April 16, 1946. J. J. JAEGER 2,398,500

CIRCUIT FOR TRACER CONTROLLED MACHINES

Filed Sept. 24, 1943 2 Sheets-Sheet 1

Fig. 1

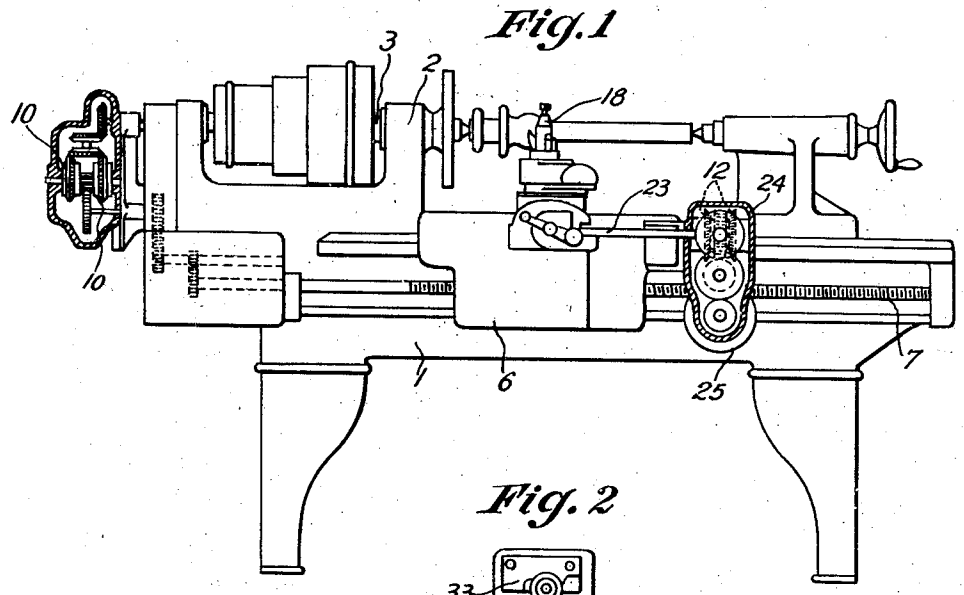


Fig. 2

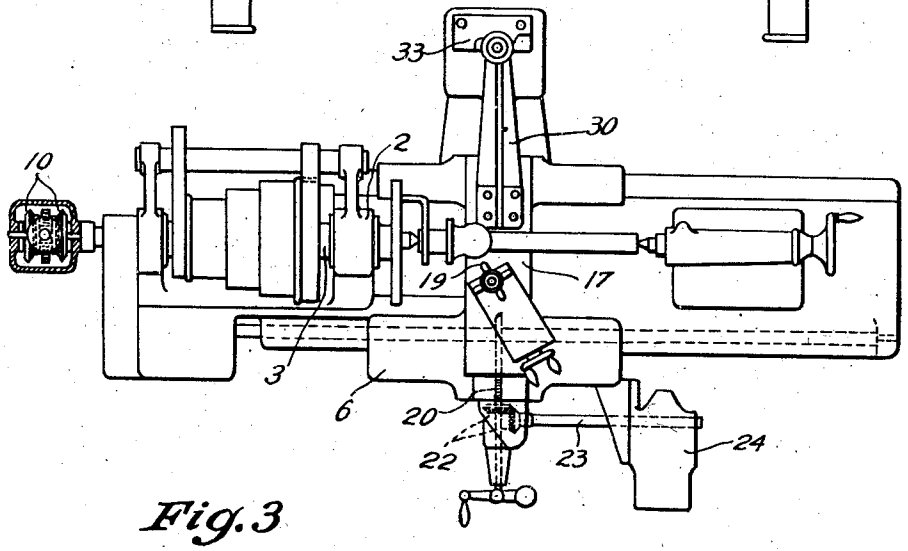
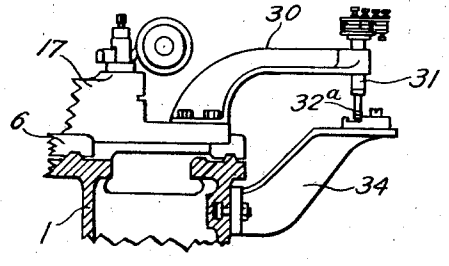


