Feb. 18, 1964 D. M. SKOGLUND ETAL 3,121,357

LATHE MACHINE

Filed March 27, 1961 4 Sheets-Sheet 1

FIG. 1

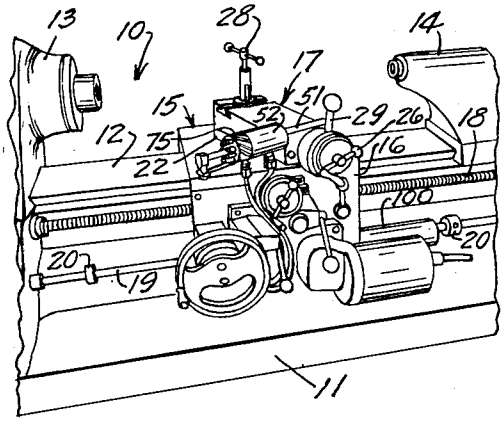


FIG. 2

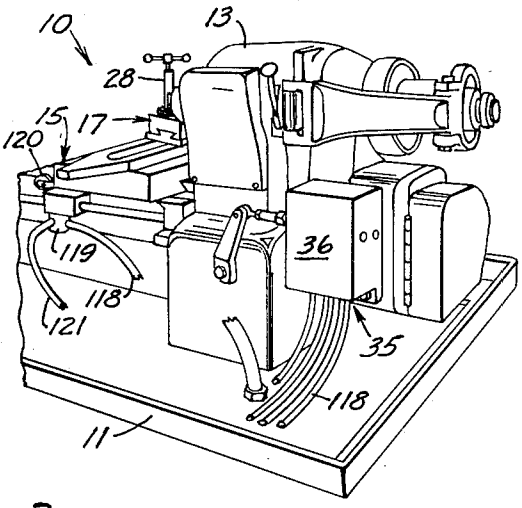


FIG. 3

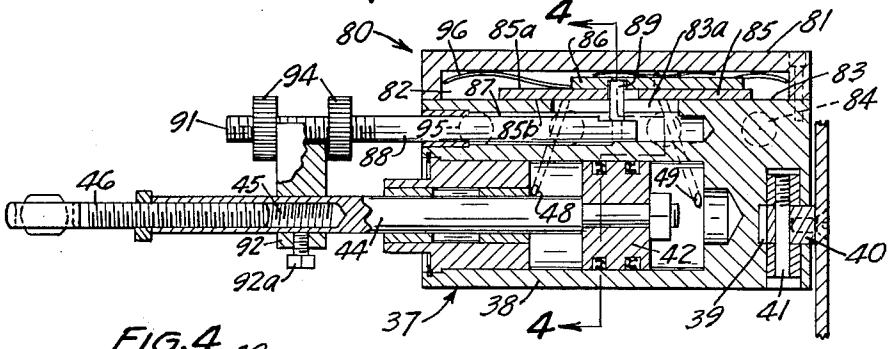


FIG. 4

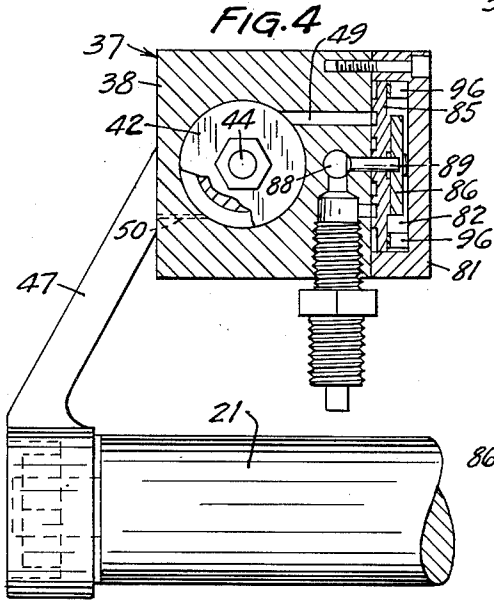


FIG. 5

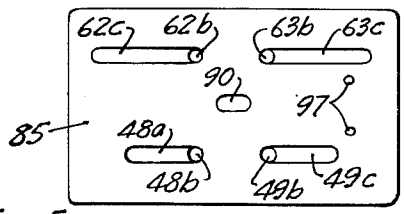
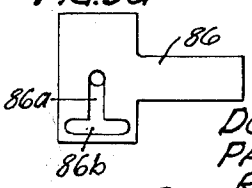


FIG. 5a



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LATHE MACHINE

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FIG. 6

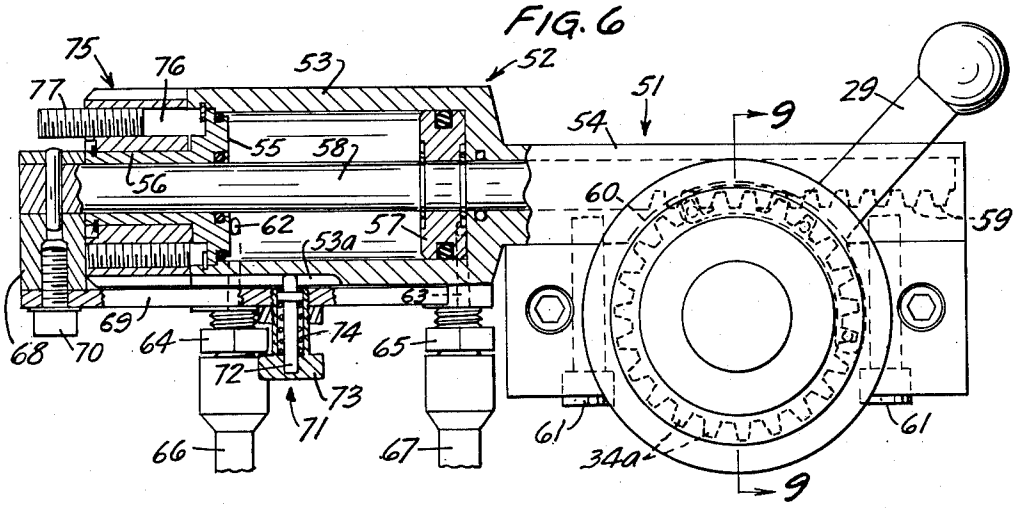


FIG. 8

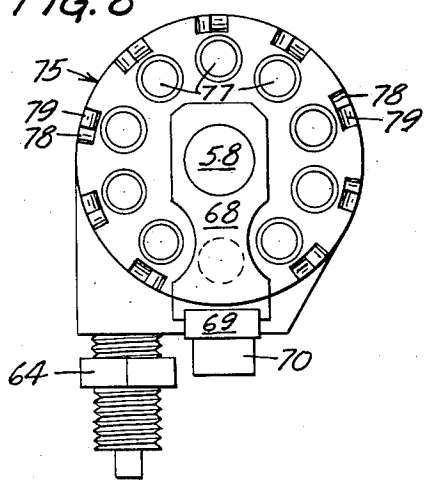


FIG 7

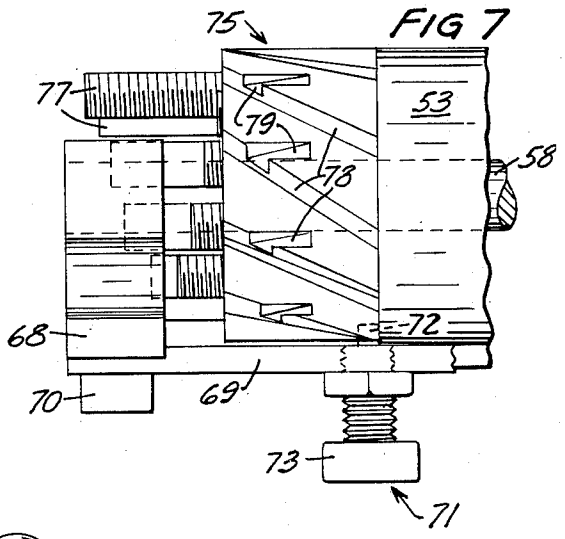
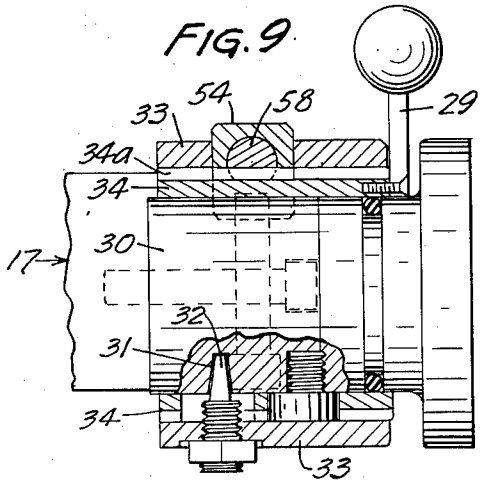


