PATENT SPECIFICATION

868,034

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COMPLETE SPECIFICATION

DRAWINGS ATTACHED

Improvements in Screwcutting Lathes

I, BENJAMIN JOHN FARROW, a British subject, of c/o, Farrow Engineering Co., Limited, of Highclere, Newbury, Berkshire, formerly of Wimborne Street, Cranbourne, Wimborne, Dorset, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement :—

The cutting of screw heads on a lathe involves causing the carriage carrying the tool to be traversed along the bed by means of a lead screw which is engaged by a nut member in the carriage. The lead screw is connected to the work by variable-ratio positive gearing. Commonly it is necessary to take a succession of cuts in order to reach the full depth of the thread. This means that repeatedly the tool must be withdrawn, the carriage returned to its starting point, the tool fed to a new setting, and the carriage traversed again. Although the return movement can be accomplished by reversing the rotation of the work and lead screw, with the nut member in continuous engagement with the lead screw, time can be saved by disengaging the nut member in the carriage from the lead screw, returning the carriage quickly by hand, and re-engaging the nut member. The nut member may be a half nut, or may be a split nut.

A problem, which has been long recognised, is then introduced of ensuring that the nut member is re-engaged at the correct instant. In most jobs the pitch of the thread being cut on the work will be different from the pitch of the thread on the lead screw. The word " pitch " is used in this specification to mean " distance between two similarly located points on successive threads " and is expressed directly in inches or m.m., e.g. $\frac{1}{4}$ means $\frac{1}{4}$ inch and 5.0 mean 5 millimetres between successive threads.

In the interval between disengagement and re-engagement of the nut member, two things happen : the work and the lead screw turn, and the carriage is moved manually along the lead screw. In the special cases in which the work pitch (i.e. the pitch of the thread on the work) is equal to, or is a multiple of, the lead pitch (i.e. the pitch of the thread on the lead screw) then wherever the nut member is engaged, the tool will re-enter the thread previously cut. In all other cases this is not so, and arbitrary re-engagement will cause the tool to be out of longitudinal register with the work thread. This will ruin the thread or tool or both.

Correct re-engagement will occur only when during the period of disengagement the sum of the revolutions of the lead screw in the traversing direction, and the number of lead threads passed by the carriage in the reverse direction (i.e. distance moved by the lead pitch) is equal to, or is a multiple of, the numerator in the fraction " work pitch divided by lead pitch " when simplified, i.e. when the numerator and denominator are given the lowest values at which they are both whole numbers. Note that the revolutions of the lead screw need not be a whole number, nod need the number of lead threads passed, but their sum must be. If the lead screw is multi-start, which is rare, then the conditions for correct re-engagement are the same, taking lead pitch as meaning the distance from start to start. If the work thread is multi-start then it is usual to cut one start at a time and the conditions are the same, taking work pitch as meaning the distance from one start to the next thread of the same start.

In practice it would be convenient to return the carriage to an arbitrary position,

or possibly to a stop, and allow the lead screw to turn, and then to re-engage the nut member at the appropriate moment. Under the British system a relatively simple device known as a thread dial exists to indicate to an operator when to re-engage the nut member. Such a device cannot cope with a variety of pitches measured on the metric system. In fact, in cutting threads on the metric system it is usual to keep the nut member engaged and to return the carriage by reversing the work and lead screw.

According to the prevent invention a device for use on a lathe comprises a mounting plate which may be the lathe apron or a plate attached thereto, a pair of spindles mounted in said plate, the first of said spindles carrying a timing disc and a series of gear-wheels of different sizes, the second of said spindles carrying a worm-wheel for engaging the lathe lead screw, and a pinion rotatably connected with the worm-wheel and engageable with any of said gear-wheels to drive the timing disc, a slide on said plate carrying a nut member engageable with the lead screw, and means on the slide co-operating with a shaped part of said timing disc whereby the slide is permitted to move to engage the nut member with the lead screw only at a pre-determined engagement position of the timing disc.

The plate may be the lathe apron or an attachment to be fixed to the lathe apron. In use the ratio chosen for the gear drive to the timing disc is such that the total gear ratio between the lead screw and the disc is, or is a simple multiple of, the numerator in the fraction " work pitch divided by lead pitch " when the numerator and denominator are given the lowest values at which they are both whole numbers.

Where the lead screw timing disc ratio is a multiple of the numerator in the fraction, then the timing disc may have a corresponding number of registering positions per revolution. The timing disc may have a number of equally spaced slots or cam lobes around its circumference to register with the said means on the slide.

