

May 13, 1930.

W. H. DONNER

1,758,563

DIE ROLLING PROCESS AND APPARATUS

Filed April 30, 1926

2 Sheets-Sheet 1

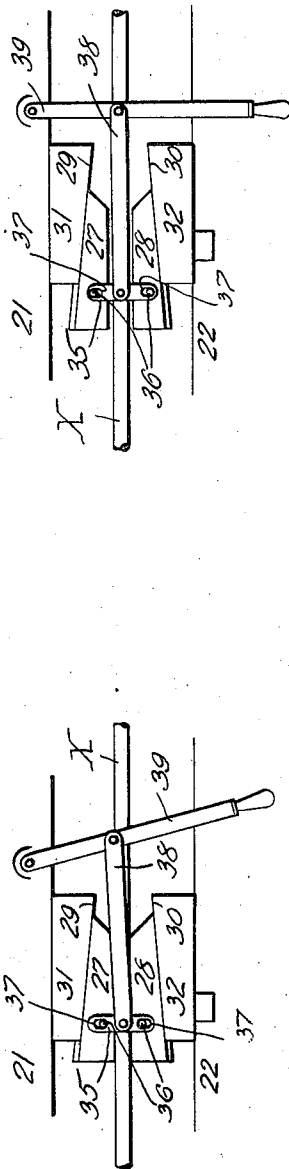
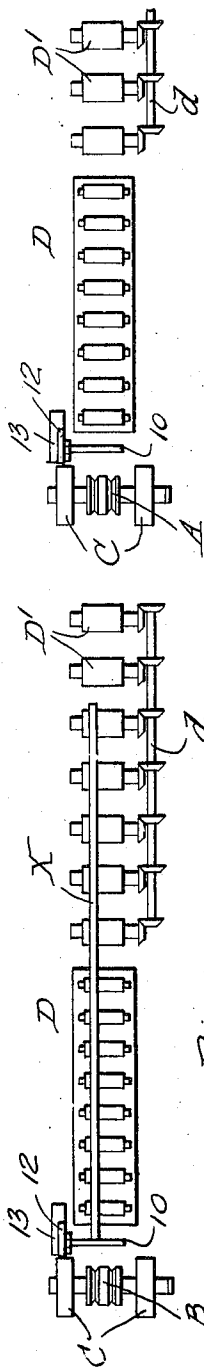


Fig. 3.

Fig. 2.

INVENTOR.

William H. Donner,

By Parker & Prochnow,
ATTORNEYS.

May 13, 1930.

W. H. DONNER

1,758,563

DIE ROLLING PROCESS AND APPARATUS

Filed April 30, 1926

2 Sheets-Sheet 2

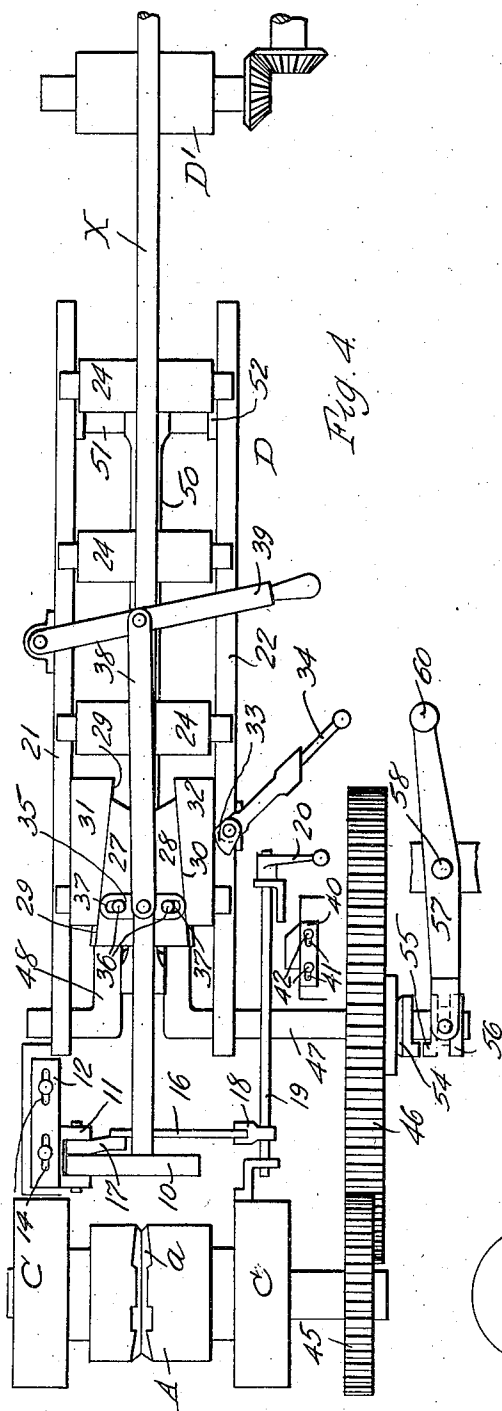


Fig. 4.

