Jan. 7, 1936. W. L. CLOUSE 2,026,823

BOLT MAKING MACHINE

Filed March 30, 1934 4 Sheets-Sheet 1

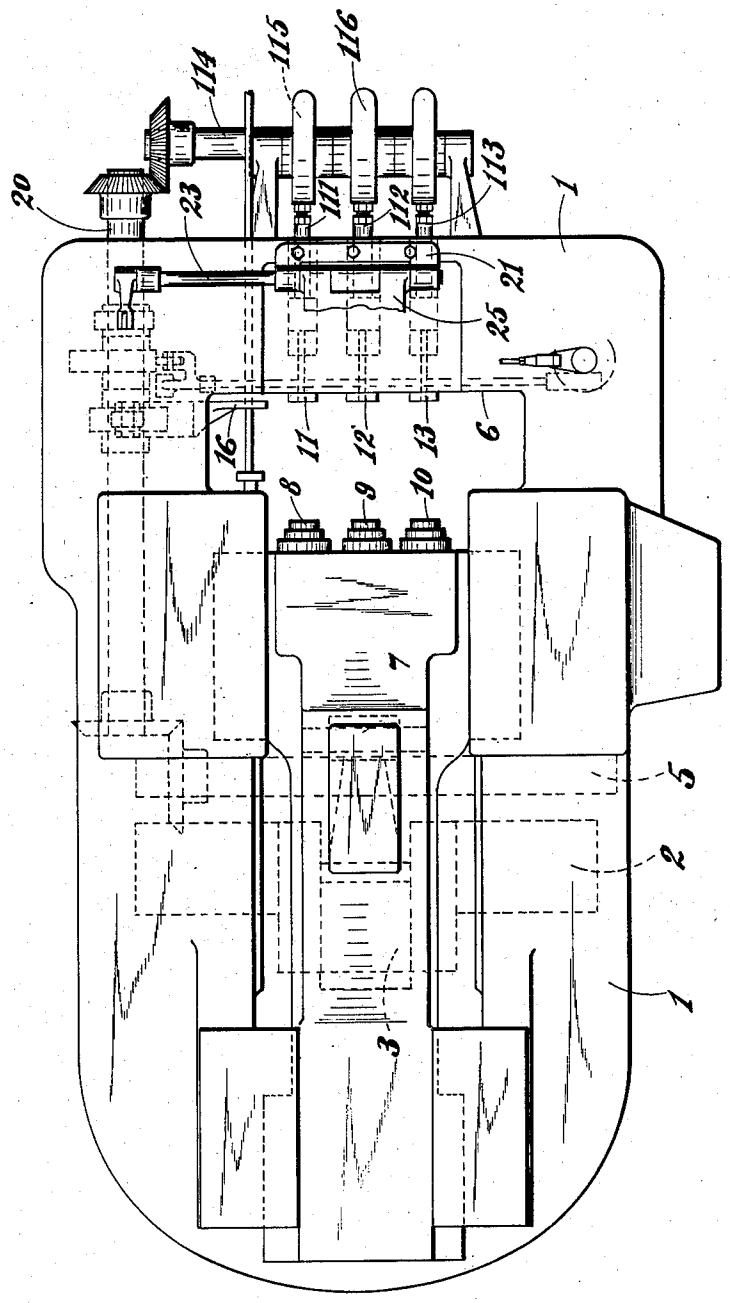

Fig 1

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BOLT MAKING MACHINE

Filed March 30, 1934 4 Sheets-Sheet 2

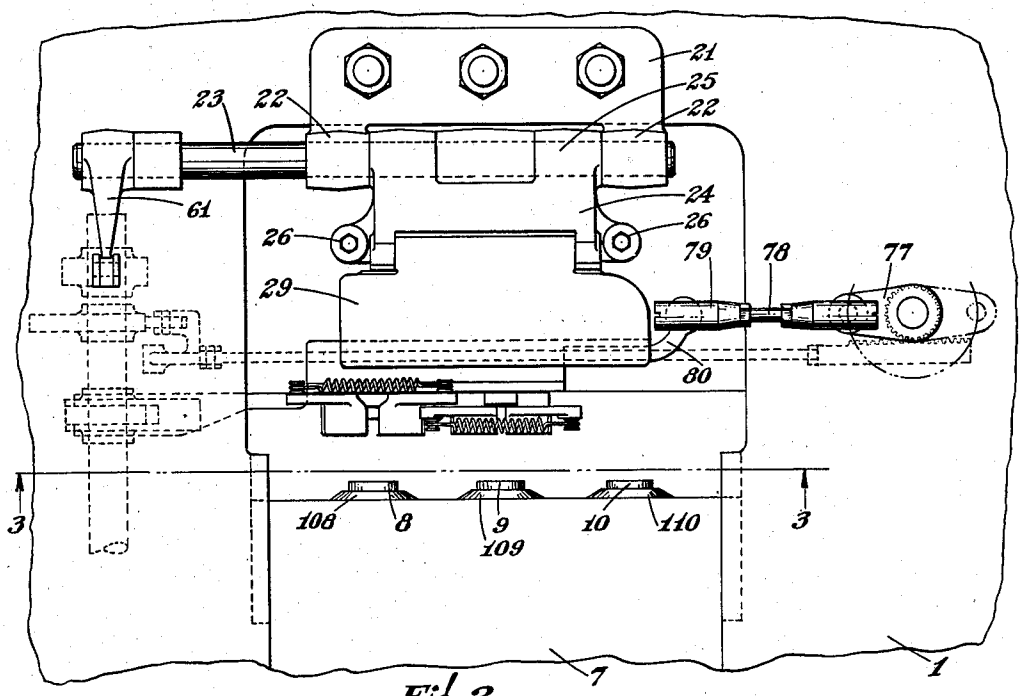

Fig. 2

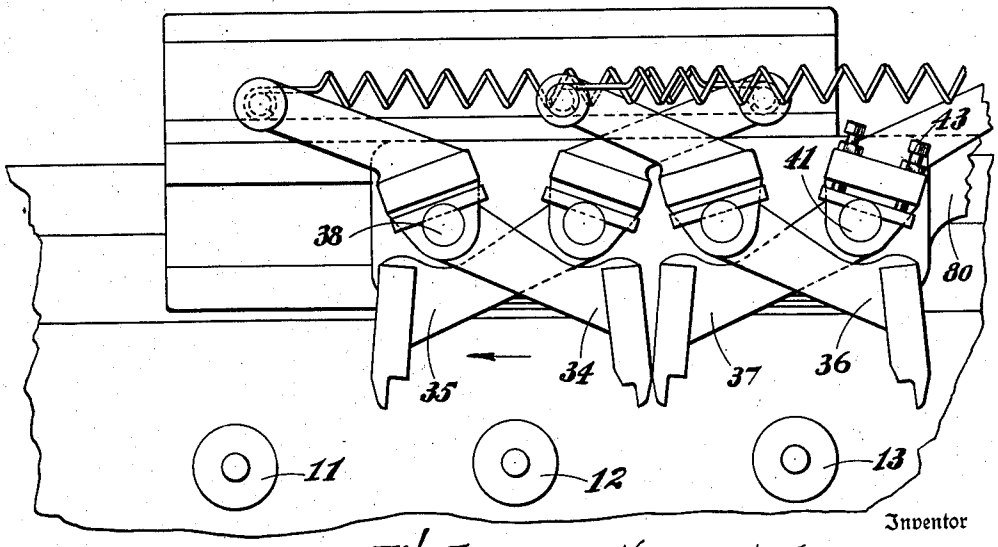

Fig. 7

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BOLT MAKING MACHINE

Filed March 30, 1934 4 Sheets-Sheet 3

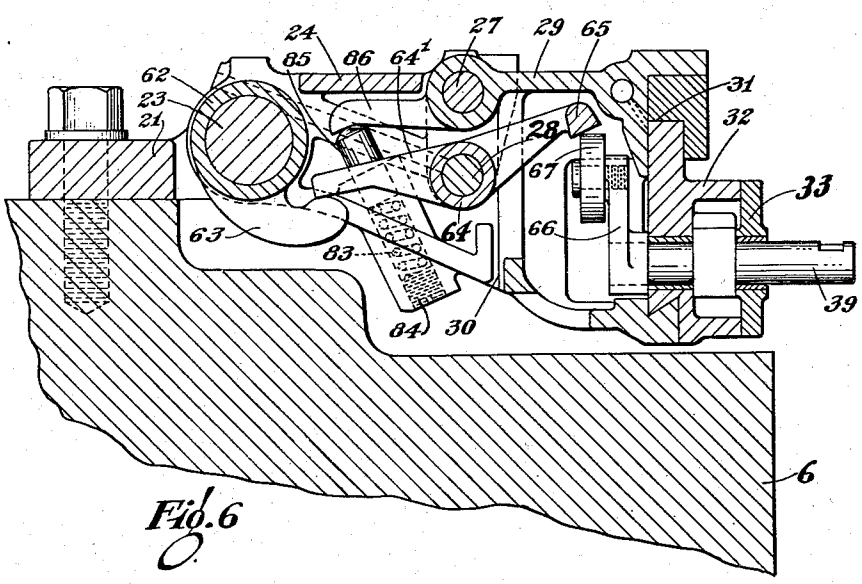

Fig. 6

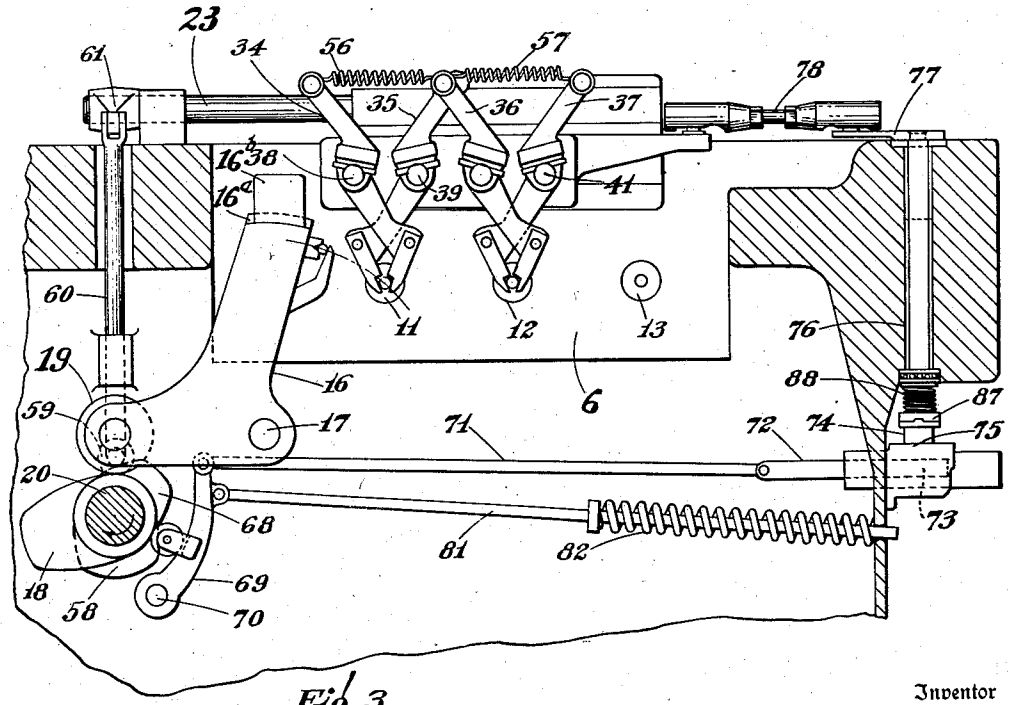

Fig. 3

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BOLT MAKING MACHINE

Filed March 30, 1934 4 Sheets-Sheet 4

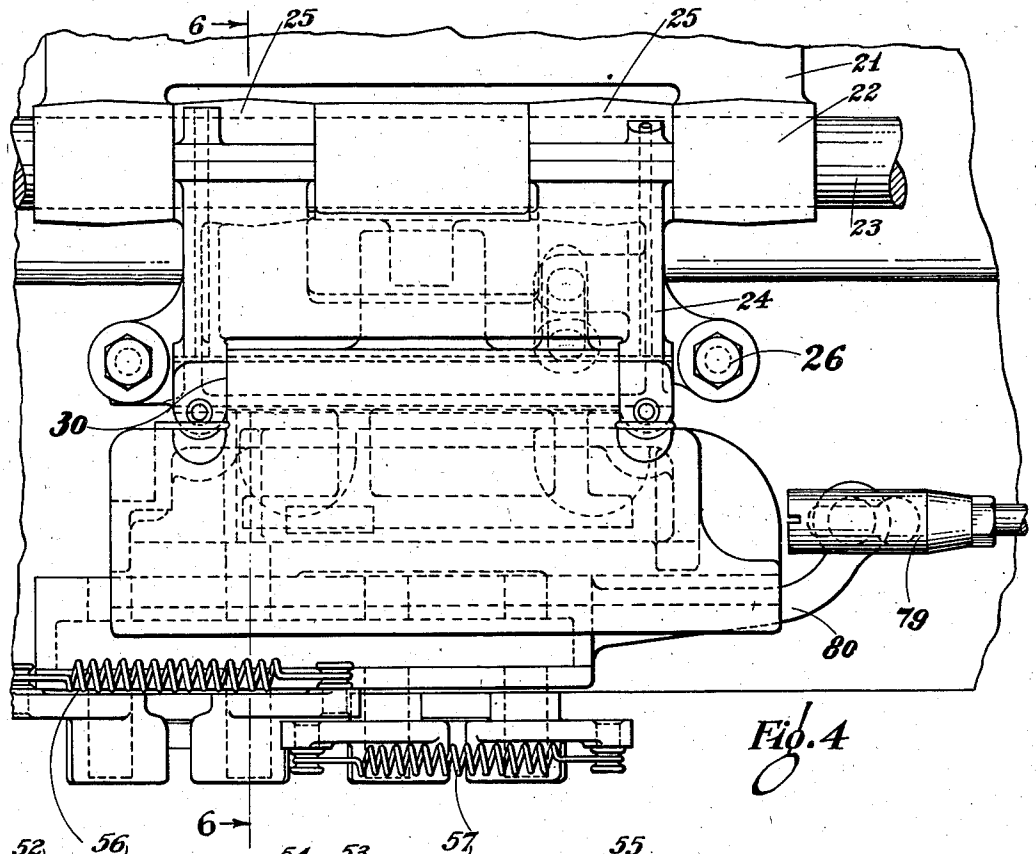

Fig. 4

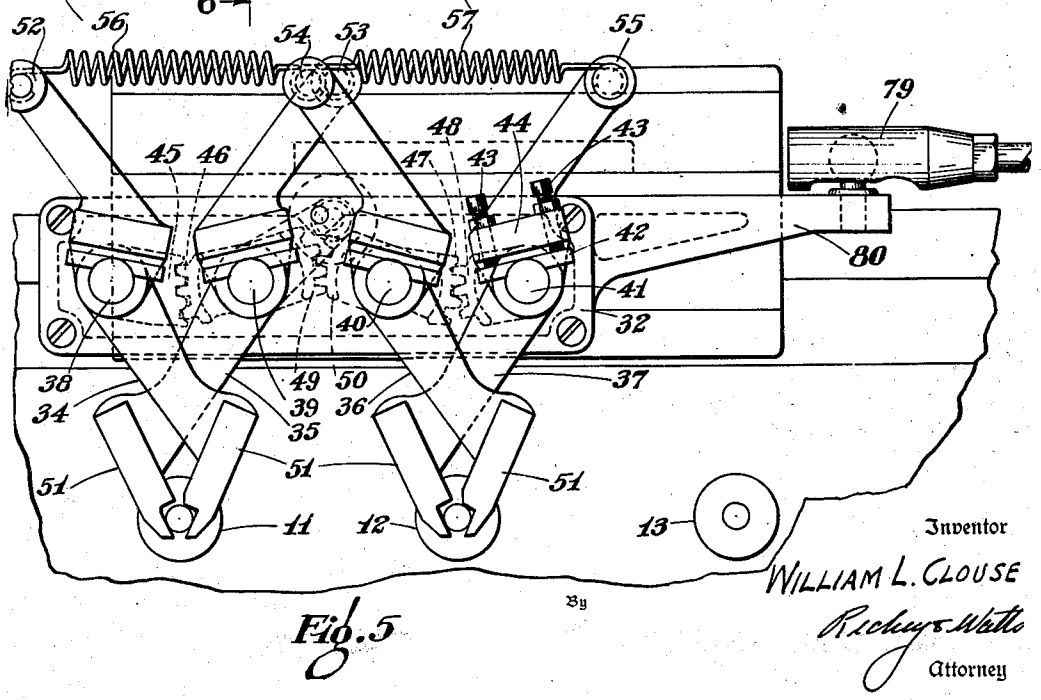

Fig. 5

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Patented Jan. 7, 1936 2,026,823

UNITED STATES PATENT OFFICE

2,026,823

BOLT MAKING MACHINE

William L. Clouse, Tiffin, Ohio, assignor to The National Machinery Company, Tiffin, Ohio, a corporation of Ohio

Application March 30, 1934, Serial No. 718,182

24 Claims. (Cl. 10—12)

This invention relates to bolt making machines and the like, of the type wherein a plurality of operations are successively performed on blanks by a reciprocating header slide, and is particularly concerned with blank transfer mechanism for such machines.

The efficiency and speed of combined machines for successively performing a plurality of operations upon a blank at different dies or work stations is ordinarily limited by the speed and efficiency of the mechanism for transferring the blanks from one work station to another. It is necessary for such transfer mechanism to position and release the blank at a work station or die at the proper time in the cycle of operation of the machine so that the blank will be held in the die or other holding means and again seize the blank after the completion of the