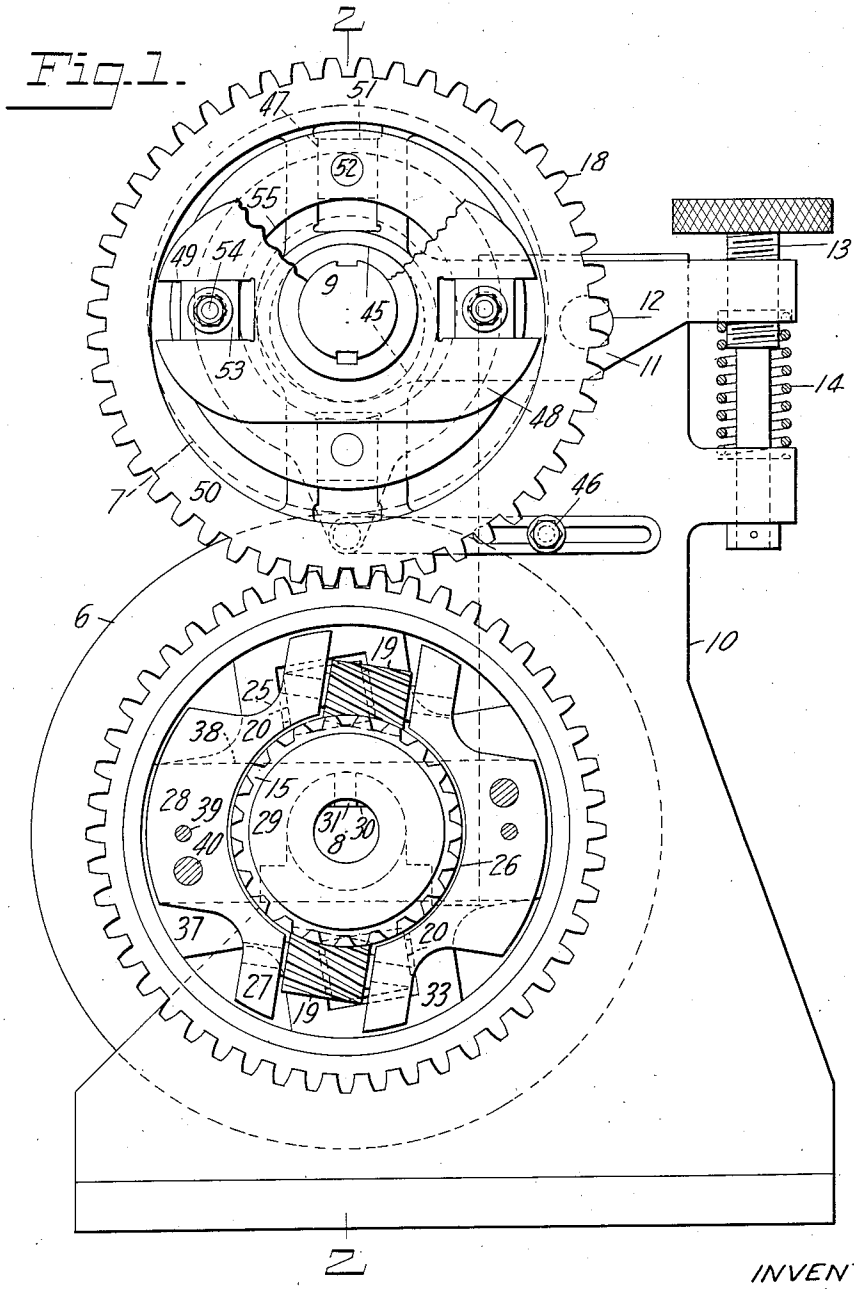
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DIFFERENTIAL DRIVE FOR ROLLS

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Fig. 1.