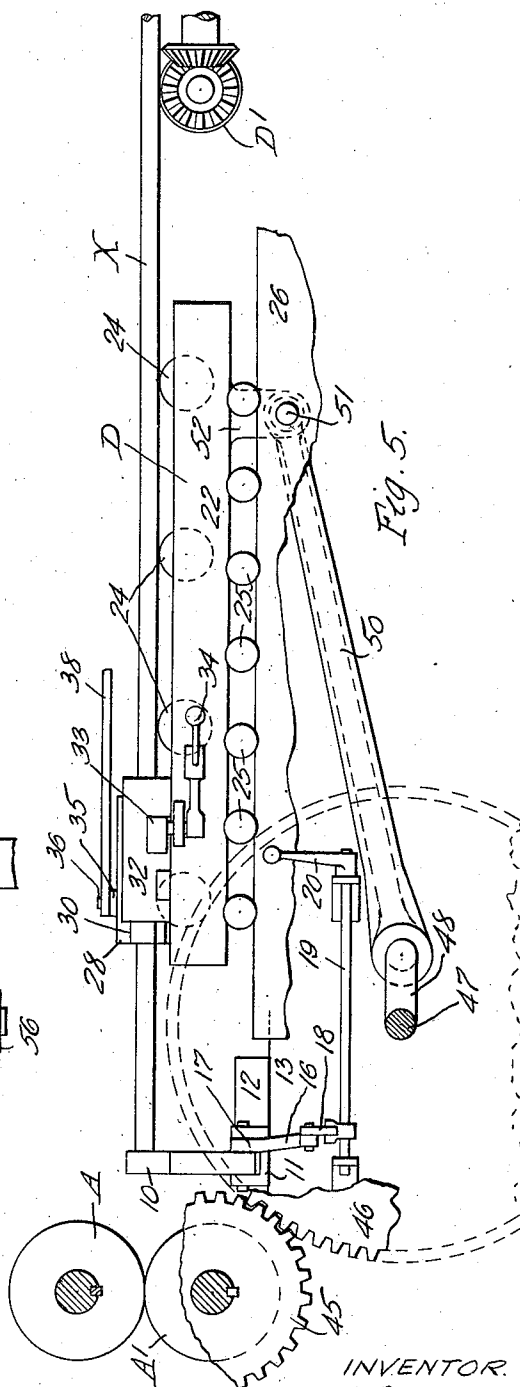


Fig. 5.

INVENTOR.
William H. Donner.
By Barker & Prochnow.
ATTORNEYS.

UNITED STATES PATENT OFFICE

WILLIAM H. DONNER, OF BUFFALO, NEW YORK

DIE-ROLLING PROCESS AND APPARATUS

Application filed April 30, 1926. Serial No. 105,724.

This invention relates to a process of and apparatus for rolling blanks of irregular cross sections in series by means of successive sets of die rolls.

Heretofore die rolling of blanks of irregular cross sections in series has been carried on only by means of a single pair of die rolls and consequently the bar of metal had to be completely formed into blanks, ready for separating and trimming after a single action of the die rolls. The variation of the cross section at different points on the blank had to be confined within a restricted range, since there are, of course, practical limits to which metal can be shaped by a single action of a pair of die rolls. In forging with dies, by hammer or press, the metal is not only subjected to several actions with a single die, but frequently to the actions of other dies, and as each action of a die squeezes the metal and reduces its thickness where applied, it will be readily seen that such blanks can be produced by a plurality of successive sets of die rolls, with a greater differential in cross section and more complicated in design than it is possible to produce with a single pair of die rolls.

It is obvious that in many designs the use of a plurality of sets of die rolls to act successively upon the bar is advantageous, as, for instance, where a greater reduction in cross section is required than can be produced with a single set of die rolls or where a more complicated pattern is involved. Two sets are also preferable in making some designs within the range of a single set because the reductions, being more gradual, are less severe, and because more perfectly formed blanks can be produced. Also less metal is required as the fin can be reduced and in some instances eliminated. The work of finishing these blanks is also lessened and their cost correspondingly reduced. The piece of metal or series of blanks after leaving the final set of die rolls, can be cut into separate blanks, the fin, if any, sheared off in a trimming press and the blank finished for the purpose as designed.

The employment of two sets of die rolls offers difficulties. In ordinary rolling prac-

tice a bar is passed from one set of rolls into another, regardless of the position of the peripheries of the rolls. Frequently only one roll in a pair is directly driven, the other being driven by friction, whereas in die rolling the peripheries of each pair must be accurately mated in accordance with the design thereon and both rolls in a set must be positively driven at the same circumferential speed and the partly formed bar in passing from one set of die rolls into another, must properly enter the succeeding set so that the action of its rolls will harmonize with the work of the preceding set.

