C. A. CAMPBELL.

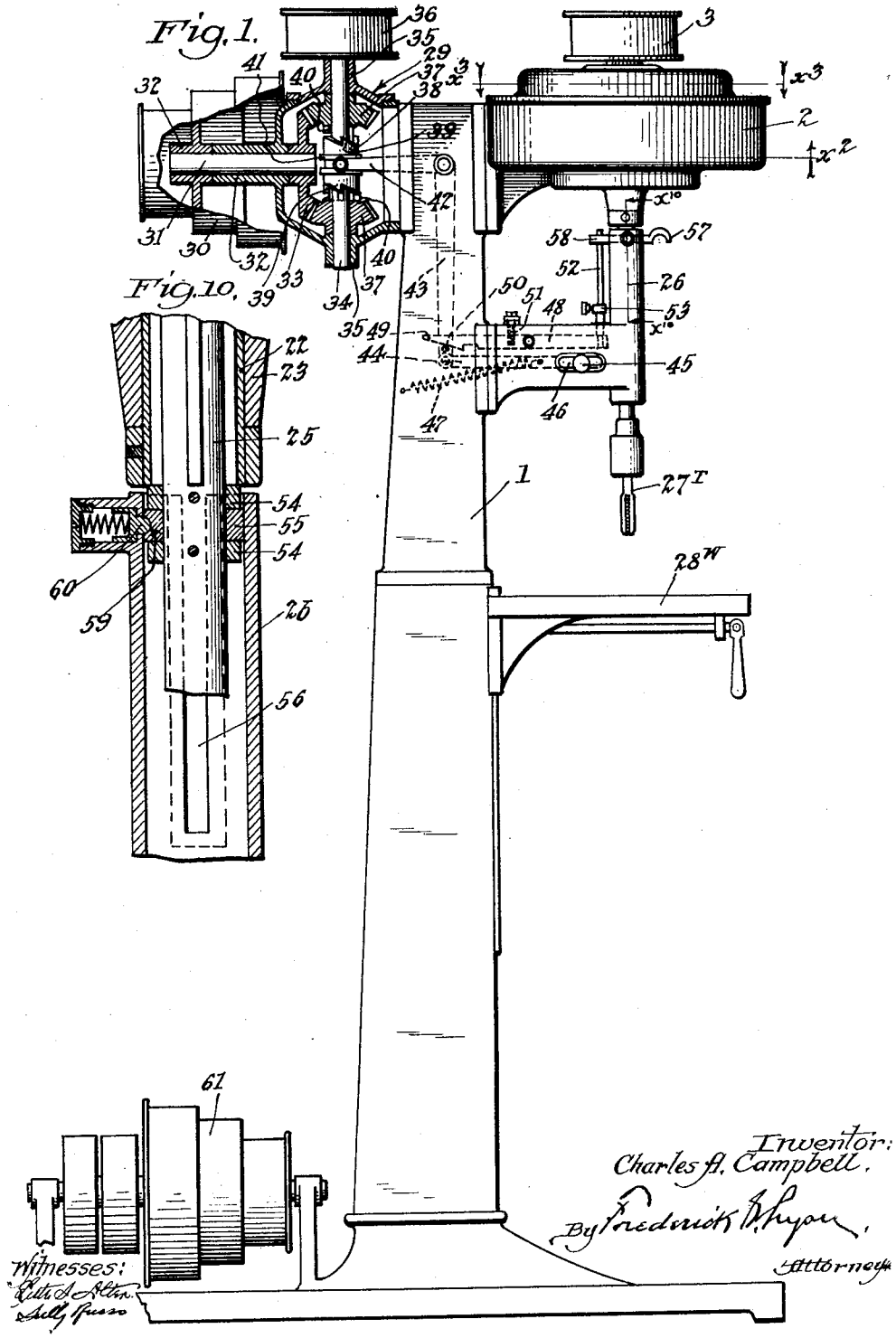
TAPPING MACHINE.

APPLICATION FILED APR. 26, 1919.

1,404,371.

Patented Jan. 24, 1922.

3 SHEETS--SHEET 1.



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3 SHEETS—SHEET 2.

Fig. 2.

