

April 27, 1965

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3,180,202

FLUTELESS THREAD-FORMING TOOLS

Filed May 28, 1963

3 Sheets-Sheet 1

FIG. 1

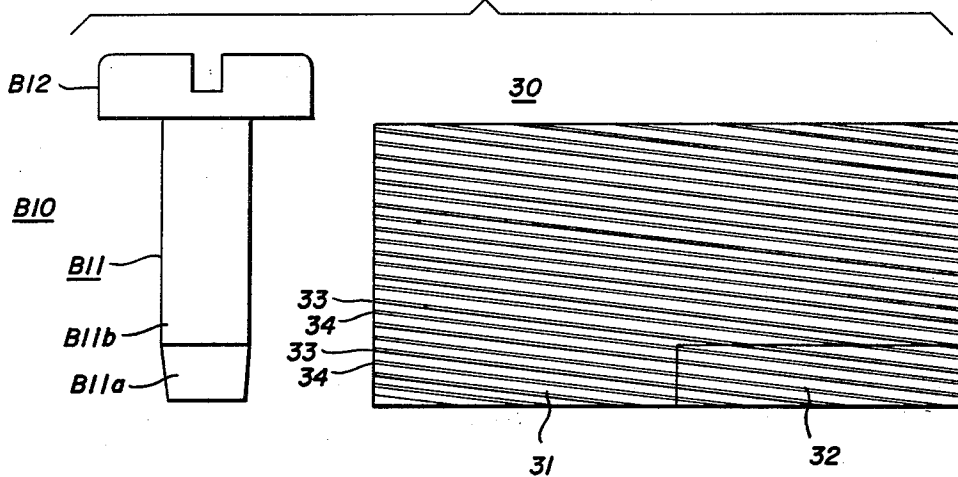


FIG. 2

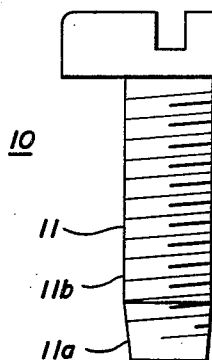


FIG. 3

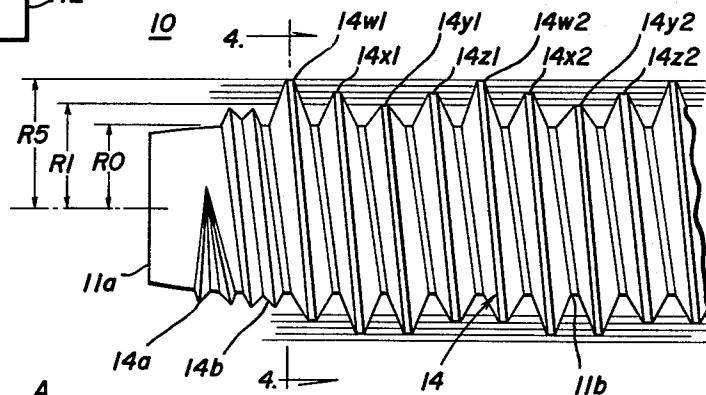
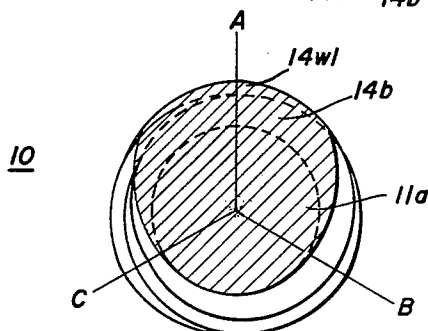


FIG. 4



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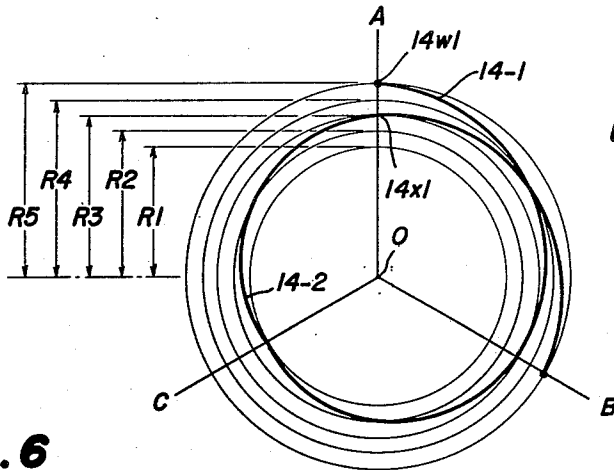


