May 4, 1943. G. WINTRITZ 2,318,445

METHOD AND APPARATUS FOR MAKING DIE ROLLS

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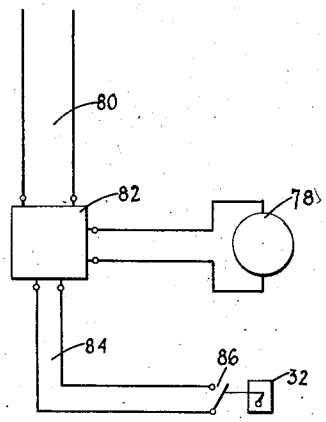

Fig. 2

Fig. 1

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Filed Oct. 4, 1939 4 Sheets-Sheet 2

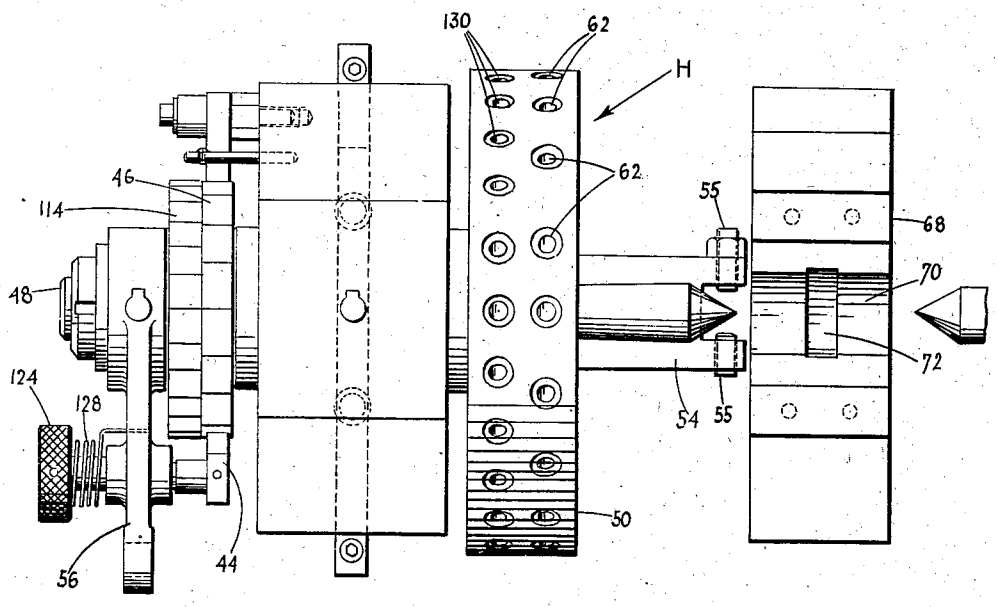

Fig. 3

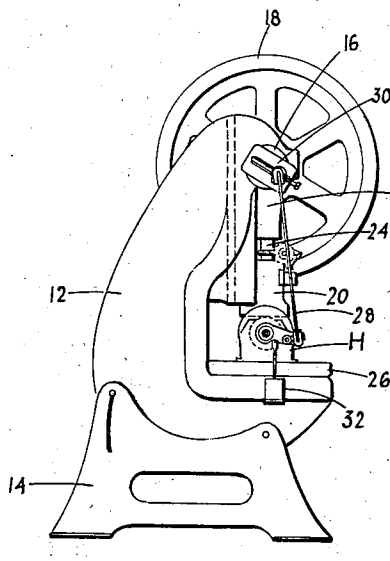

Fig. 4

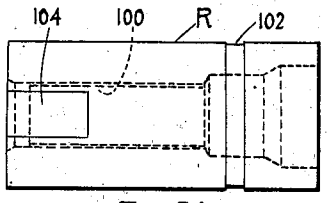

Fig. 5

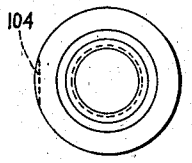

Fig. 6

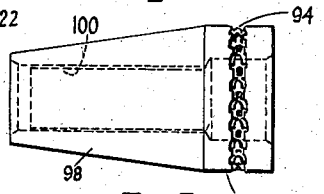

Fig. 7

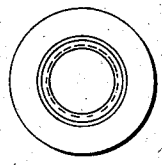

Fig. 8

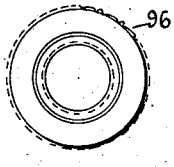

Fig. 9

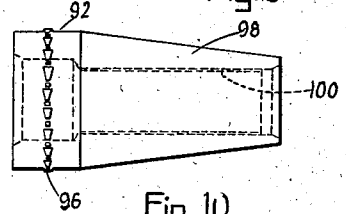

Fig. 10

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May 4, 1943. G. WINTRITZ 2,318,445

