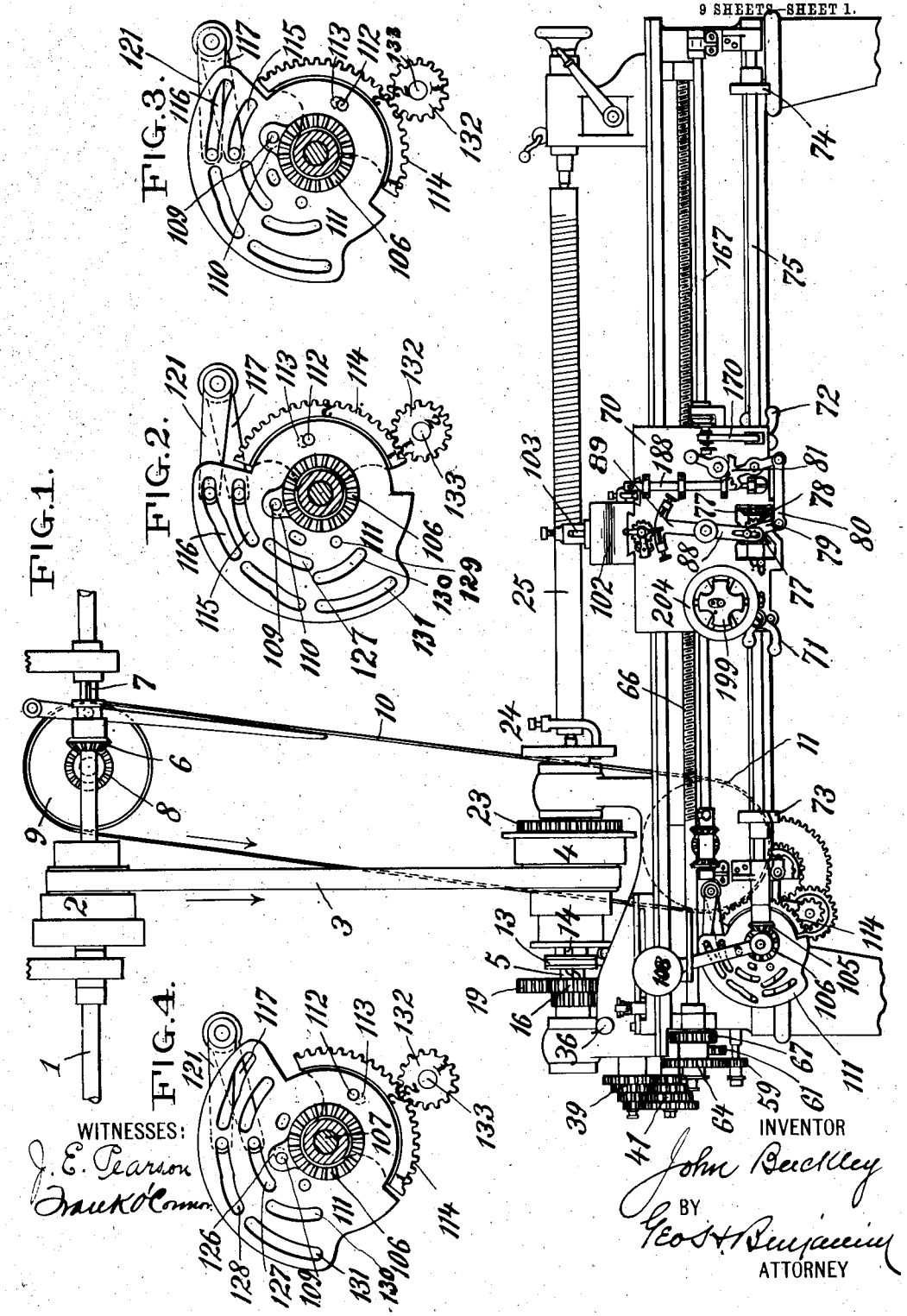
No. 834,359. PATENTED OCT. 30, 1906.

J. BUCKLEY.

AUTOMATIC LATHE.

APPLICATION FILED JULY 22, 1904.

9 SHEETS—SHEET 1.



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9 SHEETS—SHEET 2.

FIG. 6.

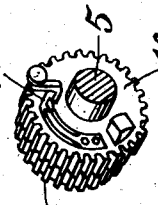

FIG. 7.

FIG. 5.

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9 SHEETS—SHEET 3.

FIG. 9.

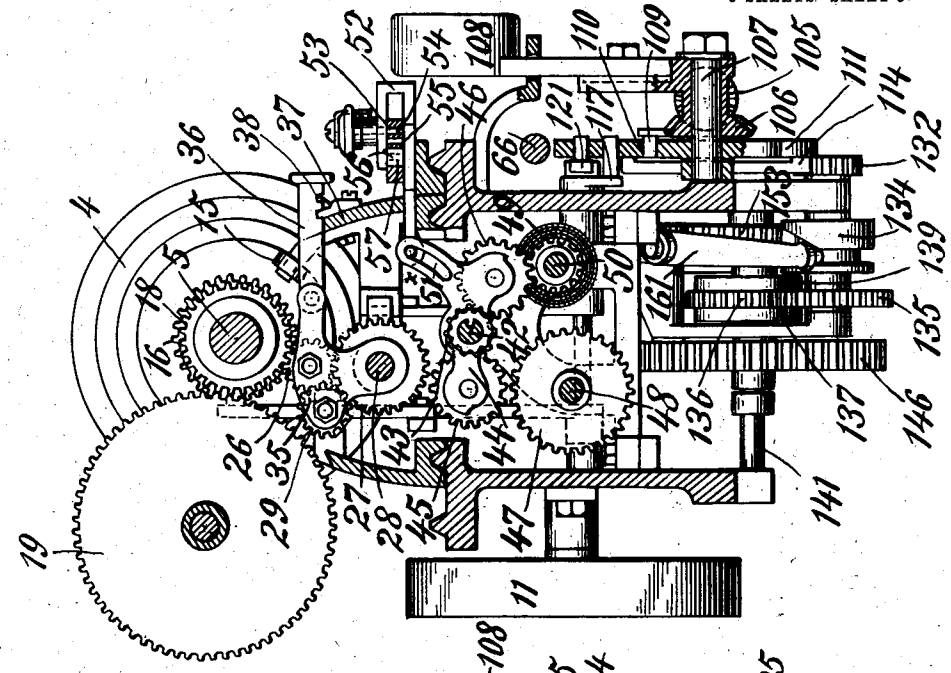


FIG. 8.

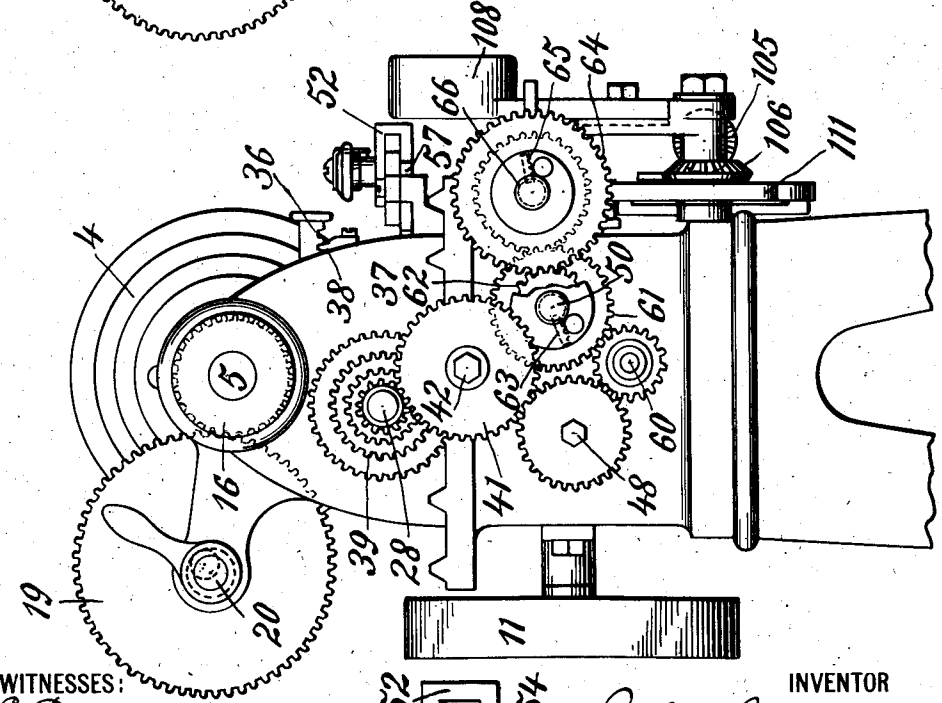
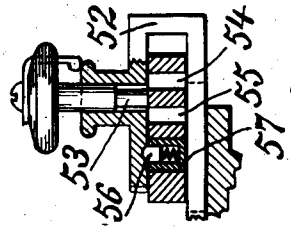


FIG. 10.



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9 SHEETS—SHEET 4.

FIG. 11.