FIG. 9



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LATHE MACHINE

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FIG. 11

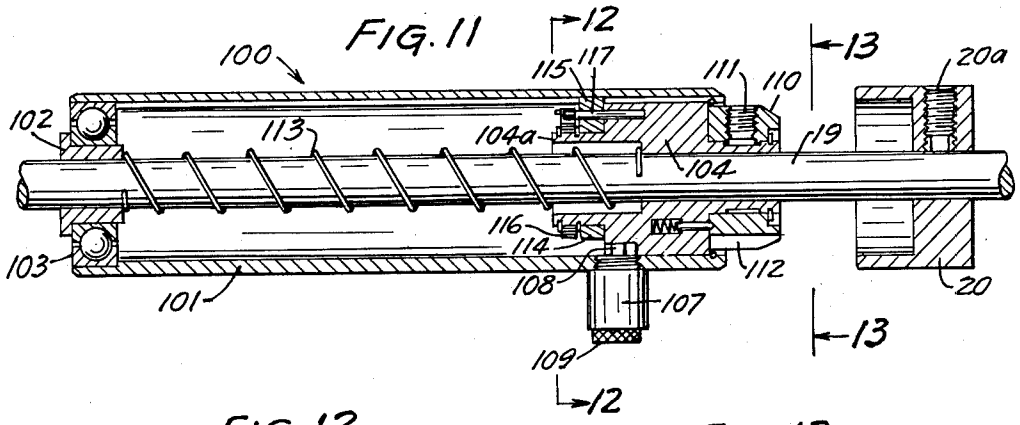


FIG. 12

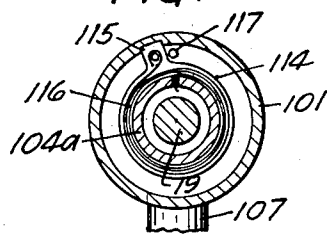


FIG. 13

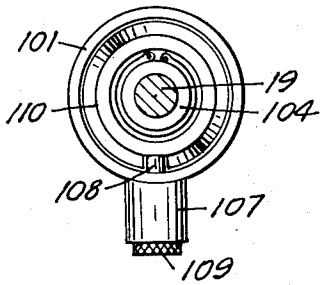


FIG. 14

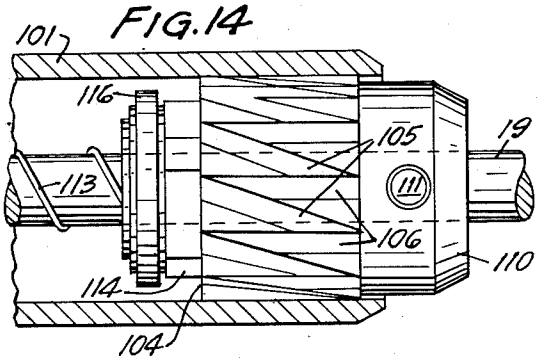
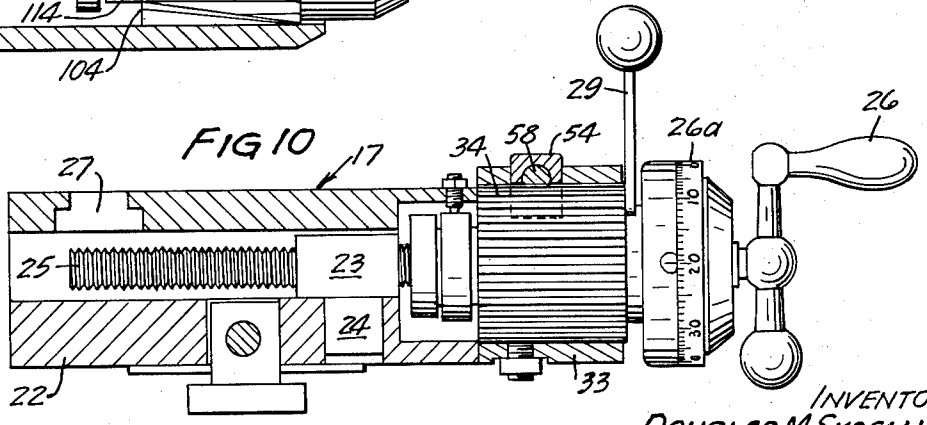


FIG 10



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LATHE MACHINE

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FIG. 15

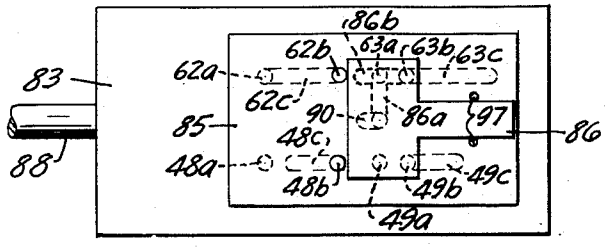


FIG. 16

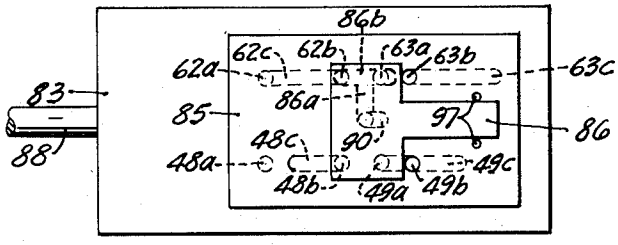


FIG. 17

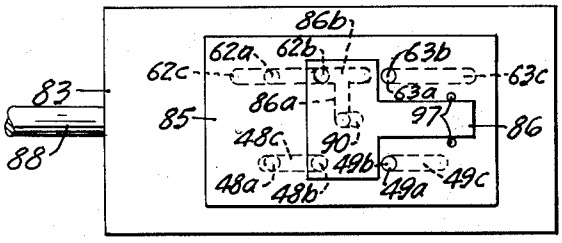


FIG. 18

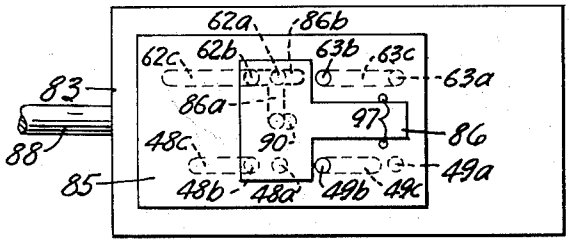
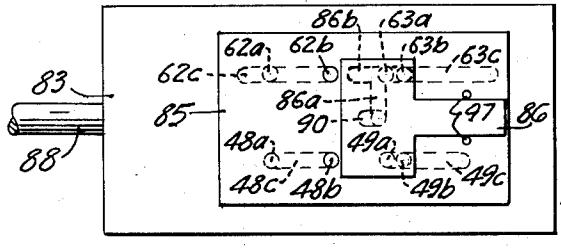


FIG. 19



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United States Patent Office 3,121,357 Patented Feb. 18, 1964

3,121,357

LATHE MACHINE

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Filed Mar. 27, 1961, Ser. No. 109,474
7 Claims. (Cl. 82—5)

This invention relates to automatic control means for machine tools and more particularly to automatic control means for conventional lathe machines which is operable to permit automatic actuation of the lathe during a threading operation.

Many attempts have been made to produce means for automatically actuating a lathe machine when the latter is used to produce threads on workpieces. Some of these prior art devices for automatically actuating the lathes during the threading operation are, generally speaking, of cumbersome construction and operation. The cost of these complicated devices is generally prohibitive and the operation of these types of control means have never been completely satisfactory.

Furthermore, attachment and removal of these cumbersome prior art devices is a very time consuming operation and because of their bulky construction the devices cannot be left on the lathes when the lathe is used for purposes other than threading.

It is, therefore, a general object of this invention to provide a simple and inexpensive but highly efficient actuating means for use in automatically actuating the various component parts of a lathe machine during the threading operation.

Another object of this invention is to provide a novel and improved actuating attachment for ready connection to a lathe machine of the type having a reversing lead screw without altering the construction of such a lathe machine, said actuating attachment being arranged and constructed to cause automatic actuation of the carriage and tool support of a lathe machine when the latter is used to produce threads on a workpiece.

A further object of this invention is the provision of a lathe machine of the type having a reversing lead screw with a novel and improved automatic actuating means including a pair of fluid pressure motors for use in cyclically and simultaneously actuating the tool support and carriage of a lathe through a predetermined number of strokes including means coacting with the tool support so that the cutting tool carried by the latter is positioned at the beginning of each successive stroke to make a deeper cut on the workpiece.

