

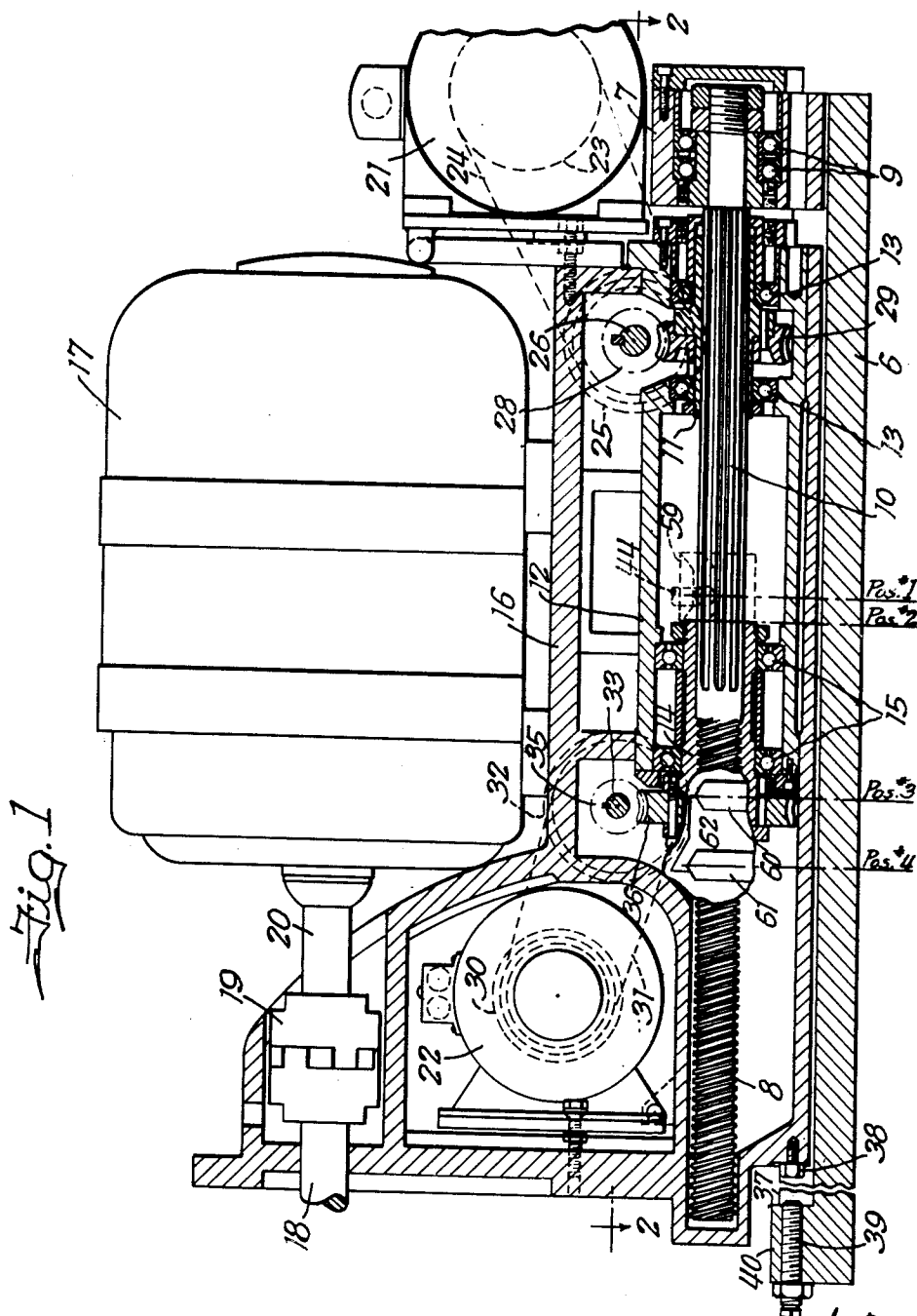
Aug. 22, 1950

A. F. REHNBERG ET AL
ELECTRICAL CONTROL MECHANISM

2,520,014

Filed April 24, 1946

3 Sheets-Sheet 1



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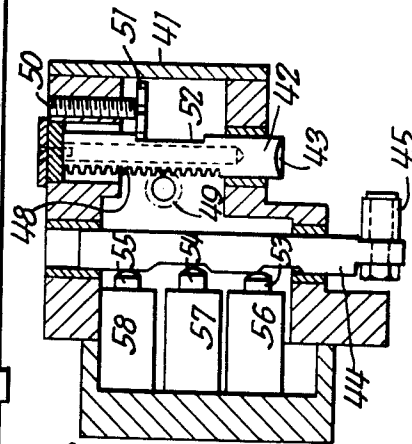
