

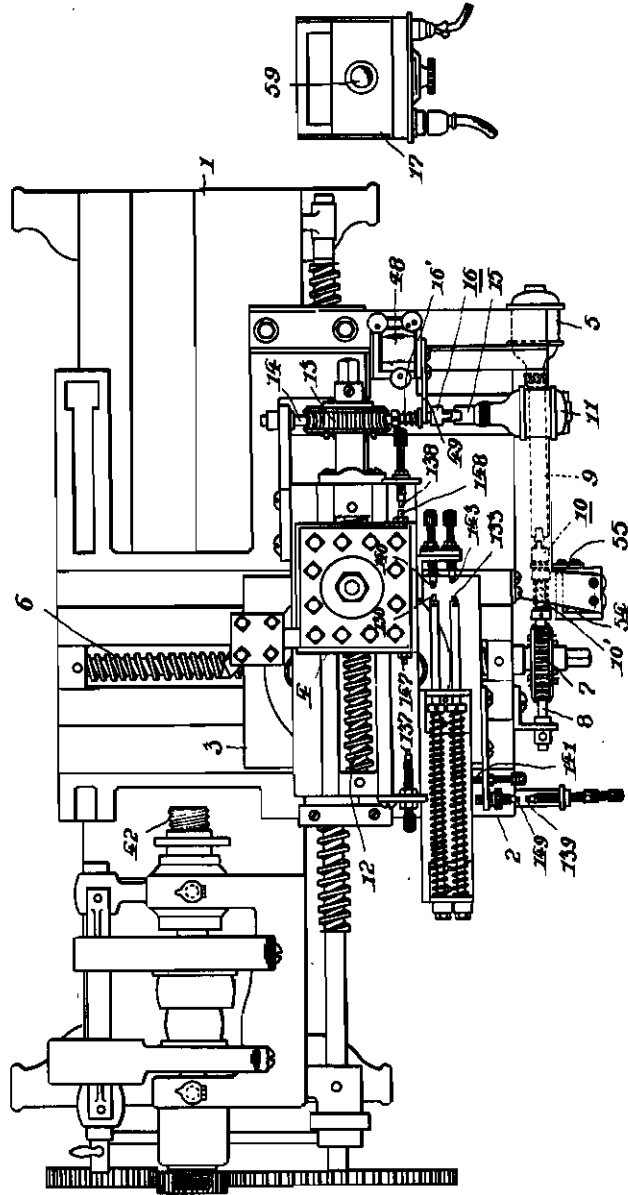
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MAY 4, 1943.  
BY A. P. C.

H. TUTIYA  
ARRANGEMENTS FOR ELECTRICALLY CONTROLLING  
OPERATION OF MACHINE TOOLS  
Filed Dec. 10, 1940

Serial No.  
369,503

3 Sheets—Sheet 1

Fig. 1.



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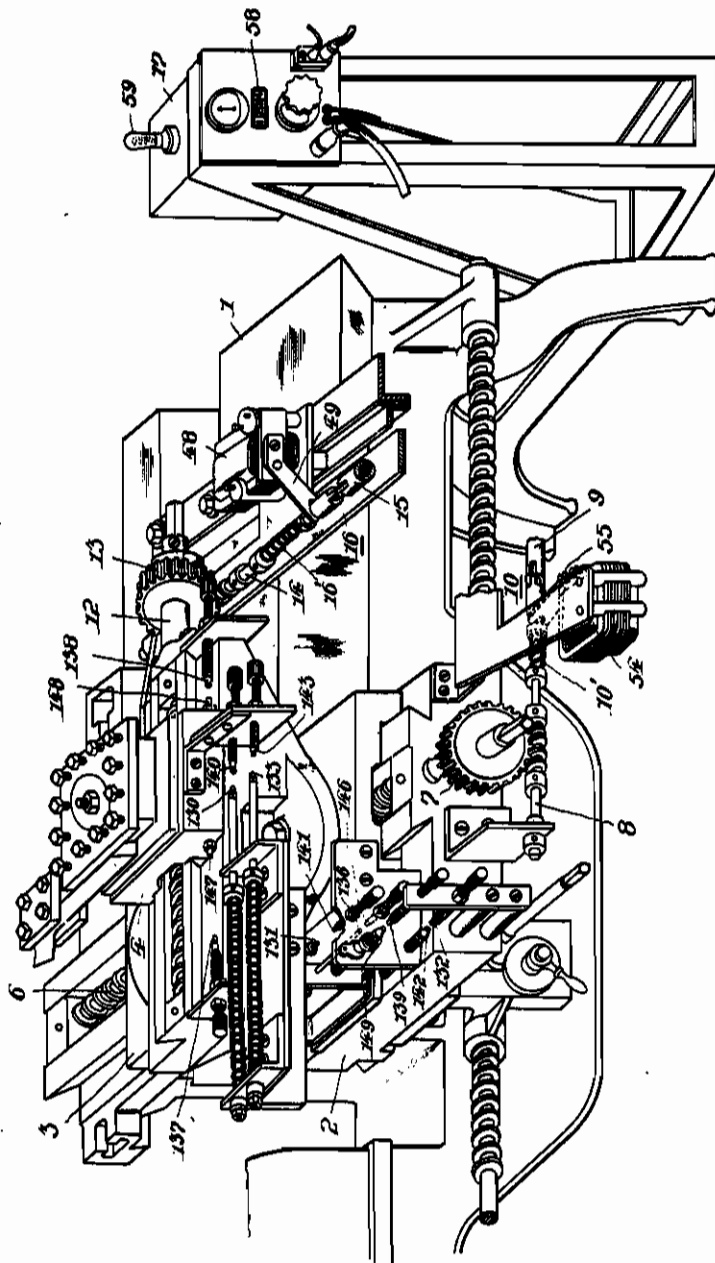
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Fig. 2.



