The gears 20, 28, 30 and 32 are arranged in substantially the same plane and form a constantly meshing gear train for the second printing unit 14. An electric motor (not shown) is connected as later described to gear 18 and gear 18 in turn drives gear 20 through a suitable clamping device. With this arrangement, rotation of the gears 18 and 20 is transmitted to the respective gears meshing therewith so that drive is provided for the first printing unit 12 and the second printing unit 14 and the gears in first printing unit 12 function as a single gear train and the gears in the second printing unit 14 function as a separate single gear train. It should be understood, however, the gear trains, during printing are interconnected and function as a single gear train to provide the desired timed rotational movement to all of the elements of the press 10. A suitable system for driving the gears 18 and 20 on the intermediate transfer cylinder 16 is disclosed in United

States Patent 2,757,610. Other drive systems for the coordinated drive of the two printing units 12 and 14 may also be employed.

There is provided a first backlash control mechanism generally designated by the numeral 34 and illustrated in FIGURES 1 and 2 for controlling the backlash of the gearing in the first printing unit 12. A second backlash control mechanism 36 is illustrated in FIGURES 1 and 3 for controlling the backlash of the gearing in the second printing unit. It should be understood, although reference is made to the first and second printing units 12 and 14, the drive gear train for the respective units includes the gears 18 and 20 on the intermediate transfer cylinder 16. The gears on the second or intermediate transfer cylinder 16 form a part of the drive train for the respective units and the respective backlash control mechanisms 34 and 36 are connected to the gears of the intermediate transfer cylinder 16.

The backlash control mechanism 34 has a shaft assembly 38 that includes axially aligned shafts 40 and 42 connected to each other at one end by a coupling device 44. The axially aligned shafts 40 and 42 are arranged in a plane substantially parallel to the plane of the constantly meshing gear train of the first printing unit 12. The shaft 40 is suitably journaled for rotation in pillow block type bearings 46 and 48 supported on a plate 50 suitably secured to the press frame 52. The plate 50 has an aperture 54 through which a stub shaft 56 extends. The shaft 56 is supported by a bearing 58 positioned in aperture 54 of plate 50 and at the other end in bearing 60. The bearing 60 is suitably supported in a second plate 62 secured to the press frame 52. A spur gear 64 is nonrotatably secured to the shaft 56 intermediate the bearings 58 and 60 and meshes with gear 26 of the feed roll drive in printing unit 12. A bevel gear 66 is nonrotatably secured to the end of shaft 56 and meshes with bevel gear 68 nonrotatably secured to the free end of shaft 40.

The shaft 42 is supported adjacent its end portion in a pillow block bearing 70 mounted on plate 72 that is secured to the press frame 52 by bolts 74. The plate 72 has an aperture 76 through which a shaft 78 extends. A bearing 80 rotatably supports the shaft 78 in the plate aperture. The opposite end of shaft 78 is supported in bearing 82 positioned in a bearing aperture 84 in the frame 52. A spur gear 86 is keyed to the shafting 78 for rotation therewith and meshes with an intermediate gear 88 suitably supported on a shaft 90 diagrammatically illustrated in FIGURE 2 by the dash-dot line. The intermediate spur gear 88 meshes with the gear 18 of the intermediate transfer cylinder 16. An electric motor (not shown) is connected to and drives shaft 78. Thus, the motor rotates shaft 78 and gear 86 nonrotatably secured thereto. Drive from gear 86 on shaft 78 is transmitted through the gear 88 to the spur gear 18.

A bevel gear 92 is nonrotatably secured to the end portion of shaft 78 beyond the plate 72 and meshes with a bevel gear 94 nonrotatably secured to the shaft 42 of the shaft assembly 38 so that rotation of the shaft 78 is transmitted through bevel gears 92 and 94 to shaft 42 and also through gears 86 and 88 to gear 18 on the intermediate transfer cylinder 16.