operation and carry it to the next station. The repeated releasing and picking up of the blank introduces a risk at each such operation of dropping or misaligning the blank, and possibly jamming the entire machine. This is particularly true if one of the operations should be imperfectly performed, as in the event the blank should be imperfect or if in any way the blank should be bent or formed irregularly.

It has been proposed in this type of machine to employ transfer mechanism embodying spring fingers which snap over the blank to pick it up and snap off of the blank to release it at a work station. This springing of the fingers on to and off of the blank, however, has a tendency to misalign the blank or to accentuate any slight misalignment already present. It is also necessary in certain of such types of mechanism to move the carriers for the spring fingers in two directions, one to effect the springing of the fingers on and off of the blanks and the other to transfer the blanks from one position to the next. In other types of spring finger transfer mechanisms in which the spring finger carriers are reciprocated in a straight line objectionable mechanical complications are introduced by the necessity of straddling the dies with the transfer carriage which is not only a more expensive type of installation, but seriously interferes with access to the dies and other working parts of the machine for repair and adjustment.

In an effort to avoid the objectionable misaligning tendency of spring transfer fingers which limits the speed and efficiency of machines of this type it has been proposed to positively open the spring transfer fingers of the type which straddle the dies by bumpers or the like carried by the reciprocating slide. Such devices, however, have been found to be extremely objectionable, in that they limit the speed of operation, and to be conducive of excess wear.