These and other objects and advantages of this invention will more fully appear from the following description made in connection with the accompanying drawings wherein like reference characters refer to the same or similar parts throughout the several views, and in which:

FIG. 1 is a fragmentary front perspective view of a conventional lathe machine with certain portions of our invention illustrated in cooperating relation therewith;

FIG. 2 is a fragmentary rear perspective view of a lathe machine with other portions of our invention illustrated therein;

FIG. 3 is a longitudinal cross sectional view on an enlarged scale of the clutch shifting mechanism and valve actuator mechanism;

FIG. 4 is a vertical section taken approximately along the lines 4—4 of FIG. 3 and looking in the direction of the arrows;

FIG. 5 is an elevational view of one of the valving members of the valve mechanism;

FIG. 5*a* is an elevational view of another of the valve members of the valve mechanism;

FIG. 6 is a detail view on an enlarged scale of the tool support shifting mechanism illustrated partly in section and partly in elevation;

FIG. 7 is a side elevational view on an enlarged scale of a portion of the tool support shifting mechanism illustrated in FIG. 6;

FIG. 8 is an end view of the mechanism illustrated in FIG. 7;

FIG. 9 is a vertical section taken approximately along line 9—9 of FIG. 6 and looking in the direction of the arrows;

FIG. 10 is a longitudinal section of the tool support;

FIG. 11 is a longitudinal section of another component part of our invention;

FIG. 12 is a vertical section taken approximately along lines 12—12 of FIG. 11 looking in the direction of the arrows;

FIG. 13 is an end elevation view of the mechanism illustrated in FIG. 11 and taken approximately along line 13—13 of FIG. 11;

FIG. 14 is a fragmentary detail view on an enlarged scale of certain of the internal parts and including the indexing means of the mechanism illustrated in FIG. 11; and

FIGS. 15–19 are a series of diagrammatic views similar to FIG. 5 illustrating certain members of the valve mechanism in various operative positions.

Referring now to the drawings and particularly to FIGS. 1 and 2, a conventional lathe machine incorporating our invention is there shown. The lathe machine illustrated in FIGS. 1 and 2 designated in its entirety by the reference numeral 10 includes a base or pedestal 11 having the conventional bed 12. Lathe 10 also includes the head stock 13 and tail stock 14 for use in supporting and rotating a workpiece.

Lathe 10 also includes a carriage 15 which is mounted on the bed 12 for longitudinal reciprocating movement relative thereto in a fore and aft direction. As is well known in the art, the workpiece may extend between and be supported by the head stock and tail stock or the workpiece may be carried solely by the head stock. The carriage during operation of the lathe is shifted forwardly towards the head stock and rearwardly relative thereto in a return direction.

This carriage 15 also includes the conventional depending apron 16 and has a tool support 17 shiftably mounted thereon, the latter removably and selectively supporting a conventional cutting tool. The carriage 15 is driven by reversible lead screw 18 in the conventional manner and this lead screw 18 is interconnected to drive means by clutch means (not shown). Although the clutch and drive means are now shown in the drawings, the clutch means does include a control rod 19 for actuating the clutch to permit the drive screw to be operatively disengaged from the drive means and also to permit the lead screw 18 to be reversibly driven. It is felt that an illustration of this clutch and drive means is unnecessary since the drive means and clutch means of the lathe are of conventional construction and, per se, do not constitute a part of the instant invention. The lathe carriage 15 also slides along the control rod 19, the latter being provided with stops 20 to permit actuation of the clutch means when the carriage engages these stops. In this connection, the control rod 19 and stops 20 actually constitute linkage connections of the carriage with the conventional clutch means of the lathe so that the clutch is operable to disengage the driving connection of the lead screw 18 from the drive means when the carriage engages the stops 20 to shift the rod 19 at the respective ends of the fore and aft strokes of the carriage.

The control rod 19 is operatively connected to the clutch shifting crank rod 21 and when the rod 19 is moved axially

the clutch shifting crank rod is rotated to shift the clutch from either forward or rearward drive to neutral or disengaged positions.

Referring now to FIGS. 1, 2, 9 and 10, it will be seen that the tool support or tool post slide **17** includes a tool support mounting **22**, which is fixedly mounted with respect to the tool support **17**. A feed nut **23** is affixed to the tool support mounting **22** by means of the key **24** and this feed nut threadedly engages an elongate feed screw **25**, the latter being rotatable by means of an adjustment crank **26** having an indicator dial **26***a*. The tool support **17** is provided with a recess **27** for reception of the conventional tool post **28**, the latter being adapted to releasably support a conventional cutting tool normally used in a threading operation.

Means for readily shifting the tool support between work engaging and return position comprises a quick shiftable lever **29** which is fixedly connected with a barrel or sleeve **30**, the latter having a helical cam groove **31** formed therein. Since the quick shiftable lever **29** is fixedly connected to the barrel **30**, shifting of the lever causes rotation of the barrel, and the cam follower **32** which is fixedly mounted on a cam follower mounting **33** is caused to be shifted axially. It is also pointed out that the cam follower mounting **33** is fixedly connected with a tool support so that rotation of the barrel causes axial shifting of the cam follower **32**, follower mounting **33** and the tool support **17** in a rectilinear direction between work engaging and return positions. A sleeve gear **34** having circumferentially arranged and radially extending teeth *34a* extending outwardly therefrom is mounted on the barrel **30** for rotation therewith. The function of this sleeve gear will be explained hereinbelow.

Generally speaking in most conventional lathe structures an operator must manually actuate the various controls on the lathe during the threading operation. In this operation the workpiece may be rotatably supported between the head stock and tail stock or may be supported merely by the head stock spindle. The tool support **17** and the cutting tool carried thereby will be adjusted by means of the adjustment crank **26** to the precise setting. The quick shiftable lever **29** will be moved to shift the tool support **17** rectilinearly towards the workpiece and the clutch means will be shifted to cause movement of the carriage in a forward direction if the threading operation involves producing external threads on a workpiece.

The carriage will be moved forwardly towards the head stock and the tool will engage and spirally cut the workpiece and threads will be produced thereupon until the carriage apron **16** strikes the mechanical stop **20** adjacent the forward end of the control rod **19**. When the carriage apron engages the mechanical stop **20** the rod **19** will be moved axially and the clutch shifting lever is moved to a neutral position so that the carriage is no longer moved longitudinally of the lathe bed. The operator then shifts the quick shiftable lever **29** to cause the tool support **17** to be moved recti-linearly to the return position and he thereafter shifts the clutch lever to cause reversal in the rotation of the lead screw **18** to shift the carriage rearwardly until the latter strikes the rear mechanical stop **20** which again causes shifting of the control rod **19** and the clutch crank rod **21** is moved to the neutral position again. The operator will then make another setting with the adjustment crank **26** so that a deeper cut may be made on the workpiece and the quick shiftable lever **29** is moved to cause recti-linear shifting of the tool support **17** and its cutting tool again to the tool-engaging position. The clutch is shifted to cause movement of the carriage **15** in a forward direction, the cycle is thus begun again.

Since this operation is that of a type lathe, which is well known in the trade, it is felt that a detail illustration of the various parts thereof, to wit, the clutch drive means, internal construction of the carriage, is unnecessary in the instant application. It should be pointed out, however, that a particular lathe machine which is illustrated in the drawings although lathes, which have reversibly driven lead screws may also be used in conjunction with our novel actuating means. It is also pointed out that with the exception of the sleeve gear **34**, the above described lathe structure is well known.

It will be noted that the foregoing description of the standard operation of a lathe when threads are produced on a workpiece is quite time consuming. We have, therefore, provided means for automatically actuating the carriage and tool support of a lathe machine through a predetermined number of strokes without requiring constant manipulation of the controls by an operator. Referring now to FIGS. 1 to 5, it will be seen that our means for automatically actuating the carriage and tool support includes mechanism for automatically shifting the clutch means, the latter defining a disengageable driving connection between the drive means and the lead screw **18**. Although this clutch means is not shown, it is, as pointed out supra, of conventional construction, and the clutch shifting crank rod **21**, as best seen in FIG. 4, is connected to the clutch means for actuation thereof between drive positions, which includes forward and rearward drive and neutral or disengaged position.

