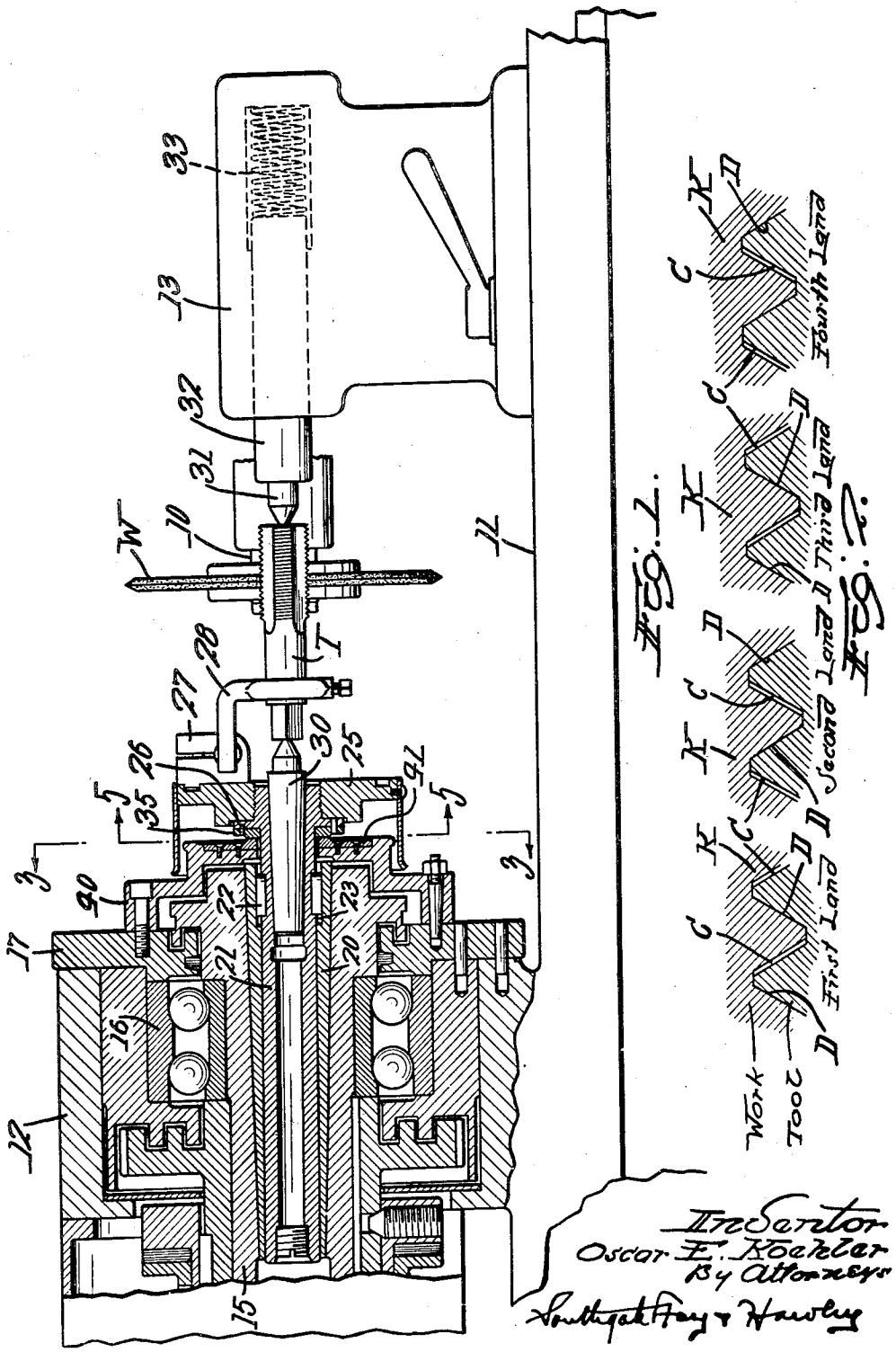
May 8, 1934. O. E. KOEHLER 1,958,105

THREAD GRINDING MACHINE

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THREAD GRINDING MACHINE

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