May 18, 1965 A. R. KULL 3,183,532

AUTOMATIC TRANSFER MECHANISM FOR FORGING MACHINES

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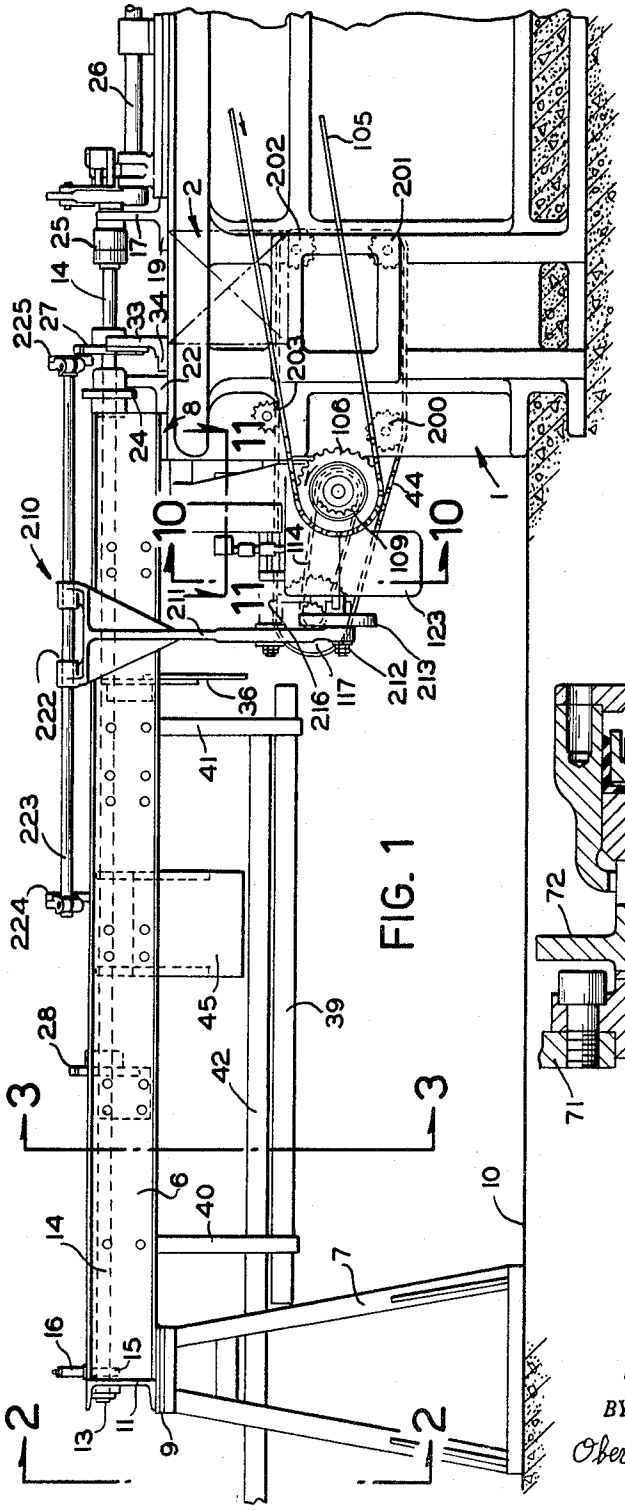


FIG. 1

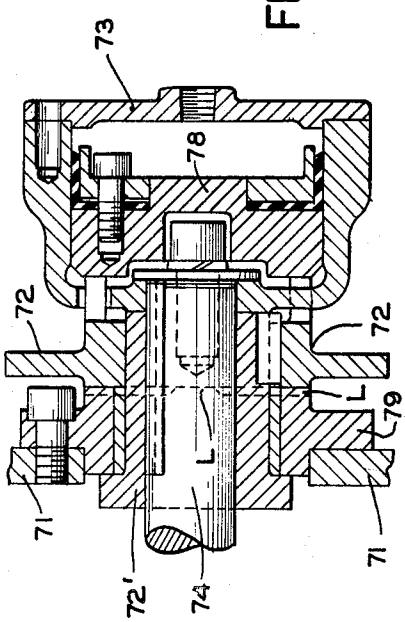


FIG. 21

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AUTOMATIC TRANSFER MECHANISM FOR FORGING MACHINES

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FIG. 2

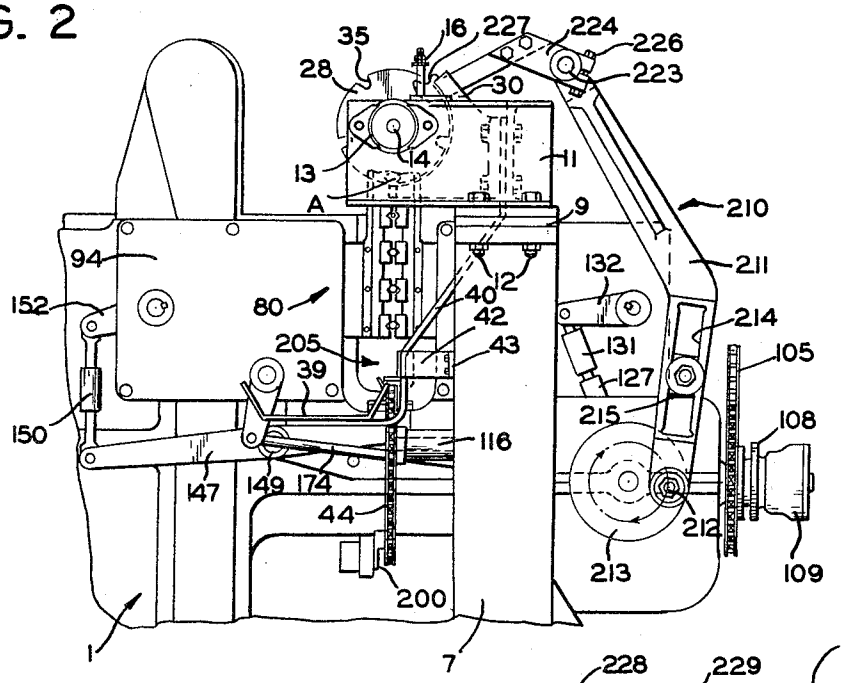
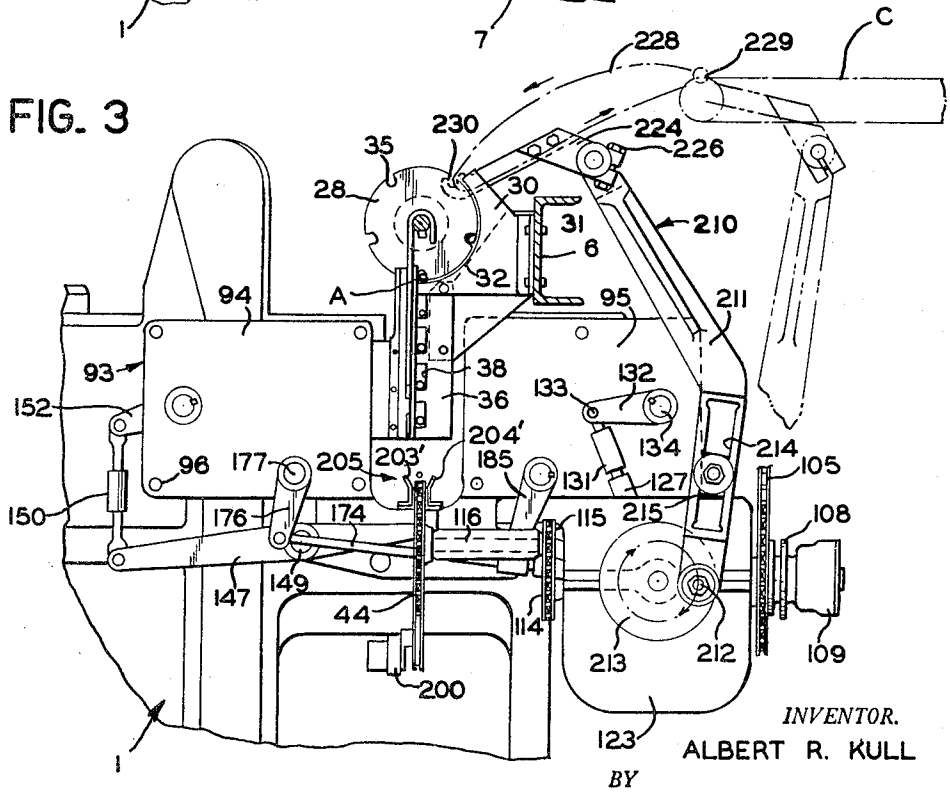


FIG. 3



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AUTOMATIC TRANSFER MECHANISM FOR FORGING MACHINES

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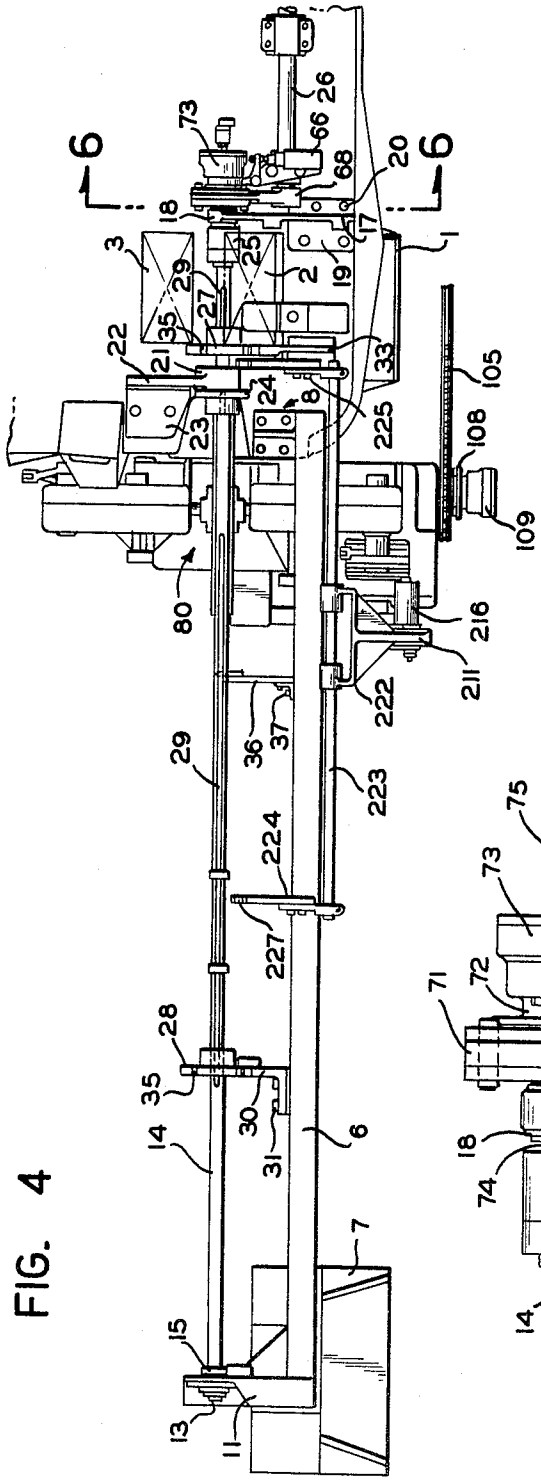