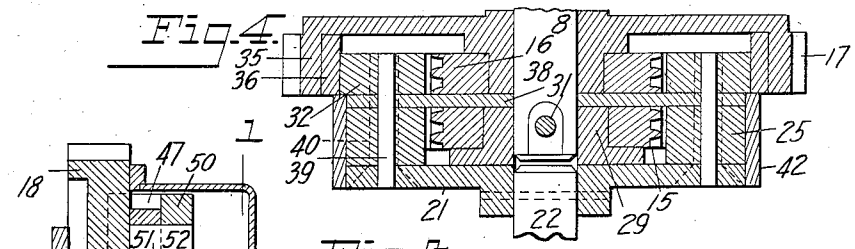
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Fig. 4.



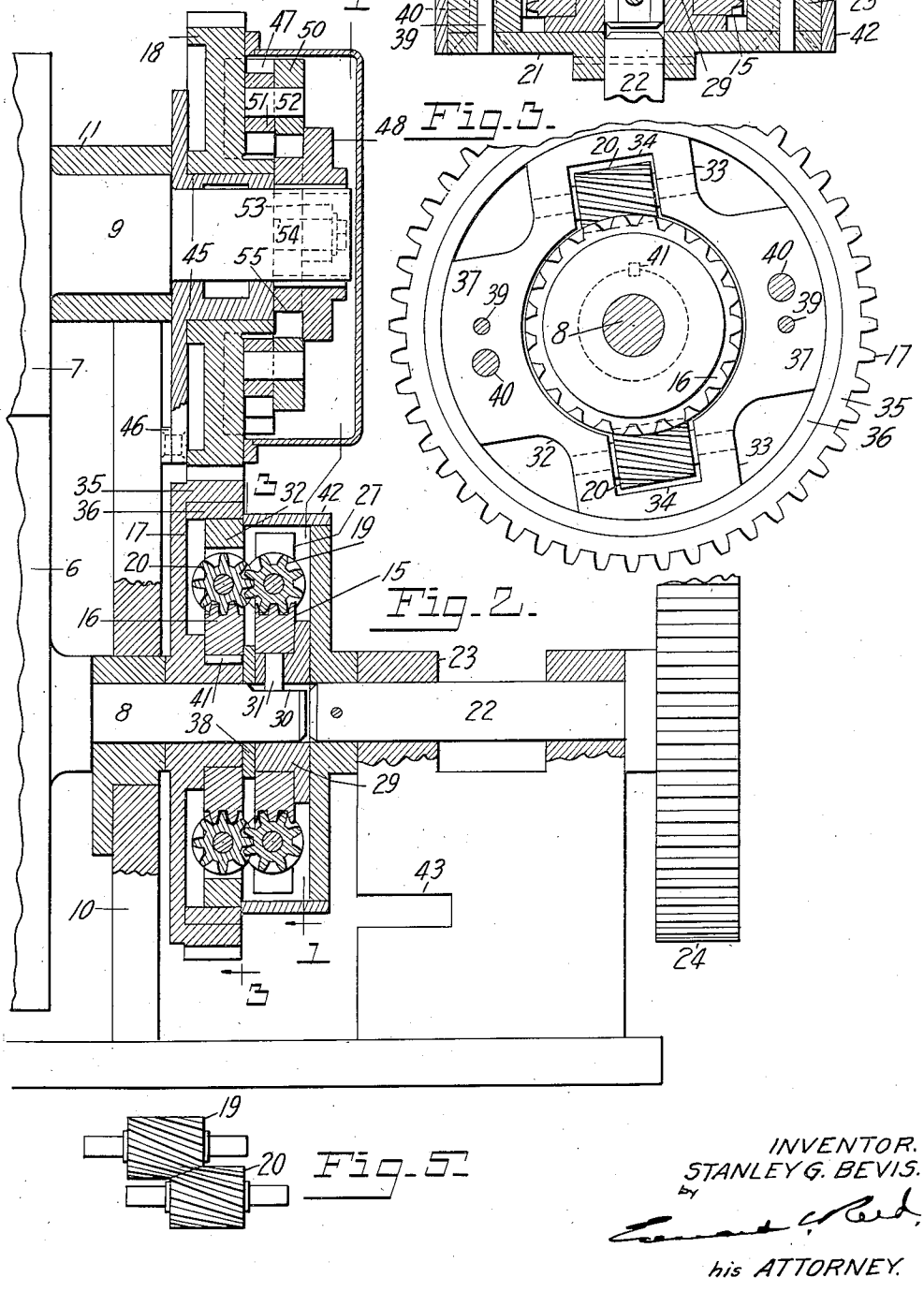


Fig. 5.

Fig. 3.

Fig. 2.

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1,968,278

DIFFERENTIAL DRIVE FOR ROLLS

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Application April 5, 1933, Serial No. 664,468

6 Claims. (Cl. 74—313)

This invention relates to a differential drive for rolls and is designed more particularly for driving the press rolls of paper making machines at the same peripheral speed.

In a paper making machine the web of wet paper, and sometimes its supporting felt, are passed between the press rolls and it is important that the rolls should travel at the same peripheral speed as otherwise there would be a relative movement of the contacting surfaces of the rolls which would be injurious both to the web of paper and to the felt. Ordinarily the press rolls are made of the same diameter and are driven at the same axial speed so that they will initially have the same peripheral speed but in service there will often be a change in the relative diameters of the rolls. This is usually due to the fact that one roll has a relatively soft surface which is subject to greater wear than is the other roll. This change in the relative diameters of the two rolls results in their having different peripheral speeds with the objectionable results noted. Various expedients have been proposed for overcoming this objectionable feature but none has been satisfactory.

One object of the present invention is to provide a differential drive for cooperating rolls which will drive both rolls at the same peripheral speed regardless of variations in the relative diameters of the two rolls.

A further object of the invention is to provide a differential drive which will automatically accommodate itself to any change in the relative diameters of the rolls.

A further object of the invention is to provide such a differential drive which will be simple and compact in construction and which may be easily applied to the press rolls.

