The invention relates to apparatus for transforming motion of one kind into motion of a different kind and has reference in particular to apparatus for modifying rotary motion.

In a number of industrial machines such as punch presses and strip feeding apparatus and generally in drive units for various machine applications it is necessary to produce intermittent rotary motion from a continuous rotary drive. For example, in sheeting lines and the like for producing sheets from a strip of material, it is necessary to stop the feeding of the strip material during the cutting action of the knife. The power for feeding the strip material is obtained from a continuously rotating drive shaft and accordingly this continuous rotary motion must be transformed into intermittent rotary motion.

For machine applications as described, the invention provides a new and improved device for modifying rotary motion and which in particular will produce intermittent rotary motion from a continuous rotating drive shaft.

A more specific object resides in the provision of apparatus wherein each revolution of a rotating input shaft will be transformed into one revolution in the same direction of an output shaft plus a dwell period.

Another object of the invention is to provide apparatus as described wherein a rack and cam combination is interposed between the drive shaft and the driven shaft for transforming the rotary input motion of the drive shaft into intermittent rotary motion of the driven shaft, and wherein the dwell period for the driven shaft and its duration is predetermined by the contour of the cam.

A further object resides in the provision of apparatus as described wherein the rack will have bodily rotary movement along with the drive shaft and in addition will have reciprocating movement as predetermined by the cam to either increase the rotary speed of the driven shaft or decrease its speed with respect to that of the drive shaft, and when the rack does not have such reciprocating movement but only rotation with the drive shaft then the two shafts will rotate at the same speed.

Another object of the invention is to provide apparatus for transforming the continuous rotary motion of an input shaft into intermittent rotary motion of an output shaft and which will be in the same direction including a dwell period following each revolution of the output shaft, the said apparatus additionally incorporating a locking arm for holding the output shaft stationary providing inadvertent rotation of the same during the dwell periods.

With these and various other objects in view, the invention may consist of certain novel features of construction and operation as will be more fully described and particularly pointed out in the specification, drawings and claims appended thereto.

In the drawings which illustrate an embodiment of the device wherein like reference characters are used to designate like parts—

FIGURE 1 is a sectional view taken substantially on line 1—1 of FIGURE 2 and showing a device for modifying rotary motion embodying the improvements of the invention;

FIGURE 2 is a front elevational view of the device shown in FIGURE 1 with the front cover plate of the housing removed for a better showing of the parts;

FIGURE 3 is a fragmentary section view taken substantially along line 3—3 of FIGURE 2;

FIGURE 4 is a rear elevational view of the device of the invention showing the arm for locking the driven shaft against rotation during the dwell period;

FIGURE 5 is a top plan view of the motion modifying device with locking arm as shown in FIGURE 4; and

FIGURE 6 is a fragmentary, side, elevational view taken substantially along line 6—6 of FIGURE 4 and showing the arm structure for locking the driven shaft.

The embodiment of the invention selected for illustration in the drawings is disclosed as including the housing 10 having supported relation on a base 11. The housing consists of the circular part 12, the cam member 14 and the front cover plate 15. The bolts 16 and 17 secure the cover plate and the cam member to the circular part so that they form a unit and which is supported on and suitably welded to the base 11 by the portion 18 formed integral with the circular part.

The cover plate 15 provides one journaling member for the drive shaft indicated in its entirety by the numeral 20. The second journaling member for the drive shaft is provided by plate 21, secured to the cam member 14 by bolts 22, and the cylindrical part 23. The said cylindrical part has a stepped exterior which forms the annular abutment 24, the same contacting the cam member 14 and which assists in uniting the cylindrical part to the cam member and to the plate in the manner as shown in FIGURE 1. The ball bearing races 25 and 26 fit within the cylindrical part 23 and said races journal the tubular rear portion 28 of the drive shaft 29 in a substantially frictionless manner. The opposite solid front end 27 of the drive shaft 20 is similarly mounted and journalled in the cover plate 15 by the ball bearing race 30. The inner ring 31 forms a spacer for the ball bearing races 25 and 26, and retaining washers such as 32 are also associated with the races, being located exteriorly thereof for releasably locking the parts in assembled relation.

