May 15, 1962 S. BUDLONG 3,034,364

MECHANICAL LOCK-UP MEANS FOR OVERRIDING DRIVES

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Fig. 5

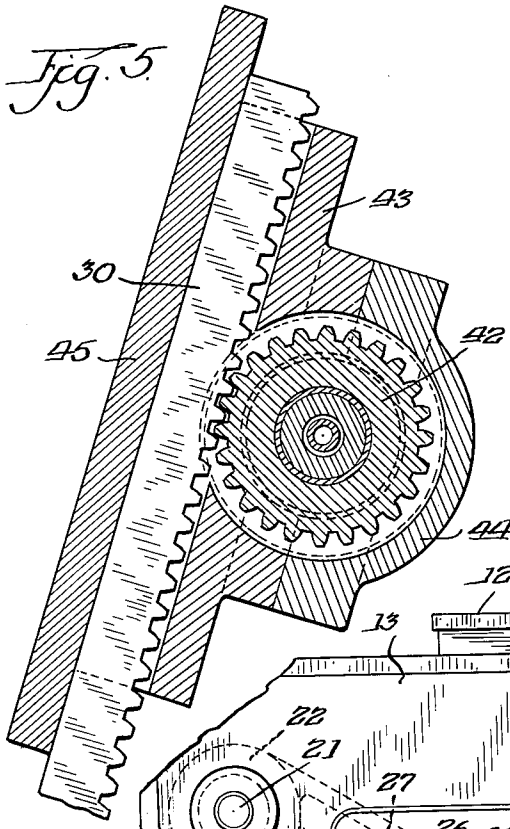


Fig. 1

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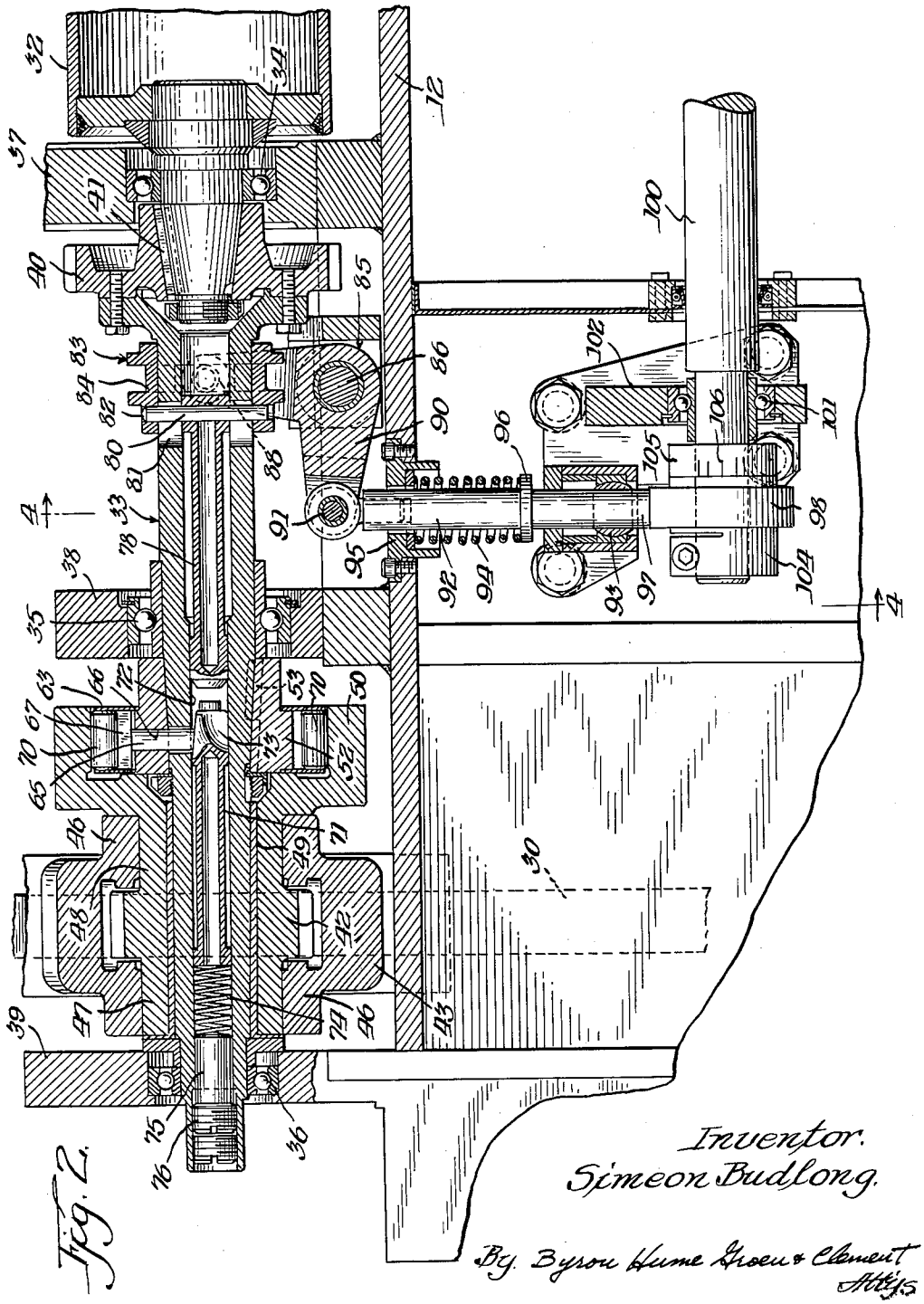