FIG. 4

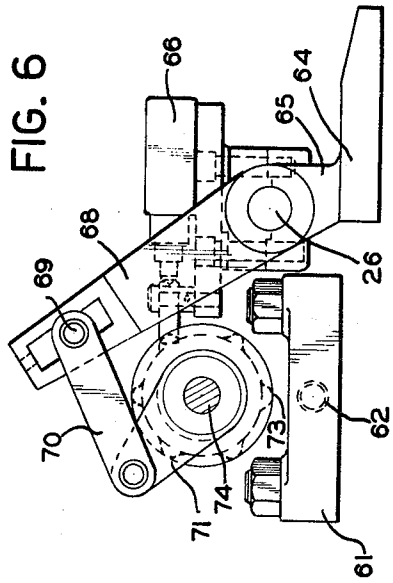


FIG. 6

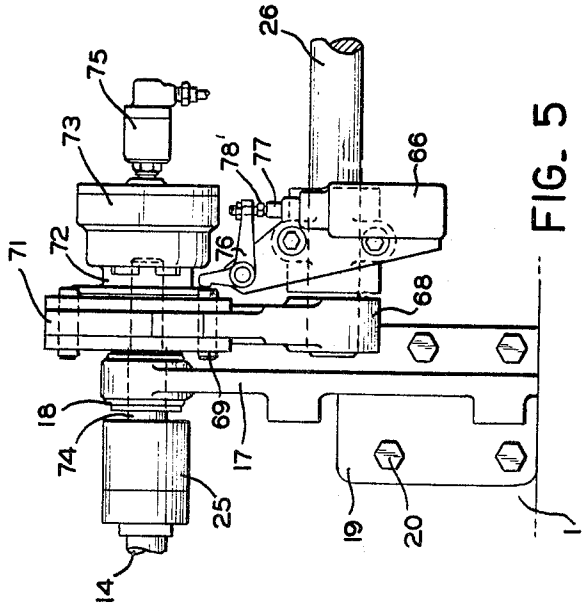


FIG. 5

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May 18, 1965 A. R. KULL 3,183,532

AUTOMATIC TRANSFER MECHANISM FOR FORGING MACHINES

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FIG. 7

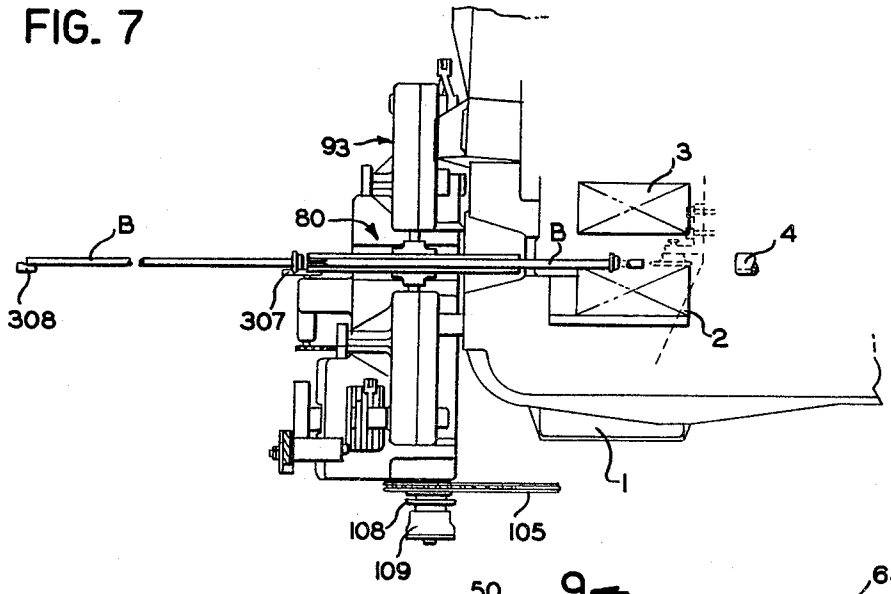
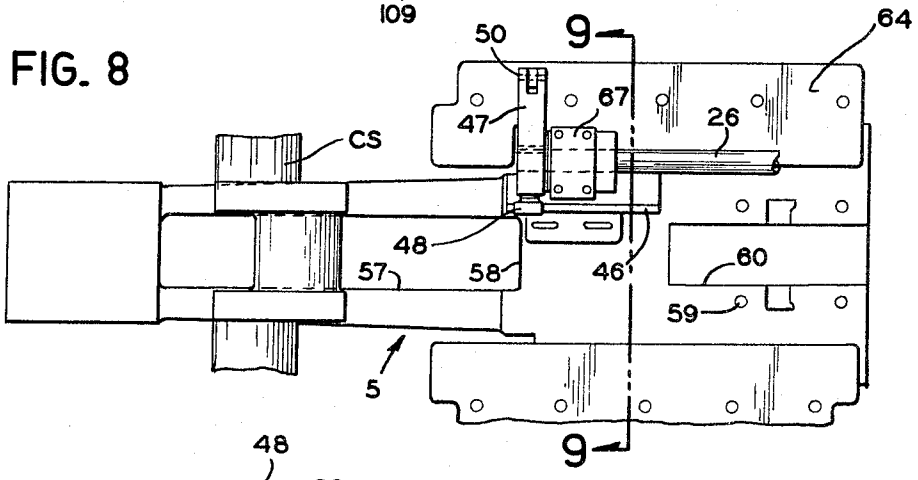


FIG. 8



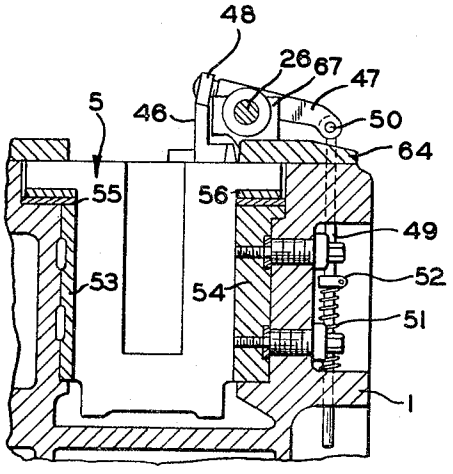


FIG. 9

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May 18, 1965 A. R. KULL 3,183,532

AUTOMATIC TRANSFER MECHANISM FOR FORGING MACHINES

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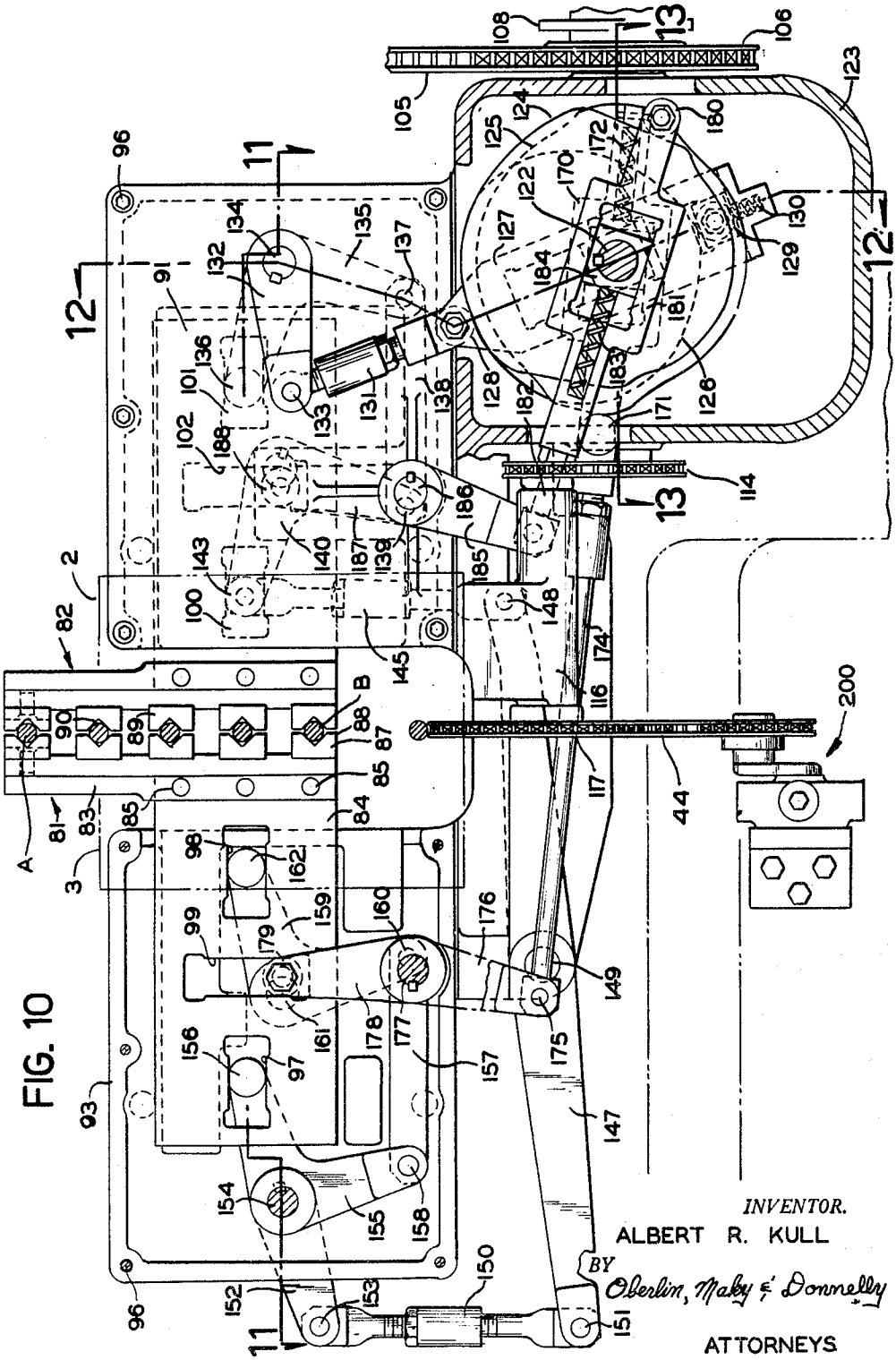