FIG. 5

FIG. 6

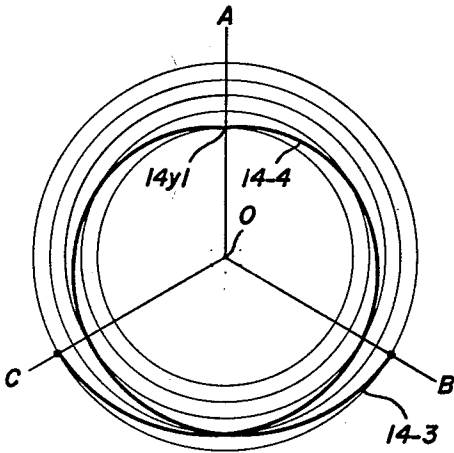


FIG. 7

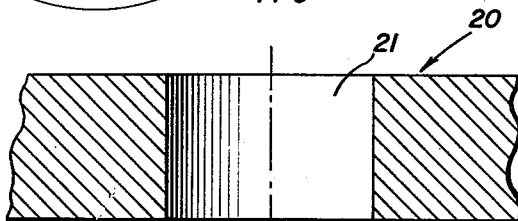
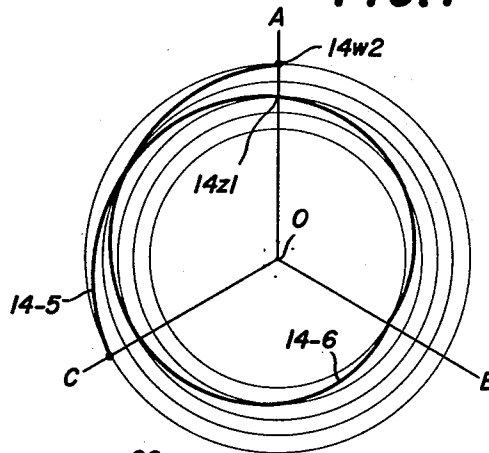


FIG. 8

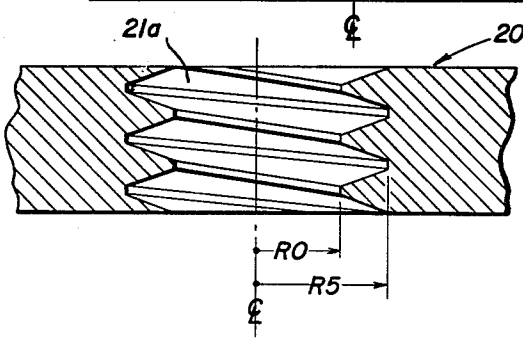


FIG. 9

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FIG. 10

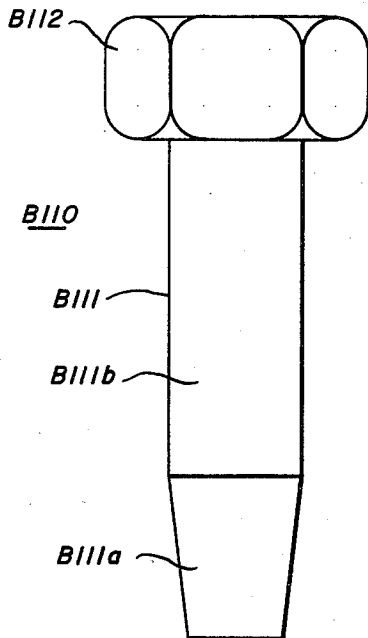


FIG. 11

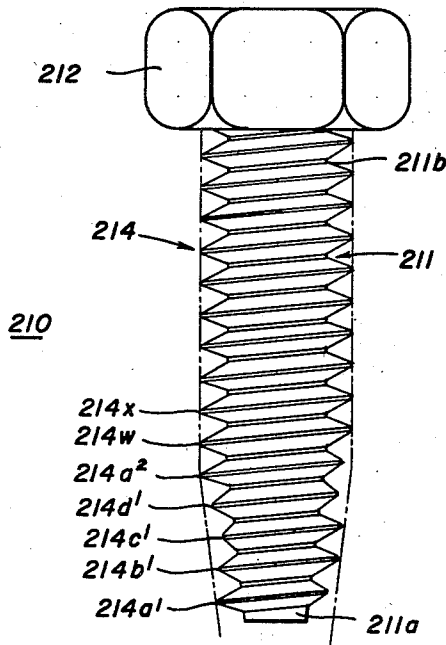
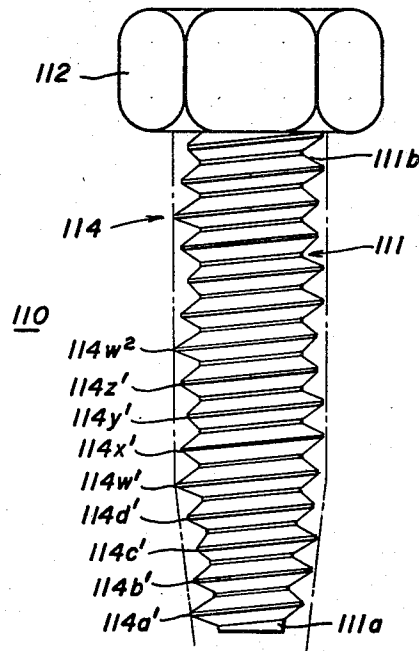