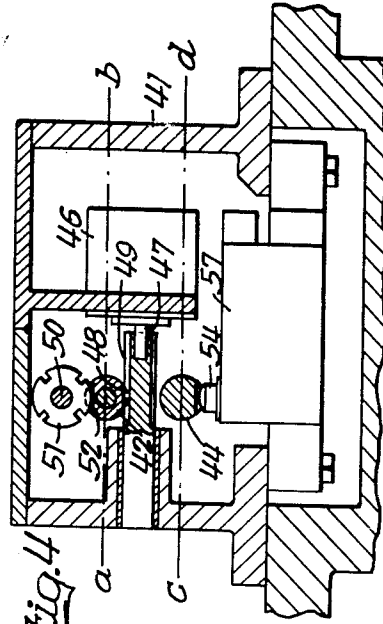
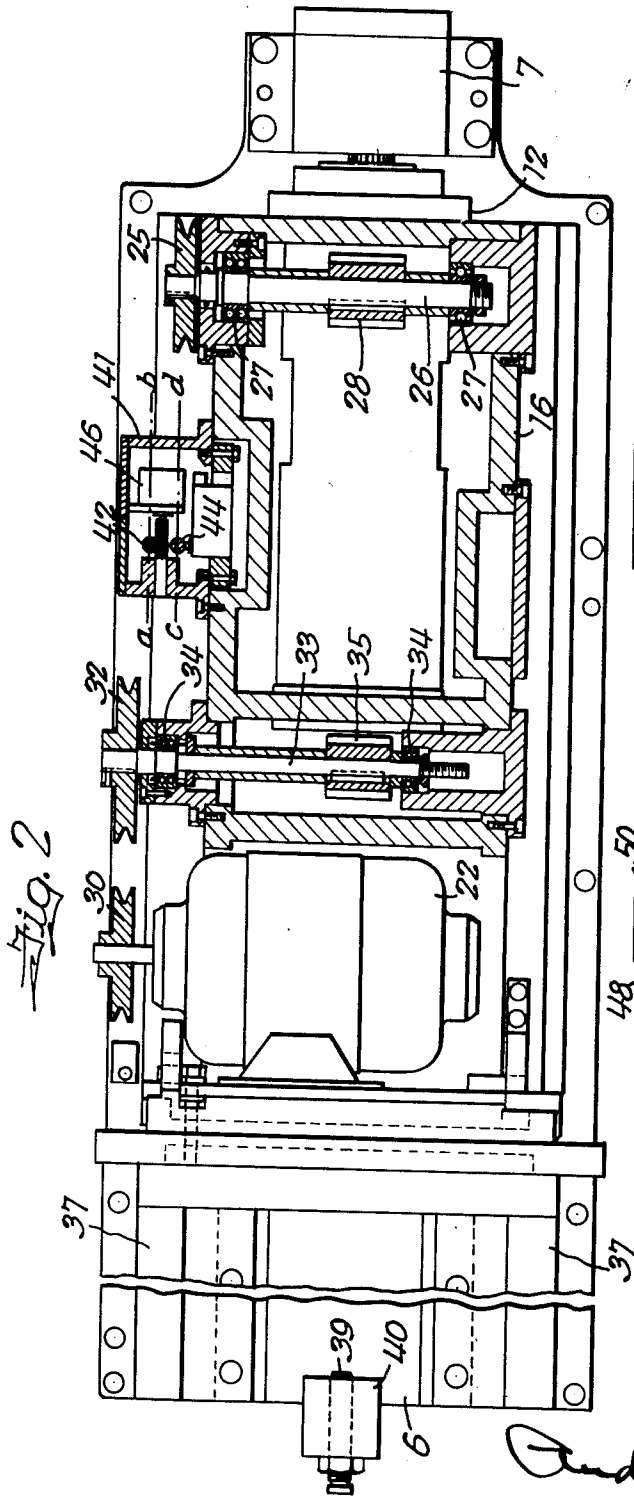
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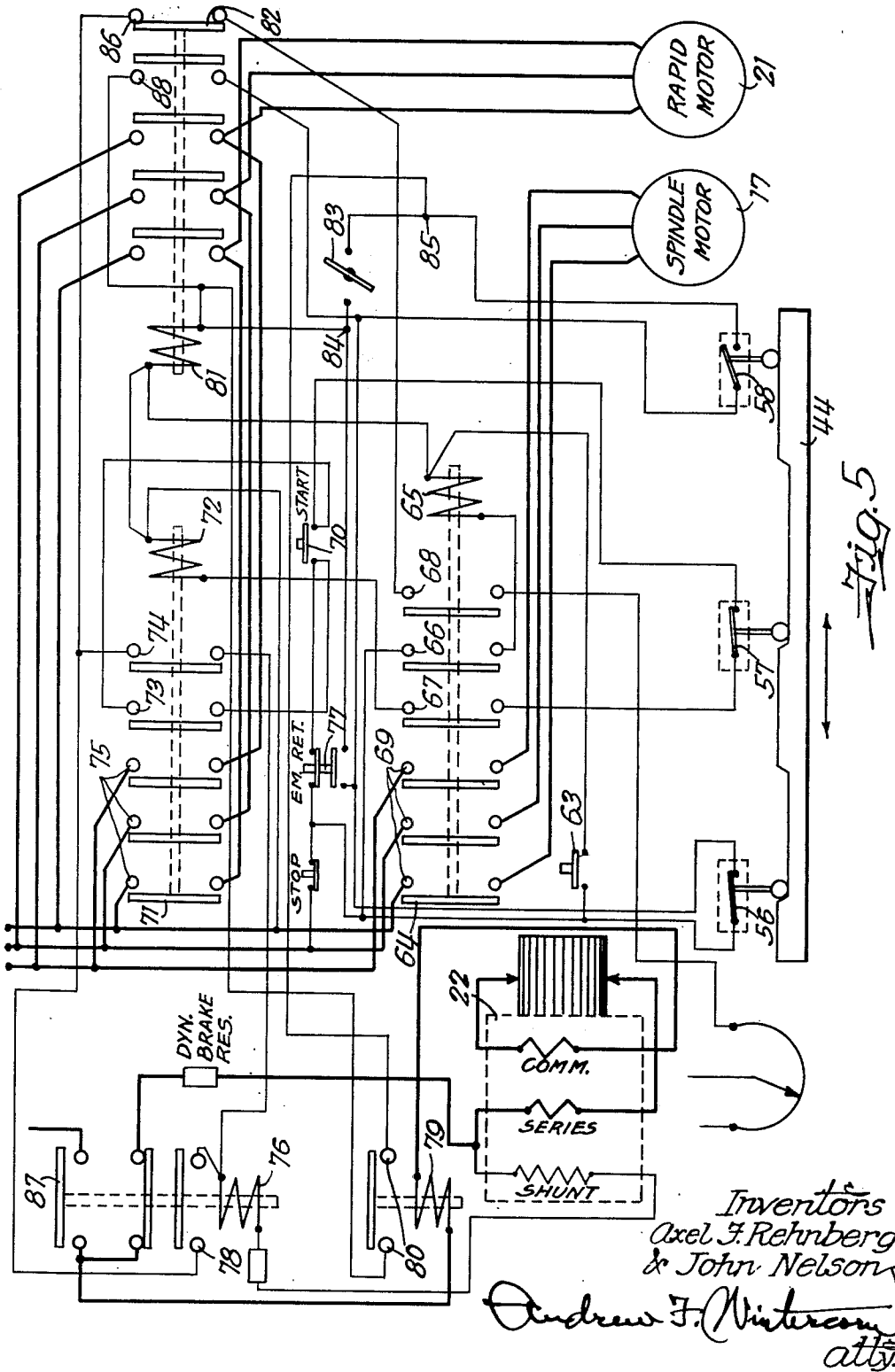
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UNITED STATES PATENT OFFICE

2,520,014

ELECTRICAL CONTROL MECHANISM

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Application April 24, 1946, Serial No. 664,468

14 Claims. (Cl. 192—116.5)

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This invention relates to an electrical control mechanism for machine tools.