FIG. 10

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AUTOMATIC TRANSFER MECHANISM FOR FORGING MACHINES

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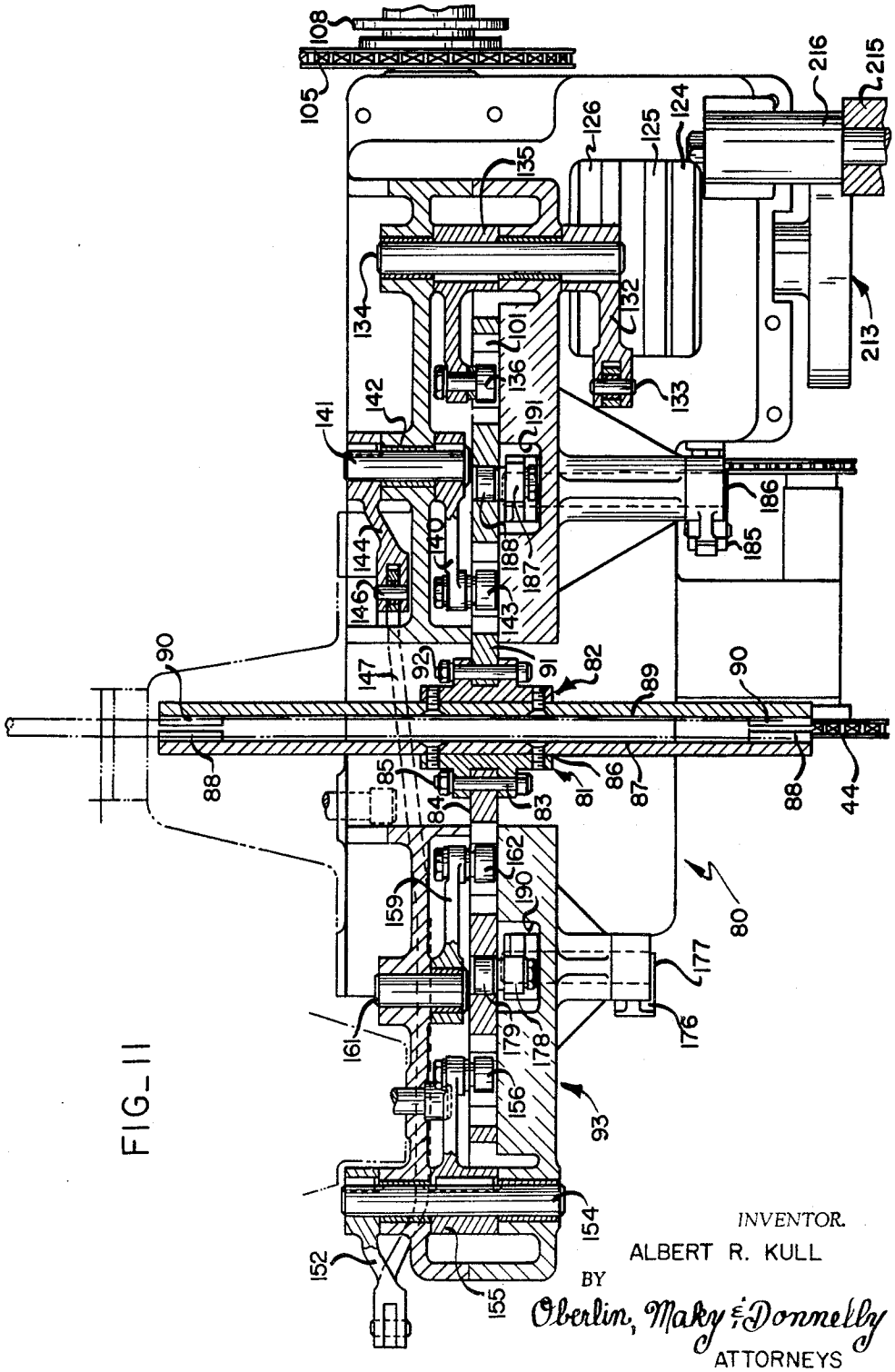


FIG_11

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May 18, 1965 A. R. KULL 3,183,532

AUTOMATIC TRANSFER MECHANISM FOR FORGING MACHINES

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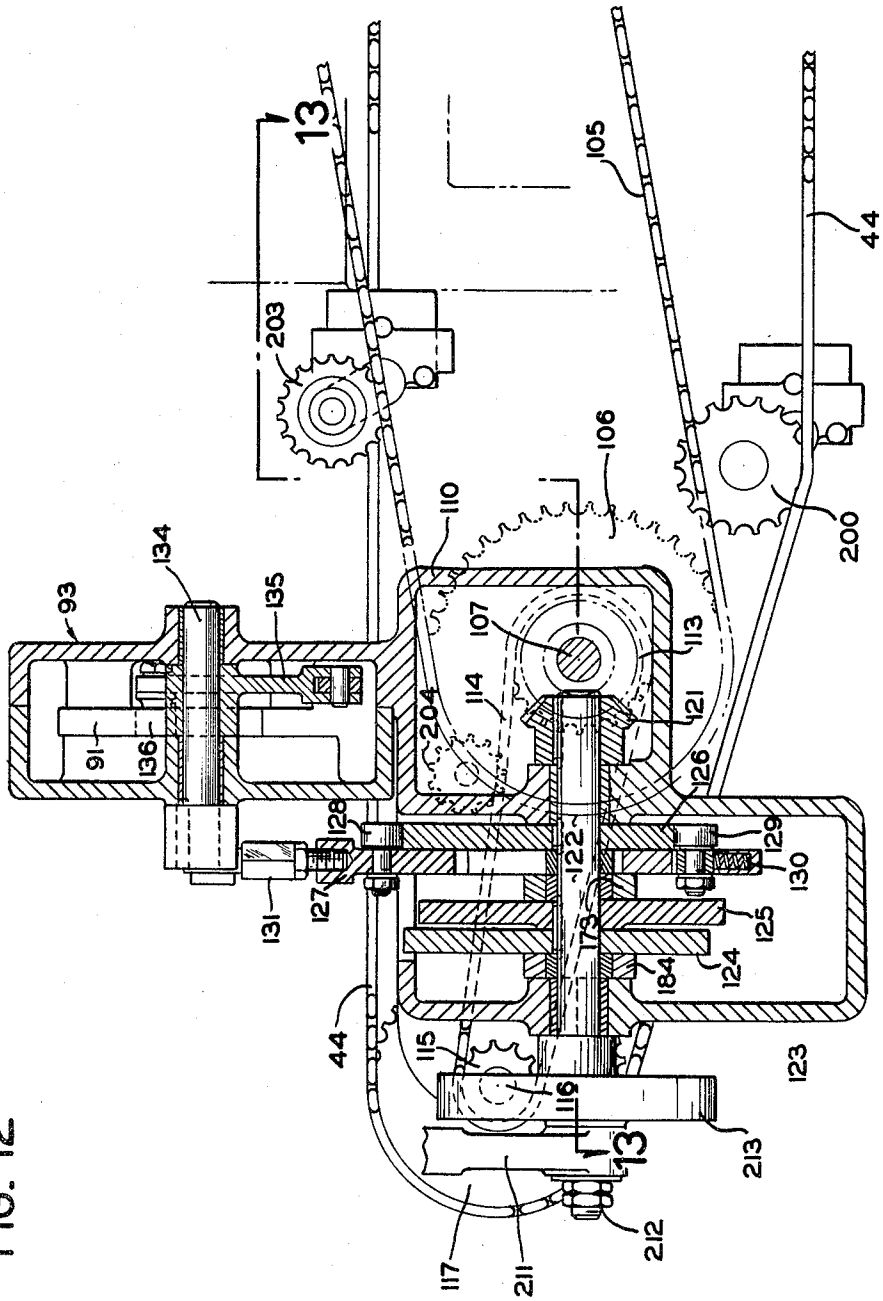