The principal object of the present invention is to transfer blanks from one die or station to another with the maximum speed and efficiency and to grip the blanks at one station and release them at the next without exerting any misaligning forces on the blanks.

Broadly my invention consists of transfer fingers which are positively opened to release a blank after it has been delivered to a work station and which are then caused to close upon a blank at another work station by swinging into closed position against the blank without snapping over the blank or otherwise exerting misaligning forces thereon.

More specifically the invention includes a transfer carrier mounted on one side of the line of dies or work stations for reciprocation in a straight line with transfer fingers extending therefrom arranged to clear the blanks and tools during the return movement by the opening of the fingers; the provision of means for coupling together a pair of transfer fingers for simultaneous swinging movement on the carriage while permitting slight relative movement of the fingers in closed position to accommodate irregularities or misalignment of a particular blank, and means for coupling together a plurality of sets of transfer fingers for simultaneous actuation while permitting relative play of each set of fingers with respect to the others when the fingers are in closed position; the mounting of the transfer mechanism in such a manner that it may be released and swung to one side to permit access to the dies and tools without destroying the timing of the mechanism with respect to the remainder of the machine; and providing for other lateral movement of the transfer fingers themselves with respect to the dies and work stations in the event the fingers encounter interference from a short or otherwise imperfect blank, which movement causes the fingers to open slightly beyond their normal position at the point where the interference is encountered.

