Aug. 8, 1933. L. S. BURBANK 1,921,654

MANUFACTURE OF BOLTS, SCREWS, AND THE LIKE

Original Filed June 7, 1928 5 Sheets-Sheet 1

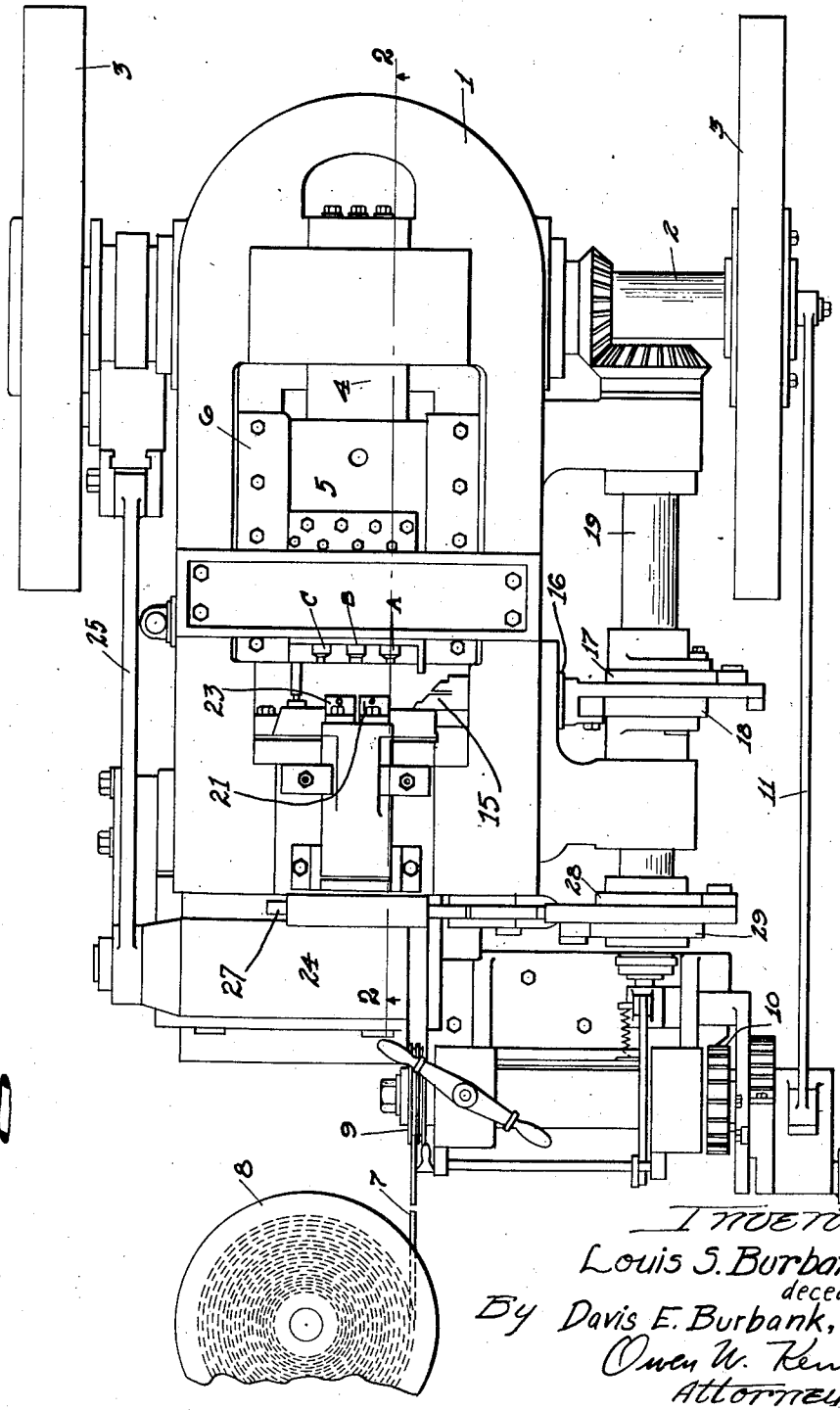


Fig. 1

Inventor:
Louis S. Burbank,
deceased
By Davis E. Burbank, Admr.
Owen W. Kennedy
Attorneys.

