Dec. 19, 1939. C. G. OLSON 2,183,688

MEANS FOR AND METHOD OF ROLLING SCREW THREADS

Filed April 24, 1937

FIG. 1.

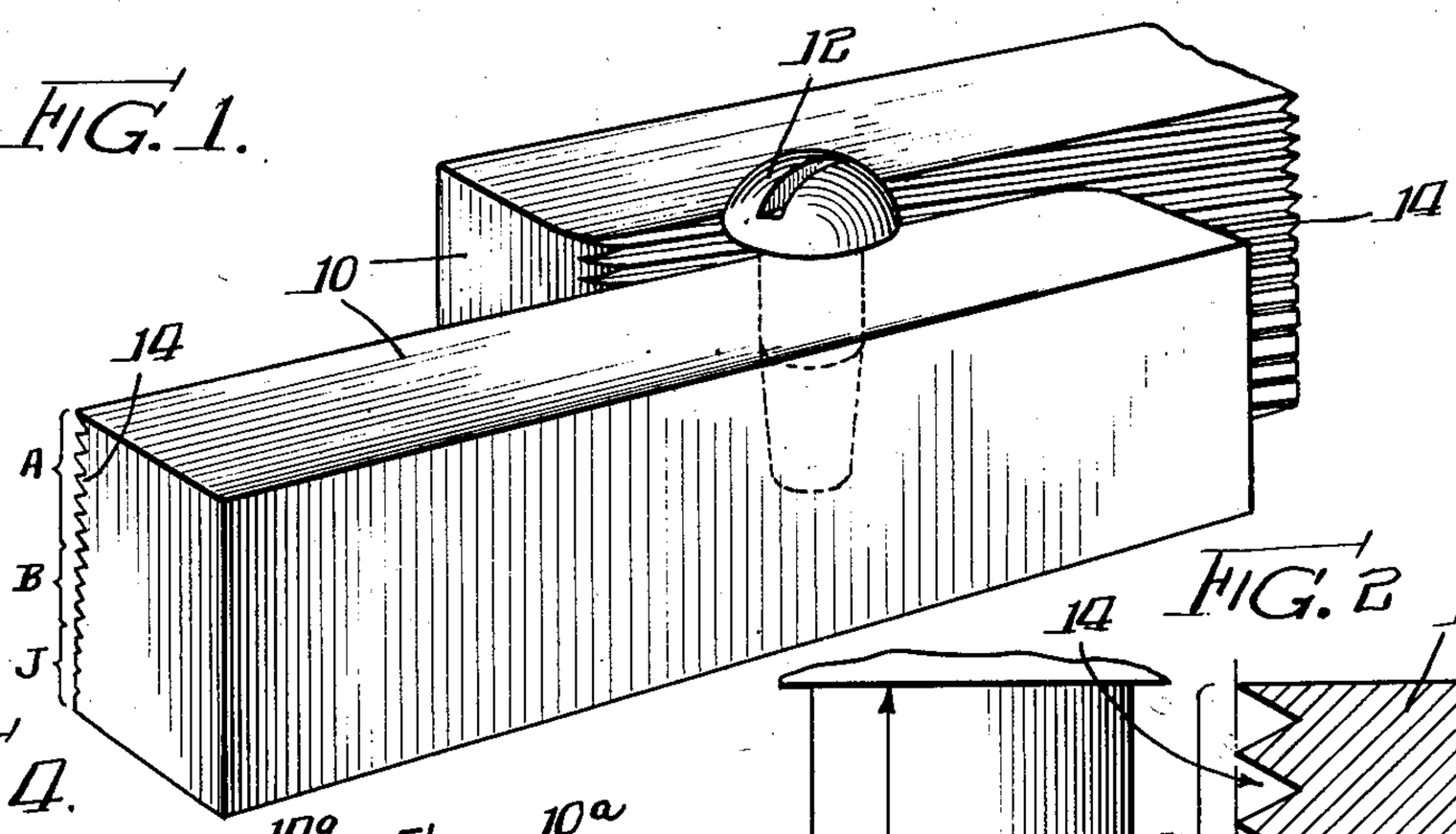


FIG. 4.