The invention will now be further described by way of example with reference to the accompanying diagrammatic drawings wherein :

Figure 1 is a front view of a lathe having a device attached thereto made in accordance with the invention ;

Figure 2 is a front view of the device itself on a larger scale so as to show more details ;

Figure 3 is a plan view of the device ;

Figure 4 is a side elevation of the device looking in the direction of the arrow 4 on Figure 2 ;

Figure 5 is a sectional view on the line X-X on Figure 2 showing the connection of the engaging lever to the slide ;

Figure 6 is a detail of the timing disc ;

Figure 7 is a detail of the masking disc ; and

Figure 8 is a detail of the timing and masking discs assembled.

The lathe comprises a lathe bed 10, headstock 11, tailstock 12, apron 13, tool holder 14, lead screw 15, stop carrying bar 16 and stop 17.

The device of the present invention is made in this example separate from and attachable to the apron and comprises a mounting plate 20 having an integral flange 21 provided with bolt holes 22 whereby it can be fixed to the apron by means of bolts. The mounting plate carries a first spindle 23 and a second spindle 24 which have their axes parallel to each other in a common horizontal plane. The spindle 24 is in practice mounted in ball bearings but these are not shown in the drawings.

Fixed on the spindle 23 is a masking disc 25 having four slots 45, 46, 47, 48 in its periphery. Rotatably mounted on the spindle 23 is a sleeve 26 having a timing disc 27 at one end thereof in contact with the masking disc 25 and an adjusting knob 28 slidably mounted on a squared portion of spindle 23 at the other end. Between the disc 27 and the knob 28 is a series of gear-wheels 30, 31, 32, 33, 34 which are secured to the sleeve 26.

The disc 27 has four equally spaced slots 36, 37, 38, 39 in its periphery and the sleeve 26 has four recesses 40, 41, 42, 43 in its face adjacent the knob 28 which has a projection 44 thereon engageable in any of the recesses. A spring 49 surrounds the squared portion of spindle 23 and is located between a flange 50 on the knob 28 and a flange 51 on the spindle 23.

The knob 28 can be pulled out to disengage the projection 44 whereupon the knob 28 and the disc 25 can be rotated in relation to the disc 27 so as to mask one, two, three or all of the slots 36, 37, 38, 39, the projection 44 engaging in the appropriate recess 40, 41, 42 or 43 to hold the parts in the selected masking position.

The position where all slots are masked is chosen to prevent engagement of the nut inadvertently when the lathe is not being used for screw-cutting.

The spindle 24 has a long toothed member 53 fixed thereon and a gear selector lever 55 engages slidably on this member. The lever 55 carries a pivot 56 on which is a pinion 57 that is in constant mesh with the member 53. By rotating the lever and sliding it along the member 53, the pinion 57 can be engaged with any of the gear-wheels 30-34 so as to obtain the desired gear ratio. The lever is held in the selected position by means of a spring pressed pin 60 engageable in any of a number of holes

51 in a bar 62 and movable by means of a knob 63.

The spindle 24 also carries a worm-wheel 64 fixed thereon which is in engagement with the lead screw 15.

A half-nut 65 is engageable with the lead screw 15, and is carried by a slide 66 that is mounted for vertical sliding movement in the plate 20 between the plate and the lead screw on the opposite side of the plate 20 to the gear-wheels 30-34 in a position such that the axis of the gear-wheels passes through the slide.

The slide carries an abutment 67 engageable in the slots 36-39 in the timing disc. The slide is urged downwardly by a spring 70 for disengaging the half-nut 65 from the lead screw 15 and the abutment 67 from the slots.

A locking pawl 74 is pivoted at 71 on the plate 20 and is urged by a spring 72 to an upright position in which it locks the abutment 67 in its position of engagement in one of the slots 36-39.

A half-nut engaging lever 76 is mounted on spindle 77 that is pivotally mounted in the plate 20 and this spindle carries an eccentric pin 79 engaged in a slot in the slide. The spindle 77 carries a block 81 which in turn carries a screw 82 that engages the lower end of the locking pawl 74. A disengaging lever 84 is pivotally mounted at 85 on the plate 20 and has a nose 86 engageable with an extension 87 of the block 81, and a nose 88 engageable by a striking lever 90. The lever 90 is pivotally mounted at 91 and its rear end 92 engages the stop 17 at the end of the screw cutting movement of the tool whereupon the lever 84 is rotated to move 81, 82 to move the locking pawl 74 away from the abutment 67 and the parts 67, 76, 66 move for disengaging the half-nut.