Fig. 3



INVENTOR
J. J. Jaeger
BY Joseph K. Schofield
ATTORNEY

April 16, 1946. J. J. JAEGER 2,398,500

CIRCUIT FOR TRACER CONTROLLED MACHINES

Filed Sept. 24, 1943 2 Sheets-Sheet 2

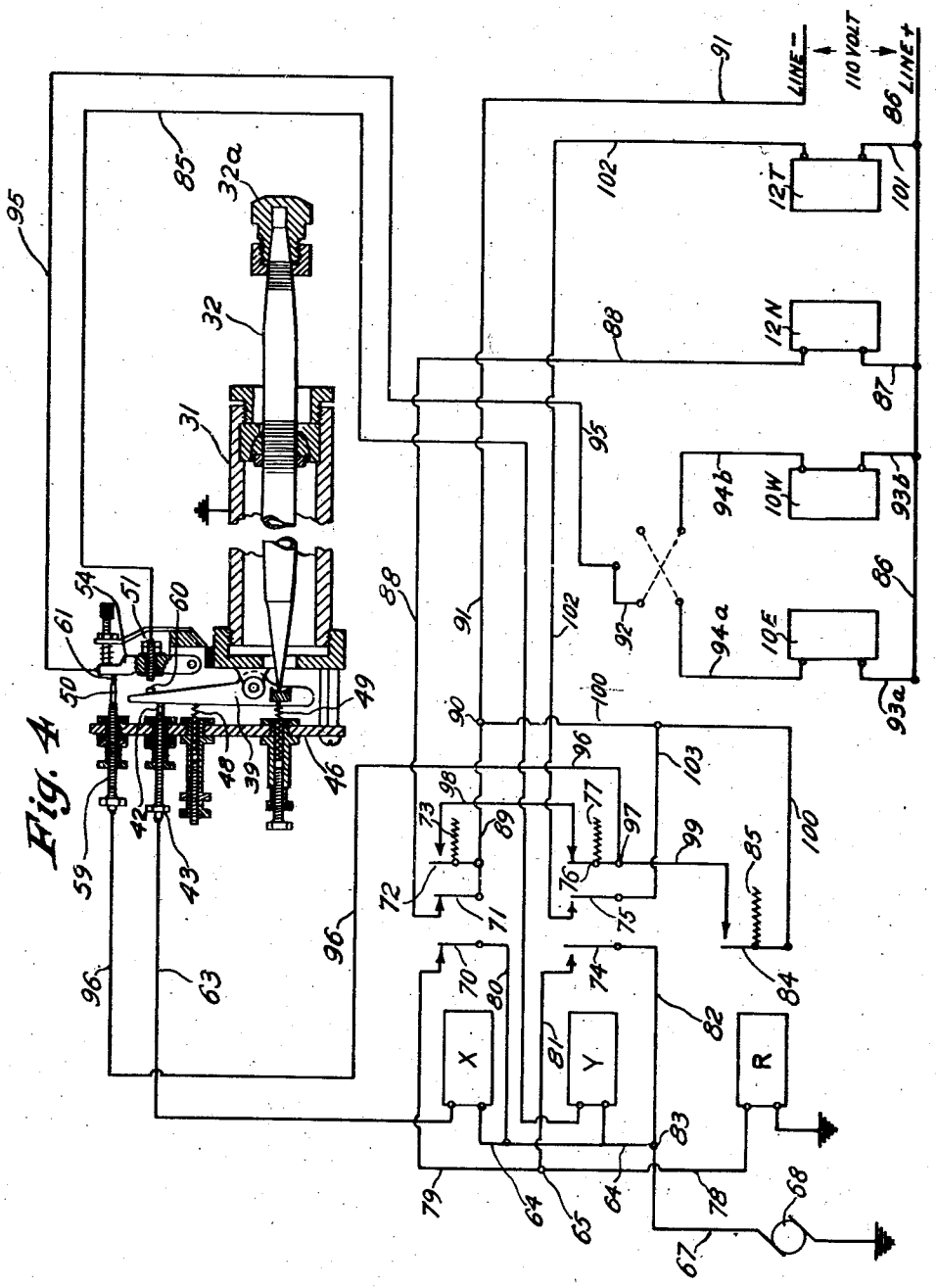


Fig. 4

INVENTOR
J. J. Jaeger
BY Joseph W. Schofield
ATTORNEY

Patented Apr. 16, 1946

2,398,500

UNITED STATES PATENT OFFICE

2,398,500

CIRCUIT FOR TRACER CONTROLLED MACHINES

Jacob J. Jaeger, West Hartford, Conn., assignor to Niles-Bement-Pond Company, Hartford, Conn., a corporation of Connecticut

Application September 24, 1943, Serial No. 503,701

6 Claims. (Cl. 172—239)

This invention relates to tracer controlled electrically operated machine tools and its object is to provide improved clutch energizing circuits for the machine tool having means to prevent de-energizing of some of the machine member moving clutches when the tracer lever is subject to vibrations sufficient to open and close its contacts.