Hydraulic control mechanisms used heretofore were operated on the principle of varying the amount of oil injected into the working cylinder behind the piston connected to the machine tool carriage to be moved. There have, however, been several serious criticisms of these hydraulic control mechanisms, and, as a result, machine tool builders have in recent years been looking for some other solution to the problem. It is, therefore, the principal object of our invention to provide an electrical control mechanism which is simple and economical in construction and thoroughly practical and widely adaptable in its application.

In the mechanism of our invention, a feed screw that is held against endwise movement relative to the bed of the machine has an elongated splined portion next to its fixed end on which a splined sleeve is slidable that is arranged to be driven by a reversible electric motor for rapid approach and return, a nut threaded on the screw and arranged to be driven by a series-wound electric motor operable by electrical control at any selected speed within a predetermined range being provided to obtain whatever feed is desired. Both motors, in accordance with our invention, are mounted on the carriage for greater compactness and to enable shortening the overall length of the machine for a given travel of the carriage, thereby also improving the appearance of the machine as a whole and lowering the cost.

Another important object of our invention is to provide a novel control box in which a cam is reciprocable to operate a plurality of switches to control the starting and stopping of the two motors mentioned above and the reversing of the first mentioned motor, and in which there is also a rheostat for control of the speed of the other motor, the stem of the rheostat being turned by means of a rack and pinion operable by means of a plunger movable like the aforesaid cam by dogs in the movement of the carriage, the plunger tending to move downwardly by gravity toward a limit position and a corresponding top speed of the motor for which a limit screw limiting the drop of the plunger is set, lower speeds being obtained by dog movement of the plunger upwardly. This permits sudden step-ups or step-downs in feeding speeds, as for example, a step-down from a feed speed suitable, let us say, for drilling to a lower feed speed suitable, let us say, for a facing operation.

The invention is illustrated in the accompanying drawings, in which

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Fig. 1 is a longitudinal section through the carriage and a portion of the bed of a machine, such as a multiple spindle drilling and facing machine, embodying electrical control mechanism made in accordance with our invention;

Fig. 2 is a view partly in plan and partly in horizontal section on the line 2—2 of Fig. 1;

Figs. 3 and 4 are sectional details in planes at right angles to one another of the control box which appears in horizontal section on a smaller scale in Fig. 2, and

Fig. 5 is a wiring diagram.

The same reference numerals are applied to corresponding parts throughout these views.

Referring first mainly to Figs. 1 and 2, the reference numeral 6 designates the bed or base portion of the machine on one end of which a housing 7 is fixed to provide radial and end thrust bearing support for one end of the feed screw 8, as indicated at 9. The feed screw 8 has an elongated splined portion 10 next to its fixed end on which a splined sleeve 11 is slidable, the latter having radial and end thrust bearing support in one end of a housing 12, as shown at 13. A nut 14 is threaded on the feed screw and has radial and end thrust bearing support in the other end of the housing 12, as indicated at 15. The housing 12 is mounted in the carriage 16 which supports the electric motor or motors 17 that drive the spindle or spindles connected to the drills, tags, reamers, milling cutters, or whatever tools are to be operated. A single spindle is indicated at 18 connected through a coupling 19 with the armature shaft 20 of the motor 17, but it is understood that the spindle 18 may drive one of a cluster of gears connected to the several tools to be driven.