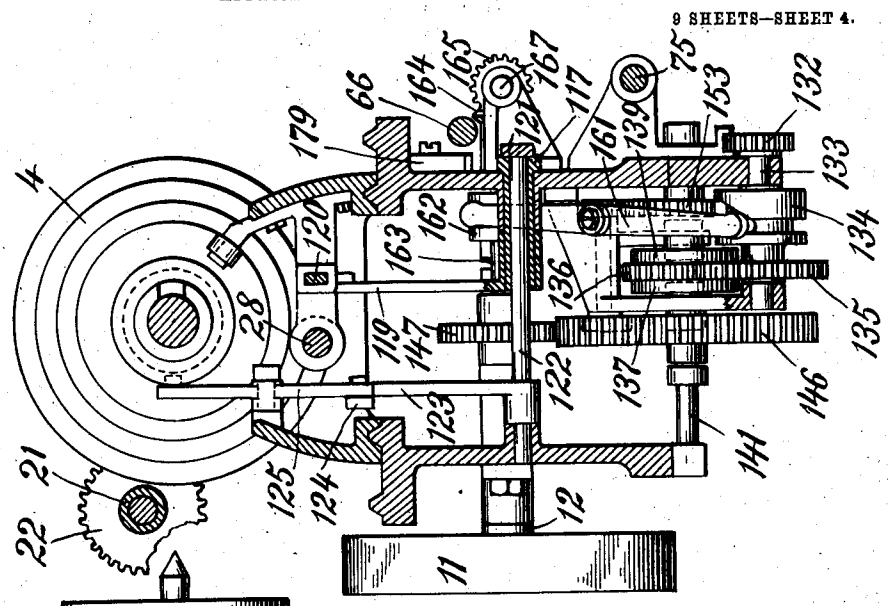
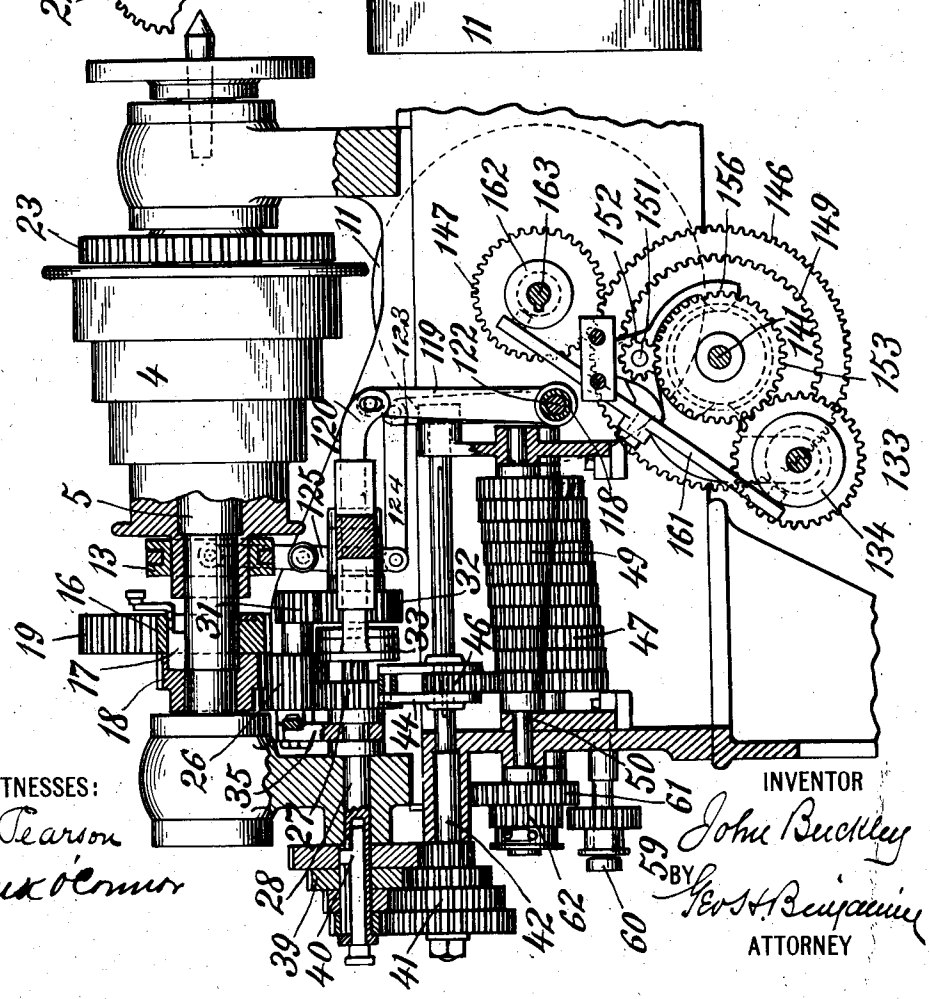


FIG. 12.



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9 SHEETS—SHEET 5.

FIG. 13.

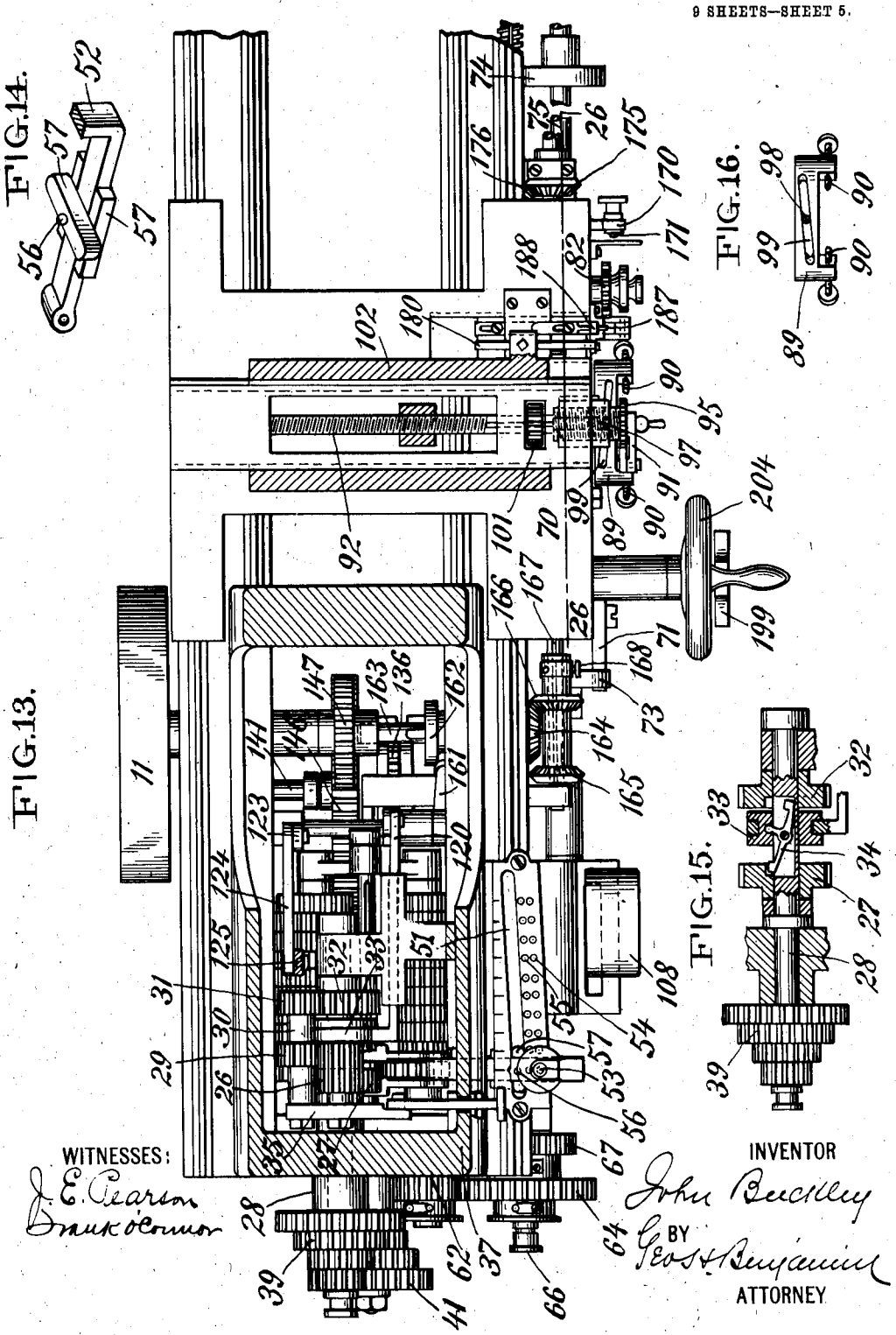

FIG. 14.

FIG. 16.

FIG. 15.

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9 SHEETS—SHEET 6.

FIG. 17.