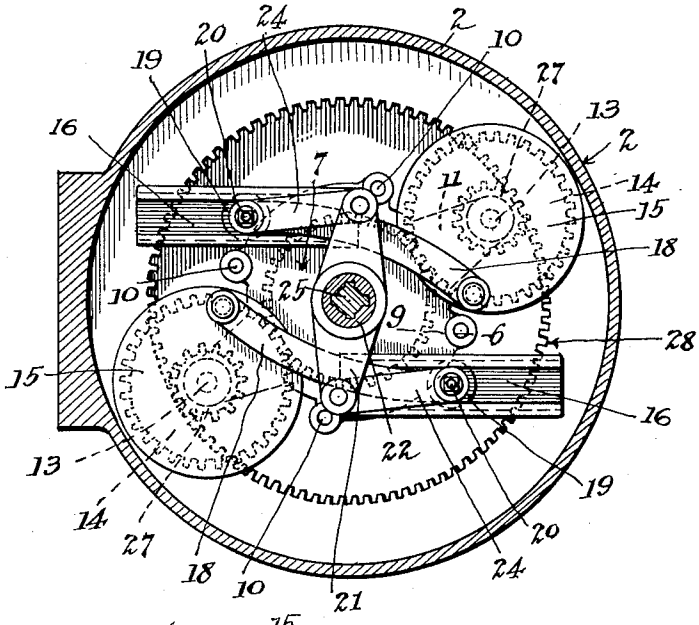
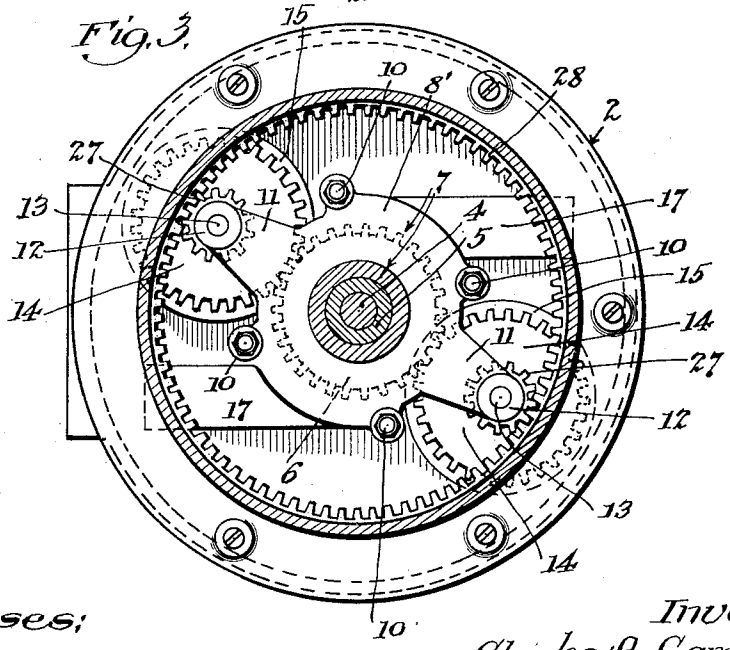


Fig. 3.



Witnesses:

Lillie A. Otter.

Sally Jones

Inventor:

Charles A. Campbell.

By Frederick K. Lyon.

Attorneys.

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3 SHEETS—SHEET 3.

Fig. 4.