Aug. 8, 1933. L. S. BURBANK 1,921,654

MANUFACTURE OF BOLTS, SCREWS, AND THE LIKE

Original Filed June 7, 1928 5 Sheets-Sheet 2

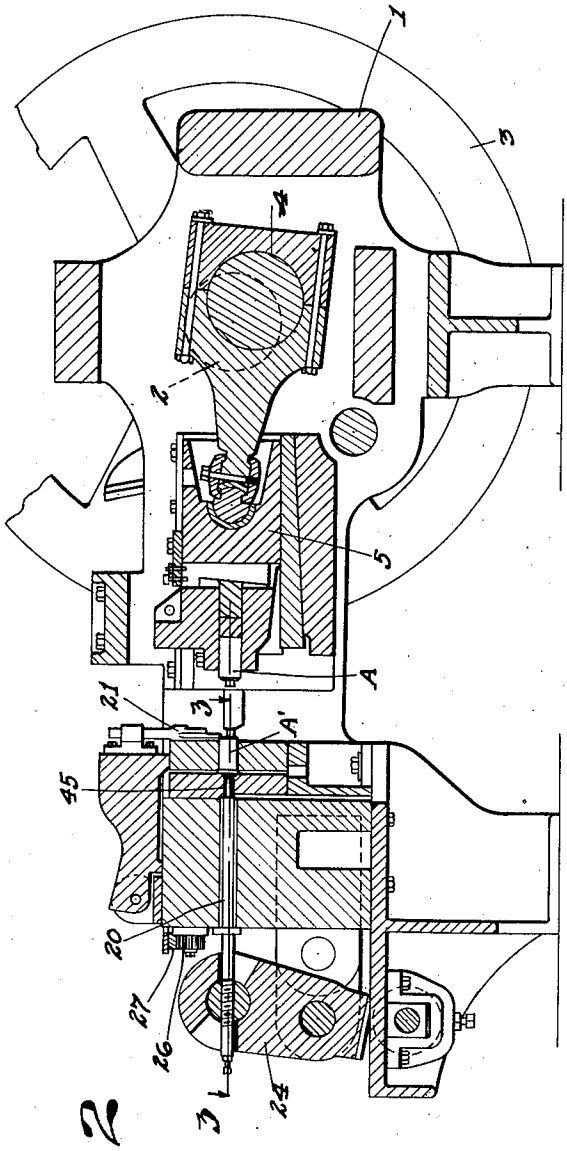


Fig. 2

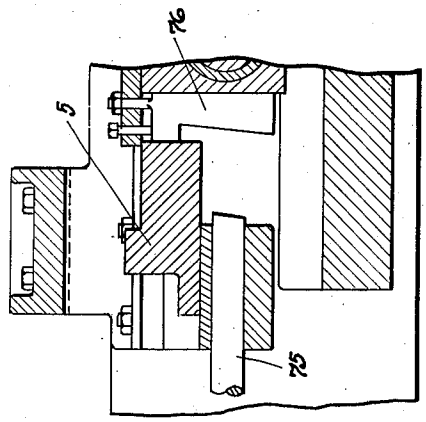


Fig. 15

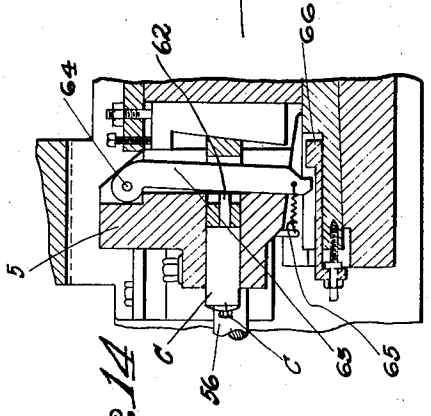


Fig. 14

Inventor:
Louis S. Burbank,
deceased.
By Davis E. Burbank, Admr.
Owen W. Kennedy
Attorney.

Aug. 8, 1933. L. S. BURBANK 1,921,654

MANUFACTURE OF BOLTS, SCREWS, AND THE LIKE

Original Filed June 7, 1928 5 Sheets-Sheet 3

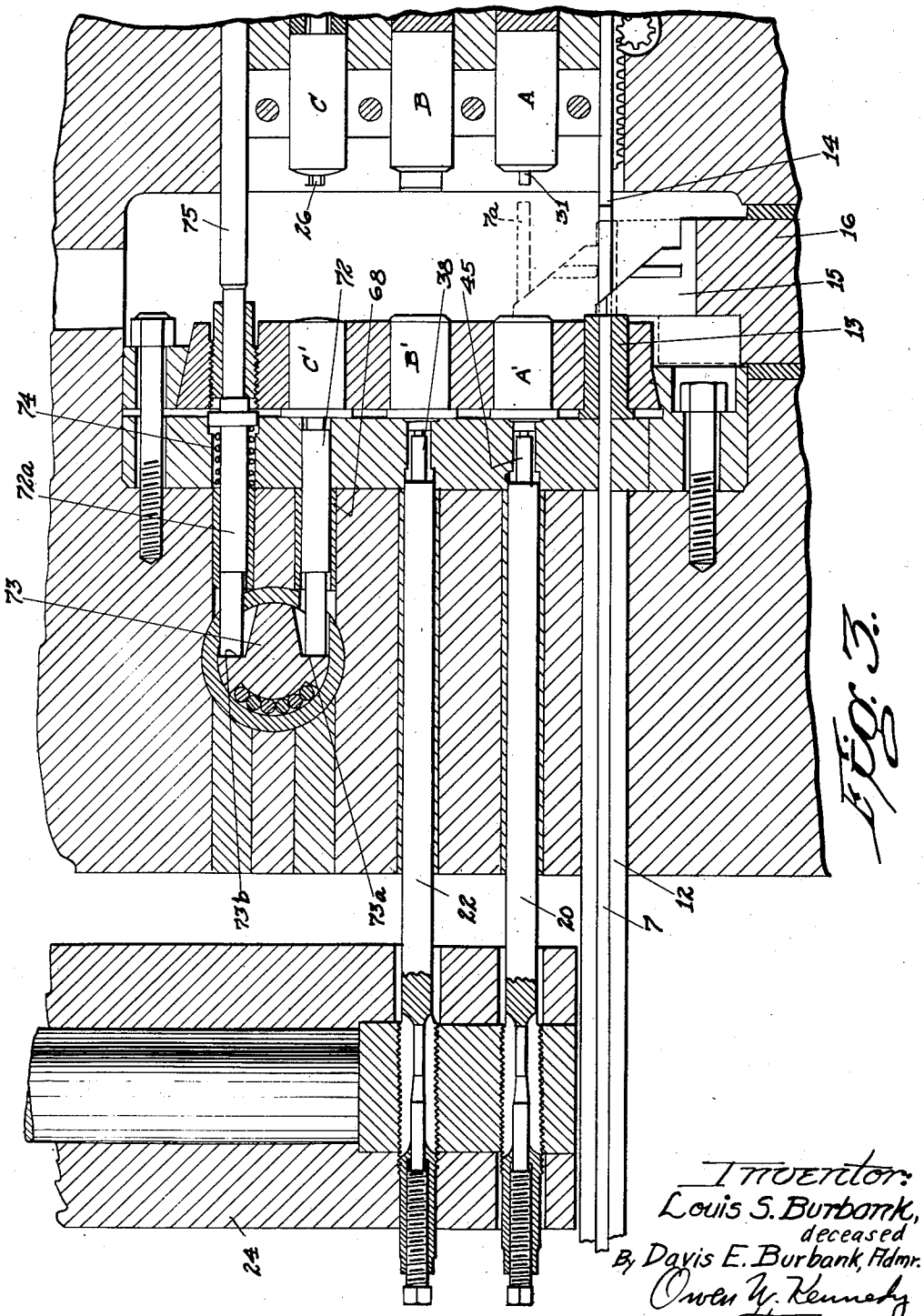


Fig. 3.

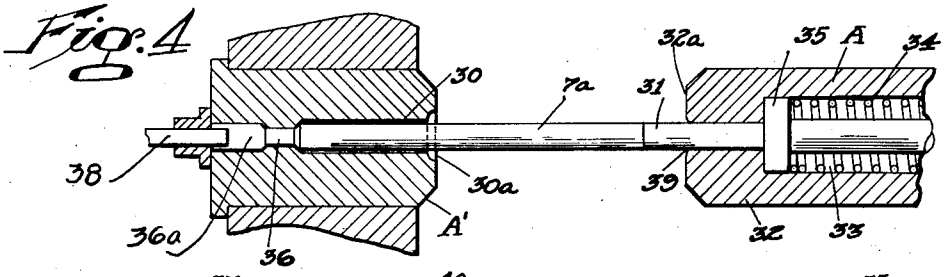
Inventor:
Louis S. Burbank,
deceased
By Davis E. Burbank, Admr.
Owen Y. Kennedy
Attorney.