The invention also embodies novel features in the driving mechanism including a crank connected to the transfer carriage by a pitman for reciprocating the carriage and arranged to oscillate through about 180° so that the carriage is smoothly accelerated and decelerated at the opposite limits of its travel and so that adjustment of the position of the carriage at one extremity

of its travel automatically properly adjusts the carriage at the other extremity of its travel. Another feature of the invention is that the reciprocating mechanism for the carriage is timed to begin its return movement after the header slide carrying the tools for acting upon the blanks at the various work stations has begun to recede so that the fingers do not need to clear the tools and tool holders in their extreme forward position, permitting wider and more rigid tool holders to be employed. A further advantage is obtained by arranging the fast quadrant of the movement of the oscillating crank which reciprocates the carriage at the end of the return movement so that the carriage moves relatively slowly when the header slide has begun to recede and then more rapidly to the end of its travel to seize the blanks after the header slide has receded a sufficient distance to permit the fingers to clear the tool holders.

It will be appreciated that all of the novel features with their accompanying advantages and improved results may best be utilized in a transfer mechanism embodying the broad combination of this invention; and likewise that these features and their advantages may also be employed independently of each other and of the broad combination in other types of transfer mechanisms. For example, the coupling together of the fingers of each set or the coupling together of the different sets of fingers may be advantageously employed in any type of transfer mechanism embodying fingers which are either opened or closed positively. Similarly the novel timing of the transfer of the present invention, the arrangement of the reciprocating mechanism to facilitate adjustment, the mounting of the mechanism to permit access to the dies and tools, or the release feature to prevent jamming may be embodied in any type of transfer mechanism whether the other features of the present invention are employed therewith or not.

A further and more general object of the invention is to provide an improved form of transfer mechanism relative to that disclosed in the copending application of Earl R. Frost, Serial No. 639,054, filed October 22, 1932, and one particularly adapted for rapid and efficient operation in a combined machine such as disclosed therein.

The foregoing and other objects and advantages will become apparent in view of the following description taken in conjunction with the drawings, wherein:

Figure 1 is a top plan view of a bolt header embodying my invention;

Figure 2 is a fragmentary plan view of the forward end of a bolt-making machine showing the improved transfer mechanism applied thereto;

Figure 3 is a sectional elevation taken substantially on the line 3—3, Figure 2;

Figure 4 is an enlarged plan view of the parts of the transfer mechanism which lie substantially within the central portion of Figure 2;

Figure 5 is an enlarged view in front elevation of the transfer fingers and adjacent coacting parts;

Figure 6 is a view in sectional side elevation taken substantially on the line 6—6, Figure 4;

Figure 7 is an elevational view of the fingers similar to Figure 5 but showing the fingers opened.

Referring to the drawings in detail, the numeral 1 designates a bed frame of any suitable design. A main crankshaft 2 is journalled in the opposite sides of the bed frame and is provided with a crank 3 having a connecting rod 4 journalled thereon. A countershaft 5 is geared to the crankshaft 2 for rotation at the same speed as the crankshaft. The bed frame is provided at its forward end with a die breast 6, and within a slideway formed in the frame a header slide 7 is mounted to reciprocate toward and away from the die breast 6. The header slide preferably spans the crankshaft as illustrated in Figure 1 and bears in suitable guides in the frame on both sides of the shaft, so as to combine maximum accuracy of alignment and maximum rigidity. With this construction the connecting rod 4 is pivoted to the slide 7 intermediate the ends of the latter as shown in Figure 1.

In order to carry out the preferred process of bolt manufacture the slide 7 is provided with a plurality of tools 8, 9 and 10 mounted in bolster plates or tool holders 108, 109 and 110, respectively, and adapted to co-operate with dies 11, 12 and 13 in the breast 6. The die 11 is an extrusion die into which the bolt blank is pressed by the tool 8 to reduce the diameter of the major portion of the blank; the die 12 is also an extrusion die for extruding the thread receiving portion of the bolt shank, the cooperating tool 9 being a heading tool which presses the blank into the die and also upsets the previously unextruded portion to form a head; while the die 13 is a holding die which co-operates with the hollow trimming tool or punch 10, which trims the upset heads of the blanks to the desired polygonal form.

Suitable knock-out rods 111, 112 and 113 are provided to eject the blanks from each of the dies 11, 12 and 13. The knockouts 111 and 112 for the dies 11 and 12 are arranged to start ejecting the blanks from these dies after the header slide has receded from the die breast and the transfer fingers which will be described hereinafter are positioned in front of the dies and are moving toward closed position so that the blanks are ejected directly into the transfer fingers. The knock-out 113 for the die 13 on the other hand is timed to eject the blank from this die immediately after the header slide has reached its forward dead center and before it has receded an appreciable distance, so as to complete the trimming of the head of the blank by pushing it through the trimming punch 10 and pushing the blank completely through a passageway in the heading slide communicating with the punch 10. The structure of the knockouts may be as illustrated in the aforementioned application of Earl R. Frost, but preferably the knock-out pins, guides, supports and actuating means are constructed as disclosed in my copending application, Serial No. 721,083, filed April 18, 1934 to which application reference is made for a more complete disclosure of the knock-out mechanism.

It will be understood, of course, that any desired combination and types of tools and dies may be used, the improved transfer mechanism not being limited by the illustrated embodiment.

Wire or rod stock is fed through the bed frame 1 by any conventional type of feed rollers or the like, and is sheared into blank lengths and transferred to the first die. In the embodiment shown the stock is engaged by a cut-off arm 16, which shears off the blanks and carries the same into alignment with the die 11. Arm 16 is pivotally anchored to the bed frame 1 at 17 and is oscillated by a cam 18 contacting a cam roller 19 rotatably mounted at the one end of said arm. Cam 18 is secured on a cam shaft 20 which is geared to the countershaft 5. Arm

16 is formed with a beveled end portion 16a which travels in a guide 16b, by means of which the arm is steadied and braced during oscillation.

During each cycle of the machine, the arm 16 is rocked by cam 18 to shear off a blank and carry the same into alignment with the die 11 during the time the header slide 7 is retracting and then returns to its initial position to receive another blank while the slide is moving forward into engagement with the work.

A shaft 114 may be geared to the shaft 20 by bevel gears and provided with cams 115 bearing on rocker arms 116 to actuate the knock-outs 111, 112 and 113. The shaft 20 being geared to the countershaft 5, which is driven by the crankshaft 2, it will be apparent that it is only necessary to properly contour and position the cams 115 in order to obtain the desired timing of the knock-out pins 111, 112 and 113 with respect to the movement of the header slide 7.

The transfer mechanism is arranged to simultaneously carry blanks from die 11 to die 12 and from die 12 to die 13. Referring to Figure 2, a bracket 21 is bolted to the top of the bed frame behind the die breast and is formed with projecting hinge ears 22 in which is journalled a shaft 23 arranged parallel with the line of the dies 11, 12 and 13. A frame 24 is formed with a pair of spaced hinge ears 25 fitting between the ears 22 and journalled on the shaft 23.