METHOD AND APPARATUS FOR MAKING DIE ROLLS

Filed Oct. 4, 1939 4 Sheets-Sheet 3

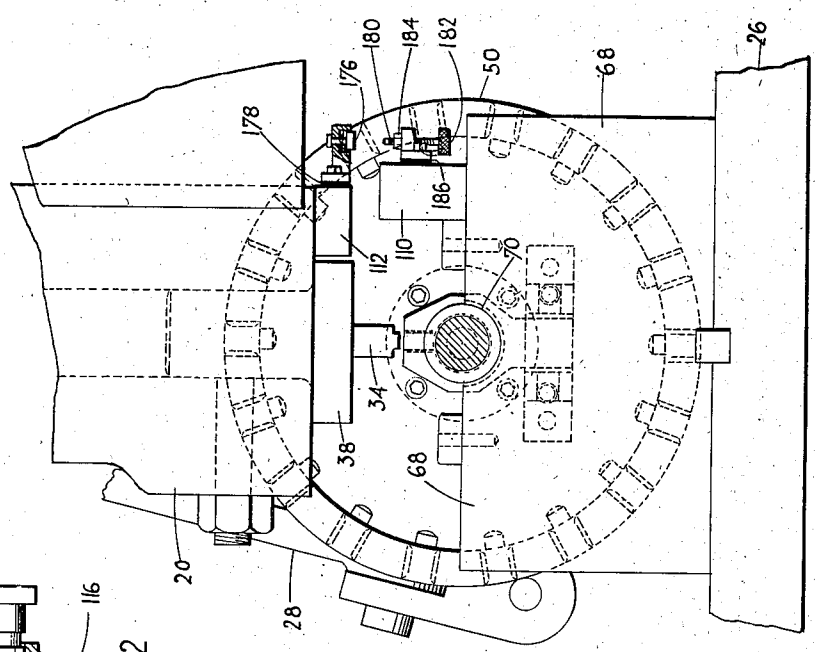

Fig. 13

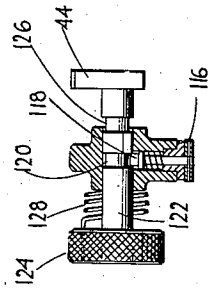

Fig. 12

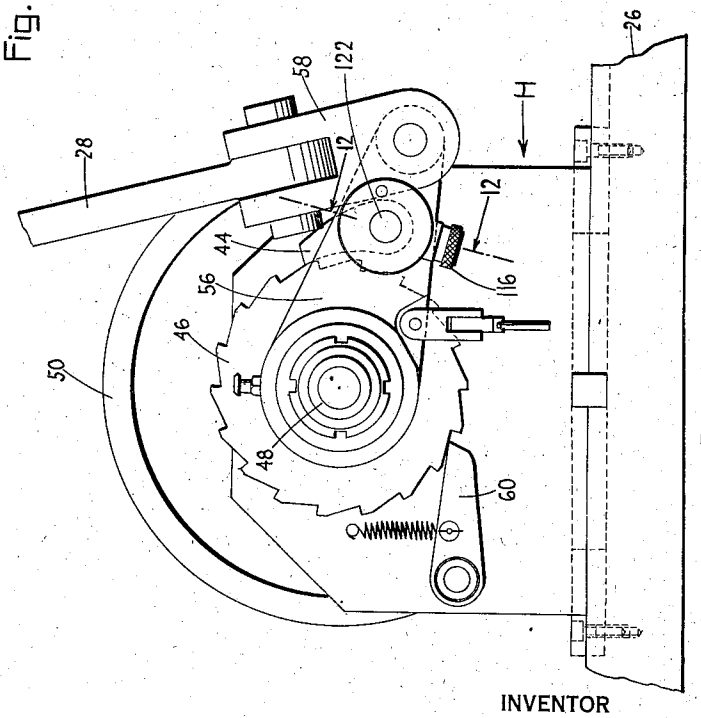

Fig. 11

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May 4, 1943. G. WINTRITZ 2,318,445

METHOD AND APPARATUS FOR MAKING DIE ROLLS

Filed Oct. 4, 1939 4 Sheets-Sheet 4

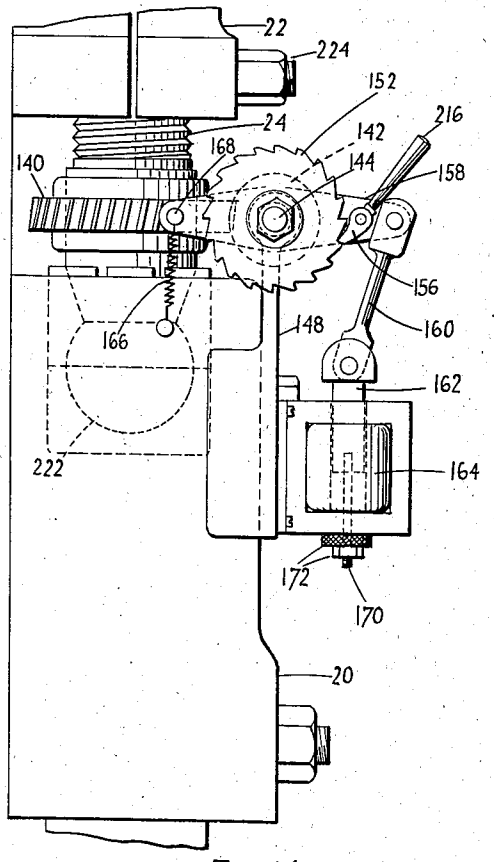

Fig. 14

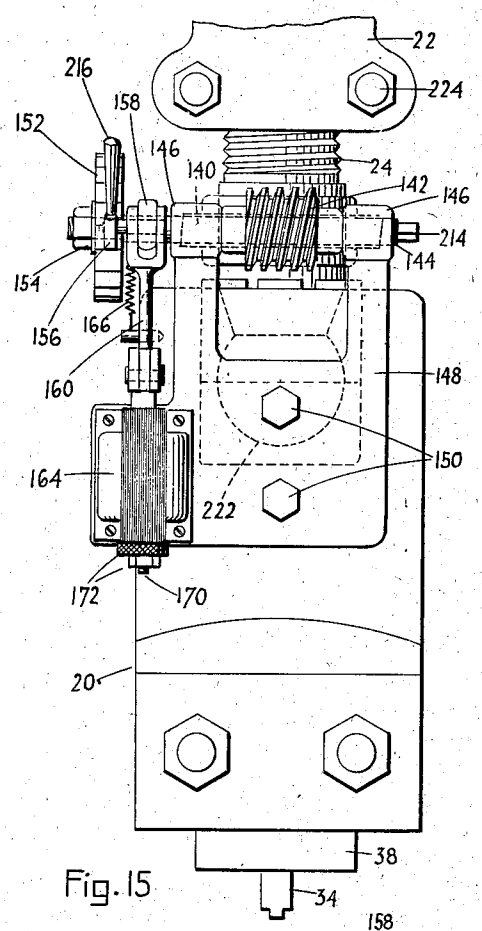

Fig. 15

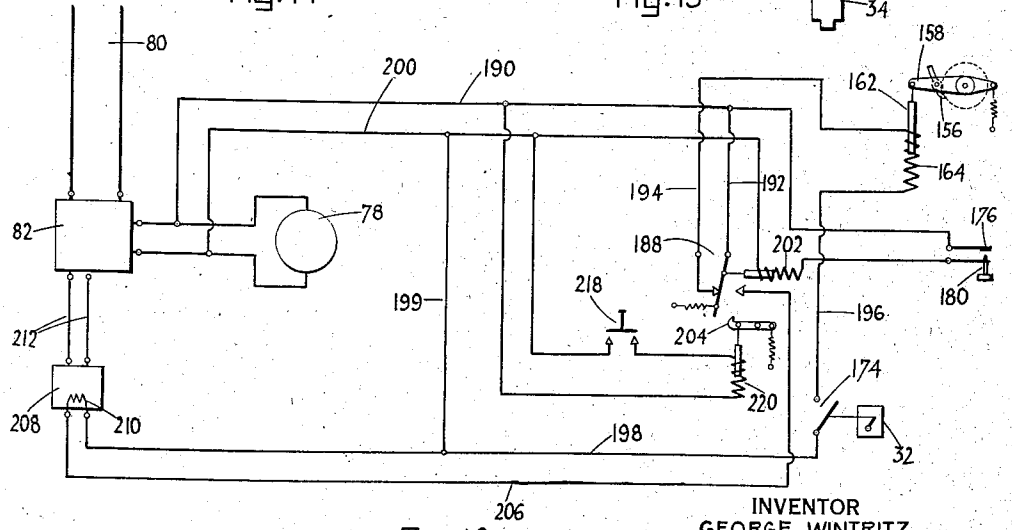

Fig. 16

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Patented May 4, 1943 2,318,445