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3 Sheets—Sheet 3

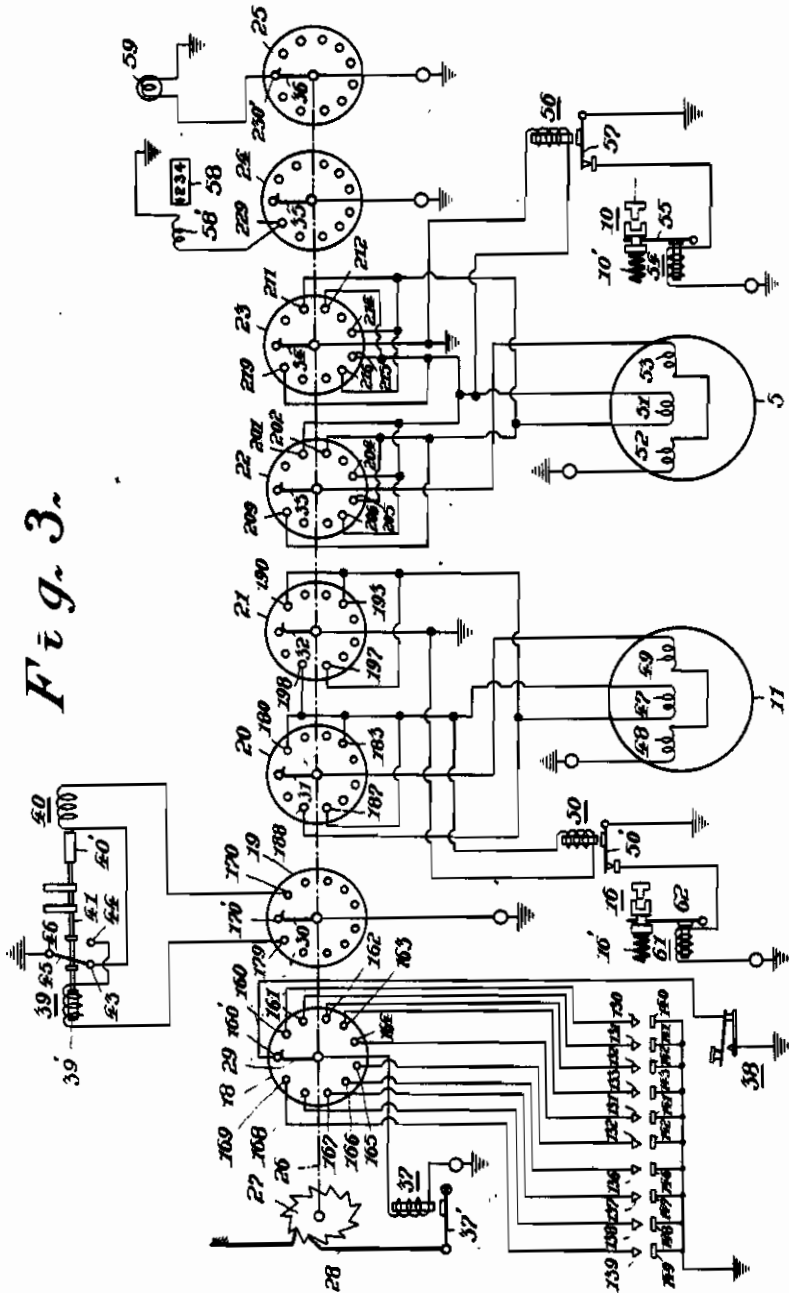


Fig. 3.