Other objects of the invention will appear as the mechanism is described in detail.

In the accompanying drawings Fig. 1 is a vertical section taken on the line 1—1 of Fig. 2; Fig. 2 is a vertical section taken on the line 2—2 of Fig. 1; Fig. 3 is a section taken on the line 3—3 of Fig. 2; Fig. 4 is a horizontal section taken centrally of Fig. 1; and Fig. 5 is a detail view of one pair of spiral pinions.

In these drawings I have illustrated one embodiment of the invention and have shown the same as applied to the press rolls of a paper making machine but it will be understood that this embodiment has been chosen for the purpose of illustration only and that the differential drive may take various forms and may be applied to rolls of various kinds without departing from the spirit of the invention.

To illustrate the application of the invention to a paper making machine I have shown a portion of the press roll mechanism, which includes a lower roll 6 and an upper roll 7, these rolls comprising shafts 8 and 9, respectively, which are journaled at their ends in frame members, one of which is shown at 10. For the purpose of illustration I have shown the rolls 6 and 7 as having a relatively great difference in diameters but in practice the difference in diameters of the rolls is usually much less than that illustrated. Preferably one of the rolls, usually the upper roll, is mounted in adjustable bearings to permit of its movement toward and from the other roll and, in the present construction, the shaft 9 of the upper roll is journaled in arms which are pivotally mounted between their ends on the frame 10, one of these arms being shown at 11 as pivotally mounted on the frame at 12. Adjusting devices are applied to the outer ends of the arms and each device may comprise an adjusting screw 13 threaded into the outer end of the arm and a spring 14 acting on the arm to move the upper roll toward the lower roll.