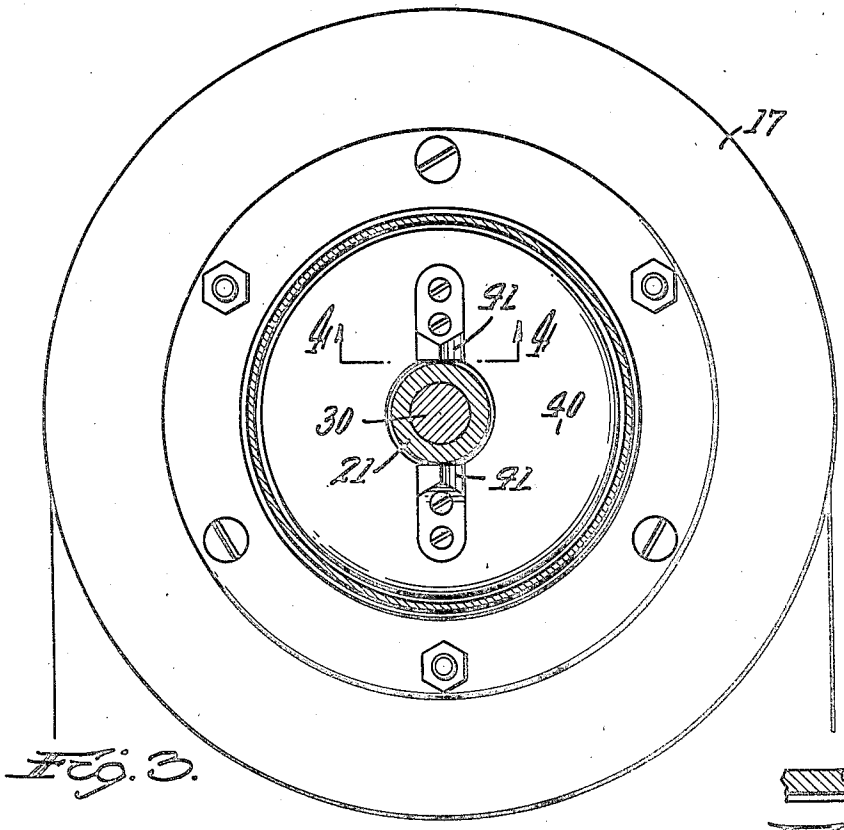


Fig. 3.

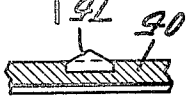


Fig. 4.

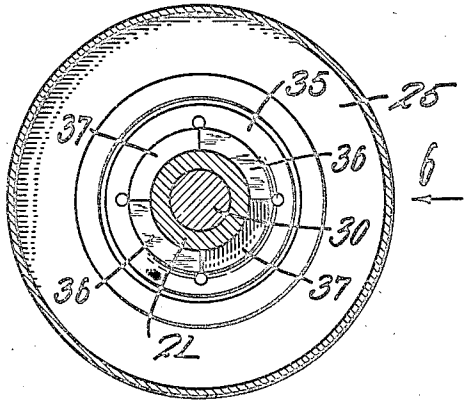


Fig. 5.

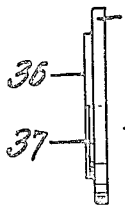


Fig. 6.