The drive shaft 20 has located intermediate its length the rack retaining elements 34 and 35, FIGURES 1 and 2, the said rack retaining elements being located within the housing 10 and being adapted to rotate with the drive shaft as a unitary structure. It will be understood that both portions of the drive shaft, namely 27 and 28, and the rack retaining elements 34 and 35, see so united as to constitute a unit adapted to rotate at the speed desired for the particular operation and which thus may be considered as the input shaft of the present motion modifying device. The bolts 36 or similar fastening means are employed for securing the spaced elements 37 and 38 to member 34 and to member 35, the spacer elements being located on respective side edges so that the members are spaced to accommodate the rack 40 and the gear 42. The member 33 extends transversely of the rack, as best shown in FIGURES 1 and 2 and provides the hub for the solid portion 27 of the shaft 20, whereas the member 35 as shown in FIGURE 3, provides the hub for the rear tubular portion 28 of the said drive shaft.

The rack indicated in its entirety by numeral 40 is located centrally within and between the members 34 and 35, being adapted to reciprocate relative to said members. However, it will be understood that the rotating movement of the members as part of the drive shaft 20 is, of course, transmitted to the rack 40 to also cause bodily rotary motion of the rack. The rack is approximately rectangular in shape, having two side walls 43 and 44, located on respective sides of the axis of the drive shaft 20, and which have a sliding fit with the edges 45 of the spacer elements 37 and 38 which form a unit with the members 34 and 35. The side walls 43 and 44 are connected at
respective ends by end walls 46 and 47, with end wall 47 having secured thereto the roller 48 and which is located centrally of the wall 47 and at the extremity of this end of the rack. The rectangular shaped rack not only supports the drive axis of the present device, but in addition the side walls 43 and 44 are located on respective sides of the gear 42. Said gear is characterized by having teeth 50 on its left hand side as shown in FIGURE 2 for approximately 180 degrees. In this respect the rack is also uniquely characterized, since coating teeth 51 are provided on the inside surface of wall 43 only. Since the rack is slidable within the unit formed by the members 34 and 35, and since the rack has a meshing relation with the gear 42, it will be understood that any reciprocating movement of the rack will be imparted to the said gear.

The gear 42 is a part of the drive shaft 52 which comprises the output shaft of the device. The gear is either integral with or suitably connected to the journaled portion 53 of the output shaft and which portion extends through the tubular part 28 of the drive shaft 20. The ball bearing pairs 54 and 55 are interposed between the tubular part 28 and the journaled portion 53, since in accordance with the invention the drive shaft and the driven shaft will rotate at different speeds with the driven shaft actually remaining at rest for a predetermined period while the drive shaft continues to rotate.

The cam member 14 remains stationary during operation of the device, since it constitutes part of the housing. However, the member is provided with a cam race 56, FIGURE 2, for accommodating the roller 48 carried by the rack 40. The contour of the cam race 56 is determined by the rotary motion desired of the output shaft. Accordingly, the cam race will produce reciprocating movement of the rack as the same is bodily rotated by the drive shaft structure, the said reciprocating movements of the rack having the effect of either adding to or subtracting from the rotary motion of the drive shaft.

As illustrated in the present embodiment shown in the drawings, the driven shaft 52 will have a complete revolution, plus a dwell period for each revolution of the drive shaft 20. In other words, the shaft 52 will rotate for one complete revolution during 300 degrees of rotation of the drive shaft 20, and the same will then dwell for 60 degrees of rotation of the drive shaft. The dwell period is produced by the portion 57 of the cam race and which consists of that portion between the dotted lines 59, FIGURE 2. When the roller 48 is passing through this portion of the race, the rack will be reciprocated in a direction to subtract or negative the rotation of the drive shaft. Thus, the drive gear 42 that the output shaft remains stationary. The remaining portion of the cam race is such as to produce reciprocation of the rack in an opposite direction or such as to effect a speeding up of the rotary motion of the output shaft. For example, assuming that the drive shaft rotates in a clockwise direction, the dwell period is effected by motion of the rack 40 to cause counter-clockwise rotation of the gear 42. This counter-clockwise rotation or action on gear 42 is such as to negative the clockwise rotation of the drive shaft so that the driven shaft does not rotate at all but remains at rest for the dwell period. A speeding up of the rotary motion of the output shaft is effected by reciprocation of the rack 40 to produce clockwise rotation of the gear 42 and thus similar rotation of the driven shaft which thus adds to the rotary motion imparted to these elements by the drive shaft.

During operation and following a dwell period the output shaft is caused to gradually accelerate as regards its rotary motion until it exceeds the speed of rotation of the drive shaft, thereafter it is gradually brought to rest for the start of the dwell period. The parts are so designed that the driven shaft will rotate for 360 degrees, or for one complete revolution, during only 300 degrees of rotation of the drive shaft. For the next 60 degrees of rotation of the drive shaft the driven shaft will remain at rest.