The frame 24 is provided with a pair of bosses receiving bolts or the like 26 by which the frame can be releasably secured down upon the bed frame or upon adjustable abutments under the bosses. When these bolts are removed the frame 24 can be swung upwardly and rearwardly about the shaft 23 carrying with it the entire transfer mechanism.

A pair of vertically spaced parallel shafts 27 and 28 are carried by the frame 24 near its front end and a second frame 29 is journalled upon the upper shaft 27 and disposed in front of the frame 24. The side walls of the frame 29 abut the forward edges of the side walls of the frame 24, as illustrated at 30 in Figure 4, so that the frame 29 is normally suspended in the position shown in Figure 6, but can be swung upwardly about its pivot on the shaft 27.

The front face of the frame 29 is formed with a horizontal slideway 31 within which is reciprocably mounted a carriage 32 which carries and supports the transfer fingers. The carriage 32 is formed as a housing closed by a front cover 33.

In the illustrated embodiment two pairs of transfer fingers 34 and 35, and 36 and 37 are mounted upon the carriage 32 and are arranged to extend over the front face of the die breast 6 in alignment with the dies 11, 12 and 13. The fingers 34, 35, 36 and 37 are secured to pins 38, 39, 40 and 41, respectively, each of which is journalled in the rear wall of the carriage 32 and in the front cover plate 33. In order to permit accurate aligning of the fingers they are adjustably fixed to their pivot pins and a preferred type of connection is illustrated between the finger 37 and its pin 41 in Figure 5, it being understood that the same arrangement or any other suitable type of adjustable connection is used for each of the fingers. As shown in Figure 5 the pin 41 is flattened and the flat is engaged by a key 42. The opposite ends of the key are pressed by set screws 43 threaded through a boss 44 integral with the finger 37. It will be apparent that angular adjustment of the finger with respect to its pin can be effected by retracting one of the set screws 43 and extending the other.

The pivot pins 38 and 39 of one pair of fingers and similarly the pivot pins 40 and 41 of the other pair of fingers are geared together so that motion of one finger of a pair in one direction causes corresponding motion of the other finger of that pair in the opposite direction. Similarly the two pins 39 and 40 are geared together to effect simultaneous action of the two pairs of fingers. Meshing gear sectors 45 and 46 are secured to the pins 38 and 39, respectively; corresponding meshing sectors 47 and 48 are secured to the pins 40 and 41, respectively; and other meshing gear sectors 49 and 50 are secured to the pins 39 and 40, respectively, to connect the two pairs of fingers. All of these gear sectors are preferably enclosed within the housing formed by the carriage 32 and the cover plate 33.

The two transfer fingers of each pair extend downwardly from their pivot pins, cross each other and are provided with recessed tips 51. In their closed position the transfer fingers are arranged as illustrated in Figures 3 and 5 with their tips 51 in position to grip a bolt blank from opposite sides. When the fingers are opened the intermeshing gears between the two fingers of each pair cause the fingers to move with a scissor-like action with their pivot pins rotating in opposite directions so as to move the tips of the two fingers directly away from each other and upwardly, as illustrated in Figure 7.

The teeth of the gear sectors 45 and 46 which are in engagement when the fingers are in their closed position, as illustrated in Figure 5, are formed slightly narrower or thinner than the spaces between the teeth so as to allow relative movement or play of the fingers 34 and 35 with respect to each other in closed position. The teeth of these sectors which are in engagement when the fingers are fully opened, or in other words, the teeth at the bottoms of the sectors 45 and 46, as seen in Figure 5, are formed in the normal manner so that each tooth closely fits the space between two teeth on the other sector, eliminating the play between the fingers when they are opened. The gear sectors 47 and 48 are formed in identically the same manner, and the gear sectors 49 and 50 are formed at their lower portions with thin teeth and at the upper portions with normal teeth so as to allow relative movement or play of one pair of fingers with respect to the others when both pairs are in their closed positions and to eliminate the play when both sets of fingers are open. Any other convenient arrangement, such as differential gear teeth or teeth of differing pitches, may be employed to obtain a slight play between the fingers of each pair in closed position to accommodate irregularities in shape or position of the blank to be gripped by that pair of fingers and similarly to permit relative play between the two pairs of fingers to accommodate any irregularity in the relative position of the two blanks to be gripped by the two pairs of fingers.

The fingers 34, 35, 36 and 37 are formed with upwardly extending projections terminating in knobs 52, 53, 54 and 55, respectively. A spring 56 is hooked over the knobs 52 and 53 to pull the fingers 34 and 35 normally to their closed position and a spring 57 is similarly connected to the knobs 54 and 55 to pull the fingers 36 and 37 toward their closed position.

The fingers are opened by a cam 58 on the cam shaft 20 acting against the tension of the springs 56 and 57 and are closed by the springs, the closing action likewise being timed and controlled by the contour of the cam. The cam 58 is engaged by a roller 59 journalled upon the end of push rod 60 guided through a vertical opening in the frame and pivotally connected at its upper end to a lever arm 61 secured to the end of the shaft 23 so that the lift of the cam rocks the shaft 23 to the left as seen in Figure 6. A collar 62 is secured to the shaft 23 between the ears 25 on the frame 24 and is formed with a projecting finger 63. A sleeve 64 is journalled on the shaft 26 carried by the frame 24 and has a projecting lever 64' disposed above and contacting the end of the finger 63. Secured to the opposite side of the sleeve 64 is a bar 65 extending substantially across the interior of the hollow frame 29. A crank arm 66 is fixed to the inner end of the pivot pin 39 for the transfer finger 35 and has a roller 67 journalled to its end and engaging the under surface of the bar 65. The engaging surface of the bar 65 is made of sufficient length to remain in engagement with the roller 67 at all times during the reciprocation of the carriage 32. It will be apparent that the lift of the cam 58 rocks the shaft 23 so that the finger 63 carried thereby lifts the lever 64', rocks the sleeve 64, and depresses the bar 65. Irrespective of the position of the carriage 32 the depression of the bar 65 acts against the crank arm 66 through the roller 67 causing the pivot pin 39 to rotate to the right, as seen in Figures 3 and 5. The pivot pins 38, 40 and 41 being geared to the pivot pin 39, this rotation of the latter causes both pairs of fingers to open in the manner previously described to the position shown in Figure 7.