Aug. 8, 1933. L. S. BURBANK 1,921,654

MANUFACTURE OF BOLTS, SCREWS, AND THE LIKE

Original Filed June 7, 1928 5 Sheets-Sheet 4

Fig. 4



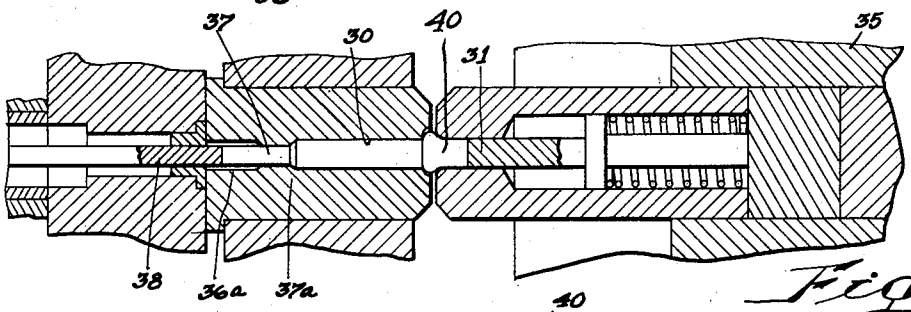


Fig. 5

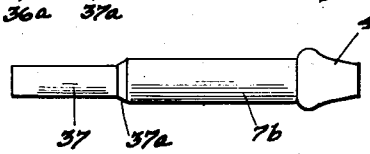


Fig. 6

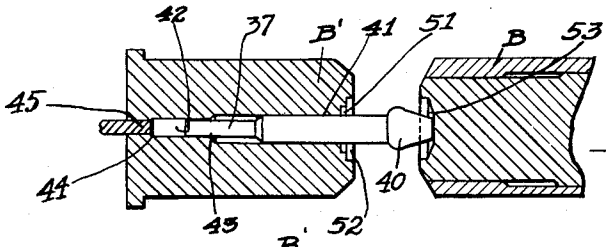


Fig. 7

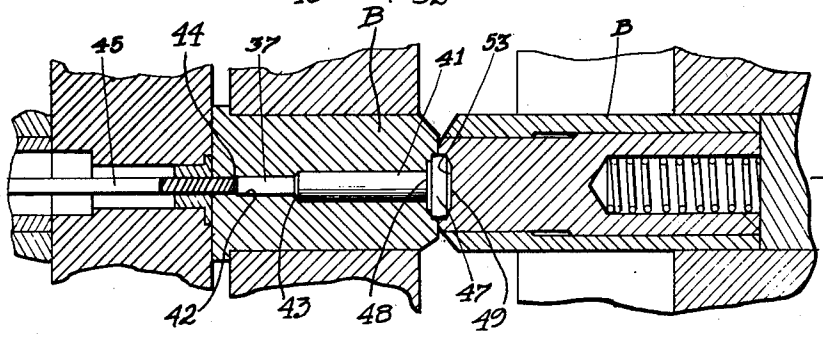


Fig. 8

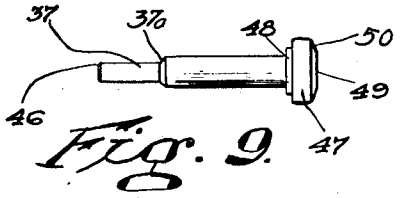


Fig. 9.

Inventor:
Louis S. Burbank,
deceased.
By Davis E. Burbank, Admr.
Cary W. Kennedy
Attorney.

Aug. 8, 1933. L. S. BURBANK 1,921,654

MANUFACTURE OF BOLTS, SCREWS, AND THE LIKE

Original Filed June 7, 1928 5 Sheets-Sheet 5

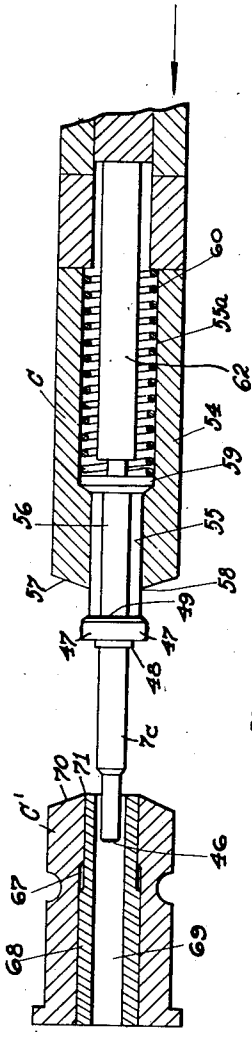


Fig. 10

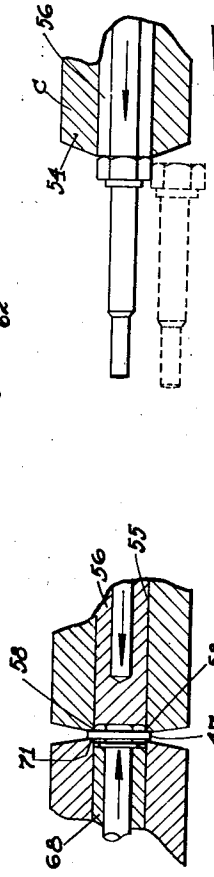


Fig. 11

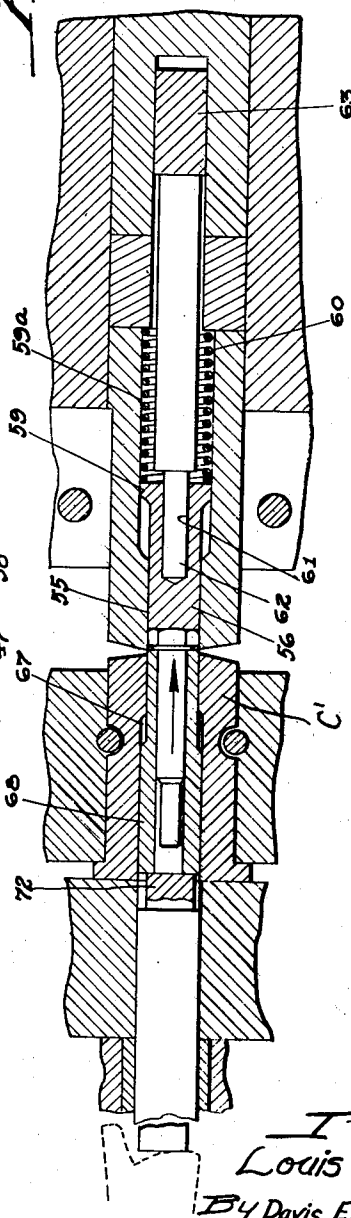


Fig. 12

Fig. 13

Inventor
Louis S. Burbank,
deceased
By Davis E. Burbank, Admr.
Owen W. Kennedy
Attorney.