Fig. 2.

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MECHANICAL LOCK-UP MEANS FOR OVERRIDING DRIVES

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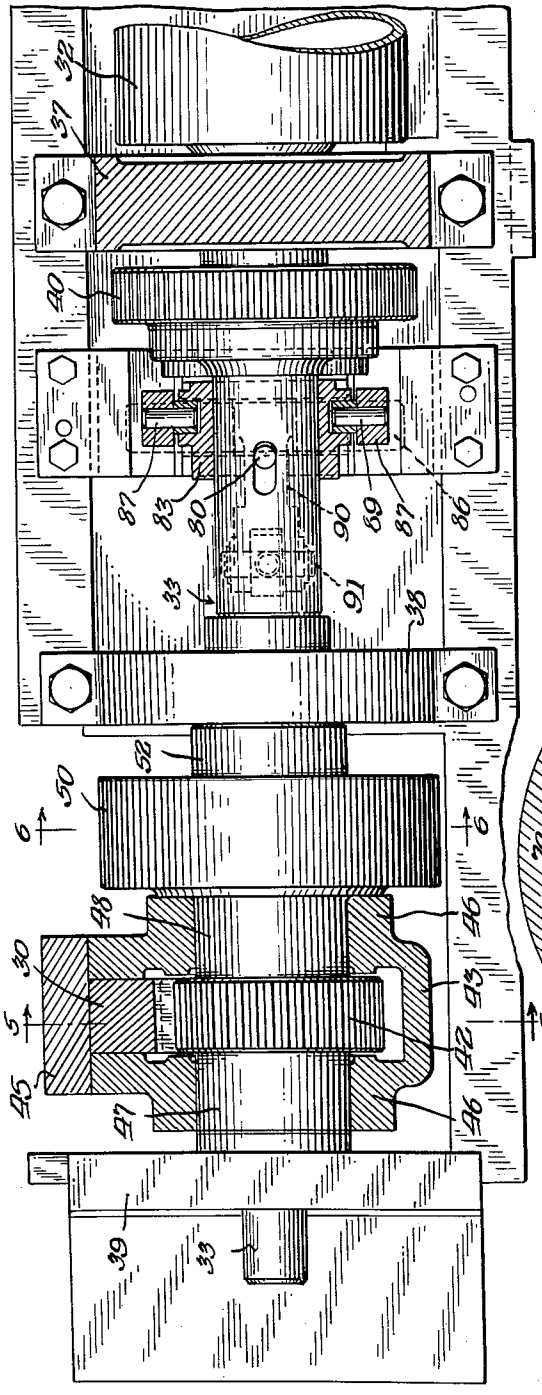