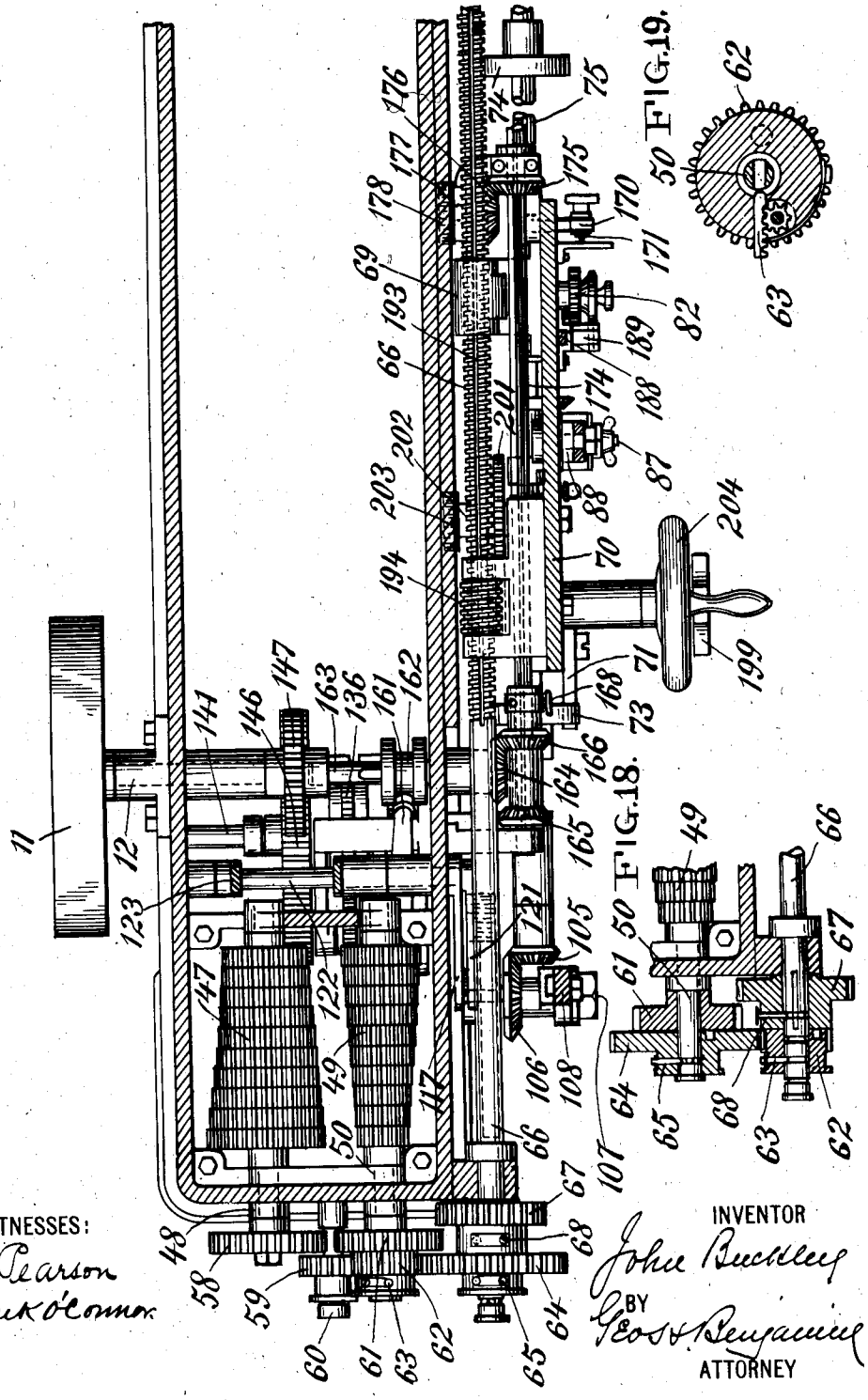

FIG. 19.

FIG. 18.

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9 SHEETS—SHEET 7.

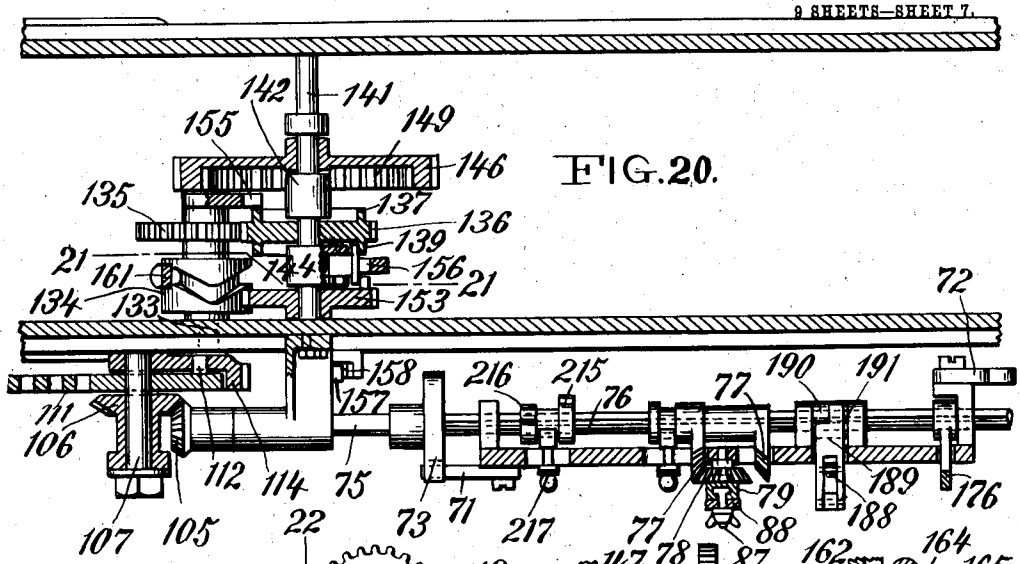

FIG. 20.

FIG. 21.

FIG. 22.

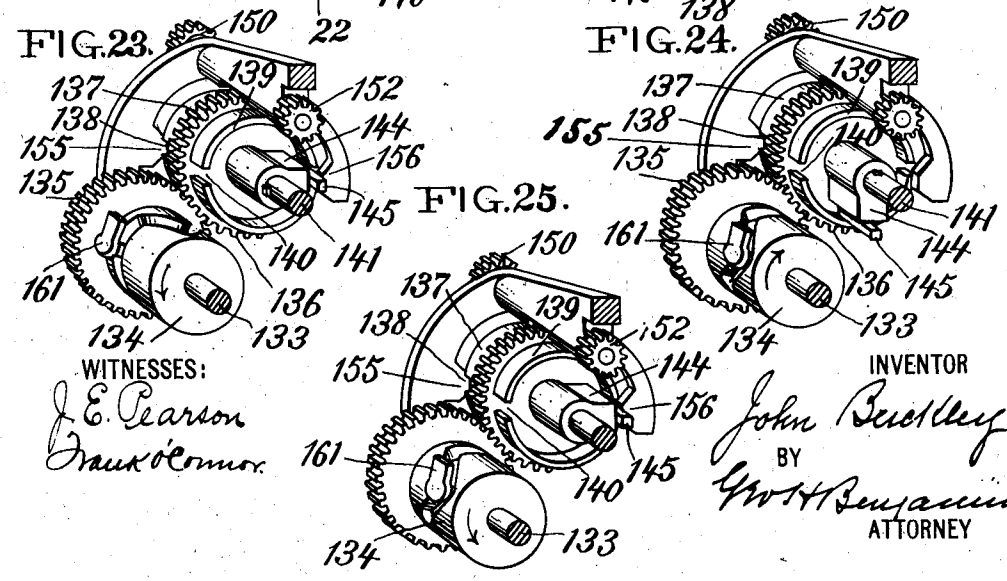

FIG. 23.

FIG. 24.

FIG. 25.

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9 SHEETS—SHEET 8.

FIG. 26.