UNITED STATES PATENT OFFICE

2,318,445

METHOD AND APPARATUS FOR MAKING DIE ROLLS

George Wintritz, Staten Island, N. Y., assignor to Conmar Products Corporation, Bayonne, N. J., a corporation of New Jersey

Application October 4, 1939, Serial No. 297,861

23 Claims. (Cl. 76—4)

This invention relates to die rolls, and more particularly to a method and apparatus for making such die rolls.

Die rolls may be used to form a series of impressions along a wire or strip of material. The use of such rolls makes it possible to form the desired impressions at exceedingly high speeds, and with a minimum of cost, compared, for example, to coining the impressions in a reciprocating press while only intermittently feeding the wire. However, for accurate results, the rolls must be perfect. The successive impressions around the periphery of the roll must be equally spaced, and of equal depth. They must be perfectly shaped and absolutely uniform in every respect, so that no one part of the roll periphery can be distinguished from any other part.

Furthermore, I have found that even the internal strain of the metal within the roll must be uniform, for after it has been completed, the roll must be hardened. The necessary heat treatment will distort the roll from the desired perfect condition if the internal strains in the metal of the roll are substantially different from one another.

The primary object of my invention is to make it possible to obtain perfect die rolls, and to provide a generally improved process and apparatus for making such die rolls. I have found that excellent results may be obtained by preliminarily forming a master punch, the end of which is negative to one of the impressions to be formed around the roll. This punch is mounted in a press and is used to strike the roll in order to form the desired impressions therein. The roll is appropriately mounted, so that it may be rotated an amount equal to the desired spacing between impressions. However, it is not desirable to punch each impression to its full depth either by one or by successive blows at one point on the roll, and to then move the roll to the next point, for there is resulting distortion in the metal and crowding between impressions making it very difficult, if not impossible, to terminate the series of impressions with conditions at the first and last impression identical with those around the other impressions.

One object of my invention is to overcome this difficulty, and for this purpose the blank roll is struck by the master punch for only a slight depth, whereupon the roll is rotated an amount equal to the desired spacing between impressions, and again struck to the same slight depth, etc., until the roll has been turned through a complete revolution. The roll is then struck by the master punch to a slightly increased depth and is intermittently rotated to the successive impressions, each of which is struck to the new slightly increased depth, until all of the impressions have been struck a second time. This operation is repeated over and over again until the desired final depth is reached.

I have found that even with this precaution, there may be a noticeable change or departure from uniformity at the end point, when a single endpoint is maintained, and a further object of my invention is to avoid this difficulty, which I do by carrying the operation at each depth through more than one revolution, or from a different viewpoint, by using endpoints which differ each time, so that the endpoint itself moves relative to the roll. Specifically, the initial operation is preferably continued through one revolution, plus one or more additional impressions. Similarly, the second operation or second depth of the impressions is carried through one revolution plus one or more additional impressions, measured from the new starting point.

If the operation is terminated as soon as the punch has been worked around the roll to the desired full depth, a perfect roll may still not be obtained because the metal at each of the impressions may not remain in desired position, due to elasticity of the metal in the roll itself, and perhaps due to elasticity in the press and roll mounting, etc. In accordance with a further feature and object of my invention, when the final depth is reached, the operation of the punch is preferably continued at the final depth during at least several extra complete rotations of the roll. The depth of the punch blow at this time may, if desired, be accurately fixed by the provision of appropriate stop blocks between the relatively moving parts of the press. This insures that there is no variation in the terminal position of the punch during the series of repeated corrective or finishing movements against the roll.

The operation as so far described would be a rather slow and painstaking one. It might take a machinist approximately a full day to shape a pair of small die rolls in the press, even with the master punch already available. A further object of my invention is to speed up the making of the die rolls, and for this purpose I have devised apparatus provided with appropriate ratchet feed means operated by the press for turning the roll holder through the desired arc between successive operations of the press. A pilot and

suitable pilot holes may be provided to insure accuracy. It is obvious that this automatic rotation of the roll between reciprocations of the press will greatly speed up the operation. In fact, the press may be operated continuously, and in accordance with a further feature and object of my invention the press may be provided with a counter set to count the number of impressions around the roll, plus one or more additional impressions. If the punch is advanced by hand as, for example, by very slightly turning the pitman screw of the press, the counter may be arranged to automatically stop the driving motor of the press after the roll has been treated at each depth, thus affording an opportunity for the operator to advance the punch to a slightly greater depth.

A further object of my invention is to provide fully automatic apparatus for shaping the die roll, and for this purpose I provide automatic feed means for the punch, said means functioning to automatically advance the punch a slight amount after the roll has gone a little more than one revolution. I further provide automatic stopping means to stop the feed of the punch after it has reached full depth, but at this time the press is not stopped, but instead continues its operation for several more revolutions of the roll so as to fix or set the impressions, all as was previously explained. The press is then stopped and the attendant has nothing further to do than to remove the shaped roll; to insert a new roll; and to return the punch feed mechanism to its starting position; whereupon the press may be started to shape the new roll.

To the accomplishment of the foregoing, and such other objects as may hereinafter appear, my invention consists in the process and apparatus for making die rolls, and their relation one to the other, as hereinafter are more particularly described in the specification, and sought to be defined in the claims. The specification is accompanied by drawings, in which:

Fig. 1 is a partially sectioned elevation taken through apparatus embodying features of my invention;

Fig. 2 is a schematic wiring diagram for the apparatus;

Fig. 3 shows a part of the apparatus in plan;

Fig. 4 is a side elevation of a press equipped with the apparatus of my invention;

Figs. 5 and 6 are side and end elevations of a blank roll preparatory to forming impressions therein;

Figs. 7 and 8 are side and end elevations respectively of a finished female roll intended to make slide fastener wire;

Figs. 9 and 10 are end and side elevations respectively of a male roll intended to work in mating cooperation with the female roll for the production of slide fastener wire;

Fig. 11 is an end elevation of the ratchet mechanism for the roll holder;

Fig. 12 is a section showing a detail and is taken in the plane of the line 12—12 of Fig. 11;

Fig. 13 is an end elevation of the roll holder and punch mechanism looking at the end opposite that shown in Fig. 11, from the plane of the line 13—13 of Fig. 1;

Fig. 14 is a side elevation showing automatic punch feed mechanism mounted on the slide of the press;

Fig. 15 is a front elevation of the same; and

Fig. 16 is a schematic wiring diagram explanatory of the operation of fully automatic apparatus embodying additional features of my invention.