The mechanism **35** for shifting the clutch shifting crank rod **21** and the clutch means includes a housing **36** rigidly secured to the lathe pedestal as best seen in FIG. 2. A fluid pressure motor **37**, which is a double acting pneumatic ram type, is positioned within the housing **36** and projects rearwardly therefrom. This pneumatic ram includes a cylinder **38** which is provided with a small recess **39** in one end thereof for receiving the small block **40** attached to the front wall of the housing **36**. Block **40** is pivoted about a pin **41** which is affixed to the cylinder **38**.

Thus, it will be seen that the cylinder **38** is mounted within the housing **36** for limited vertical swinging movement about a substantially horizontal axis.

Pneumatic ram **37** also includes a piston **42** positioned within the cylinder **38** for axial movement relative thereto and this piston **42** is provided with the conventional O-ring type seal in sealing engagement with the interior surfaces of the cylinder as best seen in FIG. 3. Again, referring to FIG. 3, it will be seen that piston **42** is removably mounted on one end of a piston rod **44**, the other end of the piston rod **44** projecting axially outwardly of the cylinder **38** and is internally threaded as at **45** for the reception of a threaded connector **46**. The threaded connector **46** has its outer terminal portion connected to the upper end of an arm **47** which is rigidly connected to the clutch shifting crank rod **21** so that movement of the arm **47** causes simultaneous movement of the crank rod **21**. The threaded interconnection of the connector **46** and the piston rod **44** permits ready adjustment of these parts so that the overall length thereof may be varied.

Air is supplied into the cylinder **38** on both sides of piston **42** through ports **48** and **49**. Shifting of the piston **42** occurs when air is supplied through the ports **48** and **49** and the piston **42** will be shifted through to the left as viewed in FIG. 3 when air passes through port **49**. Shifting of the piston rod to the left causes the piston rod to be extended with regard to the cylinder **38**. Extension of the piston rod **44** causes movement of the arm **47** and clutch shifting crank rod **21** so that the clutch mechanism operatively interconnects the lead screw **18** and the lathe drive means whereby the carriage is moved in a rearward or return direction. The exhaust of the air from the cylinder **38** from both sides of the piston **42** is accomplished by means of a pair of bleeder ports **50** although only one is shown in the drawing. These bleeder ports **50** allow air within the cylinder **38** to constantly escape therefrom but each of these ports are of a size in relation to their associated inlet ports **48** and **49** respectively, so

that when air is introduced into one side of the cylinder there is sufficient air pressure to cause axial movement of the piston head although this pressure will diminish after shifting of the piston from one position to another. Introduction of air into port 48 will cause shifting of the piston 42 to the right, as viewed in FIG. 3, and the piston rod 44 is retracted. Retraction of the piston rod 44 causes simultaneous rocking of crank rod 21.

Mechanism is also provided for automatically shifting the tool support 17 between work engaging and return positions. This tool support shifting mechanism, designated in its entirety by the reference numeral 51, includes a second fluid pressure motor 52 which is also of the double acting pneumatic ram type as best seen in FIG. 6.

The double acting ram 52 includes a cylinder 53 having a forwardly projecting, tubular, piston-rod guide 54. The rear wall portion 55 of the cylinder 53 is also provided with a rearwardly projecting tubular piston-rod guide 56 and the rear wall portion and front wall portion of the cylinder are each provided with suitable sealing rings of conventional construction.

An axially shiftable piston 57 is positioned within cylinder 53 for axial shifting movement relative thereto and this piston 57 is fixedly connected to a thrust member or piston rod 58 intermediate the ends of the latter. The lower edge of the forward portion of the piston rod 58 is provided with a plurality of teeth 59 and it will be noted that the front piston rod guide 54 is provided with a downwardly opening arcuate recess 60, as best seen in FIG. 6. Referring again to FIG. 6, it will be noted that the pneumatic ram 52 is detachably mounted on the tool support 17 by means of bolts 61 to thereby permit ready detachment of the ram therefrom. The teeth 59 on the piston rod 58 will be disposed in engaging enmeshing relation with the sleeve gear 34 of the tool support 17 so that axial movement of the piston rods 58 will cause rotation of the sleeve gear.

Air under pressure is passed into and out of the cylinder 53 through ports 62 and 63. A conventional pneumatic fitting 64 is provided for port 62 while the port 63 is provided with a pneumatic fitting 65. The fittings 64 and 65 are provided with air conduits 66 and 67 respectively through which air is supplied to the cylinder 53.

It will be seen that air introduced into cylinder 53 through port 62 will cause piston 57 to be shifted to the position as illustrated in FIG. 6 so that piston rod 58 is extended. This rotates sleeve gear 34 so that tool support 17 is shifted to the work-engaging position. Air will be simultaneously exhausted through port 63 during this stroke of the piston 57. When air is introduced into cylinder 53 the piston will shift to the left, as viewed in FIG. 6, to cause retraction of piston rod 58 and rotation of sleeve gear 34 in a direction to reciprocate the tool support 17 to the return position. Air will be exhausted through port 62 during this operation.

Means are provided for varying the lengths of the stroke of the piston rod 58 so that the cutting tool carried by the tool support will be positioned to make a deeper cut with each successive forward stroke of the carriage. Mechanism is also provided for indexing the stroke length varying means of piston rod 58 so that piston rod 58 is automatically recycled after each complete cycle of movement thereof. Referring now to FIGS. 6 to 8 it will be seen that the piston rod 58 extends rearwardly beyond the cylinder 53 and is provided with a stop member or block 68 affixed to the rear portion thereof externally of the cylinder 53. A bar 69 is affixed to the lower portion of the stop block 68 by means of a bolt 70 and it will be noted that bar 69 extends forwardly from block 68 and is disposed in substantially parallel relation with respect to the piston rod 58. An index pin structure 71 is detachably carried by the bar 69 and this index pin structure includes a cam pin 72 having adjustment knob 73 with a spring 74 urging the pin in an upward direction.

Referring now to FIG. 6, it will be seen that the outer

wall surface of a cylinder 53 is provided with an elongate groove 53*a* extending generally in an axial direction and in which the cam pin 72 moves. It will therefore be seen that axial shifting of the piston rod causes movement of a bar 69 and the cam pin 72.

A cam and index drum 75 is mounted for rotation on a rearwardly projecting piston-rod guide 56 and this cam and index drum 75 are provided with a plurality of circumferentially arranged threaded recesses 76 for adjustably receiving a plurality of stop bols 77 therein. These stop bolts are arranged in steps with regard to their rearwardly projecting lengths. Each of these stop bolts 77 is adapted to be successively engaged by the stop block 68 during extension of the forward portion of the piston. When a stop bolt 77 is in obstructing relation with regard to the stop block 68 it will be seen that the stop bolt will be disposed downwardly for engagement with the lower portion of the stop block. It will be noted that there are ten bolts illustrated in the present embodiment so that the cutting tool carried by the tool support will make ten different passes with regard to the workpiece. Thus, it will be seen that stop block 68 and stop bolts 77 cooperatively define a mechanism for varying the length of the stroke or piston rod 58.

The means for successively positioning the stop bolts in obstructing relation with regard to the stop block 68 include a plurality of cam slots or grooves 78 with these slots being circumferentially spaced on the outer peripheral surface of the cam and index drum 75. Each slot also includes an inclined ramp portion 79, the ramp portion for each slot being disposed in angulated relation with regard to its associated slot. It will also be noted that the ramp portion is constructed so that the front terminal portion thereof is disposed in alignment with and in close proximity to the forward portion of the next adjacent cam slot. The drum is rotated by the engagement of the cam pin 72 successively in each of the slots during the shifting of the piston rod 58 in the return direction. The cam pin 72 engages one of the cam slots 78 during the return stroke of the piston rod and since the slot is disposed inangulated relation with regard to the direction of movement of pin 72, the pin will cause rotation of the drum on the rearwardly projecting guide portion 56. Rotation of the drum positions the next stop bolt 77 in obstructing relation with regard to the stop block 68 so that when the piston rod is shifted forwardly to move the tool support in a work-engaging direction, the stop block 68 will engage different stop bolt. During forward movement of the pin, the ramp portion 79 of the cam groove disposed in engagement with the pin will be entered and the pin will move forwardly into engagement with the ungrooved surface of the drum and thereafter into engagement with the slot formed in the cylinder 53. The pin, however, will be disposed in position for engagement with the next adjacent cam groove during the return stroke of the piston rod.

The stop bolts 77 are adjusted so that the bolts are arranged in steps with regard to their rearwardly projecting lengths. At the beginning of the operation, the bolt projecting the greatest length rearwardly from the indexing drum will be that first engaged by the stop block 68 so that the bolt with the least projecting length will be the last engaged by the stop block. This arrangement permits the plunger or piston rod to have its length varied with each successive stroke and to also index the length varying means automatically during the cycling of the piston rod.

