Nov. 10, 1953 J. G. McILVAIN, JR 2,658,406

VARIABLE SPEED FEED MECHANISM

Filed May 4, 1951 2 Sheets-Sheet 1

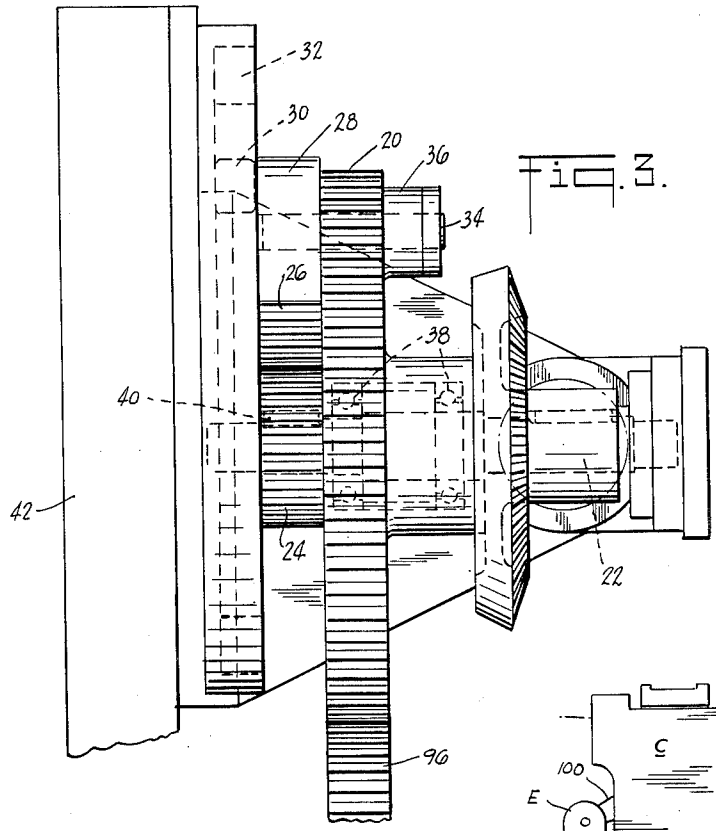


Fig. 3.

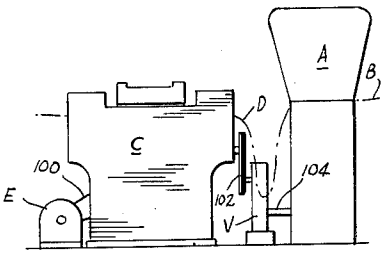


Fig. 1.

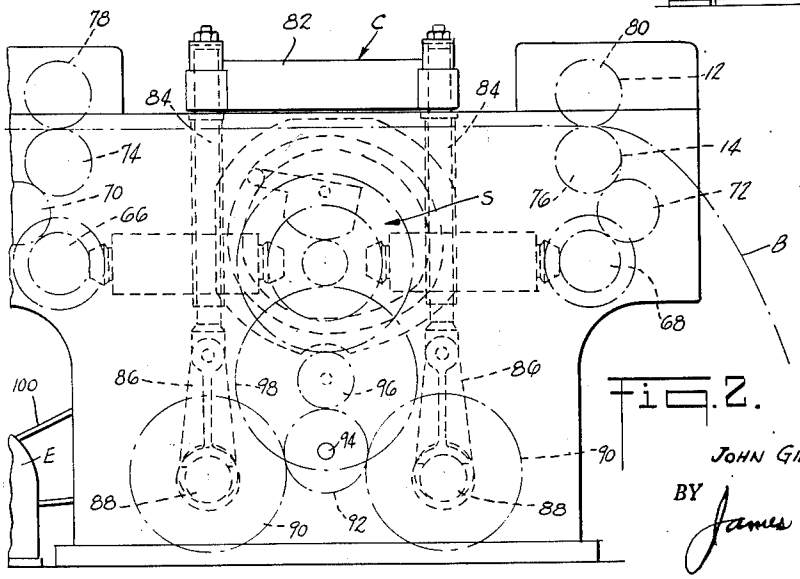


Fig. 2.