Fig. 3

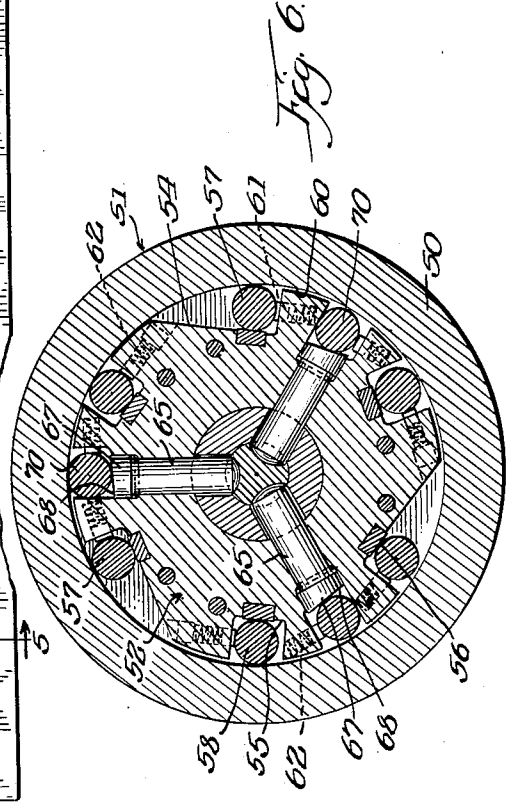


Fig. 6

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MECHANICAL LOCK-UP MEANS FOR OVERRIDING DRIVES

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Fig. 4.

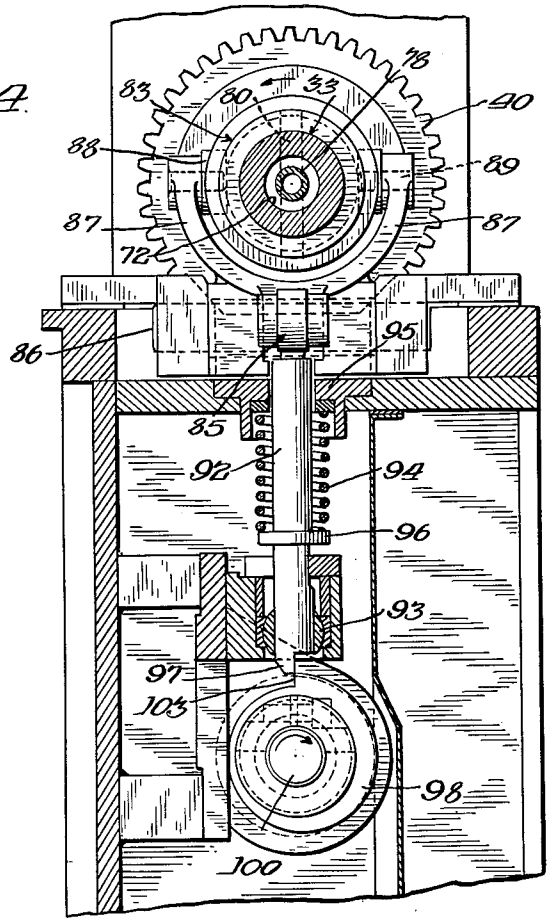
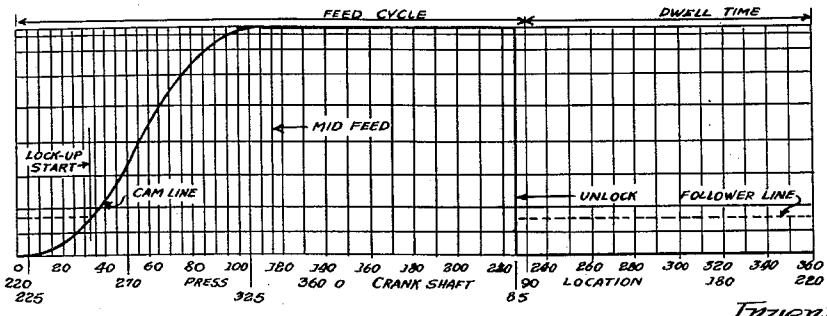


Fig. 7.

LOCK-UP CAM & FOLLOWER TIMING DIAGRAM



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3,034,364

MECHANICAL LOCK-UP MEANS FOR OVERRIDING DRIVES

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Filed Mar. 2, 1960, Ser. No. 12,400
7 Claims. (Cl. 74—148)

The invention relates to material feeding mechanism and has reference in particular to intermittent feeding mechanism employing a harmonic motion drive, and to improved apparatus providing an efficient lock-up means for the overrunning clutch of such a drive.