Reciprocation of the carriage 32 within the guideway 31 is effected by a cam 68 also secured to the cam shaft 20. As illustrated the cam 68 engages a roller upon the lever 69 pivoted to the bed frame at 70 and having its opposite end pivoted to a link 71. The link 71 extends across the machine below the die breast 6 and is pivoted to a reciprocating rack 72 guided within the bed frame and meshing with a spur gear 73. The latter is fixed to a shaft 74 journalled in a housing 75 carried by the bed frame. The shaft 74 is coupled through a releasable safety coupling with a vertical shaft 76 extending upwardly through the bed frame and terminating in a crank arm 77. An adjustable pitman 78 is pivoted to the crank arm 77 and is connected by a releasable socket joint 79 with an extension 80 which is formed integral with the reciprocating carriage 32. A spring return of any suitable construction, such as the link 81, carrying a compression spring 82, is arranged to maintain the roller on the lever 69 in engagement with the cam 68. The cam 68 is of such proportions and the spur gear 73 is of such size as to drive the shaft 76 through a 180° rotation during the lift of the cam and a corresponding return. The crank arm 77 is arranged to rotate through a half turn between the two extreme positions illustrated in Figure 2, the crank arm being parallel with the direction of movement of the carriage 32 at each extreme position. The length of the crank arm 77 is initially selected to give a travel to the carriage 32 exactly equal to the distance between the dies 11 and 12 and between the dies 12 and 13. In this way the length of the pitman 78 may be adjusted at one extreme of the travel of the carriage 32 to align the fingers with two of the die stations and the fingers will be automatically aligned with the die stations at the other extreme of the travel. In addition the movement of the crank arm 77 through 180° enables the crank arm to start the carriage from rest in one position and smoothly accelerate and decelerate the carriage throughout its travel so as to obtain a rapid and smooth reciprocation of the carriage 32 without any jars or shocks which might tend to dislodge blanks carried by the fingers.

As illustrated, the crank arm 77 is arranged on the side of the machine toward which the blanks are transferred in moving from the die 11 to the die 12 and from the die 12 to the die 13. As a consequence the pitman rod 78 is moved faster by the crank before the crank is turned through the first 90 degrees of rotation than at any other time during blank transferring movement. The pitman rod 78 does not acquire a right angle relationship with respect to the crank on return movement of the carriage until less than 90 degrees of the return rotation of the crank remains. In other words the transfer carriage is moved through more than half the total carriage travel in a blank transferring direction during the first 90 degrees of rotation of the crank. Thus the first quadrant of the crank rotation in moving the carriage toward the crank is the "fast quadrant" in that it moves the carriage farther than the second quadrant with the same rotational speed. This facilitates the timing of the device, particularly for short blanks, since the return movement of the transfer is relatively slow at the beginning while the heading slide is retracting from the dies and until the tools and tool holders are moved sufficiently far to avoid interference with the fingers, and then the return movement is completed more rapidly so that after the path is cleared the fingers can rapidly reach the position in alignment with the dies 11 and 12 so as to seize the ejected blanks.

The device is assembled upon the machine in the manner indicated in Figure 1 with the bracket 21 bolted to the top of the frame behind the die breast. It will be apparent that by uncoupling the connection 79 of the connecting rod and releasing the bolts 26 the entire assembly can be swung upwardly and rearwardly about the shaft 23, the lever arm 64 being merely lifted away from the projecting finger 63, and thus be moved out of the way without in any way effecting the timing of the mechanism. In working position the structure is held in proper position relative to the dies by the bolts 26 which secure the frame 24 down upon the bed frame or adjustable abutments, as may be desired. It will be apparent that the forward frame 29 can be swung upwardly relative to the frame 24 by pivoting about the shaft 27. This movement is yieldably resisted by a spring 83 housed in a boss 84 integrally formed in the frame 24 and yieldably pressing outwardly the plunger 85 which engages a lever arm 86 integral with the frame 29 and extended rearwardly therefrom. This swinging movement is also resisted by the fact that the bar 65 is carried upon the shaft 28 in the frame 24 so that a swinging movement of the frame 29 in effect presses down upon the roller 67 and tends to open the fingers from their position at any particular point in the cycle of operation of the machine.

This floating arrangement of the frame 29 permits the fingers 34, 35, 36 and 37 to be moved outwardly away from the dies in the event they should close before the blank is ejected so that the blank engages the fingers and pushes them

outwardly. This outward movement of the fingers, in the manner just explained, causes the fingers to be opened so that the blank carried by the other pair of fingers is dropped and the obstruction is cleared. If desired a shut-off switch may be arranged to be operated by relative movement of the frame 29 on the frame 24 so that if the fingers should be pressed out the machine would be stopped.

The releasable coupling between the shafts 74 and 76 to provide a safety in the event reciprocation of the carriage 32 should be resisted by a distorted blank or a broken knock-out pin or the like consists of a sleeve 87 splined to the shaft 76 and pressed downwardly by a spring 88. The lower end of the sleeve 87 is formed with an abutment having a transverse notch which engages a corresponding abutment on the upper end of the shaft 74 having a tongue fitting in the notch. Resistance to the reciprocation of the carriage 32 merely results in sliding the sleeve upwardly against the tension of the spring 88 to release the engagement of the tongue in the notch.

In operation wire or rod stock is fed forwardly in position to be severed by the cut-off arm 16. As the header slide 7 advances carrying the tools 8, 9 and 10 toward the dies 11, 12 and 13 the cam 18 swings the cut-off arm 16 to the right as seen in Figure 2, shearing off a length of stock sufficient to form a blank of the desired size and carrying it into alignment with the die 11. At about the same time that the cut-off arm 16 starts its movement the cam 68 engages the roller on the lever 69 and reciprocates the carriage 32 to the right so that the transfer fingers are in alignment with the dies 12 and 13. As the tools on the header slide engage blanks at each of the three die stations and start to press the blanks into the dies the cam 18 allows the cut-off arm 16 to move to the left to clear the tool 8 and at about the same time the cam 58 engages the roller 59 and causes the fingers 34, 35, 36 and 37 to be opened into the position illustrated in Figure 7, so that the fingers clear the tools 9 and 10 and also the holders for these tools. At the completion of the forward movement of the header slide, when the tools have performed their work upon the blanks in the three dies and the header slide has begun to recede, the cam 68 allows the lever 69 to be moved to the left under the influence of the spring 82 causing the carriage 32 with the fingers in their opened positions to be moved to the left. When the header slide has moved rearwardly sufficient to allow the fingers to clear all parts of the tools the fingers come into alignment with the dies 11 and 12 and the cam 58 allows the roller 59 to descend and the fingers to close under the influence of the springs 56 and 57. The blanks in the dies 11 and 12, in the meantime remain seated in the dies where they have been driven by the tools 8 and 9. Before the fingers reach their closed positions the knock-out or ejector rods in the dies 11 and 12 eject the blanks from these dies between the respective transfer fingers which continue their closing movements to grasp the shanks of the blanks behind the heads. At this time a new length of stock has been fed forwardly in front of the cut-off arm 16 and the cycle is repeated. The knock-out for the trimming die 13 operates in advance of the knock-outs for the dies 11 and 12 so as to eject the trimmed blank from the die 13 into the hollow trimming punch 10, preferably in the manner disclosed in my copending application, Serial No. 721,083 filed April 18, 1934, to which application reference is made for a more detailed description of the operation and timing of the trimmer knock-out. When the structure of the present invention is used in a combined machine such as that disclosed in the aforesaid application of Earl R. Frost, Serial No. 639,054, filed October 22, 1932, the trimmed blanks are then transferred to a position for the next operation.