The differential gear unit is, in the present instance, mounted for rotation about the axis of the shaft 8 of the lower roll and it comprises a spiral gear 15 secured to the shaft 8 for rotation therewith and a second spiral gear 16 rotatable about the axis of the shaft 8 and rigidly connected with a gear 17 which meshes with a gear 18 secured to the shaft 9 of the upper roll. Meshing with the respective spiral gears 15 and 16 are planetary spiral pinions 19 and 20 which are mounted on a suitable structure which is rotatable about the axis of the shaft 8 and these pinions are rotatable about individual axes transverse to the shaft 8 and are connected one to the other so that the movement of one pinion about its individual axis will impart a corresponding movement to the other pinion in the opposite direction. Preferably the spiral pinions mesh one with the other. There are usually a plurality of pairs of spiral pinions and, in the present instance, I have shown two pairs of such pinions. The supporting structure is positively rotated and the spiral pinions engaging the spiral teeth or ribs of the spiral gears cause the latter to rotate. When the resistance offered to the rotation of both press rolls, 6 and 7, is the same the spiral pinions 19 and 20 will be held against relative movement and the spiral gears 15 and 16 will be rotated at the same speed, but if greater re-

sistance is offered to the rotation of one press roll than is offered to the other roll this resistance will tend to retard the rotation of the spiral gear which is connected with that roll and this will impart a relative movement to the two pinions which will cause the speed of the other spiral gear to be changed proportionately. For example, when the upper roll is of a diameter less than the diameter of the lower roll it will have a less peripheral speed than the lower roll and, because both rolls are in contact, respectively, with the web of paper and felt, the rotation of the lower roll will be resisted by the upper roll, and this will tend to slow down the rotation of the lower roll and its spiral gear 15. Consequently the spiral pinion 19 will travel circumferentially of the gear 15 and will be rotated about its individual axis. This rotation of the spiral pinion 19 is transmitted to the spiral pinion 20, and the latter is caused to rotate in a direction which will cause the spiral gear 16, which is connected with the upper roller, to rotate at a speed greater than the planetary speed of the spiral pinions, thereby speeding up the movement of the spiral gear 16 and the upper roll 7. The gear ratio is such that the two rolls will thus be driven at the same peripheral speed, and both rolls are positively driven by the gearing.

The spiral gears and pinions may be mounted and driven in various ways. In the present construction the supporting structure comprises a plate or disk 21 which is rigidly secured to a shaft 22 journaled in suitable bearings 23 and provided with means for connecting the same with a source of power, such as a gear 24. Rigidly secured to the plate or disk 21 is a frame 25 which, in the present instance, is formed separately from the disk and is rigidly secured thereto. This frame as shown in Fig. 1 is provided with a circular recess 26 and two pairs of bearing arms 27. It is also provided with other arms or radially extending portions 28 by means of which it may be connected with other parts of the gear unit. The spiral gear 15 is mounted in the circular recess 26 of the frame, and is rotatable with relation to the frame but is provided with means for rigidly securing it to the end of the shaft 8 so that it will rotate with that shaft. In the present construction the end of the shaft 8 is flattened, as shown at 30, and the gear is provided with a projection 31 to engage this flattened portion of the shaft thus permitting the gear to be slipped over the end of the shaft and held against rotation with relation thereto. Preferably the gear 15 is provided with a hub 29 rigidly secured thereto and the projection comprises a pin inserted in the hub. The spiral pinions 19 are rotatably mounted between the arms 27 of the frame so that they are rotatable about axes extending transversely to the shaft 8 and have tangential relation to the spiral gear 15 with which they mesh. Mounted about the shaft 8 and rigidly connected with the frame 25 and plate 21 is a second frame 32 having radial bearing arms 33 provided with slots 34 to receive the spiral pinions 20, which are thus mounted for rotation about individual axes transverse to the shaft 8. The frame 32 extends about the spiral gear 16 and supports the spiral pinions 20 in tangential relation to and in mesh with that gear. In the present construction the gear 17, which is connected with the upper roll, has an outwardly extending flange 35 which overhangs the frame 32 and spiral gear 16, and the gear teeth are formed on the outer portion of this flange. The frame 32 is rotatable within this flanged gear and the arms 33 may have contact with the inner surface of the flange, or with a wear plate 36 mounted therein, to center the same therein and facilitate the assembly of the device. The frame 32 also has radially extending portions or arms 37 by means of which it may be connected with the frame 25 and plate 21. Preferably a spacing plate 38 is interposed between the two frames and is properly positioned with relation thereto by pins 39, and the disk 21 and the frames 25 and 32 are rigidly connected one to the other by screws 40. In the present arrangement the spiral gear 16 is rotatably mounted on the hub of the gear 17 and may be rigidly secured thereto in any suitable manner, as by shrinking the same thereon, or by a key 41. The arrangement of the two frames with relation one to the other is such that the spiral pinions 19 and 20 overlap for a portion of their length and intermesh one with the other. It will be apparent therefore that the gear unit consisting of the plate 21, the frames 25 and 32 and the gear 17 may be assembled as a unit and then mounted on the shaft 8, the drive shaft 22 being subsequently connected with the supporting structure, or the gear 17 and spiral gear 16 may be mounted on the shaft 8 and the other parts of the unit assembled and slipped onto the shaft and the pinions 20 brought into mesh with the spiral gear 16.