Referring to the drawings, and more particularly to Fig. 4, the invention may be best practiced with the aid of a press which, however, may be of conventional character. In the present case, the press comprises a body 12 mounted on a supporting frame 14, and carrying a main crank shaft 16, the motion of which may be steadied by means of flywheel 18. The press is driven by an electric motor which is located on the opposite side and, therefore, is not visible in Fig. 4. The crank shaft operates to reciprocate a slide 20, the latter being connected to the crank by means of a pitman 22 including a pitman screw 24. In accordance with the present invention, a roll holder, generally designated H, is mounted on the bolster or table 26 of the press. The holder is equipped with ratchet mechanism operated by a rod or link 28 extending upwardly to an auxiliary crank 30 of adjustable radius. The operations of the ratchet mechanism are preferably counted, as by means of a counter 32, and this is preferably so arranged as to control a contact or switch for an electric circuit.

Referring now to Figs. 1, 3 and 11 of the drawings, a blank roll R is mounted in holder H. The roll is operated upon by a master punch 34 carried in a holder 36 secured in slide 20 as by means of a conventional cap and cap studs. The punch holder is preferably enlarged at 38 to fix its location relative to the slide.

The end of punch 34 is shaped negatively to one of the series of impressions it is desired to form around the periphery of the roll R. The roll is centered between cone centers 40 and 42, the latter being advanced or retracted by a conventional crank and screw or tail-stock mechanism, not shown.

The roll is intermittently rotated by means of a pawl 44 (Figs. 3 and 11) cooperating with a ratchet wheel 46. The ratchet wheel is keyed to a shaft 48 (Fig. 1) which in turn receives the cone center 40. Shaft 48 preferably also carries an indexing wheel or pilot wheel 50, and is connected to roll R through an appropriate dog 52 moved by an arm 54 (Figs. 1 and 3) mounted on wheel or disc 50. The dog is held on roll R by set screw 106, and in an arm 54 by adjusting screws 55. Referring to Figs. 3 and 11, it will be seen that pawl 44 is carried on a pawl arm 56 which is freely oscillatable on shaft 48. Pawl arm 56 is oscillated (see Figs. 4 and 11) by link 28 through pivoted connection 58. The ratchet wheel 46 is held against return movement by a check pawl 60. The number of teeth in ratchet wheel 46 is made equal to the number of impressions which are to be formed around the periphery of roll R. The stroke of link 28 is made somewhat greater than needed to move the ratchet wheel one tooth at a time, this stroke being adjustable by a slidable connection on crank 30 (Fig. 4). It will be evident that the roll will be advanced an amount equal to the spacing between impressions for each operation of the press.

The periphery of pilot wheel 50 is provided with a series of pilot holes 62, these being spaced accurately and uniformly around the periphery of the pilot wheel and corresponding in number to the desired number of impressions around the roll. In other words, they correspond to the number of teeth on ratchet 46. The slide 20 of the press is provided with a suitable arm or fitting

64 in which is mounted a pilot 66 (Fig. 1) dimensioned to accurately fit the pilot holes. The latter are preferably lined with hardened steel bushings. It will be evident that any slight inequalities resulting from the ratchet movement are overcome by the pilot mechanism, and further that the pilot mechanism locks the roll against any possibility of movement at the time that the roll is being struck by the master punch 34.

The centers 40 and 42 are not subjected to the load of the press. Instead, this load is taken by a special support block 68 which, as is best shown in Figs. 3 and 13, is provided with a semi-cylindrical recess 70 which receives or cradles the roll R. The surface 70 may be cut away somewhat, as is indicated at 72 (Figs. 1 and 3), at the point where the impressions are punched in the roll, so that the stress attendant upon the punching operation is taken by the roll immediately at each side of but not directly on the impressions being made.

The position of the punch 34, relative to the roll, may be varied by means of the pitman screw 24 (Fig. 1), and in the present case this is assumed to be manually operated, as by means of a capstan bar 74 which is slid into one of a series of holes 76 in a capstan head formed on screw 24. It will be evident that rotation of the screw raises or lowers the slide 20, and consequently the punch 34, relative to the pitman 22, and consequently relative to the roll 70 and holder H.

In accordance with the present invention the punch is fed downwardly or advanced by screw 24 until it lightly strikes the surface of the roll R. No attempt is made to strike the impression to full depth. Instead, the impression is made to a depth ranging, say, between 2 thousandths and 15 thousandths of an inch. The depth is preferably kept at the smaller end of this recommended range, say, at 4 thousandths of an inch. The press is operated continuously until impressions have been made entirely around the roll R. In fact, the operation is preferably carried more than one revolution. It may, for example, be carried one or more impressions further than one revolution, so that the point of change of depth is not constant, but instead itself moves relative to the roll. After working around the roll plus, say, one impression more, the press is stopped, the capstan bar 74 is inserted in one of the holes 76 and is shifted by hand a very slight amount, the movement by the operator to correspond to the desired advance or feed of the punch, this being a matter of only a few thousandths of an inch, as was previously explained. The press is again started and operated until the roll has been turned through one revolution plus, say, one impression.

In order to facilitate this operation the press is preferably provided with counter 32 which counts the number of impressions needed for one revolution, plus the desired excess of, say, one impression. Thus, in the present case, the roll has eighteen impressions, and counter 32 may be set to count up to, say, nineteen, at which time it closes a contact or electric switch.

Referring now to Fig. 2, the driving motor 78 of the press is supplied with power from line 80 through starting box 82. The starting box may be released or shut down by means of a trip circuit 84 controlled by a contact or switch 86, which in turn is controlled by the counter 32. By thus adding the counter 32, the operator after feeding the punch downwardly a few thousandths of an inch need only start the press at the starting box 82, and then wait until the press is automatically stopped. The operator then again feeds the punch downwardly a few thousandths of an inch, and again starts the press.