FIG. 12

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FLUTELESS THREAD-FORMING TOOLS

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13 Claims. (Cl. 85—46)

The present invention relates to fluteless thread-forming tools, and more particularly to such tools adapted to swage threads of desired formation in generally cylindrical surfaces.

A general object of the invention is to provide a fluteless thread-forming tool that comprises an elongated shank including a generally cylindrical rear body portion and a generally frusto-conical forwardly-tapered front pilot end portion, and a continuous thread carried on the shank and including both a plurality of helical turns on the rear body portion and a plurality of helical turns on the front pilot end portion, the thread having a fixed pitch, the turns on the rear body portion having substantially the same minor radius and the successively forward ones of the turns on the front pilot end portion having gradually reduced minor radii, the turns on at least one of the shank portions having a crest projection from the root thereof that is cyclically variable between maximum and minimum values along the helix of the thread with a rotational angle A about the longitudinal axis of the shank between adjacent thread positions of maximum crest projection, wherein $A=360^\circ+B$, and wherein B is a fixed angle within the approximate range 60° to 120° .

Another object of the invention is to provide a fluteless thread-forming tool of the character described, wherein the turns on the front pilot end portion have a crest projection from the root thereof that is substantially fixed, and wherein it is the turns on the rear body portion that have the cyclically variable crest projection from the root thereof, as described above.

Another object of the invention is to provide a fluteless thread-forming tool of the character described, wherein the turns on the rear body portion have a crest projection from the root thereof that is substantially fixed, and wherein it is the turns on the front pilot end portion that have the cyclically variable crest projection from the root thereof, as described above.

Another object of the invention is to provide a fluteless thread-forming tool of the character described, where both the turns on the front pilot end portion and the turns on the rear body portion have the cyclically variable crest projection from the root thereof, as described above.

A further object of the invention is to provide a fluteless thread-forming tool of the character described, that is in the form of a thread-swaging and fastening screw, and that includes an enlarged tool-engaging head on the rear end of the shank thereof, whereby the screw swages a thread in a preformed opening provided in an associated workpiece, as the screw is set in the workpiece.

Further features of the invention pertain to the particular arrangement of the elements of the fluteless thread-forming tool; whereby the above-outlined and additional operating features thereof are attained.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification, taken in connection with the accompanying drawings, in which:

FIGURE 1 is a combination side view of a blank and a plan view of a rolling die that are employed in making the fluteless thread-forming tool embodying the present invention;

FIG. 2 is a side elevational view of one form of the

tool embodying the present invention and that is in the form of a thread-swaging and fastening screw;

FIG. 3 is an enlarged fragmentary side elevational view of the front pilot end portion and the adjacent rear body portion of the shank of the screw of FIG. 2;

FIG. 4 is an enlarged lateral sectional view of the screw, this view being taken in the direction of the arrows along the line 4—4 in FIG. 3;

FIGS. 5, 6 and 7 are three diagrammatic illustrations of the variable major radius of the thread provided on the rear body portion of the screw, as shown in FIGS. 3 and 4;

FIG. 8 is an enlarged fragmentary vertical sectional view of a workpiece having a generally cylindrical opening therethrough;

FIG. 9 is an enlarged fragmentary vertical sectional view of the workpiece of FIG. 8, illustrating the thread formation that is swaged in the cylindrical opening provided therein by the utilization of the screw of FIGS. 2 to 4, inclusive;

FIG. 10 is a side view of a modified form of blank that may be employed in making another form of the screw embodying the present invention;

FIG. 11 is a side elevational view of the other form of the screw that may be produced from the blank of FIG. 10; and

FIG. 12 is a side elevational view of a further form of the screw embodying the present invention that may be produced from the blank of FIG. 10.