In accordance with our invention, rapid traverse, forward or reverse, is obtainable by driving the feed screw 8 with the sleeve 11 in the proper direction by operation of the reversible electric motor 21, and different feeds are obtainable by driving the nut 14 at different speeds with the series-wound electric motor 22. The motor 21, which is adjustably pivotally mounted on one end of the carriage 16, has a pulley 23 on its armature shaft over which a belt 24 extends to drive the pulley 25 fixed on the outer end of a shaft 26. The latter is disposed horizontally in transverse relation to the splined end 10 of the feed screw and supported in bearings 27 in the carriage 16. A worm 28 keyed on the shaft 26 meshes with a worm gear 29 that is secured to the sleeve 11. The motor 22, which is adjustably pivotally mounted on the other end of the carriage 16, has a pulley 30 fixed on the armature shaft thereof, and has a belt 31 extending over it to

transmit drive to a pulley 32 fixed on the outer end of another shaft 33. The latter is disposed horizontally in transverse relation to the feed screw 8 and mounted in bearings 34 in the carriage. Another worm 35 keyed on the shaft 33 meshes with a worm gear 36 that is secured to the nut 14. The carriage 16, carrying the motor or motors 17 and the motors 21 and 22, is guided for reciprocatory movement on ways 37 provided on the base or bed 6 of the machine and moves through a predetermined distance, as indicated, for example, by the carriage positions labelled "Pos. #1"—"Pos. #4" in Fig. 1. The forward movement of the carriage is positively limited by engagement with a positive stop, which may be suitably adjusted. Thus, for example, the head of a screw 38 on the forward end of the carriage is arranged to engage the rear end of a set screw 39 adjustably threaded in the boss 40 provided on the front end of the bed 6.

In operation, the conventional cycle of rapid traverse forward, feed and rapid traverse reverse is obtainable with the present construction as follows:

1. The motor 21 is operated in a forward direction to drive the sleeve 11 for rapid approach movement of carriage 16 from Pos. #1 to Pos. #3 and then is stopped. The feed screw 8 in this operation is turned relative to the nut 14 to move the carriage 16 forwardly, and the sleeve 11 slides forwardly on the splined portion 10 of the feed screw 8 as the sleeve moves forward with the carriage.

2. The motor 22 then drives the nut 14 at a slow speed relative to the feed screw 8 to move the carriage 16 forwardly at a feed rate through a predetermined distance from Pos. #3 to Pos. #4 and then stops, the sleeve 11 in this movement sliding forward on the splined portion 10 of the feed screw.

3. The motor 21, running in the reverse direction, drives sleeve 11 to turn the feed screw 8 in the reverse direction relative to the nut 14 for rapid return of carriage 16 from Pos. #4 to Pos. #1, and then stops.

In accordance with our invention, we obtain whatever feed is desired by electrical control of the speed of the motor 22. A control box is indicated at 41 in Fig. 2, mounted on the side of the carriage 16. It contains a gravitating rack plunger 42 that is vertically reciprocable by dog operation of its beveled lower end 43, and also a cam plunger 44 that is vertically reciprocable by dog operation of its lateral projecting roller 45. It is obvious from Fig. 3 that one set of dogs arranged in one line *a—b* extending longitudinally of the bed 6 may operate the one plunger, another set of dogs arranged in another parallel line *c—d* on the bed 6 may operate the other plunger. Thus dogs 59, 60 and 61 are in the inner line *c—d* to operate plunger 44, and dog 62 is in the outer line *a—b* to operate the plunger 42. A rheostat 46 has a rotatable stem 47 arranged to be turned by means of the rack 48 and pinion 49, the rack 48 forming a part of the rack plunger 42. In that way, assuming there is a certain setting for the speed of the series-wound motor 22, the operator may be raising the plunger 42 change the speed for whatever interval he may desire, as for example, in making a set-up for a new job. A screw 50, which has a radially enlarged head 51 projecting into an elongated notch 52 in one side of the rack plunger 42 to limit the downward movement of the plunger and accordingly variably predetermine the top speed of the

motor 22, is set for a fixed top speed, and lower speeds are obtained by movement of the plunger 42 upwardly, accomplished either manually or by dog operation, such upward movement causing a change in the setting of the rheostat 46. Obviously, one long dog with suitable steps on it will suffice to speed up and slow down the feed movement of the carriage 16 by causing corresponding movement of the plunger 42. The cam plunger 44 operates the push buttons 53, 54 and 55 of three limit switches 56, 57 and 58, respectively, which control the starting and stopping of the motors 21 and 22 and the reversing of motors 21. Dogs for operating the plungers 42 and 44 are provided in the two lines on the base or bed 6 of the machine as previously mentioned for movement of the carriage 16 and control box 41 relative thereto, such dogs being indicated at 59, 60, 61 and 62 in Fig. 1. The dog 62 is the "one long dog" mentioned above.