Referring now to Figs. 5 through 10, the specific rolls there illustrated are intended to die roll a wire in order to deform the same into a series of embryo slide fastener elements. A rolling mill for this purpose, which utilizes the rolls here illustrated, is disclosed in my co-pending application, Serial No. 215,180, filed June 22, 1938, since issued on May 14, 1940, as Patent No. 2,201,068. In this case the rolls comprise a female roll 90, best shown in Fig. 7, and a male roll 92, best shown in Fig. 10. The wire is rolled between the impressions 94 in female roll 90, and the impressions 96 on male roll 92. The portions of the rolls on each side of the impressions may be made of equal diameter for rotation at equal speed, and may be of such diameter as to run substantially in contact with one another. The rolls are provided with tapered shanks 98 which are received in the shafts of the rolling mill. Each roll is internally threaded at 100 to receive a suitable draw rod which pulls the tapered shank into position.

Referring now to Fig. 5, I first form a blank roll R which is somewhat longer and somewhat larger in diameter than the finished rolls. It is provided with the internal thread 100, previously referred to. It is preliminarily grooved at 102 to the correct diameter for the particular roll about to be made. A flat 104 may be provided at one end to receive the set screw 106 (Fig. 1) of the dog 52.

It will be understood that two master punches are provided, one for producing the female recesses 94 in roll 90, and the other for producing the male projections 96 on roll 98. It will also be understood that after the impressions have been completed in the blank roll R, the latter may be machined to bring it to the correct diameter and length, and to give it the desired tapered shank.

Before this machine work is performed, the roll is preferably annealed or normalized to relieve any strain produced in the metal during the forming of the impressions therein, and to facilitate machining of the roll. After the roll has been machined it is hardened, then ground to exact dimension, and finally may be brushed to clean out and polish the impressions on the roll.

After the punch has been fed downwardly until the impressions are of full depth, the roll is preferably turned through two or three, or even more, extra revolutions, while the position of the punch is left unchanged. This is in order to definitely set and fix the impressions on the roll. It is desirable that the depth of operation of the punch be very accurately fixed at this time, and to avoid any variations which may arise in the drive linkage extending from the punch to and including the crank shaft of the press. For this purpose, I prefer to employ positive stop blocks for definitely limiting the downward movement of the punch. Referring to Fig. 13, a bottom stop block 110, preferably made of hardened steel, is mounted on the roll support 68. A mating stop block 112, also preferably made of hardened steel, is mounted on the bottom of slide 20 in such a position as to contact the stop block 110. The punch 34 is so mounted in its holder 38 as to provide the desired depth of impression when the stop blocks 110 and 112 meet. The

punch holder 38 is, of course, inserted all the way home into the slide 20. Thus the operator feeds the punch downwardly a few thousandths of an inch at a time until the stop blocks hit and prevent any further effective movement of the punch. The operator may then start the press several more times for several further revolutions of the roll, with the punch stroke definitely limited throughout these last revolutions of the roll by the stop blocks 110 and 112.

As so far described, the ratchet mechanism and pilot mechanism are useful for only one specific number of impressions around the roll. It happens that there are two common or popular sizes of slide fastener elements, and the present apparatus is arranged to make rolls for these two sizes of elements. The rolls so far described are for the larger elements. The rolls for the smaller elements naturally have a larger number of impressions around the periphery of the roll.

Referring to Figs. 1 and 3, it will be seen that there is a second ratchet wheel 114 alongside the ratchet wheel 46. The pawl 44 may be used with either ratchet wheel. In Figs. 3 and 12, it is shown in position to engage the ratchet wheel 46. However, by pulling the knurled knob 116 (Figs. 11 and 12) downwardly a pin 118 is released from a groove 120 in rod 122 carrying pawl 44. The rod 122 may then be pulled outwardly by means of knurled knob 124 until a second groove 126 reaches the pin 118. By then releasing the bottom knob 116, the pin 118 is raised upwardly into groove 126 by means of a push spring surrounding the pin. In this way the pawl 44 is shifted to engage the ratchet wheel 114 instead of the ratchet wheel 46. The pawl is normally urged toward the ratchet wheels by means of torsion spring 128, best shown in Figs. 3 and 12. The ratchet wheel is omitted in Fig. 11.

The pilot wheel 50 is provided with a second row of pilot holes 130 (Fig. 3), these being properly spaced to correspond to the ratchet wheel 114. Referring to Fig. 1, the pilot pin 66 may be shifted from the position shown for cooperation with the pilot holes 62, to a position for cooperation with the pilot holes 130. For this purpose, the screws 132 are loosened and pin 66 is removed from one clamping groove to a similar but displaced clamping groove 134 mating with the pilot holes 130.

As so far described, the operation of the apparatus is only semi-automatic. It may, if desired, be made fully automatic. Referring to Figs. 14 and 15 the pitman screw 24 is provided with a worm gear 140 meshing with a worm 142 mounted on a shaft 144 carried in bearings 146 cast integrally with a mounting plate 148 bolted on the front of slide 20 by means of bolts 150.

Shaft 144 carries a ratchet wheel 152 at its outer end. The ratchet wheel is readily changeable by removing nut 154, thus making it possible to vary the rate of feed of the punch by changing the number of teeth on the ratchet wheel. The ratchet wheel is operated by a pawl 156 carried on a pawl arm 158, which in turn is connected by a link 160 to a solenoid core 162. This is received within a solenoid 164 mounted on plate 148. Core 160 is normally elevated by means of a return spring 166 connected to an extension 168 (Fig. 14) of the pawl arm 158. Upon energization of solenoid 164 the core 162 is pulled downwardly, and thus causes the pawl 156 to turn the ratchet wheel 152 for, say, one tooth. Because of the worm gear reduction this results in a very slight rotation of the pitman screw which, however, is adequate to produce the desired slight feed movement of the punch. The effective stroke of feed pawl 156 is varied at the core 162, as by means of a threaded brass rod 170 projecting downwardly from core 162 and carrying adjustable, but normally locked nuts 172. These nuts limit the upward movement of the pawl. The downward movement is determined by attraction of the solenoid core 162 fully into the solenoid. Change of the stroke of the feed pawl may be made to correspond with a change of the ratchet wheel or, particularly when using a ratchet wheel with fine teeth, to change the number of teeth moved at each stroke of the pawl.