It will be seen that if the bars have been timed to pass from one set of die rolls directly into another set rotating at a fixed speed relation, their proper entrance into the latter would be possible to arrange provided the elongation of the bars was always the same, but any variation in the elongation of the bars occurring at the first set of die rolls would change their entrance into the succeeding set with respect to the design on the peripheries of the rolls of such set, and if the action of such succeeding set is not in agreement with the configurations on the bars, made by the preceding set, failures and resultant losses must occur.

It is not practicable to always control the elongation produced by the first set of die rolls because any change in the draught of the rolls, the size of the bar or its temperature will affect the elongation. Therefore, if the partly formed bars proceed directly from one set of die rolls into another, the entrance of the partly formed bars into the succeeding set of die rolls cannot be regulated so as to ensure proper registration and failures and losses due to such variation in elongation will result. If more than two sets of die rolls are employed, these difficulties would be compounded.

Furthermore, even if the partly formed bar properly enters the succeeding set, the relative action of this set must be such that there will be no buckling or stretching of the bar between the two sets of rolls. The buckling of a small sized bar could be taken care of by looping, but not so with a large sized

bar as that would put a strain on both the bar and the die rolls. The stretching of a small bar or a large sized bar would have the same effect on the die rolls and the partly formed bar.

In ordinary rolling mills consisting of a plurality of sets of rolls, a bar passes without interruption from one set of rolls into another and it is not uncommon for the bar to be in two sets of rolls at the same time. Such a mill, however, is not practicable for most purposes in die rolling. If it were possible to produce a series of forging blanks by passing a bar directly from one set of die rolls into another, the relative speed of both sets, the question of flash, quarter turning the bar, and the reduction in cross section of the bar effected by each set would have to be so carefully taken into consideration to assure coordinate action of the two sets of rolls and to obviate buckling or stretching the bar, that a special machine to produce each type of blank would be required which could not be readily changed for rolling other designs of blanks, and even then the partly formed bar would always be subject to the danger of variation in elongation and improper registration as heretofore explained.

The objects of this invention are to provide a die rolling process and apparatus whereby various sizes and designs of blanks can be rolled by means of the same equipment, excepting, of course, the die rolls themselves; also to provide a process and apparatus for die rolling by which a bar is acted upon by only one set of die rolls at a time, and after leaving a set of die rolls is delivered with precision into a succeeding set of die rolls in such a manner that the configurations on the partly formed bar register correctly with the depressions in said rolls so as to form the series of blanks desired; also to provide a method and apparatus which is efficient, dependable, and accurate in harmonizing or coordinating the action of two successive sets of die rolls on a bar.

Other objects of this invention are to provide a method of and apparatus for die rolling in which a bar or work is so fed to the first set of die rolls that the configurations formed in each bar will be located in a definite or predetermined relation to the forward end of the bar, which predetermined relation is utilized for correctly positioning the bar or work with reference to succeeding sets of die rolls; also to provide a process and apparatus in which a bar, after it has passed through a set of rolls, is brought to a stop and then fed to a succeeding set of rolls in such a manner that the configurations on the bar will register correctly with the depressions in the rolls; also to improve methods and apparatus of this kind in other respects hereinafter specified.

In the accompanying drawings,

Fig. 1 is a top plan view showing more or less diagrammatically a die rolling mill on which my process may be carried out.

Fig. 2 is a top plan view on an enlarged scale of a single set of the work-clamping means, in clamping position.

Fig. 3 is a similar view thereof in released position.

Fig. 4 is a top plan view on an enlarged scale, of one set of die rolls and the associated feed mechanism.

Fig. 5 is a fragmentary side elevation thereof, partly in section.

In the embodiment of the invention shown in the drawings, two sets of die rolls are shown, together with the necessary mechanism for correctly feeding the bar to each set of rolls. It will be understood, however, that it is not intended to limit this invention to use in connection with two sets of die rolls only, since it is obvious that more successive sets of die rolls may be employed without departing from my invention.

In accordance with my improved method of die rolling, each bar of predetermined shape and area, is positioned and fed into operative relation to the first set of die rolls in such a manner that each bar is delivered to these rolls in definite and proper relation to the design on the peripheries of the rolls. In the first set of die rolls the forming of the first blank is started in a definite or predetermined relation to the forward end of the bar, for example, the first blank may be started exactly at the forward end of the bar, or at a definite distance rearwardly from the forward end of the bar. The object of accurately regulating the delivery of the bars into the first set of die rolls is to establish a definite or predetermined relationship between the partly formed blanks and the forward end of each bar, so that all bars after passing through the first set of die rolls will have the partly formed blanks thereon in the same relation to the forward ends of the bars. For example, if the apparatus is adjusted so that the distance from the forward end of the bar to the beginning of the first partly formed blank is one inch, this same distance will be maintained on all bars passing to the same die rolls. I thereafter use this established relationship between the partly formed blanks and the forward ends of the bars for regulating, by means of another similar delivering or feeding mechanism, the introduction of the bars into the succeeding set or sets of die rolls, so that the configurations on the bar or work will register with the rolls in proper relation to their design.

