This invention relates to bolt making machines of the type wherein each blank is subjected to a plurality of successive operations at different stations or dies, and is particularly concerned with a blank transfer mechanism for carrying the blanks from one station to another.

In machines of this general type, it is desirable to perform an operation upon a blank at each die station during each cycle of the machine, and to transfer each blank to the next successive station during the inoperative portion of the cycle, so as to produce a completed blank during each cycle of the machine. The purpose of this arrangement is primarily to attain as high a rate of production of completed blanks as possible with a minimum of intermediate handling. It is found, however, that in many instances the limiting factor on the speed of production of multiple station machines of this type is the speed at which the blank transfer mechanism can be operated.

The purpose of the present invention is to provide a simple, rapid and efficient blank transfer mechanism with blank gripping means moving through a relatively wide uniform curve from one station to another and approaching and leaving the die stations at the most efficient angle of incidence to facilitate the gripping and releasing of the blanks at the die stations. Other objects of this invention are: to mount the blank transfer mechanism in such a manner that the blank gripping means are brought into accurate alignment in one direction with the die stations at the opposite ends of the movement of the mechanism, and to provide a simple and easily manipulated adjustment to align the blank gripping means with the die stations in a perpendicular direction so that accurate registration of the blank gripping means with the dies may be readily obtained at all times; to move the blank gripping means in synchronism with the movement of the header slide in such a manner as to utilize to a maximum the available time for operation in the cycle of the header slide; to reduce the inertia forces to a minimum by maintaining the angular acceleration of the blank gripping means at a minimum and also by permitting a smooth acceleration and deceleration of the blank gripping means in the path of movement; and to provide a simple and economical means for operating the blank transfer mechanism in timed relation to the operation of the header slide, obtaining the desired movement in two directions with a single driving means; and to provide a simple, economical and efficient spring finger construction for gripping the blanks.

Other objects and advantages of this invention relating to details of construction and economies of manufacture will appear hereinafter.

In the accompanying drawings which illustrate two embodiments of this invention:

Figure 1 is a plan view of the forward end of a bolt making machine with one embodiment of the transfer mechanism of this invention applied thereto;

Figure 2 is an elevation of the face of the dies and transfer mechanism taken substantially on the plane indicated by the line 2—2 of Figure 1 and looking in the direction of the arrows;

Figure 3 is a similar view showing the blank transfer mechanism in a different position during its cycle of operation;

Figure 4 is a view corresponding to Figure 1 showing a different embodiment of the invention;

Figure 5 is an elevation of the front face of the dies and transfer mechanism taken substantially on a plane indicated by the line 5—5, Figure 4 looking in the direction of the arrows, and;

Figure 6 is a detailed perspective view of one of the crank arms of the embodiment of the invention shown in Figures 4 and 5.

Referring to the drawings, the numeral 10 designates a bed frame of a bolt making machine having at its forward end a die breast 11. A header slide 12 is slidably mounted in the frame 10 for longitudinal reciprocation and is provided with a plurality of punches or hammers 13, 14, and 15 arranged to co-operate with the dies 16, 17, and 18, respectively, which are mounted in the die breast 11.

The particular construction of the hammers 13, 14, and 15 and dies 16, 17, and 18 and the number of co-operating hammers and dies may be varied depending upon the particular operations to be performed and the process to be carried out. The present invention is particularly valuable, however, in connection with the type of machine disclosed in the pending application of Earl E. Frost, Serial No. 659,004, filed October 24, 1932 and for the purpose of Illustration the invention is shown applied to this type of machine. As disclosed in said application the header slide 12 is reciprocated within the bed frame 10 by means of a main crank shaft and connecting rod, and a cam shaft 19 is driven by the main crank shaft and at the same speed as the crank shaft. When designed to carry out the process disclosed in said application, the die 16 is an extrusion die for extruding the shank portion of the blank and the hammer 13 functions to press the blank into said die. The die 17 is also an
extrude the thread receiving portion of the blank and the hammer 14 functions to press the blank into the die 17 and also to upset the previously un extruded portion of the blank to form a bead. The die 18 and hammer 15 operate to trim the head of the blank to the desired polygonal form. Suitable ejectors are also incorporated in the machine, driven by the levers 28 to eject the blanks from the dies 16, 17, and 18 at the completion of the operations thereon.