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# ALIEN PROPERTY CUSTODIAN

## ARRANGEMENTS FOR ELECTRICALLY CONTROLLING OPERATION OF MACHINE TOOLS

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Application filed December 10, 1940

This invention relates to an arrangement for electrically controlling operation of machine tools and has for its object to automatically control the operation of machine tool so as to work up a work or material to a predetermined measure and shape.

The accompanying drawings illustrate the invention, as applied to an engine lathe when turning a work or material by way of example, in which:

Fig. 1 shows a plan view;

Fig. 2 shows a perspective view of Fig. 1 with the lathe partly broken away; and

Fig. 3 shows a diagrammatic view of switching means with associated parts.

Referring to Figs. 1 and 2, the bed of the lathe is indicated at 1, the carriage at 2, the cross slide at 3 and the tool post at 4. The cross slide 3 is arranged to be moved with the tool post 4 by an electric motor 5 which is drivable in either direction and supported on the carriage 2 or associated part by any suitable means, such as brackets, through the cross feed shaft 6, a worm wheel 7 secured on one end of the cross feed shaft 6 and a worm shaft 8 adapted to engage with the worm wheel 7 and to be connected and disconnected with the shaft 9 of the motor 5 through means of a clutch device 10. The tool post 4 is arranged to be transversely moved by an electric motor 11 which is drivable in either direction and supported on the cross slide 3 or associated part by any suitable means, such as brackets, through the feed shaft 12, a worm wheel 13 secured on one end of the feed shaft 12 and a worm shaft 14 adapted to engage with the worm wheel 13 and to be connected and disconnected with the shaft 15 of the motor 11 through means of a clutch device 16.

A number of contact maker sets, each consisting of a stationary contact element and a movable contact element, is provided for controlling the circuits of the motors 5 and 11 to control the movement of the cross slide 3 and the tool post 4, as will be described later, and the stationary contact elements and the movable contact elements of the contact maker sets are indicated at 130 and 140, 133 and 143, 137 and 147, 138 and 148, 131 and 141, 132 and 142, 136 and 146 and 139 and 149 respectively. The stationary contact elements 130, 133, 137 and 138 are mounted on the cross slide 3 or associated part, insulated therefrom through suitable means, such as suitable brackets, while the co-operative movable contact elements 140, 143, 147 and 148 are conductivity mounted on the tool post 4, or associated part

through suitable means, such as suitable brackets, as shown. The stationary contact elements 131, 132, 136 and 139 are mounted on the carriage 2 or associated part insulated therefrom, through suitable means, such as suitable brackets, while the co-operative movable contact elements 141, 142, 146 and 149 are conductivity mounted on the cross slide 3 or associated part through suitable means, such as suitable brackets. The stationary contact members 130 and 133 are shown as mounted yieldingly through means of springs as seen in the drawings. One contact element of each of the other contact maker sets may be similarly mounted, if desired. The contact elements 137, 140, 143, 138, 141, 146, 139 and 132 are adjustably mounted and connected to the positive side of a current source (not shown) by conductors through switching means enclosed in a casing 17 set near by the lathe, while the body of the lathe is connected direct to the negative side of the current source by a conductor for the purpose as will be described later.

It must be noted that the contact maker sets must be arranged and adjusted in accordance with the measure and shape to which a work or material is to be turned, as will be seen later.

The switching means are diagrammatically shown in Fig. 3 with associated circuits and appliances. There are provided 8 switching discs 18, 19, 20, 21, 22, 23, 24 and 25 of an insulating material, each with 11 contact pieces, some of which are given reference numerals 160', 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 179, 170, 180, 183, 187, 188, 190, 193, 197, 198, 202, 204, 206, 209, 211, 212, 214, 215, 216, 219, 229 and 230' in the drawings.