Referring now, for a moment, to Fig. 16, the solenoid 164 operates on core 162 to move the feed pawl 156. Solenoid 164 is energized by closing a switch 174, which in turn is controlled by counter 32. Thus each time that the roll has been worked upon for one revolution plus a desired over-travel of, say, one impression, the counter energizes the feed solenoid, and the press continues to operate without interruption, but with the punch at a new feed level. This continues until further movement of the punch is prevented by the stop blocks 110, 112, previously referred to. In order to prevent further operation of the feed mechanism, after the stop blocks engage, appropriate means may be provided to stop the feed. In the present case, I employ electrical contacts, best shown in Fig. 13. Referring to that figure, it will be seen that a preferably yieldable, but non-adjustable contact 176 is mounted on slide 20 or, as here shown, on stop block 112. The mounting is preferably an insulated one, as by means of insulation 178 inserted between the parts. A micrometrically adjustable contact 180 is mounted on stop block 110, this contact being adjustable by knob 182, and its adjustment being locked by nut 184. Here again, the contact is preferably insulatedly mounted, as by means of insulation inserted at 186. The contact 180 is so adjusted that contact is made when the stop blocks 110 and 112 strike. The adjustment is critical, yet is easily made because the punch is advanced downwardly by an appreciable increment during each feed movement. If the feed is, for example, 4 thousandths of an inch, then there is a tolerance of almost 4 thousandths of an inch in the adjustment of the contacts, because the only requirement for these contacts is that they do not engage during a preceding feed movement, yet do engage after one additional feed movement, which, however, has changed the relative position of the contacts by 4 thousandths of an inch.

The stop contacts might be used to stop the entire press, but this would not provide the desired extra revolutions of the roll R to finally set or fix the impressions therein. The contacts are therefore used to first stop only the feed of the punch and to later stop the press.

Referring to Fig. 16, the driving motor 78 of the press is driven by power taken from line 80 through starting box 82. The circuit through feed solenoid 164 runs through a relay 188, as well as through the control switch 174. This relay is normally closed to the left, as shown. Current then flows through wires 190 and 192 to the movable blade of relay 188, and thence upwardly through wire 194 to solenoid 164. The solenoid circuit is completed by means of wire 196, control switch 174 and wires 198, 199 leading back to wire 200 and the motor circuit. It will be evi-

dent that each momentary closing of control switch 174 will cause an operation of solenoid 164 and feed pawl 156.

This continues until the punch has reached full depth, at which time the contacts 176 and 180 are closed. This energizes the coil 202 of relay 188, for coil 202 is connected across the wires 190 and 200, and in series with contacts 176, 180. The movable contact of relay 188 is drawn to the right, and is there latched by a latch 204, the relay 188 being a latching relay. Movement of the relay from the left-hand position shown to the right-hand position opens the circuit between wires 192 and 194, and thus prevents further energization of feed solenoid 164. At the same time the relay is closed to the right, and this supplies current from wire 190 through wire 206 to a time-delay relay 208, which in turn is appropriately connected to the starting box 82 in such a manner as to trip and open the starting box after a predetermined desired amount of time has elapsed. The delay relay 208 may be of any conventional type, such as those using a heating coil 210 and a bi-metallic or other thermostatic element which becomes heated up enough to close a previously open circuit. In the present case the circuit which is controlled by the relay, is indicated by the wires 212 and functions within starting box 82 to release or open the starting box. The time delay produced by relay 208 is made sufficient to provide the desired extra revolutions of the roll after the punch has reached full depth.

The press then stops and the circuits are all de-energized until a new roll is placed in the machine, and the machine again started.

When a new roll is placed in the machine, it is necessary to return the punch to its retracted or elevated position. For this purpose the shaft 144 (Fig. 15) is provided with a squared end 214 adapted to receive a small removable crank which is not shown in the drawing. The feed pawl 156 is provided with a handle 216 (Figs. 14 and 15) and this is pushed inwardly while worm shaft 144 is being cranked in reverse direction the small amount needed to raise the punch to its initial position. Feed pawl handle 216 is then released preparatory to renewed operation of the press.

While referring to Figs. 14 and 15, it may be explained that there is a slight oscillation of pitman 22 and pitman screw 24 relative to slide 20 during operation of the press. This oscillation is accommodated at the ball joint 222. The axis of worm 142 is spaced from worm gear 140 an amount adequate to provide the necessary clearance between the gears to accommodate the oscillation of the pitman screw and with it the worm gear 140. The movement is small because the necessary stroke of the press is small, and furthermore the gear 140 is located very close to the ball joint 222. The depth of the teeth is greater than the movement involved, and the teeth always assume the same relative mesh at the instant the feed solenoid is actuated. The pitman screw is self-locking because of its large diameter relative to the pitch and also because any desired amount of friction may be introduced at the studs 224.

Reverting now to Fig. 16 the press is started by appropriate manipulation at the starting box 82. This starts the press motor 78, and the press begins to operate. However, the automatic feed mechanism is not operative until a feed starting button 218 is depressed, this energizing a magnet 220 which releases latch 204, thus permitting relay 188 to swing from its right-hand or latched position to the left-hand position shown. This makes the feed mechanism operative and it remains so until the contacts 176, 180 are closed, at which time the relay 188 is again moved to the right and latched in that position.

It is believed that my improved method for making die rolls, and the construction and operation of my improved apparatus, as well as the many advantages thereof, will be apparent from the foregoing detailed description. The rolls may be made rapidly in only a small fraction of an hour, instead of, say, a half day or more for each roll. The impressions on the roll are perfectly uniform and equally spaced and there are no abnormal or non-uniform strains in the metal of the roll.

The procedure is as follows: A master punch is first made which is negative to the desired recess. Preferably a master master punch is first made which corresponds to the recess, this master master punch being used when making the master punch. The master punch is mounted in the press. A blank cylinder is turned to appropriate size and may be provided with a groove at the location of the impressions. The roll is then treated, as above described, until the impressions have been brought to proper depth. The end point at each depth is preferably varied, and the roll is preferably treated at the final depth through a number of revolutions.

The roll is then annealed or normalized to remove any strains which may have been set up by the coining operation. The roll is then machined to provide the proper outside shape and dimension. For example, a tapered shank may be provided. The roll is then hardened and finally ground and brushed for smoothness.

It will be understood that the screw feed for the punch need not be the pitman screw, but instead may be a special screw, and in fact the feed need not be a screw at all. Moreover, instead of moving the punch, the table and roll holder may be moved upwardly by a suitable feed, such as is used on milling machines. The press itself need not be crank-operated, and may be hydraulic or even foot-operated.

It will therefore be apparent that while I have shown and described my invention in several preferred forms, many changes and modifications may be made in the method and structures disclosed without departing from the spirit of the invention defined in the following claims.