In the general operation of the machine wire or rod stock is fed through the bed frame by feeding means of any suitable type and engages an adjustable stock gauge 21. A cut-off arm 22, which may be of any suitable construction, is oscillated by a cam 23 mounted on the shaft 19 to shear a blank of the desired length from the projecting end of the stock 2 and carry the blank over into alignment with the die 16. When the header slide 12 moves forward the hammer 13 engages the blank in the die 16. As soon as the blank is engaged in the die 16 the cam 23 allows the cut-off arm 22 to return out of the path of the header slide and in position to permit another length of stock to be fed forward to form the next blank.

The transfer mechanism of this invention is arranged to grip a blank when it is ejected from the die 16 at the completion of the operation at that die, carry the blank into registration with the die 17 and hold it in position until the header slide again advances and starts to press the blank into the die 17, and then move out of the path of the header slide to permit the completion of the operations on the blanks. Simultaneously, the transfer mechanism conveys a blank from the die 17 to the die 18 in the same manner.

The transfer mechanism is mounted upon a support 24 which is journalled at its opposite ends upon two crank pins 25 and 26. The crank pins 25 and 26 are carried upon crank arms 27 and 28, respectively, formed on the ends of the guide 29 and 30 journalled in the frame above the line of the dies 16, 17, and 18. The two crank arms are of the same length and are arranged to move and remain in the same angular relation to their respective centers of rotation to thereby oscillate the support 24. As shown in Figure 2 the support is at one extreme, of its movement with the two crank arms 27 and 28 disposed in alignment and both extending horizontally to the right of the respective shafts 29 and 30. The shafts 29 and 30 are designed to be turned through 180 degrees to carry the support 24 upwardly and to the left as shown in Figure 2 and then downwardly until the crank arms 27 and 28 extend horizontally to the left of their respective shafts. The support is shown midway between the extremes of its movement in Figure 3 in which the crank arms 27 and 28 extend substantially vertically above their shafts 29 and 30.

Any suitable means may be employed to move the crank arms 27 and 28 through a half revolution and to maintain the crank arms in the same relative position with respect to their centers of rotation. As shown in Figures 1, 2, and 3 the shafts 29 and 30 are extended rearwardly through the machine and are provided at their ends with spur gears 31 and 32, respectively. A bar 33 having rack teeth thereon is slidably supported on the frame and is arranged to be reciprocated to impart the desired movement to the shafts 29 and 30. The reciprocation of the rack 33 may conveniently be accomplished as illustrated in Figure 2 by means of a lever 34 having a slidable connection 35 with the end of the rack 33, and spring 36 being provided for carrying 35 and a cam roller 37. A plate 38 having a cam groove 39 therein may be fixed to the shaft 15 so that as the shaft rotates the cam groove 39 engages the roller 37 and rocks the lever 34. The motion of the lever 34 is transmitted to the rack 33 and is arranged to rotate the spur gears 31 and 32 through a half revolution first in one direction and then back in the opposite direction to oscillate the support 24.

A set of transfer fingers is carried by the support 24 to carry blanks from the die 18 to the die 17 and a similar set is provided to carry blanks from the die 17 to the die 16. Each set includes a finger 40 pivoted to the support 24 and a shorter finger 41 journalled on an eccentric stud 42 which in turn is journalled to the support 24.

Each finger 40 carries a plate 43 formed with a spacing extension 35 at its lower end and each finger 41 carries a plate 44 formed with a spacing extension 35 at its upper end arranged to engage the plate 43 and at its lower end with a notch 46 to engage and position a blank. Suitable means are provided to urge the two fingers 40 and 41 toward each other, such as the bolt 47 mounted on the finger 41, extending loosely through an opening in the finger 40 and carrying a compression spring 48. This spring means is located below the eccentric stud 42 and tends to urge the two fingers 40 and 41 toward each other. The pivot for the finger 40 is located above the eccentric stud 42 and therefore the spring 48 acts on a longer lever arm of the finger 40 than of the finger 41. The finger 40 is provided with an adjustable abutment screw 45 arranged to engage the fingers 40 and 41 about in line with the center of the rotation thereof to limit the movement of the fingers 40.