FIG. 12

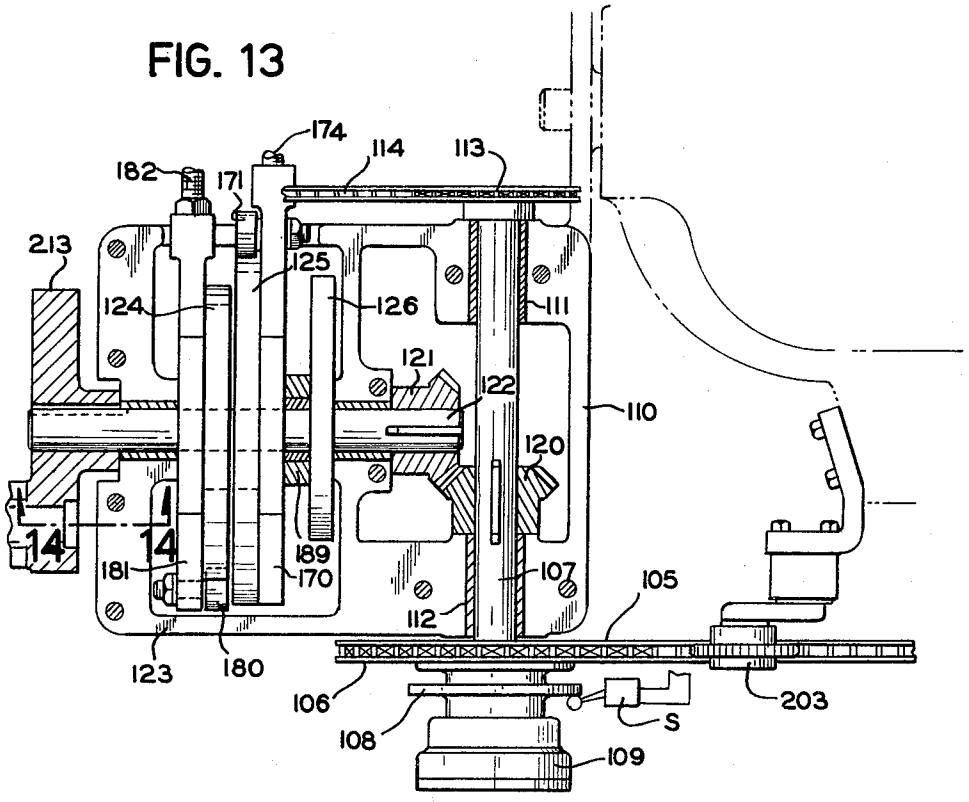
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May 18, 1965 A. R. KULL 3,183,532

AUTOMATIC TRANSFER MECHANISM FOR FORGING MACHINES

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FIG. 13



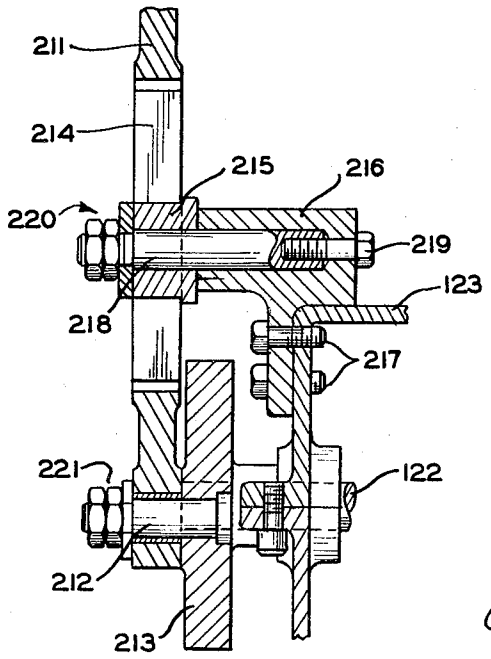


FIG. 14

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AUTOMATIC TRANSFER MECHANISM FOR FORGING MACHINES

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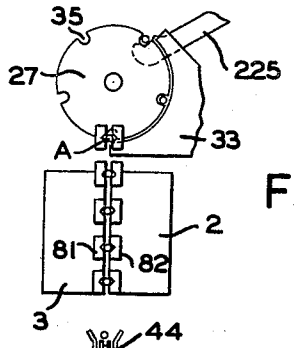


FIG. 15

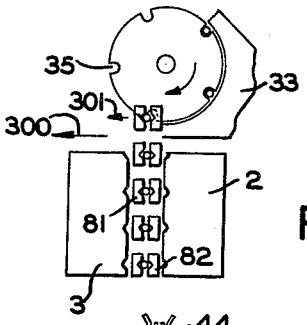


FIG. 16

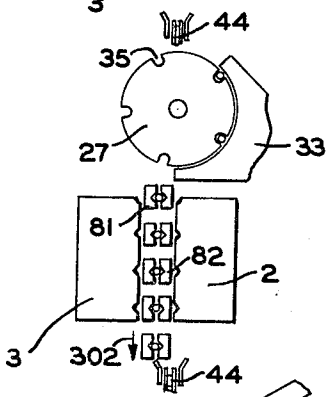


FIG. 17

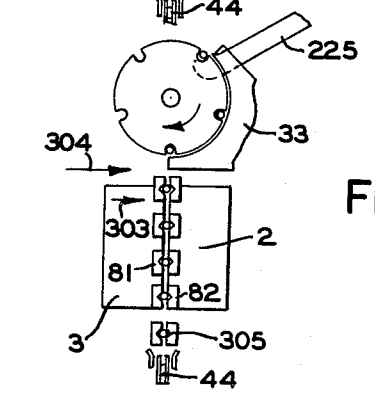


FIG. 18

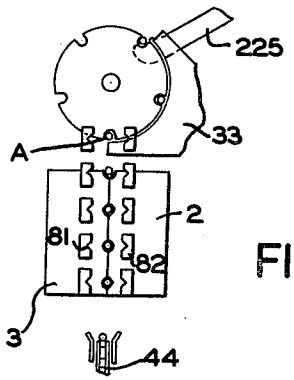


FIG. 19

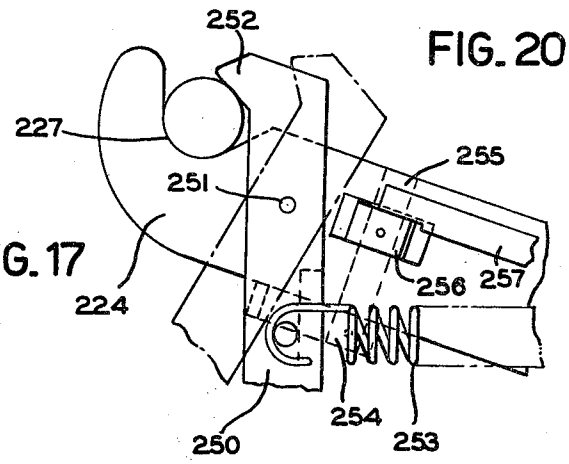


FIG. 20

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United States Patent Office 3,183,532 Patented May 18, 1965

3,183,532

AUTOMATIC TRANSFER MECHANISM FOR FORGING MACHINES

Albert R. Kull, Beachwood, Ohio, assignor to the Ajax Manufacturing Company, Euclid, Ohio, a corporation of Ohio

Filed Mar. 2, 1960, Ser. No. 12,439
18 Claims. (Cl. 10—12)

This invention relates, as indicated, to an automatic transfer mechanism, and more particularly to a feed and transfer mechanism adapted to feed and then shift elongated blanks of circular cross-section from one position to another in a forging machine or the like for the performance of one or more operations thereon.

In an upsetting forging machine or header, such as that commonly employed for the manufacture of bolts, for example, the work may be shifted from one set of die cavities to another by manual means for performance of a series of operations thereon in a particular desired sequence. It is, however, very much more efficient in the case of an automatic machine of this type to provide stock transfer means which will also be fully automatic in operation. Stock transfer mechanisms are shown and described in the Leinweber Patent 2,796,616 and Criley Patent 1,998,272, such mechanisms having been extensively utilized in connection with Ajax bolt heading and forging machines.

The present invention represents further improvements in mechanisms of this nature in providing automatic transfer mechanism capable of handling efficiently very long lengths of rod or bar stock. Prior art mechanism wherein the work is fed in from the back of the machine takes up excessive space when utilizing such very long stock. It is of course, generally not possible to feed such long stock from the front or top of the machine because there is not sufficient clearance when the header slide is back. If a front or top feed is attempted, it then becomes necessary to gauge the stock against a rear gauge, but this is a very inaccurate method unless the stock has been preliminarily cut to proper length with great precision. Moreover, the mechanism employed in the past to feed the stock between the dies required that the dies be cut away to afford clearance, this, of course, structurally weakening the dies.

It is therefore a principal object of my invention to provided an automatic transfer mechanism capable of handling efficiently very long lengths of rod or bar stock.

It is another principal object of my invention to provide an automatic transfer mechanism for forging machines and the like in which the work will mechanically be held by gripping fingers to be moved in a rectilinear path.

It is still another principal object of my invention to provide such mechanism wherein such fingers cannot be separated by compression of a resilient backup means.

It is a further object to provide a forging machine with such automatic feed and transfer means for very long lengths of stock including accurate stock gauging means.

It is still another object to provide such feed and transfer means for such long lengths of stock wherein the finished work is discharged first downwardly and then rearwardly through the throat of the machine.

It is a still further object to provide such feed and automatic transfer means for very long lengths of stock which is adapted to be installed in existing forging machines without any substantial modification of the latter.

It is yet another object to provide such work transfer means incorporating safety devices for both the machine and the operator.

It is yet a further object to provide such work transfer means that will not require or necessitate the cutting away or otherwise reducing the strength of the dies and their supports.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

In said annexed drawings:

FIG. 1 is a fragmentary side elevational view of a commercially available Ajax bolt header and forging machine well known in the art, showing my new transfer mechanism mounted thereon;

FIG. 2 is an enlarged fragmentary end elevation of such machine taken substantially along the line 2—2 of FIG. 1 with parts removed for clarity of illustration;

FIG. 3 is an enlarged fragmentary vertical section taken substantially on the line 3—3 of FIG. 1;

FIG. 4 is a fragmentary top plan view of the machine as shown in FIG. 1;

FIG. 5 is an enlarged fragmentary view of the index shaft drive mechanism as shown in FIG. 4;

FIG. 6 is an enlarged fragmentary sectional view of such drive taken substantially along the line 6—6 of FIG. 4;

FIG. 7 is a fragmentary top plan view with parts removed for clarity of illustration showing the manner in which the finished bolts are discharged from the machine;

FIG. 8 is a fragmentary top plan view of the header slide showing the mechanism for actuating the index shaft;

FIG. 9 is a fragmentary sectional view taken substantially on the line 9—9 of FIG. 8;

FIG. 10 is an enlarged fragmentary sectional view taken substantially on the line 10—10 of FIG. 1 illustrating the mechanism for movement of my stock gripping fingers;

FIG. 11 is a horizontal fragmentary sectional view taken substantially along the lines 11—11 of FIGS. 1 and 10;

FIG. 12 is a fragmentary sectional view taken substantially along the line 12—12 of FIG. 10;

FIG. 13 is a fragmentary sectional view taken substantially on the lines 13—13 of FIGS. 10 and 12;

FIG. 14 is a fragmentary sectional view taken substantially along the line 14—14 of FIG. 13;

FIGS. 15 through 19 inclusive are semi-diagrammatic end elevational views of my feed and transfer mechanism showing sequential steps in the operation of the same;

FIG. 20 is a fragmentary view of a latching mechanism that may be employed with my stock loading arm finger assembly; and

FIG. 21 is a fragmentary sectional view of the clutch mechanism employed with my invention.