For the purpose of carrying out my invention, in accordance with the particular method illustrated, the bar or work is first brought to a stop at a definite distance from the first set of rolls, this being preferably done by stop means arranged in the path of move-

ment of the bar to the rolls. After the bar has been stopped at a definite distance from the rolls, it is advanced to or fed to the rolls in synchronism with the rotation of the pattern or depressions in the rolls so that the first partly formed blank in the bar is formed in definite predetermined relation to the forward end of the bar, and all succeeding bars are fed to the same set of rolls in the same manner, so that the configurations on all bars rolled have the same positions in relation to the forward ends of the bars. After the bar is discharged from the first set of rolls, the operation is repeated at each succeeding set of rolls, the bar being first stopped at a definite distance from the rolls and then advanced to the rolls in exact synchronism with the rolls, so that the configurations on the bar formed by a previous set or sets of rolls register accurately with the pattern on the succeeding set of die rolls.

The delivery of each bar into each of two or more successive sets of mated die rolls is mechanically controlled by a separate apparatus preceding each set of die rolls and timed therewith, which introduces successive bars into said sets at exactly the same points in the peripheries of each set and by properly adjusting the apparatus preceding the succeeding set of rolls the correct registration of the design in rolls with the configurations formed by the previous set of die rolls is insured.

It will be understood that where the process employs two sets of die rolls, the work of the first set only approaches the ultimate design of the blanks to be formed and the second set completes it. If more than two sets are used, the work of the second set is only supplementary to that of the first set and where more than two sets are used, each succeeding set must have a separate apparatus to precede it, the function of which will be the same as that of the apparatus preceding the second set.

Referring to the mechanism shown, by means of which my process may be carried on, A and A' represent, respectively, the upper and lower die rolls of the first set and B, represents the second set of die rolls, only the upper roll of which is shown in Fig. 1. These rolls may have any suitable designs, patterns or grooves α formed on their peripheries, depending upon the nature of the work which is being rolled, the action of the first set of die rolls A, A', being such as to approach somewhat the form ultimately desired. If only two sets of rolls are used, the action of the second set will produce the final shape desired. It will be understood that, while the rolls A and B are shown in the drawings as of the same diameter, the diameters of each roll depend upon the number and length of blanks designed in each roll, as the blanks are elongated in each reduc-

tion. If more than two sets of rolls are used, the action of each succeeding set of rolls will approach more closely the ultimate shape desired and attained by the last set.

Since the two sets of rolls (except for the designs on the peripheries thereof) and the apparatus for feeding the work to each set are alike, one description only will be given and the reference characters applied to both sets of rolls and apparatus. The die rolls may be mounted in any suitable or desired manner on the usual frame or bearing housings C. The work or bar X while being fed to or discharged from a set of rolls is supported on the usual roller feed table D, which in the particular construction shown includes a series of rollers on which the work may rest or move lengthwise. D' represents a series of driven rollers, driven by bevel gears from a shaft Z, and these rollers are rotated at will to advance the work of the roller feed table D.

At the entrance side of each set of rolls, a stop device is arranged in such a position that the work in passing to the rolls will engage the stop device and be held from further forward movement thereby. This stop device may be of any suitable or desired construction, that shown in the accompanying drawings including a stop member or bar 10 secured at one end to a block or hinge member 11, which is hinged or pivoted to swing the bar 10 in a vertical plane extending transversely of the direction of movement of the bar or work X. The hinge member 11 is hinged or journalled on a member 12 which is adjustably mounted on a base 13 in any suitable manner, for example the adjustable member 12 may be provided with slots 14 through which suitable bolts extend for holding the member 12 in any adjusted position relatively to the base 13. This adjustment permits the stop 10 to be positioned at different distances from the die rolls. The stop is so located that when in its horizontal position, it is located directly across the path of movement of the bar to the rolls, to stop the bar from further movement toward the rolls. The stop 10 may be moved into a position out of the path of movement of the bar X by means of any suitable mechanism. In the construction shown the bar 10 may be swung about its hinge by means of a link 16, one end of which is connected to an arm 17 of the hinge member 11 to which the bar 10 is secured, and the other end of the link 16 being pivotally connected with a crank arm 18 secured on a rotary shaft 19 suitably journalled on fixed parts of the rolling mill. One end of the shaft 19 is provided with a handle or crank 20 by means of which the shaft 19 may be turned sufficiently to move the link 16 to swing the stop 10 into or out of its operative position. Any other means for control-

ling the position of the stop bar 10 may be provided.