Patented Aug. 8, 1933 1,921,654

UNITED STATES PATENT OFFICE

1,921,654

MANUFACTURE OF BOLTS, SCREWS, AND THE LIKE

Louis S. Burbank, deceased, late of Worcester, Mass.; by Davis E. Burbank, administrator, Worcester, Mass., assignor, by mesne assignments, to The Waterbury Farrel Foundry and Machine Company, Waterbury, Conn., a Corporation of Connecticut

Original application June 7, 1928, Serial No. 283,469, now Patent No. 1,892,445, dated December 27, 1932. Divided and this application April 8, 1931. Serial No. 528,617

13 Claims. (Cl. 10—27)

The present invention relates to the manufacture of bolts, screws and the like from elongated pieces of metal, this application being a division of the original application of said Louis S. Burbank, deceased, Serial No. 283,469, filed June 7, 1928.

In the aforesaid copending application there is shown and described a machine for producing bolts, screws, and the like characterized by the provision of certain instrumentalities which cooperate to discharge a completed blank from the machine upon each stroke thereof, and the present application covers certain essential steps in the process of manufacture as performed by the aforesaid machine, or similar machines. Briefly stated, the present invention resides in the performance of a number of related steps on an elongated piece of metal which serve to develop the piece from a rough to a finished form, without interrupting the operating continuity of the machine. In other words, each separate step performed on the blank alters the form thereof to such an extent that the next step may be most readily performed thereon, each step bearing a definite relation to the final form of the completed blank. The above and other advantageous features of the invention will hereinafter more fully appear with reference to the accompanying drawings, in which:—

Fig. 1 is a plan view of a machine particularly adapted for carrying out the invention.

Fig. 2 is a vertical sectional view along the line 2—2 of Fig. 1, looking in the direction of the arrows.

Fig. 3 is a horizontal sectional view along the line 3—3 of Fig. 2, looking in the direction of the arrows, the parts being shown on an enlarged scale.

Fig. 4 is a fragmentary view illustrating the insertion of the blank into the first developing die.

Fig. 5 is a fragmentary view illustrating the performance of the first developing operation on the blank.

Fig. 6 shows on an enlarged scale the appearance of the blank after the performance of the first operation.

Fig. 7 is a fragmentary view showing the reception of the blank of Fig. 6 in the second developing die.

Fig. 8 is a fragmentary view illustrating the complete performance of the second developing operation on the blank.

Fig. 9 is a view showing the blank after the performance of the second developing operation.

Fig. 10 is a fragmentary view illustrating the insertion of the blank into the head trimming die.

Fig. 11 is a fragmentary view illustrating the start of the head trimming operation by the third die and punch.

Fig. 12 is a fragmentary view illustrating the completion of the head trimming and burnishing operation.

Fig. 13 is a view illustrating the appearance of the completed blank as discharged from the machine.

Figs. 14 and 15 are detail views illustrating portions of the punch and die operating mechanism.

Like reference characters refer to like parts throughout the drawings.

Referring first to Figs. 1, 2, and 3, the invention is shown, for purposes of illustration, as being carried out by a machine of the type shown and described in the original copending application Serial No. 283,469, although, as will hereinafter appear, the various steps in the development of a blank could be carried out by machines differing structurally from the machine shown in the drawings. Since this particular machine is completely described and illustrated in my aforesaid copending application, only such portions thereof will be described herein as are necessary for a complete understanding of the manner in which the motions of the various mechanisms contribute to carrying out the several steps in the development of a blank.

The machine shown in Fig. 1 generally comprises a frame 1 which rotatably supports a shaft 2 adapted to be driven in any suitable manner as by a belt on one of the flywheels 3. As best shown in Fig. 2, the shaft 2 provides a centrally disposed crank portion 4 connected at its free end to a head or ram 5 slidable in guideways 6 provided by the frame 1, so that rotation of the shaft 2 imparts a reciprocatory movement to the ram 5. The ram 5 carries a series of punches generally designated by the reference characters A, B, and C, in Fig. 3 and these punches are adapted to cooperate with a series of stationary dies carried by the frame 1, the dies being generally designated by the reference characters A′, B′ and C′. As will be hereinafter described, the punches A, B, and C cooperate in unison with the dies A′, B′, and C′ to accomplish certain developing operations on a metal blank delivered to the first punch A and die A′. However, before entering into a detailed description of the particular form of the punches and dies which contribute to the de-

velopment of a blank, there will first be briefly described the essential elements of the mechanism whereby a blank is cut from a length of stock, presented to the first punch and die for the first developing operation and successively transferred to the other punches and dies for the performance of further developing operations.

The metal stock from which the screws or other pieces are made is preferably provided in the form of a wire 7 coiled upon a reel 8 rotatably mounted so that the wire may be drawn therefrom by a pair of grooved feed rolls 9. The rolls 9 are adapted to tightly grip the wire 7 between them and by their rotation feed it forward in the direction of the punch carrying ram 5. The rolls 9 are adapted to be intermittently rotated by means of a suitable ratcheting mechanism indicated at 10 connected to the drive shaft 2 by means of a rod 11, so that each revolution of the shaft is adapted to cause the rolls 9 to feed a predetermined length of wire 7.