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THREAD GRINDING MACHINE

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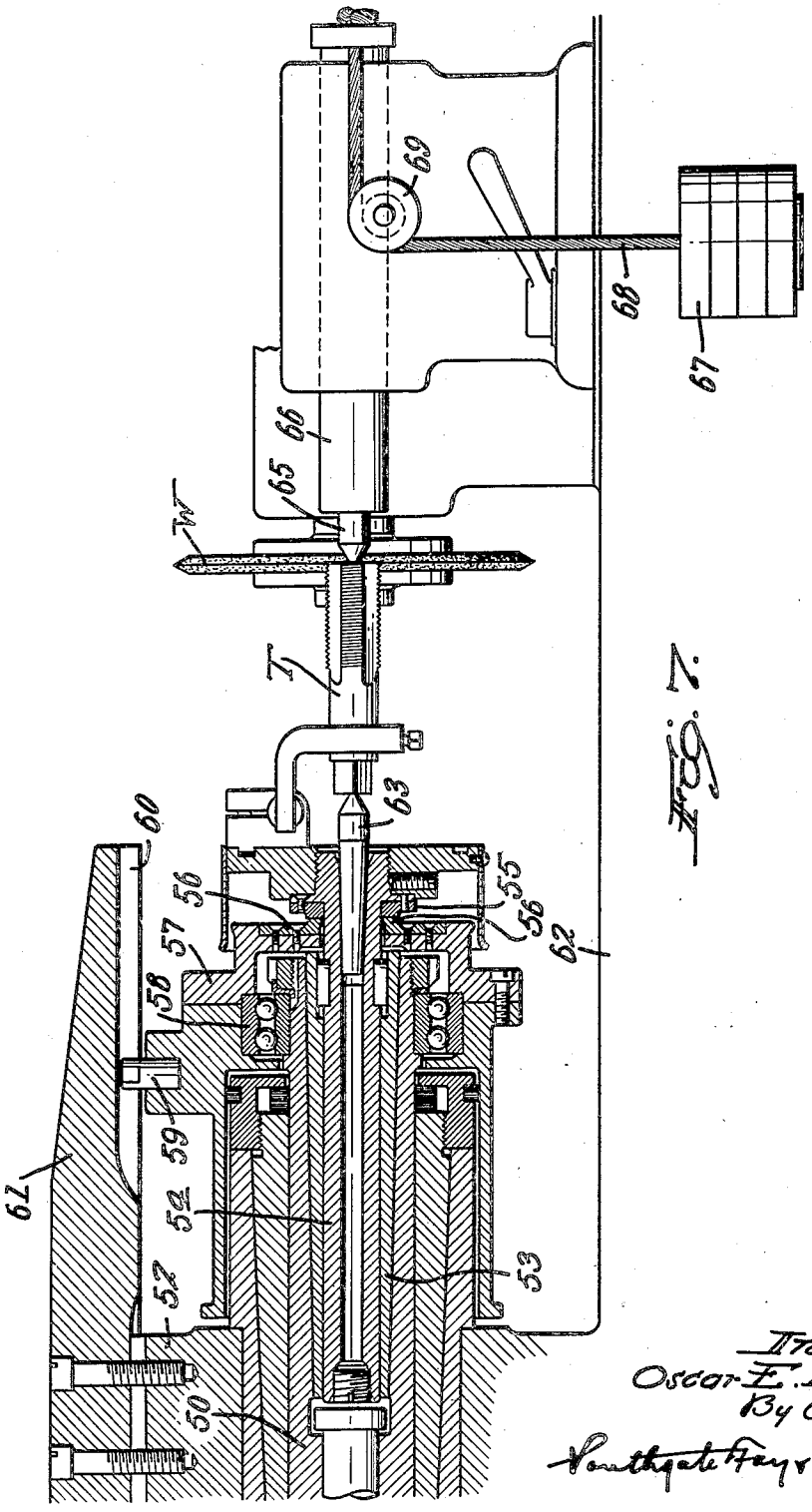