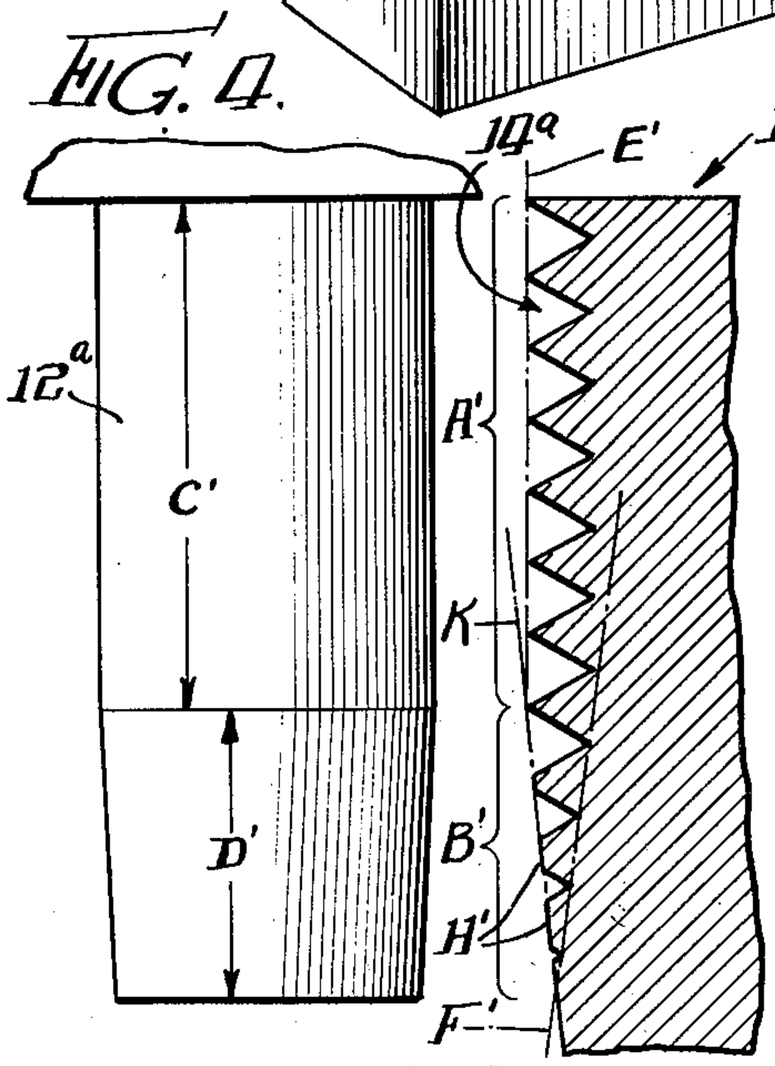


FIG. 2.