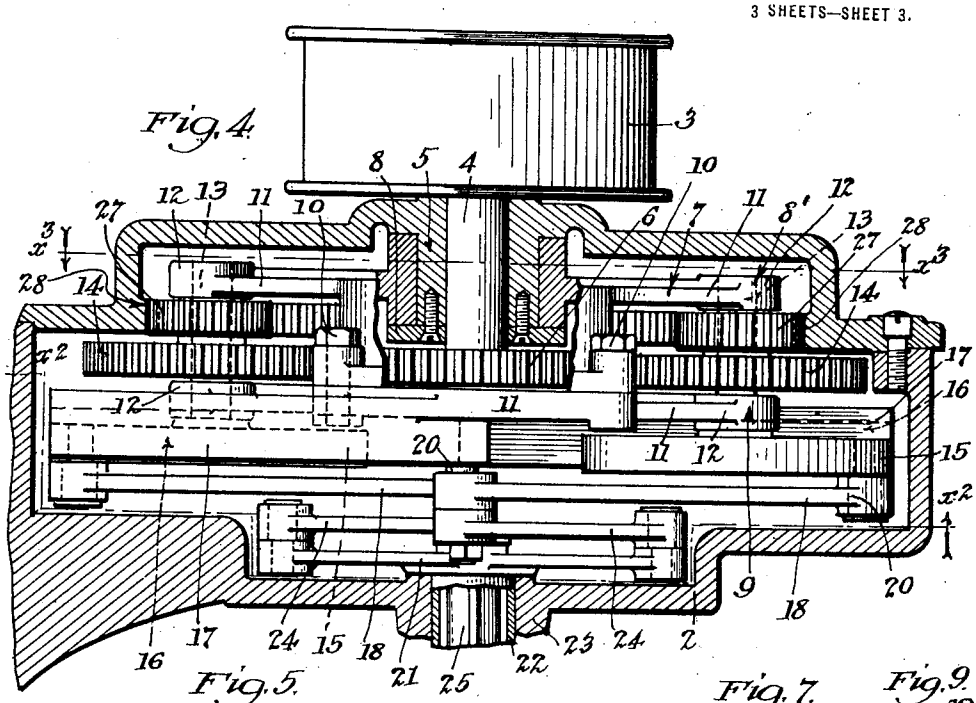


Fig. 5.

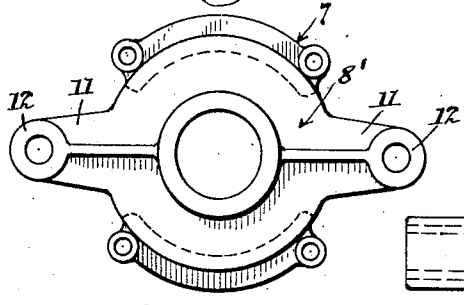


Fig. 7.

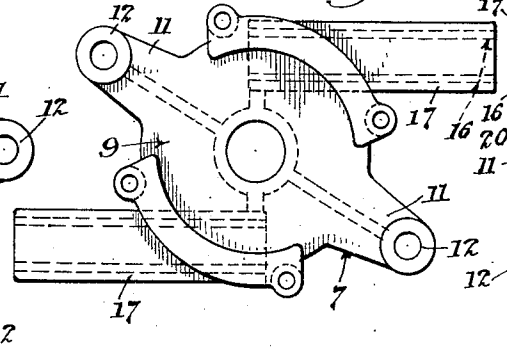


Fig. 9.

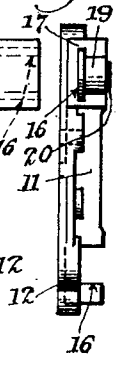


Fig. 6.

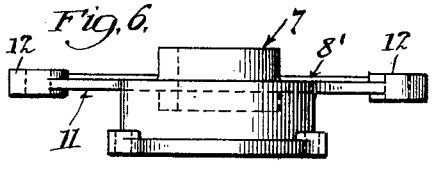
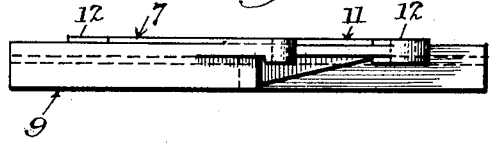


Fig. 8.



Witnesses:
Lulu S. Alter.
Lulu Spurr.

Inventor:
Charles A. Campbell.
By Frederick P. Fish.
Attorney

UNITED STATES PATENT OFFICE.

CHARLES A. CAMPBELL, OF LOS ANGELES, CALIFORNIA, ASSIGNOR TO PROGRESSIVE ENGINEERING COMPANY, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF DELAWARE.

TAPPING MACHINE.

1,404,371. Specification of Letters Patent. **Patented Jan. 24, 1922.**

Application filed April 26, 1919. Serial No. 292,882.

To all whom it may concern:

Be it known that I, CHARLES A. CAMPBELL, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Tapping Machine of which the following is a specification.

My invention relates to a device for cutting screw-threads by the use of a tap.