After the bar X to be rolled has passed upon the feed table or carriage D and has engaged the stop 10, so that further forward movement of the bar is stopped, the bar is suitably clamped on the feed table or carriage D, which, in the construction shown, includes side frame members 21 and 22 on which rollers 24 are suitably journaled, which rollers support the bar X. This roller table or carriage D is preferably mounted on rollers 25 which operate on a suitable track 26, see Fig. 5, so that the carriage may move toward and from the die rolls to feed a bar held on the carriage to the rolls.

Any suitable or desired means for clamping the work or bar X on the roller carriage D may be provided, and preferably these clamping means are made releasable so that when the rolls grip the bar and advance the same, the bar will be automatically released by the jaws. In the particular construction shown for this purpose, a pair of clamping jaws 27 and 28 are provided which are normally spaced apart and between which the bar X may enter on its way to the stop 10. The jaws 27 and 28 are provided with oppositely inclined rear faces 29 and 30, which maintain contact through at least a part of their lengths with corresponding oppositely inclined faces formed on the blocks 31 and 32. The block 31 is rigidly secured on the frame member 21 of the roller table or carriage D and the other block 32 is movable transversely of the carriage, so that when the jaws 27 and 28 are in their back positions shown in Fig. 2, the jaw assembly 28 and 32 may be moved toward the jaw parts 27 and 31 to clamp the work between the jaws. This transverse movement of the jaw 28 is preferably effected by means of an eccentric 33 journaled on the frame member 22 of the carriage and acting on the block 32, the eccentric being adapted to be turned by a hand lever 34.

It will be obvious from the foregoing description that when a bar is clamped between the jaws 27 and 28 and moving towards the die rolls at a slower speed than the peripheral speed of the die rolls, the die rolls will, after the bar enters, grip the same and draw the bar forward faster than the carriage travels, causing the jaws 27 and 28 to slide forward. The inclined bearing faces 29 and 30 of the jaws will also cause these jaws to move apart during their forward movement by the bar, and thus release the bar and permit the same to pass freely through the rolls. After the bar has passed out of the jaws, the jaws may be returned to their original positions relatively to the blocks 31 and 32 by any suitable means, for example a cross link 35 may connect with pins 36 in the jaws 27 and 28. The pins 36 preferably engage in slots 37 in the link 35 to permit lateral movement

or separation of the jaws relatively to the link. The link may be actuated to move the jaws back lengthwise to their original or gripping positions by means of a rod or bar 38 pivotally connected to the cross link 35 and the rod or bar may be actuated by means of a lever 39 pivoted at one end of the frame 21 of the roller carriage and at a distance from this end to the rod or bar 38, the free end of the lever extending into a position to be readily actuated by an operative. Any other means for returning the jaws 27 and 28 to their gripping positions may, of course, be provided.

The movement of the eccentric lever 34 into its clamping position is preferably effected by hand, and the releasing of the lever may be effected by means of an adjustable striking block 40 arranged on any suitable base, the striking block being provided with slots 41 through which clamping bolts or screws 42 extend for securing the striking block 40 on the base in different positions relative to the length of the rolling mill. The adjustable block 40 is so arranged that upon the forward movement of the carriage D, the arm 34 will come in contact with the adjustable block 40 and cause the arm to be swung to the right in Fig. 4, thus moving the movable jaw 32 away from the fixed jaw 31 to permit the bar or work X to pass through the die rolls. After the bar X has been clamped on the roller table as described, the stop bar 10 is moved by means of the hand lever 20 out of its stopping position and mechanism is then actuated for feeding the bar to the adjacent set of die rolls.

The mechanism for accurately feeding the bar to the die rolls may be of any suitable or desired construction, that shown including a gear 45 rigidly mounted on the shaft of one of the die rolls, for example on the shaft of the lower roll. This gear meshes with another gear 46 which in the particular construction shown is of twice the periphery of the gear 45, so that one revolution of the gear 45 produces a half revolution of the gear 46. This gear 46 is mounted to rotate freely about the axis of a crank shaft 47 suitably journaled on the base of the machine and having a crank portion 48 which connects with one end of a pitman or connecting link 50, the other end of which is pivoted at 51 to a part or bracket 52 secured to the roller table D. Consequently the rotation of the crank shaft 47 produces a reciprocatory movement of the roller table D lengthwise of its supporting base 26, toward and from the adjacent set of die rolls.