The operating units which comprise the feeding mechanism for supplying metal strip material to blanking machines, stamping machines, punch presses and the like, include feed rolls which are generally actuated from a main drive through a ratchet clutch or an overrunning type of clutch. For an operating stroke the action consists of an accelerating portion for positively bringing the feed rolls up to the desired speed and which is followed by a decelerating portion during which the feed rolls will overrun the drive unless prevented from doing so. It has been customary to apply friction braking pressures to such an overrunning type of drive so that the inertia of the rotating parts will not cause the feed rolls to overrun. Should the feed rolls overrun the drive, the accuracy of the measured feed length is, of course, destroyed.

The continuously driven main operating shaft of the apparatus as illustrated in the drawing is connected to the feed rolls by a reciprocating rack driving an overrunning clutch, the rack having an operating stroke and a non-operating stroke for each revolution of the main shaft. Thus the intermittent driving of the feed rolls results in the feeding of successive lengths of strip material. However, to obtain perfect accuracy in the feeding of the measured lengths, it is necessary to obtain similar accuracy in the rotation of the feed rolls. However, the feed rolls present a problem in control due to the necessary incorporation in the drive of an overrunning clutch.

An object of the invention is to provide lock-up means for overrunning drives which will solve the control problem as regards the feed rolls in a highly efficient and satisfactory manner.

Another object of the invention is to provide friction means which are uniquely combined with an overrunning clutch to form lock-up means for releasably locking the driving and driven members of the clutch and wherein the lock-up means may be released substantially instantaneously.

Another object is to provide apparatus of the character described wherein the overrunning clutch and the lock-up means for the same are incorporated within the hub constituting the driven member of the clutch and wherein the said hub and contained structure are enclosed as a unit within the annular housing provided by the driving member.

Another object resides in the provision of an overrunning type of clutch having lock-up means of the friction type combined therewith, and wherein said lock-up means can be released instantaneously by hammer action although the lock-up means may be applied gradually through cam action and by employing the compressive force of a resilient coil spring.

Another object of the invention is to provide a new and improved arrangement of lock-up means for an overrunning clutch, and which will have combined therewith a release hammer capable of releasing the lock-up means instantaneously and completely. The lock-up means of the invention including the release hammer, is entirely

mechanical in operation, and accordingly, it is possible to accurately time the actuations of the release hammer with respect to the rotary movement of the main driving shaft.

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 and wherein like reference characters are used to designate like parts:

FIGURE 1 is a side elevational view of apparatus for intermittently feeding metal strip material, said apparatus incorporating a reciprocating rack and overrunning clutch arrangement, together with the improved lock-up means of the invention;

FIGURE 2 is a longitudinal sectional view taken substantially along line 2—2 of FIGURE 1 and showing in detail the improved release hammer and mechanical actuating means for the same, all of which is effective for releasing the lock-up means for the overrunning clutch;

FIGURE 3 is a longitudinal view, parts being shown in section, of the rack and pinion arrangement with overrunning clutch constituting the drive for the lower feed roll drive shaft;

FIGURE 4 is a transverse sectional view taken substantially along line 4—4 of FIGURE 2 and illustrating the camming mechanism for effecting actuation of the release hammer;

FIGURE 5 is a transverse sectional view taken substantially along line 5—5 of FIGURE 3 and showing the rack and pinion drive arrangement;

FIGURE 6 is a transverse sectional view of a conventional overrunning clutch device having the improved lock-up means of the invention combined therewith; and

FIGURE 7 is a schematic diagram illustrating the action of the cam for applying and releasing the lock-up means during each revolution of the drive shaft.