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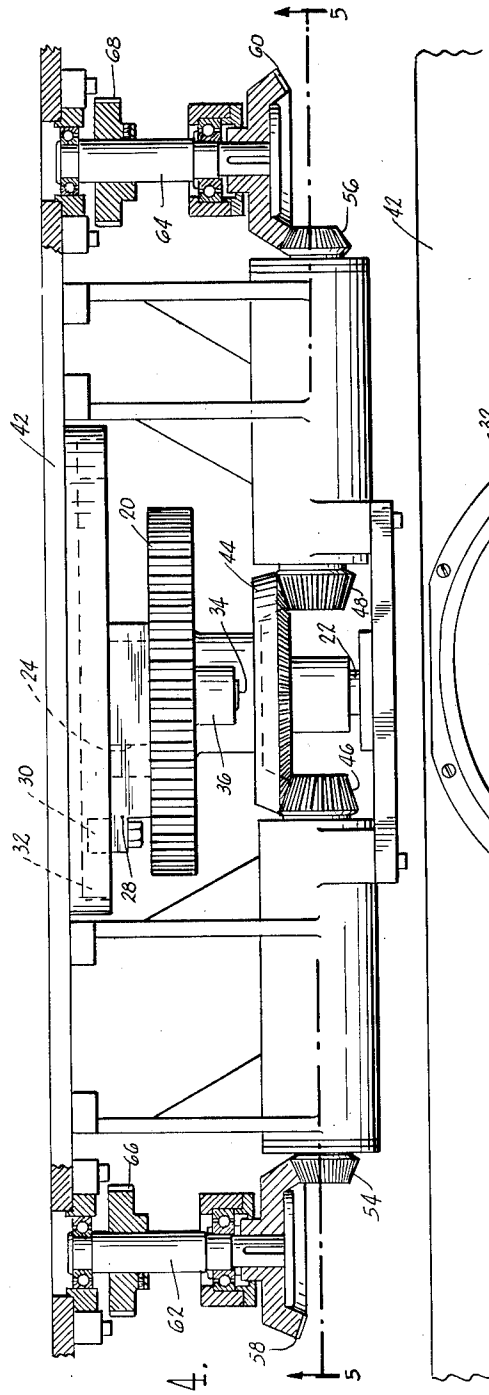


Fig. 4.

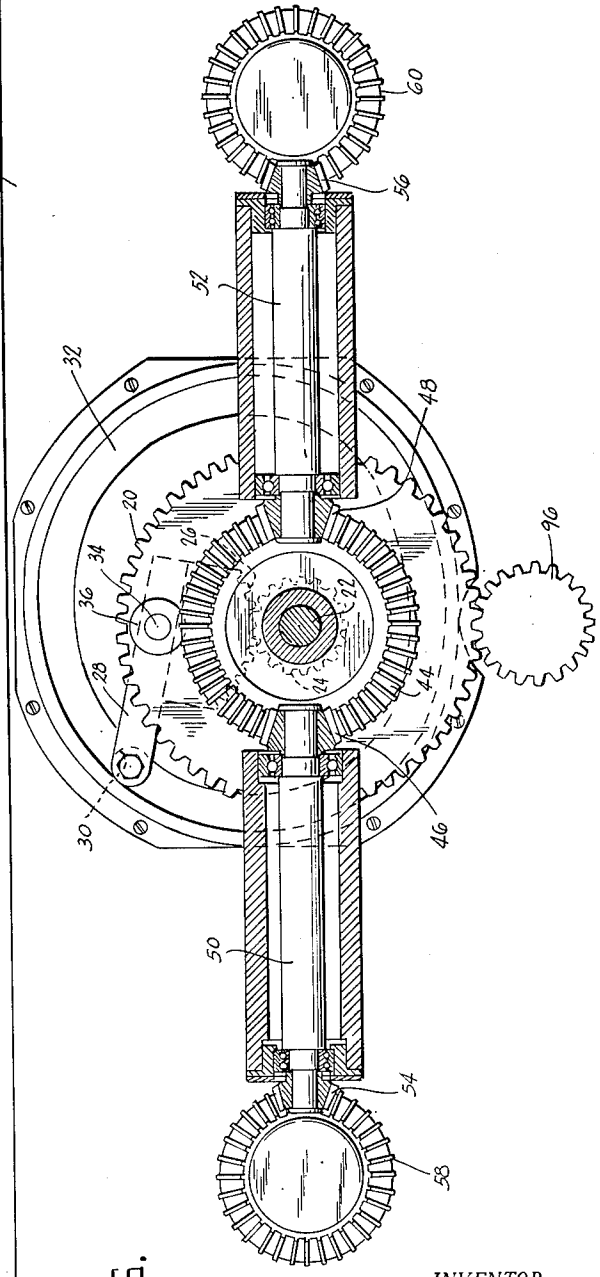


Fig. 5.