A shaft 26 rotatably extends through the center of the switching discs, and carries a ratchet wheel 27 with the same number of teeth as the number of the contact pieces, that is, 11 teeth in this case, co-operating with a pawl 28, securely mounted on one end, and contactors 29, 30, 31, 32, 33, 34, 35 and 36 securely mounted thereon in position opposite the front face of the switching discs 18, 19, 20, 21, 22, 23, 24 and 25 respectively to co-operate with the contact pieces on each disc.

The pawl 28 is arranged to be driven by means of an electromagnet device 37, coil of which is connected to the positive side of the current source at the one end, the other end being connected to the contactor 29 of the switching disc 18 by a conductor.

With the switching disc 18, the contact piece 160' is arranged so as may be earthed to the

body of the lathe or connected to the negative side of the current source by a conductor through means of a key 38, the body of the lathe being connected to the negative side of the source by a conductor as hereinbefore stated. The contact pieces 160 to 169 are arranged so as may be earthed to the body of the lathe or connected to the negative side of the current source by conductors through means of the contact maker sets 130 and 140, 131 and 141, 132 and 142, 133 and 143, 136 and 146, 137 and 147, 138 and 148, and 139 and 149 respectively.

With the switching disc 18, the contactor 38 is connected to the positive side of the source by a conductor. The contact pieces 179 and 170 are respectively connected by a conductor to one end of the coils of electromagnetic devices 39 and 40 for operating respective core 39' and 40' secured to either end of a belt shifter 41 for controlling the operation of the main spindle 42 of the lathe (Fig. 1). The other ends of the coils are arranged so as may alternately be earthed to the body of the lathe or connected to the negative side of the source by conductors through means of contacts 43 and 44 and a contactor 45 co-operating the contacts, one end of the contactor being pivotally connected at 45 so as may bring the other end into engagement with the contact 43 or 44 when the shifter is operated. The contactor 30 is connected to the positive side of the source by a conductor, the negative side being connected to the body of the lathe by a conductor.

With the switching discs 20 and 21, the connections of the contact pieces 180, 183, 187, 188, 190, 193, 197 and 198 are such that shown in Fig. 3, in which 11 represents the motor with an armature coil 47 and field coils 48 and 49 for moving the tool post 4 as stated hereinbefore, 16 the clutch device for connecting and disconnecting the worm shaft 14 with the shaft 15 of the motor 11, 61 an electromagnetic device for actuating an armature 62, whereby the clutch device may be actuated, 50 an electromagnet device for actuating an armature 50' to disconnect the circuit of the electromagnet device 61, and the contactor 32 and the armature 50' are earthed to the body of the lathe or connected to the negative side of the source by conductors, one end of the field coil 48 and the coil of the electromagnet device 61 is connected to the positive side of the source, and the contactor 31 is connected to one end of the field coil 49.

With the switching discs 22 and 23, the connections of the contact pieces 201, 202, 204, 200, 209, 211, 212, 214, 215, 216 and 219 are such that shown in Fig. 3, in which 5 represents the motor having an armature coil 51 and field coils 52 and 53 for moving the cross slide 3 as stated hereinbefore, 10 the clutch device for connecting and disconnecting the worm shaft 8 with the shaft 9 of the motor 5, 54 an electromagnet device for actuating an armature 55, whereby the clutch device may be actuated, 56 an electromagnet device for actuating an armature 57 to disconnect the circuit of the electromagnet device 54, and the contactor 34 and the armature 67 are earthed to the body of the lathe or connected to the negative side of the source, one end of the field coil 52 and the core of the electromagnet device 54 is connected to the positive side of the source, and the contactor 33 is connected to one end of the field coil 53.

With the switching disc 24, the contactor 35 is connected to the positive side of the source by

a conductor, and the contact piece 229 is connected to the actuating coil 58' of an operameter 58, the other end being earthed to the body of the lathe or connected to the negative side of the source by a conductor.

With the switching disc 25, the contactor 36 is connected to the positive side of the source by a conductor, and the contact piece 230' is earthed to the body of the lathe or connected to the negative side of the source by a conductor through a pilot lamp 59 inserted therein.