In cutting internal threads with the use of a tap operated by hand it is the practice and necessary to reverse the tap after each portion of a forward turn. If the operator persists in continuing the tap forward an excessive torsional strain will be put upon the tap resulting in the breaking of the same. Among the causes for such resistance to the continuing of the tap forward is the binding and clogging of the same with chips from the material cut. In practice a frequent reversal of the tap is employed to relieve this binding and clogging, which reversal is followed by a further forward movement of the tap until another reversal becomes necessary.

This operation by hand consists in the turning of the tap alternately in opposite directions, the movement taking the form of oscillations, the tap being intermittently advanced into the work by an oscillating movement having a greater amplitude in one direction than in the other.

The fundamental object of my invention is to provide in power-driven tapping tapping mechanism improved means for imparting to the tap an equivalent of the oscillatory motion employed by hand.

If tapping mechanism having an oscillatory motion is to be driven at high speed, provision must be made to prevent shock at the points of reverse of each alternation of oscillation. Where the velocity is constant there results a shock which is directly proportional to the mass times the velocity.

In my invention, to obviate shoke, I employ cranks to impart the oscillatory motion to the tap. Thus the alternations of oscillation are of varying velocity throughout their amplitudes, being accelerated from a state of rest at the initial extremity of arc to maximum velocity and decelerated from maximum velocity to a state of rest at the final extremity of arc. By reason of the absence of shock at the points of reverse, the mechanism may be driven at high speed.

To advance the tap intermittently to cut a thread, the alternations of ocillation must be through arcs of greater amplitude in one direction than in the other. This I accomplish by providing means for revolving the cranks around their common center at suitable ratio to the velocity of rotation of the cranks upon their axes. As shown in the accompanying drawings, this ratio is as 6:1; i. e., the cranks rotate six times on their axes to one revolution around their common center. The throw of the cranks is so related to the oscillating members as to cause them normally to move through an arc of 110 degrees; but during each such impulse the cranks also revolve through 30 degrees, so that alternate movements of the oscillating members are through arcs of 140 degrees and 80 degrees respectively, thus providing an intermittent advance of 60 degrees at each oscillation, and six oscillations to one complete rotation of the tap.

Other objects and advantages will appear in the detailed subjoined description.

In the accompanying drawings,

Figure 1 is a side elevation with parts broken away of a tapping machine incorporating a preferred form of my invention.

Fig. 2 is a horizontal section on a line indicated by x^2—x^2, in Figs. 1 and 4, of the oscillating mechanism and case.

Fig. 3 is a horizontal section on a line indicated by x^3—x^3, in Figs, 1 and 4, of the oscillating mechanism and case.

Fig. 4 is a vertical mid section of the case containing the oscillating mechanism.

Fig. 5 is a top plan view of the upper portion of the gear and crank support.

Fig. 6 is a side elevation of the portion of the support illustrated in Fig. 5.

Fig. 7 is a top plan view of the lower portion of the gear and crank support.

Figs. 8 and 9 are side elevations of the portion of the support illustrated in Fig. 7.

Fig. 10 is a side elevation of a portion of the spindle, the associated parts being illustrated in vertical section.

Referring to the drawings there is provided a column 1, which supports at one side of its upper end a housing 2.

A pulley 3 is fixed to the upper end of a

vertical shaft 4, which shaft is free to rotate within a bearing formed by a boss 5 inwardly extending from the top of the housing 2.

A central driving gear 6 is fixed to the lower end of the shaft 4.

A support 7 is revolvably mounted upon the boss 5 and is suspended thereon by the retaining ring 8. For convenience in assembly the support 7 is formed with an upper section 8′ and a lower section 9. The sections 8′ and 9 are secured together by suitable means 10.

The upper and lower sections 8′ and 9 respectively are provided with horizontal arms 11 terminating in bearings 12, the respective bearings 12 of the lower section being alined and spaced below the corresponding bearings 12 of the upper section. A pair of crank shafts 13 are rotatably received within the bearings 12.

Gears 14 are fixed to the crank shafts 13 between the bearings 12 and mesh on opposite sides of the central driving gear 6. Each of the crank shafts 13 has fixed on its lower end a crank disk 15.