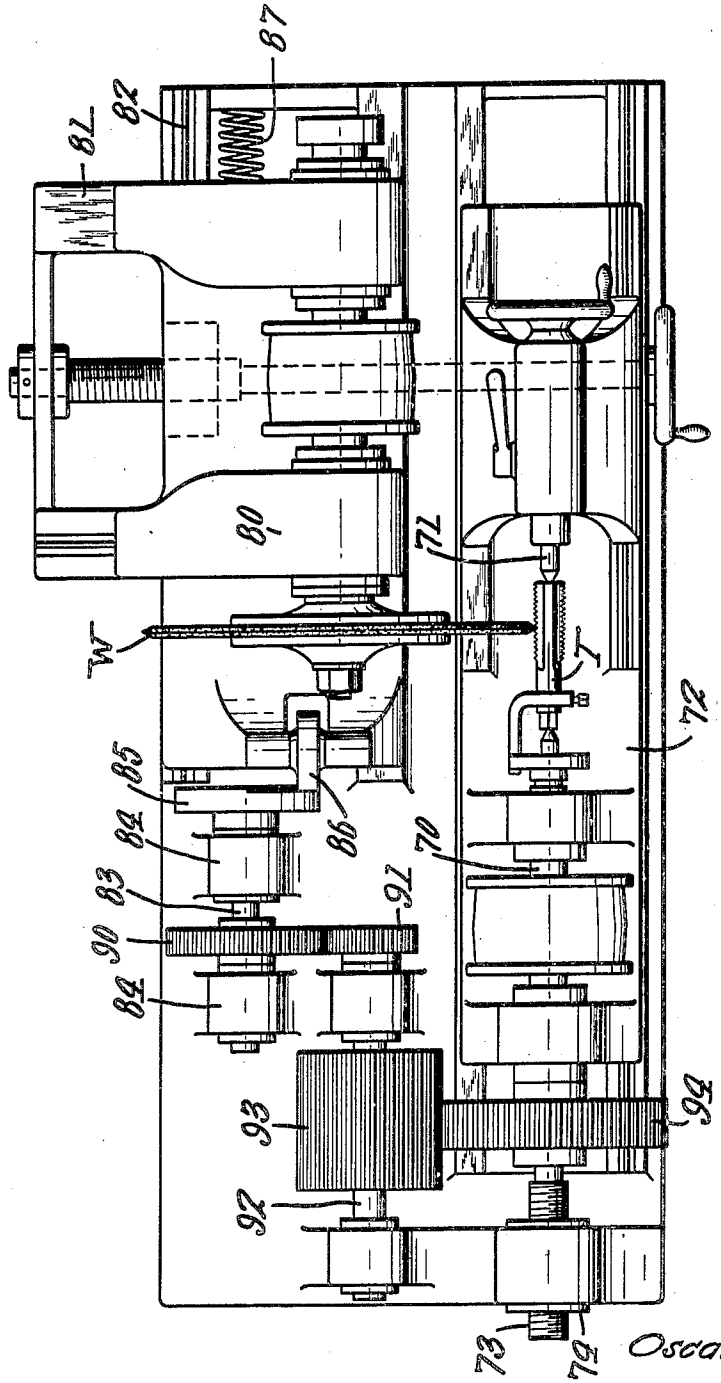
Fig. 7.

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THREAD GRINDING MACHINE

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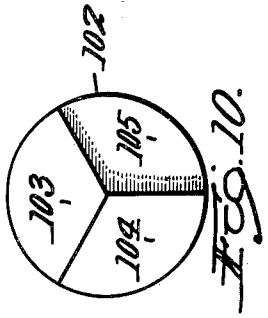


Fig. 10.

Fig. 8.

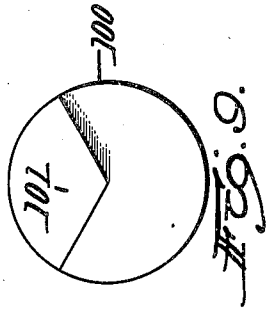


Fig. 9.

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UNITED STATES PATENT OFFICE

1,958,105

THREAD GRINDING MACHINE

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Application August 21, 1933, Serial No. 686,111

23 Claims. (Cl. 51—95)

This invention relates to machines for producing threading tools such as taps or dies by a grinding operation, and relates more particularly to a grinding machine for producing threading tools in which the teeth on successive lands are offset to provide clearance at alternate sides of the teeth during a threading operation performed thereby.

It is the general object of my invention to provide an improved thread grinding machine, so designed and constructed that this alternate offset of successive teeth will be automatically effected.

More specifically, I provide cooperating fixed and movable cam elements by which slight relative alternating longitudinal adjustments between the grinding wheel and the threading tool will be produced as the threading teeth are ground.

My invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claims.

Three forms of my invention are shown in the drawings, in which

Fig. 1 is a front elevation, partly in section, of portions of a thread grinding machine embodying my improvements and in which a reciprocated worktable is provided;

Fig. 2 is a diagrammatic view showing the offsetting of the teeth in a threading tool as produced by my improved machine, and the utility thereof;

Fig. 3 is a sectional elevation, taken along the line 3—3 in Fig. 1;

Fig. 4 is a detail sectional view, taken along the line 4—4 in Fig. 3;

Fig. 5 is a sectional view, taken along the line 5—5 in Fig. 1;

Fig. 6 is a side elevation of a cam plate, looking in the direction of the arrow 6 in Fig. 5;

Fig. 7 is a front elevation, partly in section, of a second form of my invention in which the work-supporting spindles are reciprocated relative to the headstock and tailstocks in which they are mounted;

Fig. 8 is a plan view of a third form of my invention in which the offsetting of successive teeth is effected by slight axial adjustments of the grinding wheel itself, and

Figs. 9 and 10 show modified cam plates.