A driving connection between the driven gear 46 and the crank shaft 47 is established by means of a clutch of any suitable construction, which is so designed that movement of the roller carrier or table D toward the die rolls is effected during a definite portion

of the revolution of the gear 46, and consequently during a predetermined part of the rotation of the die rolls, a clutch of the kind commonly used in connection with punch presses being preferably employed. In the particular construction illustrated this clutch consists of a member 54 rigidly secured on the gear 46 and rotating therewith, and a complementary clutch member 55 splined on the shaft 47. The clutch member 55 includes a sleeve 56 having an annular groove therein, in which groove the forked end of a clutch shifting lever 57 engages. This lever is pivoted at 58 and is provided at the end thereof opposite to the forked end with a handle 60. When this handle 60 is swung in a direction to cause the clutch member 55 to move toward the clutch member 54, a driving connection will be established between the gear 46 and the crank shaft 47 as soon as the gear 46 reaches its predetermined position, which driving connection starts the rotation of the crank shaft 47 only at a predetermined portion of the movement of the gear 46. The relationship between the die rolls, the stop bar 10, the gears 45 and 46 and the clutch members 54 and 55 is such that the forward movement of the roller carriage D will feed the bar X into correct relation to the pattern or design on the periphery of the rolls. The clutch is so constructed, as is common with punch press clutches, that the two parts or members of the clutch are disengaged upon the completion of one revolution of the gear 46, such disengagement mechanism not being shown. Consequently after the clutch members have been placed into engagement the rotation of the gear 46 will turn the crank shaft 47 to move the roller carriage D toward the rolls to feed the bar into the rolls. After the bar has been gripped between the rolls, it is released from the gripping jaws 27 and 28 as described. A further separation of the jaws is effected when the clamping lever 34 engages the striking block 40 which swings this lever into a direction to move the movable jaw 28 of the gripping device away from the other jaw 27. After the roller table has completed its path of movement toward the rolls, it is returned to its initial position shown in Figs. 4 and 5 and the stop bar 10 is then swung into its operative position. The device is then ready to receive another bar. When the bar passes on to the table or carriage it comes to rest at stop 10, after which lever 39 is thrown into position as shown from Fig. 3 to the position as shown in Fig. 2, and brings the blocks 27 and 28 in contact with the bar, after which lever 34 is pulled which tightly grips the bar and secures it to the carriage, and the operation of the apparatus is then repeated as described.

It will be noted that this method permits the utilization of long bars which can be rolled more economically than short ones and

where the bar must be turned about its axis through a quarter of a revolution in entering the succeeding set of rolls, and is only in one set of rolls at a time, there is no torsion, the elimination of which is of considerable advantage in rolling bars of large diameter, and the maximum power required at any one time is less than where the bar is in two sets of rolls at the same time.

I claim as my invention:—

1. The process of die rolling a series of connected forging blanks which consists of passing a bar of metal at a forging temperature through a set of die rolls to form a series of blanks approaching in form the blank ultimately desired, then stopping the movement of said bar after the same has been discharged from said die rolls, and passing the bar into correct registration with depressions in a succeeding set of die rolls in which the partly formed blanks are further acted upon to form the same into the shape desired.

2. The process of die rolling a series of connected forging blanks which consists of passing a bar of metal at approximately forging temperature successively through different sets of die rolls, stopping the movement of the bar after the same is discharged from a set of rolls, and positively feeding said bar to a succeeding set of die rolls by movement of its support in synchronism with the rotation of said succeeding set of die rolls so that the configurations on the bar will register correctly with depressions in the succeeding set of die rolls.

3. The process of die rolling a series of connected forging blanks which consists of passing a bar of metal at approximately forging temperature successively through a plurality of sets of die rolls, feeding the bar to the first set of die rolls so that a constant and predetermined relationship is established between the forward end of the bar and the configurations produced on said bar by said die rolls, mounting the bar on a support in predetermined position thereon, and shifting said support in synchronism with a succeeding set of die rolls in a manner to present the partially formed bar to the said succeeding set of die rolls in accordance with said relationship and in synchronism with the rotation of said succeeding set of die rolls.

4. The process of die rolling a series of connected forging blanks which consists of passing a bar of metal at a forging temperature through a set of die rolls to form on the bar a series of configurations partly forming said blanks, the first of these configurations being spaced in definite relationship to the front end of the bar, and feeding the bar to a succeeding set of die rolls in accordance with said relationship by movement of the support of the bar in synchronism with the rotation of said succeeding set of die rolls.

5. The process of die rolling a series of connected forging blanks consisting of feeding the bars at a forging temperature to a set of die rolls to form a series of configurations thereon which are spaced in a definite relation to the leading ends of the bars, spacing said bars with their leading ends in a definite and accurate position relatively to a succeeding set of die rolls, and then feeding the bars from said position to said succeeding set of die rolls in synchronism with the rotation of said succeeding set of die rolls, to cause configurations on said succeeding set of die rolls to register with configurations on said bars.

6. The process of die rolling a series of connected forging blanks which consists of passing a bar of metal at a forging temperature into proximity to a set of die rolls, stopping the movement of the bar at a definite distance from said set of die rolls, delivering the bar to the die rolls so that the front end of the bar engages with a predetermined portion of said die rolls, advancing the bar in proximity to a succeeding set of die rolls, and feeding the bar into said succeeding set in definite relation thereto whereby the configurations on the bar register with the design on said die rolls.