In use the ratio of the gearing is chosen such that the total gear ratio between the lead screw and the rotary timing disc divided by the number of slots or lobes in the timing disc is, or is a simple multiple of, the numerator in the fraction "Work Pitch" divided by "Lead Pitch" when the numerator and denominator are given the lowest values at which they are both whole numbers expressed in the same units.

Note that when converting from one set of units to another for this purpose consideration must be made of the conversion factor inherent in the lathe.

In the case of a lathe having a lead screw of 4 threads per inch (i.e. $\frac{1}{4}$" PITCH) and a metric conversion factor utilising a gear of 127 teeth (i.e. 1" = 25.4 mm) the following gears will be found suitable for cutting all English threads including fractional threads (i.e. 8, 11, $4\frac{1}{2}$, $9\frac{3}{4}$, $3\frac{3}{8}$, etc. threads per inch) and the following metric pitches which are those in most common usage (.5, .75, 1.0, 1.25, 1.5, 1.75, 2.0, 2.25, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 6.0).

Gears:

Worm	- N teeth	Where N and n are
Long Pinion	- N teeth	any convenient
Idler	- n teeth	number of teeth.
Cone gears	- 120 T, 100, 90, 80, 70 and 32 Teeth.	

The timing disc may have four equally spaced slots on its periphery which may be masked to leave all four slots, two opposite slots, one slot only or none. The latter position is a safety setting when the lathe is not being used for screw-cutting. For example:

(a) To cut 1.75 mm pitch $\left(= \frac{1.75 \times 5 \text{ inches}}{127}\right)$

$$\frac{\text{Work Pitch}}{\text{Lead Pitch}} = \frac{1.75 \times 5 \times 4}{127} = \frac{35}{127}$$

(b) to cut 3.5 mm pitch $\left(= \frac{3.5 \times 5 \text{ inches}}{127}\right)$

$$\frac{\text{Work Pitch}}{\text{Lead Pitch}} = \frac{3.5 \times 5 \times 4}{127} = \frac{70}{127}$$

By selecting the cone gear of 70 teeth, and masking all but one slit in the timing disc (b) will be correctly engaged. By masking two opposite slots (a) will be correctly engaged in the positions of the two unmasked slots.

WHAT I CLAIM IS:—

1. A device for use in a lathe comprising a mounting plate which may be the lathe apron or a plate attached thereto, a pair of spindles mounted in said plate, the first of said spindles carrying a timing disc and a series of gear-wheels of different sizes, the second of said spindles carrying a worm-wheel for engaging the lathe lead screw, and a pinion rotatably connected with the worm-wheel and engageable with any of said gear-wheels to drive the timing disc, a slide on said plate carrying a nut member engageable with the lead screw, and means on the slide co-operating with a shaped part of said timing disc whereby the slide is permitted to move to engage the nut member with the lead screw only at a predetermined engagement position of the timing disc.

2. A device as claimed in claim 1, wherein the second spindle carries a toothed member coaxial with the spindle on which a gear selector lever is slidably mounted, said lever carrying a pivot for the pinion offset from the second spindle, said pinion being in constant mesh with said toothed member; detent means being provided to hold the lever in any of a selected number of gear ratio positions.

3. A device as claimed in claim 1 or 2, wherein the gear-wheels and slide are

located on opposite sides of the plate with the axis of the first spindle passing through the slide, and the timing disc between the gear-wheels and the plate.

4. A device as claimed in any of the preceding claims having slots in the timing disc engageable by an abutment carried by the slide.

5. A device as claimed in claim 4, having a masking disc adapted to mask one or more of the slots in the timing disc.

6. A device as claimed in claim 5, wherein the timing disc is carried by a sleeve on the first spindle and the gear-wheels are fixed on this sleeve, said sleeve being pressed into engagement with the masking disc, said disc and sleeve being rotatably adjustable in relation to each other and held in adjusted position by a projection carried by one disc entering any of a plurality of openings in a part fixed to the other disc.

7. A device as claimed in claim 4, having a spring urged locking pawl for holding the abutment in its slot, an engaging lever operably connected with the slide for engaging the abutment in the slots, said lever also operating said locking pawl to move it to its disengaged position, and disengaging means mounted on the plate for moving the engaging lever to its disengaged position when said disengaging means encounters a stop suitably arranged on the lathe.