A type of threading tool for the production of which my invention is particularly adapted and the utility thereof are disclosed in Fig. 2, in which the teeth of the threading tool are of the standard shape for cutting a V thread in the work K, except for the fact that clearance C is provided at one side or the other of each cutting tooth of the threading tool.

As shown in Fig. 2, the teeth are alternately offset so that clearance C is provided at the right side of each tooth in the first land of the tool, and an associated cutting edge D is provided at the left side of each tooth. In the second land, the teeth are offset in the opposite direction, so that the clearance and cutting edges are reversed, bringing a clearance C at the left side of each tooth and a cutting edge D at the right side of each tooth. The arrangement in the third and fourth lands corresponds to the arrangement in the first and second lands respectively.

It will be evident that as the teeth follow each other in cutting a thread groove, the clearance C in effect shifts alternately from right to left or from left to right as each succeeding tooth enters the thread groove in the work. Consequently, for every cutting tooth there is provided a clearance C at one side thereof and a cutting edge D at the other side, and cutting operations are performed by successive teeth first on one side of the thread groove and then on the other side.

I make no claim in this application to a threading tool having the above-defined characteristics, as that feature broadly is not of my invention. My present invention relates particularly to the provision of a grinding machine adapted to produce a threading tool such as is illustrated diagrammatically in Fig. 2.

It is evident that in the production of such a tool by a continuous grinding operation, a slight axial shift of the wheel or the tool, the one relative to the other, must occur after the grinding of each tooth on each successive land of the tool.

Referring to Figs. 1 and 3 to 6 inclusive, I have shown portions of a thread-grinding machine in which a grinding wheel W is mounted on a wheel spindle 10 and is rotated in fixed axial position. A worktable 11 is mounted to reciprocate in front of the grinding wheel W and is provided with a headstock 12 and tailstock 13.

Suitable provision is made for moving the worktable 11 relatively to the grinding wheel W in timed relation to the rotation of the work, shown in the drawings as a four-fluted tap T, so that teeth of the required pitch will be produced on the tap T. Such mechanism is common to lathes and grinding machines and may be of any usual type.

A work spindle 15 is rotatably mounted in the headstock 12 and is supported on anti-friction

bearings 16 retained in the headstock by an end plate 17. The spindle 15 has the usual tapered recess to receive a tapered sleeve 20 which is firmly seated therein.

The sleeve 20 has a cylindrical axial opening in which an auxiliary work spindle 21 is axially slidable. Keys 22 carried by the auxilary spindle 21 are received in keyways 23 in the sleeve 20 and prevent rotation of the auxiliary spindle relative to the sleeve 20, while permitting free sliding movement therein.

A driving plate or disc 25 is threaded on the outer end of the auxiliary spindle 21 and is seated against an annular flange 26 of said spindle. The plate 25 has a driver 27 engaging a dog 28 on the tap T, which tap is supported on a head center 30 in the auxiliary spindle 21 and a tail center 31 in a tail spindle 32 slidable axially in the tailstock 13.

A spring 33 in the tailstock 13 forces the tail center 31 against the tap T and forces the tap T against the head center 30. A cam plate 35 (Figs. 1, 5 and 6) is secured to the left-hand face of the flange 26, as viewed in Fig. 1, and rotates with the work spindle 15 and tap T. As the tap T is shown as a four-fluted tap, the cam plate 35 is shown as having two raised quadrants 36 and two depressed quadrants 37.

A cap 40 (Fig. 1) is rigidly secured on the headstock end plate 17 and supports a pair of fixed cam followers 41 (Figs. 3 and 4) in position for engagement by the rotating cam plate 35. The cam followers 41 are preferably provided with the oppositely beveled cam-engaging surfaces shown in Figs. 3 and 4, and the cam plate 35 and cam followers 41 are preferably of hardened steel capable of resisting extended wear.