In Fig. 3, parts are shown as being in inoperative position, and in operation, a work or material, such a cylindrical body to be turned is attached to the main spindle 42 of the lathe, and then the starting key 38 is pushed a short time, whereby the circuit for energizing the magnet 37 extends from the positive side of the source, the coil of the magnet 37, the contactor 29, contact piece 160', the key 38 to ground on the body of the lathe or negative side of the source. The magnet 37 operates the armature 37', whereby the pawl 28 is actuated to step the ratchet wheel 27 secured on the shaft 26 one tooth. The contactors 28 to 36 are thereupon moved from the first contact pieces on which the contactors are standing in Fig. 3 to corresponding second contact pieces, such as 160, 170, 180, 190, and the other idle contact pieces in clockwise direction.

The circuit for energizing the magnet 40 extends thereupon from the positive side of the source, the contactor 30 on the disc 19, contact piece 179, the coil of the magnet 40, contact 43, contactor 45 to ground on the body of the lathe or the negative side of the source. The magnet 40 operates the core 40' to move the belt shifter 41 to the right in Fig. 3, whereby the main spindle 42 of the lathe is set in motion, and at the same time the contactor 45 is swung from the contact 43 into engagement with the contact 44 to deenergize the magnet 40 ready for the case of stopping the motion of the main spindle of the lathe.

At the same time, the circuit for energizing the field coils 48, 40 and the armature coil 47 of the motor 11 in series extends from the positive side of the source, the coils 48 and 49, the contactor 31 and contact piece 180 on the disc 20, the armature coil 47, contact piece 190 and contactor 32 on the disc 21 to ground on the body of the lathe or the negative side of the source, whereby the motor 11 is driven in normal direction. At the same time, the circuit for energizing the magnet 50 extends from the contact piece 190 on the disc 20, the coil of the magnet 50 to ground on the body of the lathe or the negative side of the source. Upon energization of the magnet 50, at the armature 50' the circuit for energizing the magnet 91 extending from the positive side of the source, the coil of the magnet 61, the armature 50' to ground on the body of the lathe or the negative side of the source is interrupted to release the armature 62. Thereupon, the clutch device 18 is coupled by means of a compression spring 16' to connect the worm shaft 14 to the motor shaft 15. The tool post 4 is thereupon transversely fed by the motor 11 through means of the worm shaft 14, worm wheel 13, and feed shaft 13. When the tool post 4 is moved to the cutting position of the one end of the work or material to be turned, the contact element 140 engages with associated contact element 130 of the contact maker set, and the energizing circuit of the magnet 37 extends from the positive side

of the source, the coil of the magnet 37, contactor 20 and contact piece 160, contact maker set 130, 140 to ground on the body of the lathe or the negative side of the source. Magnet 37 operates to step the ratchet wheel 27 one tooth and to rotate the shaft 25 to bring the contactors 29 to 36 into engagement with corresponding the third contact pieces, that is, the contactors 29, 33 and 34 into engagement with corresponding contact pieces 101, 201 and 211 and the other contactors into engagement with corresponding idle contact pieces. The circuit of the motor 11 is thereupon interrupted, and the motor stops, and at the same time the magnet 50 deenergizes to close the circuit for energizing the magnet 61 at the armature 48. The magnet 61 operates thereupon to uncouple the clutch device 10 against the spring 10' by means of the armature 49. The traverse feed of the tool post 4 thereupon discontinues. At the same time, the circuit for energizing the field coils 52, 53 and the armature coil 51 in series extends from the positive side of the source, field coils 52 and 53, contactor 33 and contact piece 281 on disc 22, armature coil 51, contact piece 211 and contactor 34 on disc 23 to ground on the body of the lathe or the negative side of the source, and the motor 5 thereupon is driven in normal direction. At the same time, the circuit for energizing magnet 56 extends from contact piece 281 on disc 22, the coil of magnet 56 to ground on the body of the lathe or the negative side of the source. Upon energization of magnet 56, at armature 57 the circuit for energizing magnet 54 extending from the positive side of the source, the coil of magnet 54, armature 57 to ground on the body of the lathe or the negative side of the source is interrupted to release armature 55. The clutch device 10 thereupon is coupled by means of compression spring 10' to connect the worm shaft 14 to the motor shaft 15. The cross slide 3 is thereupon cross fed with the tool post 4 by the motor 5 through means of the worm shaft 6, the worm wheel 7 and feed shaft 8, whereby the end of the work or material is cut. At the end of the cutting, contact element 141 will engage with associated contact element 131, and the circuit for energizing magnet 37 extends from the positive side of the source, the coil of magnet 37, contactor 29 and contact piece 161 on disc 29, contact maker set 131 and 141 to ground on the body of the lathe or the negative side of the source. Magnet 37 operates and the ratchet wheel 27 is stepped one tooth to rotate the shaft 26 to bring contactors 29—36 into engagement with corresponding fourth contact pieces, that is, contactors 29, 33 and 34 into engagement with corresponding contact pieces 162, 202 and 212 and the other contactors into engagement with corresponding idle contact pieces. The circuit of the motor 5 extends thereupon from the positive side of the source, field coils 52 and 53, contactor 33 and contact piece 202 on disc 22, armature coil 51, contact piece 212 and contactor 34 on disc 23 to ground on the body of the lathe or the negative side of the source, and the motor 5 thereupon is driven in reverse direction due to reversal of the current flowing through armature coil 51 of the motor 5. At the same time, the circuit for energizing magnet 56 extends from contact piece 202 on disc 22, armature coil 51, the coil of magnet 56 to the ground on the body of the lathe or the negative side of the source. Upon energization, magnet 56 at armature 57 interrupts the circuit for energizing magnet 54 to release armature 55.