The bottom of the lower section 9 of the support 7 is provided with parallel cross head guides 16 formed by the grooved horizontal extensions 17.

Connecting rods 18 are pivotally mounted at one end to the peripheries of the crank disks 15, and terminate at their respective opposite ends in crossheads formed by rollers 19 and studs 20 adapted to reciprocate within the crosshead guides 16.

A bar 21 is provided with an internally splined sleeve 22, which sleeve is rotatably mounted within a bearing 23 formed by a central boss on the bottom of the housing 2.

Links 24 are pivotally connected at one end to the crosshead studs 20 and at their other respective ends to the opposite ends of the bar 21.

A spindle 25 is slidably and rotatably supported by a bracket 26 extending from the column 1, below the housing 2. The spindle 25 is provided at its upper end with external splines adapted to slidably engage the internal splines of the sleeve 22. The lower end of the said spindle is provided with means for retaining a thread cutting tool 27^T.

A work holding table 28^W is adjustably supported by the column 1 below the spindle 25.

Upon the rotation of the pulley 3 the central driving gear 6 will be rotated through the shaft 4. The gear 6 in turn will rotate the gears 14, which through the crank shafts 13 will rotate the crank disks 15. The crank disks 15 will impart a harmonic motion to the crossheads through the connecting rods 18. This motion will be transformed through the links 24, into an oscillatory motion of the bar 21, sleeve 22, spindle 25 and tap 27^T, the alternations of oscillation being of varying velocity throughout their amplitudes, the motion starting from a state of rest, accelerating to maximum velocity and then decelerating to a state of rest again during each alternation in either direction.

A pair of feed gears 27 are fixed to the crank shafts 13 above the gears 14. The feed gears 27 mesh with a stationary internal gear 28 formed within the upper portion of the housing 2.

A rotation of the gears 14, produced by the central driving gear 6 will, through the crank shafts 13, cause a rotation of the feed gears 27. The rotation of the feed gears 27 in mesh with the stationary internal gear 28 will cause a rotation of the support 7 and a consequent revolution of the crank discs 15. The combined revolution and rotation of the crank discs 15 will impart to the bar 21, sleeve 22, spindle 25 and tap 27^T relative to the table 28^W, an oscillatory motion, the alternations of which will be through arcs of greater amplitude in one direction than in the other and of varying velocity throughout their amplitudes, the velocity accelerating from a state of rest at the initial extremity of arc to maximum, and decelerating from maximum velocity to a state of rest at the final extremity of arc, thus intermittently advancing the tap 27^T to cut a thread, and providing against shock to tap and mechanism when driven at high speed.

The fundamental features of my invention has been heretofore set forth, but of necessity my invention must be included within a complete thread cutting apparatus. I now will proceed to describe the associated parts forming the complete apparatus illustrated in the drawings, it being understood that the details of construction disclose but one of many specific forms and that my invention is in no manner limited thereto.

The column 1 supports at its upper end opposite the housing 2, a second housing 29. A cone pulley 30 is fixed to one end of a horizontal shaft 31 projecting through a bearing 32 formed by the said housing 29. The opposite end of the horizontal shaft 31 is provided with a bevel gear 33. A vertical shaft 34 is rotatably received within bearings 35 formed by the said housing 29, which vertical shaft carries at its upper end exterior of the housing a pulley 36, the said pulley being alined with the pulley 3.

Pinions 37 are rotatably mounted on the vertical shaft 34 and mesh with opposite sides of the bevel gear 33. The vertical shaft 34 is centrally provided with splines with which slidably engage a splined sleeve 38. The sleeve 38 has formed at each end ratchet teeth 39 adapted to engage with

ratchet teeth 40 formed on the hubs of the pinions 37.

Parallel flanges 41 are formed on the sleeve 38 and a yoke 42 is fitted between the said flanges. The said yoke 42 is carried at one end of the bell crank 43 pivoted at its fulcrum to the column 1.

A link 44 is received within the bracket 26, and is pivoted at one end to the lower end of the bell crank 43. The opposite end of the link 44 is provided with a handle 45 projecting through a slot 46. A coil spring 47 is attached at one end to the link 44 and at the other end to the inner wall of the column 1.