Referring now more particularly to said annexed drawings and especially to FIGS. 1, 4 and 7 thereof, the embodiment of my invention illustrated therein is adapted to be installed on a bolt heading and forging machine of well-known type which may comprise a main frame 1 carrying a fixed work gripping die 2 opposed to a cooperating reciprocable gripping die 3, such dies 2 and 3 being shown schematically. When die 3 has been reciprocated toward die 2 to grip the blank B therebetween, a header die or tool 4 (see FIG. 7) carried by header slide 5 (see FIG. 8) is reciprocated axially of such blank to

upset the protruding end thereof within a cavity formed by the gripping dies 2 and 3 to form, for example, a hexagonal bolt head or other desired shape on such blank. The machine is, of course, powered by an electric motor operative to drive a large fly wheel in turn to drive a crankshaft to move the dies in the conventional manner, such machines being readily commercially available (note the machine disclosed in the aforementioned Leinweber patent).

Now referring additionally to FIGS. 2 and 3, my new transfer mechanism may comprise a horizontally extending support beam 6 mounted at one end on an A-frame pedestal 7 and at the other end on the machine frame 1 as shown at 8. A spacer 9 may be provided between the beam 6 and pedestal 7 to ensure proper horizontal alignment of such beam. Both the pedestal and machine frame will be securely mounted on the floor 10. A further support beam 11 is mounted on the pedestal 7 as by bolts 12 passing through spacer 9, such beam extending generally normal to beam 6. Situated within this relatively short cantilevered support beam 11 is a bearing 13 rotatably supporting the distal or outboard end of index shaft assembly 14. Such bearing may, for example, be a Boston gear self-aligning ball bearing and adjacent such bearing, a collar 15 may be provided cooperating with a drag brake mechanism 16 preventing free rotation of such index shaft 14.

The proximal or inboard end of the index shaft 14 is mounted directly on the machine frame 1 by a bracket 17 including a bearing 18 for such shaft. As shown perhaps more clearly in FIG. 5, the bracket 17 includes a mounting plate 19 whereby such bracket may be secured directly to the machine frame 1 as by bolts 20.

As a further inboard support for the shaft 14, I provide a further bearing structure 21 mounted on bracket 22 having shoe 23 secured directly to the machine frame 1. Adjacent such bearing, I provide a detent plate 24 cooperating with a detent mechanism in known manner to ensure the proper rotative positioning of the index shaft. The bearing 21 may be, for example, a conventional "Oilite" bushing, such bearing and the bearing supported by bracket 17 providing all the inboard support necessary for such index shaft. Adjacent the bearing 18 supported by bracket 17, I provide an overrunning or one-way clutch 25 whereby a unidirectional intermittent rotary motion may be imparted to the index shaft from an oscillating motion of the stock gauge shaft 26 of the conventional Ajax machine in a manner hereinafter described.

Mounted in spaced relation on the index shaft 14 are two dealer discs 27 and 28. The index shaft 14 is provided with elongated key-ways as shown at 29 whereby both the inboard dealer disc 27 and the outboard dealer disc 28 may be longitudinally adjusted with respect to such index shaft better to accommodate different lengths of stock. The outboard dealer disc 28 cooperates with an outboard index shoe 30 which may be bolted directly to the support beam 6 as shown at 31. This shoe is provided with an arcuate cutout portion 32 closely conforming to the periphery of the dealer disc 28. An inboard index shoe 33 is provided cooperating with the inboard dealer disc 27, such shoe also having an arcuate cutout portion closely conforming to the periphery of such dealer disc. The inboard index shoe may be bolted directly to the machine frame 1 as shown at 34.

As shown more clearly in FIGS. 2 and 3, each of the dealer discs 27 and 28 is provided with five equally spaced peripheral notches 35 of a size sufficient substantially completely to enclose the circular cross-section stock therewithin. It will be understood that the discs are so arranged on shaft 14 that the notches therein will be aligned. Accordingly, it will now be seen that the arcuate portions of the index shoes cooperate with such notches to retain such stock within the notches as the dealer disc is rotated with respect to the shoes. The arcuate portions of the index shoes extend for about 130° of the periphery of the dealer discs.

In addition to supporting the distal or outboard end of the index shaft 14 as well as the index shoe 30, the beam 6 also serves to support a notched plate 36. This plate may be bolted directly to the side or web of the beam as shown at 37 and provides a rest at each transfer position of the stock to take the sag out of long lengths while gripped in the gripping dies 2 and 3. As shown more clearly in FIG. 3, this plate has a series of notches 38 providing shelves to support the elongated stock when the transfer fingers hereinafter described are open and returning to their gripping position. In addition to the notched plate 36, the beam 6 supports stock catcher or bin 39 as seen in FIG. 2 which is attached to the beam by means of depending brackets 40 and 41. The runout angle 42 secured to the pedestal 7 as at 43 is also employed to guide the work as it is ejected through the throat of the machine toward the rear by ejector conveyor 44. The brackets and runout angle serve to space the chute adjacent the discharge end of such conveyor readily to accommodate the headed stock in a manner hereinafter described. Further, a retainer plate 45 may also be suspended from the beam 6 properly to guide and support the work in such machine.

Index shaft assembly drive

In order to impart unidirectional intermittent rotary motion to the index shaft 14 timed with the operation of the components of the foregoing machine as, for example, the movement of the header slide, I employ the stock gauge shaft on the standard forging machine. On such standard machine, the shaft 26 operates a stock gauge head and is driven for oscillation by a linear cam 46 mounted on the header slide 5. With special reference to FIGS. 8 and 9, it will be seen that the linear cam 46 pivots arm 47 fixed to shaft 26 about the longitudinal axis thereof. A roller type cam follower 48 is employed to rock the arm 47 thus to oscillate shaft 26. A rod 49 pivoted to the other end of the arm as at 50 extends through the machine frame and is enclosed by a compression spring 51, a collar 52 being mounted on such rod so that the pressure of the spring 51 will maintain the follower 48 in engagement with the linear cam 46.

The header slide 5 is provided with the side liners 53 and 54 as well as bed liners 55 and 56, the heading tool 4 being clamped thereto in the conventional manner. Such header slide is operated by a pitman driven by the crankshaft CS which fits within the hollowed out center portion 57 and is pivotally connected within the body of the die slide as at 58.

With my transfer mechanism, the stock will be gauged by a gauging pin mounted on the heading tool holder in turn bolted on the header die 5 as at 59. This gauging pin will contact the elongated stock when it is at the lowermost center position held between the arcuate portion of the index shoes and the dealer discs as shown at A. Thus, the header die will provide a gauging pin which will contact the stock, pushing it toward the gripping dies 2 and 3 when the header die moves toward such gripping dies to form stock held therebetween. The stock in such position cannot drop downwardly since the arcuate portions of the index shoes extend slightly beyond the vertical plane through the index shaft. The heading tool 4 is held within the cavity 60 of the header slide 5 by a tool holder clamp 61 (note FIG. 6) bolted to the top of the header slide through threaded openings or holes 59. The gauging pin 62 is mounted on such tool holder clamp to contact the stock at the position A. The relative position of the gauging pin and the axis of the index shaft 14 is shown more clearly in FIG. 6 and is shown at A in FIGS. 2, 3 and 10.

Now referring to FIGS. 5 and 6, it will be seen that the stock gauge shaft is mounted adjacent the header slide on the right hand header slide cover plate 64 by a

bracket 65. Such bracket 65, in addition to providing a bearing for the oscillating shaft 26 mounts a limit switch 66 for a purpose hereinafter described. This bracket 65 together with the bracket 67 for the other end of the oscillating shaft 26 supports such shaft for oscillation and such bearings are preferably of the split type held together by screws. These screws can additionally provide a means to support the limit switch 66.

Fixedly secured to the end of oscillating shaft 26 beyond bracket 65 is an arm 68 that will oscillate through a 25° stroke as the result of the oscillation of shaft 26. Pivoted as at 69 to the arm 68 is a connecting link 70 which is pivoted at its distal end to a link or clutch lever 71 the hub of which is drivingly interconnected to member 72 by beveled lugs interengaging similar beveled lugs on clutch hub member 72.

As shown in FIGS. 5 and 21, this hub member 72 is movable axially to the left by the piston 78 of an air cylinder 73 so that the lugs L thereon interengage the lugs on member 79 fastened to clutch lever 71, the member 72 being keyed through sleeve member 72' to stub shaft 74 which constitutes a continuation of the index shaft 14 beyond the overrunning clutch 25. An air coupling 75 is provided for such air cylinder in a conventional manner. Thus, it can be seen that an air pressure within cylinder 73 will maintain the beveled lugs L in engagement whereby oscillation of shaft 26 will cause a unidirectional intermittent rotation of shaft 14. Should the shaft encounter a certain resistance, the beveled lugs will force the hub member 72 to the right against the air pressure within cylinder 73 to throw the clutch out of engagement. Such movement of the member 72 pivots bell crank 76 to actuate limit switch 66 to stop the operation of the machine. Accordingly, any overload on the shaft 14 will (1) disengage the hub member 72 and the clutch lever 71; and (2) operate switch 66 through bell crank 76 actuating plunger 77 of limit switch 66.

