A drive mechanism in a machine such as a printing press comprises a gear structure including a spline shaft on which a spur gear is mounted for axial movement. The spline shaft has straight or helical grooves on its exterior surface which are engaged by inwardly projecting teeth on the spur gear. The inwardly projecting teeth are adjustably movable with respect to the grooves to reduce or eliminate backlash.

12 Claims, 6 Drawing Figures
ADJUSTABLE TEETH FOR GEAR SLIDABLY MOUNTED ON SPLINE SHAFT

BACKGROUND OF THE INVENTION

1. Field of Use

This invention relates generally to adjustable drive mechanisms for machines such as printing presses which employ a roll and a drive shaft for ultimately driving the roll. More specifically, it relates to drive mechanisms wherein a gear driven by the drive shaft is axially movable on a spline shaft attached to the roll.

Related Application

This application is related to my pending application entitled "Registration Adjustment Mechanism", Ser. No. 244405, filed in the U. S. Pat. Office on Apr. 17, 1972.

2. Description of the Prior Art

Some printing presses employ a plate cylinder press roll to apply printing to a web moving through the press. The press roll is ultimately driven by a shaft which also drives other press components. It is sometimes necessary to change the phase relationship between rotation of the press roll and the drive shaft or to change the axial position of the press roll to achieve proper registration between the press roll and the web. It is desirable to make either or both changes while the press is stationary or in operation and to make these changes without affecting other press components. Hence these separate mechanisms were used for each change. Some prior art adjustable drive mechanisms for achieving the phase change employ a spur gear or a helical gear which is axially movable on a splined shaft. Due to manufacturing problems, the splined shaft, whether the grooves therein are straight or helical, contribute to gear pitch line run-out and backlash. It is desirable, therefore, to provide improved adjustable drive mechanisms which have less pitch line run-out and have reduced backlash.

SUMMARY OF THE PRESENT INVENTION

In accordance with the invention, there is provided a machine, such as a printing press, having a roll which is supported for rotation on the press frame and is ultimately driven by the press drive shaft through an adjustable drive mechanism. The drive mechanism is adjustable while the printing press is stationary or in operation, first, to effect a phase change between the drive shaft and the press roll and, second, to axially move the press roll to achieve proper registration between the press roll and a web moving through the press. Both adjustments can be carried out independently. The adjustable drive mechanism contemplates a bull spur gear driven by the drive shaft; and comprises a spur plate cylinder gear in constant mesh with the bull spur gear and axially movable with respect thereto. The mechanism also comprises a hollow cylindrical circumferential register ring attached to (or integral with) the spur plate cylinder gear and hollow cylindrical pilot ring which is connected to the press roll and on which the register ring is slidable mounted. The pilot ring is, in effect, a spline shaft and is provided with grooves on its outer surface which are in constant mesh with inwardly projecting gear teeth affixed to the register ring. In one embodiment shown, the grooves are helical. However, in accordance with the invention the grooves may be straight, as shown in another embodiment. The inwardly projecting teeth are adjustably movable with respect to the grooves they engage so as to reduce pitch line run-out and to reduce or eliminate backlash. Means are provided to effect a phase change between the roll and drive shaft and to change the axial position of the roll. Thus, the register ring is provided with a circumferential groove on its outer surface which engages an axially movable phase adjustment yoke. Movement of the phase adjustment yoke effects axial sliding movement of the register ring and the spur plate cylinder gear and, because of the cooperative action of the gear teeth on the register ring and the helical grooves on the pilot ring, causes relative rotation of the pilot ring and press roll with respect to the drive shaft. The pilot ring is provided with a circumferential groove on its outer surface which engages an axially movable press roll adjustment position yoke. Movement of the position adjustment yoke effects axial movement of the pilot ring and press roll. Spring connection means between the phase adjustment yoke and the position adjustment yoke cause the former to move with the latter so that there is no relative movement between the pilot ring and register ring.

DRAWINGS

FIG. 1 is a perspective view of a portion of a printing press having a registration adjustment mechanism in accordance with the invention;

FIG. 2 is a top plan view, partly in section, of the portion of the press and the mechanism shown in FIG. 1;

FIG. 3 is an end view of a yoke shown in FIG. 1;

FIG. 4 shows another embodiment of the invention and is an enlarged end view of a spline shaft with an axially movable gear thereon;

FIG. 5 is an enlarged detail view of one of the adjustable teeth shown in FIG. 4; and

FIG. 6 is a side view of the embodiment shown in FIG. 4.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2, the numeral 10 designates a portion of a machine, such as a printing press, comprising a suitable supporting frame 12 on which press components, hereinafter identified are supported for operation. As FIG. 2 shows, the press comprises a plate cylinder press roll 14 having an integrally formed press roll shaft 16 which is supported for rotation and is slidable in a bearing 18 on frame 12. Press roll 14 is adapted to have a printing plate cylinder (not shown) secured thereon which cooperates with a web of paper (not shown) moving through the press to apply printing thereto as press roll 14 rotates.