With the parts constructed as above described, it will be evident that the tailstock spring 33, acting through the tail center 31, the tap T, the head center 30 and auxiliary spindle 21, will force the cam plate 35 firmly against the cam followers 41, thereby determining the axial position of the work relative to the headstock 12.

As the work spindle rotates, the cam plate 35 will be intermittently moved axially relative to the fixed cam followers 41, causing a slight axial adjustment of the work relative to the grinding wheel in one direction or the other at every quarter rotation of the work. The tap is so placed in the dog 28 that the flute in the tap T will be opposite the grinding wheel W whenever the cam followers 41 pass from a raised cam portion 36 to a depressed cam portion 37 or vice versa.

The amount of offset is very slight and the axial movements of the work relative to the grinding wheel for producing the offset are not over a few thousandths of an inch.

Having described one form of my invention, it will be seen that by the provision of the auxilary spindle and the cam plate and cam followers, I am able to produce a threading tool of the type indicated in Fig. 2 by the same grinding operation which is required for the production of a standard tap; and that the operation of my improved offsetting mechanism, while very effective, is almost imperceptible.

In Fig. 7 I have shown the adaptation of my invention to a grinding machine in which the work spindle and tail spindle are moved axially in the headstock and tailstock to provide the necessary normal feed between the tap T and grinding wheel W during the grinding operation.

In this construction, a work spindle 50 is slidable as well as rotatable in a spindle bearing mounted in fixed position in the work head 52. The spindle 50 is provided with a tapered sleeve 53 and with a slidable auxiliary spindle 54, all as in the form previously described, and the spindle 54 carries a cam plate 55 corresponding to the cam plate 35 of Fig. 1.

Cam followers 56 are mounted on a supporting member 57, and the member 57 is mounted on thrust bearings 58 carried by the sliding work spindle 50. A stud 59 projects upward from the supporting member 57 into a slot 60 formed in a fixed guide member 61 secured to the work head 52 and extending axially of the worktable 62.

A head-center 63 is mounted in the auxiliary spindle 54 and a tail center 65 is mounted in a tailstock spindle 66 which is yieldingly moved toward the work by a weight 67 supported on a cord or cable 68 and passing over a guide pulley 69 to a point of connection with the rear end of the tailstock spindle 66.

The usual driving connections common in this type of machine are provided, so that the normal axial movement of the work spindle 50 is effected in timed relation to the rotation of the work and also in the required relation to the pitch of the teeth to be ground.

The tap is thus rotated and normally moved axially relative to the wheel W to cut the teeth as in the production of a standard tap, while the auxiliary spindle 54 is given a supplemental axial movement or offset of a few thousandths of an inch in alternately opposite directions by the cooperation of the cam plate 55 and cam followers 56, as in the form of my invention previously described.

In Fig. 8 I have shown a third form of my invention in which the offsetting is produced by slight axial movements of the grinding wheel W. In this construction, the tap T is mounted between a work spindle 70 and tail center 71, and is maintained in fixed axial relation relative to the worktable or slide 72.

A lead screw 73 is mounted at the end of the work spindle 70 and is rotatable therewith in a fixed nut 74. Rotation of the work spindle thus effects longitudinal sliding movement of the worktable 72 and normal feed of the tap in definite relation to the rotation of the tap, the pitch of the lead screw 73 corresponding to the desired pitch of the teeth on the tap T.

The grinding wheel W is mounted on a wheel slide 80 adjustable toward and from the work on a wheel carriage 81 slidable longitudinally of the machine on fixed guide ways 82. A cam shaft 83 is rotatable in fixed bearings 84 and is provided with a cam plate 85 having raised and depressed portions and corresponding in general to the cam plates 35 and 55 previously described.

A cam follower or roll 86 is mounted on the wheel carriage 81 and engages the face of the cam plate 85. A relatively heavy coil spring 87 forces the wheel carriage 81 to the left and holds the roll 86 in firm engagement with the cam plate 85.

The cam shaft 83 is connected through gears 90 and 91 to an intermediate shaft 92 having a wide face or cylinder gear 93 engaged by a gear 94 on the work spindle 70. The cam plate 85 is thus rotated in timed relation to the tap T and preferably makes one rotation for each rotation of the tap.