It will be evident that the speed and efficiency of the transfer mechanism is greatly improved by the fact that the transfer carriage 32 is reciprocated in a straight line and is not given a compound lateral and vertical movement. Likewise the timing of the machine so that it may be readily adjusted to various lengths of blanks including extremely short blanks is greatly facilitated by the fact that the transfer carriage remains stationary during the engagement of the tools with the blanks and that the blanks are ejected from the dies 11 and 12 into the transfer fingers after the tools carried by the header slide have been retracted out of the way. The fingers are arranged to open just sufficiently to clear the die holders which can thus be made relatively short and in wide conical form as illustrated in Figures 2 and 4 so as to increase the strength of the tool holders and the rigidity with which the tools are held with respect to the header slide.

Since the fingers neither snap on to nor snap off of the blanks it is apparent that there are no forces exerted upon the blanks tending to misalign them either when they are seized by or released from the transfer fingers. Any misalignment of one blank with respect to the pair of transfer fingers which grasp it is accommodated by the play allowed in the gears between the two fingers of each pair at closed position. In this way even if a blank should be ejected from a die at a slight angle in one direction or another the fingers will close about it without binding and then when free of the die and during the carriage movement the springs will function to straighten the blank and position it properly to be driven into the next die. As shown in Figure 5 the springs 56 are in tension and tend to pull the outer ends of the levers 34 and 35 toward each other and thus the gripping portions are urged toward each other. Since the spring pull is equal on each lever the spring tends to arrange the levers to form an equilateral triangle with the gripping portions at the apex. If the intermeshing gear parts on the levers 34 and 35 were proportioned to fit tightly a slight projection on one side of a blank would move the gripper at that side and effect through the tight gear fit a movement of the other gripper in the opposite direction. This would render the grippers inoperative to grip an imperfect blank. In a like manner, if the intermeshing gears between the two sets of levers, that is between 35 and 36 were provided with a tight fit and one set of levers should receive an imperfect blank eccentric of the die it would be forced to remain in that eccentric position and could not align the blank in the next successive die. The loose gear fit between the levers 35 and 36 permits one set of levers to adjust themselves independently of the other when free of the dies and thus insure an accurate centering of even imperfect blanks when moved to blank registering position.

It will be understood that the foregoing specific description is not to be construed as a limitation of the invention and that various structural changes and modifications may be adopted with-

in the scope of the invention as defined by the following claims. Many of the features of this invention may be employed in any type of transfer and in various different kinds of machines.

I claim:

1. In combination, a plurality of dies arranged in a straight line, a reciprocating slide carrying a plurality of tools arranged to coact with said dies to work upon blanks held therein, transfer mechanism, and means for moving said mechanism to transfer blanks from the first die to the second and from the second to the third during the time the tools carried by said slide are spaced from said dies, for holding said mechanism stationary during the time the tools are in engagement with the blanks in said dies, and for moving said mechanism on its return travel from the third and second dies to the second and first dies, respectively, after said tools have begun to move out of engagement with the blanks.

2. In combination, a pair of dies, a reciprocating slide carrying tools to act upon blanks held in said dies, means for ejecting blanks from said dies, transfer mechanism including a pair of fingers arranged to grip a blank ejected from the first die and to carry the same into alignment with the second die while said tools are spaced from said dies, means for moving said fingers away from the blank to release the same after one of the tools carried by said slide has engaged the blank and started it into the second die, and means for moving said fingers on their return travel from the second die to the first die beginning after said tools have begun to move out of engagement with the blanks in said dies.

3. In combination, a pair of dies, a reciprocating slide carrying tools to act upon blanks held in said dies, means for ejecting blanks from said dies, transfer mechanism including a pair of fingers arranged to grip a blank ejected from the first die and to carry the same into alignment with the second die while said tools are spaced from said dies, means for moving said fingers away from the blank to release the same after one of the tools carried by said slide has engaged the blank and started it into the second die, and means for moving said fingers on their return travel from the second die to the first die beginning after said tools have begun to move out of engagement with the blanks in said dies, said transfer mechanism remaining stationary during the engagement of said tools with the blanks to permit said slide to closely approach said dies.

4. In a bolt making machine, a bed frame having a plurality of dies arranged in a line, a reciprocating slide carrying tools to act upon blanks held in said dies, a transfer carriage mounted to reciprocate in a single straight line on said bed frame on one side of the line of said dies and having one or more pairs of transfer fingers supported thereon and projecting into the line of said dies, means for spreading said fingers apart to release blanks held thereby and clear said tools, and means for moving said carriage in one direction on its transfer travel and in the opposite direction on its return travel.

5. In a bolt making machine, a bed frame having a plurality of dies arranged in a line, a reciprocating slide carrying tools to act upon blanks held in said dies, a transfer mechanism mounted to reciprocate in a single straight line on said bed frame and disposed wholly on one side of the line of said dies, said transfer mechanism including co-operating gripping fingers arranged to project into the line of said dies, means for spreading said fingers apart to release blanks held thereby and clear said tools, and means for alternately moving said fingers on their transfer travel and their return travel.

6. In combination, a pair of dies, tools coacting with said dies to act upon blanks held therein, means for reciprocating said tools, transfer mechanism for transferring blanks from the first of said dies to the second including a slide arranged on one side of the line of dies and reciprocable in a direction transverse to the direction of movement of said tools, a pair of co-operating pivoted fingers carried by said slide and arranged to be moved toward each other to grip a blank ejected from the first of said dies, means for moving said slide to carry a blank gripped by said fingers into alignment with the second of said dies while said tools are retracted from the dies and means for spreading said fingers apart by rotation on their pivots to release a blank held thereby and move the fingers out of the path of said tools.

7. In a blank heading machine, a pair of work stations arranged to receive blanks, tools for acting upon blanks at said work stations, means for reciprocating said tools toward and away from said stations, a slide arranged parallel with and on one side of the line of said work stations, a pair of co-operating blank gripping fingers pivoted to said slide for movement toward each other to grip a blank therebetween and means for spreading said fingers apart to release a blank gripped thereby and clear said tools.

8. In combination, a pair of work stations for receiving blanks, tools for acting upon blanks held in said work stations, means for reciprocating said tools toward and away from said work stations, transfer mechanism for carrying blanks from the first of said stations to the second including a carriage, a pair of fingers pivoted to said carriage and arranged to be moved together to grip a blank therebetween, a shaft operating in timed relation to the reciprocation of said tools, a cam driven by said shaft, and means operated by said cam for spreading said fingers apart.

9. In a bolt making machine, a plurality of spaced transversely aligned dies, means for shearing stock in suitable lengths to form bolt blanks and for carrying the blanks to the first of said dies, a plurality of sets of transfer fingers adapted to engage and carry blanks, a support on which said fingers are pivotally mounted, the fingers of each set being connected for positive synchronous opening and closing movement with respect to one another, and means for actuating said support to impart transfer movements to said fingers with respect to said dies.