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VARIABLE SPEED FEED MECHANISM

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Application May 4, 1951, Serial No. 224,598

9 Claims. (Cl. 74—394)

1

This invention relates to drive mechanisms, especially intermittent drive mechanisms, and still more particularly to feed mechanisms for intermittently feeding a web through a reciprocating press.

One object of the present invention is to generally improve intermittent drive mechanisms. A more particular object is to improve mechanisms for intermittently feeding a web at high speed. In a copending application of Frederick Auer, Serial No. 678,612, filed June 22, 1946, now Patent No. 2,548,136 and entitled "Feed Mechanism," there is disclosed such a mechanism intended to operate in synchronism with machines requiring a continuously moving web, a common example being the combination of a printing machine with a cutting and scoring press. A slack loop is provided between the machines and the web is kept under positive control by feed wheels which are driven through a cam and roller mechanism which causes the wheels to be accelerated, then rotated at uniform speed, then decelerated, and then dwell briefly for the cutting operation in the press.

One object of the present invention is to generally improve the aforesaid accelerating feed mechanism. More specific objects are to greatly reduce the mass of the parts which must be accelerated and decelerated. Instead of a large heart-shaped cam it is only a small diameter gear which is subjected to the variable speed drive. A large cam is still employed to introduce the accelerating and decelerating components, but in accordance with the present improvement this cam is a stationary cam which may be fixedly secured to the frame of the machine. Thus the cam may be made as heavy and strong as desired, instead of being minimized in mass, and so a sturdier drive is provided. In accordance with other features and objects of the invention, a number of accessory parts previously required are eliminated, and those parts which are employed remain continuously in mesh, thus affording positive control at all times.

It has been suggested to employ a planetary drive in which the planet gears are carried by a spider which is oscillated by linkage driven by a cam. A further object of the present invention is to simplify and improve such an arrangement. More specific objects are to eliminate the ring gear; to eliminate the need for the offset cam with its special drive means for rotating the same; to eliminate the spider and multiple planet gears; and to devise a more compact and simple mechanism providing a more direct drive.

2

The intermittent feed wheels may be located at the entrant end of the press, and the web may be drawn by slip wheels at the discharge end of the press. However, in the case of webs which are largely scored and cut away this may tend to tear the web, and in accordance with a further feature of the invention both ends of the press are provided with intermittently operated feed wheels which exercise positive control on the web. That, however, requires identical movement of the feed wheels at both ends, and it has been found that even a slight difference in backlash or lost motion in gearing or chain drives as, for example, if the feed wheels at one end are driven from the feed wheels at the other end, is sufficient to tear the web. The same is true if two supposedly identical accelerating cam mechanisms are provided at the ends of the press.

A further object of the present invention is to help insure identical rotation of the feed wheels, and with that object in view a symmetrical drive is provided, a single accelerating mechanism being connected to the feed wheels at both ends of the press by gear trains made up of equal numbers of gears of like type and dimension in order that the rollers may be subjected to the same probable lost motion or backlash.

To accomplish the foregoing general objects, and such other objects as may hereinafter appear, my invention resides in the accelerating feed elements and their relation one to another as are hereinafter more particularly described in the following specification. The specification is accompanied by drawings in which:

Fig. 1 is a small view schematically showing a common use for the invention;

Fig. 2 is a side elevation of a press with feed mechanism embodying features of the invention;

Fig. 3 is an end view of the accelerating feed mechanism employed in the press of Fig. 2;

Fig. 4 is a partially sectioned plan view of the same; and

Fig. 5 is a partially section front elevation taken approximately in the plane of the line 5—5 of Fig. 4.

Referring to the drawing, and more particularly to Fig. 1, the apparatus comprises a first machine A which operates on a continuously moving web B, and a second machine C which operates on the same web, with the web moved only intermittently, there being a slack loop of web D between the two machines. The motor E runs continuously, and drives the machines A and C, the machine C including accelerating feed mechanism to move the web intermittently.

In the present case the machine A is a printing press, it being understood that there may be a bank of printing presses for multi-colored printing, instead of a single press as shown, and the machine C is a punch press which may be used for scoring or cutting the web. A typical problem may be to make blanks for milk containers, in which case the web is scored to mark the fold lines and is cut to mark the outlines of the blank.