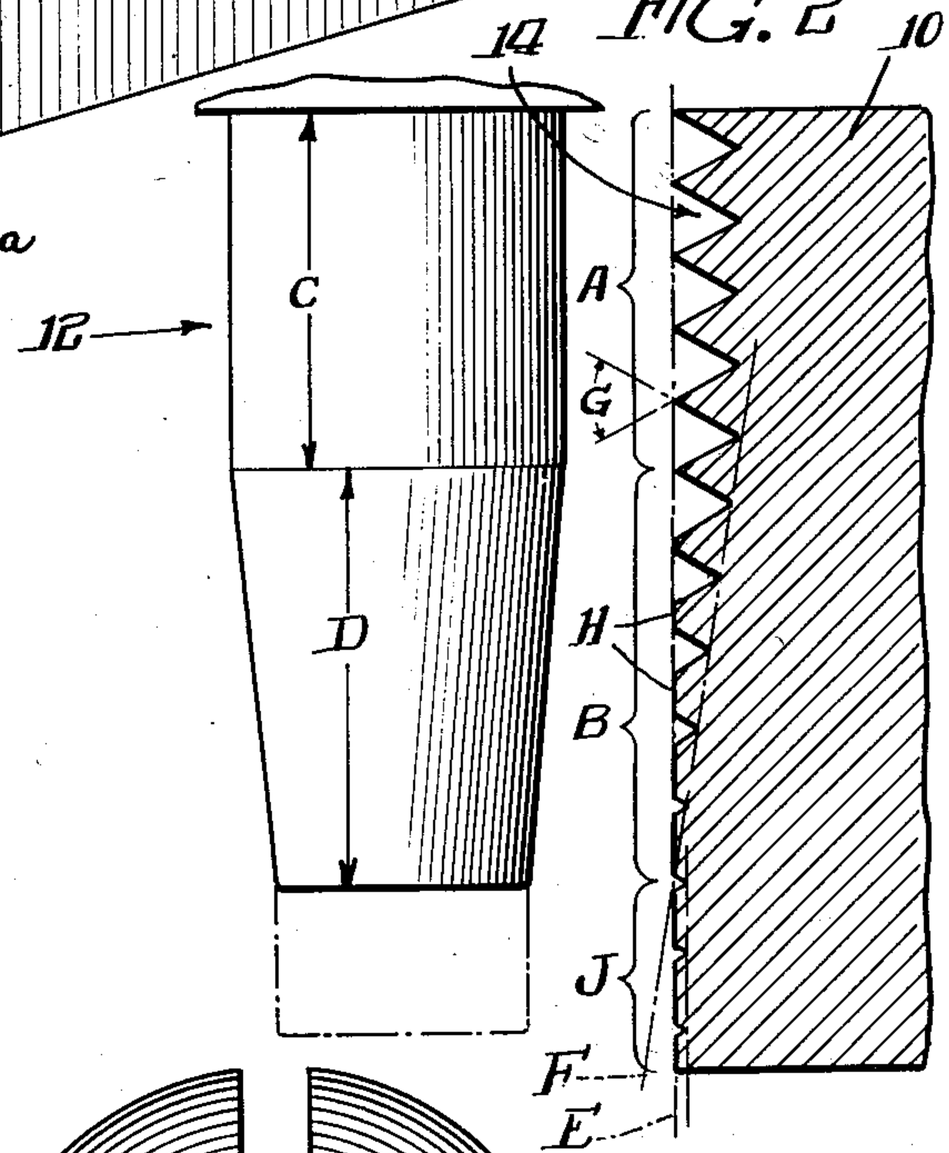


FIG. 5.

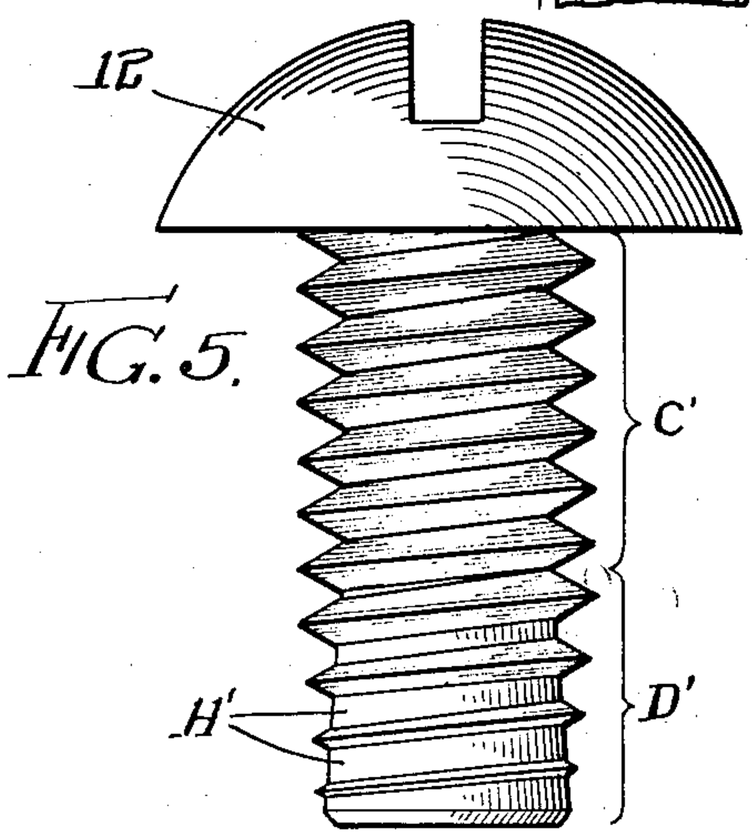
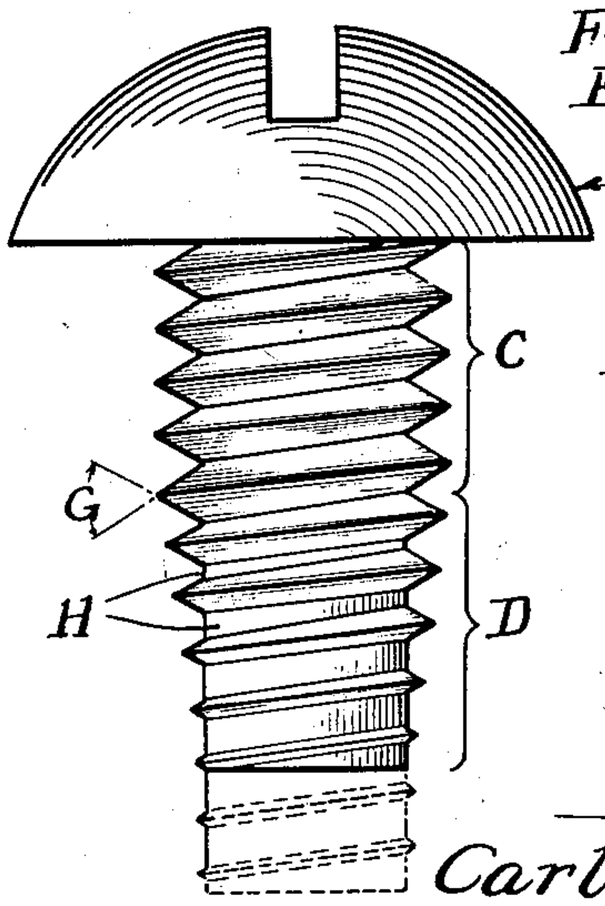


FIG. 3.