7. The process of die rolling a series of connected forging blanks which consists of passing a bar of metal at approximately forging temperature successively through a plurality of sets of die rolls, stopping the bar with its front end located at a definite distance from each set of die rolls, gripping the bar while the same is stopped at a definite distance from the rolls, and advancing the bar from such position into the die rolls in synchronism with the rotation of said die rolls so as to enter the bar in definite relation to the rolls, and releasing the grip on said bar after the same enters said rolls.

8. The process of die rolling a series of connected forging blanks which consists of passing a bar of metal at a forging temperature through a set of die rolls in a definite relation to the pattern thereof to form a series of blanks approaching in form the blank ultimately desired, then stopping the movement of said bar after the same has been discharged from said die rolls at a predetermined distance from a succeeding set of die rolls, and positively feeding said bar toward said succeeding set of die rolls when the rolls of said succeeding set are in a predetermined position in their rotary movement, to cause the configurations of said bar to register with the depressions in said succeeding set of die rolls.

9. The process of die rolling a series of connected forging blanks by passing a bar of metal at approximately forging heat successively through different sets of die rolls, and feeding said bar, after the bar has been

discharged from a set of die rolls, to a succeeding set of die rolls having a continuous peripheral rolling pattern thereon in the same rolling relation to the pattern thereof that the bar occupied with the pattern of the preceding rolls.

10. The process of die rolling forging blanks by passing a bar of metal at a forging heat through a set of die rolls having a peripherally continuous rolling pattern to form a series of connected blanks approaching in form the blank ultimately desired, then, after said bar has been discharged from said die rolls, delivering said bar independently of other sets of rolls into correct registration with a succeeding set of die rolls also having a peripherally continuous rolling pattern, further rolling said partly formed blanks in said succeeding set of die rolls to further shape the blanks in accordance with the ultimate shape desired.

11. The process of rolling a series of connected forging blanks by passing a bar of metal at approximately forging heat successively through a plurality of sets of die rolls, accurately regulating the entrance of each bar into the first set of die rolls so as to establish a constant relation between the forward end of the bars and the configurations to be made thereon, and introducing the partly formed bars into a succeeding set of die rolls having a peripherally continuous rolling pattern in accordance with said established constant relation and in synchronism with the rotation of said succeeding set of rolls, so that the configurations on each bar will register in proper relation to the depressions in said rolls.

12. A rolling mill for die rolling forging blanks which includes a plurality of sets of die rolls arranged so that the work must pass completely out of one set of die rolls before passing to the next set of rolls, means for stopping the work at each set of die rolls with its front end in proximity to the die rolls, a gripping device which grips the work when the same is stopped, and driving connections between said die rolls and said gripping means for advancing the gripping means to position the front end of the work in definite relation to the design on said die rolls.

13. In a rolling mill for die rolling forging blanks, the combination of a plurality of sets of die rolls arranged so that the work must pass completely out of one set of die rolls before passing to the next set of die rolls, normally stationary means for gripping the work when the same is positioned at a definite distance from the rolls, and means for advancing said gripping means in synchronism with the rotation of said rolls to deliver the work to said rolls so that a definite predetermined relation is established and maintained between the leading ends of the work and the blanks formed thereon.

14. In a rolling mill for die rolling forging blanks, the combination of a plurality of sets of die rolls arranged so that the work will be in only one set of die rolls at a time, feed tables adjacent each roll and movable toward a roll to feed work to a roll, means for feeding the work to said feed tables, and means for advancing each of said feed tables toward a set of die rolls in synchronism with the rotation of the rolls so that configurations on the work will register properly with depressions in the rolls.

15. In a rolling mill for die rolling forging blanks, the combination of a plurality of sets of die rolls arranged so that work will be in only one set of die rolls at a time, feed tables adjacent each roll upon which the bars to be rolled are fed, and which feed tables are movable toward the adjacent sets of rolls to feed the bars to the rolls, means for correctly positioning the bars on the feed tables with reference to the rolls, and means for advancing the feed tables in synchronism with the rotation of the rolls to feed the bars to the rolls.

16. In a die rolling mill, the combination of a plurality of sets of die rolls spaced apart so that the work will be in only one set of die rolls at a time, stop means for stopping each bar at a predetermined distance from a set of rolls, feed tables on which the bars rest while stopped, and means for advancing the feed tables toward the rolls in synchronism with the rotation of the rolls to feed the bars to the rolls.

17. In a die rolling mill, the combination of a plurality of sets of die rolls arranged so that the work will be in only one set of die rolls at a time, means for feeding the bars to the rolls, stops for interrupting the movement of the bars to the rolls, and means for advancing the bars, after they have been stopped, to the rolls in synchronism with the rotation of the rolls.