8. A device for attachment to a lathe substantially as described with reference to the accompanying drawings.

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PROVISIONAL SPECIFICATION

Improvements in Screwcutting Lathes

I, BENJAMIN JOHN FARROW, a British subject, of Wimborne Street, Cranbourne, Wimborne, Dorset, do hereby declare this invention to be described in the following statement:—

The cutting of screw threads on a lathe involves causing the carriage carrying the tool to be traversed along the bed by means of a lead screw which is engaged by a nut in the carriage. The lead screw is connected to the work by variable-ratio positive gearing. Commonly it is necessary to take a succession of cuts in order to reach the full depth of the thread. This means that repeatedly the tool must be withdrawn, the carriage returned to its starting point, the tool fed to a new setting, and the carriage traversed again. Although the return movement can be accomplished by reversing the rotation of the work and lead screw, time can be saved by disengaging the nut in the carriage from the lead screw, returning the carriage quickly, and re-engaging the nut. For this purpose the nut may be a half nut, or be split.

A problem, which has been long recognised, is then introduced of ensuring that the nut is re-engaged at the correct instant. In most jobs the pitch of the thread being cut on the work will be different from the pitch of the thread on the lead screw. Now pitch is expressed in two ways. In countries using British units of measurement, pitch is expressed as so many threads per unit length, e.g. "$5\frac{1}{4}$" means $5\frac{1}{4}$ threads per inch. In countries using metric units of measurement, pitch is expressed in m.m., e.g. 5.0 means 5 millimetres between successive threads. However since this invention deals with the problem in its more acute form which arises when the metric system is used, the word "pitch" is used in this specification to mean "distance between two similarly located points on successive threads."

Now in the interval between disengagement and re-engagement of the nut two things may happen: the work and the lead screw may turn; the carriage may be moved along the lead screw. In the special cases in which the work pitch (i.e. the pitch of the thread on the work) is equal to, or is a submultiple of, the lead pitch (i.e. the pitch of the thread on the lead screw) then wherever the nut is engaged, the tool will re-enter the thread previously cut. In all other cases this is not so, and arbitrary re-engagement will cause the tool to be out of longitudinal register with the thread. This will ruin the thread or tool or both.

Correct re-engagement will only occur if during the period of disengagement the sum of the revolutions of the lead screw in the traversing direction, and the number of lead threads passed by the carriage in the reverse direction (i.e. distance moved divided by the lead pitch), is equal to, or is a multiple of, the numerator in the fraction "work pitch divided by lead pitch" when simplified, i.e. when the numerator and denominator are given the lowest values at which they are both whole numbers. Note that the revolutions of the lead screw need not be a whole number, nor need the number of lead threads passed, but their sum most be. (If the lead screw is multi-start, which is rare, then the conditions for correct re-engagement are the same, taking lead pitch as meaning the distance from start to start. If the work thread is multi-start then it is

usual to cut one start at a time and the conditions are the same, taking work pitch as meaning the distance from one start to the next thread of the same start).

Now in practice it would be convenient to return the carriage to an arbitrary position, or possibly to a stop, and allow the lead screw to turn, and then to re-engage the nut at the appropriate moment. Such a moment, with the usual single start lead screw, only occurs once per revolution of the lead screw. Under the British system of pitch measurement a relatively simple device known as a thread dial exists to indicate to an operator when to re-engage the nut. Such a device cannot cope with a variety of pitches measured on the metric system. In fact in cutting threads on the metric system it is usual to keep the nut engaged and to return the carriage by reversing the work and lead screw.

According to the present invention a lathe carriage, having a nut disengageable from a lead screw, carries a worm wheel engaging the lead screw, a rotary indicator, and variable-ratio positive gearing between the worm wheel and the indicator. In use the ratio is such that the total gear ratio between the lead screw and the indicator is, or is a simple multiple of, the numerator in the fraction "work pitch divided by lead pitch" when the numerator and denominator are given the lowest values at which they are both whole numbers. The indicator has an associated datum mark, and before each cut the nut is re-engaged when the indicator registers with the datum mark. This ensures correct engagement on each occasion.

The indicator may be for visual observation by an operator who has manual control over re-engagement of the nut. For example it may be a disc revolving relatively to a fixed mark or pointer or it may be a needle revolving relatively to a dial. Alternatively the indicator may operate an automatic nut re-engaging mechanism, in which case it may, for example, be a cam disc or a rotary valve member or switch member.