This switch may, for example, control an air valve to exhaust air from a clutch on the crankshaft CS which disconnects the flywheel and automatically sets the brake, this arrangement stopping the machine within a fraction of a second. It is noted that the bell crank is provided with an adjusting screw contact 78' whereby the amount of movement of hub member 72 required to actuate switch 66 can closely be regulated. It can now be seen that by the use of air pressure regulated clutches, a double safety advantage is obtained. Thus a failure of the air supply will automatically stop the machine. Moreover, with the use of air, the load point at which the clutch will disengage can infinitely be regulated, i.e., the greater the pressure, the higher the torque load required to disengage the clutch.

It will now be seen that with the mechanism described, the oscillation of shaft 26 will cause the rocking of arm 68 through an arc of 25° in turn to cause the split link 70 to rock the clutch lever 71 thereby to rock the stub shaft 74 through an arc of 58°. This movement of the shaft 74 through an arc of 58° thus will cause intermittent unidirectional rotation of the index shaft 14 through the same 58° arc as the result of the employment of overrunning clutch 25 between shafts 14 and 74. It is noted that the link 69 is adjustable longitudinally of arm 68 whereby the stroke imparted to the shaft 14 may be closely adjusted.

Transfer finger mechanism

In order to transfer the stock from the dealer discs downwardly to the various die cavities for the heading operation, I provide a transfer finger mechanism generally shown at 80 in FIG. 4 and illustrated in more detail in FIGS. 10, 11 and 12. Referring especially to FIGS. 10 and 11, it will be seen that my transfer finger mechanism includes two finger assemblies 81 and 82. The left hand assembly 81 includes a vertical support 83 fixed to a movable slide 84 as by a plurality of vertically spaced nut and bolt assemblies 85. Secured to such vertically extending support 83 as by screws 86 are a plurality of horizontally extending stock supports or fingers 87, the ends of which are provided with V-shape horizontally extending recesses 88 of a size sufficiently large substantially to enclose and grip the stock B therebetween.

The assembly 82 is identical in form to the assembly 81 and includes a plurality of horizontally extending stock supports or fingers 89 having the ends thereof shaped as at 90 to provide similar stock engaging recesses. It can thus be seen that the fingers 87 and 89 of each assembly 81 and 82 are arranged opposite each other whereby they mutually cooperate to grip the stock therebetween. The right hand assembly 82 is affixed to a horizontally extending slide plate 91 by a plurality of vertically spaced nut and bolt assemblies 92 in the same manner that the slide plate 84 is affixed to the assembly 81.

Both the left hand slide plate 84 and the right hand slide plate 91 are mounted within a U-shape slide housing assembly 93 having a left hand cover plate 94 and a right hand cover plate 95 (note especially FIG. 3). Such left and right hand cover plates are removably secured as by bolts 96 whereby access to the interior of such slide housing may be obtained.

As seen more clearly in FIG. 10, the left hand slide plate 84 is provided with two horizontally extending slots or recesses 97 and 98. Intermediate such horizontally extending slots is a vertically extending slot or recess 99. The right hand slide plate 91 is similarly provided with two horizontally extending recesses 100 and 101 and an intermediate vertically extending slot 102. Thus, it can be seen that the left hand finger assembly 81 and the right hand finger assembly 82 including the slide plates 84 and 91 respectively are identical in form. In the embodiment illustrated, I have shown my finger assemblies providing five vertically spaced sets of jaws or gripping recesses enclosing or gripping a blank therebetween. It will be understood that the slide plates 84 and 91 are mounted for movement in the left and right hand sides respectively of the slide plate housing 93. The manner in which the proper movement is imparted to such slide plates and hence to the finger gripping mechanisms will now be described.

Referring to FIGS. 1, 10, 11, 12 and 13 it will be seen that I provide a drive for my transfer finger mechanism including a drive chain 105 for sprocket 106 driving shaft 107 through pneumatic clutch member 108 controlled by air cylinder 109. The chain 105 is itself driven by a sprocket identical in form to the sprocket 106 which is mounted on the crankshaft of the machine 1. Thus for every revolution of the crankshaft there will be a revolution of shaft 107. The clutch member 108 is similar to the clutch member 72 shown in FIG. 5, such member being slidably keyed to shaft 107 and having beveled lugs thereon engaging with similar beveled lugs on the sprocket 106. Pneumatic cylinder 109 holds the lugs on the member 108 and sprocket 106 in interengagement and an excessive load on the shaft 107 will move the member 108 away from the sprocket 106 against the fluid pressure within the cylinder 109 to disengage the drive between chain 105 and the shaft 107. It will be understood that the pressure within the cylinder 109 may be closely regulated whereby the torque at which the member 108 and the sprocket 106 will disengage can be readily predetermined. If desired, a limit switch S may also be employed with this clutch to stop the operation of the machine.

The shaft 107 is mounted in gear housing 110 which depends integrally from the slide housing 93 as seen more clearly in FIGS. 12 and 13. Bushings 111 and 112 may be provided to support such shaft 107 within the housing. Shaft 107 continues through the housing 110 and has a sprocket 113 mounted on the opposite end thereof driving chain 114. Chain 114 drives a smaller sprocket 115 in turn driving shaft 116. Mounted on this shaft 116 is the

drive sprocket 117 for my ejector conveyor or chain 44.

Within the housing 110, I provide a bevel gear 120 keyed to shaft 107 engaging a bevel gear 121 keyed to cam shaft 122. Thus a right angle drive is provided from shaft 107 to shaft 122, such shaft extending through a portion of the housing 110 which I shall designate cam housing 123. The pitch of the beveled gears 120 and 121 will be the same so that for each revolution of the shaft 122 there will be a revolution of the main drive crankshaft of the machine. Keyed to the shaft 122 within the housing 123 are three finger gripping mechanism actuating cams 124, 125 and 126. The cam 126 is a symmetrical cam controlling the up and down movement of the fingers in unison and the cams 125 and 124 control the in and out movement of the left and right hand fingers, respectively. As seen more clearly in FIG. 12, a yoke 127 encloses the shaft 122 and has mounted thereon cam followers or rollers 128 and 129. Spring 130 is employed to press roller 129 toward roller 128 to maintain such rollers in engagement with the surface of the symmetrical cam 126. Yoke 127 is threadedly connected to a link 131 which is in turn pivotally connected to a crank lever 132 as at 133. Such crank lever 132 is keyed to shaft 134 extending transversely through the right hand side of the slide housing 93. It will thus be seen that the transverse shaft 134 constitutes a rock shaft which will be oscillated by the movement of arm 131 as the result of rotation of cam 126. Secured to the rock shaft 134 is an outer right vertical travel bell crank 135. One end of the bell crank 135 has a roller 136 mounted thereon which closely fits within the horizontal slot or recess 101 in the right hand slide 91. The other or lower end of the bell crank is pivoted at 137 to a connecting link 138. The opposite end of the lever 138 is connected at 139 to the lower end of the inner right vertical travel bell crank 140 which is secured to stub shaft 141 to oscillate therewith. Such shaft is mounted in bushing 142 in the wall of the housing 93. The upper end of the bell crank 140 has a roller 143 pivotally mounted thereon riding within the horizontally extending slot or recess 100 in the right hand slide 91. At the outer end of shaft 141, a crank 144 is secured thereto to oscillate therewith and at the distal end of such crank, a connecting link 145 is pivoted thereto as shown at 146 (note FIG. 11). The opposite end of the connecting link 145 is pivoted to a rocker lever 147 as shown at 148. Such rocker lever 147 is pivoted intermediately to the housing or frame as shown at 149. The outer end of the rocker lever 147 is pivoted to a connecting link 150 as shown at 151. It is noted that the links 145 and 150 are essentially identical in form and include a turnbuckle mechanism whereby they may be axially extended or shortened to adjust the resultant movements obtained in my transfer mechanism. The top end of link 150 is connected to a crank 152 by pivot 153 and the crank 152 is in turn keyed or secured to transverse rock shaft 154. The transverse rock shaft 154 is similar to the transverse rock shaft 134 and performs the same function as will hereinafter be more clearly shown. Secured to the rock shaft 154 is an outer left vertical travel bell crank 155, the upper end of which pivotally mounts roller 156 positioned within the horizontal slot 97 of the left hand slide 84. The lower end of the bell crank 155 is pivotally connected to a connecting link 157 as shown at 158 and the opposite end of such connecting link is connected pivotally to the lower end of inner left bell crank 159 as shown at 160. The bell crank 159 is mounted on stub shaft 161 and the upper end of such bell crank pivotally mounts roller 162 riding within the horizontal slot 98 in the left hand slide 84.

It can now be seen that the rotation of symmetrical cam 126 will cause the movement of the gripping fingers in a vertical direction. Thus the yoke 127 following the cam 126 will reciprocate arm 131 to oscillate transverse rock shaft 134. This, of course, will move the roller 136 through an arc to move the slide in an up and down direction, and the link 138 will similarly move the crank 140 to move the roller 143 the same extent that roller 136 is moved. The links 145, 147 and 150 translate the same oscillatory movement to the transverse shaft 154 and through the link 157 to the bell crank 159. Thus the rollers 156, 162, 143 and 136 will be oscillated about the respective bell crank shafts to move the gripping fingers in unison vertically.

The in and out movement of the left hand fingers is controlled by the cam 125. As seen in FIGS. 10 and 13, the yoke 170 surrounds shaft 122 and mounts a roller cam follower 171 thereon which is held in engagement with the surface of the cam by a spring 172 pressing between the outer end of yoke 170 and the center block 173 surrounding shaft 122. Threadedly connected to yoke 170 is a connecting arm or link 174 which is pivotally connected at 175 to an operating lever 176. The operating lever 176 is secured to one end of a stub shaft 177 which is rotatably mounted on the housing 93 and the opposite end of such shaft mounts a lever 178 which in turn has roller 179 mounted thereon which closely fits within the vertically extending recess or slot 99 in the left hand slide plate 84. Thus the rotation of cam 125 will cause the follower to oscillate the operating lever 176 about the shaft 177 to move the roller 178 within the vertically extending slot 99 to control the in and out movement of the left hand set of gripping fingers.