With the construction above described, it will be seen that the worktable 72 is reciprocated to provide the normal axial travel of the tap past

the grinding wheel, while the cam shaft 83 is rotated to provide slight axial reciprocations of the grinding wheel itself for offsetting successive teeth of the tap.

Having described three forms of my invention, it will be evident that in each form a slight intermittent relative axial adjustment of the wheel and work commonly takes place after the grinding of each tooth on each separate land of the work. It will be further evident that this slight axial adjustment is automatic, requiring no attention from the operator and interfering in no respect with the usual operation of the machine.

While I have illustrated the production of an externally threaded tap, my invention is applicable to the production of other threading tools, such as an internally threaded die.

If the number of lands on the tap or die be even, the number of axial adjustments of the wheel and work per revolution of the work will commonly equal the number of lands. If the number of lands is odd, however, the shift between two selected successive lands may be omitted, making the number of adjustments per revolution one less than the number of lands and using a single cam follower.

An odd number of lands may also be taken care of by making one axial adjustment in two steps, with the teeth on one land in an intermediate position.

In Fig. 9 I show a cam plate 100 having a single raised portion 101 and adapted to form a three-flute tap by the first method, while in Fig. 10 I show a cam plate 102 having a raised portion 103, an intermediate portion 104 and a depressed portion 105, and adapted to form a three-flute tap by the second method.

Obviously any desired number and arrangement of raised portions and depressions may be provided on the cam plate and one or two cam followers may be used.

Having thus described certain forms of my invention, and the advantages thereof, I do not wish to be limited to the details herein disclosed, otherwise than as set forth in the claims, but what I claim is:—

1. A thread grinding machine comprising a grinding wheel, a work support, means to effect relative normal axial feed between the wheel and the work, and additional means to effect regularly repeatedly slight additional axial adjustments between the wheel and work.

2. A thread grinding machine comprising a grinding wheel, a work support, means to effect relative normal axial feed between the wheel and the work, and additional means to effect regularly repeated slight additional axial adjustments between the wheel and work in timed relation to the rotation of the work.

3. A thread grinding machine comprising a grinding wheel, a work support, means to effect relative normal axial feed between the wheel and the work, and additional means to effect a plurality of slight additional axial adjustments between the wheel and the work during each revolution of the work.

4. A thread grinding machine comprising a grinding wheel, a work support, means to effect relative normal axial feed between the wheel and the work, and additional means to effect regularly repeated slight additional axial adjustments between the wheel and work, successive adjustments being in opposite directions.

5. A thread grinding machine comprising a grinding wheel, a work support, means to effect relative normal axial feed between the wheel and the work, and additional means to effect regularly repeated slight additional axial adjustments between the wheel and work, successive adjustments being in opposite directions and of equal extent.

6. A thread grinding machine comprising a grinding wheel, a work support, means to effect relative normal axial feed between the wheel and the work, and additional means to effect regularly repeated slight additional axial adjustments between the wheel and work, the number of adjustments per revolution of the work corresponding to the number of lands on the work.

7. A thread grinding machine comprising a grinding wheel, a work support, means to effect relative normal axial feed between the wheel and the work, and additional means to effect regularly repeated slight additional axial adjustments between the wheel and work, said additional means comprising a cam plate and a cam follower, one of said parts being mounted to rotate with the work.

8. A thread grinding machine comprising a grinding wheel, a work support, means to effect relative normal axial feed between the wheel and the work, and additional means to effect regularly repeated slight additional axial adjustments between the wheel and work, said additional means comprising a cam plate having alternating raised and depressed portions, and a cam follower, one of said parts being mounted to rotate with the work.

9. In a thread grinding machine, a worktable, a work spindle rotatable in fixed position on said worktable, an auxiliary spindle mounted within and rotatable with said work spindle but slidable axially relative thereto, and means to effect regularly repeated slight axial adjustments of said auxiliary spindle relative to said work spindle.

10. In a thread grinding machine, a worktable, a work spindle rotatable in fixed position on said worktable, an auxiliary spindle mounted within and rotatable with said work spindle but slidable axially relative thereto, and means to effect a plurality of regularly repeated slight axial adjustments of said auxiliary spindle relative to said work spindle during each revolution of said work spindle.