Where the lead/indicator ratio is a multiple of the numerator in the fraction, then the indicator may have a corresponding number of registering positions per revolution. Thus a disc may have a number of equally spaced marks around its circumference to register with a single fixed mark. This is merely a means of saving a little further time and is not essential.

For example the mechanism may consist of a vertical shaft carrying the worm wheel and a long pinion, a second vertical shaft carrying an indicator disc at the top, and beneath it a number of gears of different sizes. There is a lever free to turn and slide on the first shaft and carrying an idler gear in constant mesh with the long pinion, the lever having a handle moving in a stepped gate so as to carry the idler gear successively into engagement with the gears on the second shaft. The handle can be locked in each step of the gate.

For cutting the threads of the International Metric series the following sizes are suitable:

Worm wheel	...	10 teeth.
Long pinion	...	10 teeth.
Gears (set of five)		10, 14, 18, 22 and 24 teeth.
Indicator ...	...	2 marks at 180° spacing.

Then, for example, if it is required to cut a 1.75 mm thread using a 5 mm lead screw, the fraction "work pitch divided by lead pitch" is

$$\frac{1.75}{5} = \frac{7}{20}$$

The gear ratio lead screw/indicator is to have a value equal to 7 or a multiple of it. This can be provided by moving the 14 tooth gear into mesh with the long pinion. Then the gear ratio lead screw/indicator is $10/1 \times 14/10 = 14$. Now correct re-engagement can occur at intervals of 7 revolutions of the lead screw, that is to say at intervals of half a revolution of the indicator. Consequently if the nut has initially been engaged when one or other indicator mark is in register with the datum, then re-engagement will always be correct if made when one or other mark is in register. (In fact precise registration does not necessarily occur. There are 14 possible moments of re-engagement per revolution, and those are chosen at which the marks are closest to the datum. However it is possible to set the angular positions of all the gears on the indicator shaft so that precise registration does occur.)

Note that the same gear system will work with different pitches of lead screw, only the worm wheel being changed for one with the same number of teeth but an appropriately different circular pitch.

More unusual pitches may be cut by providing additional or exchangeable gears in the gear system.

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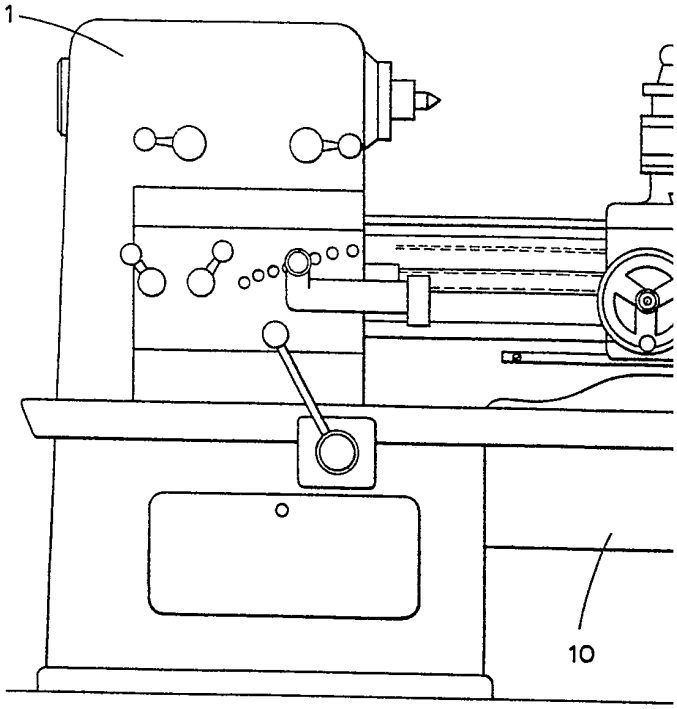
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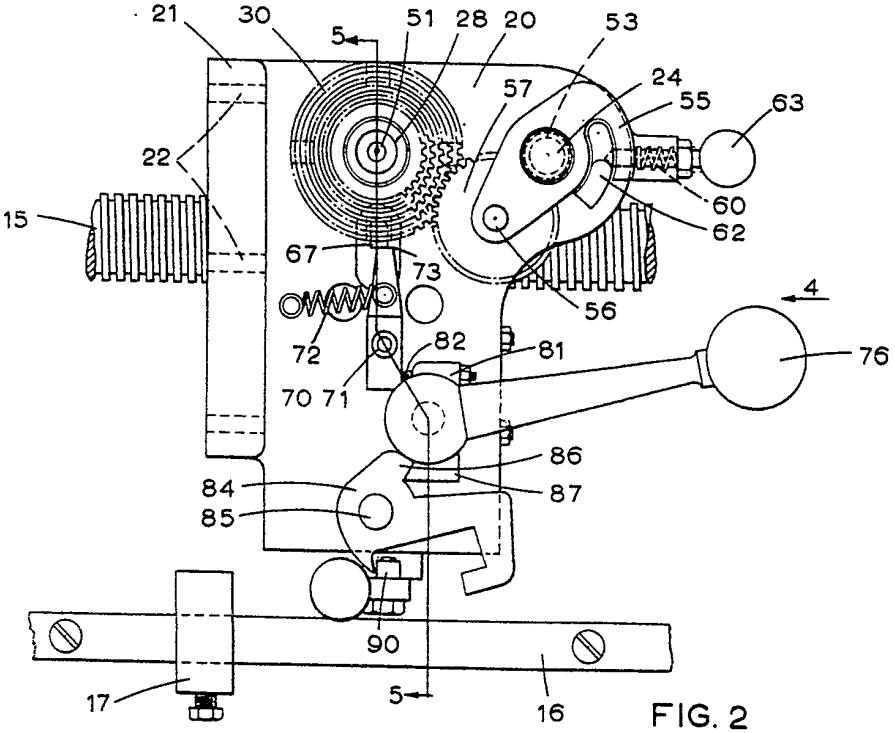
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FIG. 2