The coupling device 44 connecting the ends of shafts 40 and 42 has a first element 96 with an end face 98 and a longitudinal bore 100 therethrough. The end of shaft 40 extends through bore 100 and is nonrotatably secured therein by suitable means such as key 102. The element 96 has a plurality of tapped threaded bores 104 therein at locations equidistant from and parallel to the axial bore 100. The coupling device 44 has a second similar element 106 that has a longitudinal bore 108 therethrough in which the end of shaft 42 is secured by means of key 110. The element 106 has a face portion 112 in abutting relation with the face portion 98 of element 96 and has a plurality of longitudinal bores 114 which are aligned within the threaded bores 104 in the other element

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96. Bolts 116 extend through the bores 114 in elements 106 and are threadably secured in the threaded bores 104 in element 96. The longitudinal bores 114 in element 106 are larger than the body portion of the bolts 116 and may, where desired, be arcuate in shape where greater torque is desired in the shafts as hereinafter described.

The elements 96 and 106 each has a radial bore 118 and 119 therein as is illustrated in FIGURES 1 and 2. By means of the coupling device 44, a torque can be imparted to the shaft assembly 38 by rotating the elements 96 and 106 in the directions indicated by the arrows in FIGURE 1 and secured in the torqued position by tightening the bolts 116 and nonrotatably securing the elements 96 and 106 to each other. Levers are inserted in the radial bores 118 and 119 of the elements 96 and 106 and moved in opposite directions, i.e. the direction of the arrows, until the desired torque is imparted to the shaft assembly. It should be noted that the shafts 40 and 42 are rotated in opposite directions as indicated by the arrows in FIGURES 1 and 2 to apply a torque to the shaft assembly 38. The amount of torque applied to shaft 38 is controlled by the axial rotation of elements 96 and 106 to each other in opposite directions. The shaft assembly 38 of backlash assembly 34 is connected at one end to gear 26 of the feed roll drive and at the other end through gearing 86 and 88 to the inner gear 18 of intermediate transfer cylinder 16.

The direction of drive imparted to the gearing of the first printing unit 12 is indicated by the directional arrows in FIGURE 1. Gear 18 rotates in a clockwise direction and is in meshing relation with the gear 22 of the first transfer cylinder in the first printing unit 12 and rotates the transfer cylinder 22 in a counterclockwise direction. The gear 24 on the impression cylinder meshes with the gear 22 on the transfer cylinder and is driven in a clockwise direction by the gear 22. The feed roll gear 26 meshes with the impression cylinder gear 24 and is driven by the impression cylinder gear in a counterclockwise direction. In this gear train the gear 18 on the transfer cylinder 16 is rotating in the opposite direction to the gear 26 associated with the feed roll drive. The torque in shaft assembly 38 urges the gear 18 of intermediate transfer cylinder 16 in a direction the same as the direction of drive and also urges the gear 26 associated with the feed roll drive in a direction opposite to the direction of rotation by the drive mechanism. The backlash mechanism 34 thus urges the meshing teeth of the respective gears in the gear train into contact with each other and eliminates any clearance between the pressure side of the drive tooth and the tooth of the gear meshing therewith.

The backlash control mechanism 34 through its geared connection rotates in unison with the constantly meshing gear train 18, 22, 24 and 26 and provides a second connection between gears 18 and 26. This second connection between gears 18 and 26 includes intermediate gear 88, gear 86 on shaft 78, bevel gear 92 on shaft 78, meshing bevel gear 94 on shaft assembly 38 and meshing bevel gears 68, 66, shaft 56, and gear 64 which meshes with gear 26 associated with the feed roll drive. The second connection, however, has a torque applied thereto that urges the meshing teeth of gears 18, 22, 24 and 26 into contact with each other and applies a pressure or force on the gear teeth so that they remain in contact when a vibratory force is exerted on the respective gears in a direction opposite to the direction of drive.

The backlash control mechanism 34 also includes a cylinder adjusting mechanism generally designated 120 operable to rotate the cylinders of the first printing unit 12 when the gear 20 is disengaged from the shaft of the intermediate cylinder 16 to position the respective cylinders of the first printing unit 12 for either perfecting or two color operation. The cylinder adjusting mechanism includes a shaft 122 extending through an aperture in plate 50 and rotatably supported in the frame 52. A gear 124 is nonrotatably secured to the shaft 122 and meshes

with a gear 126. The gear 126 is supported on a shaft 128 and has a gear 130 secured thereto in meshing relation with the gear 22 of the first printing unit transfer cylinder. The shaft 122 has a receiver portion 132 and a handle 134 schematically illustrated in FIGURE 2. With this arrangement, rotation of handle 134 rotates shaft 122, gears 124, 126, 130 and gear 22 on the transfer cylinder of the first printing unit to rotate the cylinders of the entire first printing unit and position the cylinders therein relative to the second printing unit.