Inventor
Carl G. Olson
By:- Cox & Moore attys

Patented Dec. 19, 1939 2,183,688

UNITED STATES PATENT OFFICE

2,183,688

MEANS FOR AND METHOD OF ROLLING SCREW THREADS

Carl G. Olson, Chicago, Ill., assignor to Illinois Tool Works, Chicago, Ill., a corporation of Illinois

Application April 24, 1937, Serial No. 138,757

17 Claims. (Cl. 80—9)

This invention relates generally to means for and methods of rolling screw threads, and more particularly to apparatus and methods whereby screws of the self-threading or self-tapping variety may be rolled.

The present invention contemplates rolling a thread on the screw blank in such a manner as to produce a thread of uniform crown cross-section with a gradual taper at the entering end without subjecting the core of the screw at the entering end to any reduction in diameter.

It is a further object of the present invention to provide means and methods whereby a blank may be provided with a holding portion having conventional machine screw threads of constant height and the entering portion with thread convolutions of diminishing crest diameter and of uniform crown cross-section, exposed core portions being presented between convolutions on the entering end of the screw.

More specifically the invention contemplates means and methods whereby screws of the above mentioned type may be rolled, and in which the above mentioned core at the entering end actually increases in diameter and the thread thereon decreases in crest diameter.

Still another object of the present invention is to present thread rolling dies having the working surfaces thereof configurated so as to roll threads of the above mentioned type upon a screw blank.

The foregoing and numerous other objects and advantages will be more apparent from the following detailed description when considered in connection with the accompanying drawing, wherein—

Figure 1 is a perspective view of a pair of thread rolling dies constructed in accordance with the teachings of the present invention, a partially rolled screw bank being shown in operative association with the working faces of said dies;

Figure 2 is an enlarged vertical sectional view of one of the dies of Figure 1 positioned adjacent a screw blank which is adapted to be rolled by said die;

Figure 3 is a side elevational view of the screw after it has been rolled between dies of the type shown in Figures 1 and 2, the extension shown in the dotted lines on the screw indicating the manner in which the thread on the blank of Figure 2 will be rolled if an extension, as indicated by the dot-and-dash lines of Figure 2, is provided on said blank;

Figure 4 discloses a die of slightly modified form in association with a screw blank; and

Figure 5 is a side elevational view of a screw adapted to be rolled by dies of the type shown in Figure 4, the screw of Figure 5 differing from the screw of Figure 3 in that the core diameter at the entering end increases, whereas the core diameter of the screw in Figure 3 is constant throughout the entire extent of the screw body.

Referring now to the drawing more in detail wherein like numerals have been employed to designate similar parts throughout the various figures, it will be seen that the invention contemplates means in the form of dies or die blocks 10, whereby my improved method of thread rolling may be effectively practiced. The die blocks 10 are preferably of a size and shape which enables them to be mounted in conventional thread rolling machines (not shown). In these conventional machines one of the dies is held in a fixed position and the other is reciprocably mounted. In Figure 1 the foremost die block is stationary, whereas the rearmost die is reciprocable. A screw blank indicated generally by the numeral 12 is adapted to be rolled between the working faces 14 of the die blocks, the blank being initially positioned at the right end of the front block, the reciprocable die block serving to grip the blank and roll it between said working surfaces 14.

Particular attention is directed to the structural characteristics of the working surfaces 14, and these characteristics may best be observed in Figure 2. Each working surface 14 comprises a plurality of serrations which are inclined with respect to the horizontal in accordance with the desired thread angle in the completed screw. The serrations on each working surface 14 may be divided into two distinct groups, one group being indicated by the bracket A (Figure 2) and the other group being indicated by the bracket B in Figure 2. The group A constitutes serrations of constant height in transverse cross section which, when impressed within the corresponding portion C of the screw blank 12, produces threads of constant height and constant root diameter indicated by the bracket C in Figure 3. This portion C of the screw may properly be referred to as the holding portion because this is the part of the screw which is held within the work.