It will be seen that the indexing mechanism comprises the indexing and camming drum 75, cam slots 78 and cam pin 72. It should be pointed out that the reset knob 73 must be manually reset at the end of the predetermined number of strokes of the tool support. At the end of the last stroke of the piston rod 58, the block 68 will engage the screw 77 having the shortest projecting length. The index drum will be maintained in this position until

manually reset to permit cleaning of the threaded member at the end of a threading operation.

Valve means are also provided for controlling actuation of the pneumatic ram 37 and pneumatic ram 52 and this valve mechanism, designated in its entirety by the reference numeral 80, includes a housing 81 mounted on the pneumatic ram 37 in cooperating relation therewith to define a chamber 82. The housing 81 is mounted against the outer surface of side wall 83 of the cylinder 38 and this side wall surface is provided with a pair of spaced apart ports 48*a* and 49*a* communicating with the ports 48 and 49 respectively of the pneumatic ram 37. Referring now to FIGS. 3 to 5 and FIGS. 15 to 18, it will be seen that the side wall 83 has another pair of ports 62*a* and 63*a* formed therein. Ports 62*a* and 63*a* are provided with conventional fittings and these fittings are respectively connected with conduits 66 and 67. Port 62*a* is in communicating relation with port 62 and port 63*a* is in communicating relation with port 63. It will be seen that the valve mechanism 80 is arranged in fluid controlling relation with both the fluid pressure motor 52 and the fluid pressure motor 37. Air is supplied into the valve chamber 82 of valve mechanism 80 through an inlet 84 which is connected to a source of air under pressure.

Valve mechanism also includes an elongate substantially rectangular flat valve member 85 mounted for sliding movement on the outer surface of side wall 83 in chamber 82. Valve member 85 is disposed in fluid controlling relation with respect to the ports 48*a*, 49*a*, 62*a*, and 63*a* respectively. Another valve member 86 of generally flat T-shaped configuration is mounted for relative shifting movement with respect to the valve member 85 which also serves to control the flow of air to the respective pneumatic rams. Means are also provided for actuating or shifting the valve members 85 and 86 and to this end, a wall of the cylinder 38 is provided with an elongate recess 87 formed therein. A valve actuating rod 88 is positioned within the recess 87 for axial shifting movement relative thereto and this valve actuating rod 88 is provided with a pin 89 at its inner terminal end, the pin projecting laterally outwardly from the rod 88 and being engaged by the T-shaped valve member 86. Pin 89 extends through an elongate slot 83*a* formed in the wall 83 of the cylinder 38 and this pin extends upwardly through a relatively small elongate slot 90 formed in valve member 85. Thus, it will be seen that shifting of the valve actuating rod 88 causes sequential shifting of the T-shaped valve member 86 and the valve member 85. It will also be noted from FIGS. 3 to 5 and 15 to 19 that the slot 90 in the valve member 85 is substantially larger than the diameter of the pin 89. The pin 89 and slot 90 actually define a lost motion connection between the valve members 85 and 86 respectively. Therefore, initial movement of the valve actuating rod 88 actually causes relative movement between the valve member 85 and the T-shaped valve member 86.

The outer terminal portion of the valve actuating rod 88 is threaded as at 91 and the piston rod 44 is provided with a block 92 rigidly secured thereto by means of a lock screw 92*a*. This block 92 is interposed between a pair of positioning nuts 94 on the threaded end 91 of the rod 88. It will be seen that both the block 92 and the lock nuts 94 may be adjusted with respect to their respective rods. Thus, it will be seen that reciprocating movement of the piston rod 44 causes simultaneous shifting of the valve actuating mechanism, the latter being comprised of the valve actuating rod 88, pin 89, the lock 92 and the locking nuts 94.

The valve mechanism 80 is also porvided with an exhaust port 95 which communicates with elongate recess 87. A pair of resilient spring elements 96 engage the inner surface of the valve housing 81 and bear against marginal portions of the valve member 85 to constantly urge the latter into engagement with the surface of the side wall 83. Since there is relative movement between the valve member 85 and the T-shaped valve member 86 because of the lost motion connection therebetween it will be seen that the valve member 85 is provided with a pair of guide pins 97 for engagement with the opposed edges of the T-shaped valve member 86. A small resilient leaf spring 96*a* also retains the valve member 86 in place as best seen in FIG. 3.

Referring now to FIGS. 5 and 15 to 19, it will be seen that the valve member 85 has a substantially flat outer surface 85*a* and the substantially flat inner surface 85*b*, the latter being disposed in engagement relation with the outer surface of the wall 83. The valve member 85 is provided with a pair of spaced apart ports or apertures 62*b* and 63*b* extending therethrough and it will be seen that the aperture or port 62*b* is in communicating relation with an elongate slot 62*c* formed in the inner surface 85*b* of the valve member. The aperture or port 63*b* is disposed in communicating relation with an elongate slot 63*c* the latter being disposed in longitudinal alignment but longitudinally spaced from the elongate slot 62*c*. Thus, it will be seen that air passes from the chamber 82 selectively through one of the ports 62*b* or 63*b* and thereafter through the slot associated with said last-mentioned ports.

Referring again to FIGS. 5 and 15 to 19, it will be seen that the valve member 85 is provided with another pair of ports 48*b* and 49*b* respectively and it will be noted that these ports are in longitudinal alignment but that the spacing between the ports is substantially the same as the spacing between the ports 62*b* and 63*b* respectively. The port 48*b* is in communicating relation with an elongate slot 48*c* formed in the inner surface 85*b* of the valve member 85 and the port 49*b* is in communicating relation with an elongate slot 49*c* also formed in the inner surface 85*b* of the valve member 85. These slots 48*c* and 49*c* are disposed in longitudinal alignment and each is of substantially the same length. It will also be noted that the slots 48*c* and 49*c* are of a length substantially shorter than the lengths of the slots 69*c* and 63*c* respectively.

The valve member 86 is provided with a T-shaped slot on the undersurface thereof and this T-shaped slot includes a transverse slot portion 86*a* extending transversely from a centrally located point and has its outer terminal portion in communicating relation with a longitudinally extending slot portion 86*b*. This T-shaped slot is in communicating relation with the slot 90 in the valve member 85 when the valves 85 and 86 are in engaging relation. It will also be noted that in FIG. 3 since slot 90 of valve member 85 is in communicating relation with recess 87 then the transverse slot 86*a* is constantly disposed in communicating relation with the exhaust port 95, the latter being in communicating relation with the recess 87. Referring to FIGS. 15 to 19 and 5, it will be noted that the longitudinal portion 86*b* of the T-shaped member may be shifted so that it is selectively in communicating relation with one of the ports 62*a* or 63*a* respectively. Thus, it will be seen that the T-shaped slot 86*a*, 86*b* provides means for permitting the exhaust of air pressure from the pneumatic ram 52.

Mechanism is also provided for stopping operation of the carriage 15 after the latter has been reciprocated through a predetermined number of strokes. This mechanism designated in its entirety by the reference numeral 100 is mounted on the clutch control rod 19 adjacent the rear portion thereof as best seen in FIG. 1. Referring now to FIGS. 11 and 12 through 14, it will be seen that the carriage control mechanism 100 includes an elongate barrel or cylinder 101 mounted in coaxial relation on the control rod 19 by means of a sleeve bearing 102. Barrel 101 is rotatably mounted on the sleeve bearing 102 by means of a ball bearing 103. The sleeve bearing 102 is slidably mounted on the control rod 19 so that the barrel may be moved in an axial direction relative to the control rod.

The rear end portion of the barrel 101 is rotatably and slidably mounted adjacent its rear end in coaxial relation

upon an indexing drum 104, as best seen in FIGS. 11 and 14. Referring now to FIG. 14, it will be noted that this indexing drum is provided with a plurality of axially extending grooves 105 circumferentially arranged in the outer peripheral portion of the drum 104. Each of these grooves 105 is interconnected with the next adjacent groove by means of connecting grooves 106. It will be noted that the grooves 105 are disposed in angulated relation with respect to grooves 106. A small tubular sleeve 107 having a threaded end threadedly engages the barrel 101 as best seen in FIG. 11, and projects radially therefrom. Sleeve 107 adjustably mounts a spring urged cam pin 108 having a knob 109 therein. The spring urged cam pin 108, as best seen in FIG. 11 and FIG. 13, rides or moves within the grooves 105 and 106 when the barrel 101 is moved relative to the indexing drum 104. It will be seen that when the barrel is moved axially rearwardly the cam pin 108 rides within one of the grooves 105 and since the indexing drum is fixedly mounted on the control rod 19 then the barrel 101 is caused to rotate relative to the drum. At the end of its travel in one of the grooves 105, the pin 108 is returned through one of the interconnecting grooves 106 and is positioned for movement again through the next adjacent groove 105.