868,034 COMPLETE SPECIFICATION

2 SHEETS

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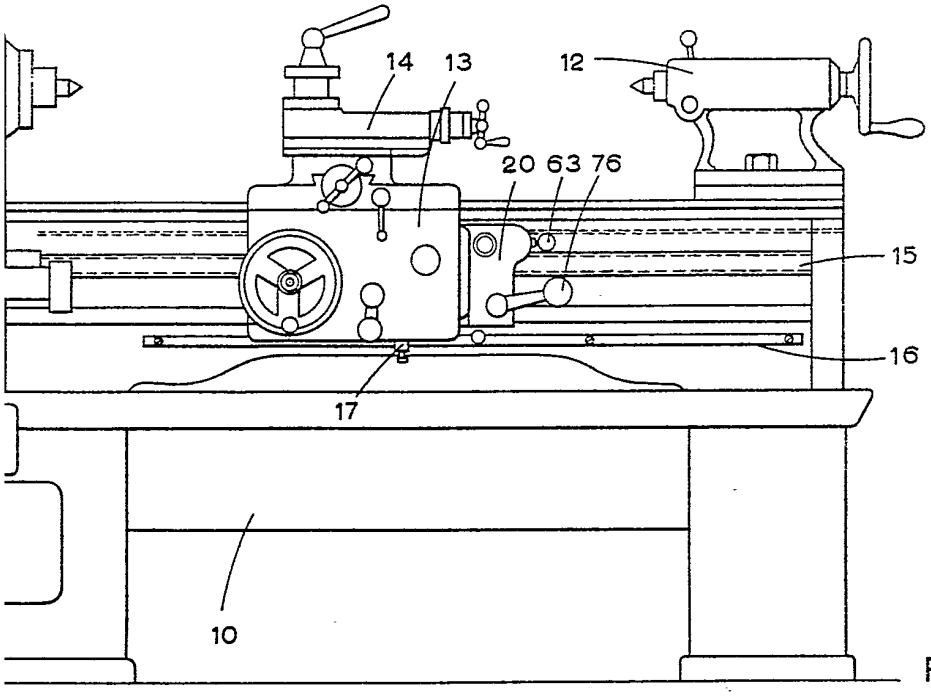
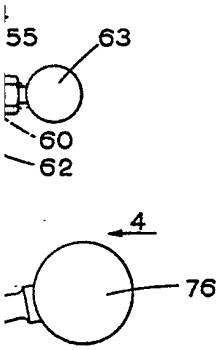