Referring now to FIGS. 2 to 4, inclusive, of the drawings, there is illustrated a fluteless thread-forming tool, in the form of a combination thread-swaging and fastening screw 10, and embodying the features of the present invention, and that may be made in accordance with the present method; which screw 10 comprises an elongated shank 11 including a forwardly tapered substantially frusto-conical front pilot end portion 11a and a substantially cylindrical rear body portion 11b. Also, the screw 10 comprises an enlarged head 12 terminating the extreme rear end of the rear body portion 11b of the shank 11; which head 12 may be of any suitable type, a pan head 12 being illustrated for the purpose of the present description. The head 12 carries a cross-slot 13 that is adapted to receive the bit of a screw driver, or the like, not shown, that is employed to set the screw 10. Further, the screw 10 comprises a continuous rolled thread 14 carried on the shank 11 and including a number of front helical turns 14a and 14b disposed on the front pilot end portion 11a and a number of rear helical turns 14w1, 14x1, 14y1, 14z1, 14w2, 14x2, 14y2, 14z2, etc., disposed on the rear body portion 11b.

Referring now to FIGS. 3 and 4, it will be observed that the thread 14 has a fixed pitch; the front turns 14a and 14b have a progressively increasing minor diameter and a progressively increasing major diameter in the rearward direction along the front pilot end portion 11a; and the rear turns 14w1, 14x1, etc., 14w2, 14x2, etc., have a fixed minor diameter and a cyclically variable major diameter in the rearward direction along the rear body portion 11b. Specifically, the minor radius of the rear turns 14w1, etc., is R_0 , while the major radius of the rear turns 14w1, etc., varies between the values R_1 and R_5 , through the values R_2 , R_3 and R_4 . Also, the maximum major radius of the rear turns 14w1, etc., is referred to as " R " and the minimum major radius of the rear turns 14w1, etc., is referred to as " r ."

Referring now to FIGS. 5, 6 and 7, the three lines AO, BO, and CO are respectively arranged in mutually intersecting relation at the center O and are respectively disposed 120° from each other; and the circles R_1 , R_2 , R_3 , R_4 and R_5 are respectively arranged in concentric relation to each other about the center O. In FIG. 5: the

curve 14-1 proceeds from the line AO through 240° to the line CO decreasing gradually from the radius R5 to the radius R1 in the general manner of a spiral of Archimedes; and the curve 14-2 proceeds from the line CO through 240° to the line BO increasing gradually from the radius R1 to the radius R5 in the general manner of a spiral of Archimedes. In FIG. 6: the curve 14-3 proceeds from the line BO through 240° to the line AO decreasing gradually from the radius R5 to the radius R1 in the general manner of a spiral of Archimedes; and the curve 14-4 proceeds from the line AO through 240° to the line CO increasing gradually from the radius R1 to the radius R5 in the general manner of a spiral of Archimedes. In FIG. 7: the curve 14-5 proceeds from the line CO through 240° to the line BO decreasing gradually from the radius R5 to the radius R1 in the general manner of a spiral of Archimedes; and the curve 14-6 proceeds from the line BO through 240° to the line AO increasing gradually from the radius R1 to the radius R5 in the general manner of a spiral of Archimedes. The curves 14-1, 14-2, 14-3, 14-4, 14-5 and 14-6 of FIGS. 5, 6 and 7 represent five of the rear turns of the thread 14 provided upon the rear body portion 11b of the shank 11 of the screw 10, as shown in FIG. 3. Thus, it will be observed: the major radius of the top of the rear turn 14w1 is equal to R5, as shown at the beginning of the curve 14-1 on the line AO in FIG. 5; the major radius of the top of the rear turn 14x1 is equal to R3, as shown at the intersection of the curve 14-2 with the line AO in FIG. 5; the major radius of the top of the rear turn 14y1 is equal to R1, as shown at the intersection of the curve 14-3 with the line AO in FIG. 6; the major radius of the top of the rear turn 14z1 is equal to R3, as shown at the intersection of the curve 14-5 with the line AO in FIG. 7; and the major radius of the top of the rear turn 14w2 is equal to R5, as shown at the end of the curve 14-6 on the line AO in FIG. 7. Accordingly, it will be understood: the thread 14 proceeds cyclically, from the maximum major radius R5 to the minimum major radius R1, through the angle of 240°, and then from the minimum major radius R1 to the maximum major radius R5, through the angle of 240°; between two adjacent positions of the maximum major radius R5, there is disposed an angle of 480°; and between two adjacent positions of the maximum major radius R5 in the same line AO, BO or CO, there is disposed an angle of 1440°. This angle of 1440° corresponds to 4 complete turns of the thread 14; whereby it will be observed that there are 3 complete turns of the thread 14 between the two adjacent positions of the maximum major radius R5 in the line AO, as illustrated in FIGS. 5, 6 and 7. Generalizing upon this angle of 480°, in the form of the thread 14 illustrated, the same may be designated "A", where $A=360^\circ+B$, where $B=120^\circ$.