Referring in particular to FIGURE 1 of the drawings the invention is illustrated as applied to a feeding machine adapted to receive metal strip material from a coil or the like and which is intermittently fed by a pair of feed rolls to a punch press or similar machine for further processing, such as pressing, punching, blanking or similar operations. The various parts and elements going to make up the feeding machine 10 are supported or mounted by a housing structure such as indicated by 11 and which includes a top wall 12, a front wall 13, and side walls 14. The main driving shaft 15 is suitably journalled by the housing structure and said shaft has fixed thereto the face plate 16 to which is fixed the guide block 17. The guide block rides within a guideway 18 formed in the pivot arm 20 and which is pivoted to the frame of the housing at 21 by means of the adjustable bearing 22. The pivot arm includes the member 23 having superimposed relation on the top longitudinal surface of the arm and which member is longitudinally grooved at 24. A threaded rod 25 is located within the groove 24, and said rod is suitably journalled at respective ends by the members such as 26. The rod may be rotated by applying a suitable tool to the squared end 27 thereof, and depending on the direction of rotation of the rod, it will be understood that the stud shaft 28 can be adjusted along the groove 24 lengthwise of the pivot arm 20. For this purpose the stud shaft 28 is made integral with or otherwise secured to lower member 26 which is in the form of a block mounted to ride within the groove 24 and having threaded relation with the rod 25.

The lower end of the rack 30 is journalled on the stud shaft 28 by a ball bearing race or other journalling means and the structure is releasably retained on the stud shaft

by the securing nut 31. Accordingly, upon rotation of the main operating shaft 15 reciprocating movement is imparted to the rack. Since the stud shaft 28 can be adjusted longitudinally within the groove 24, it is possible to vary the magnitude of the reciprocating strokes of the rack which, however, requires that the feeding operation be stopped in order to rotate the threaded rod 25. However, micro adjustments of the reciprocating stroke of the rack 30 can be made during operation by varying the position of bearing 22. Also, the structural arrangement including the face plate 16, the guide block 17, and the pivot arm 20 provides for a quick return of the rack 30 on its non-operative stroke, thus giving a greater part of each revolution of the main operating shaft to the operative feeding stroke. As an example, the feeding stroke may comprise 230 to 240 degrees of each revolution of shaft 15 with a quick return comprising the remainder, and which thus ranges from 120 to 130 degrees. For a more particular description of the feeding mechanism reference is made to the Wiig Patent 2,756,994, granted July 31, 1956, and entitled Intermittent Feeding and Cutting Machine with Variating Means.

The feeding machine 10 on its top wall 12 journals a pair of feeding rolls which are geared to rotate in unison and which are instrumental in feeding the strip material at intervals on each operative stroke. The lower feeding roll 32 as best shown in FIGURES 2 and 3, is suitably fixed to the feed roll drive shaft 33 and said shaft is journalled by the ball bearing races 34, 35 and 36 in a substantially frictionless manner with the bearings being respectively retained in the frame members 37, 38 and 39. The gear 40 is located on the feed roll drive shaft 33, being interposed between the feed roll 32 and the said shaft and adjacent the bearing race 34. The gear will rotate with the shaft since it is keyed thereto at 41 so that rotation of the lower feed roll for feeding purposes is accordingly imparted to the upper feed roll, not shown, the same having a similar gear meshing with gear 40. Thus the two feed rolls will rotate in unison and to an equal extent for feeding successive lengths of strip material. Also, it is generally possible to separate the feed rolls by lifting the upper roll in order to facilitate insertion of the strip material between the rolls.

The feed rolls of the machine are rotated intermittently since intermittent rotation is imparted to the feed roll drive shaft 33 by the rack and pinion drive to be presently described, and which incorporates an overrunning clutch. However, the invention provides lock-up means for the overrunning clutch in order that control of the feed rolls can be maintained for substantially the entire length of the operating stroke with the result that the strip material can be fed to an accuracy within one or two thousandths of an inch, and at speeds materially in excess of the feeding speeds heretofore employed.