FIG. 1



IG. 2

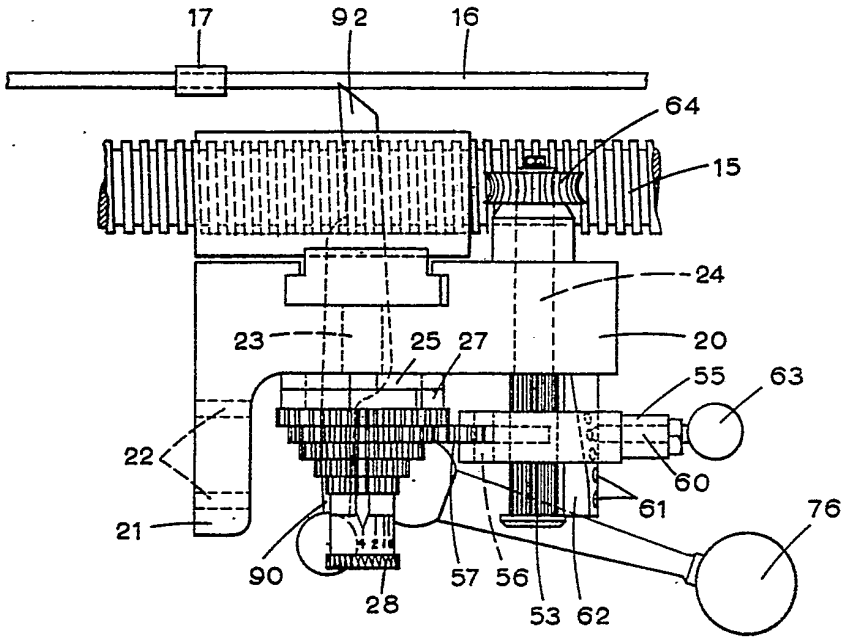


FIG. 3

868,034 COMPLETE SPECIFICATION

2 SHEETS

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SHEET 1

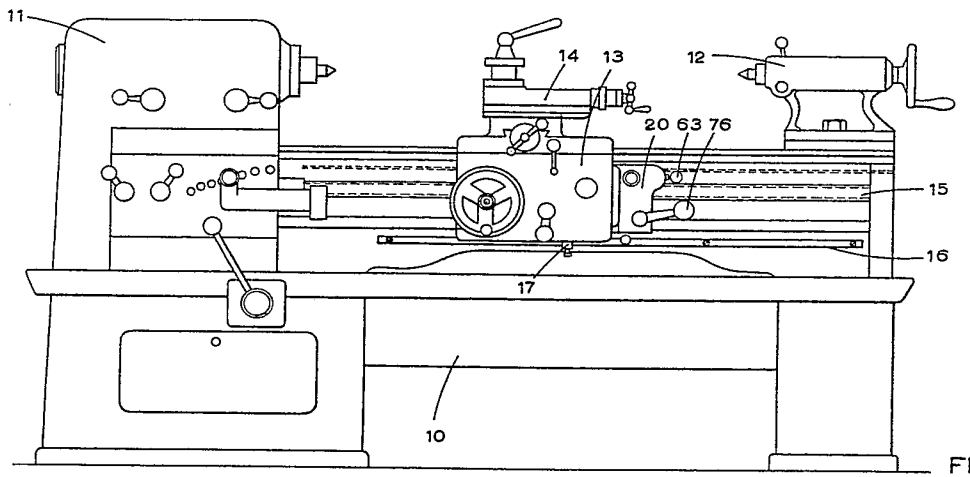

FIG. 1

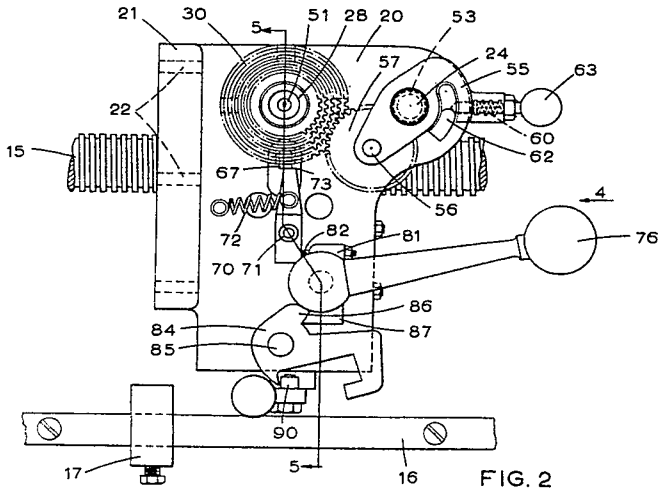

FIG. 2