A lever 48 is pivotally mounted within the bracket 26 above the link 44. The lever 48 projects within the column 1 and terminates in a latch 49. The latch 49 is adapted to engage a latch pin 50 fixed to the juncture of the bell crank 43 and the link 44. A compression spring 51 is positioned intermediate the latch 49 and fulcrum of the lever 48 and is adapted to depress the said latch.

The opposite end of the lever 48 is fixed to the lower end of a vertical rod 52, which extends upward through the bracket 26 parallel to the spindle 25. An adjustable stop collar 53 is slidably mounted on the rod 52.

The spindle 25 is provided with spaced flanges 54 between which is received a collar 55. The collar 55 is provided with horizontal extensions which project without the bracket 26 through the vertical slots 56. One of the said extensions terminates in a handle 57 and the end of the other extension forms an eye 58 which surrounds the rod 52.

The collar 55 is provided with a depression 59 which receives a spring detent 60 supported at the upper extremity of the bracket 26.

The base of the column 1 is provided with a cone pulley 61 alined with the cone pulley 30 between which a belt, not shown, is rove. Mounted on the shaft supporting the pulley 61 is a tight and loose pulley adapted to be driven by suitable power means not shown.

The operation of the tapping machine is as follows: A proper adjustment of the work holding table 28^{W} having been made and the stop collar positioned relative to the depth of the desired thread, and the work mounted below the tap, power is applied to the cone pulley 61 which in turn drives the cone pulley 30. The pulley 30 imparts a rotation to the bevel gear 33 which in turn rotates the pinions 37 in opposite directions.

Upon the operator moving the handle 45 toward the spindle 25 the splined sleeve 38 is propelled downwardly by the bell crank 43 and the yoke 42, and the lower ratchet of the sleeve engages the ratchet of the lower pinion 37, imparting a forward rotation to the pulley 36 through the vertical splined shaft 34. Through a belt, not shown, rove around the pulleys 36 and 3, the central driving gear 6 imparts to the tap 27^{T} by the means above set forth, the oscillatory motion hereinbefore fully described.

A pressure on the handle 57 disengages the spring detent 60 permitting the spindle to be lowered to bring the tap into operative engagement with the work.

As the tap 27^{T} continues into the work carrying the spindle downwardly with it, the eye 58 descends on the rod 52, and because of the previously described adjustment of the stop collar 53 encounters the said stop collar and depresses the same at the moment the tap reaches the depth desired. The stop collar 53 in turn depresses the lever 48 and disengages the latch 49. This allows the coil spring 47 to throw the bell crank 43 whereupon the yoke 42 propels the sleeve 38 upwardly disengaging the lower pinion 37 and engaging the upper pinion 37, thus imparting a reverse rotation to the pulley 36. Through the belt, not shown, this reverse rotation is transferred to the pulley 3, and by the above described means the motion of the spindle 25 is reversed and the tap 27^{T} is withdrawn from the work. The operator may then raise the handle 57 which will raise the spindle 25 until it is suspended by the spring detent 60.

Other than the mechanical means described and illustrated would serve to produce and coordinate the desired motions and such equivalent means are included within the subjoined claims which set forth the full scope of my invention.

I claim:

1. A thread cutting mechanism comprising a work holding member, a thread cutting member, and means for imparting a relative harmonic oscillatory motion as between the said members, the alternations of oscillation being through arcs of greater amplitude in one direction than in the other.

2. A thread cutting mechanism comprising a work holding member, a thread cutting member, and means for imparting a relative oscillatory motion as between the said members, the alternations of oscillation being through arcs of greater amplitude in one direction than in the other and of varying velocity throughout their amplitudes.

3. A thread cutting mechanism comprising a work holding member, a thread cutting member, and means for imparting a relative oscillatory motion as between the said members, the alternations of oscillation being through arcs of greater amplitude in one direction than in the other and of varying velocity throughout their amplitudes, accelerating from a state of rest at the initial extremity of arc to maximum velocity and de-

celerating from maximum velocity to a state of rest at the final extremity of arc.