The portion B of the die 10 includes parallel serrations which, in cross section, gradually diminish in height with respect to a plane indicated by a dot-and-dash line E of Figure 2. This

plane E is coincident with the crests of the constant height serrations included within the bracket A of Figure 2. A dot-and-dash line F (Figure 2) indicates the degree with which the serrations B diminish in height. Attention is directed to the fact that the included angle of the serrations on the die 10 indicated by the letter G (Figure 2) remains constant along the sections A and B. In other words, the included angle of the walls defining the parallel ribs or ridges on the die 10 remains constant. Thus, although the V-shaped recesses included within the group B on the die 10 become shallower, the side walls which define these recesses have a constant included angle, so that in cross-section the V bottoms of the serrations included within groups A and B remain constant. Furthermore, the distance between the bottoms of the V grooves in the die 10 measured along a line parallel with the dot-and-dash line E is constant.

In addition to the foregoing structural characteristics, it will be noted that the outer surfaces or crests of the ribs included within the zone B are provided with flat surfaces H, which are coincident with the plane indicated by the dot-and-dash line E and which increase in width toward the lower portion of the section or zone B. The letter D in Figure 2 indicates the portion of the screw blank which is adapted to be acted upon by the zone B of the die 10, and in Figure 3 the portion D of the screw is formed by the serrations of the die section B. The included thread angle G of the die 10 produces a thread in the screw having the same included angle, and the flat surfaces H of the ribs on the section B of the die produce corresponding exposed peripheral core surfaces H on the screw of Figure 3. These exposed core surfaces H increase in axial width and the diameter thereof remains constant, said diameter being equal to the root diameter along the portion C of the screw. The fact that the outermost portions of the die serrations or teeth lie within the plane E positively prevents the diameter of the exposed core portions H from being less or greater than the root diameter of the full threads along the section C, provided that the taper of the blank 12 is such as to enable the valleys or grooves within the die 10 to be completely filled by the material of the blank. In other words, the taper of the blank 12 must be so related to the tapering of the grooves of the die as indicated by the dot-and-dash line F of Figure 2 as to insure complete filling of the grooves in the die. Any insufficiency of material in the blank would cause an incomplete or unfilled thread to be formed by the die. Also, the serrated working surfaces 14 of the die blocks must be accurately spaced in accordance with the diameter of the screw blank in order to insure the proper formation of the threads.

It will be apparent from the foregoing that the invention contemplates a method of thread rolling whereby incomplete or unfilled threads at the entering end of a screw are eliminated. In conventional types of die blocks which have heretofore been used in rolling screw threads, the serrations or die teeth are of substantially equal depth over the entire working face of the die. Hence, if a screw blank having a slightly tapered end is rolled between a pair of such dies, the insufficiency of the metal, due to the presence of the taper in the blank, will result in the formation of incomplete or unfilled thread convolutions in the screw. The present invention contemplates the complete avoidance of such thread formations, and, in fact, insures the formation of thread convolutions extending along both the holding and the thread forming portions of the screw which have a perfect uniform crown cross-section. When the thread forming screw provided with the thread structure shown in Figure 3 is hardened and applied to an unthreaded aperture in a work piece, it is only necessary for the entering thread convolutions to slightly engage the work so as to start a helical path in the work. As the screw continues to be turned into the work, it is necessary for the succeeding thread convolutions to become greater in height until the full height of the thread on the holding portion is reached. By having the core portions along the entering end of the screw exposed, as indicated by the surfaces H, the strength of the screw at this extremity is maintained. On smaller sized screws, when the valley of the thread extends below the root diameter of the holding portion, the core is materially weakened. By employing the herein described method of thread rolling, the strength of the screw at the entering end is not impaired because the core diameter is not less than the root diameter of the holding portion, and at the same time the thread in the vicinity of the exposed core surfaces H sufficiently extends outwardly therefrom to effectively engage the work in forming a female thread in the work.

The die 10 is also provided with a section or zone indicated by the letter J (Figure 2). If it is desired to continue the thread of small height beyond the point indicated by the solid lines in Figure 3, it is only necessary to roll the thread on the blank which includes the dot-and-dash portion indicated in Figure 2. This will cause the screw to be formed with the thread convolutions and juxtapositioned exposed core surfaces indicated by the dotted lines in Figure 3. This structure affords a plurality of convolutions at the entering end of the screw of constant height which merge with the thread forming section D of the screw.

In Figure 4 a slightly modified die is shown which is designated generally by the numeral 10*a*. This die is provided with a working face 14*a* designed to cooperate with a companion oppositely disposed working face in rolling a thread upon a screw blank 12*a*. The die 10*a* is provided with a zone or section A' and a section or zone B'. The serrations or teeth within the zone A' are constant in height and extend in parallelism similarly to the serrations or teeth A of the die 10. The outer edges of the serrations in the zone A' are positioned within a common plane designated by the dot-and-dash line E'. The bottoms of the grooves in the die 10*a* positioned within the zone B' taper with respect to the plane E', as indicated by the dot-and-dash line F'. The ribs or serrations included within the zone B' have flat outer surfaces H' which increase in width toward the bottom of the die. Particular attention is directed to the fact that these flat surfaces H' of increasing width lie in a plane designated by a dot-and-dash line K which is angularly disposed with respect to the plane E'. This is to be distinguished from the outer surfaces H of the die 10 (Figure 2) which lie within the plane E.