The structure for holding the driven shaft 52 in a stationary position during the dwell period, is best shown in FIGURE 4. As shown in FIGURE 4, the cam 20, the cam being suitably fixed to the tubular part 28 of the drive shaft as shown in FIGURE 4. The locking arm 61 is fixed to the projecting end of the driven shaft 52, and thus the two elements of the holding structure have the characteristic rotary motion as described for the respective elements of the drive shaft. In this case, the standing supports 62 which pivotally mount the shaft 63. A pair of pivot arms such as 64 and 65 are fixed to the shaft and the arms are resiliently biased by the coil spring 66 in a direction toward the cam 60. The arm 64 carries the roller 67 at its upper free end and which is journaled for free rotation, being normally held by the spring 66 in contact with the periphery of the cam 60. In a similar manner the arm 65 carries the roller 68 which is mounted at the upper free end of the arm for rotation and which is shown in FIGURE 4 as adapted to coact with the bifurcated end of the locking arm 61. The said bifurcated end of arm 61 provides an opening 70 and which has sufficient width to receive the roller 68.

In operation of the device, the pivot arm structure including the arms 64 and 65 will be oscillated in a back and forth direction by the cam 60. The peripheral contour of the cam is designed so that it impart some oscillating motion to the arm structure as will properly connect with the rotary movement and dwell period of the locking arm 61. It will be observed from FIGURE 4 that both the cam and the locking arm rotate in the same direction and as the locking arm approaches the start of a dwell period, the arm structure and roller 67 will be caused to pivot in a left hand direction towards the slot 70 of the approaching locking arm. Thus, at the beginning of the dwell period the roller 68 enters the slot 70 and remains within the slot during the dwell period. However, prior to the end of the dwell period, the pivot arm structure will be moved outward in a direction toward the right whereby to move the roller 68 out of the slot 70. Upon such action taking place, the locking arm 61 will start its rotary movement again in a counter-clockwise direction.

The present device will modify continuous rotary motion by transforming it into intermittent rotary motion and wherein one or more dwell periods may occur for each revolution of the output shaft. The rack and the retaining means are all part of the input shaft, whereas only the drive gear is fixed to shaft portion 53 so as to be a part of the output shaft. Another desirable feature of the invention resides in the fact that the input shaft and output shaft are on the same axis and further that both shafts are concentric on the delivery side of the device. The invention is not to be limited to or by details of construction of the particular embodiment thereof illustrated by the drawings, as various other forms of the device will, of course, be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

We claim:

1. In a device for modifying rotary motion to produce intermittent rotary motion from a continuous rotating input shaft, the combination with a housing providing a cam plate having a cam race of characteristic contour, an input shaft journaled by the housing, said input shaft having rack retaining means formed intermediate its length and which has location within the housing, said input shaft including a tubular part projecting from the housing on one side thereof, a rack member carried by the rack retaining means and adapted to reciprocating movement in said cam plate, an output shaft journaled by the tubular part of the input shaft and projecting from the same, a drive gear fixed to the output shaft and having location within the rack member and being operatively geared
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5. thereto, and a roller fixed to the rack member at one end thereof and having location within the said cam race.

2. In a device for modifying rotary motion to produce intermittent rotary motion from a continuous rotating input shaft, the combination with a housing providing a cam plate having a cam race of characteristic contour, an input shaft journaled by the housing and providing at respective ends a projecting drive shaft portion and a projecting tubular portion, said input shaft having rack retaining means formed between the drive shaft and tubular portions of said input shaft, said means being located within the housing, a rack member carried by the rack retaining means and adapted to have reciprocating movement, an output shaft journaled by the tubular portion of the input shaft and projecting from the same, a drive gear fixed to the output shaft and having location within the rack member and being operatively geared thereto, and a roller fixed to the rack member at one end thereof and having location within the said cam race.

3. In a device of the character as defined by claim 2, wherein the housing includes a cover plate, journaled means between the cover plate and the projecting drive shaft portion of the input shaft, and additional journaled means between the cam plate and the projecting tubular portion of the input shaft.

4. In a device of the character as defined by claim 2, additionally including a cam fixed to the projecting tubular end of the input shaft, a locking arm fixed to the end of the output shaft which projects from the said tubular end of the input shaft, and means actuated by the cam and operative to engage and hold the locking arm during the non-rotating intervals in the rotary motion of the output shaft.

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