I claim:

1. The method of making a series of uniform impressions around a blank die roll, which includes making a master punch negative to one of the impressions to be formed around the roll, striking the blank roll with the master punch for a slight depth, rotating the roll an amount equal to the desired spacing between impressions, again striking the roll to the same slight depth, and so on, continuing this operation until the roll has been turned through at least one revolution, striking the roll with the master punch to a slightly increased depth, rotating the roll to successive impressions and striking each of these to the slightly increased depth for at least one revolution, and so on, until the desired final depth is reached.

2. The method of making a series of uniform impressions around a blank die roll, which includes making a master punch negative to one of the impressions to be formed around the roll, striking the blank roll with the master

punch for a slight depth, rotating the roll an amount equal to the desired spacing between impressions, again striking the roll to the same slight depth, and so on, continuing this operation until the roll has been turned through one revolution plus one or more additional impressions, thereupon striking the roll with the master punch to a slightly increased depth, rotating the roll to successive impressions and striking each of these to the slightly increased depth for one revolution plus one or more impressions, and so on, until the desired final depth is reached.

3. The method of making a series of uniform impressions around a blank die roll, which includes making a master punch negative to one of the impressions to be formed around the roll, striking the blank roll with the master punch for a slight depth, rotating the roll an amount equal to the desired spacing between impressions, again striking the roll to the same slight depth, and so on, continuing this operation until the roll has been turned through one revolution, striking the roll with the master punch to a slightly increased depth, rotating the roll to successive impressions and striking each of these to the slightly increased depth for one revolution, and so on, until the desired final depth is reached, and thereupon striking the successive impressions at the final depth during one or more extra revolutions of the blank.

4. The method of making a series of uniform impressions around a blank die roll, which includes making a master punch negative to one of the impressions to be formed around the roll, striking the blank roll with the master punch for a slight depth, rotating the roll an amount equal to the desired spacing between impressions, again striking the roll to the same slight depth, and so on, continuing this operation until the roll has been turned through one revolution plus one or more additional impressions, thereupon striking the roll with the master punch to a slightly increased depth, rotating the roll to successive impressions and striking each of these to the slightly increased depth for one revolution plus one or more additional impressions, and so on, until the desired final depth is reached, and thereupon striking each of the successive impressions at the final depth during one or more extra revolutions of the blank.

5. Apparatus for making a series of uniform impressions around a blank die roll, said apparatus comprising a master punch negative to one of the impressions to be formed around the roll, means to repeatedly strike the roll with the master punch for a slight depth, means to intermittently rotate the roll an amount equal to the desired spacing between impressions, said latter means operating between the successive operations of the master punch, and means operable to advance the master punch to a slightly increased depth, whereby the alternate operation of the master punch and the roll rotating means may be continued at successive slightly increased depths, until the desired final depth is reached.

6. Apparatus for making a series of uniform impressions around a blank die roll, said apparatus comprising a master punch negative to one of the impressions to be formed around the roll, means to repeatedly strike the roll with the master punch for a slight depth, means to intermittently rotate the roll an amount equal to the desired spacing between impressions, said latter means operating between the successive operations of the master punch, until the roll has turned through one revolution, means to then automatically advance the master punch to a slightly increased depth, the alternate operation of the master punch and the roll rotating means being continued at the slightly increased depth for one revolution, and so on, until the desired final depth is reached, and means to thereupon stop the feed of the master punch without stopping the alternate operations of the master punch and the roll rotating means.

7. Apparatus for making a series of uniform impressions around a blank die roll, said apparatus comprising a master punch negative to one of the impressions to be formed around the roll, means to repeatedly strike the roll with the master punch for a slight depth, means to intermittently rotate the roll an amount equal to the desired spacing between impressions, said latter means operating between the successive operations of the master punch, until the roll has turned through one revolution, means to advance the master punch to a slightly increased depth, the alternate operation of the master punch and the roll rotating means being continued at the slightly increased depth for one revolution, and so on, until the desired final depth is reached, means to thereupon stop the feed of the master punch without stopping the alternate operations of the master punch and roll rotating means until the roll has turned through one or more extra revolutions, and means to then stop the operation of the complete apparatus.

8. Apparatus for making a die roll out of a generally cylindrical blank, said apparatus comprising a reciprocating press including a table, a crank shaft thereabove, a slide therebetween, and a pitman connecting said crank shaft to said slide, a rotatable roll holder mounted on said table and including centers arranged to accurately receive the ends of the blank, ratchet feed means connected to said roll holder and operated by said press, a master punch mounted in the slide, and means including a screw forming a part of the pitman for changing its length, said means being operable to advance the punch a slight amount at a time.

9. Apparatus for making a die roll, said apparatus comprising a reciprocating press, a roll holder mounted in said press, ratchet feed means connected to said roll holder and operated by said press, a master punch mounted in the press, a disc secured to said roll holder and having pilot recesses spaced at the desired spacing of the impressions around the roll, a pilot reciprocated by said press to enter said pilot recesses, and means adapted to advance the punch a slight amount at a time.

10. Apparatus for making a die roll, said apparatus comprising a reciprocating press including a table, a crank shaft, a slide, and a pitman connecting said shaft to said slide, a roll holder mounted on said table, ratchet feed means connected to said holder and operated by said press, a master punch mounted in the slide, a disc secured to said roll holder and having pilot recesses spaced at the desired spacing of the impressions around the roll, a pilot reciprocated by said slide to enter said pilot recesses, and a pitman screw adapted to advance the punch a slight amount at a time.

11. Apparatus for making a die roll, said apparatus comprising a reciprocating press, a rotatable roll holder mounted in said press, ratchet feed means connected to said holder and operated by said press, a master punch mounted in

the press, readily accessible means operable to advance the punch a slight amount at a time, and stop blocks to positively limit movement of the punch when it has reached a predetermined desired full depth relative to the roll holder, despite further operation of the aforesaid means to advance the punch.

12. Apparatus for making a die roll, said apparatus comprising a reciprocating press, a roll holder mounted in said press, ratchet feed means connected to said holder and operated by said press, a master punch mounted in the press, a disc secured to said roll holder and having pilot recesses spaced at the desired spacing of the impressions around the roll, a pilot reciprocated by said press to enter said pilot recesses, means adapted to advance the punch a slight amount at a time, and stop blocks to limit movement of the punch when it has reached a predetermined desired full depth relative to the roll holder.