As best shown in Fig. 3, the wire 7 is projected through an opening 12 in the frame 1 into a cutoff bushing 13 through which it passes until it comes into engagement with a wire stop 14 in alinement with the opening in the bushing 13. Preferably the feed rolls 9 are adapted to slightly overfeed the wire 7 and then slip, so as to insure the full amount of feed and bring the front end of the wire fully against the stop 14 which is adjustable, so as to provide for the feeding of the proper length of wire to provide a blank for the screw, bolt, or other article that is to be formed. After the wire 7 has been fully fed in against the stop 14, it is cut off by knives 15 mounted on a slide 16 having a reciprocatory movement at right angles to the line of wire feed. Since the construction of the knives 15 is fully shown and described in my aforesaid copending application, it is sufficient for present purposes to state that movement of the slide 16 towards the first punch A and die A' is adapted to sever a blank 7*a* of predetermined length from the wire and carry it forward into register with the first die A', as indicated in dotted lines in Fig. 3. The mechanism for operating the cutoff slide 16 is indicated in Fig. 1 and comprises separate cams 17 and 18 mounted on a cam shaft 19 for moving the slide 16 in opposite directions and controlling its motion in such a manner that the blank 7*a* is held in register with the die A' until the advancing punch A starts to insert the blank 7*a* into the die A', as indicated in Fig. 4.

Following the performance of the first developing operation on the blank 7*a* by cooperation of the punch A and die A', the blank is ejected from the die A' by means of a knock-out rod, indicated at 20 in Fig. 3, whereupon the blank is seized by oscillatory transfer fingers, indicated at 21 in Fig. 2. The fingers 21 then convey the blank into register with the second die B', whereupon a second developing operation is performed upon the blank by cooperation of the die B' with punch B. The blank is then ejected from the blank B' by a second knock-out rod 22, whereupon it is seized by the second set of transfer fingers 23, see Fig. 1, and conveyed into register with the third die C'. Upon completion of the third developing operation by cooperation of the die C' and punch C, the finished blank is ejected from the machine, by instrumentalities cooperating with the punch C, as will hereinafter be described.

As best shown in Figs. 1 and 2, the knock-out rods 20 and 22 are operated in unison by means of an arm 24 operated through a link 25 from the driving shaft 2, as described in my aforesaid copending application, the rods 20 and 22 being adjustable longitudinally in accordance with the length of the blanks operated upon. The transfer fingers 21 and 23 are adapted to be oscillated by means of a pinion 26 cooperating with a rack 27, best shown in Fig. 2, the rack 27 being given a reciprocatory movement by means of cams 28 and 29 on the shaft 19, see Fig. 1, so as to cause the fingers 21 and 23 to operate in timed relation with the ejection of blanks by the knock-out rods 20 and 22.

Having described the various mechanisms embodied in the machine for handling the blanks with relation to the cooperating punches and dies, there will now be described the form and function of the punches and dies by means of which each blank severed from the wire stock is subjected to a series of developing operations which transform the rough blank into the finished product.

Referring now to Fig. 4, the blank 7*a* is shown as having been partially inserted in a longitudinal opening 30 in the die A', the diameter of the opening being substantially the same as the diameter of the blank so that the blank will pass freely into the opening 30. The insertion of the blank 7*a* into the opening 30 is caused by the engagement of the end of the blank 7*a* with the end of a plunger 31 which projects beyond the end of the punch member 32. The punch member 32 provides an internal opening 33 into which the plunger 31 extends, and a spring 34 pressing on the head 35 of the plunger 31 serves to yieldingly maintain the end of the plunger 31 beyond the face 32*a* of the punch member 32.

As the blank 7*a* is moved into the die opening 30 by the plunger 31, as shown in Fig. 4, the advancing end of the blank is forced into a reduced throat or constriction 36 of the die opening, thereby extruding the end portion of the blank to provide a tenon 37 having a reduced diameter corresponding to that of the throat 36, see Fig. 5. The inward movement of the blank 7*a* into the die is continued until the end of the extruded tenon portion 37 reaches a stationary stop 38 provided on the knock-out rod 20, the end of the stop extending freely into an enlarged portion 36*a* of the die beyond the throat 36. The stop 38 is held stationary as the blank enters the die by means cooperating with the rod 20, so that the advancing end of the tenon portion 37 comes to rest against the stop 38. Because of the force with which the blank 7*a* is driven into the die and reduced by the throat 36, there is formed on the blank at the inner end of the tenon portion 37 a beveled shoulder 37*a*, the slope of which is determined by the inclination of the shoulder between the die opening 30 and the throat 36. As shown, the inclination of the shoulder 37*a* is approximately 30° which is found to be the proper angle for bringing about a ready reduction of the blank by extrusion of the metal of the blank at the throat 36.

After the advancing end of the blank 7*a* reaches the stationary stop 38, and therefore can enter the die A' no further, the remainder of the forward motion of the punch member 32 is utilized, first, to cause that portion of the blank within the die opening 30 to be swelled out to the full diameter of the opening 30 and, next, to upset the portion of the blank extending outside of the die opening 30 to form a preliminary head on the blank. As previously pointed out,

the mouth of the die opening 30 is flared outwardly, as indicated at 30*a*, while the mouth of the opening 33 in which the punch plunger 31 moves is tapered slightly, as indicated at 39. Consequently, when the blank comes to rest following the extruding operation, the metal of the blank between the end of the compressed plunger 31 and the mouth of the die opening is upset to form a preliminary head 40 of tapering form, the metal flowing freely into the flaring mouth 30*a* without substantial engagement with the walls of the mouth. When the head 35 carrying the punch A recedes, there being more friction in the die A' between the blank and the walls of the die than between that portion of the head 40 received within the punch opening 39, the blank 7*a* remains in the die A' and, after the punch A has receded sufficiently, the knock-out rod 20 is operated to cause the stop 38 to force the blank out of the die A', the blank then appearing as shown in Fig. 6. The expelled blank 7*b* is then acted upon by the first set of transfer fingers 21 which seize and convey the blank into alinement with the second die B' for operation upon by the punch B.

As best shown in Fig. 7, the die B' provides a central opening 41 of such diameter as to freely receive the body portion of the blank 7*b* and a secondary opening 42 of reduced diameter adapted to freely receive the tenon portion 37 of the blank, with a shoulder 43 joining the two openings 41 and 42. It is also to be noted that the length of the tenon portion 37 of the blank 7*b* is greater than the length of the die opening 42 between the shoulder 43 and a shoulder 44 adjacent a stationary stop 45 at the end of the opening 42. Consequently when the advancing punch B forces the blank 7*b* into the die B', the blank passes freely through the die openings 41 and 42 until the end of its tenon portion 37 strikes the stop 45. When this occurs, the impact of the punch B on the blank 7*b* results in thoroughly flattening the end of the tenon portion 37 against the stationary stop 45 and in beveling the end of the tenon portion 37, as indicated at 46, thus finishing the point of the blank which has been left more or less rough by the cutting-off knife. The impact of the punch also tends to set metal of the blank more firmly so as to form a tough cold forged point at the end of the tenon portion 37. Practically simultaneously with the beveling and flattening at the end of the blank, as just described, the tenon portion 37 is upset to the diameter of the opening 42, thereby decreasing its length and increasing its diameter as compared to the tenon portion 37, as originally formed. As the tenon portion 37 assumed its final form, the shoulder 43 between the die openings 41 and 42 changes the angle of the bevel between the upset tenon 37 and the body of the blank from approximately 30° to 60°. As previously pointed out, the original angle of the bevel 37*a*, about 30°, is the best angle for extruding the tenon 37 and the change of this angle to approximately 60° is made for the purpose of approximating the angle of the threads which are finally formed on the tenon portion of the completed blank.