The cam pin 108 is normally prevented from moving axially rearwardly with the barrel 101 beyond a predetermined distance by an escape ring 110. This escape ring is fixedly mounted to the rod 19 by means of a set screw 111, however, escape ring 110 is also provided with a notch 112 which is disposed in alignment with one of the cam grooves 105. Thus, it will be seen that when the barrel and cam pin are rotated so that the pin is moving in the particular groove 105 aligned with the notch 112 in the escape ring 110, the barrel may be moved rearwardly beyond the escape ring 110 until the rear end portion of the barrel 101 strikes the rear stop member 20. It will be noted that each of the stop members 20 affixed to the control rod 19 are adjustably secured thereto by means of a set screw 20*a*. It will also be noted that during normal operation the barrel will be rotated during rearward movement of the barrel by coaction of the cam pin 108 in the cam grooves 105. The rearward axial movement of the barrel 101 will be normally stopped when the cam pin 108 strikes the escape ring 110. At this point a coil spring 113 constantly urges the barrel forwardly and this operation continues until the cam pin moves through the notch 112 in the escape ring.

Means are also provided to cause the barrel 101 to reposition itself on the indexing drum 104, after the barrel camming pin 108 has been moved beyond the escape ring 110. This repositioning means for the barrel includes an annular collar 114 rotatably mounted on the forwardly reduced portion 104*a* of the connecting drum 104. This collar 114 is provided with a readily extending lug 115 which is disposed within an elongate internal slot 101*a* formed in the barrel 101. A torsion spring 116 has one end thereof affixed to the forward portion 104*a* of the index drum 104 and is wound therearound and has its other end affixed to the lug 115. A stop pin 117 is affixed to the indexing drum 114 and projects forwardly therefrom in obstructing relation with regard to the lug 115. It will be seen that as barrel 101 rotates, the lug 115 will rotate therewith and cause tightening of the torsion spring 116. This torsion spring 116 will be wound until the pin 108 escapes through the escape ring notch 112 and the torsion spring will then unwind causing the barrel to be repositioned in place for the next reciprocating action of the carriage. The stop 117 prevents further rotative movement of the collar 114 after unwinding of the coil spring 113.

Rearward movement of the barrel 101 is caused by the carriage 15 as the carriage is driven rearwardly by the lead screw 18 and when the carriage strikes the barrel 101, the latter is moved in telescoping sliding fashion along the control rod 19 until the cam pin 108 engages the escape ring 110. When this occurs, the clutch shifting crank rod 21 is shifted since the control rod 19 is interconnected with the latter and the carriage is thereafter caused to reverse its direction of movement.

Means are also provided for closing off the supply of air to the valve mechanism 80 when the barrel 101 is moved in engagement with the rear stop 20. It will be noted that the carriage 15 will be permitted to move further rearwardly when the barrel cam pin 108 moves beyond the escape ring 110 and this additional movement of the carriage actuates the valve mechanism which is interposed in fluid controlling relation between the supply of air under pressure and the valve mechanism 80. In this connection, the inlet 84 for the valve mechanism 80 has a conduit 118 connected therewith for supplying air into the air chamber 84 of the valve mechanism 80. This conduit 118 is connected in fluid communication to the valve mechanism 119 the latter being positioned on the lathe base in close proximity to the lathe bed 12. This valve mechanism 119 is provided with a cam arm 120 which is connectible to a valve element so that when the cam arm is actuated, air will be prevented from flowing from the valve mechanism 119 and into the conduit 118. The valve mechanism 119 is interconnected to a supply of air under pressure by means of a conduit 121. Thus, it will be seen that when the carriage 15 is moved, the additional distance in a rearward direction, that is when the barrel cam pin 108 moves beyond the escape ring 110 then the supply of air to the valve mechanism will be closed. Simultaneously, with the closing of the air to the valve mechanism 80 will be the axial shifting of the control rod 19 in a rearward direction to move the clutch to a neutral position. The carriage and the control means will therefore be rendered inoperative.

Operation

When the lathe machine is operated to produce threads on a workpiece, the workpiece will be positioned on the head stock 13 by means of the conventional collet and the head stock will be drivingly rotated by conventional drive means. If the workpiece is of relatively short length, then the workpiece may be supported solely by the head stock or it may be supported between the head stock and tail stock 14 in the conventional well known manner. The carriage 15 will be disposed in a rearward position relative to the head stock and will be caused to move forwardly when the feed screw 18 is disposed in operative engagement with the lathe drive means. The manual clutch-shifting lever, which is in the neutral position when the threading operation begins, will be shifted to the forward drive position so that the lead screw 18 drives the carriage in a forward direction. It is also pointed out that at the beginning of the operation the piston rod 58 of the pneumatic ram 52 will be in a retracted position so that the tool support is in the return position. When the manual clutch shifting lever is shifted for forward drive, the valve member 85 and the T-shaped valve 86 will be in the position illustrated in FIG. 15. When the valve mechanism is in the condition illustrated in FIG. 15, there will be no effective air pressure within the cylinder 38. The piston rod 44 will be completely retracted and, since the inlet ports 48*a* and 49*a* formed in the cylinder wall 83 are closed to chamber 82 and are not in communicating relation with their respective slots 48*c* and 49*c* and their associated ports 49*b* and 48*b* of the valve member 85, no air will be supplied into this cylinder. Further, the outlet ports 50 will allow the escape of air completely from this cylinder.

However, it will be noted that the port 62*b* is open with respect to the valve chamber 82 so that air may pass downwardly through the slot 62*c* and thereafter through aperture or port 62*a*.

Thus, it will be seen that air under pressure will be introduced to the pneumatic ram 52 through the port 62

so that the piston rod 58 is extended. During extension of the piston rod 58, the sleeve gear 34 is rotated thus causing rotation of the barrel 30, and the helical cam groove 31. The coaction of the follower 32 with the helical cam groove 31 causes axial shifting of the tool support 17 in a direction to dispose the tool carried by the tool support in the work-engaging position.

The carriage 15 will thereafter be moved along the lathe bed thus carrying the tool support along the workpiece until the carriage strikes the forward mechanical stop 20 on the control rod 19. The control rod 19 will be moved axially forward thus simultaneously shifting the clutch shifting crank rod 21. When the clutch rod 21 is shifted, the arm 47 which is affixed thereto is also shifted. Shifting of the arm 47 causes outward extension of the piston rod 44 of the pneumatic ram 37 so that the piston is moved to a position approaching the center of the cylinder. When in this position, the clutch will be in a neutral position and the movement of the piston rod 44 also causes simultaneous movement of a valve actuating mechanism 88 which includes the valve actuating pin 89. Axial movement of this valve actuating pin 89 causes shifting of the valve member 86 relative to the valve member 85 because of the lost motion connection therebetween. The extent of this relative movement between these two members is determined by the length of the slot 90 in the valve member 85. The initial part of this movement closes the port 62*b* in the valve member 85 thus closing off the supply of air to the port 62 of the pneumatic ram 52. Furthermore, movement of the valve member 86 causes the transverse slot 86*b* in the underside thereof to be moved into communicating relation with the port 62*b*, as best seen in FIG. 16, so that air is exhausted from the pneumatic ram 52 through port 62. Simultaneously, with this exhausting operation the ports 49*b* and 63*b* in the valve member 85 are uncovered so that air may pass therethrough and into their associated slots 49*c* and 63*c* respectively. Thereafter the valve member 86 and the valve member 85 will be moved together so that the slots 49*c* and 63*c* are each simultaneously moved into communicating relation with the ports 49*a* and 63*a* in the cylinder wall 83 as best seen in FIG. 17. This allows air to pass through the port 49 of the pneumatic ram 37 and through the port 63 of the pneumatic ram 52. This causes simultaneous shifting of the respective piston rods 44 and 58 in their cylinders so that the clutch shifting rod 21 is shifted to the reverse position and the piston rod 58 is retracted and revolves the sleeve gear 34 in a direction to cause retraction of the tool support 17. Thus the carriage is driven in a rearward direction while the tool support is reciprocated to its return position.