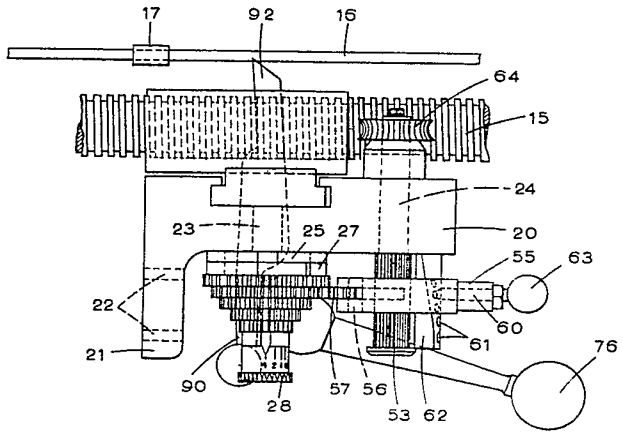

FIG. 3

868,034 COMPLETE SPECIFICATION
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SHEET 2

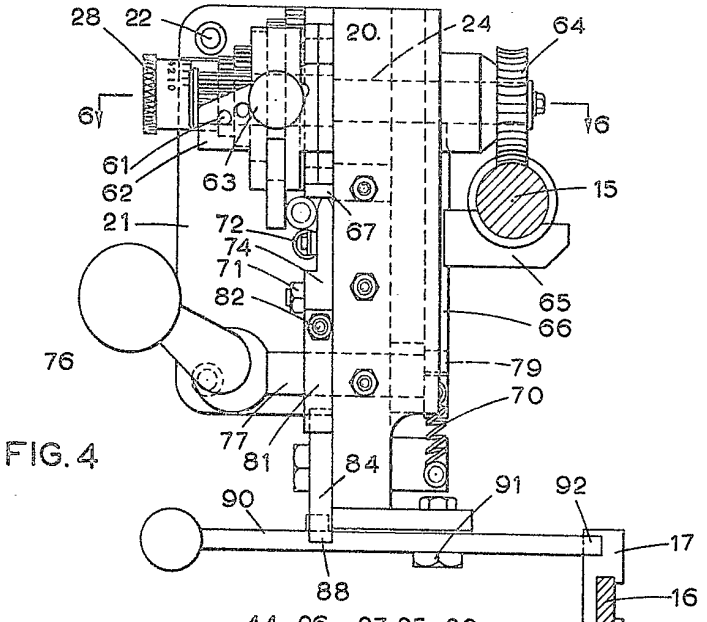

FIG. 4

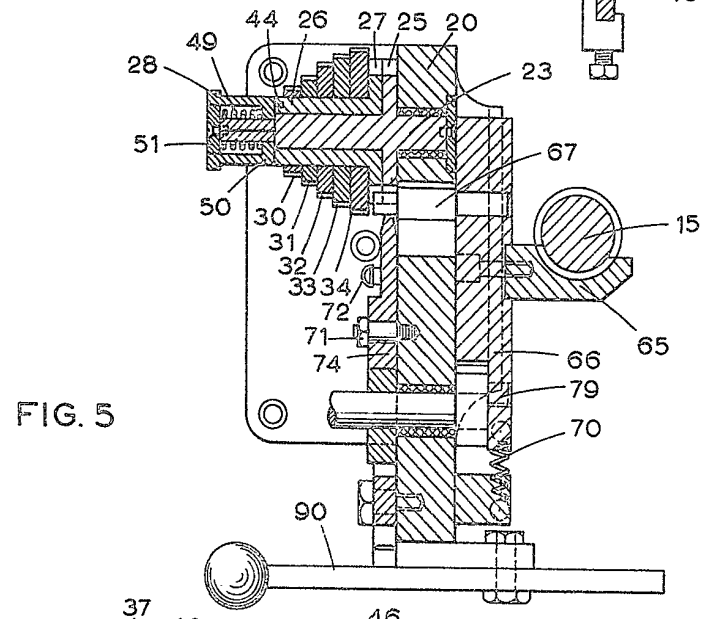

FIG. 5

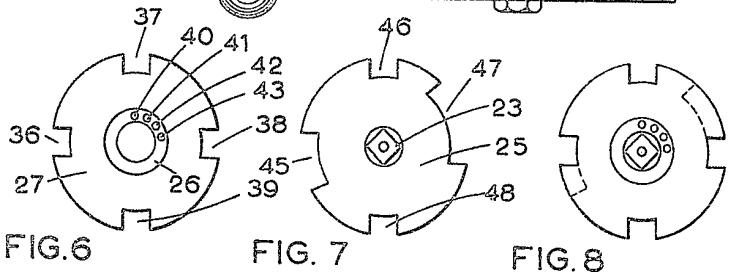

FIG. 6 FIG. 7 FIG. 8