11. The combination in a thread grinding machine as set forth in claim 10, in which the adjusting means comprises a cam plate having a plurality of raised and depressed portions, and a cam follower, one of said parts being mounted to rotate with said auxiliary spindle.

12. The combination in a thread grinding machine as set forth in claim 10, in which the adjusting means comprises a cam plate having a plurality of raised and depressed portions, and a cam follower, one of said parts being mounted to rotate with said auxiliary spindle, and the other part being mounted in fixed axial relation to said work spindle.

13. In a thread grinding machine, a work spindle having a tapered opening, a tapered sleeve seated in said tapered opening and having a cylindrical axial opening, an auxiliary spindle slidable in the cylindrical opening in said sleeve but keyed to said sleeve, and means to intermittently and regularly shift said auxiliary spindle axially relative to said work spindle.

14. In a thread grinding machine, a work spindle having a tapered opening, a tapered sleeve seated in said tapered opening and having

a cylindrical axial opening, an auxiliary spindle slidable in the cylindrical opening in said sleeve but keyed to said sleeve, and means to shift said auxiliary spindle relative to said work spindle a predetermined number of times for each revolution of said work spindle.

15. In a thread grinding machine, a grinding wheel, a headstock, a work spindle slidable in said headstock to effect normal feed of the work relative to the grinding wheel, and additional means to effect a plurality of regularly repeated slight additional axial adjustments between the work and the grinding wheel during each revolution of the work.

16. In a thread grinding machine, a grinding wheel, a headstock, a work spindle slidable in said headstock to effect normal feed of the work relative to the grinding wheel, and additional means to effect a plurality of regularly repeated slight additional axial adjustments between the work and the grinding wheel during each revolution of the work, said additional means comprising a cam plate having alternate raised and depressed portions, and a cam follower, one of said parts being secured in fixed axial relation to said work spindle and being slidable therewith, and the other part being rotatable with the work.

17. In a thread grinding machine, a grinding wheel, a headstock, a work spindle slidable in said headstock to effect normal feed of the work relative to the grinding wheel, an auxiliary spindle, and additional means to effect a plurality of repeated slight additional axial adjustments between the work spindle and the auxiliary spindle during each revolution thereof.

18. In a thread grinding machine, a grinding wheel, a headstock, a work spindle slidable in said headstock to effect normal feed of the work relative to the grinding wheel, an auxiliary spindle, and additional means to effect a plurality of repeated slight additional axial adjustments between the work spindle and the auxiliary spindle during each revolution thereof, said additional means comprising a cam plate having alternate raised and depressed portions and a cam follower, one of said parts being secured in fixed axial relation to said work spindle and being movable axially therewith, and the other part being mounted on and rotatable with said auxiliary spindle.

19. A thread grinding machine comprising a grinding wheel mounted for axial movement, a worktable, means to move one of said parts relative to the other to effect normal axial feed between the wheel and work, and additional means to effect a plurality of regularly repeated slight additional axial adjustments of the grinding wheel during each revolution of the work.

20. A thread grinding machine comprising a grinding wheel mounted for axial movement, a worktable, means to move one of said parts relative to the other to effect normal axial feed between the wheel and work, and additional means to effect a plurality of regularly repeated slight additional axial adjustments of the grinding wheel during each revolution of the work and in timed relation thereto, said latter means comprising a cam plate having a plurality of alternate raised and depressed portions, means to rotate said cam plate in definite relation to the rotation of the work, and a cam follower fixed in axial relation to said grinding wheel.

21. A thread grinding machine comprising a grinding wheel, a work support, means to effect relative normal axial feed between the wheel and the work, and additional means to effect slight additional axial adjustments between the wheel and the work, said adjustments being repeated in identical order during each revolution of the work.

22. A thread grinding machine comprising a grinding wheel, a work support, means to effect relative normal axial feed between the wheel and the work, and additional means to effect slight additional axial adjustments between the wheel and the work, said adjustments being repeated in identical order during each revolution of the work and being one less in number than the number of lands of the work.

23. A thread grinding machine comprising a grinding wheel, a work support, means to effect relative normal axial feed between the wheel and the work, and additional means to effect slight additional axial adjustments between the wheel and the work, said adjustments being repeated in identical order during each revolution of the work and two successive adjustments each being of substantially one-half the extent of the other adjustments and in the same direction.

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