Referring now to Fig. 2 of the drawing, the punch press C receives the web B as fed to it intermittently by top and bottom feed wheels 12 and 14, these being intermittently driven by speed-up mechanism generally designated S. To maintain registration and to guard against cumulative change in the size of the slack loop of web, compensating mechanism may be provided. Such mechanisms are described in greater detail in the copending application of Frederick Auer, Serial No. 678,612, now Patent No. 2,548,136 previously referred to, and the compensation may take effect either by supplying a corrective movement through differential gearing or, in the alternative, by means of a positive infinite variable drive indicated at V in Fig. 1, this being disposed in the drive connection between the machines C and A.

The accelerating or speed-up mechanism S is shown in greater detail in Figs. 3, 4 and 5 of the drawing, referring to which it will be seen that there is a rotatable input member 20 and a rotatable output member 22 disposed coaxial therewith. A sun gear 24, preferably of small diameter, is disposed on one of said members, in this case the output member 22, while a planet gear sector 26 is carried by the other member, in this case the input member 20. The planet gear sector 26 meshes with the sun gear 24 and is held against free rotation by means of an arm 28 fixed to the sector. This arm extends outwardly from the sector and may be used to oscillate the same relative to the input member 20.

For this purpose the arm 28 carries a cam follower 30 which is received in a stationary cam track 32, the said cam track extending around the axis of the rotatable members 20 and 22. The cam track 32 is so shaped as to oscillate the sector 26 during each revolution of the same about the axis of the members 20, 22, and this introduces accelerating and decelerating components into the drive from the member 20 to the member 22. In the specific case here illustrated the rotation of the output member 22 may be divided into four periods corresponding to rotation of the input member 20 as follows: acceleration for 108°, uniform high velocity for 54°, deceleration for 108°, and dwell for 90°. These values are given solely by way of example and are not intended to be in limitation of the invention, for it is evident that one important advantage of the present improvement is that it makes possible great flexibility in the timing cycle which may be provided.

Considering the arrangement in greater detail, in the specific arrangement here shown the input member 20 is a gear of relatively large diameter, the diameter being sufficient to make it possible to pivotally mount the gear sector 26 directly on the member 20, as indicated at 34, and for this purpose the gear may be provided with a boss 36 to increase the bearing surface. The output member 22 is a shaft, and the gear 20 is freely rotatable around the shaft 22, as is indicated in Fig. 3 by the ball bearing 38. The sun gear 24 is fixedly secured to the shaft 22, as by means of a key 40. The mechanism is mounted on the side frame 42 of the machine in such a manner that the relatively large cam 32 may be secured directly against the frame, as is clearly shown in the drawing. In Fig. 3 it will be seen that the sun gear 24 is preferably disposed between the cam 32 and the input gear 20, in which case the arm 28 may be mounted on a pivot projecting in one direction to the gear 20, while the cam roller 30 projects in the opposite direction. This arrangement has the advantage that the radius of the cam track may become less than the radius of the gear 20, as shown near the bottom of Fig. 5.

A most important feature of the present invention is that it readily provides a dwell period. Fig. 5 shows the cam roller 30 in the dwell portion of the cam (which in the present case is 90° long). The dwell is obtained by a part of the cam which may be developed by tracing the motion of the cam roller when holding the sun gear 24 stationary while rolling the planet gear about the sun gear.

The present cam is laid out to accelerate the web for one-third the length of a single sheet portion of the web, to feed the web at uniform high speed for one-third the length of the sheet, to decelerate the web for one-third the length of the sheet, and to dwell for a time equivalent to one-third of the total travel time of the web. In degrees, there is acceleration for 108°, uniform velocity for 54°, deceleration for 108°, and dwell for 90°. The acceleration for 108° provides the same amount of sheet travel as the uniform high velocity provides in one-half that time or 54°.

One might provide a more gradual acceleration and deceleration by eliminating the uniform velocity part of the cycle. Thus one might have acceleration, deceleration, and dwell alone. However, to obtain the desired web travel or sheet length in the same limited time, such an arrangement would require a very high maximum velocity at the top speed between acceleration and deceleration. It is primarily with a view to limiting the necessary maximum web speed that a period of uniform velocity travel is employed between the acceleration and the deceleration. However, the portion of the cycle used for uniform velocity cannot be lengthened too much because the more it is prolonged the sharper becomes the necessary acceleration and deceleration, which again is bad. Thus the cycle here employed is a compromise between a desire, on the one hand, to limit the maximum sheet velocity, and a desire, on the other hand, to provide a gradual acceleration and deceleration.