10. In combination, a pair of work stations arranged to receive blanks and transfer mechanism for carrying blanks from the first station to the second comprising a reciprocating carriage, a pair of transfer fingers pivotally mounted on spaced pivots on said carriage and means coupling said fingers together for simultaneous and opposite swinging movement.

11. In combination, a pair of work stations arranged to receive blanks and transfer mechanism for carrying blanks from the first station to the second comprising a reciprocating carriage, a pair of transfer fingers pivotally mounted on said carriage and means coupling said fingers together for simultaneous and opposite swinging movement, said means being arranged to permit

limited independent movement of said fingers as said fingers approach each other to grip a blank therebetween.

12. In combination, a plurality of work stations arranged to receive blanks and transfer mechanism for carrying blanks from the first station to the second and from the second to the third and so on, including a reciprocating carriage, a plurality of pairs of fingers pivotally mounted on said carriage arranged to move toward each other to grip a blank therebetween and to move apart to release a blank, and means coupling all of said pairs of fingers together for simultaneous movement to blank gripping and blank releasing positions.

13. In combination, a plurality of work stations arranged to receive blanks and transfer mechanism for carrying blanks from the first station to the second and from the second to the third and so on, including a reciprocating carriage, a plurality of pairs of fingers pivotally mounted on said carriage arranged to move toward each other to grip a blank therebetween and to move apart to release a blank, and means coupling all of said pairs of fingers together for simultaneous movement either to blank gripping or blank releasing positions, said means being arranged to permit limited independent movement of one of said pairs of fingers with respect to the other at blank gripping positions.

14. In a bolt making machine, a plurality of spaced transversely aligned dies, means for shearing stock in suitable lengths to form bolt blanks and to carry the blanks to the first of said dies, a transfer finger support, a plurality of sets of coacting transfer fingers pivotally mounted on said support, gears connecting the fingers of each set one with the other, means for actuating said support to move the fingers into alternate blank-gripping and blank-feeding alignment with said dies, and means for rotating said gears to open and close said fingers.

15. In a bolt making machine, a plurality of spaced transversely aligned dies, means for shearing stock into suitable lengths to form bolt blanks and for carrying blanks to the first of said dies, a transfer finger support, a pair of coacting transfer fingers pivotally mounted on said support, a segmental gear connection between said fingers, means for rotating at least one of said gears to open and close said fingers, and means for actuating said support to move said fingers bodily into alternate blank-gripping and blank-feeding registration with respect to said dies.

16. In a bolt making machine, a plurality of spaced transversely aligned dies, means for shearing stock into suitable lengths to form bolt blanks and for carrying the blanks to the first of said dies, a transfer finger support, a plurality of sets of coacting transfer fingers pivotally mounted on said support, intermeshing gears operatively connecting said fingers for positive synchronous movement of the latter, means for actuating said support to move said fingers into alternate blank-gripping and blank-feeding registration with respect to said dies, means for rotating said gears to open said fingers, and yieldable means for urging said fingers towards closed position.

17. In a bolt making machine, a plurality of spaced transversely aligned dies, a transfer finger slide, a plurality of sets of coacting transfer fingers pivotally mounted on said slide, intermeshing gears operatively connecting the fingers of each set for positive synchronous opening and closing movements of the fingers, means for horizontally reciprocating said support to move said fingers into alternate blank-gripping and blank-feeding registration with respect to said dies, and means for rotating at least one of said gears to open and close said fingers.

18. A transfer mechanism for advancing blanks step by step through a plurality of work stations, comprising a transfer carriage having means for gripping blanks and carrying the same from one work station to the next, and means for reciprocating said carriage including a crank and a connecting rod pivoted to said carriage and to said crank, the extremities of the reciprocating movement of said carriage being reached substantially at the opposite dead centers of said crank.

19. A transfer mechanism for advancing blanks step by step through a plurality of work stations, comprising a transfer carriage having means for gripping blanks and carrying the same from one work station to the next, and means for reciprocating said carriage including a crank and a connecting rod pivoted to said carriage and to said crank, said crank being arranged at the end of said carriage toward which the blanks are advanced through the work stations and proportioned to turn through substantially 180° in moving the carriage from one end of its stroke to the other.

20. A transfer mechanism for intermittently advancing blanks through a plurality of work stations comprising a slidable support, a plurality of sets of transfer fingers operatively disposed with respect to said work stations carried by said support, means for reciprocating said support to effect transfer movements of said fingers with respect to said stations, and means for opening and closing said fingers to grip and release bolt blanks; said means including shafts on which said fingers are secured, intermeshing gears on said shafts, a crank arm connected to one of said shafts, a rocker arm having an elongated cam portion adapted to actuate said crank arm, and means for actuating said rocker arm.

21. A transfer mechanism for intermittently advancing blanks through a plurality of work stations comprising a slidable support, a plurality of sets of transfer fingers operatively disposed with respect to said work stations carried by said support, means for reciprocating said support to effect transfer movements of said fingers with respect to said stations, and means for opening and closing said fingers to grip and release bolt blanks; said means comprising shafts on which said fingers are secured, intermeshing gears on said shafts, a crank arm secured on one of said shafts, a cam roller on said arm, a rocker arm provided with an elongated cam portion adapted to engage said roller during reciprocation of said slide, and means for actuating said rocker arm to thereby cause said elongated cam portion to engage said roller and actuate said crank arm in one direction to open said fingers, and resiliently acting means for closing said fingers.

22. A transfer mechanism for intermittently advancing blanks through a series of work stations comprising a reciprocable carriage, transfer fingers normally in a plane parallel to the faces of the work stations carried by said carriage and projecting in front of said work stations in position to grip blanks and carry the same from one station to the next, and means for opening and closing said fingers, said fingers being yieldably mounted in such a manner as to permit the same to be forced out of said plane away from said

work stations and said means being arranged in such a manner as to further open said fingers when the same are forced away from said work stations.

23. In a bolt heading machine, a bed frame, a reciprocating header slide, a plurality of dies carried by said bed frame and arranged in a straight line, a plurality of tools carried by said header slide to act upon blanks held in said dies, transfer mechanism for carrying blanks from the first die to the second and from the second to the third comprising a reciprocating carriage, a plurality of sets of transfer fingers pivotally mounted on said carriage and movable toward each other to grip blanks therebetween and away from each other to release blanks, yieldable means for urging the fingers of each of said sets toward each other, a shaft operated in timed relationship to the movement of said header slide, and a cam driven by said shaft, said cam being arranged to actuate a finger opening mechanism to move said fingers apart to release blanks carried thereby and to control the movement of said fingers toward each other under the influence of said yieldable means to grip blanks.

24. In a bolt heading machine, a bed frame, a reciprocating header slide, a plurality of dies mounted in said bed frame and arranged in line, tools carried by said header slide for acting upon blanks in said dies, a transfer carriage arranged parallel with and on one side of the line of said dies, a plurality of pairs of transfer fingers pivotally mounted on said carriage and extending therefrom into the line of said dies, means for reciprocating said carriage and cam means for opening and closing said pairs of fingers.

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