The clutch device 10 thereupon coupled by means of compression spring 10' to connect the worm shaft 14 to the motor shaft 15.

The cross slide 3 is thereupon cross fed back with the tool post 4, and when contact element 142 engages with associated contact element 132 the circuit for energizing magnet 37 extends from the positive side of the source, the coil of magnet 37, contactor 29 and contact piece 162 on disc 29, contact maker set 132 and 142 to ground on the body of the lathe or the negative side of the source. Magnet 37 operates and the ratchet wheel 27 is stepped one tooth to rotate the shaft 26 to bring contactors 29—36 into engagement with corresponding fifth contact pieces, that is, contactors 29, 31 and 32 into engagement with corresponding contact pieces 163, 183 and 193 and the other contactors into engagement with corresponding idle contact pieces. The circuit of the motor 5 is thereupon interrupted and the clutch device 10 is uncoupled, so that the cross feed back of the cross slide 3 discontinues. At the same time, the circuit of the motor 11 for driving in normal direction extends as hereinbefore traced, excepting contact pieces 180 and 190 being replaced with contact piece 183 and 193 respectively, and at the same time the circuit for energizing the magnet 50 extends from contact piece 193 on disc 20, the coil of magnet 50 to ground on the body of the lathe or the negative side of the source.

The motor 11 is thereupon driven in normal direction and the clutch device 10 is coupled, so that the tool post 4 is transversely fed.

When the tool post 4 is transversely fed to a predetermined position of the work or material to be worked, contact element 143 will engage with associated contact element 133. Similarly to the above stated manner, the circuit of magnet 37 is closed, and the magnet operates to step the ratchet wheel 27 one tooth, whereby the shaft 26 is rotated to bring contactors 29 to 36 into engagement with corresponding sixth contact pieces, that is, contactors 29, 33 and 34 into engagement with contact pieces 164, 204 and 214 respectively and the other contactors into engagement with corresponding idle contact pieces.

Obviously, the circuit of the motor 11 is thereupon interrupted, the clutch device 10 uncoupled, and the traverse feed of the tool post 4 discontinued, while the circuit of the motor 5 is closed to drive the motor in normal direction, and clutch 10 coupled, whereby the cross slide 3 and hence the tool post 4 are cross fed to cut the end of the work or material to be worked.

At the end of cutting of the work or material to predetermined size, contact element 141 will engage with associated contact element 131, and obviously the circuit of magnet 37 thereupon is closed, and the magnet operates to step the ratchet wheel 27 one tooth, whereby the shaft 26 is rotated to bring contactors 29 to 36 into engagement with corresponding seventh contact pieces, that is, contactors 29, 33 and 34 into engagement with contact pieces 165, 205 and 215 respectively and the other contactors into engagement with corresponding idle contact pieces.

Obviously the circuit of the motor 5 is closed to rotate the motor in reverse direction, and the cross slide 3 is thereupon cross fed back with the tool post 4 until contact element 142 engages with associated contact element 132. Obviously the circuit of magnet 37 is thereupon closed to step the ratchet wheel 27 one tooth, whereby the shaft 26 is rotated to bring contactors 29 to 36

into engagement with corresponding eighth contact pieces, that is, contactors 29, 33 and 34 into engagement with contact pieces 169, 206 and 216 respectively and the other contactors into engagement with corresponding idle contact pieces.