When the blank 12*a* is rolled between a pair of the dies 10*a*, the die serrations in the zone A' produce thread convolutions of constant height and constant root diameter along the portion C'

of the screw blank 12*a*, and the serrations or die teeth in the zone B' act upon the portion D' of the screw blank 12*a*. Referring to Figure 5, it will be seen that the holding portion C' of the screw is rolled by the zone A' of the die 10*a*, and the entering or thread forming portion D' of the screw is formed by the zone B' of the die. By reason of the angular disposition of the plane K with respect to the plane E', the exposed peripheral core surfaces extending between the thread convolutions at the entering end of the screw (Figure 5) increase in diameter toward the entering end thereof. This is to be distinguished from the exposed core surfaces H of the screw in Figure 3, which are of a constant diameter equal to the root diameter of the holding portion C. The increase in the core diameter toward the entering end of the screw lends additional strength to the screw body in this vicinity and has other functional advantages over the screw shown in Figure 3.

From the foregoing description it will be apparent that the present invention contemplates a novel and improved method of rolling threads on a screw blank. Practicing a method of rolling screw threads by the use of dies similar to the die 10 in Figure 2 produces thread convolutions of constant height and root diameter along the holding section of the screw blank, and threads of diminishing height along the entering end of the screw which have a crown cross-section corresponding with the crown cross-section of the full height threads. This method of thread rolling causes the material of the blank to flow outwardly in a predetermined manner along the tapering portion of the blank with the result that the core diameter of the completed screw at the entering end maintains a diameter which is at least equal to the root diameter of the thread convolutions on the holding portion of the screw. Likewise, in practicing a method of rolling threads by the use of dies similar to the die 10*a* (Figure 4), a thread configuration at the entering end of the screw is provided wherein the crown cross-section is not only maintained uniform throughout the entire length of the screw thread, but the root or core diameter at the entering end of the screw is increased toward the entering end of the screw. The above described method is particularly adaptable in connection with the production of tapping or thread forming screws which are designed to form internal machine screw threads in an unthreaded aperture of a work piece. To this end the invention contemplates a die which will produce thread convolutions having uniform axial pitch along the crest of the completely rolled thread and exposed peripheral core surfaces extending between the thread convolutions of decreasing crest diameter along the entering end of the screw. The dies which are disclosed and described herein are provided with serrated working surfaces, in which the crests and valleys thereof are located in predetermined planes. In one of the dies, namely, the die 10, the outer or crest portions of the die teeth are positioned in a common plane which enables the production of a screw having a constant core or root diameter. The other die construction, namely, the die 10*a* is formed with serrations or die teeth, the outer surfaces of which lie in a common plane along one zone, and in another plane along a second zone, whereby to produce a screw having a constant root diameter along the holding portion and exposed peripheral core surfaces which increase in diameter along the entering or thread forming portion.

It will also be apparent from the foregoing that the invention contemplates methods of rolling threads in which the periphery of a metal screw blank is indented at spaced intervals so as to cause the metal along the periphery to flow, and also contemplates the step of confining the flow of metal along one zone of the blank, for example, the zones C and C' within cavities of uniform or V-shaped cross-section, for example, the V-shaped elongated cavities or recesses included within the zones A and A' of the dies, and simultaneously confining the flow of metal along a second zone, for example, the zones D—D' of the screw blank within a plurality of cavities or recesses of decreasing cross-section, for example, the elongated die cavities or recesses within the zones B—B' of the dies. Also, the points of maximum indentation along the second zone are maintained at radial distances from the blank axis which are not less than the corresponding radial distances from said axis of the points of maximum indentation along the first zone. Thus, the teeth in the die 10 will cause indentations along the zone D of the screw in Figure 3, and the maximum points of indentation along the zone D in the screw are positioned the same radial distances from the screw axis as the points of maximum indentation along the zone C. In using the die 10*a*, the points of maximum indentation produced by the zone B' of said die are maintained at a greater distance from the screw axis (see Figure 5) than the points of maximum indentation along the zone C' of said screw.

A screw structure of a type adapted to be produced by the means and method described herein is disclosed and claimed in applicant's copending application, Serial No. 137,720, filed April 19, 1937, for Threaded Fasteners, which has since matured into Patent No. 2,113,600. In said copending application, screws of the type provided with a serrated cutting edge for tapping the thread in an aperture are disclosed, as well as unslotted screws designed to indent or crowd their way into the work to produce an internal thread. The present application contemplates means and methods whereby screws of the aforesaid slotted and unslotted types may be rolled.