The rack 30 has meshing relation with the pinion 42 of the rack and pinion drive, as clearly shown in FIGURE 5, and both elements are housed within the housing 43 having a cover plate 44 and a rear plate 45. The body portion of the housing is formed to provide the side flange portions 46 and which comprise the journalling means for rotatably mounting the housing on the trunnions 47 and 48 of the pinion 42, see FIGURE 2. The pinion, in turn, is mounted for free rotation on the left end portion of the feed roll drive shaft 33 for which purpose there is interposed between the shaft and the pinion the bearing sleeves 49. The trunnions 47 and 48 are integral with the pinion 42 and said trunnions extend on the respective sides of the pinion. The right hand trunnion 48 is further extended and has formed intergral therewith the cylindrical housing 50 of the over-running clutch indicated in its entirety by numeral 51 and shown in detail in FIGURE 6. It will be understood, therefore, that the pinion 42 constitutes an integral unit with the cylindrical housing 50 of the clutch and that said housing provides the exterior driving member of the clutch. The interior or driven member of the overrunning clutch 51 is in the form of a hub 52 which is keyed at 53 to the feed roll drive shaft so that any rotation of the hub member 52 will be transmitted to the feed roll drive shaft and thus to the feed rolls.

The hub member 52 is provided with off center gripping faces 54 and 55 which receive the hardened steel inserts 56 for supporting and mounting the gripping rollers 57 and 58, respectively. The rollers are disposed between the gripping faces provided by the steel inserts 56 and the inside cylindrical gripping surfaces 60 of the annular housing 50. By means of the pins 61 which are backed by the coil springs 62, a one-way clutch is provided whereby the reciprocating strokes of the rack in one direction only, will be transmitted to the feed roll drive shaft 33. The position of the rack 30, FIGURES 1 and 5, and the particular orientation of the clutch hub 52 is such that movement of the rack in a downward direction constitutes an operative stroke and produces rotation of the feed roll shaft 33 and rotation of the feed rolls for a feeding operation. Conversely, reciprocating movement of the rack in an upward direction constitutes a non-operative stroke and which comprises a quick return for the rack and pinion arrangement. Side plates 63 are suitably secured to the hub structure and said plates retain the rollers 57 and 58, the pins 61, and the springs 62 in operative relation and within the recesses provided therefor.

Referring again to FIGURE 6, it will be observed that the hub member 52 is provided with six gripping rollers, the same being located around the periphery of the hub and being spaced approximately 60 degrees from each other. The friction lock-up elements of the invention are located between certain of the gripping rollers, being so mounted by the hub 52 and which are thus located at 120 degree intervals around the hub. Each lock-up element essentially consists of a piston 65 having location within a cylindrical recess 66 formed in the hub 52 and being adapted to reciprocate within its recess although to a slight extent only. Each piston is approximately T-shaped in outline, having a head portion 67 and which is bevelled to provide the sloping surface 68 as clearly illustrated in FIGURE 6. The sloping surface 68 of each piston is adapted to engage a roller 70, and by radial movement outwardly of said pistons it is possible to pinch the rollers between the surface 68 and the inside cylindrical surface 60 of the annular housing 50, whereby to frictionally lock the hub member 52 to the annular housing 50 of the overrunning clutch.

The friction locking action of the rollers 70 is controlled by the cam rod 71 located for longitudinal movement within the passage 72 extending axially of the feed roll shaft 33. The cam rod 71 is formed at its right hand end with cam surfaces 73 and said rod is resiliently urged into a camming position by a coil spring 74 having location at the left end of the rod. The coil spring is retained in position by the plug 75 and by the set screws 76. Three cam surfaces such as 73 are provided by the rod 71 and each surface has camming engagement with a piston 65 whereby to force the piston radially outwardly into a locking position. Accordingly the normal action of the coil spring 74 is to cam the pistons in a radially outward direction to effect a locking of the rollers 70 carried by the hub with the housing 50 of the clutch. With the driving and driven members of the clutch locked to each other, it will be understood that upon an operative stroke of the rack the feed roll drive shaft will be rotated to rotate the feed rolls. In actual operation the lock-up means are preferably rendered operative during the accelerating portion of the operative stroke so that the driving and driven members of the clutch will be definitely locked together at the beginning of the decelerating portion of the operative stroke. The members remain locked up almost to the end of the operative stroke, although the actual point of release is not critical and will depend on