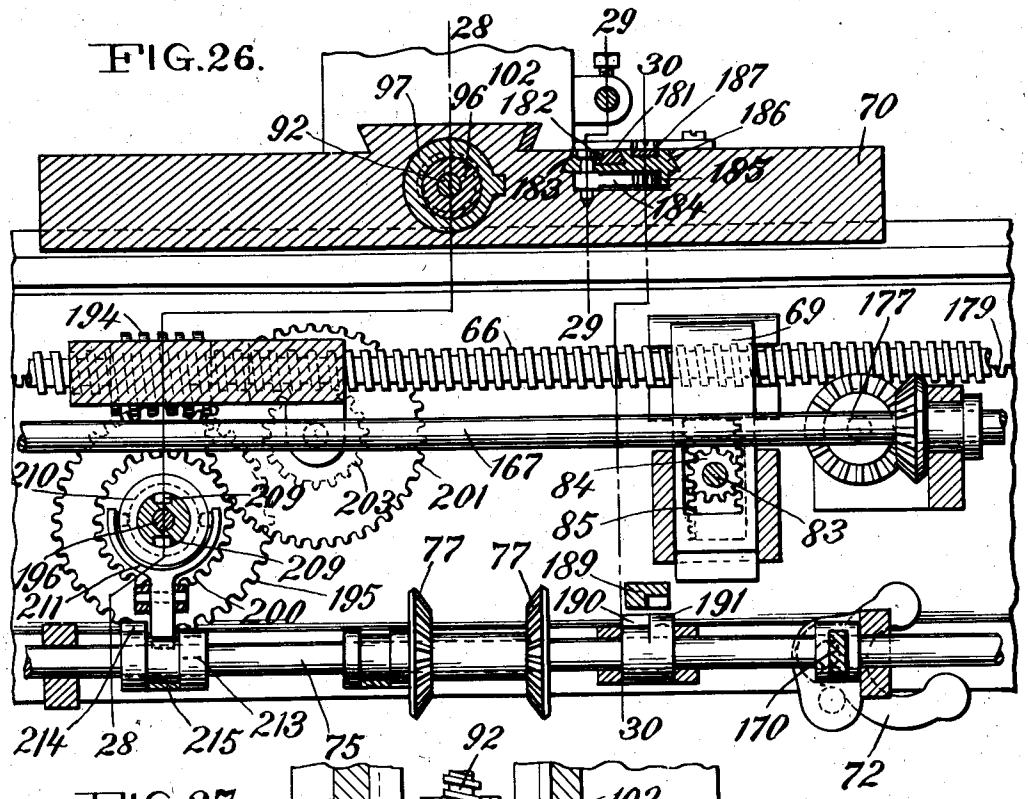
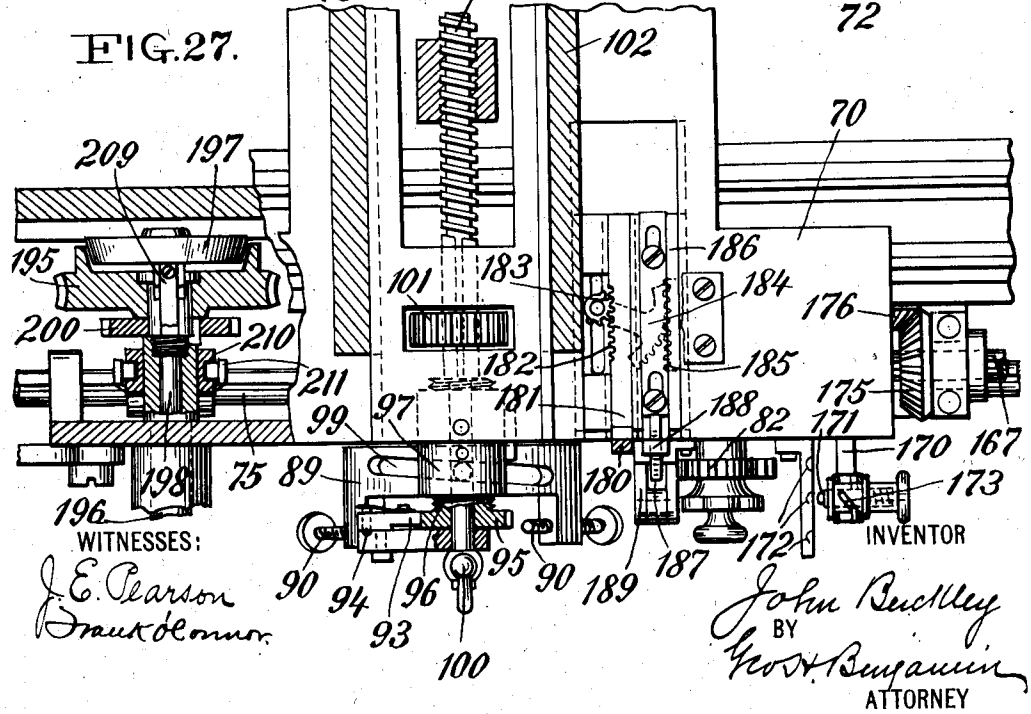


FIG. 27.



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9 SHEETS—SHEET 9.

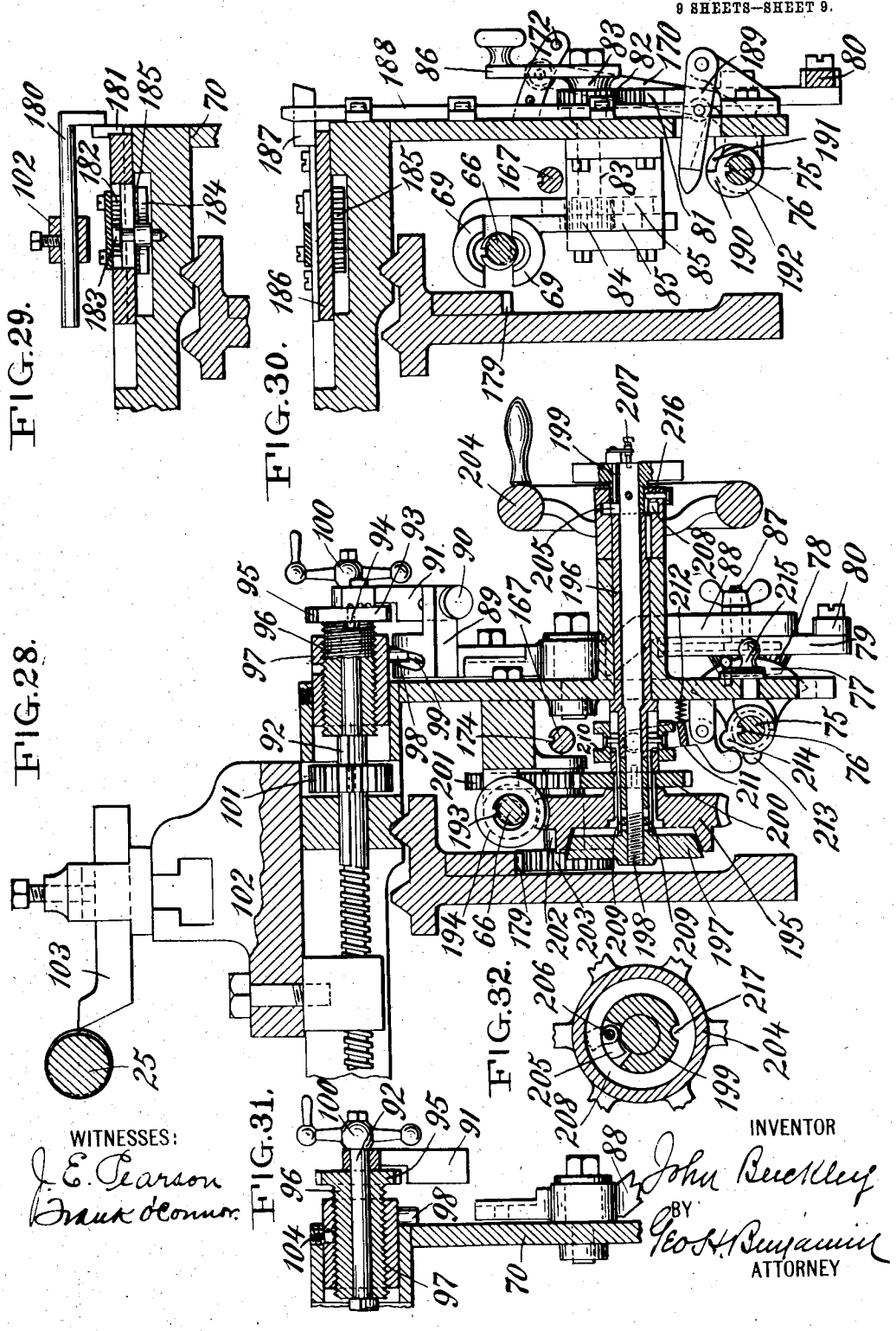

FIG. 29.

FIG. 30.

FIG. 28.

FIG. 32.

FIG. 31.

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UNITED STATES PATENT OFFICE.

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AUTOMATIC LATHE.

No. 834,359. Specification of Letters Patent. Patented Oct. 30, 1906.

Application filed July 22, 1904. Serial No. 217,743.

To all whom it may concern:

Be it known that I, JOHN BUCKLEY, a citizen of the United States, residing at Waterbury, county of New Haven, State of Connecticut, have invented certain new and useful Improvements in Automatic Lathes, of which the following is a specification.

My invention relates to a lathe which may be employed for turning or screw-cutting, as desired.

Broadly stated, my invention consists in a lathe in which the cutting-tool is first adjusted to the work, then makes a cut, then is automatically moved from the work, returned to its first position, and fed forward to the work, such tool making successive cuts until the material acted upon is reduced to the required size (turning) or has formed in it the required screw-thread, as previously determined and which the machine has been adjusted to produce.

My invention further consists in a construction by reason of which the lathe is made adjustable for cutting right or left hand screws of any desired length, pitch, or depth of cut.

My invention further relates to various details of construction, which will be described in the specification and specifically pointed out in the claims.

The object of my invention is a lathe in which the work the lathe is designed to do may be automatically carried on from start to finish or controlled by hand, and, further, which may be adjusted to cover a wide range of work and do a great variety of work entirely automatically, thus permitting the use of unskilled labor or a skilled lathe-tender to tend a number of lathes simultaneously.

The general operation of my improved lathe is as follows: The tool is first adjusted to the work. The tool-carriage then carries the tool to make the first cut. The tool is then automatically withdrawn from the work and carried back by the reverse movement of the tool-carriage to its first position, the movement of the tool-carriage at such time being at a greater speed than when carrying the tool forward to make the cut. When the tool-carriage has returned to its first position, the tool is automatically fed forward to the work and the tool-carriage is again carried forward to make the second cut, this movement being repeated until the required depth of cut is reached, at which time the machine is automatically thrown out of action and comes to rest.