In considering the disclosure in the drawings, it should be borne in mind that the degree of taper on the blanks and on the teeth of the dies as shown are only illustrative. In other words, the dimensional structural features, as shown in the drawings, are only for illustrative purposes, and obviously in the practical commercial embodiment of the invention these dimensions and specific structural details may be departed from without digressing from the invention described and claimed herein.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Thread rolling means including die means adapted to roll a thread upon a screw blank, said die means having a working surface including a zone comprised of elongated die teeth of constant cross-sectional height and a second zone provided with elongated die teeth which, in cross-section, decrease in height as they digress laterally from the first zone for rolling the entering portion of a screw body, the outermost portions of the die teeth in the first zone lying in a common plane and the outermost portions of the die teeth in the second zone positioned so as not to extend

beyond the above mentioned plane, the bottom areas between said die teeth being of uniform cross-section.

2. Thread rolling means including die means adapted to roll a thread upon a screw blank, said die means having a working surface including a zone comprised of elongated die teeth of constant cross-sectional height and a second zone provided with elongated die teeth which, in cross-section, decrease in height as they digress laterally from the first zone, the outermost portions of the die teeth in the first zone lying in a common plane and the outermost portion of the die teeth in the second zone positioned in the above mentioned plane, the bottom areas between said die teeth being of uniform cross-section.

3. Thread rolling means including die means adapted to roll a thread upon a screw blank, said die means having a working surface including a zone comprised of elongated die teeth of constant cross-sectional height and a second zone provided with elongated die teeth which, in cross-section, decrease in height as they digress laterally from the first zone for rolling the entering portion of a screw body, the outermost portions of the die teeth in the first zone lying in a common plane and the outermost portions of the die teeth in the second zone positioned so as not to extend to the above mentioned plane.

4. Thread rolling means including die means adapted to roll a thread upon a screw blank, said die means having a working surface including a zone comprised of elongated die teeth of constant cross-sectional height and a second zone provided with elongated die teeth which, in cross-section, decrease in height as they digress laterally from the first zone for rolling the entering portion of a screw body, the outermost portions of the die teeth in the first zone lying in a common plane and the outermost portions of the die teeth in the second zone positioned in a common plane so as not to extend beyond the above mentioned plane, the bottom areas between said die teeth being of uniform cross-section.

5. Thread rolling means including die means adapted to roll a thread upon a screw blank, said die means having a working surface including a zone comprised of elongated die teeth of uniform cross-section and a second zone provided with elongated die teeth which decrease in cross-section as they digress laterally from the first zone for rolling the entering portion of a screw body, the die teeth in said second zone extending outwardly to points which do not lie beyond the outer extremities of the teeth in the first zone, the bottom areas between said die teeth being of uniform cross-section.

6. Thread rolling means including die means adapted to roll a thread upon a screw blank, said die means having a working surface including a zone comprised of elongated die teeth of constant cross-sectional height and a second zone provided with elongated die teeth which, in cross-section, decrease in height as they digress laterally from the first zone for rolling the entering portion of a screw body, the outermost portions of the die teeth in the first zone lying in a common plane and the outermost portions of the die teeth in the second zone having flat surfaces positioned so as not to extend beyond the above mentioned plane.

7. Thread rolling means including die means adapted to roll a thread upon a screw blank, said die means having a working surface including a zone comprised of elongated die teeth of constant cross-sectional height and a second zone provided with elongated die teeth which, in cross-section, decrease in height as they digress laterally from the first zone for rolling the entering portion of a screw body, the outermost portions of the die teeth in the first zone lying in a common plane and the outermost portions of the die teeth in the second zone having surfaces of increasing lateral width positioned so as not to extend beyond the above mentioned plane.

8. Thread rolling means including die means adapted to roll a thread upon a screw blank, said die means having a working surface including a zone comprised of elongated die teeth of uniform cross-section and a second zone provided with elongated teeth which decrease in cross-section as they digress laterally from the first zone for rolling the entering portion of a screw body, the die teeth on the second zone extending outwardly to points which do not lie beyond the outer extremities of the teeth in the first zone, the teeth in the second zone being truncated.

9. Thread rolling means including die means adapted to roll a thread upon a screw blank, said die means having a working surface including a zone comprised of elongated die teeth of uniform cross-section and a second zone provided with elongated teeth which decrease in cross-section as they digress laterally from the first zone for rolling the entering portion of a screw body, the die teeth on the second zone extending outwardly to points which do not lie beyond the outer extremities of the teeth in the first zone, the teeth in the second zone being truncated and presenting flat outer surfaces.