the inertia of the rotating parts. The greater the inertia the longer the members of the clutch will remain locked. In other words, the release of the lock-up means may be delayed until a few degrees before the end of the decelerating portion of the operative stroke in those installations where the inertia is excessive due to the mass of the rotating parts, or due to high speeds and where the accuracy of the feed lengths must be maintained within a few thousandths of an inch. In accordance with the invention it is possible to release the lock-up means instantaneously and completely, and to also accurately time the releasing actuations. For this purpose the passage 72 extending axially of the shaft 33 retains a rod 78 which is adapted to have hammer action against the cam rod 71 for effecting movement of the camming rod into a released direction. A retaining pin 80 is carried by the release hammer 78 and the exterior projecting ends of the pin ride within the slots 81 formed in the shaft 33. The projecting ends of the pin 80 also connect at 82 with the collar 83 which is mounted on the shaft 33 so as to move lengthwise within the limits as determined by the slots 81. The collar thus provides a member exteriorly of the shaft 33 for actuating the release hammer 78 within the shaft and wherein said actuations can be effected during rotation of the shaft.

For the purposes as above described the collar 83 is grooved at 84 and a crank arm 85 is pivotally mounted at 86 to the frame of the machine. Said crank arm has its upper leg bifurcated to provide the arms 87 which are disposed on respective sides of the collar 83. Each arm carries a block 88 fixed thereto by pin 89 and which block is located within the groove 84 of the collar, as best illustrated in FIGURE 4. The other leg 90 of the crank arm 85 is pivotally connected at 91 to the spring tensioned rod 92. Said rod is mounted for movement vertically, being guided at 93 and tensioned in a downward direction by the coil spring 94. The coil spring is backed by the frame at 95 and said spring applies its tension to the rod through the fixed flange 96. The tensioning of rod 92 in a downward direction is for the purpose of maintaining the formed end 97 of the rod in contact with the timing cam 98. Said timing cam is suitably fixed to the timing cam shaft 100 journalled for rotation at 101 in the frame member 102. It will be understood that the timing cam shaft 100 is suitably rotated in timed relation with the main operating shaft 15, and thus the shaft rotates in timed relation with the reciprocations of the rack 30. The timing cam 98 has a spiral contour which accordingly is provided with an abrupt drop-off edge 103. The position of the cam 98 on shaft 100 may be adjusted by loosening the split sleeve member 104 and which is then tightened to hold the cam in adjusted position on the shaft. The numeral 105 indicates a member having graduations 106 for facilitating the positioning and adjustment of the timing cam so that the actuations of the release hammer rod 78 can be accurately timed.

In FIGURE 2 the release hammer rod 78 is shown in retracted position, since the spring tensioned rod 92 is held elevated by the timing cam 98. Continued rotation of the cam in a clockwise direction, FIGURE 4, will presently bring the drop-off edge 103 into alignment with the formed end 97 of the spring tensioned rod 92. The rod will thus descend rapidly under the tension exerted by coil spring 94 and which will rock the crank arm 85 in a counterclockwise direction, FIGURE 2. This rocking of the crank arm 85 will move the release hammer rod 78 in a direction towards the left, thus causing the rod to contact the camming rod 71 with a hammer blow. The result of this hammer blow on the camming rod 71 is to move the rod to the left, thereby releasing the locked-up pistons 65. The release of the pistons is instantaneous by reason of the hammer blow and the camming rod is held in a left hand position with the pistons released until the cam 98 again produces a lifting action of the spring tensioned rod 92. In this connection it will be understood that the spring 94 overpowers the coil spring 74.

In the lock-up cam and follower timing diagram, FIGURE 7, the feed cycle is illustrated as taking place for 240 degrees of each revolution of the main operating shaft with a dwell time of 130 degrees during which period a quick return is imparted to the reciprocating rack. The camming rod 71 is rendered effective to cause a lock-up of the hub 52 with the housing 50 after approximately 35 degrees of rotation has taken place from the start of an operative stroke. Thus the parts of the clutch are locked relatively early in the accelerating portion of the operative stroke. The lock-up continues until a few degrees before the end of the decelerating portion of the operating stroke at which instant the timing cam will allow the spring tensioned rod 92 to drop and cause the rod 78 to deliver a hammer blow against the cam rod 71. This instantaneous and complete releasing of the lock-up means is important, since it permits the locked-up relation of the overrunning clutch to continue until near the end of the operative stroke.

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.