13. Apparatus for making a die roll, said apparatus comprising a reciprocating press, a roll holder mounted in said press, ratchet feed means connected to said roll holder and operated by said press, a master punch mounted in the press, a disc secured to said roll holder and having pilot recesses spaced at the desired spacing of the impressions around the roll, a pilot reciprocated by said press and arranged to enter said pilot recesses, means adapted to advance the punch a slight amount at a time, a motor for driving the press, a counter set to count the number of ratchet movements of the roll holder, and means responsive to said counter to stop the motor of the press after each revolution of the roll holder, in order to afford an opportunity to advance the punch.

14. Apparatus for making a die roll, said apparatus comprising a reciprocating press, a roll holder mounted in said press, ratchet feed means connected to said roll holder and operated by said press, a master punch mounted in the press, a disc secured to said roll holder and having pilot recesses spaced at the desired spacing of the impressions around the roll, a pilot reciprocated by said press and arranged to enter said pilot recesses, means adapted to advance the punch a slight amount at a time, a motor for driving the press, a trip counter set to count the number of ratchet movements and to trip after one revolution of the roll holder plus one or more additional impressions, and means responsive to tripping of said counter to stop the motor of the press, in order to afford an opportunity to advance the pitman screw.

15. Apparatus for making a die roll, said apparatus comprising a reciprocating press, a roll holder mounted in said press, ratchet feed means connected to said roll holder and operated by said press, a master punch mounted in the press, punch feed means to advance the punch a slight amount at a time, a counter for counting the operations of the press for approximately one revolution of the roll, and means whereby said counter operates said feed means to advance the punch after each such revolution of the roll.

16. Apparatus for making a die roll, said apparatus comprising a reciprocating press, a roll holder mounted in said press, ratchet feed means connected to said roll holder and operated by said press, a master punch mounted in the press, punch feed means to advance the punch a slight amount at a time, a counter for counting the operations of the press for approximately one revolution of the roll, means whereby said counter operates said feed means to advance the punch after each such revolution of the roll, and means to automatically stop the feed of the punch when the punch has reached a desired full depth relative to the roll holder.

17. Apparatus for making a die roll, said apparatus comprising a reciprocating press, a roll holder mounted in said press, ratchet feed means connected to said roll holder and operated by said press, a master punch mounted in the press, punch feed means to advance the punch a slight amount at a time, a counter for counting the operations of the press for approximately one revolution of the roll, means whereby said counter operates said feed means to advance the punch after each such revolution of the roll, means to automatically stop the feed of the punch without stopping the press when the punch has reached a desired full depth, and means to automatically stop the press some time later after the roll has been turned through one or more additional revolutions.

18. Apparatus for making a die roll, said apparatus comprising a reciprocating press including a table, a shaft, a slide and a pitman connecting said shaft to said slide, a roll holder mounted on said table, ratchet feed means connected to said roll holder and operated by said press, a master punch mounted in the slide of the press, a disc secured to said roll holder and having pilot recesses spaced at the desired spacing of the impressions around the roll, a pilot reciprocated by said press and arranged to enter said pilot recesses, a pitman screw adapted to advance the punch a slight amount at a time, automatic feed means including a solenoid, pawl and ratchet feed mechanism operated thereby, and worm and gear mechanism driven by said feed ratchet for turning said pitman screw a small amount at a time, a counter for counting the operations of the press for approximately one revolution of the roll, means whereby said counter operates said feed solenoid to advance the punch after each such revolution of the roll, and means to automatically stop the feed of the punch when the punch has reached a desired depth.

19. Apparatus for making a die roll, said apparatus comprising a reciprocating press including a table, a shaft, a slide, and a pitman connecting said shaft to said slide, a roll holder mounted on said table, ratchet feed means connected to said roll holder and operated by said press, a master punch mounted in the slide of the press, a disc secured to said roll holder and having pilot recesses spaced at the desired spacing of the impressions around the roll, a pilot reciprocated by said press and arranged to enter said pilot recesses, a pitman screw adapted to advance the punch a slight amount at a time, automatic feed means including a solenoid, pawl and ratchet feed mechanism operated thereby, and worm and gear mechanism driven by said feed ratchet for turning said pitman screw a small amount at a time, a counter for counting the operations of the press for one revolution of the roll plus a small additional amount, means whereby said counter operates said feed solenoid to advance the punch after each such revolution of the roll, means to automatically stop the feed of the punch without stopping the press when the punch has reached a desired depth, and means to automatically stop the press some time later after the roll has been turned through one or more additional revolutions.

20. Apparatus for making a die roll out of a

generally cylindrical blank, said apparatus comprising a reciprocating press including a table, a crank shaft, a slide, and a pitman connecting said shaft to said slide, a rotatable roll holder mounted on said table, ratchet feed means connected to said rotatable roll holder and operated by said press, a master punch mounted in the slide, means operable to advance the punch a slight amount at a time, and a recessed support block on said table directly beneath and substantially in contact with said blank to take the reaction of the punch.

21. Apparatus for making a die roll out of a generally cylindrical blank, said apparatus comprising a reciprocating press, a rotatable roll holder mounted in said press, ratchet feed means connected to said rotatable holder and operated by said press, a master punch mounted in the press, means operable to advance the punch a slight amount at a time, a support block directly beneath and substantially in contact with said blank to take the reaction of the punch, and stop blocks to limit movement of the punch when it has reached a predetermined desired full depth relative to the roll holder.

22. Apparatus for making a die roll with either of two sizes of impression, said apparatus comprising a reciprocating press including a table, a crank shaft, a slide and a pitman connecting said shaft to said slide, a roll holder mounted on said table, ratchet feed means connected to said holder and operated by said press, said feed means including two adjacent ratchet wheels having different numbers of teeth, a master punch mounted in the slide, circular means secured to said roll holder and having two sets of differently spaced pilot recesses spaced at the desired spacing of the impressions around the roll, one set of pilot recesses corresponding to one ratchet wheel, and the other set of pilot recesses corresponding to the other ratchet wheel, a pilot reciprocated by said slide for cooperation with the pilot recesses, and a pitman screw adapted to advance the punch a slight amount at a time.

23. The method of making a series of uniform impressions around a blank die roll, which includes making a master punch negative to one of the impressions to be formed around the roll, striking the blank roll with the master punch for a slight depth, rotating the roll an amount equal to the desired spacing between impressions, again striking the roll to the same slight depth, and so on, continuing this operation until the roll has been turned through more than one revolution, striking the roll with the master punch to a slightly increased depth, rotating the roll to successive impressions and striking each of these to the slightly increased depth for more than one revolution, and so on, until and including rotation for more than one revolution at the desired final depth.

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