Considering now the general mode of operation of the screw 10, it is first noted that the same is especially adapted for use in threading a generally cylindrical surface. For example, as shown in FIG. 8, the workpiece 20 has a generally cylindrical hole or bore 21 formed therein; and it may be assumed that the cylindrical surface of this bore 21 is to be threaded, as indicated at 21a in FIG. 9, employing the screw 10. In this case, the pilot end 11a of the shank 11 of the screw 10 is inserted into the bore 21; and the screw 10 is pressed toward the workpiece 20 and rotated, employing a screwdriver, or the like. As the shank 11 is thus rotated, the two front helical turns 14a and 14b provided upon the front pilot end portion 11a break the cylindrical surface of the bore 21 and swage the metal of the workpiece 20 to begin the internal thread formation 21a. The rear threads 14w1, 14x1, 14y1, 14z1, etc., successively enter and swage the metal in the bore 21, so as to produce the internal thread formation 21a, without the production of chips, and entirely by the swaging action of the thread 14 upon the surface of the bore 21.

In connection with FIGS. 8 and 9, it will be appreciated that the thread 21a has a minor diameter that is smaller than the initial diameter of the bore 21 and a major diameter that is larger than the initial diameter of the bore 21. In other words, in the swaging action of the thread 14 upon the bore 21, the metal of the workpiece 20 is moved radially inwardly to form the root of the thread 21a, and the metal of the workpiece 20 is moved radially outwardly to form the crest of the thread 21a, which movements of the metal mentioned is caused by the peculiar eccentricity of the rear turns 14w1, 14x1, 14y1, 14z1, 14w2, etc., provided upon the rear body portion 11b of the shank 11. Specifically, the thread formation 21a in the workpiece 20 has the minor diameter 2(R0) and the major diameter 2(R5), as illustrated in FIG. 9.

Turning now to the present method of making the screw 10, a corresponding blank B10 is provided, as illustrated in FIG. 1. The blank B10 is forged or formed of metal and comprises an elongated shank B11 including a substantially frusto-conical front pilot end portion B11a and a substantially cylindrical rear body portion B11b. Also, the blank B10 comprises the pan head B12 terminating the rear end of the rear body portion B11b. Also, there are provided a pair of rolling dies, one of which is illustrated at 30 in FIG. 1. The die 30 illustrated comprises a main body portion 31 and a corner card portion 32. The top of the main body portion 31 is disposed in a given reference plane, while the top of the corner card portion 32 is disposed above the given reference plane mentioned. Specifically, the top of the corner card portion 32 is sloped upwardly out of the reference plane both from left to right and from top to bottom, as shown in FIG. 1. Further, in the top of the die 30 alternate lands 33 and flutes 34 are arranged in parallel skewed relation in order to define the complement of the thread 14 provided upon the shank 11 of the screw. Of course, two complementary rolling dies are provided, although only one of these dies 30 is illustrated in FIG. 1. The shank B11 of the blank B10 is subjected to rolling pressure between the complementary mating flat dies described; whereby the continuous thread 14 is formed upon the shank 11 of the resulting screw 10.

Ordinarily, the metal blank B10 is formed of low carbon steel; and after the screw 10 is formed therefrom in the present rolling method, the same is subjected to heat treatment so as to case harden it, in a well-known manner. Specifically, it is highly desirable that the front helical turns 14a and 14b, as well as the rear helical turns 14w1, 14x1, 14y1, 14z1, 14w2, 14x2, 14y2, 14z2, etc., be quite hard, since the screw 10 is frequently employed in forming an internal thread 21a in the pilot hole 21 provided in the workpiece 20, when such workpiece 20 is formed of steel.

Again referring to FIGS. 3 to 7, inclusive, the sections of the thread 14 provided upon the rear body portion 11b of the shank 11 that have the major radius R5 may be viewed or considered as lobes, provided thereon, since all other sections of the thread 14 have a major radius that is less than R5, and in the range from R5 down to R1. In this illustrated formation or embodiment of the thread 14 there is an angle of 480° between adjacent lobes along the thread 14. Accordingly, there are three longitudinally extending rows of the lobes along the thread 14, as viewed from the front of the screw 10, as illustrated in FIG. 4; which three rows are angularly spaced apart by 120° about the longitudinal center line of the shank 11. This is the case, where $B=120^\circ$ in the general formula: $A=360^\circ+B$, as previously explained.