By reason of the location of the pivots and the spring, the latter holds the finger 40 swung outward in a forward direction before the finger 41 with the abutment screw 45 in engagement therewith and also holds the finger 41 pressed toward the finger 40 with the extension 43 in engagement with the plate 43. When the fingers are pressed apart the finger 41 normally moves on a substantially greater arc with the abutment screw 45 in engagement with the finger 41. Should the finger 40 encounter any obstacle, however, or be in any other way impelled to move, it is clear that it will also rotate about its pivot point. In the embodiment shown two sets of fingers are utilized in order to produce the two transfer steps. It will be understood, however, that one or any desired number of fingers may be used.

The driving means for the support 24 is timed with respect to the reciprocation of the header slide so that as the slide recedes from the dies and the blanks are ejected from the dies 16 and 17, the fingers move downwardly and to the left as shown in Figure 3 and snap over the blanks facing of the die being ejected from the blank. The extent of the lateral movement of the support 24 is definitely fixed by the length of the crank arms 21 and 22. The abutment screw 49 on the finger 40 is adjusted so that the inner surface of the 70 plate 43 lines up exactly with the adjacent surface of the kinematic meshing with the fingers engage the blank the finger 41 is pressed to the right and the blank seats in the notch 46 of the plate 44, the spring holding the
blank pressed between the notch 46 and the surface of the plate 43. The vertical position of the notch 46 is accurately adjusted and aligned with the blank being ejected by rotation of the eccentric 42 upon which the finger 41 is mounted so as to slightly raise or lower the finger 41.

As the support 24 approaches the end of its movement to the left so that the fingers are engaging the blanks, the direction of motion of the fingers approaches a straight line as indicated in Figure 3, since the crank arms 27 and 28 reach a substantially horizontal position at the end of the movement. This arrangement causes the fingers to be moving in a substantially vertical direction as they engage the blanks to facilitate the snapping of the fingers on the blanks. When the fingers have snapped over the blanks being ejected from the dies 16 and 17 the cam groove 39 stops the movement of the transfer mechanism and allows the same to remain stationary for an interval. During this dwell period the header slide continues to recede from the dies and the blanks are completely ejected so as to be free from both the dies and the hammerers on the header slide and supported only by the spring fingers 40 and 41.

As the header slide continues to recede the cam 2, moves the rack 33 to the left, as seen in Figure 2, causing the two sets of transfer fingers to rise up and move to the right in a semi-circular path, in the opposite direction to that indicated by the arrows in Figure 3. This movement continues while the header slide continues to recede and starts its forward movement. When the carrier 24 reaches the limit of its movement to the right the blanks carried by the two sets of transfer fingers 40 and 41 are aligned with the openings in the dies 17 and 18, so that the blank which was received from the die 16 is aligned with the die 17 and the blank which was received from the die 17 is aligned with the die 18. At this point, with the crank arms 27 and 28 in a substantially horizontal position, as shown in Figure 2, the hammerers 14 and 15 on the header slide engage the blanks and start to press them into the dies 17 and 18.

As soon as the blanks are engaged in the dies the carrier 24 starts its return movement with the two sets of transfer fingers moving upward and to the left along the paths indicated by the arrows in Figure 3. The blanks being held against movement by their engagement in the dies, the fingers 40 and 41 are pressed apart and snap off of the two blanks.

As the header slide continues to advance the blanks into the dies the carrier 24 continues its movement to lift the fingers out of the path of the hammerers on the header slide so as to permit the blanks to be pressed completely into the dies and the work upon the same performed by the hammerers. As the header slide starts to recede and the blanks again start to be ejected from the dies 16 and 17, the fingers snap over those blanks and repeat the cycle of operation.