When the piston rod 58 of the pneumatic ram 52 is retracted, coaction between the pin 72 with the cam grooves 78 of the cam and index drum 75 cause rotation of the drum thus positioning the next adjacent stop bolt in place to be engaged by the stop block 68 upon the forward stroke of the piston rod 58. As pointed out above, the rotation of the indexing and cam drum 75 is in a direction so that the bolts are successively positioned in obstructing relation with the stop block. The bolts are arranged so that the one having the greatest rearwardly projecting length is engaged first and with the bolt having the shorter projecting length is the last to be engaged by the stop block. With this arrangement, the length of stroke of the piston rod 58 is successively increased with each forward stroke of the piston rod.

The carriage 15 will be moved in a rearward direction while the tool support will be in the return position and the carriage will continue to move in the rearward direction until the rear portion thereof strikes the forward portion of the bearing 102 causing retraction of the barrel on the control rod 19 until the cam pin 108 strikes the escape ring 110. Since the escape ring is fixed to the control rod 19, the control rod will be shifted axially rearwardly causing the clutch shifting crank rod to be moved to a neutral position and simultaneously shifting the valve actuating rod 88. It should be pointed out that during shifting movement of the clutch rod to reverse the drive of the carriage from a forward to rearward direction by retraction of the piston rod 44 of the pneumatic ram 37, the valve members 85 and 86 will move together relative to the wall 83 of the cylinder 38 the distance of the length of the slot 83*a* until the valve member 85 is positioned as indicated in FIG. 18. With this arrangement, it will be noted that port 63*b* is in communicating relation with the port 63*a* so that air under pressure is supplied to the fluid pressure ram 52 through the port 63 thereof to maintain the piston rod in retracted position. It will also be noted however that the port 49*a* is not in communicating relation with the port 49*b* since the slot 49*c* associated with the latter is not communicating with the port 49*a*. It will also be noted that the port 48*a* is not in communicating relation with the port 48*b* since the latter is closed by the valve member 86. Therefore, there will be no air pressure being supplied to the pneumatic ram 37. The bleeder ports 50 in the cylinder 38 will permit escape of any air in this cylinder.

Therefore, when the control rod 19 is shifted axially rearwardly by the coaction of the carriage 15 with the barrel 101, the valve 86 will be shifted from the position illustrated in FIG. 18 to the position indicated in FIG. 19. During the initial part of the movement, the lost motion connection between the valve members 85 and 86 cause ports 63*b* and 49*b* of the valve member 85 to be closed simultaneously with opening of the ports 62*b* and 48*b* thereof. This prevents further passage of air from air chamber 82 through port 63*a* and into the port 63 in the pneumatic ram 52 but the initial part of the movement does not position port 62 in communicating relation with the port 62*a*. The first operation of the valve 80 is to shift the member 86 to a position so that while the support 63*b* is closed with respect to the air chamber 82 this port is in communicating relation with the slot 86*b* to permit exhausting of the air from the pneumatic ram 52.

However, when the valve member 86 is moved the length of the slot 90 relative to valve member 85, movement of the valve members 86 and 85 together relative to the wall 83 of the cylinder 38 causes the ports 48*a* and 62*a* to be placed in communicating condition with respect to the valve chamber 82 so that the piston 42 will be shifted from a centrally located position to a retracted position. Retraction of piston 42 causes the piston rod 44 to be retracted thus causing the clutch shifting crank rod to be shifted from the neutral position to a position for forward drive. The clutch shifting crank rod 21 is shifted from rear drive to neutral position by the axial shifting of the control rod 19, the latter being shifted by barrel 101 and carriage 15. Simultaneously with the shifting of the clutch shifting crank rod 21, the piston rod 58 of pneumatic ram 52 will be extended since air is supplied through the port 62*a*, conduit 66 and port 62 into the cylinder 53 to cause the piston rod 58 to be shifted forwardly which rotates the sleeve gear 34, the barrel 30 with the helical cam groove 31. The coaction between the helical cam groove and the follower 32 causes axial shifting of the tool support to the work-engaging position. As the piston rod 58 is shifted forwardly, the length of the stroke will be greater than the length of the previous stroke since the stop bolt 77 positioned in obstructing relation with respect to stop block 68 will be adjusted relative to the camming and indexing drum 75 so that it has a shorter projecting length than the previously engaged stop bolt. Thus, a deeper cut may be made in the workpiece since the tool support is disposed in closer proximity to the workpiece with respect to its previous forward position.

The carriage and tool support are, therefore, reciprocated through a predetermined number of strokes until

the cam pin **108** moves within the groove **105** which is aligned with the escape notch **112** of the escape ring **110**. When this occurs, the barrel **101** can telescope until the rear portion thereof strikes the rear mechanical stop on the control rod **19**. The barrel **101** strikes the stop **20** and then the control rod is shifted thus moving the clutch shifting crank rod **21** to the neutral position and simultaneously with this operation, the carriage **15** will engage the cam arm **120** associated with the valve mechanism **119** so that the valve is actuated to close the supply of air under pressure through the conduit **118** to the valve mechanism **80**. The tool support **17** will be disposed in retracted position and the clutch shifting rod will be in a neutral position when the air supplied to the valve mechanism **80** is closed. The barrel **101** will be repositioned for the next operation and the cam and index drum **73** must be manually rotated to again position the stop bolt **77** having the longest rearwardly projecting length for engagement by the stop block **68**. The workpiece will have been successively engaged by the cutting tool carried by the tool support so that a deeper cut is successively made on the workpiece without constant manipulation by an operator. It will also be noted that at the end of an operation, all the various parts of the actuating means must be recycled for the next operation including each of the indexing mechanisms associated with the carriage and the tool support.

It will also be noted that with regard to the controlling of the carriage **15** through a predetermined number of strokes, the rearmost stop member **20** on the control rod **19** may be positioned in engagement with the escape ring **110** so that escape of the barrel **101** from the escape ring is prevented, with this arrangement the carriage may be continuously reciprocated so that a continuous operation of the lathe machine is possible. It is also pointed out that while the threading operation previously described has been that for producing external right hand threads on a workpiece, our means for controlling and simultaneously actuating the carriage tool support is readily adaptable for formation of left handed threads since this merely requires interchanging of the conduits to ram **52**. It is also pointed out that our unique control means is also readily usable for automating the operation of the carriage and tool support when internal threads are to be formed on a workpiece whether these threads are left handed or right handed. The formation of internal threads will merely necessitate repositioning of a carriage and tool support in a well known manner and attaching ram **52** in a reverse manner and it will be noted that our control means for operating the carriage and tool support when arranged for internal threading will be substantially very similar to that previously described.

It will, therefore, be seen from the preceding paragraphs that we have provided a novel control and actuating means for use with a conventional lathe machine which permits automation of the carriage and tool support thereof during the threading operation.

It will also be noted that our unique control attachment consists of relatively few parts and utilizes the air pressure as a source of motive power, which permits inexpensive operation of the control means since most machine shops are provided with air compressors.

It will also be noted that the fluid motor **52** which operatively controls the tool support **17** may be readily detached from the lathe and be moved to an out-of-the-way position, and replaced by a protective cap.

It will also be seen that the construction, operation and interrelation of the various parts permit multiple functioning of these parts so that the overall complete structure of this control attachment is basically of relatively simple construction. It will be noted, for example, that the pneumatic ram **52** not only has means for indexing the position of the stop screws so that the length of the piston rod may vary on each successive stroke, but that the movement of the piston rod itself causes actuation of the indexing drum.

It will further be noted that this particular arrangement will allow a wide range of operation since the indexing drum may be constructed to have any number of mechanical stops, thereby permitting the rate of infeed of the stroke of the piston rod associated with the pneumatic ram **52** to be varied over a relatively wide range.

It will also be noted that the means for indexing the number of reciprocating strokes of carriage **15** of the lathe machine may be constructed to permit wide variances with regard to the number of strokes of this carriage.

It will further be noted from the foregoing description that the normal operation of the lathe mechanism is not at all impaired when our control attachment is connected to a conventional lathe structure nor is the lathe structure itself altered. Thus, it will be seen our novel control attachment is readily adaptable for lathe machines of the type having a reversing lead screw and it permits highly efficient and automatic operation thereof during a thread-making process.

It will, therefore, be seen that we have provided a novel control attachment for automatically controlling the carriage and tool support for a lathe machine of the type having a reversibly driven lead screw during a threading operation in a more efficient and economical manner than any heretofore known comparable devices.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the various parts without departing from the scope of our invention.