Following the finishing of the end of the blank and the upsetting of the tenon 37 to its final length and diameter, as described above, further movement of the punch B to complete its stroke results in further upsetting and changing the preliminary head 40 from a tapering form to a generally cylindrical form, as indicated at 47 in Fig. 8. This further upsetting of the head also forms a washer face 48 on the under side of the head 47, which face makes a sharp corner between the head 47 and the body of the blank, as well as a flat top 49 and bevel 50 at the other end of the head. The washer face 48 is formed by the provision of an annular groove 51 at the mouth of the die opening 41, see Fig. 7, beyond which groove 51 a countersink 52 is provided so as to permit free flowing of the metal during the second upsetting operation on the head. The end of the punch B provides a recess or seat 53 having a flat bottom and tapered walls for forming the flat top 49 and bevel 50 on the head 47 of the blank, the rim of the seat 53 being flared outwardly beyond the bevel 50 to permit free flowing of the metal in the head 47 beyond the bevel 50. In other words, the combined action of the punch B and die B' as the punch completes its stroke is to alter the preliminary head 40 so as to form a finished washer face 48 on the body side of the head and a flat top 49 and bevel 50 on the opposite side of the head, the cylindrical portion of the head 47 between these finished surfaces being more or less irregular due to the fact that the metal is not forced into close engagement with either the countersink 52 or the outer edges of the recess 53 in the end of the punch B.

When the head carrying the punch B again recedes, the knock-out rod 22 causes the stop 45 to eject the blank just operated upon from the die B', the blank then appearing as shown in Fig. 9. As the blank is ejected from the die B', it is seized by the second pair of transfer fingers 23 which grip the blank and convey it into register with the third die C' for operation upon by the third punch C in order to trim the head 47 and finish the same. In the particular embodiment of the invention shown, the cooperation between the third punch C and die C' is adapted to trim the generally cylindrical head 47 formed by the cooperation of the punch B and die B' so as to change the head 47 to a polygonal form corresponding to the hex-head usually found on bolts, screws, and the like. It is to be understood, however, that the invention is in no way limited to the utilization of the third punch and die to trim the head 47 into this particular form, it being obvious that the head may be trimmed to provide a truly cylindrical, square, or other form.

As best shown in Fig. 10, the punch assembly designated by the reference character C comprises a main punch member 54 providing a central opening 55 to receive a plunger 56 which is polygonal in cross section. The front end of the punch member 54 is beveled rearwardly, as indicated at 57, so as to provide a clean polygonal edge 58 surrounding opening 55. The plunger 56 extends rearwardly into an enlargement 55*a* of the opening 55, and a head 59 of the plunger 56 is engaged by a spring 60, the pressure of which tends to yieldingly maintain the end of the plunger 56 beyond the cutting edge 58.

As best shown in Fig. 12, the plunger 56 provides a central opening 61 in which is received the reduced end of an ejector pin 62 passing freely through the spring 60. The inner end of the ejector pin 62 is adapted to be engaged by a lever 63 which, as best shown in Fig. 14, is pivoted at 64 upon the punch carrying ram 5 with its lower end projecting below the under surface of the ram 5. A spring 65 serves to maintain the edge of the lever 63 in engagement with the end of the pin 62, and the projecting end of the lever

is adapted to engage, upon return movement of the ram 5, a stop 66 adjustably mounted on the frame 1. Consequently, upon the completion of each return stroke of the ram 5, the engagement of the lever 63 with the stop 66 causes it to project the ejector pin 62 towards the plunger 56 for the purpose of ejecting a finished blank, as will hereinafter appear.

As best shown in Figs. 10 and 12, the die C' provides a central opening 67 which slidably receives a sleeve 68 polygonal in cross section with a central opening 69 of such diameter as to freely receive the body of the blank 7c. The front end of the die C' is beveled rearwardly at 70, so that the rim of the opening 67 provides a cutting edge 71 of exactly the same form as the cutting edge 58 of the punch member 54. The sleeve 68 within the die opening 67 is adapted to be engaged by a plunger 72 which, as best shown in Fig. 3, is adapted to be moved axially by means of a rockshaft 73 which is cut away to provide shoulders 73*a* and 73*b* for receiving the plunger 72 and a second plunger 72*a* extending parallel thereto. Normally, the plunger 72*a* is held retracted by a spring 74, so that the sleeve 68 and plunger 72 are adapted to yield within the die opening 67 as the third punch C begins its inward stroke. However, as best shown in Fig. 15, as the punch ram 5 reaches the end of its inner stroke, an abutment 76 carried thereby engages the end of an operating rod 75 slidably mounted in the frame 1, and this rod 75 engaging the plunger 72*a* turns the rockshaft 73 and causes the plunger 72 to move the sleeve 68 so as to push the head of the bolt into the punch C, see Fig 12.

When the blank 7*b* with its cylindrical head 47 is transferred to the third die C', and is engaged by the advancing end of the plunger 56, the body of the blank enters freely into the opening 69 of the die sleeve 68 until the head 47 engages the cutting edge 71 of the die, thereby checking the movement of the blank. As this occurs the plunger 56 yields inwardly, so that the cutting edge 58 of the punch member 54 engages the opposite side of the head 47 almost simultaneously with the engagement of the cutting edge 71 with the head. Therefore, continued movement of the punch C causes the head 47 to be cut from opposite sides, as indicated in Fig. 11. As the cutting edges 58 and 71 nearly meet each other, the sleeve 68 is moved toward the punch by the plunger 72 through the operation of the rockshaft 73, previously described, with the result that the head of the blank is forced into the opening 55 of the punch 54, the plunger 56 yielding, as indicated in Fig. 12. The result of this action is that the scarf made by the cutting edge 58 of the punch member 54 passes by the scarf started by the cutting edge 71 of the die C', the movement of the sleeve 68 being sufficient to entirely clear the blank head from the cutting edge 71 and enter the trimmed head completely with the punch opening 55.