Similarly, the cam 124 controls the in and out movement of the right hand set of gripping fingers, such movement being obtained by cam roller or follower 180 mounted on yoke 181 which is threadedly connected to a relatively short link 182. A spring 183 pressing between the opposite end of yoke 181 and the center block 184 maintains roller 180 against the periphery of cam 124. The link 182 is pivotally connected to the righthand in and out operating lever 185 which is secured to one end of stub shaft 186. The other end of the shaft has mounted thereon lever 187 which mounts roller 188 riding within the vertically extending slot or recess 102 in the right hand slide plate 91. Thus, the in and out movement of the left and right hand slide plates is controlled independently by separate cams whereas the vertical movement of such slide plates is controlled by one cam whereby a movement in unison in a vertical direction is obtained.

It is noted that the links 174, 182 and 131 are connected to the respective yokes by threaded connections whereby the position of oscillation resulting from the throw of such cams to operate the various operating links may be adjusted to obtain the proper movement of the gripping fingers. The cams and cam followers are of a generally conventional nature, each employing a yoke straddling or surrounding the shaft 122 and held thereagainst by spring mechanisms within the yoke. All such yokes include a center block which rotates freely about the shaft 122, the yoke 127 having center block 189 slidable within the slot in the center of such yoke to permit longitudinal movement of the yoke with respect to the shaft 122.

It can now be seen that the drive for my finger transfer mechanism is obtained directly from the machine crankshaft driving the forging machine and moreover such provides a drive for the ejector conveyor 44. Referring particularly to FIGS. 1 and 12, it will be seen that the ejector conveyor passes around the drive sprocket 117 and over an idler tensioning sprocket mechanism 200 and then around two small vertically spaced sprockets 201 and 202 and then horizontally back through the throat of the machine and over the drive sprocket 117. Tensioning sprockets 203 and 204 may also be employed in connection with the drive chain 105 and the drive chain 114, respectively. Such drive tensioners may, for example, be "Whitney" automatic drive tensioners employing a single sprocket to maintain the chains at the proper drive tension in well-known manner. As seen perhaps more clearly in FIG. 3, the top horizontal flight of the

ejector conveyor 44 may be provided with stock guides 203' and 204' to maintain the stock in engagement therewith when it has been released by the stock engaging fingers thereabove. Thus with my arrangement the stock will be ejected from the machine rearwardly through the throat generally shown at 205 (note FIG. 3).

With the movable and stationary dies having half round cavities therein (note FIGS. 15–19 inclusive), it can be seen that a rectilinear movement of the gripping and transfer fingers to move or strip the stock cleanly, directly away from the cavities is provided. This rectilinear movement precludes the wearing of the corner of the die cavities and also prevents possible damage to the stock. Moreover, a positive strip is provided since the opposing fingers are mechanically positively held by rollers 171 and 180 respectively and cannot be separated inadvertently as the result of the compression of a backup spring. The elongated fingers 87 and 89 are sufficiently resilient to give up to 1/16 of an inch to compensate for any cam inaccuracies.

Stock loading

In order to facilitate the feed of stock from a point above the machine die slide, I employ a stock transfer feed arm assembly generally shown at 210. Such assembly includes a stock loading arm 211, the proximal or lower end of which is attached as by eccentric pin 212 to eccentric 213. As seen more clearly in FIGS. 12 and 14, the eccentric 213 is mounted on the outer end of the cam drive shaft 122 which is driven through shaft 107 by sprocket 110 which is rotating at the same speed as the main shaft of the machine. The lower end of the arm 211 includes a longitudinal cutout portion or recess 214. Slidably mounted within such cutout portion or slide is a loading arm slide block 215 which is pivotally mounted to bracket 216 fastened to the cam housing 123 as by screws 217. The slide block 215 is pivotally carried on the bracket by pin 218 which is held in such bracket by screw 219, the slide block 215 being held on the pin by nut and washer assembly 220. It is noted that a similar nut and washer assembly 221 may be employed to hold the arm 211 on the eccentric pin 212.

Thus the arm 211 is free to reciprocate past the slide block 215 as well as to pivot about pin 218 as a result of the circular movement of the lower end of the arm following the eccentric 213.

The upper end of the arm 211 is bifurcated as shown at 222 and supports an elongated loading arm bar 223 having clamped to each end thereof loading arm fingers 224 and 225. It is noted that the fingers 224 and 225 may be adjusted about the axis of the loading arm bar 223 by adjustment of the nut and bolt assemblies 226 provided at the proximal end of each finger 224 and 225. Thus the angular inclination of the finger with respect to the arm 211 may be set as desired. As shown, the distal ends of the fingers are provided with notches 227 to provide a cradle for the transfer of the elongated stock. Referring particularly to FIG. 3, it will be seen that the bracket 216 mounting the slide block 215 acts as a fulcrum whereby the movement of the notches at the ends of the fingers may readily be controlled by movement of the eccentric 213 which is moving at the same r.p.m. as the main shaft of the machine. In this manner, the notches in the fingers can be caused to move over the path indicated by the phantom line shown at 228 to pick up stock from a furnace conveyor C or the like at the point 229, which is moving in timed relation to the operation of the machine, to move the stock in the direction of the arrow to deposit the same in a pair of aligned notches 35 in the dealer discs 27 and 28 at the point 230 just above the index shoes. After the stock has been deposited in the dealer disc notches, the fingers will move downwardly slightly to clear the thus deposited stock to move back to the pick-up point 229 at the discharge end of the furnace conveyor.

FIG. 20 illustrates a latching mechanism that may be employed with the stock loading arm finger 224 to latch or hold firmly the stock within the notches 227 as the stock is transferred from the furnace conveyor C to the dealer discs. The mechanism includes a latching arm 250 pivoted to finger 224 as at 251 and having a rebent top portion 252 overlying the notch 227. A spring 253 is secured between the finger 224 and latching arm 250 to tend to pivot the same in a counterclockwise direction as seen in FIG. 20. A locking mechanism 254 pivoted on pin 255 secured to lever 256 and actuated by rod 257 will hold the arm 250 in its open phantom line position. Actuation of this rod will release the lock closing the latch arm on the stock at the furnace conveyor pickup. A suitable mechanism will open the arm 250 to release the stock on the dealer discs with the mechanism 254 locking the arm open to be automatically released at the furnace conveyor pickup. It will be obvious that a latching mechanism of this type should only be necessary for a high speed operation of the machine since the arms 241 will be rapidly moved in transferring the stock to the machine.

Operation

Referring now more especially to the semi-diagrammatic FIGS. 15 through 19 inclusive, the operation of my transfer mechanism through a complete cycle may now be described as follows.

The fingers 224 and 225 on the feed arm 211 will deposit the stock in the dealer discs 27 and 28 received from the end of the furnace conveyor, such dealer discs, feed fingers and furnace conveyor being timed to operate continually to feed long lengths of stock to the forging machine. As shown in FIG. 15, while the fingers are depositing a length of stock in the dealer discs at the top of the arcuate portion of the shoe 33, the finger assemblies 81 and 82 are moved together by the cams 125 and 124, respectively, to grip the stock therebetween while such stock is also gripped by the closed dies 2 and 3, the moving die having moved to the right as shown in FIG. 15 to enclose or grip the lengths of stock within the cavities formed thereby. The uppermost fingers of the assemblies 81 and 82 grip the stock in the lowermost position of the dealer discs as shown at A.

When the stock has thus been gripped, as shown in FIG. 16, the movable die 3 will first back off to the left as shown by the arrow 300. The cam 124 then acts to move the right hand finger gripping assembly 82 away from the stationary die 2 carrying the work out of the die face. The left hand finger assemblies 81 will move with the right hand assembly 82 under the control of cam 125 to maintain a grip on the work. The movement of the finger gripping assemblies in this manner moves the stock to the left as shown by the arrow 301 and the movement of the stock within the bottom notch of the dealer discs as shown at A causes a further rotation of the dealer discs to the extent of 14°. Thus with five cutouts 35 in such dealer discs, the discs will be rotated by the stock gauge shaft a total of 58° and further moved by the movement of the gripping fingers 81 and 82 to move the dealer discs an additional 14°. This movement also clears the stock from the lower edge of the arcuate shoe 33. If desired, a leaf spring or the like may be employed to maintain the stock under frictional pressure from the arcuate shoe 33 thus to maintain such stock within the notch 35 in the lowermost position. The detent 24 will, however, ensure the proper positioning of the notches when the dealer discs are moved both by the stock gauging shaft and the movement of the finger gripping assemblies 81 and 82.

After the movable die 3 has moved away from the face of the stationary die 2 and the finger gripping assemblies have moved to the left, thus vertically clearing the stock from the die cavities, the finger assemblies will jointly move downwardly due to the action of cam 126. The downward movement is equal to a distance between adjacent die cavities. The finger assemblies continue to grip

the work during this downward movement in unison. The downward movement is shown by the arrow 302 in FIG. 17.

Referring to FIG. 18, the cam 15 now moves the left hand finger gripping assembly 81 toward the face of the stationary die 2 and the finger assembly 82 follows as the result of rotation of cam 124. This unitary movement to the right of the finger gripping assemblies 81 and 82 is shown by the arrow 303 in FIG. 18. At this time, the movable die 3 now closes on the face of the stationary die 2 to grip the stock within the cavities thereof as shown by the arrow 304.

While this is occurring, the dealer discs are being rotated through a 58° arc by the action of the stock gauging shaft to position an empty notch 35 adjacent the top of the arcuate shoe 33. When the empty notch is in place, the finger 225 will position a blank therein from the furnace conveyor. This also positions a blank at the point A held in place by the bottom of the shoe 33.

Once the dies 2 and 3 are gripping the work, the finger gripping assemblies 81 and 82 separate as the result of the action of cams 125 and 124, respectively, and then move upwardly in unison to a position to grip the work as shown in FIG. 15. Since the lowermost stock element as shown at 305 was no longer gripped by the dies 2 and 3, the separation of the assemblies 81 and 82 drops such stock having the head forged thereon onto the ejector conveyor 44 between the guides thereof. In the position shown in FIG. 19, the rear end of such stock will be supported by the notches 38 in member 36 to eliminate any sag therein. The assemblies 81 and 82 will now move together gripping the stock to assume the position shown in FIG. 15.