18. In a die rolling mill, the combination of a plurality of sets of die rolls arranged so that the work will be in only one set of die rolls at a time, means for stopping the bars at predetermined distances from the rolls, clamping devices for engaging the bars while stopped, means for moving said clamping devices toward the rolls to feed the bars to the rolls, and means for releasing the clamping devices when the bars are gripped by the rolls.

19. In a die rolling mill, the combination of a plurality of sets of die rolls arranged so that the work will be in only one set of die rolls at a time, gripping devices for engaging said bars, means for advancing said gripping devices toward the rolls to feed the bars to the rolls, said gripping devices including jaws which are movable by said bar when said bar is advanced by said rolls, to cause said movable jaws to release the bars.

20. In a die rolling mill, the combination of a plurality of sets of die rolls arranged so that the work will be in only one set of die rolls at a time, means for stopping said bars at predetermined distances from each set of rolls, and means for advancing the bars after the same have been stopped, to the rolls, said means including a crank adapted to be rotated from said rolls and a clutch for coupling said crank with one of said rolls at a certain point in the rotation of said rolls to cause said bars to be fed to said rolls in synchronism with the rotation of the rolls.

21. In a die rolling mill, the combination of a plurality of sets of die rolls arranged so that the work will be in only one set of die rolls at a time, means for stopping said bars at predetermined distances from each set of rolls, means for advancing the bars after the same have been stopped, to the rolls, and a clutch for connecting said advancing means with one of said rolls, said clutch serving to connect said advancing means with said roll at a predetermined point of the revolution of said roll to cause the bar to be fed to the rolls in synchronism with the rotation thereof.

22. In a die rolling mill, the combination of a plurality of sets of die rolls arranged so that the work will be in only one set of die rolls at a time, stops arranged in the path of movement of the bars to said rolls, means for adjusting said stops relatively to said rolls to cause said bars to be stopped at the desired distances from said rolls, feed tables upon which said bars rest when stopped, means on said feed tables for engaging said bars while stopped, mechanism for advancing said feed tables toward said rolls to feed said bars to said rolls, drive connections between said feed table advancing mechanism and an adjacent set of rolls, a clutch in said drive connections which begins the operation of said drive connections during a predetermined point of the revolution of the rolls of the set to which the bar is to be fed, to cause the configuration on the bar to register correctly with depressions in the rolls, and means for releasing said gripping means when the bars are advanced by said rolls.

23. The process of die rolling a series of connected blanks, which consists in transferring a bar of metal of uniform cross section at approximately forging temperature until it reaches a predetermined position on a delivering table, having a positive forward movement timed with the rotation of the die rolls to which it delivers the bar, positioning and attaching the bar to the table, starting forward the table with the attached bar and delivering it into a set of die rolls, automatically releasing the bar from the delivering table as the bar enters the rolls, thereby establishing a relationship between the forward end of the bar and the configurations

thereon produced by the die rolls, transferring the deformed bar after it passes through the die rolls onto another delivering table in a predetermined position thereon, positioning the deformed bar on this delivering table and attaching it thereto, starting forward the table with the attached bar in the same relation to the pattern of the second set of rolls that it occupied with respect to the pattern in the preceding rolls, and automatically releasing the bar after it enters the rolls, whereby the bar will be properly acted upon and formed into the shape desired.

24. The process of die rolling a series of connected blanks, which consists in transferring a bar of metal of uniform cross section at approximately forging temperature until it reaches a predetermined position on a delivering table, having a positive forward movement timed with the rotation of the die rolls to which it delivers the bar, positioning and attaching the bar to the table, starting forward the table with the attached bar and delivering it into a set of die rolls, automatically releasing the bar from the delivering table as the bar enters the rolls, thereby establishing a relationship between the forward end of the bar and the configurations thereon produced by the die rolls, transferring the deformed bar after it passes through the die rolls onto another delivering table in a predetermined position thereon, turning the deformed bar on this delivering table and attaching it thereto, starting forward the table with the attached bar in the same relation to the pattern of the second set of rolls that it occupied with respect to the pattern in the preceding rolls and automatically releasing the bar after it enters the rolls, whereby the bar will be properly acted upon and formed into the shape desired.

25. The process of die rolling a series of connected forging blanks which consists of passing a bar of metal at a forging temperature into proximity to a set of die rolls, stopping the movement of the bar at a definite distance from said set of die rolls, delivering the bar to the die rolls so that the front end of the bar engages with a predetermined portion of said die rolls, advancing the bar in proximity to a succeeding set of die rolls, placing the bar in the same position from said succeeding set of die rolls that it occupied before the preceding set of die rolls, and then feeding the bar into engagement with said succeeding set of die rolls in synchronized relation to the pattern of those rolls, whereby the configurations of the bar will properly register with the configurations of the pattern on the said second set of die rolls while passing therethrough.

WILLIAM H. DONNER.