Obviously the circuit of the motor 5 is closed to rotate the motor in normal direction, and the cross slide 3 is cross fed with the tool post 4 until the tool post is in predetermined position opposite the work or material to be worked, and then contact element 146 engages with associated contact element 136, whereby the circuit of magnet 37 is closed and the ratchet wheel 27 is stepped one tooth to rotate the shaft 26 to being contactors 29 to 36 into engagement with corresponding ninth contact pieces, that is, contactors 29, 31 and 32 into engagement with contact pieces 167, 197 and 197 respectively and the other contactors into engagement with corresponding idle contact pieces.

Obviously, the circuit of the motor 5 is interrupted and the clutch device 10 is uncoupled to discontinue the cross feed of the cross slide 3 and hence the tool post 4, while the circuit of the motor 11 is closed to rotate the motor in normal direction and the clutch 16 is coupled to transversely feed the tool post 4, until the work or material to be worked is turned to predetermined diameter. Then contact element 147 engages with associated contact element 137, and obviously the circuit of magnet 37 is closed to step the ratchet wheel 27 one tooth to rotate the shaft 26 to being contactors 29 to 36 into engagement with corresponding tenth contact pieces, that is, contactors 29, 31 and 32 into engagement with contact pieces 169, 169 and 198 respectively and the other contactors into engagement with contact pieces 168, 188 and 199. The circuit of the motor 11 is obviously closed to rotate the motor in reverse direction, whereby the tool post 4 is transversely fed back until contact element 148 engages with associated contact element 138. Then the circuit of magnet 37 is obviously closed to step the ratchet wheel 27 one tooth to rotate the shaft 26 to bring contactors 29 to 36 into engagement with corresponding eleventh contact pieces, that is, contactors 29, 30, 33, 34 and 35 into engagement with contact pieces 169, 179, 209, 219 and 229 respectively and the other contactors into engagement with corresponding idle contact pieces.

Obviously, the circuit of the motor 11 is thereupon interrupted and the clutch device 16 is uncoupled to discontinue the traverse feed back of the tool post 4, while the circuit of the motor 5 is closed to rotate the motor in reverse direction, and the clutch device 18 is coupled, whereby the cross slide 3 and hence the tool post 4 are cross fed back. Furthermore, magnet 39 ener-

glizes through the circuit extending from the positive side of the source, contactor 30 and contact piece 179 on the disc 19, the coil of magnet 39, contact 44 and contactor 45 operated as hereinbefore stated to ground on the body of the lathe or the negative side of the source. Magnet 39 operates core 39' to move the belt shifter 41 to the left, that is, the original position in Fig. 3, whereby the motion of the main spindle 42 of the lathe is discontinued. Magnet 56' is also energized through the circuit extending from the positive side of the source, contactor 35 and contact piece 229 on the disc 24, the coil of the magnet to ground on the body of the lathe or the negative side of the source, whereby one working cycle number is added in the operameter 59.

Thus, the cross slide 3 and hence the tool post 4 are cross fed back to return to the original position as just above stated, and when contact element 149 engages with associated contact element 139, the circuit of magnet 37 is obviously closed to step the ratchet wheel 27 one tooth, whereby the shaft 26 is rotated to bring contactors 29 to 36 into engagement with corresponding first or original contact pieces, that is, contactors 29, 30 and 36 into engagement with contact pieces 160', 170' and 230' respectively and the other contactors into engagement with corresponding idle contact pieces. The circuit of the motor 5 is obviously interrupted, and the clutch device 10 is uncoupled to discontinue the cross feed back of the tool post 4, whereby the cross slide 3 and the tool post 4 are returned to the original position. At the same time, the pilot lamp 59 is lighted through the circuit extending from the positive side of the source, contactor 36 and contact piece 230' on disc 25, the lamp to ground on the body of the lathe or the negative side of the source. A cycle of turning the work or material to be worked is completed, and the parts restore in positions as shown in Fig. 3.

It will be understood that even if other contact maker sets than a contact maker set defined to be set in operation at the end of each feed or feed back of the cross slide and the tool post makes contact, when or before the latter contact maker set makes contact, no objection is raised due to the idle contact pieces of the switching discs, particularly one contact element being yieldingly mounted.

The invention is not intended to be limited to the exact embodiment herein selected for purposes of illustration, but should be regarded as covering modifications and variations thereof without departing from the scope of the invention.

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