A further object of the invention is to provide a supplementary relay within the control circuits for the machine member moving clutches, this relay serving to hold the magnet circuits for the longitudinal motion of the machine closed when the tracer lever vibrates between its open and closed positions for the "in" and "out" motions of the tool so that the longitudinal motion will not stop until the "in" or "out" tracer contact has fully opened.

Another object of importance is that a supplementary or additional relay is provided so that it will operate out of synchronism with either of a pair of relays controlling the circuits for the machine member moving clutches.

With the above and other objects in view the invention consists in the features of construction and operation set forth in the following specification and illustrated in the accompanying drawings.

In the drawings annexed hereto and forming a part of this specification, I have shown the invention embodied in an engine lathe, but it will be understood that the invention can be otherwise embodied and that the drawings are not to be construed as defining or limiting the scope of the invention, the claims appended to this specification being relied upon for that purpose.

In the drawings:

Figure 1 is a front elevation of a lathe, the carriage and cross slide of which may be controlled by a tracer following a template or former mounted in fixed position on the base of the lathe.

Fig. 2 is a plan view of the machine shown in Fig. 1.

Fig. 3 is a fragmentary cross sectional view of the machine shown in Figs. 1 and 2 showing the tracer, its mounting and the template by means of which the movements of the tool are controlled.

Fig. 4 is a diagrammatic view of the circuits controlled by the tracer lever for effecting movements of the carriage and cross slide.

In its preferred form, the invention may include the following principal parts: first, a machine tool such as an engine lathe shown in the drawings having tool slides mounted one above the other for movements at right angles to each other; second, magnetic clutches for actuating each of the slides in either direction; third, a pattern or template supported in fixed position on the machine; fourth, a tracer movable with said slides over a surface or edge of said pattern or template; fifth, relays operated by contacts on said tracer controlling circuits for said clutches; sixth, a delay or supplemental relay energized by operation of either of the first mentioned relays so that the supplemental relay operates momentarily after either of said first relays operates; and seventh, a circuit for one pair of machine member moving clutches being controlled by said supplemental relay.

In the operation of tracer controlled machines in which a tool or cutter is actuated relative to a work piece to reproduce the shape of a template or model traversed by the tracer, extremely rapid vibrations may be set up by the tool or cutter sufficiently extensive to adversely affect operation of the machine to accurately reproduce the desired form. The tracer may be so rapidly vibrated that its tracer contacts controlling engagement and disengagement of its machine member moving clutches will be prevented from effectively closing the clutch circuits. The machine will therefore fail to properly function.

The invention has been illustrated in connection with a machine of the type shown and described in the patent to Shaw 1,711,290, granted April 30, 1929, and the present invention will be described in connection with controlling circuits, which are a development of those shown in that patent, for controlling movements of a tool carriage and cross slide. It will be understood, however, that the invention may be embodied in other types of machine tools in which movements of the tool relative to the work are controlled by a tracer spindle traversing a pattern or template adapted to open and close opposed contacts and in which the means for traversing the tool over the work piece include rotating clutch magnets coupled, when energized as indicated in the above-referred to patent, to operate lead screws or other actuating means for the movable members of the machine.

Referring more in particular to the figures of the drawings, the lathe comprises the usual bed 1 having a headstock 2 at one end within which is mounted a work rotating spindle 3. A carriage 6 is provided on the bed which may be moved to the left or right by means of a suitable lead screw 7. Lead screw 7 is connected through suitable driving connections to magnetic clutches 10 so

that when one electromagnet of one clutch is energized the carriage 6 will be moved in one direction and when the electromagnet of the other clutch is energized the carriage will be moved in the opposite direction. It will thus be seen that by simply changing the energization from one to the other of the clutch magnets 10, movements of the carriage 6 may be reversed, or, by breaking the circuit to both of the clutch magnets movement of the carriage 6 will be stopped.