When the two rolls are of the same diameter and therefore are moving at the same peripheral speed the pinions 19 and 20 will be locked against relative rotation and as they are rotated about the axis of the shaft 8 they will carry the spiral gears 15 and 16 with them at a uniform speed but if one of the pinions 19 or 20 is caused to rotate about its individual axis, by the retardation of the roll with which it is connected, it will impart movement to the other pinion and move the same in a direction to cause the speed of the other spiral gear to be increased in an amount sufficient to cause the two rolls to be actuated at axial speeds which will impart the same speed to the peripheries thereof.

Preferably the outer part of the gear unit, comprising the frame 25 and disk 21, is provided with a closure, such as a ring 42, which is removably mounted thereon to completely enclose the gearing. When the bracket carrying the bearings 23 is arranged close to the gear unit, as shown, this bracket may be slotted, as shown at 43, to permit the closure ring to be withdrawn. When this closure ring is in its operative position the gearing is completely enclosed.

When one or both of the rollers wear down to a smaller diameter the movement of the upper roller toward the lower roller is limited by the gears, these gears permitting only a slight movement of the upper roller toward and from the lower roller. In time therefore it would be necessary to substitute smaller gears for those shown. To avoid this necessity of changing gears and thus provide for the relatively large movement of the upper roller toward the lower roller, as may be made necessary by its decreasing diameter, I have provided an adjustable connection between the upper gear 8 and its roller shaft. For this purpose I have rotatably mounted on the shaft of the upper roller 7 an eccentric bushing which is held in adjusted positions by a locking device 46 which connects the same with the main frame. The gear 18 is rotatably mounted on the bushing and is provided in its outer face and on opposite sides of the shaft with radial guide-

ways 47. Rigidly secured to the outer end of the shaft is a plate 48 having radial guideways 49 on the opposite sides of the shaft, the guideways of the plate 48 being arranged transversely to and preferably at right angles to the guideways in the gear. Interposed between the plate 48 and the gear is a driving member 50 which is here shown in the form of a disk and which is provided on its inner face with parts adapted to enter and travel in the guideways 47 of the gear. These parts are here shown as slide blocks 51 fitting in the guideways and carried by studs 52 on the driving member or disk 50. On its outer side this driving member is provided with parts slidably mounted in the guideways 49 of the plate, these guideways also consisting of slide blocks 53 mounted on studs 54 carried by the driving member. The driving member or disk is mounted about the end of the shaft and is provided with a relatively large central opening 55 which permits it to move in any direction with relation to the shaft. Consequently as the gear is rotated the driving member will transmit the motion to the shaft and will automatically adjust itself to the relative positions of the gear and shaft so as to compensate for the off-center position of the gear with relation to the shaft.