Now in this formula, the angle B may have any desired value in the approximate range 60° to 120°. When the angle B has a value (60°, 72°, 80°, 90° or 120°) that is evenly divisible into 360°, the lobes in the thread 14 are disposed in straight rows extending longitudinally along the rear shank portion 11b; and when the angle B has a value that is not evenly divisible into 360°, the

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lobes in the thread 14 are disposed in skewed rows extending longitudinally along the rear shank portion 11b. In these several embodiments of the thread 14: when the angle B is 60°, there are 6 longitudinally extending rows of lobes; when the angle B is 72°, there are 5 longitudinally extending rows of lobes; when the angle B is 80°, there are 4 longitudinally extending rows of lobes; when the angle B is 90°, there are 3 longitudinally extending rows of lobes; and when the angle B is 120°, there are 3 longitudinally extending rows of lobes. In each case, the rows of lobes are equally spaced-apart about the longitudinal center line of the shank 11. While a wide variety of these thread formations are entirely satisfactory, it has been found that those designs involving an odd number of rows of lobes are generally preferred, since these thread formations are easy to drive and provide a better balance of the torque required in the starting of the rear eccentric portion of the thread 14 into the pilot hole 21 in the workpiece 20 in setting the screw 10, in the manner previously explained.

Referring now to FIG. 10, a modified form of blank B110 is there illustrated that is essentially the same as the blank B10 of FIG. 1, except the enlarged head B112 thereof is of hexagon form and is thus adapted to cooperate with a socket-wrench, or the like, instead of a screwdriver. Also, the front pilot end portion B111a of the shank B111 is somewhat elongated by virtue of the circumstance that it is adapted to carry several front helical turns of the thread, as explained more fully hereinafter. The rear body portion B111b of the shank B111 is, of course, of suitable length, depending upon the desired overall length of the finished screw that is to be produced from the blank B110 in accordance with the present method.

Referring now to FIG. 11, the modified form of the screw 110 there illustrated and embodying the features of the present invention is essentially of the same construction as the screw 10, except in this case the thread 114 provided on both the front pilot end portion 111a of the shank 111 and on the rear body portion 111b of the shank 111 comprises the previously described cyclically variable form. As illustrated, the helical turns 114a1, 114b1, 114c1 and 114d1 are carried on the front pilot end portion 111a, while the helical turns 114w1, 114x1, 114y1, 114z1, 114w2, etc., are carried upon the rear body portion 111b.

This cyclically variable form of the thread 114 may be viewed as a perturbation superimposed thereupon; whereby the major radius of the front helical turns 114a1, 114b1, etc., is constantly increasing progressively rearwardly along the front pilot end portion 111a, but is also subject to the previously described perturbation, wherein the value thereof is cyclically variable with each complete cycle subtending the angle of 480°, as previously explained, wherein $A=360^\circ+B$, and wherein $B=120^\circ$; and whereby the major radius of the rear helical turns 114w1, 114x1, etc., is constant rearwardly along the rear body portion 111b, but is subject to the aforesaid perturbation, wherein the value thereof is cyclically variable with each complete cycle subtending the angle of 480°, as previously explained, wherein $A=360^\circ+B$, and wherein $B=120^\circ$. Also, in the form of the thread 114 on the front pilot end portion 111a, the angular rate of increase of the major radius from turn to turn rearwardly therealong is substantially greater than the angular rate of variation of the aforesaid perturbation, so that there is an increase in the major radius of the thread 114 between any two contiguous elements of any turn thereof, on the front pilot end portion 111a in the direction of the helix toward the rear body portion 111b. This arrangement insures that an increasing major radius of the thread 114 on the front pilot end portion 111a is presented to each element of the cylindrical surface of the bore in the workpiece, as the screw 110 is set therein.

The operation of the screw 110 with respect to the asso-

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ciated workpiece is essentially the same as that previously described in connection with the screw 10, except that in this case, the thread is swaged in the bore formed in the workpiece fundamentally by the front helical turns 114a1, 114b1, etc., incident to setting of the screw 110, as is obvious from an inspection of the screw 110 in FIG. 11.

Of course, the screw 110 may be produced from the blank B110 employing a rolling step in the manner previously described in connection with the production of the screw 10, except in this case the dies employed must be constructed so as to effect the particular form of the thread 114, as described above.

Referring now to FIG. 12, the modified form of the screw 210 there illustrated and embodying the features of the present invention is essentially of the same construction as the screws 10 and 110, except in this case only the thread 214 provided on the front pilot end portion 211a of the shank 211 comprises the previously described cyclically variable form, the thread 214 provided on the rear body portion 211b of the shank 211 being of conventional form. As illustrated, the helical turns 214a1, 214b1, 214c1, 214d1 and 214a2 are carried on the front pilot end portion 211a, while the helical turns 214w, 214x, etc., are carried upon the rear body portion 211b.