The lathe is adjustable and may be controlled by hand for cutting right or left hand screws.

The lathe is also adjustable for turning work controlled by hand or automatic mechanism.

The speed of lead-screw can be changed, also the direction of rotation, or it can be thrown out of action, leaving the spindle free to be used for finishing work.

Figure 1 of the drawings is a side elevation of my improved lathe with the means for driving it adjusted to automatically cut a right-hand screw-thread. Figs. 2 and 3 are details of a portion of the automatic device adjusted for cutting a right-hand screw. Fig. 4 is a similar view when adjusted for cutting a left-hand screw. Fig. 5 is a side elevation of a portion of the lathe with the parts in position when the limit of cut is reached. Fig. 6 is a detail of a clutching device on the lathe-spindle. Fig. 7 is a detail of a rock-shaft operated by the tool-carriage. Fig. 8 is an end elevation of the lathe. Fig. 9 is a transverse sectional view on the line 9 9 of Fig. 5. Fig. 10 is a detail of an adjusting device for changing the speed of the lead-screw. Fig. 11 is a transverse sectional view on the line 11 11 of Fig. 5. Fig. 12 is a detail elevation, partly in section, showing the driving and speed-changing gearing. Fig. 13 is a sectional plan view on the line 13 13 of Fig. 5. Fig. 14 is a detail of an adjustable slide for adjusting the speed of the lead-screw. Fig. 15 is a detail of a reversing-clutch for changing the direction of rotation of lead-screw. Fig. 16 is a detail of a portion of the device for withdrawing the tool from the work, to be used for internal cutting. Fig. 17 is a sectional plan view on the line 17 17 of Fig. 5. Fig. 18 is a detail of the means for changing the speed of the lead-screw. Fig. 19 is a detail of adjusting device for changing the speed of lead-screw. Fig. 20 is a sectional plan view on the line 20 20 of Fig. 5. Fig. 21 is a sectional view on the line 21 21 of Fig. 20. Fig. 22 is a sectional view on the line 22 22 of Fig. 21. Figs. 23, 24, and 25 are perspective views showing different positions of the parts shown in Figs. 21 and 22. Fig. 26 is an enlarged sectional view on

the line 26 26 of Fig. 13. Fig. 27 is an enlarged sectional plan view of a portion of the tool-carriage. Fig. 28 is a sectional view on the line 28 28 of Fig. 26. Fig. 29 is a sectional view on the line 29 29 of Fig. 26. Fig. 30 is a sectional view on the line 30 30 of Fig. 26. Fig. 31 is a detail of adjustment of parts for turning work. Fig. 32 is a detail of an adjusting device to be used for turning work.

Secured to counter-shaft 1 is a cone-pulley 2, which, through belt 3, drives the cone-pulley 4, loosely mounted on the spindle 5 of the lathe. Upon the shaft 1 is a bevel gear-wheel 6, rotated by the shaft by means of a slot 7 and key in the gear-wheel and capable of being thrown into mesh with a bevel gear-wheel 8, secured to a pulley 9, which by means of belt 10 drives another pulley 11, which is secured to a shaft 12, extending transversely in the lathe-bed. Cone-pulley 4 drives a clutch-collar 13 by means of a slot 14 and a key movable therein with the collar, the cone-pulley being held in place by a guide-roller 15, enabling the clutch-collar to be thrown into engagement with a gear-wheel 16, turning loosely on spindle 5 and provided with a clutching device 17, clutching it to gear-wheel 18, secured to spindle 5. When desired, clutch device 17 can be withdrawn from gear-wheel 18 and the back gear-wheel 19 thrown into engagement with gear-wheel 16 by means of eccentric 20, Fig. 8, causing the spindle 5 to be driven at a slower speed through the sleeve 21 and small gear-wheel 22, meshing with gear-wheel 23, secured to the spindle. By means of the usual attaching devices 24 the work 25 is secured to spindle 5.

Meshing with gear-wheel 18 is a small gear-wheel 26, with a broad face. One portion of gear-wheel 26 meshes with a gear-wheel 27, turning loosely on a shaft 28. The other portion meshes with a small gear-wheel 29, secured to a sleeve 30, to which is secured another small gear-wheel 31, meshing with a gear-wheel 32, turning loosely on shaft 28, by which means a collar 33, operating a clutch-lever 34, pivoted in a slot formed in the shaft 28, will cause the shaft to be turned in one direction or the other, according to which of the gear-wheels 27 or 32 is engaged by clutch-lever 34, Fig. 15′.

Gear-wheel 26 and the sleeve 30, having the gears 29 and 31 attached, are mounted upon a frame 35, which is pivoted upon the shaft 28. A pivoted connection 36 to the frame 35 engages the head-stock 37 by the notches 38, by which means the gear-wheel 26 can be held in mesh with gear-wheel 18 or thrown out, leaving the spindle free for finishing work.

Upon the outer end of shaft 28 is loosely mounted a cone series of gear-wheels 39, and a sliding key 40 is fitted in the shaft and adapted to engage any one of the gears 39, which being in mesh with gear-wheels 41 turn shaft 42, to which gear-wheels 41 are secured. A gear-wheel 43 is turned by shaft 42 by means of a slot formed in the shaft and a key in the gear, which can be worked along the shaft by means of a frame 44, which carries gear-wheels 45 and 46, which are in mesh with gear-wheel 43. Frame 44 is capable of being rocked upon the shaft 42 in order that the gear-wheel 45 may be placed in mesh with any one of a cone series of gear-wheels 47, secured to shaft 48, or that the gear-wheel 46 may be placed in mesh with any one of a cone series of gear-wheels 49, secured to shaft 50. A slot $51^{\times}$ is formed in frame 44, in which rides a pin forming part of a slide 52, in which is fitted an adjustable pin 53, which when fitted in one of a series of holes 54 cause the gear-wheel 46 to engage one of the gear-wheels 49, or if fitted into one of a series of holes 55 cause the gear-wheel 45 to engage one of the gear-wheels 47.

If the pin 53 be placed midway between the holes 54 and 55, then the gear-wheels 45 and 46 do not engage with the gear-wheels 47 and 49. Frame 44 is then free to be moved along the shaft 42, slide 52 being held in the middle position by a spring-pressed pin 56, fitting in a recess formed in the slide. Pin 56 is fitted in a slide 57, which serves as a guide for the slide 52 and which is guided by an inclined slot 51, the series of holes 54 and 55 being alongside and parallel. The inclined position of the holes and slot corresponds with the position of the gear-wheels 45 and 46 when in mesh with the different gear-wheels forming the cone-gears 47 and 49. Shaft 48 has a gear-wheel 58 secured to it, which can be put in mesh with a sliding adjustable gear-wheel 59 on a stud-shaft 60, gear-wheel 59 being at such time in mesh with a gear-wheel 61, secured to a smaller gear-wheel 62, provided with a clutching device 63, which at this time is thrown out, leaving the gear-wheels 61 and 62 free to turn on the shaft 50. Gear-wheel 62 being in mesh with a large gear-wheel 64, having the adjusting device 65, drives the lead-screw 66 at a slow speed, or gear-wheel 64 can be thrown out of gear with gear-wheel 62 and gear-wheel 67, having the adjusting device 68, thrown into gear with gear-wheel 61, causing the lead-screw to be turned at a greater speed. The lead-screw is turned by gear-wheel 67 by means of a slot in the lead-screw and a key in the gear-wheel. When the gear-wheel 59 is thrown out of mesh with the gears 58 and 61 and the clutch device 63 thrown in, then the lead-screw is driven by the shaft 50 by either one of the gear-wheels 61 and 62, according to the position of the gear-wheels 64 and 67. The shafts 48 and 50, to which are secured the cone series of gear-wheels 47 and 49, serve to drive the

lead-screw at different speeds, according to which is in gear, the gear-wheels 47 being larger than gear-wheels 49. By removing gear-wheel 62 from gear-wheel 61 and placing it on the lead-screw 66 and by removing gear-wheel 64 from lead-screw and attaching it to gear-wheel 61 another change can be made in the speed of lead-screw, as shown in Fig. 18.

The lead-screw 66, turning in split nut 69, moves the tool-carriage and apron 70 toward the head-stock, when adjustment is made for cutting a right-hand screw-thread. A bell-crank 71 is pivoted to the end of apron toward the head-stock and a similar one 72 to the opposite end, the upper end of bell-cranks coming in contact with the sides of corresponding toothed wheels 73 and 74, adjustably secured to opposite ends of a rock-shaft 75, causing the lower end of bell-cranks to rise, which, taking under the tooth of wheels 73 and 74, will give the rock-shaft a partial rotation as the carriage nears the head-stock and as it nears the end of its return movement. This partial rotation of shaft 75 through intermediate mechanism, to be described, withdraws clutch 13 from engagement with gear-wheel 16, causing the tool-carriage to come to a standstill.