Press roll shaft 16 is ultimately driven by a drive shaft 20 having a gear 21 affixed thereon through or by means of an adjustable drive means or registration adjustment mechanism, generally designated 24. Drive shaft 20 also drives other press components, not shown.

Adjustable drive mechanism or registration adjustment mechanism 24 transmits power from drive shaft 20 to press roll 14 and also serves as a means by which two adjustments of press roll 14 are possible, namely, rotational adjustment of press roll 14 to change its phase relationship with respect to drive shaft 20, and axial adjustment of press roll 14 position to move it axially with respect to frame 12. Both adjustments, which can be carried out independently of each other, change the position of press roll 14 with respect to a paper web moving through printing press 10 and are essential, es-
To permit relative movement between register ring 35 and pilot ring 37 when the former is moved axially to effect a phase change, the motor 47 for moving phase adjustment yoke 44 is physically mounted on position adjustment yoke 53. To prevent relative movement between register ring 35 and pilot ring 37 when the latter is moved axially (i.e., so that both rings 35 and 37 move simultaneously) a resilient connecting means, such as a coil spring 57, is connected between the two yokes 44 and 53. Thus, when position adjustment yoke 53 is moved, phase adjustment yoke 44 moves with it by means of connecting spring 57. However, when phase adjustment yoke 44 is moved, the connecting spring 57 yields to allow position adjustment yoke 53 to remain stationary.

FIG. 1 shows that the four inwardly projecting gear teeth 38 are adjustably secured to the end of register ring 35 to be releasable attachment means such as screws or bolts. It is to be understood that each tooth 38 is adjustably movable into and out of the groove 39 in the pilot ring 37 which it engages. Such adjustability of the gear teeth 38 enables backlash between the gear teeth 38 and the grooves 39 to be reduced or eliminated. This feature is desirable because of loose machine tolerances that might otherwise exist between the sides of each gear tooth 38 and the sides of its cooperating groove 39. Adjustability of each gear tooth is accomplished in its simplest form by making the hole in each gear tooth 38 of slightly larger diameter than the screw or bolt which secures it to register ring 35, thereby enabling the gear tooth to be moved inwardly or outwardly with respect to the axis of the pilot ring 37.

In the embodiment of the invention hereinafter described in connection with FIGS. 1, 2 and 3, the grooves 39 are helical. In the embodiment of the invention shown in FIGS. 4, 5 and 6, the grooves 70 in the spline shaft 72 (which corresponds to pilot ring 32) are straight instead of helical. The grooves 70 define gear teeth 71 on spline shaft 72. Furthermore, the gear 74 is a unitary member having gear teeth 76 on its exterior surface, a central opening 78 for accommodating spline shaft 72, and four adjustable teeth 80 which are adjustably secured directly to gear 74 by bolts 82. Therefore, gear 74 corresponds to the first hollow cylindrical member; spline shaft 72 corresponds to a second cylindrical member; the adjustable teeth 80 on gear 74 correspond to first gear means; and the grooves 70 and gear teeth 71 correspond to second gear means. As FIG. 6 shows, each bolt 82 extends through an opening 84 in its adjustable tooth 80 and takes into a threaded hole 87 in the body of gear 74. The opening 84 is of slightly longer diameter than the shank of the bolt 82 therein so as to enable a gear tooth 80 to be slidable adjustably inwardly or outwardly with respect to the groove 70 in the spline shaft 72 which it engages. In practice total adjustment travel of each gear tooth 80 would be on the order of ten thousandths of an inch. As FIG. 4 shows, each tooth 80 is fitted within a recess 86 in the end face of gear 74, which recess serves to hold the tooth in proper alignment and prevent sideward movement or pivoting.