In some cases it may prove desirable to have a somewhat more gradual acceleration and deceleration, and a somewhat higher uniform velocity to compensate, but that still would retain the idea of a compromise motion, as explained.

In the present mechanism the diameter of the planet gear is twice that of the sun gear. This is done because there is a practical limit to the swing of the cam follower lever. In theory it might be carried to 180°, but in practice should not be carried beyond, say 120°, and in the present case is much less than that, about 70°.

The press is preferably provided with supply feed wheels at one end, and discharge feed wheels at the other end, and they are preferably driven from the accelerating mechanism by gear trains made up of equal numbers of gears of like type and dimension, in order that the supply

and discharge wheels may be operated alike and be subjected to the same probable lost motion or backlash. Thus in Figs. 4 and 5 it will be seen that the shaft 22 carries a bevel gear 44 meshing with bevel pinions 46 and 48, which in turn drive shafts 50 and 52 (Fig. 5) which carry bevel pinions 54 and 56, which in turn mesh with bevel gears 58 and 60. These in turn drive spindles 62 and 64 (Fig. 4) which carry spur gears 66 and 68. Referring now to Fig. 2 of the drawing, the spur gears 66 and 68 drive gears 70 and 72, which in turn mesh with gears 74 and 76, which turn feed wheels of corresponding diameter. These gears also mesh with gears 78 and 80 which turn upper feed wheels of corresponding diameter. It will thus be seen that the gear trains are made as much alike as possible with a view to insuring equal and simultaneous feed movement at both ends of the press, and thus avoid stress or tearing of the web even though the web is weakened by removal of large portions by the punching action of the press itself.

The punch press C shown in Figs. 1 and 2 may be of conventional construction, it comprising a bolster or platen 82 reciprocated by four corner rods 84 connected to links 86 operated by eccentrics 88 driven by gears 90. These mesh with gears 92 carried on a shaft 94 which also carries pulley 98 which receives belt 100 leading to the main drive motor E previously referred to. One of the gears 92, or another gear carried by the shaft 94, meshes with the intermediate gear 96, which in turn meshes with the large input gear 20 previously referred to, as is also shown in Figs. 3 and 5.

To drive the printing press, power is taken from the shaft 94, and through bevel gearing of conventional character (not shown), is led to the chain drive 102 shown in Fig. 1, which runs to the main shaft 104 of the line of printing presses. The positive infinitely variable drive V is interposed when such a drive is desired for compensation, as previously mentioned.

It is believed that the construction and operation of my improved accelerating feed mechanism, as well as the advantages thereof, will be apparent from the foregoing detailed description. The feed wheels grip the web tightly at all times, and maintain positive control of the web. This is true at both ends of the press, and the web may be accelerated, moved at high speed, decelerated, and then caused to dwell, all in a manner which utilizes the available time most efficiently. The supply and discharge wheels are operated alike, and are subjected to the same probable lost motion or backlash. As to the accelerating cam mechanism itself, the mass of the sun gear which must be accelerated and decelerated is minimized. The oscillating gear sector too is of comparatively small mass, and its movement is over only a comparatively small angle. The large cam, which is the part of greatest mass, is absolutely stationary, it being bolted to the frame of the machine. The input gear 20 which carries the gear sector is a full circular gear rotated at uniform speed, and any unbalance introduced by adding the gear sector is readily counterbalanced by the addition of an equivalent weight at the opposite side. This is preferably done, although not so shown in the drawing in order not to unduly complicate the same.

The present mechanism has the advantage that there is no jamming or locking point. It can even be turned in reverse direction without jamming or locking. It has the advantages of providing uniform or harmonic acceleration and deceleration if desired, and of providing a real dwell, and the length of dwell may be made whatever is needed or desired. It has the advantage that the parts are simple and open so that they can be "beefed up" as much as necessary, and thus can be subjected to heavy loads.

For example, in the disclosed mechanism two sets of feed rollers are driven from a single cam mechanism, and if desired, three sets or more could be so driven. Incidentally, when using two sets, as in Fig. 5, it is not necessary that the shafts point diametrically opposite one another, nor that the shafts be of equal length.