What is claimed is:

1. A device for automatically controlling operation of a conventional lathe machine through a predetermined number of cycles during a threading operation, the lathe machine being of the type having a carriage mounted thereon for reciprocating movement in a fore-and-aft direction adjacent the work piece, a tool support mounted on the carriage for reciprocating transverse movement relative thereto between work-engaging and return positions, reversible drive means for shifting the carriage in a fore-and-aft direction including a conventional clutch means defining a disengageable drive connection with the carriage, and a clutch shifting mechanism connected to the clutch means and being engageable by the carriage at the ends of the respective fore-and-aft strokes to normally disengage the drive thereto,

said device including a first fluid pressure motor comprising a cylinder,

a piston positioned within the cylinder for axial movement therein,

an elongate piston rod having one end thereof connected to said piston for axial movement therewith and having the other end projecting outwardly of the cylinder and being connectible with the clutch shifting mechanism, said piston rod being extensible and retractable at the end of the fore-and-aft stroke of the carriage to shift the clutch shifting mechanism from the normally drive disengaged position to a position with the drive means drivingly engaging the carriage,

a second fluid pressure motor including a cylinder,

a piston positioned within said second mentioned cylinder for axial movement therein,

an elongate piston rod having one end connected to said second mentioned piston and having the other end portion thereof engageable with the tool support and during extension and retraction thereof causing reciprocation of the tool support between work-engaging and return positions,

valve mechanism connected to a source of fluid under pressure and connected in fluid controlling communicating relation with said first and second cylinders respectively,

valve actuator means including an elongate valve actuating element having one end thereof connected with said first mentioned piston rod for movement therewith and having its other end connected with said valve mechanism to actuate the same whereby said valve mechanism is operable in response to movement of the carriage at the respective ends of the fore-and-aft strokes of the latter to simultaneously actuate said first and second fluid pressure motors and thereby cause reversal in the direction of movement of the carriage simultaneously with shifting of the tool support between work-engaging and return positions.

2. The structure as defined in claim 1 and a second valve mechanism interposed in fluid controlling relation between said first valve mechanism and the source of fluid under pressure,

and mechanism operatively connected with the clutch shifting mechanism and cooperating therewith and with the carriage during terminal movement of the carriage in an aft direction at the end of a predetermined number of fore-and-aft strokes to cause shifting of the clutch shifting mechanism to the drive disengaged position and simultaneously actuating said second valve mechanism to prevent flow of fluid through said first mentioned valve mechanism.

3. A device for automatically controlling operation of a conventional lathe machine through a predetermined number of cycles during a threading operation, the lathe machine being of the type having a carriage mounted thereon for reciprocating movement in a fore-and-aft direction adjacent the work piece, a tool support mounted on the carriage and having revolvable drive means for reciprocating the support transversely of the carriage between work-engaging and return positions, reversible drive means for shifting the carriage in a fore-and-aft direction including a conventional clutch means defining a disengageable drive connection wtih the carriage, and clutch shifting mechanism connected to the clutch means and being engageable by the carriage at the end of the fore-and-aft strokes to normally disengage the drive thereto,

said device including a first fluid pressure motor comprising a cylinder,

a piston positioned wtihin the cylinder for axial movement therein,

an elongate piston rod having one end thereof connected to said piston for axial movement therewith and having the other end projecting outwardly of the cylinder and being connectible with the clutch shifting mechanism, said piston rod being extensible and retractable at the end of the respective fore-and-aft strokes of the carriage to shift the clutch shifting mechanism from the normally drive disengaged position to a position where the drive means drivingly engages the carriage,

a second fluid pressure motor including a cylinder,

a piston positioned within said second mentioned cylinder for axial movement therein,

an elongate piston rod having one end connected to said second mentioned piston for movement therewith and having a serrated edge surface adjacent the other end thereof,

a ring gear being mountable upon the tool support revolvable drive means for revolving the same and engaging said serrated surface of said second mentioned piston rod and cooperating therewith during extension and retraction of the second mentioned piston rod to cause reciprocation of the tool support between work-engaging and return positions,

valve mechanism connected to a source of fluid under pressure and connected in fluid communicating relation with said first and second cylinders respectively,

valve actuator means including an elongate actuating element having one end thereof connected with said first metioned piston rod for axial movement therewith and having its other end connected with said valve mechanism to actuate the same whereby said valve mechanism is operable in response to the movement of the carriage at the end of the fore-and-aft strokes of the latter to simultaneously actuate said first and second fluid pressure motors and thereby cause reversal in the direction of movement of the carriage simultaneously with shifting of the tool support between work-engaging and return positions.

4. The structure as defined in claim 3 and means for varying the length of strokes of said second mentioned piston rod during each successive stroke thereof, said stroke length-varying means including a stop engaging member carried by said second mentioned piston rod for movement therewith, automatically adjustable stop means mounted on said second mentioned cylinder exteriorly thereof being adjustable during each successive stroke of the second mentioned piston rod and being engageable by the stop engaging member thereof during extension of the second mentioned piston rod to thereby vary the length of the stroke thereof and to automatically change the work-engaging position of the tool support, and means carried by said last mentioned piston rod and said adjustable stop means respectively for shifting the latter during retractive movement of said second mentioned piston rod.

5. A device for automatically controlling operation of a conventional lathe machine through a predetermined number of cycles during the threading operation, the lathe machine being of the type having a carriage mounted thereon for reciprocating movement in fore-and-aft direction adjacent the work piece, a tool support shiftably mounted on the carriage and having revolvable drive means operable for reciprocating the tool support transversely of the carriage between work-engaging and return positions, reversable drive means for shifting the carriage in a fore-and-aft direction including a conventional clutch means defining a disengageable drive connection with the carriage, a clutch shifting mechanism including an elongate axially shiftable control rod connected to the clutch means and being engageable by the carriage in the fore-and-aft strokes to normally disengage the drive thereto,

said device including a first pneumatic motor comprising a cylinder,

a piston positioned within the cylinder for axial movement therein,

an elongate piston rod having one end connected to said piston for axial movement therewith and having the other end projecting outwardly of the cylinder and being connectible with the clutch shifting mechanism, said piston rod being extensible and retractable at the end of the fore-and-aft strokes of the carriage to shift the clutch shifting mechanism from the normally drive disengaging position to a position wherein the drive means drivingly engage the carriage,

a second pneumatic motor including a cylinder, having means thereon to permit mounting thereof on the carriage,

a piston positioned within said second mentioned cylinder for axial movement therein,

an elongate piston rod having one end connected to said second mentioned piston and being axially movable therewith and having the other end portion defining a rack engageable with the tool support drive means and being operable during extension thereof to shift the tool support to the work-engaging position, and shifting the tool support to the return position during retraction thereof,

a valve mechanism connected to a source of air under pressure and being connected in flow controlling communicating relation with said first and second pneumatic motors respectively,

said valve mechanism including a shiftable valve element being oriented during movement of the carriage in a forward direction to cause pneumatic pressure

to the second mentioned pneumatic motor to extend the second mentioned piston rod and to thereby advance the tool support to the work-engaging position, and being shiftable at the end of the forward stroke of the carriage to shift the clutch shifting mechanism from the disengaged position to interconnect the drive means with the carriage for drive in an aft direction and simultaneously retracting the second mentioned piston rod to shift the tool support to the return position,

valve actuator means including an elongate valve actuating element having one end thereof connected with said first mentioned piston rod for axial movement therewith and having the other end connected with said valve element to shift the same whereby said valve mechanism is operable in response to movement of the carriage at the ends of the fore-and-aft strokes of the latter to simultaneously actuate said first and second fluid pressure motors and thereby cause reversal in the direction of movement of the carriage simultaneously with shifting of the tool support between work-engaging and return positions.

6. The structure as defined in claim 5 and a second valve mechanism interposed in fluid controlling relation between said first valve mechanism and the source of air under pressure,

and mechanism operatively connected with the elongate control rod and cooperating therewith and with the carriage during terminal movement of the carriage in an aft direction at the end of a predetermined number of fore-and-aft strokes to permit the carriage to travel beyond its normal predetermined rearward position whereby to actuate the second valve mechanism to prevent the flow of air to said first valve mechanism simultaneously with disengagement of the drive to the carriage.

7. The structure as defined in claim 6 and a stop engaging member mounted on said second mentioned piston rod for axial movement therewith,

a revolvable stop member mounted on said second mentioned cylinder exteriorly thereof and having a plurality of stop elements of varying axial lengths being selectively shiftable into obstructing relation with said stop member on the second mentioned piston rod,

a cam element carried by said second mentioned piston rod for movement therewith,

a plurality of cam follower surfaces on said revolvable stop element being engageable by said cam element during retraction of said second mentioned piston rod to shift said revolvable stop member whereby the length of the stroke of the second mentioned piston rod is varied during each successive stroke thereof.

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