As shown in FIG. 7, a discharge cam 307 for the head end of the bolt which has been discharged onto the ejector conveyor is fastened to a stock guide in the throat of the machine. The cam 308 for the tail end of the bolt is fastened to the runout angle 42 and is positioned so that the tail end of the bolt strikes it simultaneously with the head end of the bolt striking cam 307, thus moving the finished bolt sideways into the stock catcher 39.

It can now be seen that in my index mechanism, which transfers the stock first from the furnace conveyor to the dealer discs and then from the dealer discs down through the various cavities in the gripping dies, the movement of the stock by the gripping fingers as well as by the fingers of the feed arm is not controlled or powered by the moving die, such movement being controlled by chain 105 connected directly to the crankshaft of the machine. Should any parts of the transfer mechanism become jammed or out of synchronism, the pneumatic clutches shown on the driven sprocket 106 as well as the drive for the index shaft provide automatic safety devices disengaging the various drives of the machine and additionally setting the brake for the crankshaft.

My transfer mechanism has been found very efficient in the making of such bolts as mine roof bolts in that it enables the stock to be fed from above the machine rapidly to prevent excessive cooling and incorporates an automatic gauging feature which enables it to be attached to readily available forging machines such as the aforementioned Ajax machines without undue modification of the same. Moreover, in making such bolts, the mechanism will operate at a rapid rate of speed making, for example, as many as 45 complete cycles per minute.

Other modes of applying the principles of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I, therefore, particularly point out and distinctly claim as my invention:

1. In an upsetting forging machine having a stationary gripping die, a horizontally reciprocable gripping die adapted to be reciprocated into and out of cooperative work gripping relationship to said stationary die, support means spaced from such gripping dies operative to help support and thus prevent sagging of an elongated cylindrical workpiece gripped by such gripping dies, and a third die horizontally reciprocable in a direction normal to such reciprocation of said reciprocable gripping die to engage and upset an end portion of such elongated cylindrical workpiece thus gripped by said gripping dies; work feed and transfer means comprising a stock loading arm having spaced workpiece supporting finger means thereon disposed above said gripping dies operative directly to deliver individual cylindrical blanks from a position remote from such machine to such machine, said arm being mounted for oscillation about a fulcrum mounted on such machine; a pair of spaced dealing discs having aligned equally peripherally spaced notches therein for receiving such blanks from said finger means, said dealing discs being mounted on an index shaft directly above the parting line of said gripping dies, said index shaft being rotatably mounted on such machine; a plurality of pairs of vertically spaced substantially parallel opposed stock gripping fingers having spaced stock engaging portions mounted on such machine rearwardly of said gripping dies and operative directly to receive such stock from said dealing discs and move such stock through said gripping dies when separated to position such stock successively in a plurality of vertically spaced pairs of opposed die cavities in the respective work engaging faces of such gripping dies, such pairs of cavities being vertically spaced distances equal to the vertical distance separating said opposed stock engaging fingers, such support means providing support for such stock when gripped in each of such pairs of opposed die cavities; drive means substantially directly vertically to reciprocate said gripping fingers in unison successively to position such stock in such opposed die cavities as aforesaid; drive means laterally to separate said gripping fingers; drive means laterally to close said gripping fingers, such closing and separating of said gripping fingers occurring alternately with a vertical reciprocatory stroke of said fingers in unison; drive means to impart a unidirectional intermittent rotary movement to said index shaft; and drive means to oscillate said stock loading arm about said fulcrum, all said drive means being driven in synchronism with such header die thereby to effect a continuous automatic operation of such forging machine.

2. The machine of claim 1 wherein said stock engaging fingers are driven by cams on a shaft driven from the crankshaft of such machine, said cam shaft having an eccentric mounted on the end thereof, said eccentric driving said stock loading arm for oscillation about said fulcrum.

3. A machine as set forth in claim 2 including cam means on said cam shaft operative to move said stock gripping fingers in unison in a substantially direct vertical direction.

4. A machine as set forth in claim 3 including cam means to move the fingers on one side of such stock laterally and cam means to move the fingers on the other side of such stock laterally, thereby to obtain independent separating and closing movements for said fingers from said cam shaft, respective slide plates for said opposed fingers, and followers for said cams moving said slide plates as aforesaid.

5. A stock supporting and transfer mechanism for forging machines and the like of the type including a stationary gripping die, a movable gripping die, and a reciprocable header die, comprising an elongated shaft assembly, at least one disc on said assembly having peripheral notches therein adapted to support a cylindrical workpiece therein, drive means for said shaft assembly imparting thereto a unidirectional intermittent rotary movement in timed relation to the reciprocation of said header die, said drive means comprising a cam on said header die operative to oscillate a drive shaft for said shaft assembly to impart thereto such unidirectional intermittent rotary movement, said shaft and shaft assembly

being interconnected by an adjustable linkage thereby to control the oscillation imparted to said shaft assembly, and an overrunning clutch in said shaft assembly thereby to impart such unidirectional movement to said disc.

6. A mechanism as set forth in claim 5 including a safety clutch interconnecting said linkage and said shaft assembly.

7. A mechanism as set forth in claim 6 wherein said safety clutch will disconnect said linkage and said shaft assembly responsive to an excessive torque in said shaft assembly.

8. A mechanism as set forth in claim 7 wherein the torque at which said clutch will disconnect is controlled by a fluid pressure cylinder, variations in such fluid pressure varying the torque at which said clutch will disconnect.

9. A mechanism as set forth in claim 8 including means responsive to the disconnect of said clutch to deenergize said forging machine.

10. An accessory for forging machines of the type having a stationary gripping die, a movable gripping die and a reciprocable header die driving a stock gauging shaft, such accessory enabling such machine to accommodate cylindrical blanks of extremely long length and comprising a support beam mounted on the rear of said machine above the throat thereof, means at the distal end of said support beam mounting an index shaft for rotational movement, the opposite end of said index shaft being mounted on said machine, dealer discs mounted on said index shaft and spaced apart a distance sufficient to support said long length blanks adjacent the ends thereof, means to drive said index shaft in a unidirectional intermittent rotary movement from the oscillations of the stock gauging shaft of said machine, and means to place such long length blanks in aligned peripheral notches in said dealing discs, such rotary movement of said discs positioning such long length blanks to be gripped by a stock transfer mechanism to be moved through said forging machine.

11. An accessory as set forth in claim 10 including a stock catcher pendently mounted from said support beam and adapted to receive such long length blanks after their discharge from said forging machine.

12. In a forging machine of the type having a stationary gripping die, a movable gripping die and a reciprocable header die driven by a crankshaft, a stock transfer and gripping mechanism adapted to transfer elongated cylindrical blanks through cavities in such gripping dies, said mechanism comprising opposed gripping finger assemblies, said assemblies providing opposed stock engaging gripping fingers vertically spaced a distance corresponding to the vertical spacing of the die cavities in such gripping dies, said assemblies being mounted on slide plates, each said slide plate being mounted for vertical and horizontal reciprocation, drive means to move said slide plates in such vertical and horizontal direction comprising a plurality of cams mounted on a shaft driven at the same speed as the crankshaft of said machine, and link means interconnecting said cams and slide plates operative directly mechanically thus to reciprocate said slide plates in response to rotation of said cams.

13. A forging machine as set forth in claim 12 wherein said slide plates are each provided with horizontal and vertical slots, and rollers in said slots connected to said link means supporting and moving said slide plates at the direction of said cams.

14. A forging machine as set forth in claim 12 wherein said slide plates are each provided with a vertical slot and a pair of horizontal slots, rollers in each slot, the two rollers in each pair of horizontal slots being connected for movement in unison, said link means being operatively connected to each roller supporting and moving said slide plates at the direction of said cams.

15. In an upsetting forging machine having a stationary gripping die, a horizontally reciprocable gripping die adapted to be reciprocated into and out of cooperative work gripping relationship to said stationary die, support means spaced from such gripping dies operative to help support and thus prevent sagging of a long length cylindrical workpiece gripped by such gripping dies, and a third die horizontally reciprocable in a direction normal to such reciprocation of said reciprocable gripping die to engage and upset an end portion of such long length cylindrical workpiece thus gripped by said gripping dies; a work feed and transfer mechanism including a stock loading means having spaced workpiece supporting elements operative firmly longitudinally to support such elongated workpieces and directly deliver them one at a time from a position remote from such machine to such machine in spaced relation; a plurality of pairs of vertically spaced substantially parallel opposed stock gripping fingers having stock engaging portions substantially spaced longitudinally of such elongated workpieces and mounted on such machine rearwardly of said gripping dies, said fingers being operative directly to receive such stock from said stock loading means and move such stock through said gripping dies when separated to position such stock successively in a plurality of vertically spaced pairs of opposed die cavities in the respective work engaging faces of such gripping dies, such pairs of cavities being vertically spaced in relation to the vertical distance separating said opposed stock engaging fingers, such support means providing support for such stock when gripped in each of such pairs of opposed die cavities; drive means directly vertically to reciprocate said gripping fingers in unison successively to position such stock in such opposed die cavities as aforesaid, drive means to separate said gripping fingers, and drive means to close said gripping fingers, such closing and separating of said gripping fingers occurring alternately with a vertical reciprocatory stroke of said fingers in unison; and drive means to impart unidirectional intermittent motion to said stock loading means, all such drive means being driven in synchronism with such header die thereby to effect a continuous automatic operation of such forging machine.

16. The machine of claim 15 wherein said stock engaging fingers are driven by cams on a shaft driven from the crankshaft of such machine and a cam means is provided on said cam shaft to move said stock gripping fingers in unison in a substantially direct vertical direction.

17. A machine as set forth in claim 16 including cam means to move the fingers on one side of said stock laterally, cam means to move the fingers on the other side of said stock laterally, such cam means being operative to obtain independent separating and closing movements for said fingers from said cam shaft, respective slide plates for said opposed fingers, and followers for said cam means moving said slide plates as aforesaid.

18. The machine set forth in claim 17 including means automatically to gauge such stock while held by said stock loading means just prior to being gripped by said stock gripping fingers.

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