The ability to "beef up" the mechanism leads ultimately to a higher speed drive. This is so because the dwell period is usually fixed by the needs of the particular mechanism requiring the dwell, in this case the punch press. To increase the overall speed the only thing that can be done is to speed up the motion part of the cycle, and that increases the load on the accelerating mechanism.

It will be understood that while I have shown a gear sector for the planet, a full gear might be employed; and conversely, while I have shown a full gear for the sun gear, a sector might be employed, particularly so when using a lower gear ratio, say 1:1, instead of the ratio of 2:1 here shown. In general it will prove less expensive and more satisfactory to employ the full sun gear even though only a portion of the periphery is used.

Compared to some prior mechanisms, it is not necessary to employ a large ring gear, nor to employ multiple planet gears with a spider, nor to employ a separate rotatable cam with special drive mechanism for rotating the same. The new drive is simple, requires a minimum number of parts, and is direct in nature. The new drive is compact in dimension, for the input and output members have a common axis, yet may be disposed close to one another in axial direction, for in essence the axial dimension may be reduced to merely the sum of the thickness of the cam, the sun gear, and the input gear.

It will be understood that the invention is not limited to web feed mechanism, and may be applied to sheet feed mechanism, and indeed may be applied to other and wholly different mechanisms where an intermittent motion is wanted. For example, in automatic machines employing a turret the turret often is turned by a Geneva gear mechanism. Such mechanisms have proved troublesome because of their abrupt acceleration, and their short travel time in contrast with the long dwell time, which frequently is far greater than wanted. The present mechanism may be employed to drive a turret by simply introducing a gear reduction between the sun gear shaft and the turret shaft, with a reduction ratio corresponding to the number of stations. Thus the motion from one station to the next is provided by the present mechanism, and may be apportioned as desired to provide gradual acceleration and deceleration and a limited dwell period no greater than needed for the operation to be performed at the station. This makes the full remaining time available for a more gradual and therefore more satisfactory acceleration and deceleration.

It will be understood that while I have shown and described my invention in a preferred form, changes may be made in the structure disclosed, without departing from the scope of the inven-

tion, as sought to be defined in the following claims. In the claims the reference to a "sun gear" is not intended to exclude the use of a sun gear sector, and the reference to a "planet gear sector" is not intended to exclude the use of a full planet gear. The quoted terminology is employed simply for easier recognition and consequent clarity.

I claim:

1. An accelerating feed mechanism comprising a rotatable input member, a rotatable output member coaxial therewith, a sun gear on one of said members, a planet gear sector carried by the other member and meshing with the sun gear, an arm extending from said gear sector for oscillating the same, a cam follower carried by said arm, and a stationary cam track receiving said cam follower and surrounding the axis of said rotatable members, said cam track being so shaped as to oscillate the sector during revolution of the same and to thereby introduce accelerating and decelerating components into the drive from one of said members to the other.

2. An accelerating feed mechanism comprising a rotatable input member, a rotatable output member coaxial therewith, a sun gear on the output member, a planet gear sector carried by the input member and meshing with the sun gear, an arm extending outwardly from said gear sector for oscillating the same, a cam follower carried by said arm, and a stationary cam track receiving said cam follower and surrounding the axis of said rotatable members, said cam track being so shaped as to oscillate the sector during revolution of the same and to thereby introduce accelerating and decelerating components into the drive from said input member to said output member.

3. An accelerating feed mechanism comprising a frame, a rotatable input member, a rotatable output member coaxial therewith, a sun gear on the output member, a planet gear sector carried by the input member and meshing with the sun gear, an arm fixedly related to and extending outwardly from said gear sector for oscillating the same, a cam follower carried by said arm on the side remote from the input member, and a stationary cam track receiving said cam follower and surrounding the axis of said rotatable members, said cam track being fixedly secured to said frame and so shaped as to oscillate the sector during revolution of the same and to thereby introduce accelerating and decelerating components into the drive from said input member to said output member, said sun gear being disposed between said cam and said input member, and said cam being disposed between said sun gear and said frame.