The backlash control mechanism 36 is similar in many respects to the backlash control mechanism 34 and has a shaft assembly 136 that has two axially aligned shafts 138 and 140. The axially aligned shafts 138 and 140 are arranged in a plane substantially parallel with the constantly meshing gear train of the second printing unit 14. The shaft 138 is supported in pillow block type bearings 142 and 144 which are secured to a plate 146 mounted on the printing press frame in a suitable manner. A coupling device 148 connects the ends of the shafts 138 and 140 to form the shaft assembly 136. The shaft 140 is supported adjacent its end portion in a pillow block bearing 150 that is secured to a plate 152 suitably supported on the press frame 50. The plate 152 has an aperture 154 through which a shaft 156 extends and is rotatably supported at one end by bearing 158 on the press frame 50 and by bearing 160 positioned in aperture 154. A bevel gear 162 is connected to the end of shaft 156 and an intermediate gear 164 is nonrotatably secured to shaft 156 between plate 152 and the press frame 50. The gear 164 meshes with gear 32 associated with the sheet delivery mechanism. The shaft 140 has a bevel gear 166 nonrotatably secured thereto in meshing relation with the gear 162 so that gear 32 associated with the sheet delivery mechanism is connected to the shaft 140 through the previously described gearing.

The plate 146 (FIGURE 3) has an aperture 168 there-through in which there is positioned a bearing 170 that supports an intermediate portion of shaft 172. The end of shaft 172 is supported by a bearing 174 positioned in an aperture 176 in the press frame 50. Another shaft 178 is positioned in parallel spaced relation to shaft 172 and is suitably supported in bearings 180 and 182. The shaft 172 has a spur gear 184 nonrotatably secured thereto that meshes with gear 186 on shaft 178. The shaft 178 also has a spur gear 188 nonrotatably secured thereto that meshes with the gear 20 of the intermediate transfer cylinder 16. The shaft 172 has a bevel gear 190 secured thereto that meshes with a bevel gear 192 secured to shaft 138 of the shaft assembly 136. With this arrangement, the gear 132 of the sheet delivery mechanism is connected to the gear 20 of the intermediate transfer cylinder 16.

The coupling device 148 is similar to the coupling device 44 and has a first element 194 and a second element 196. With aligned longitudinal bores 198-200 there-through in which the ends of shafts 140 and 138 are nonrotatably secured. The element 196 has a plurality of threaded bores 202 positioned parallel to and equidistant from the axial bore 200. The element 194 has a plurality of enlarged bores 204 extending therethrough and aligned with the threaded bores 202 in element 196. Bolts 206 are threadably secured in the bores 202. The size of the bores 204 are larger than the diameter of the body portion of bolts 206 so that relative rotation to a limited extent can take place between elements 194 and 196 when the bolts extend through the aligned bores 202 and 204 are threadably secured in the bores 202. The elements 194 and 196 have receiving passageways 208 and 210 for levers to apply a torque to the shaft assembly 136. The bolts 206 are loosened to permit rotation of elements 194 and 196 relative to each other and levers are positioned in passageways 208 and 210 and moved in opposite directions to each other as indicated by the arrows in FIGURES 1 and 3. When the desired amount of torque is applied to shaft assembly 136, the bolts 206 are tightened

and the torque remains in the shaft assembly 136. The torque in shaft assembly 136 attempts to unwind the shaft assembly 136 and exerts a force or pressure on the gear teeth of gears 32 and 20 in the direction of gear rotation to thus apply a positive pressure or force on the meshing gear teeth in the direction of rotation of the gear train comprising gears 20, 28, 30 and 32.