At this moment the punch carrying ram 5 starts its movement away from the dies, and since the trimmed head is fully received in the punch opening 55 with some frictional engagement, the punch C withdraws the blank entirely from the sleeve 68 which, as previously pointed out, freely receives the body of the blank. As the punch ram 5 reaches the end of its withdrawing movement, the lever 63 strikes the stop 66, see Fig. 14, thereby causing the punch plunger 56 to be projected outwardly to eject the finished blank from the punch. This movement of the trimmed head in the punch opening 55 is in the opposite direction of the movement of the head which completed the trimming by the cutting edge 58. Consequently, the trimmed head is burnished as the finished blank is ejected. At this point it should be noted that the trimming and burnishing of the head is accomplished by one complete back and forth movement of the punch ram 5, with the use of only one die, and without making it necessary to push the blank entirely through either the punch or the die, thereby distinguishing the present invention from previous practice in the trimming and burnishing of heads. In other words, according to the present invention, the trimming and burnishing of the head is carried out in what amounts to a continuous operation involving merely the reversal of the direction of movement of the blank..

From the foregoing, it is apparent that by the present invention there is provided an improved method of forming bolts, screws, and the like, from elongated pieces of stock in which each blank is subjected to a number of consecutive operations which serve to develop the blank from a rough to a finished form. From a consideration of the drawings illustrating the previously described operations on the blank, it will be evident that there is a definite relation between the design of any two adjacent dies in the series, so that, generally speaking, the development of the blank in one die prepares it for the work to be done on it in the next succeeding die, and this principle is carried on irrespective of the number of dies employed. In other words, the length and diameter of any given portion of the blank at any stage in the cycle of operations bears a definite relation to the final length and diameter of the same portion in the completed blank.

For example, the cooperation between the first punch A and die A' results in making the diameter of the extruded tenon portion smaller than the internal diameter of the tenon opening of the second die, so that the preparatory tenon portion will enter freely into the second die, without friction. This is essential in order that the impact of the end of the blank against the stop in the second die, as it freely enters, will result in a concentrated pressure being applied at the point of the blank. After the point is formed, the preliminary tenon is upset to the final tenon diameter by swelling of the tenon portion under compression. Furthermore, it is necessary that the length of the preliminary tenon portion be greater than the length of the final tenon portion so as to concentrate the pressure at the point and still provide sufficient metal for expanding the tenon after formation of the point. This extra length of the preliminary tenon portion is also necessary in order to make it possible to change the inclination of the beveled shoulder between the tenon portion and the body of the blank. Thus the initial extruding of the tenon portion results in an inclination of this shoulder at an angle best suited for the extruding action, namely, about 30°. Then, when the elongated tenon is projected into the second die, this shoulder is not altered until after the point is formed by the concentrated pressure at the end of the blank. In fact, the angle of the shoulder is not changed until after the tenon portion has been expanded to its final diameter with the shoulder then having an inclination of approximately that of the threads to be formed on the tenon, approximately 60°.

In order to carry out the gradual development of the blank, it is also necessary that the preliminary body portion of the blank be longer than the final body portion, so that the body will swell out into the body opening in the second die before the preliminary tapered head is flattened, outside of the die opening. In other words, when the blank is projected into the second die the proportions of the preliminary tenon and body portions are such that there ensues a gradual development along the whole length of the blank beginning at the point and ending at the head.

It will also be evident that the preliminary form of the head bears a very definite relation to the final form of the head obtained by the action of the last punch and die. That is to say, just enough metal is upset in the first operation to form a tapered head that may be readily converted into a cylindrical head by the second operation. This cylindrical head resulting from the second operation is in turn of just the right diameter, so that the cutting edges of the trimming punch and die will convert the head into polygonal form, with a minimum waste of material. It should also be noted that the trimming and burnishing performed by the last punch and die is accomplished by the same movement of the punch head which effects the developing operations on the blanks in the preceding stages. Thus forward movement of the punch head toward the dies results in trimming of the head, simultaneously with the change of form brought about in the other blanks in process, whereas movement of the head away from the dies results in withdrawal of the blank with the trimmed head simultaneously with the ejection of the other blanks in process from their dies. As the punch head reaches the end of its withdrawal stroke, the blank with the trimmed head is ejected by a reverse movement so as to burnish the head and discharge the completed blank simultaneously with the inward movement of the cutter slide to sever a new blank and hold it in readiness for delivery to the first die. Then as the head starts its forward movement to initiate the operating cycle, the tranfer fingers operate simultaneously to convey blanks in process from one die to another simultaneously with the delivery of the newly cut blank to the first die. Thus each operating cycle of the machine results in the performance of developing operations on blanks in process, each bearing a definite relation to the operation preceding or following the same.

What is claimed:

1. An improved method of continuously forming bolts, screws, and the like, which consists in presenting an elongated metal blank of predetermined length and uniform diameter to the successive actions of cooperating punches and dies which progressively develop the blank by extrusion and upsetting to form a point and a tenon portion and by successive upsetting operations to form a body portion and a head on said blank of different diameters and of different lengths.

2. An improved method of continuously forming bolts, screws, and the like, which consists in feeding an elongated piece of metal stock, severing the leading end thereof to provide a blank of predetermined length and of uniform diameter and in presenting said blank successively to the action of a series of pairs of cooperating dies and punches, which progressively decrease and then increase the diameter of one portion of said blank while successively increasing the diameters of other portions thereof to form a point, a tenon portion, a body portion and a head on said blank of different diameters.

3. An improved method of continuously forming bolts, screws, and the like, which consists in feeding an elongated piece of metal stock, severing the leading end thereof to provide a blank of predetermined length and of uniform diameter and in presenting said blank successively to the action of a series of pairs of cooperating dies and punches, which progressively decrease and then increase the diameter of one portion of said blank by extruding and upsetting actions, while increasing the diameter of other portions of said blank by an upsetting action to form a tenon and body of different diameters intermediate the ends of said blank and a point and enlarged head at opposite ends of said blank.

4. An improved method of forming bolts, screws, and the like, which consists in providing an elongated metal blank of predetermined length and uniform diameter, forcing said blank into a die to reduce the diameter of a portion thereof while reducing the overall length of said blank to upset a preliminary head at one end and then forcing said blank into another die to form by an upsetting action a point at one end of the previously reduced portion while further reducing the overall length of the blank to form by an upsetting action at the other end thereof a head with finished faces on opposite sides of the head.