As FIG. 5 shows, an adjustable gear tooth 80 engages or makes contact with an adjacent gear tooth 71 on spline shaft 72 along a pitch line 90. The sides of the teeth 71 and 80 are machined during manufacture so that the teeth angles are tangent to the pitch line. Because of the close tolerances involved during manufac-
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ture and the interchangeability of parts required during assembly, it is not practical to machine a spline shaft, such as spline shaft 72, or a meshing gear, such as gear 74, which will have teeth that mesh perfectly. Consequently, some backlash, caused by improper engagement of the meshing teeth, will almost inevitably occur. Backlash problems also result from wear on the meshing teeth during use. Since, in accordance with the invention, the teeth 80 are adjustably movable, they can be moved into proper meshing position with respect to the teeth 71 and secured in such proper position by the bolts 82.

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RESUME

A printing press roll 14 is driven by a drive shaft 20 by means of a drive mechanism 24. The latter is adjustable, first, to change the phase relation between press roll 14 and drive shaft 20 and, second, to move roll 14 axially with respect to frame 12. Both adjustments are used to achieve proper registration between the press roll 14 and a web moving through the press 10. The adjustable drive mechanism 24 comprises a cylindrical pilot ring 37 rigidly secured to the shaft 16 of press roll 14 and a hollow cylindrical register ring 35 slidably mounted on the pilot ring 37. A first spur gear 22 is attached to register ring 37 and is in constant mesh (and sliding relationship) with a second spur gear 23 driven by drive shaft 20. Adjustably inwardly projecting teeth 38 on register ring 35 engage spiral grooves 39 on the surface of pilot ring 37. Means including a yoke 44, member 42 and a groove 41 in the register ring 35 are provided to axially move register ring 35 and thereby change the phase relation between press roll 14 and drive shaft 20. Means including a yoke 53, members 51 and a groove 50 in the pilot ring 37 are also provided to simultaneously move both register ring 35 and pilot ring 37 axially and thereby move press roll 14 axially with respect to press frame 12 without causing a phase change. Yoke 44 is movable by motor 47 mounted on yoke 53 and having a threaded shaft 48 which engages a threaded sleeve 49 on yoke 54. A spring 57 between the yokes 44 and 53 allows independent movement of yoke 44 with respect to yoke 53 and effects coordinated movement of yoke 44 when yoke 53 is moved. In accordance with another embodiment of the invention, there is shown a spline shaft 72 having gear teeth 71 and straight grooves 70 on its exterior surface. These teeth 71 mesh with adjustable inwardly projecting teeth 80 on a gear 74 which is mounted for axial sliding movement on spline shaft 72.

1 claim:
1. In a drive mechanism:
   a first hollow cylindrical member, a second cylindrical member located within and axially movable with respect to said first member, first gear means on said first member, and second gear means on said second member for cooperative engagement with said first gear means, one of said first and second gear means comprising at least one tooth and the other comprising at least one groove, said tooth being adjustably mounted so as to be moveable in said groove toward and away from the axis of said members to reduce backlash between said first and second gear means.
2. A drive mechanism according to claim 1 wherein said first gear means on said first cylindrical member comprises said tooth.
3. A drive mechanism according to claim 2 wherein said groove is straight.
4. A drive mechanism according to claim 2 wherein said groove is helical.
5. In a drive mechanism:
   a first hollow cylindrical member, a second cylindrical member located within and axially movable with respect to said first member, a plurality of gear teeth and grooves on the exterior surface of said second cylindrical member, and a plurality of inwardly projecting adjustably movable gear teeth on said first cylindrical member for engagement in at least some of said grooves.
6. A drive mechanism according to claim 5 wherein each of said adjustable gear teeth is secured to said first cylindrical member by a bolt of a predetermined diameter and wherein each tooth is provided with an opening for accommodating said bolt which is, of larger diameter than that of said bolt.
7. A drive mechanism according to claim 6 wherein said grooves are straight.
8. A drive mechanism according to claim 6 wherein said grooves are helical.
9. In a drive mechanism:
   a first hollow cylindrical member having a first set of gear teeth on the exterior thereof and having an end face, a second cylindrical member located within and axially movable with respect to said first member, a plurality of gear teeth and grooves on the exterior surface of said second cylindrical member, a plurality of recesses in said end face of said first member, an inwardly projecting gear tooth adjustably mounted in each of said recesses for engagement in a groove on said second member, and means for securing each gear tooth in said recess.
10. A drive mechanism according to claim 9 wherein said means comprises a bolt of predetermined diameter which makes threaded engagement with a threaded hole in said first member and wherein each tooth is provided with an opening for accommodating said bolt, each opening being of larger diameter than the diameter of said bolt.
11. A drive mechanism according to claim 10 wherein said grooves are straight.
12. A drive mechanism according to claim 10 wherein said grooves are helical.

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