What is claimed is:

1. In a machine of the class described, the combination with a drive shaft, of driving means having operation to rotate the drive shaft intermittently, said driving means including an overrunning clutch having an annular outer housing comprising the driving member and an interior hub keyed to the feed roll drive shaft and comprising the driven member of the clutch, lock-up means for releasably locking the hub to the housing, said lock-up means including at least one locking member carried by the hub, resilient means for actuating the locking member to render the lock-up means operative, and a reciprocable member adapted to apply a hammer blow in a direction against the resilient means for instantaneously releasing the locking member.

2. In a machine of the class described, the combination with a drive shaft, of driving means having operation to rotate the drive shaft intermittently, said driving means including an overrunning clutch having an outer annular housing comprising the driving member and an interior hub keyed to the drive shaft and comprising the driven member of the clutch, lock-up means for releasably locking the hub to the housing, said lock-up means including at least one locking member carried by the hub and having frictional contact with the annular housing when rendered operative, a camming rod for camming the locking member into an operative position, resilient means for so actuating the camming rod as to render the locking member operative, and a reciprocable member capable of actuation to apply a hammer blow against the camming rod for instantaneously releasing the locking member.

3. In a machine of the class described, the combination with a drive shaft, of driving means having operation to rotate the drive shaft intermittently, said driving means including an overrunning clutch having an annular housing comprising the driving member and an interior hub comprising the driven member of the clutch, lock-up means for frictionally and releasably locking the hub to the annular housing, said lock-up means including a plurality of pistons carried by the hub and having frictional contact with the annular housing when rendered operative, a camming rod for camming the pistons into an operative position when moved in one direction, resilient means for yieldingly moving the camming rod in said one direction to render the pistons operative, a reciprocable member in alignment with the camming rod and opposed to the resilient means, and means for actuating the reciprocable member to apply a hammer blow against

the camming rod whereby to instantaneously release the pistons.

4. A machine of the character as defined by claim 3, wherein the hub is keyed to the drive shaft, and wherein the drive shaft is provided with an axial passage for receiving the resilient means, the camming rod and the reciprocable member.

5. In a machine of the class described, the combination with a drive shaft, a clutch member on the shaft and fixed thereto so as to rotate with the shaft, a rotatable sleeve on the shaft, a rack having a geared relation with the sleeve and rotating the sleeve in opposite directions as the rack reciprocates, said clutch member forming with said sleeve an overrunning clutch whereby rotation in one direction only is imparted to said shaft, lock-up means for frictionally and releasably locking the clutch member to the sleeve, said lock-up means comprising a plurality of pistons carried radially by the clutch member, said drive shaft having an axial passage for approximately the length thereof, a camming rod located in the passage for camming the pistons radially outward into a locking position, resilient means engaging the camming rod and normally operative for camming the pistons into a locking poistion, a hammer release rod within the passage in alignment with the camming rod and opposed to the resilient means, and means for actuating the hammer release rod to apply a hammer blow against the camming rod whereby to instantaneously release the pistons.

6. A machine as defined by claim 5, wherein the means for actuating the hammer release rod includes a timing shaft having rotation in timed relation with the reciprocations of the rack, and an actuating cam fixed to and rotated by the timing shaft.

7. In a machine of the class described, the combination with a drive shaft, a clutch member fixed to the shaft, a sleeve on the shaft and free for independent rotation, a rack having a geared relation with the sleeve and rotating the sleeve in opposite directions as the rack reciprocates, said clutch member forming with the sleeve on overrunning clutch whereby rotation in one direction only is imparted to the shaft, lock-up means for frictionally and releasably locking the clutch member to the sleeve comprising a plurality of pistons carried by the clutch member and mounted for movement radially, said drive shaft having an axial passage for approximately the length thereof, a camming rod located in the passage for camming the pistons radially outward into a locking position, resilient means engaging the camming rod and normally operative for camming the pistons into a locking position, a hammer release rod within the passage in alignment with the camming rod and opposed to the resilient means, a crank arm journalled exteriorly of the drive shaft and having connected relation with the hammer release rod, a timing shaft, an actuating cam on the shaft, and a spring tensioned member disposed between the actuating cam and the crank arm for actuating the crank arm as predetermined by the cam whereby to cause the hammer release rod to apply hammer blows against the camming rod for instantaneously effecting release of the pistons.

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