5. An improved method of forming bolts, screws, and the like by a succession of operations upon the same blank and simultaneously upon several blanks, which consists in providing an elongated metal blank of predetermined length and of uniform diameter, forcing said blank into a die to reduce the diameter of a portion thereof while reducing the overall length of said blank to upset a preliminary head at one end, then forcing said blank into another die to form by an upsetting action a point at one end of the previously reduced portion, while further reducing the overall length of the blank by an upsetting action to enlarge the preliminary head and form finished faces on opposite sides thereof, and finally in forcing the blank into cooperating dies to trim the head by cutting the same first from opposite directions and then in one direction only, burnishing of the trimmed head being accomplished by its ejection from the last cutting die in a direction opposite to the direction of the last trimming cut.

6. An improved method of forming bolts, screws, and the like by a succession of operations upon the same blank and simultaneously upon several blanks which consists in providing an elongated metal blank of predetermined length and of uniform diameter, forcing said blank into a die to reduce the diameter of a portion thereof while reducing the overall length of said blank to upset a preliminary head at one end, then forcing said blank into another die to form by an upsetting action a point at one end of the previously reduced portion, while further reducing the overall length of the blank by an upsetting action to enlarge the preliminary head and form finished faces on opposite sides thereof, then subjecting the blank to the action of cooperating dies which first trim the head by cutting simultaneously from opposite directions, then forcing the head completely into one of said dies to finish the trimming cut, and finally eject-

ing the head from the last cutting die to burnish the trimmed faces of the same.

7. An improved method of forming bolts, screws, and the like by a succession of operations upon the same blank and, simultaneously upon several blanks, which consists in providing an elongated metal blank of predetermined length and of uniform diameter, forcing said blank into a die to reduce the diameter of a portion thereof while reducing the overall length of said blank to upset a preliminary head at one end, then forcing said blank into another die to form by an upsetting action a point at one end of the previously reduced portion, while further reducing the overall length of the blank by an upsetting action to enlarge the preliminary head and form finished faces on opposite sides thereof, then subjecting the blank to the action of cooperating dies which trim the blank by cutting from opposite directions until their cutting edges are close together, then forcing the blank into one cutting die to complete the trimming thereof, then separating said dies to cause the last cutting die holding the head to withdraw the blank from the other die, and finally ejecting the blank from the withdrawing die to burnish the trimmed surfaces of the head.

8. An improved method of forming bolts, screws, and the like, which consists in providing an elongated metal blank of predetermined length and of uniform diameter, then forcing said blank into a die having a contracted opening adapted to reduce the diameter of the advancing end of the blank by an extruding action, then arresting longitudinal movement of the extruded end portion of the blank while applying pressure at the opposite end to upset the remainder of the blank into an enlarged body portion with a preliminary head, then projecting said blank, without resistance, into a second die until its extruded end engages a fixed stop, and finally in applying pressure to the headed end of the blank to form a point at the extruded end, increase the diameter of the extruded portion and to further upset the head to increase its diameter and form flat faces on opposite sides thereof.

9. An improved method of forming bolts, screws, and the like, which consists in providing an elongated metal blank of predetermined length and of uniform diameter, then forcing said blank into a die having a contracted opening adapted to reduce the diameter of the advancing end of the blank by an extruding action, then arresting longitudinal movement of the extruded portion of the blank while applying pressure at the opposite end of the blank to upset the remainder thereof into an enlarged body portion, with a beveled shoulder between the extruded portion and the upset body portion at an angle such as to expedite the free flow of metal in the extruding action, then projecting the extended portion of said blank into a die opening of greater diameter but of less depth than said extruded portion while applying pressure at the opposite end of said blank, whereby the impact of the extruded end of the blank at the bottom of the die opening forms a beveled point and the pressure upsets the remainder of the blank to increase the diameter of both the extruded portion and the body portion with a beveled shoulder between these portions at an angle best suited for threading of the extruded portion.

10. An improved method of forming bolts, screws, and the like by a succession of operations upon the same blank and simultaneously upon several blanks, which consists in providing an elongated metal blank of predetermined length and of uniform diameter, then forcing said blank into a die having a contracted opening adapted to reduce the diameter of the advancing end of the blank by an extruding action, then arresting longitudinal movement of the extruded end portion of the blank while applying pressure at the opposite end to upset the remainder of the blank into an enlarged body portion with a preliminary head, then projecting said blank freely into a second die until its reduced end engages a fixed stop while applying pressure to the headed end of the blank to form a beveled point at the opposite end, increase the diameter of the reduced portion and to further upset the preliminary head into cylindrical form and finally in subjecting the head to the action of cooperating cutting dies which trim the head by cutting from opposite directions, and burnish the head movement in a direction opposite to the last cutting.

11. An improved method of forming bolts, screws and the like, which consists in providing an elongated metal blank of predetermined length and of substantially uniform diameter, then by pressure forming a tenon portion of reduced diameter by an extruding process, thereafter by other tools swelling the tenon portion to increase the diameter thereof, and at the same time shaping the free end thereof.

12. An improved method of forming bolts, screws and the like, which consists in providing an elongated metal blank of predetermined length and of substantially uniform diameter, then applying pressure to one end of the blank to force the other end into a die having a contracted opening, and thereby reduce by an extruding action, the diameter of the last mentioned end of the blank until it engages a rigid abutment, and thereafter while the extruded portion is in an opening in another die of greater diameter than that of the extruded portion, applying pressure to the non-extruded end of the blank, while the opposite end is in engagement with an abutment, whereby the end of the extruded portion will first be shaped and thereafter the diameter of the extruded portion will be increased.

13. An improved method of forming bolts, screws and the like, which consists in providing an elongated metal blank of predetermined length and of substantially uniform diameter, then applying pressure to one end of the blank to force the other end into a die, having a contracted opening, and thereby reduce by an extruding action, the diameter of the last mentioned end of the blank until it engages a rigid abutment, and thereafter while the extruded portion is in an opening in another die of greater diameter than that of the extruded portion, applying pressure to the non-extruded end of the blank, while the opposite end is in engagement with an abutment, whereby the end of the extruded portion will first be shaped and thereafter the diameter of the extruded portion will be increased, and a preliminary head of still greater diameter is formed at the pressure end of the blank.

DAVIS E. BURBANK,
Administrator of Louis S. Burbank, Deceased.