The major radius of the front helical turns 214a1, 214b1, etc., is constantly increasing progressively rearwardly along the front pilot end portion 211a, and further comprise the previously described perturbation, wherein the value thereof is cyclically variable with each complete cycle subtending 480°, as previously explained, wherein $A=360^\circ+B$, and wherein $B=120^\circ$. Of course, the minor radius of the front helical turns 214a1, 214b1, etc., merely increases progressively rearwardly along the front pilot end portion 211a. The major radius and the minor radius of the rear helical turns 214w, 214x, etc., are fixed along the rear body portion 211b, and are thus subject to no variation whatsoever. Moreover, the major radius and the minor radius of the rear helical turns 214w, 214x, etc., are as great as the respective maximum major radius and maximum minor radius of the rearmost front helical turn 214a2, so that substantially all of the swaging action of the screw 210 is performed by the thread 214 on the front pilot end portion 211a, and so that the thread 214 on the rear body portion 211b then tightly engages the thus formed thread produced in the associated workpiece, incident to the setting of the screw 210 in the associated workpiece. Accordingly, the operation of the screw 210 is essentially the same as that of the screws 10 and 110, as previously described.

Of course, the screw 210 may be produced from the blank B110 employing a rolling step in the manner previously described in connection with the production of the screw 10, except in this case, the dies employed must be constructed so as to effect the particular form of the thread 214, as described above.

Recapitulating: in the screw 10, the perturbation described is present in only the portion of the thread 14 disposed on the rear body portion 11b of the shank 11; in the screw 110, the perturbation described is present in both portions of the thread 114 respectively disposed on the front pilot end portion 111a and on the rear body portion 111b of the shank 111; and in the screw 210, the perturbation described is present in only the portion of the thread 214 disposed on the front pilot end portion 211a of the shank 211.

In view of the foregoing, it is apparent that there has been provided a fluteless thread-forming tool, and specifically a fastening screw of improved construction and arrangement. This tool is very advantageous, since the same is operative to form the internal thread in the generally cylindrical surface of a pilot hole formed in a workpiece altogether by a swaging action and without the formation of chips or cuttings from the workpiece. Moreover, the improved tool is substantially easier to operate in

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its thread-forming action than is a comparable conventional tool of the chip-forming type, in the sense that the improved tool requires substantially less driving torque than does the conventional tool mentioned.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A fluteless thread-forming tool for threading a generally cylindrical surface; said tool comprising an elongated shank including a generally cylindrical rear body portion and a generally frusto-conical forwardly-tapered front pilot end portion, and a continuous thread carried on said shank and including both a plurality of helical turns on said rear body portion and a plurality of helical turns on said front pilot end portion, said thread having a fixed pitch, the turns on said rear body portion having substantially the same minor radius and successively forward ones of the turns on said front pilot end portion having generally reduced minor radii, the turns on at least one of said shank portions having a crest projection from the root thereof that is cyclically variable between maximum and minimum values along the helix of said thread with a rotational angle A about the longitudinal axis of said shank between adjacent thread positions of maximum crest projection, wherein $A=360^\circ+B$, and wherein B is a fixed angle within the approximate range 60° to 120° .

2. The tool set forth in claim 1, wherein the fixed angle B is evenly divisible into 360° .

3. The tool set forth in claim 1, wherein B is approximately 120° .

4. The tool set forth in claim 1, wherein B is approximately 90° .

5. The tool set forth in claim 1, wherein B is approximately 72° .

6. The tool set forth in claim 1, wherein B is approximately 60° .

7. A fluteless thread-forming tool for threading a generally cylindrical surface; said tool comprising an elongated shank including a generally cylindrical rear body portion and a generally frusto-conical forwardly-tapered front pilot end portion, and a continuous thread carried on said shank and including both a plurality of helical turns on said rear body portion and a plurality of helical turns on said front pilot end portion, said thread having a fixed pitch, the turns on said rear body portion having substantially the same minor radius and successively forward ones of the turns on said front pilot end portion having gradually reduced minor radii, the turns on said front pilot end portion having a crest projection from the root thereof that is substantially fixed, the turns on said rear body portion having a crest projection from the root thereof that is cyclically variable between maximum and minimum values along the helix of said thread with a rotational angle A about the longitudinal axis of said shank between adjacent thread positions of maximum crest projection, wherein $A=360^\circ+B$, wherein B is a fixed angle within the approximate range 60° to 120° .