Rock-shaft 75 has a slot 76 extending its entire length, which serves to turn a gear-segment 77, having a key to fit the slot and moved along the shaft by the apron. Gear-segment 77 is in mesh with a bevel gear-wheel 78, to which is attached a bar 79, upon one end of which is connected a link 80, connecting it to a gear-segment 81 in mesh with a gear-wheel 82, secured to a shaft 83, on the other end of which is secured a gear-wheel 84, which by means of the racks 85 operate the jaws of the split nut 69. By the means above described the split nut 69 is thrown out of engagement with the lead-screw when the end of cut is reached. Split nut 69 can also be controlled by means of hand-crank 86, which is secured to shaft 83. There are two gear-segments 77 adjustable in the apron 70, so that one segment will be in engagement when adjustment is made for cutting a right-hand screw-thread, the other gear-segment 77 being in engagement when adjustment is made for cutting a left-hand screw-thread. The gear-segments 77 can be adjusted in a central position out of engagement with gear-wheel 78, in which case split nut 69 will not be operated by rock-shaft 75, but can be operated by the hand-crank 86.

To the upper end of bar 79 is adjusted a pin 87, engaging the slotted end of a pivoted lever 88, the opposite end of the lever being provided with a movable portion 89, having adjusting-screws 90, which take against one arm of a bell-crank 91, pivoted upon a shaft 92, the other end of the bell-crank carrying a double-ended pawl 93, capable of adjustment by means of a spring-pressed pin 94, to engage a rachet-wheel 95, forming part of a short screw 96, to move it in one direction or the other. Screw 96 works in a nut 97, having a pin 98, which rides in a spiral slot 99, formed in the removable part 89 of the lever 88. The spiral slot and the pin cause withdrawal or advance of the nut 97 and shaft 92 when the lever 88 is swung on its pivot. Shaft 92 has a shoulder against which the screw 96 bears, the shaft extending through the screw, bell-crank 91 being pivoted upon the shaft and held against the opposite end of screw 96 by a hand-crank 100, secured to the shaft. Shaft 92 can be turned by the hand-crank 100 and by the cross-feed gear-wheel 101 by means of a slot formed in the shaft and a key in the gear. The other end of shaft 92 is screw-threaded into the tool-stock 102, carrying the tool 103. The tool 103 is adjusted to the work by turning the screw-shaft 92 and hand-crank 100, the screw-shaft being held in position by screw 96 and nut 97.

When the tool-carriage reaches the limit of its cut, part 89 of pivoted lever 88 will be moved from the position shown in Fig. 1 in the direction of the arrow shown in Fig. 5, in doing which slot 99, acting on pin 98, will withdraw nut 97 from the tool-carriage, carrying tool 103 with it. At the same time set-screw 90 will move bell-crank 91, causing pawl 93 to turn screw 96, forcing tool in for an additional cut.

When adjustment is to be made for internal cutting, the removable part 89, (represented by Fig. 16,) having the slot 99 inclined in the opposite direction from the one used for external cutting, will be attached to pivoted lever 88 and double-ended pawl 93 will be adjusted to turn ratchet-wheel 95 and screw 96 in the opposite direction, resulting in a reverse movement of tool 103 in withdrawing it from the work and feeding it in for additional cut. When the part 89 is removed, the nut 97 is held in place by screw 104. Upon the end of rock-shaft 75, near the head-stock, is a bevel gear-wheel 105 in mesh with a bevel gear-wheel 106, turning upon a stud-shaft 107. Bevel gear-wheel 106 has a weighted arm 108 attached, also a pin 109, which extends through a short slot 110 in a cam-disk 111, having a pin 112 extending through a short slot 113 in a segmental gear 114. On a radial line with the slot 110 are two longer slots 115 and 116. Riding in slot 115 is a pin forming part of an arm 117, secured to a sleeve 118, having an arm 119 connected to a slide 120, which actuates the clutch-collar 33, as shown in the drawings, to clutch-gear wheel 27 to shaft 28. Riding in slot 116 is a pin forming part of an arm 121, secured to a shaft 122, extending through sleeve 118 and having an arm 123, connected by the bar 124 to a pivoted lever

125, the other end of the lever operating clutch-collar 13 to throw it out of engagement with gear-wheel 16 when the disk 111 rotates.

When cutting a left-hand thread, the pin 109 will be fitted in a short slot 126. On a radial line with slot 126 are the two longer slots 127 and 128. Slot 127, operating arm 117, serves to keep clutch-collar 33 in a position to cause the lead-screw to rotate in the opposite direction, forcing the tool-carriage 70 away from the head-stock. Slot 128, operating arm 121, serves to throw clutch-collar 13 out of engagement with gear-wheel 16 when the tool-carriage nears the end of its travel away from the head-stock.

When cutting right or left hand screws without using the automatic device, pin 109 will be fitted in a hole 129. On a radial line with hole 129 are the two long slots 130 and 131. Slot 130, operating arm 117, serves to change the direction of rotation of lead-screw when disk 111 is rotated. Slot 131, operating arm 121, serves to keep clutch-collar 13 in engagement with gear-wheel 16. As the bevel gear-wheel 106 with the pin 109 rotates, the disk 111 does not rotate until the limit of short slot 110 is reached. Then the disk rotates until the pin 112 on disk reaches the limit of short slot 113 of segmental gear 114. The movement of disk 111 and segmental gear 114 is continued by pin 109 on bevel gear-wheel 106 from bevel gear-wheel 105 until the weighted arm 108 passes over the center, which takes place when the center of long slots 115 and 116 are just over the center of gear-wheel 106. It is during this movement of disk 111 that clutch 13 is thrown out of engagement with gear-wheel 16 by means of long slot 116.

When the weighted arm 108 has passed over the center, it then serves to continue the rotation of disk 111 and gear-segment 114. Gear-segment 114 is in mesh with a gear-wheel 132, secured to a shaft 133, to which is secured a cam 134 and a gear-wheel 135 in mesh with a gear-wheel 136, having a rim 137 with two notches 138 on one side of it and a rim 139 with two notches 140 on the opposite side. The rim gear-wheel 136 is mounted loosely upon a shaft 141, and keyed to the shaft inside the rim 137 is an arm 142, having a spring-pressed plunger 143, which can engage the notches 138. Inside the rim 139 is an arm 144, keyed to shaft 141, extending radially at right angles to the direction of arm 142 and having a spring-pressed plunger 145, which can engage the notches 140. Mounted loosely upon shaft 141 next to arm 142 is a gear-wheel 146, driven by a gear-wheel 147, secured to positively-driven shaft 12. Gear-wheel 146 has a pin 148 in line with rim 137 and in position to be engaged by plunger 143. Gear-wheel 146 has internal gear-teeth 149, which mesh with a small gear-wheel 150, secured to a short shaft 151, upon the opposite end of which is another small gear-wheel 152 in mesh with a gear-wheel 153, mounted loosely upon shaft 141 and provided with a pin 154 in line with rim 139 and in position to be engaged by plunger 145. Plungers 143 and 145 are held out of engagement with the notches in the rims 137 and 139, in one case by the rims, in another by fixed cams 155 and 156, which throw the plungers out of engagement with the rims. Shaft 141 is held in place by an arm 157, secured to one end and having a spring-pressed plunger 158, which engages with notches 159 and 160 after making a quarter-revolution, first in one direction, then in the other. The end of plunger 158 is made tapering to allow it to escape the notches 159 and 160 when sufficient force is applied to rotate shaft 141. Cam 134 actuates a pivoted lever 161 and clutch-collar 162, sliding upon a shaft 163, which is turned by means of a slot formed in the shaft and a key in the collar when the collar is thrown into engagement with positively-driven shaft 12.

By means of a bevel gear-wheel 164, secured to shaft 163, meshing with bevel gear-wheel 165 or 166 a shaft 167 is turned. By means of the adjusting device 168, fitting in one of three holes 169 in shaft 167, the double gear-wheel 165 166 may be engaged on either side of gear-wheel 164 or disengaged from gear-wheel 164. A slot extends through the hub of gear-wheel 165 166 and a key is fixed firmly in shaft 167, the key being fitted to allow the double gear to be moved endwise. By this means shaft 167 may be turned in either direction, which will by means to be described move the tool-carriage 70 in one direction or the other.

The movement of gear-segment 114 from the position shown in Fig. 2 to the position shown in Fig. 5 moves cam 134 from the position shown in Fig. 23 to the position shown in Fig. 20 and the rim gear-wheel 136 from the position shown in Fig. 23 to the position shown in Fig. 21, the notch 138 being nearly in line with plunger 143 of arm 142 and the plunger held from engagement by the rim 137. It is at this time that weighted arm 108 comes into action to continue the movement of rim gear-wheel 136 until notch 138 shall be in line with plunger 143, when the plunger will drop into the notch. Plunger 143, dropping into notch 138, is now in line of travel of pin 148 on the positively-driven gear-wheel 146, causing plunger 143, arm 142, shaft 141, and rim gear-wheel 136 to be turned until plunger 143 is thrown out of notch 138 by means of fixed cam 155, as shown in Fig. 24. This movement of rim gear-wheel 136 will be transmitted to cam 134, moving it from the position shown in Fig. 20 to the position shown in Fig. 24, the

inclined portion of cam-operating lever 161 to throw clutch-collar 162 into engagement with shaft 12 resulting in movement of rim tool-carriage 70. In addition to moving cam 134 the movement of rim-gear 136 will by means of shaft 133 and gear-wheel 132 be transmitted to gear-segment 114 and cam-disk 111, causing them to occupy the position shown in Fig. 3.