According to the provisions of the patent statutes, I have explained the principle, preferred construction and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. In a printing press having a backlash control device, the combination comprising,

a constantly meshing gear train having a plurality of gears positioned in substantially the same plane and adapted to transmit rotational movement to elements of said press,

a backlash control device for said constantly meshing gear train including,

a pair of axially aligned shaft members positioned in a plane substantially parallel to and spaced from the plane of said constantly meshing gear train,

coupling means connecting said shaft members to form a shaft assembly,

first connecting means operatively connecting one end of said shaft assembly to one of the gears of said constantly meshing gear train,

second connecting means operatively connecting the other end of said shaft assembly to another one of the gears of said constantly meshing gear train,

said coupling means having two elements operable to rotate relative to each other and apply a torque to said shaft assembly, and

locking means to lock said two elements of said coupling means against relative rotational movement,

said shaft assembly and said first and second connecting means operable to apply a force on said gears in said constantly meshing gear train in the direction of rotation of said gears, said force on said gears being proportional to the torque in said shaft assembly.

2. In a printing press as set forth in claim 1 in which said first connecting means includes,

a bevel gear nonrotatably secured to the shaft assembly adjacent one end,

a second bevel gear meshing with said first bevel gear and nonrotatably secured to a first intermediate shaft disposed substantially perpendicular to said shaft assembly,

gear means connecting said intermediate shaft to one of the gears in said gear train so that torque in said shaft assembly is transmitted through said bevel gears, intermediate shaft and gear means to said one of the gears in said gear train.

3. In a printing press as set forth in claim 2 in which said gear means includes,

a third gear nonrotatably secured to said first intermediate shaft, and

a connecting gear meshing with said third gear and said one of the gears of said constantly meshing gear train.

4. In a printing press as set forth in claim 2 in which said connecting means includes,

a third bevel gear nonrotatably secured to the other end of said shaft assembly,

a fourth bevel gear meshing with said third bevel gear and nonrotatably secured to a second intermediate

shaft disposed substantially perpendicular to said shaft assembly,

gear means connecting said intermediate shaft to another one of said gears of said constantly meshing gear train so that torque in said shaft assembly is transmitted through said bevel gears, second intermediate shaft and gear means to said other one of said gears in said gear train.

5. In a printing press as set forth in claim 1 in which said coupling means includes,

a first element having a front face and a plurality of threaded passageways spaced radially from and parallel to said shafts,

a second element having a front face and a plurality of passageways spaced radially from said shafts and aligned with said threaded passageways in said first element,

said front face of said first and second elements positioned in abutting relation with each other,

bolts extending through said passageways in said second element and threadedly secured in said aligned threaded passageways in said first element,

said second passageways having a transverse dimension larger than the transverse dimension of said first passageways so that said elements are rotatable relative to each other with said bolts positioned in said passageways to thereby apply a torque in said shaft assembly.

6. In a sheet fed offset printing press having a backlash control device, the combination comprising,

a gear train adapted to transmit rotational movement to elements of said printing press, said gear train including,

a first rotary gear,

an impression cylinder gear meshing with said first rotary gear,

a first transfer cylinder gear meshing with said impression cylinder gear,

a second transfer cylinder gear meshing with said first transfer cylinder gear,

a backlash control device having,

two axially aligned adjacent shaft members,

coupling means joining said shaft members and forming a shaft assembly,

first connecting means operatively connecting one end of said shaft assembly to said second transfer cylinder gear,

second connecting means operatively connecting the other end of said shaft assembly to said first rotary gear,

said coupling means having two elements with abutting faces for rotational movement relative to each other to apply a torque to said shaft assembly, and

locking means to retain said two elements of said coupling means against rotational movement relative to each other,

said shaft assembly and said first and second connecting means operable to apply a force on said meshing gears in the direction of drive of said gears, said force being proportional to the torque of said shaft assembly.

7. In a sheet fed offset printing press having a backlash control device as set forth in claim 6 in which said press includes,

a second gear train to transmit rotational movement to elements of said printing press comprising,

a second gear on said second transfer cylinder,

a third transfer cylinder gear meshing with said second gear on said second transfer cylinder,

a second impression cylinder gear meshing with said third transfer cylinder gear,

a second rotary gear meshing with said second impression cylinder gear, and

a second backlash control device operable to apply

a force on said meshing gears of said second gear train in the direction of rotation of said gears.

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U.S. Cl. X.R.

101—177; 287—129