10. Thread rolling means including die means adapted to roll a thread upon a screw blank, said die means having a working surface including a zone comprised of elongated die teeth of uniform cross-section and a second zone provided with elongated teeth which decrease in cross-section as they digress laterally from the first zone for rolling the entering portion of a screw body, the die teeth on the second zone extending outwardly to points which do not lie beyond the outer extremities of the teeth in the first zone, the teeth in the second zone being truncated and presenting outer surfaces of progressively increasing width.

The method of rolling screw threads which consists in indenting the periphery of a metal screw blank at spaced intervals so as to cause the metal along said periphery to flow, confining the flow of metal along one zone of said blank within cavities of uniform V-shaped cross-section, simultaneously confining the flow of metal along a second adjoining zone toward the entering end of the blank within a plurality of cavities of decreasing V-shaped cross-section having the same included angle as the first mentioned V-shaped cavities, and maintaining the points of maximum indentation along said second zone at radial distances from the blank axis which are not less than the corresponding radial distances from said axis of the points of maximum indentation along the first zone.

12. The method of rolling screw threads which consists in indenting the periphery of a metal screw blank at spaced intervals so as to cause the metal along said periphery to flow, said blank being tightly tapered toward the entering end thereof, confining the flow of metal along one zone of said blank within cavities of uniform V-shaped cross-section, simultaneously confining the flow of metal along the tapered portion of

the blank within a plurality of cavities of decreasing V-shaped cross-section having the same included angle as the first mentioned V-shaped cavities, and maintaining the points of maximum indentation along said second zone at radial distances from the blank axis which are not less than the corresponding radial distances from said axis of the points of maximum indentation along the first zone.

13. The method of rolling screw threads which consists in indenting the periphery of a metal screw blank at spaced intervals so as to cause the metal along said periphery to flow, confining the flow of metal along one zone of said blank within cavities of uniform V-shaped cross-section, simultaneously confining the flow of material along a second adjoining zone toward the entering end of the blank within a plurality of cavities of decreasing V-shaped cross-section having the same included angle as the first mentioned V-shaped cavities, and maintaining the points of maximum indentation along said second zone at radial distances from the blank axis which are equal to the corresponding radial distances from said axis of the points of maximum indentation along the first zone.

14. The method of rolling screw threads which consists in indenting the periphery of a metal screw blank at spaced intervals so as to cause the metal along said periphery to flow, confining the flow of metal along one zone of said blank within cavities of uniform V-shaped cross-section, simultaneously confining the flow of metal along a second adjoining zone toward the entering end of the blank within a plurality of cavities of decreasing V-shaped cross-section, and maintaining the points of maximum indentation along said second zone at radial distances from the blank axis which are greater than the corresponding radial distances from said axis of the points of maximum indentation along the first zone.

15. The method of rolling screw threads which consists in indenting one zone of the periphery of a metal screw blank at spaced intervals so as to cause the metal along said zone to flow, confining the flow of metal along said zone within juxtapositioned cavities of uniform V-shaped cross-section, simultaneously confining the flow of metal along a second adjoining zone toward the entering end of the blank within a plurality of axially spaced cavities of decreasing V-shaped cross-section, and controlling the points of maximum indentation along said zones to predetermined radial distances from the blank axis.

16. The method of rolling screw threads which consists in indenting one zone of the periphery of a metal screw blank at spaced intervals so as to cause the metal along said zone to flow, confining the flow of metal along said zone within juxtapositioned cavities of uniform V-shaped cross-section, simultaneously confining the flow of metal along the second adjoining zone toward the entering end of the blank within a plurality of axially spaced cavities of decreasing V-shaped cross-section, and maintaining the points of maximum indentation along said second zone at radial distances from the blank axis which are not less than the corresponding radial distances from said axis of the points of maximum indentation along the first zone.

17. The method of rolling screw threads which consists in indenting one zone of the periphery of a metal screw blank at spaced intervals so as to cause the metal along said zone to flow, confining the flow of metal along said zone within juxtapositioned cavities of uniform V-shaped cross-section, simultaneously confining the flow of metal along a second adjoining zone toward the entering end of the blank within a plurality of progressively spaced cavities of decreasing V-shaped cross-section, and controlling the points of maximum indentation along said zones to predetermined radial distances from the blank axis.

CARL G. OLSON.

CERTIFICATE OF CORRECTION.

Patent No. 2,183,688. December 19, 1939.

CARL G. OLSON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 40, for the word "bank" read blank; page 4, first column, line 13, claim 2, for "portion" read portions; same page, second column, line 50, before "The" insert the claim number and period 11.; line 71, claim 12, for "tightly" read slightly; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 30th day of January, A. D. 1940.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.