4. A thread cutting mechanism comprising a work holding member, a thread cutting member, and means for imparting an oscillatory motion to one member relative to the other, the alternations of oscillation being through arcs of greater amplitude in one direction than in the other, said means comprising mechanism adapted to convert the rotary motion of an actuating member into a harmonic oscillatory motion in the actuated member.

5. A thread cutting mechanism comprising a work holding member, a thread cutting member, and means for imparting a relative oscillatory motion as between said members, the alternations of oscillation being of varying velocity throughout their amplitudes, together with means adapted to vary the amplitude of arc of one alternation relative to the other.

6. A thread cutting mechanism, comprising a work holding member, a thread cutting member, and means for imparting an oscillatory motion to one of the said members relative to the other, said means comprising mechanism adapted to convert the rotary motion of an actuating member into a harmonic oscillatory motion in the actuated member, together with means adapted to vary the amplitude of arc of one alternation of oscillation relative to the other, the last said means comprising mechanism adapted to revolve the rotating member around the oscillating member.

7. A thread cutting mechanism comprising a work holding member, a thread cutting member, and means for imparting a relative oscillatory motion as between the said members, the alternations of oscillation being through arcs of different amplitude, said means comprising a crank operably conjoined through suitable connecting members to said thread cutting member and adapted to convert the rotary motion of said crank into a harmonic oscillatory motion in said thread cutting member.

8. A thread cutting mechanism having in combination a work holding member, a thread cutting member, and means for imparting an oscillatory motion to one of the said members relative to the other, said means comprising mechanism including a rotatable crank and suitable connective members adapted to impart a harmonic oscillatory motion to said thread cutting member, together with means for varying the amplitude of arc of alternate movements of the said thread cutting member, the last said means comprising mechanism adapted to revolve said crank around the axis of oscillation of the said thread cutting member at suitable ratio of velocity to the ratio of velocity of rotation of said crank.

9. A tapping mechanism having in combination a work holding member, a rotatable tap holding spindle, a crank mounted in a carrier, members connecting said crank to said spindle and a driving member adapted simultaneously to rotate said crank on its axis and revolve said crank around the axis of rotation of the said tap holding spindle.

10. In a tapping machine, a thread cutting member supported by a spindle, a driving member, means for rotating said driving member, cranks operatively associating said driving member and said spindle adapted to transform the rotary motion of said driving member into an oscillatory motion in said spindle.

11. A thread cutting mechanism comprising a work holding member, a thread cutting member, a driving member, means to rotate said driving member, cranks rotated by said driving member and connective means actuated by said cranks and adapted to produce an oscillatory motion as between said work holding and thread cutting member.

12. A thread cutting mechanism comprising a work holding member, a thread cutting member, and means for imparting an oscillatory motion as between said members, together with means for varying the amplitude of arc of alternations of oscillation, said means comprising cranks mounted on shafts rotatable in a carrier, rods connecting said cranks with the said thread cutting member through a splined sleeve, pinions mounted on said shafts, a stationary gear in mesh with said pinions and a driving gear adapted simultaneously to rotate and revolve said cranks through said shafts and pinions and to convert the rotary motion of said driving gear into the oscillatory motion of the thread cutting member as above described.

13. A thread cutting mechanism comprising a work holding member, a thread cutting member, and means for producing a relative oscillatory movement between said members, such movement being greater in one direction than in the other, said means including means to transform a rotary movement into a reciprocatory movement and said reciprocatory movement into an oscillatory movement.

14. In a thread cutting mechanism, a thread cutting member, a driving member, means to rotate said driving member, cranks oppositely rotated by said driving member, and means associating said cranks with said thread cutting member adapted to produce an oscillatory movement in said thread cutting member.

15. In a thread cutting mechanism, a thread cutting member, a driving member, means to rotate said driving member, means associating said driving member and said

thread cutting member to produce an oscillatory movement in said thread cutting member, a fixed gear engaging feed gear mechanism driven by said driving member to impart a forward movement to said thread cutting mechanism coordinated with said oscillatory movement.

Signed at Los Angeles, California this 21st day of April 1919.

CHARLES A. CAMPBELL.

Witnesses:
LEONARD S. LYON,
L. BELLE WEAVER.