While I have shown and described one embodiment of my invention I wish it to be understood that I do not desire to be limited to the details thereof as various modifications may occur to a person skilled in the art.

Having now fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In combination with the press rolls of a paper making machine, said rolls having parallel shafts spaced laterally one from the other, a spiral gear mounted on one of said shafts for rotation therewith, a second spiral gear mounted on said shaft for rotation with relation thereto, a shaft in axial alinement with said roll shaft, a supporting structure carried by the last mentioned shaft and having a part overhanging said spiral gears, a pair of spiral pinions mounted on said part of said supporting structure for rotation about individual axes transverse to said shaft, said pinions meshing one with the other and with the respective spiral gears, means for connecting said second spiral gear with the other of said shafts, and means for rotating the last mentioned shaft.

2. In a differential drive for parallel shafts spaced laterally one from the other, a spiral gear mounted on one of said shafts for rotation therewith, a second spiral gear mounted on said shaft for rotation with relation thereto, a third shaft in axial alinement with said shaft, a supporting structure carried by said third shaft and having a part extending across said spiral gears, spiral pinions rotatably mounted on said part of said structure and meshing one with the other and with the respective spiral gears, a driving connection between said second spiral gear and the other of said parallel shafts, and means for rotating said third shaft.

3. In a differential drive for parallel shafts spaced laterally one from the other, a spur gear having driving connection with one of said shafts, a second spur gear rotatably mounted on the other of said shafts and meshing with the first mentioned spur gear, said second gear having a hub and a flange overhanging said hub, a spiral gear rigidly mounted on said hub, a second spiral gear mounted on the last mentioned shaft for rotation therewith, a structure rotatable about the axis of said last mentioned shaft and comprising a frame member mounted within and centered by the flange of said second spur gear and a second frame member mounted about said second spiral gear, spiral pinions carried by the respective frame members and meshing one with the other and with the respective spiral gears, and means for rotating said structure.

4. In a differential drive for parallel shafts spaced laterally one from the other, a spur gear having driving connection with one of said shafts, a second spur gear rotatably mounted on the other of said shafts and meshing with the first mentioned spur gear, said second gear having a hub and a flange overhanging said hub, a spiral gear rigidly mounted on said hub, a second spiral gear mounted on the last mentioned shaft for rotation therewith, a structure rotatable about the axis of said last mentioned shaft and comprising a frame member mounted within the flange of said second spur gear and a second frame member mounted about said second spiral gear, spiral pinions carried by the respective frame members and meshing one with the other and with the respective spiral gears, a closure carried by said structure and extending about said second frame member and its spiral pinion, and means for rotating said structure.

5. In a differential drive for parallel shafts spaced laterally one from the other, a spiral gear mounted on one of said shafts for rotation therewith, a second spiral gear mounted on said shaft for rotation with relation thereto, a supporting structure mounted for rotation about the axis of said shaft, a third shaft having driving connection with said supporting structure, spiral pinions rotatably mounted on said supporting structure, meshing with the respective spiral gears and having driving connection one with the other, a driving connection between said second spiral gear and the other of said parallel shafts, and means for rotating said third shaft.

6. In a differential drive for parallel shafts spaced laterally one from the other, a spiral gear mounted on one of said shafts for rotation therewith, a second spiral gear mounted on said shaft for rotation with relation thereto, a third shaft in axial alinement with said shaft, a rotatable supporting structure having a part to rotate about said spiral gears and having driving connection with said third shaft, spiral pinions mounted on said part of said supporting structure, meshing with the respective spiral gears and having driving connection one with the other, a driving connection between said second spiral gear and the other of said shafts, and means for rotating said third shaft.

STANLEY G. BEVIS.