8. A fluteless thread-forming tool for threading a generally cylindrical surface; said tool comprising an elongated shank including a generally cylindrical rear body portion and a generally frusto-conical forwardly-tapered front pilot end portion, and a continuous thread carried on said shank and including both a plurality of helical turns on said rear body portion and a plurality of helical turns on said front pilot end portion, said thread having a fixed pitch, the turns on said rear body portion having substantially the same minor radius and successively forward ones of the turns on said front pilot end portion having gradually reduced minor radii, the turns on both said front pilot end portion and said rear body portion having a crest projection from the root thereof that is

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cyclically variable between maximum and minimum values along the helix of said thread with a rotational angle A about the longitudinal axis of said shank between adjacent thread positions of maximum crest projection, wherein $A=360^\circ+B$, and wherein B is a fixed angle within the approximate range 60° to 120° .

9. A fluteless thread-forming tool for threading a generally cylindrical surface; said tool comprising an elongated shank including a generally cylindrical rear body portion and a generally frusto-conical forwardly-tapered front pilot end portion, and a continuous thread carried on said shank and including both a plurality of helical turns on said rear body portion and a plurality of helical turns on said front pilot end portion, said thread having a fixed pitch, the turns on said rear body portion having substantially the same minor radius and successively forward ones of the turns on said front pilot end portion having gradually reduced minor radii, the turns on said rear body portion having a crest projection from the root thereof that is substantially fixed, the turns on said front pilot end portion having a crest projection from the root thereof that is cyclically variable between maximum and minimum values along the helix of said thread with a rotational angle A about the longitudinal axis of said shank between adjacent thread positions of maximum crest projection, wherein $A=360^\circ+B$, and wherein B is a fixed angle within the approximate range 60° to 120° .

10. The tool set forth in claim 9, wherein the angular rate of increase of the minor radius of successively rearward ones of the turns on said front pilot end portion is substantially greater than the angular rate of variation of the crest projection from the root thereof, so that there is an increase in the major radius of said thread between any two contiguous elements of any turn thereof on said front pilot end portion in the direction toward said rear body portion.

11. A thread-swaging and fastening screw comprising an elongated shank including a generally cylindrical rear body portion and a generally frusto-conical forwardly tapered front pilot end portion, an enlarged head carried on the rear end of said rear body portion, and a continuous thread carried on said shank and including both a plurality of helical turns on said rear body portion and a plurality of helical turns on said front pilot end portion, said thread having a fixed pitch, the turns on said rear body portion having substantially the same minor radius and successively forward ones of the turns on said front pilot end portion having gradually reduced minor radii, the turns on at least one of said shank portions having a crest projection from the root thereof that is cyclically variable between maximum and minimum values along the helix of said thread with a rotational angle A about the longitudinal axis of said shank between adjacent thread positions of maximum crest projection, wherein $A=360^\circ+B$, and wherein B is a fixed angle within the approximate range 60° to 120° .

12. A thread-swaging and fastening screw comprising an elongated shank including a generally cylindrical rear body portion and a generally frusto-conical forwardly tapered front pilot end portion, an enlarged head carried on the rear end of said rear body portion, and a continuous thread carried on said shank and including both a plurality of helical turns on said rear body portion and a plurality of helical turns on said front pilot end portion, said thread having a fixed pitch, the turns on said rear body portion having substantially the same minor radius and successively forward ones of the turns on said front pilot end portion having gradually reduced minor radii, the turns on said rear body portion having a crest projection from the root thereof that is substantially fixed, the turns on said front pilot end portion having a crest projection from the root thereof that is cyclically variable between maximum and minimum values along the helix of said thread with a rotational angle A about the longitudinal axis of said shank between adjacent thread posi-

tions of maximum crest projection, wherein $A=360^\circ+B$, and wherein B is a fixed angle within the approximate range 60° to 120° .

13. A thread-swaging and fastening screw comprising an elongated shank including a generally cylindrical rear body portion and a generally frusto-conical forwardly tapered front pilot end portion, an enlarged head carried on the rear end of said rear body portion, and a continuous rolled thread carried on said shank and including both a plurality of helical turns on said rear body portion and a plurality of helical turns on said front pilot end portion, said thread having a fixed pitch, the turns on said rear body portion having substantially the same minor radius and successively forward ones of the turns on said front pilot end portion having gradually reduced minor radii, the turns on said rear body portion having a crest projection from the root thereof that is substantially fixed, the turns on said front pilot end portion having a crest

projection from the root thereof that is cyclically variable between maximum and minimum values along the helix of said thread with a rotational angle A about the longitudinal axis of said shank between adjacent thread positions of maximum crest projection, wherein $A=360^\circ+B$, and wherein B is a fixed angle within the approximate range 60° to 120° .

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