The carriage 6 is provided with a cross slide 17 carrying a tool holder 18 for a tool 19 and is adapted to be moved directly toward or from the work. To effect movements of this cross or tool carrying slide 17 there is provided a transverse lead screw 20. The cross feed screw 20 may be manually operated in the usual manner, and, in addition, is connected by means of bevel gears 22 to a shaft 23 adapted to be driven by either of a pair of magnetic clutches 12 provided in a suitable clutch housing 24 supported upon the tool carriage 6 so as to travel therewith. These clutches 12 are, as shown, driven by a motor 25 preferably mounted upon the carriage 6 for movement along the bed 1. The two clutches 12 in this housing 24 are similar to the clutches 10 for longitudinally moving the carriage 6 so that when one clutch 12 is energized the tool moves "in" and when the other clutch 12 is energized the tool moves "out." The work being turned may be held between centers in the usual manner and may be rotated at any desired speed.

The cross slide 17 is provided with a bracket or arm 30 the outer end of which supports an electric tracer 31, the tracer point 32ª of which is adapted to engage a pattern or template 33 corresponding in outline to the work being formed. The pattern or template 33 is mounted in fixed position and may be directly supported on a suitable bracket 34 secured to the lathe bed 1. The tracer 31 is caused to follow the pattern by the operation of the respective lead screws 7 and 20, the operation of which is controlled by the tracer through the pairs of magnetic clutches 10 and 12. The cross slide and the lathe tool 19 will be moved toward or from the axis of the work during longitudinal movement of the slide 6 to the left or right and will reproduce the form or outline of the template on the work piece. In this mechanism the electric tracer controls the "in" and "out" movement of the lathe tool by controlling the circuits for the magnetic clutches 12 through which the transverse screw 20 is operated, and controls the longitudinal traversing of the work by controlling the circuits for the magnetic clutches 10 by which the rotation of the lead screw 7 is controlled. The control is such that when one of the screws 7 or 20 is operated the other is held stationary. This control of the magnetic clutches through the electric tracer is described in detail in connection with the wiring diagram.

The magnetic clutches 10 for operating the longitudinal lead screw 7 for traversing the carriage 6 to the right and to the left are indicated respectively in the wiring diagram, Fig. 4, at 10E and 10W and the magnetic clutches 12 for operating the transverse screw 20 to move the slide "in" and "out" are indicated respectively at 12N and 12T. The tracer 31 is indicated diagrammatically and may be similar to that shown in the U. S. patent to J. C. Shaw 1,518,114, granted December 2, 1924. The tracer and tracer point form no part of the present invention and will be referred to only briefly. The tracer spindle 32 is adapted to actuate the contact carrying lever 39 pivotally mounted within the head of the tracer body 31 whenever its lowermost end touches the template. The lever 39 carries a contact 42 cooperating with an adjustable contact at the end of an insulated contact screw 43 in the bracket plate 46 supported on the tracer body 31. The tracer body 31 is grounded, as indicated, so that an electric circuit may be completed through the contacts 42—43 and lever 39. A tension spring 48 and a compression spring 49 cooperate to move the upper end of the lever 39 outwardly, as shown in Fig. 4, to normally hold the "in" contacts 42—43 closed. Normally, therefore, the tool 19 travels in or toward the work until the tracer lever 32 is tilted by contact with the template.

The pivotally mounted lever 39 also carries a contact 60 on the opposite side from contact 42 which is adapted to cooperate with an adjustable contact 51 on an adjusting screw suitably insulated and mounted on a lever 54 pivoted to the tracer body 31 but insulated completely therefrom. A compression spring and suitable adjusting screws are provided for yieldably pressing the lever 54 forwardly toward the upper end of the first mentioned lever 39, but the forward or normal position of this auxiliary lever 54 is limited by an adjusting screw 59, the end of which carries a contact 50 cooperating with a contact 61 on the upper end of the lever 54. The adjusting contact screw 59 is, as shown, insulated and is mounted in the bracket plate 46.

In the circuit including the contact points 42 and 43 is the solenoid of a triple pole relay X the three contact arms of which are indicated at 70, 71 and 72. When the solenoid of the relay is energized the contact arms 70 and 71 will be in their closed positions as shown while the third contact arm 72 will be in its open position also as shown. When the solenoid of the relay is deenergized the contact arms 70 and 71 and the contact arm 72 will be moved simultaneously to their open and closed positions respectively, as for instance by the spring 73. The circuits controlled by these contact arms will be described later.

In the circuit including the contact points 51 and 60 is the solenoid of a second triple pole relay Y, the contact arms of which are indicated at 74, 75 and 76. When the solenoid of the relay is energized the contact arms 74 and 75 will be in their closed positions while the third contact arm 76 will be in its open position. When the solenoid of the relay is deenergized the contact arms 74 and 75 and the contact arm 76 will be moved simultaneously to their open and closed positions respectively as shown, by the spring 77.