Referring to Fig. 24, plunger 145 will now be the one which is held from engagement with notch 140 by rim 139. When the tool-carriage 70 nears the end of its movement away form the head-stock, rock-shaft 75 is rotated in an opposite direction by bell-crank 72 taking under tooth 74 on the opposite side of rock-shaft from tooth 73, and through the reverse movement of bevel gear-wheel 106 and intermediate mechanism cam 134 is rotated from the position shown in Fig. 24 to the position shown in Fig. 20, the inclined portion of cam operating through lever 161 and clutch-collar 162 to stop the tool-carriage. At the same time rim gear-wheel 136 is rotated in an opposite direction, causing plunger 145 to engage notch 140 in rim 139. Plunger 145, dropping into notch 140, is now in line of travel of pin 154 on positively-driven gear-wheel 153, rotating in a direction the reverse of gear-wheel 146, causing plunger 145, arm 144, shaft 141, and rim gear-wheel 136 to be turned until plunger 145 is thrown out of notch 140 by means of fixed cam 156, as shown in Fig. 23, cam 134 being moved from the position shown in Fig. 20 to the position shown in Fig. 23, the straight portion of cam having no effect upon lever 161, gear-segment 114 and cam-disk 111 being moved to the position shown in Fig. 1. The purpose of elongating the hole 113 in segmental gear 114 is that disk 111 will be a little behind in driving gear-wheel 132, causing the spring-pressed plungers to be delayed in dropping in the notches of rim gear-wheel 136 as weighted arm 108 passes the perpendicular. This intermission gives time for stop-motion work.

When adjustment is made for cutting left-hand screws with cam 134 in the position shown in Fig. 24, arm 144 will be turned to the position shown in Fig. 21, as shown in Fig. 25. As the tool-carriage 70 nears the head-stock on its return to make a new cut cam 134 will be moved in the direction of arrow in Fig. 25, the inclined portion of cam moving lever 161 to stop the tool-carriage. The action of rim gear-wheel 136, plungers 143 and 145, and gear-segment 114 and disk 111 is the same as that described for Figs. 2 and 21, except that long slot 127, through arm 117, causes the lead-screw to rotate in the opposite direction and that long slot 128, through arm 121, throws clutch-collar 13 into engagement with gear-wheel 16 in the last part of movement of disk 111 to cause the rotation of lead-screw.

Changing the direction of rotation of lead-screw causes the tool-carriage to be moved away from the head-stock in making the cut, and in order that the tool-carriage shall be returned toward the head-stock by means of shaft 167 bevel gear-wheel 165 will be put in mesh with bevel gear-wheel 164.

When the automatic mechanism is not in use, bevel gear-wheel 6 on the counter-shaft 1 is disengaged from gear-wheel 8, the disk 111 is turned so that pin 109 on gear-wheel 106 can be inserted in hole 129 of the disk, weighted arm 108 is removed from gear-wheel 106, and gear-wheel 132 is withdrawn from mesh with segmental gear 114. When gear-wheel 132 is replaced, marked tooth 1 of segmental gear 114 will occupy space 1 of gear-wheel 132 for right screw-cutting, or marked tooth 2 of segmental gear 114 will occupy space 2 of gear-wheel 132 for left-hand screw-cutting.

When cam-disk 111 is adjusted for hand-work, cam 134 will be rotated in the direction indicated by the arrow in Fig. 23 until lever 161 rides in straight part of cam. Any further movement of cam caused by rotation of disk 111 will not change the position of lever 161, as it will still ride in the straight part of cam 134, keeping clutch-collar 162 out of engagement with shaft 12.

Cam-disk 111 can be rotated by means of a hand-lever 170 on rock-shaft 75 and held in any one of three positions—central or two opposite. In one position of disk 111 long slot 130, through arm 117, will cause the lead-screw to rotate in a direction to cause the tool-carriage to move toward the head-stock. In the central position lead-screw will not rotate. The opposite end of long slot 130 will cause the lead-screw to rotate in the opposite direction. Hand-lever 170, having a key to ride in slot 76 of rock-shaft 75, is moved along the shaft by the tool-carriage. A pin 171 in the free end of lever 170 is fitted in one of three notches 172 on the tool-carriage, or the pin can be thrown out of engagement by means of a spiral cam 173, leaving the rock-shaft 75 free to be moved, as before described, when the automatic mechanism is in use. Shaft 167 has a slot 174 its entire length, which turns a bevel gear-wheel 175, having a key to ride in the slot and mounted on the tool-carriage 70. Bevel gear-wheel 175 meshes with a bevel gear-wheel 176 secured to a short shaft 177, to the other end of which is secured a gear-wheel 178 in mesh with a rack 179 on the lathe-bed. As shaft 167 is turned gear-wheel 178 is turned, which, taking against the fixed rack 179, causes movement of the tool-carriage 70, which is much faster than when moved by lead-screw 66.

Secured to the tool-rest 102 is a hooked rod 180, which as the tool 103 is fed to the work 25 engages a slide 181, provided with a rack 182, which engages a pinion 183, to which a segmental gear 184 is attached. Segmental gear 184, meshing with a rack 185, forming part of a slide 186, causes slide 186 to move a greater distance than tool-rest 102. An adjustable bar 187 is attached to slide 186, one end having graduation-marks and supporting a rod 188, attached to a pawl 189, pivoted to the tool-carriage. One portion of the free end of pawl 189 is shaped to engage a tooth 190, the other portion of pawl being shaped as a hook to engage a tooth 191, facing in the opposite direction, the teeth 190 and 191 forming part of a sleeve 192, having a key to ride in slot 76 of rock-shaft 75 and moved along the shaft by the tool-carriage.

When the final depth of cut is reached by tool 103, rod 188, which is supported by bar 187, will be released, throwing pawl 189 into engagement with the teeth 190 and 191 of the sleeve 192.

That part of the movement of rock-shaft 75 controlled by the weighted arm 108 is checked by the pawl 189 engaging either tooth 190 or 191, according to direction of rotation of rock-shaft. If the rotation of rock-shaft 75 is stopped before the rim gear-wheel 136 releases one of the plungers 143 or 145, cam 134 will not operate lever 161 and clutch 162 to cause rotation of shaft 163. The tool-carriage not being returned to make a new cut, everything remains at rest.

For turning work, which may be automatic or by hand, the device now to be described will be used.

The lead-screw 66 has a slot 193 its entire length, which turns a worm 194, having a key to ride in the slot and moved along the lead-screw by the tool-carriage. Worm 194 turns a worm-wheel 195, turning loosely upon a hollow shaft 196, the worm-wheel being engaged by a friction-clutch 197 by means of screw-shaft 198, turned by the hand-wheel 199. Friction-clutch 197 turns the hollow shaft 196 by means of slots formed in the shaft and projections from the clutch, the shaft 196 having gear-wheel 200 keyed to it, which meshes with a large gear-wheel 201, secured to a sleeve 202, having a small gear-wheel 203 secured to it, which meshes with rack 179, causing the tool-carriage to move slowly in one direction or another, according to direction of rotation of lead-screw. Gear-wheel 200, keyed to hollow shaft 196, can be turned by hand-wheel 204, which is also keyed to shaft 196. Friction-clutch 197 is held in position to be thrown in or out of engagement with worm-wheel 195 through screw-shaft 198 by means of an arm 205, secured to a shaft 206 in the hub of hand-wheel 199 and held in position by catch 207, the arm 205 riding in a groove 208, formed in the hub of hand-wheel 204, as shown by dotted lines in Fig. 32.

For turning-work, using the automatic mechanism, friction-clutch 197 is connected by the strips 209 to a collar 210, controlled by a pivoted lever 211, which by means of a spring 212 is forced against cams 213 and 214, having a key to ride in slot 76 of rock-shaft 75, moved along the rock-shaft and adjusted by the device 215, so that one cam will be in use to throw friction-clutch 197 into engagement with worm-wheel 195 when the tool-carriage is to be moved in one direction, the other cam being in use when the tool-carriage is to be moved in the opposite direction or adjusted so that lever 211 being in the center is not operated by the cams 213 or 214, in which case friction-clutch 197 will not be thrown into engagement with worm gear-wheel 195 by the automatic mechanism.

When the automatic mechanism is in use, the arm 205 is thrown out of engagement with the groove 208 in the hub of hand-wheel 204, leaving the friction-clutch 197 free to be moved by the automatic mechanism, screw-shaft 198 being held in place by a spring-pressed pin 216, riding in a groove 217 in the hub of hand-wheel 199, holding it to the hub of hand-wheel 204.

For turning-work part 89 is removed from pivoted lever 88 and nut 97 secured to tool-carriage 70 by means of screw 104.