4. An accelerating feed mechanism comprising a frame, a rotatable input member, a rotatable output member coaxial therewith a sun gear on the output member, a planet gear sector carried by the input member and meshing with the sun gear, an arm fixedly related to and extending outwardly from said gear sector for oscillating the same, a cam follower carried by said arm on the side remote from the input member, and a stationary cam track receiving said cam follower and surrounding the axis of said rotatable members, said cam track being fixedly secured to said frame and being so shaped as to oscillate the sector during revolution of the same and to thereby introduce accelerating and decelerating components into the drive from said input member to said output member, said sun gear being disposed between said cam and said input member, and said cam being disposed between said sun gear and said frame, and said sun gear, said gear sector, and said lever all being disposed in a common plane perpendicular to the axis of the mechanism.

5. An accelerating feed mechanism comprising a frame, a rotatable input member, a rotatable output member coaxial therewith, a sun gear on the output member, a planet gear sector carried by the input member and meshing with the sun gear, an arm fixedly related to and extending outwardly from said gear sector for oscillating the same, a cam follower carried by said arm on the side remote from the input member, and a stationary cam track receiving said cam follower and surrounding the axis of said rotatable members, said cam track being fixedly secured to said frame and being so shaped as to oscillate the sector during revolution of the same and to thereby introduce accelerating and decelerating components into the drive from said input member to said output member, said sun gear being disposed between said cam and said input member, and said cam being disposed between said sun gear and said frame, an output shaft carrying said sun gear, said shaft passing through said input member, and anti-friction bearings between said input member and said output shaft.

6. A drive mechanism comprising a rotatable input member, a rotatable output member coaxial therewith, a sun gear on the output member, a planet gear sector carried by the input member and meshing with the sun gear, an arm fixedly related to and extending outwardly from said gear sector for oscillating the same, a cam follower carried by said arm, and a stationary cam track receiving said cam follower and surrounding the axis of said rotatable members, said cam track being so shaped as to oscillate the sector during revolution of the same and to thereby convert uniform rotation to non-uniform rotation, a part of said cam track being shaped to eliminate forward motion of the sun gear over a period.

7. A drive mechanism comprising a rotatable input member, a rotatable output member coaxial therewith, a sun gear on the output member, a planet gear sector carried by the input member and meshing with the sun gear, an arm fixedly related to and extending outwardly from said gear sector for oscillating the same, a cam follower carried by said arm, and a stationary cam track receiving said cam follower and surrounding the axis of said rotatable members, said cam track being so shaped as to oscillate the sector during revolution of the same and to thereby convert uniform rotation to non-uniform rotation, a part of said cam track being developed to correspond to the motion of the cam follower when the planet gear sector is rolled about the sun gear while holding the sun gear stationary, thereby providing a dwell period.

8. An accelerating feed mechanism comprising a frame, a rotatable input member, a rotatable output member coaxial therewith, a sun gear on the output member, a planet gear sector carried by the input member and meshing with the sun gear, an arm fixedly related to and extending outwardly from said gear sector for oscillating the same, a cam follower carried by said arm on the side remote from the input member, and a stationary cam track receiving said cam follower and surrounding the axis of

said rotatable members, said sun gear being disposed between said cam track and said input member, and said cam track being disposed between said sun gear and said frame, said cam track being fixedly secured to said frame and being so shaped as to oscillate the sector during revolution of the same and to thereby convert uniform rotation to non-uniform rotation, a part of said cam track being shaped to eliminate forward motion of the sun gear over a period of time.

9. An accelerating feed mechanism comprising a frame, a rotatable input member, a rotatable output member coaxial therewith, a sun gear on the output member, a planet gear sector carried by the input member and meshing with the sun gear, an arm fixedly related to and extending outwardly from said gear sector for oscillating the same, a cam follower carried by said arm on the side remote from the input member, and a stationary cam track receiving said cam follower and surrounding the axis of said rotatable members, said sun gear being disposed between said cam track and said input member, and said cam track being disposed between said sun gear and said frame, said cam track being fixedly secured to said frame and being so shaped as to oscillate the sector during revolution of the same and to thereby convert uniform rotation to non-uniform rotation, a part of said cam track being developed to correspond to the motion of the cam follower when the planet gear sector is rolled about the sun gear while holding the sun gear stationary, thereby providing a dwell period.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,080,978	Johnston	Dec. 9, 1913
2,253,367	Di Prima	Aug. 19, 1941
2,309,595	James	Jan. 26, 1943
2,498,036	Grace	Feb. 21, 1950
2,536,754	Dudley et al.	Jan. 2, 1951