The circuit for the solenoid of relay X can be traced as follows: from the ground through the tracer body 31, lever 39, contacts 42 and 43, line 63, solenoid of relay X, line 64, junction point 83, line 67, and generator 68 to ground.

The circuit for the solenoid of relay Y can be traced as follows: from the ground, through the tracer body 31, lever 39, contacts 60 and 51, line 85, solenoid of relay Y, line 64, junction point 83, line 67 and generator 68 to ground.

The solenoid of a single pole supplementary relay R is also provided in circuit with the generator 68, this solenoid being energized when either of the contact arms 70 and 74 is in closed position. The circuit of this relay is as follows: from the ground, through the solenoid of said relay R, line 78, junction point 65, branch line comprising line 79, contact arm 70, line 80 and line 64 to junction

point 83 or the branch line comprising line 81, contact arm 74 and line 82 to the junction point 83 and thence through line 67 and generator 68 to ground. The relay R controls contact arm 84 which is under the influence of a spring 85 tending to move it to its closed position.

The relay X is adapted to control the energizing of the clutch magnet 12N and thereby the inward movement of the tool 19. The relay Y is adapted to control the energizing of the clutch magnet 12T and thereby the outward movement of the tool 19.

The operation is as follows: Presume that the lever 39 is in the position shown in Fig. 4 closing the contacts 42 and 43, then the solenoid of relay X will be energized and contact arms 70 and 71 will be in closed positions as shown while contact arm 72 will be in open position as shown. The contact arm 70 will close the circuit of the solenoid of relay R and thus contact arm 84 of said relay will lie in open position as shown. Contact 71 will close a circuit by which the clutch magnet 12N will be energized, said circuit being as follows: from the positive line 86, line 87, clutch magnet 12N, line 88, contact arm 71, line 89 and junction point 90 to the negative line 91. The tool 19 will consequently move inwardly towards the work.

When the tracer point 32^a strikes the pattern, contacts 42 and 43 will be opened resulting in the deenergization of the solenoid of relay X and the consequential opening of the contact arms 70 and 71 and the closing of the contact arm 73. The opening of contact arm 70 will deenergize the solenoid of relay R resulting in the closing of contact arm 84. The opening of the contact arm 71 will result in the breaking of the circuit through the magnet clutch 12N and the consequential stoppage of the inward movement of the tool 19. The closing of the contact arm 72 will result in the energizing of one or the other of the magnet clutches 10E, 10W depending upon the position of hand operated switch 92, and the consequential movement of the carriage 6 to the left or to the right. The circuit by which the magnet clutch 10E or 10W is energized is as follows: positive line 86, line 93^a or 93^b, magnet switch 10E or 10W, line 94^a or 94^b, switch 92, line 95, contacts 61 and 50, line 96, junction point 97, contact arm 76, line 98, contact arm 72, line 89, and junction point 90 to the negative line 91. The closing of contact arm 84 which takes place consequent upon the opening of contact arm 70, momentarily after the closing of the contact arm 72 provides a holding circuit for the clutch magnet 10L or 10R making said circuit independent of either of the contact arms 72 or 76. This holding circuit extends from junction point 97 through line 99, contact arm 84 and line 100 to the junction point 90 thus short circuiting contact arms 72 and 76. The carriage moves to the left or the right until the shape of the pattern or template causes the tracer spindle 32 to move a sufficient distance either to re-close the contacts 42—43 if the pressure on the tracer point 32^a is released or to close the contacts 50—61 if the pressure is increased. Presume that the contacts 50—61 are closed. The closing of these contacts will result in the energizing of the solenoid of the relay Y which controls the operation of the outward movement of the tool 19. Energization of the solenoid of the relay Y causes the closing of the contact arms 74 and 75 and the opening of the contact arm 76. The closing of the contact arm 75 results in the closing of a circuit which causes the energization of the magnet clutch 12T and the consequential outward movement of the tool 19. The circuit energizing the magnet clutch 12T is as follows: from positive line 86, line 101, magnet clutch 12T, line 102, contact arm 75, line 103, line 100, and junction point 90, to the negative line 91.

The opening of the contact arm 76 has no immediate effect. This contact arm is in the circuit including the contact arm 72 by which the magnet clutch 10E or 10W is energized but the energization of such magnet clutch is momentarily maintained owing to the holding circuit previously described which includes the contact arm 84 of the relay R which is in closed position. This contact arm 84 is, however, opened almost immediately owing to the energization of the solenoid of said relay R which takes place upon the closing of the contact arm 74 which is closed simultaneously with the contact arm 75. Upon the opening of the contact arm 84 the circuit for the magnet clutch 10E or 10W will be broken and the traversing movement of the carriage 6 will be arrested.