The dwell portions in the cam groove 39 as illustrated are arranged substantially opposite each other, which arrangement is possible when the point at which the fingers snap on to the blanks and the point at which the fingers snap off of the blanks are equally spaced in respect to the rotation of the crank shaft. For blanks with a different shank length with respect to the length of stroke of the header slide, as for example, with relatively short blanks, it is necessary that the movement of the fingers to the left as viewed in Figure 2 take place through a smaller number of degrees of rotation of the shaft 18.

It will be understood that the two shafts 29 and 30 can be connected to move together by any convenient means, as by a link or gears, and that the transfer mechanism can be driven by the machine in any suitable way.

In Figures 4, 5, and 6, a modification of the invention is shown in which the two cranks are connected for simultaneous rotation by a link and the mechanism is driven directly from the cut-off arm. In this embodiment the support 24 is journaled at its ends upon the crank pins 50 of a pair of similar double armed cranks as shown in perspective in Figure 6. The stud shafts 51 which carry the cranks are journaled in the frame in substantially the same position as the shafts 29 and 30 in the embodiment first described. Each shaft 51 is provided with an arm 52 carrying a crank pin 53 which in turn carries an arm 54 upon which the main crank pin 56 is mounted. Thus each crank is provided with two crank pins 50 and 53 which are angularly spaced from each other about the center of rotation.

A link 55 is journaled at its ends on the crank pins 53 of the two cranks. This link 55 and the support 24, which is journaled to the pins 50 of the two cranks, together constitute a parallelogram linkage, insuring the turning of the two stub shafts 51 in unison and avoiding all dead centers.

This arrangement for coupling the two cranks which carry the support 24 may conveniently be combined with a drive for the transfer mechanism directly from the cut-off arm 22. To provide such a drive the cut-off arm is provided with an upward extension 56 which pivotally carries at its end a link 57 which is journaled on the crank pin 53 of the adjacent crank. In this manner the two parallel connecting rods formed by the support 24 and the link 55 are journaled respectively on the crank pins 50 and 53 of the two cranks and the driving link 51 is likewise journaled on the crank pin 53 of one of the cranks.

At one extremity of the travel of the support 24 the crank pins 50 are disposed to the right of the shafts 29, as shown in Figure 5, and the crank pins 53 are below the level of the shafts 51. At this point the cut-off arm 22 is in its extreme right hand position, as shown in Figure 5, and the link 57 extends upwardly to the end of the arm 56 and to the right of the center of rotation of the shaft 51. When the cut-off arm 22 moves to the left the end of the extension 56 travels in an arc and rotates the adjacent shaft 51 to the left by means of the link 57. When the cut-off arm reaches the opposite extremity of its travel the support 24 likewise is at the opposite limit of its motion and the crank pins 50 are disposed to the left of and in the same horizontal plane as the shafts 51. At this time it will be evident that the crank pins 53 by reason of their angular spacing from the crank pins 50 are disposed above the horizontal plane through the crank pins 51 and the link 57 therefore extends upwardly from the end of the extension 56 to its connection with the crank pins 50. When the cut-off arm 22 is again rocked to the right the support is again swung to the right by the rotation of the shafts 51 and the cycle of operation is repeated. It will be evident that the dead center positions are avoided by the connection of the link 57 to the crank pins 53 and the arrangement of the extension 56.
The spring fingers for gripping and transferring the blanks illustrated in Figures 4 and 5 are identical with those previously described in connection with Figures 1, 2, and 3. The timing of the mechanism in the embodiment shown in Figures 4, 5, and 6 is effected by the cam 23 which oscillates the cut-off arm 22. The cut-off arm and two sets of transfer fingers hold the blanks thereby in alignment with the dies 16, 17, 18, and 19, respectively, while the header slide advances and starts to press the blanks into these dies. The cut-off arm and the transfer mechanism are then moved out of the path of the header slide, permitting the completion of the operations performed by the header slide and as the blanks are being ejected from the dies 16 and 17 the two sets of transfer fingers snap over the same. At the same time the cut-off arm 22 clears the opening for the stock feed and a new length of stock is fed through to form a new blank.