Having thus described my invention, I claim—

1. In a lathe, the combination with means for rotating the work, of a tool-carriage, means for traveling the tool-carriage along the bed of the lathe in one direction, means for automatically starting the work-rotating means and the tool-carriage-traveling means when the tool-carriage is at one limit of its movement and for automatically stopping said work-rotating means and tool-carriage-traveling means when the tool-carriage is at the other limit of its movement, independent means for traveling the tool-carriage back to initial position when the means aforesaid have stopped, and means for automatically stopping said tool-carriage-returning means when the tool-carriage arrives at its initial position.

2. In a lathe, the combination with driving means, of work-rotating means, a tool-carriage, means for traveling the tool-carriage along the lathe-bed, releasable means for operably connecting or disconnecting both the work-rotating means and the tool-carriage-traveling means to the driving means aforesaid, a tool movable on the tool-carriage, means for determining the final depth of cut, automatically-acting mechanism controlling the releasable connecting means aforesaid, and means for arresting the action of the automatic mechanism aforesaid when the final depth of cut has been made to

thereby release the work-rotating means and the carriage-traveling means from the driving means and thus stop their action.

3. In a lathe, the combination with a tool-carriage, and means for traveling said tool-carriage along the lathe-bed, of a tool movable on the tool-carriage, means for determining the final depth of cut, a rock-shaft operated by the tool-carriage at predetermined times, automatic mechanism controlled by said rock-shaft for automatically starting, stopping, and reversing the travel of the tool-carriage, and means automatically actuated when the tool has reached the final depth of cut which prevents operation of the rock-shaft and automatic mechanism controlled thereby and thereby stops the movement of the tool and tool-carriage.

4. In a lathe, the combination with a tool-carriage, of a tool-holder movable thereon, means for traveling the tool-carriage along the lathe-bed, and means for automatically withdrawing and feeding said tool-holder at the end of a cut comprising a slidable cross-feed screw, a slidable nut with which the cross-feed screw is connected by screw-threads, a ratchet-wheel connected to the cross-feed screw, a movable cam engaging the slidable nut aforesaid, a pawl for turning the ratchet-wheel, means carried by the cam for operating the pawl, and means for automatically operating the cam at the ends of the movement of the tool-carriage.

5. In a lathe, the combination with a tool-carriage, of a tool-holder movable thereon, means for traveling the tool-carriage in one direction along the lathe-bed, independent means for traveling the tool-carriage in the other direction along the lathe-bed, means for automatically withdrawing and feeding said tool-holder at the end of a cut comprising a slidable cross-feed screw, a slidable nut with which the cross-feed screw is connected by screw-threads, a ratchet-wheel connected to the cross-feed screw, a movable cam engaging the slidable nut aforesaid, a pawl for turning the ratchet-wheel, means carried by the cam for operating the pawl, means for releasing the tool-carriage from its advancing traveling means at the end of the cut and connecting it thereto at the beginning of the cut, a rock-shaft operated by the carriage at the limits of its movements, gearing interposed between the rock-shaft and the cam and releasing means aforesaid, and means controlled by the rock-shaft for throwing the return feeding means of the tool-carriage into and out of operative connection with the tool-carriage.

6. In a lathe, the combination with a tool-carriage, of means for advancing said tool-carriage along the lathe-bed, independent means for traveling it back again, automatic mechanism comprising a movable controlling member, means operated from said movable member for starting and stopping the advancing feeding means of the tool-carriage at predetermined limits of the movement of the tool-carriage, means operated by said movable member for starting and stopping the return feeding means of the carriage at the predetermined limits of the movement of the tool-carriage, a pivoted arm coöperating with said movable controlling member, means acting on said arm to move it to one side or the other of its dead-center, and means actuated by the tool-carriage at the limits of its movement for automatically actuating said arm to thereby actuate the movable controlling member aforesaid.

7. In a lathe, the combination with a tool-carriage, of means for advancing said tool-carriage along the lathe-bed, independent means for traveling it back again, automatic mechanism comprising a movable controlling member, means operated from said movable member for starting and stopping the advancing feeding means of the tool-carriage at predetermined limits of the movement of the tool-carriage, means operated by said movable member for starting and stopping the return feeding means of the carriage at the predetermined limits of the movement of the tool-carriage, means for delaying the operation of the carriage-returning means until after the carriage-advancing means has stopped at one limit of the movement of the tool-carriage and for stopping the action of said carriage-returning means before the carriage-advancing means begins to operate at the other limit of the movement of the tool-carriage, and means actuated by the tool-carriage at the limits of its movement for automatically actuating the movable controlling member.

8. In a lathe, the combination with a tool-carriage, of means for advancing said tool-carriage along the lathe-bed, independent means for traveling it back again, automatic mechanism comprising a movable controlling member, means operated from said movable member for starting and stopping the advancing feeding means of the tool-carriage at predetermined limits of the movement of the tool-carriage, means operated by said movable member for starting and stopping the return feeding means of the carriage at the predetermined limits of the movement of the tool-carriage, means for delaying the operation of the carriage-returning means until after the carriage-advancing means has stopped at one limit of the movement of the tool-carriage and for stopping the action of said carriage-returning means before the carriage-advancing means begins to operate at the other limit of the movement of the tool-carriage, a pivoted arm coöperating with the movable controlling member, means acting on said arm to move it to one side or the other of its dead-center, and means actuated

by the tool-carriage at the limits of its movement for automatically actuating the pivoted arm.

9. In a lathe, a tool-carriage, means for traveling the tool-carriage along the lathe-bed, and automatic mechanism governing the means aforesaid, comprising a movable controlling member, a pivoted arm for shifting said movable controlling member, means acting on said arm to move it to one side or the other of its dead-center, an oscillatory wheel operated by the movable controlling member and provided with engaging means, a positively-driven wheel, means for clutching the positively-driven wheel to the engaging means on the oscillatory wheel at predetermined times to cause rotation of said oscillatory wheel and automatically unclutching said wheels at other times to stop the oscillatory wheel, means for automatically operating the pivoted arm and movable controlling member at predetermined times, and means controlled by the oscillatory wheel governing the tool-carriage-traveling means.

10. In a lathe, a tool-carriage, means for traveling the tool-carriage along the lathe-bed, and automatic mechanism governing the means aforesaid, comprising a movable controlling member, a pivoted arm for shifting said movable controlling member, means acting on said arm to move it to one side or the other of its dead-center, an oscillatory wheel operated by the movable controlling member and provided with engaging means, a positively-driven wheel, means for clutching the positively-driven wheel to the engaging means on the oscillatory wheel at predetermined times to cause rotation of said oscillatory wheel and automatically unclutching said wheels at other times to stop the oscillatory wheel, means for automatically operating the pivoted arm and movable controlling member at predetermined times from the tool-carriage by the movement thereof, and means controlled by the oscillatory wheel governing the tool-carriage-traveling means.

11. In a lathe, a tool-carriage, means for traveling the tool-carriage along the lathe-bed, and automatic mechanism governing the means aforesaid comprising a movable controlling member, a pivoted arm for shifting said movable controlling member, means acting on said arm to move it to one side or the other of its dead-center, an oscillatory wheel operated by the movable controlling member and provided with engaging means, oppositely-rotating positively-driven wheels, independent devices for clutching the respective positively-driven wheels to the engaging means of the oscillatory wheel at different predetermined times according to the direction of movement of the oscillatory wheel to cause rotation of said oscillatory wheel and automatically unclutching the respective positively-driven wheels from the oscillatory wheel at other predetermined times to stop the oscillatory wheel, means for automatically operating the pivoted arm and movable controlling member at predetermined times, and means controlled by the oscillatory wheel to alternately stop and start the tool-carriage-traveling means according to the direction of movement of the oscillatory wheel.

12. In a lathe, a tool-carriage, means for traveling the tool-carriage along the lathe-bed, and automatic mechanism governing the means aforesaid comprising an oscillatory wheel having rims provided with notches, oppositely-driven wheels, independent plungers normally restrained by the respective rims aforesaid but adapted to drop into the notches to move with the oscillatory wheel, means on the oppositely-driven wheels for engaging the plungers alternately at predetermined times when in the notches, means for releasing the plungers from the notches at predetermined times, means for actuating the oscillatory wheel at different predetermined times in opposite directions, and means controlled by the oscillatory wheel to alternately stop and start the tool-carriage-traveling means according to the direction of movement of the oscillatory wheel.

13. In a lathe, a tool-carriage, means for traveling the tool-carriage along the lathe-bed, and automatic mechanism governing the means aforesaid comprising an oscillatory wheel having rims provided with notches, oppositely-driven wheels, independent plungers normally restrained by the respective rims aforesaid but adapted to drop into the notches to move with the oscillatory wheel, means on the oppositely-driven wheels for engaging the plungers alternately at predetermined times when in the notches, means for releasing the plungers from the notches at predetermined times, means controlled by the tool-carriage at predetermined times for actuating the oscillatory wheel in opposite directions, and means controlled by the oscillatory wheel to alternately stop and start the tool-carriage-traveling means according to the position of the tool-carriage.

In testimony whereof I affix my signature in the presence of two witnesses.

JOHN BUCKLEY.

Witnesses:

AMBROSE H. BUCKLEY,

CHAS. G. ROOT.