The outward movement of the tool will continue until the contacts 51, 60 are broken due to the pressure on the tracer point 32^a being decreased.

If the contacts 42, 43 are closed after being open then the magnet clutch 12N will be energized through the circuit previously described but there will be a momentary delay in the opening of the circuit through the longitudinal magnet clutch 10E or 10W due to the holding circuit controlled by the contact arm 84 as described with reference to the relay Y, since the opening of the contact arm 72 consequent upon the oscillation of the solenoid of the relay Y, does not break the aforesaid holding circuit. The breaking of the holding circuit has to await the opening of the contact arm 84 consequent upon the energizing of the solenoid of the relay R due to the closing of contact arm 71 by the relay Y.

From the above it will be seen that closing tracer contacts 42, 43 or 60, 51 causes the operation of the supplemental relay R, and, as the circuit for operating this supplemental relay includes contacts controlled by the relays X and Y, relay R is not energized until after the relay controlling the "in" or "out" movement of the tool 19 has been energized. Supplemental relay R when energized opens one normally closed contact which opens the circuit to the 10E or 10W clutch magnet to stop longitudinal movement of the carriage 6.

A moment after the relay X or Y is energized the relay R is energized and opens the circuit through the clutch magnet 10E or 10W, thus stopping the traversing movement of the carriage. As soon, however, as the relay X or Y releases, longitudinal movement of the carriage is immediately started by closure of contact 71 or 75.

If, during the closing operation of such contacts, the tracer contacts vibrate, due to action of the tool or cutter, the relay X or Y controlling the "in" or "out" movement of the tool 19 will operate and release very rapidly as the tracer contacts open and close. In this condition none of the clutches may be energized for a sufficient length of time to develop the torque necessary to move the slides. However, since the supplemental relay R is energized through the contacts on said relays X and Y it will not operate in exact synchronism with said relays. Consequently, the circuit to the 10E or 10W magnet will remain closed for a longer period of time

than would be otherwise obtained and sufficient time will be provided for this motion to continue operation until the "in" or "out" contact points of the tracer are definitely closed or opened.

It will be seen that a manual selector switch 92 enables either the E or W clutch to be used for the traversing or leading movement of the carriage 6 and tool 19 along the lathe bed 1 so as to move either toward or away from the headstock.

What I claim is:

1. A tracer control for machine tools comprising in combination, a tracer, contacts opened and closed thereby, relays operated under control of said tracer contacts, clutch energizing circuits controlled by said relays, and a supplementary relay in the circuit of said first relays, said supplementary relay providing additional control of one of the clutch energizing circuits controlled by said first relays.

2. A tracer control for machine tools comprising in combination, a tracer, contacts opened and closed thereby, relays operated under control of said tracer contacts, clutch energizing circuits controlled by said relays, and a supplementary relay in the circuit for and energized when either of said first relays is energized, said supplementary relay providing additional control of one of the clutch energizing circuits controlled by said first relays.

3. A tracer control for machine tools comprising in combination, a tracer, contacts opened and closed thereby, relays operated under control of said tracer contacts, clutch energizing circuits controlled by said relays, and a supplementary relay in the circuit for said first relays, said supplementary relay when energized opening one of said clutch energizing circuits.

4. A tracer control for machine tools comprising in combination, a tracer, contacts opened and closed thereby, relays operated under control of said tracer contacts, clutch energizing circuits controlled by said relays, and a supplementary relay in the circuit for and energized when either of said first relays is energized, said supplementary relay when energized opening one of said clutch energizing circuits.

5. A tracer control for machine tools comprising in combination, a tracer, contacts opened and closed thereby, relays operated under control of said tracer contacts, clutch energizing circuits controlled by said relays, and a supplementary relay in the circuit for said first relays, said supplementary relay operating out of synchronism with said first relays and controlling one of the circuits controlled by said first relays.

6. A tracer control for machine tools comprising in combination, a tracer, contacts opened and closed thereby, relays operated under control of said tracer contacts, clutch energizing circuits controlled by said relays, and a supplementary relay in the circuit for said first relays and energized when either of said first relays is energized, said supplementary relay operating out of synchronism with said first relays and controlling one of the circuits controlled by said first relays.

JACOB J. JAEGER.