It will be pointed out that the connection of the two cranks to operate in unison by means of the link 25 may be used with a rack and gear driving arrangement as illustrated in Figures 1, 2, 3, and 5, or with any other suitable type of driving connection. It will also be understood that a gear connection between the cranks may be employed with the driving connection from the cut-off arm as shown in Figure 5 or any other type of driving connection.

Various other modifications and re-arrangements of parts may be resorted to without departing from the scope of the invention as defined in the following claims.

I claim:

1. In a bolt making machine, in combination, a plurality of dies arranged in a straight line, a header slide co-operating with said dies, a pair of angularly spaced double cranks mounted in a line on one side of said line of dies, a support carrying blank gripping fingers pivoted at spaced points to corresponding arms of said two cranks, and a link connecting the other corresponding arms of said cranks.

2. In a bolt making machine, in combination, a plurality of dies arranged in a straight line, a header slide co-operating with said dies, a pair of angularly spaced double cranks mounted in a line on one side of said line of die, a support carrying blank gripping fingers pivoted at spaced points to corresponding arms of said two cranks, a link connecting the other corresponding arms of said cranks, and means for swinging one of said cranks to move said support in timed relation to the operation of said header slide.

3. In a machine for making bolts or the like, in combination, a plurality of dies, means for transferring a blank from one die to another comprising a carriage supported on spaced parallel cranks, gripping fingers pivotally supported by said carriage, spring means engaging said gripping fingers to urge the fingers toward each other in blank gripping position, and an adjusting screw carried by one of said fingers providing a means for carrying said carriage to limit movement of said fingers toward each other.

4. In a machine for making bolts or the like, a plurality of dies, means for transferring a blank from one die to another comprising a carriage supported on spaced parallel cranks, gripping fingers of unequal length individually pivoted at spaced points on said carriage, spring means engaging said fingers and urging the fingers toward each other into blank gripping position, an adjusting means carried by one finger and engaging said other finger adjacent its pivotal mounting, said adjusting means limiting the swing of the fingers toward each other and affecting the alignment of said fingers with the die.

5. In a machine for making bolts and the like, in combination, a plurality of die stations arranged in a straight line, ejectors for ejecting blanks from said die stations, a header slide carrying tools to act upon blanks held in said die stations means for cutting off lengths of continuous stock and also carrying the same into alignment with the first of said die stations and transfer means for carrying blanks from one die station to another including a pair of rotatable members arranged parallel to and on one side of said line of dies, each of said members carrying a crank pin, a support journaled at spaced points to said crank pins, and a plurality of sets of spring fingers carried by said support and projecting toward said line of dies, a pair of rotatable members being arranged to grip a blank ejected from one of said die stations and carry the same to another.

6. In a machine for making bolts and the like, in combination, a plurality of die stations arranged in a straight line, ejectors for ejecting blanks from said die stations, a header slide carrying tools to act upon blanks held in said die stations, means for cutting off lengths of continuous stock and also carrying the same into alignment with the first of said die stations, driving means for said last named cutting and carrying means, a transfer mechanism for carrying blanks from one die station to another including a pair of rotatable members arranged parallel to and on one side of said line of dies, each of said members carrying a crank pin, a support journaled at spaced points to said crank pins, and a plurality of sets of spring fingers carried by said support and projecting toward said line of dies, each of said sets of fingers being arranged to grip a blank ejected from one of said die stations and carry the same to the next adjacent die station, and driving means for said transfer mechanism independent of said first named driving means.

7. In a machine for making bolts and the like, in combination, a plurality of die stations arranged in a straight line, ejectors for ejecting blanks from said die stations, a header slide carrying tools to act upon blanks held in said die stations, means for cutting off lengths of continuous stock and also carrying the same into alignment with the first of said die stations, driving means for said last named cutting and carrying means, a transfer mechanism for carrying blanks from one die station to another including a pair of rotatable members arranged parallel to and on one side of said line of dies, each of said sets of fingers being arranged to grip a blank ejected from one of said die stations and carry the same to the next adjacent die station, driving means for said transfer mechanism comprising a reciprocating rack, and pinion gears secured to said rotatable members arranged in position to mesh with said rack, said last named driving means being mounted for movement independent of the driving means for said cutting and carrying means.

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