The operation of the electrical control mechanism can be best understood by reference to the positions marked in Fig. 1, and by reference to the wiring diagram, Fig. 5, and is as follows:

Position #1.—The carriage 16 is at a standstill after completion of a cycle, ready for the start of the next cycle. The operator first depresses the push button 53 to operate the contactor 64 through energization of the coil 65, thereby closing interlocks 66, 67 and 68, and also closing the circuit through the spindle motor 17 at 69, to place the machine in readiness to start the cycle. To start the cycle, the operator next depresses the starter button 70, thus operating the contactor 71 through energization of the coil 72, closing interlocks 73 and 74 and completing the circuit through the motor 21 at 75 for rapid approach movement of the carriage 16. The motor 22 also has a circuit completed through it by reason of the closing of the interlock and the consequent energization of coil 76. In that way the nut 14 is turned, thus increasing the speed of approach movement of the carriage.

Position #2.—Limit switch 56 is closed by movement of plunger 44 by dog 59, so as to permit the carriage 16 to be returned during approach movement by the operator's depressing a push button 77. This is for emergency purposes only.

Position #3.—Limit switch 57 is opened at the end of the rapid approach movement by movement of the plunger 44 by dog 60. The coil 72 of contactor 71 is thereby de-energized and motor 21 is stopped, but the feed motor 22 continues to run for the feed movement of the carriage from position #3 to position #4, because interlock 78 keeps the coil 76 energized while interlock 74 is open. During this feed movement, the dog 62 operates plunger 42 to regulate rheostat 46 and accordingly regulate the speed of motor 22. At any point in the feed movement the speed may be stepped up or down quickly or gradually as required. Thus, dog 62 has a rise on the end to cause plunger 42 to be raised accordingly for a slowing up gradually of the speed of motor 22 for a corresponding gradual slow up of the carriage 16 at the end of the feed movement, as may be desired, for example, in a facing operation.

Position #4.—At this position, limit switch 58 is closed by means of plunger 44 moved by dog 61, and when the carriage 16 is run up against the positive stop 39 current in the windings of motor 22 is increased, causing the work relay 79 to close contacts 80 and thus energize coil 81 of

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contacter 82 and start motor 21 operating in the reverse direction.

Alternatively, in this position, selector switch 83, which may be provided in the control box 41 and suitably operated, let us say by the dog 62, is closed to permit current flow from 84 to 85, so that when switch 58 is closed, as above described, coil 81 of contacter 82 is energized and motor 21 is started operating for rapid return of the carriage 16. In either kind of operation, when contacter 82 is closed interlock 86 is opened and coil 76 de-energized thereby opening contacter 87 and stopping feed motor 22. Coil 81 is kept energized during rapid return by interlock 88 until limit switch 56 is opened. When that occurs at the end of the rapid return movement, motor 21 stops and the machine is ready for a new cycle.

It is believed the foregoing description conveys a good understanding of the objects and advantages of our invention. The appended claims have been drawn to cover all legitimate modifications and adaptations.

We claim:

1. In a machine tool feed mechanism, the combination with a bed and a carriage movable thereon, of a feed screw disposed parallel to the direction of carriage movement and supported at one end for rotation on the bed and having an elongated splined portion and an elongated threaded portion, a splined sleeve on the carriage slidable on the splined portion, a nut threaded on the threaded portion of the feed screw and mounted for rotation in fixed spaced relationship to the sleeve on the carriage, a reversible motor for driving the splined sleeve, another motor on the carriage for driving the nut, a control box on the carriage movable with it relative to dogs on the bed, switches in the control box controlling the starting and stopping of said motors and the reversal of the first mentioned motor, means operable by one or more of said dogs in the movement of the carriage for automatically operating said switches in a predetermined relationship for a predetermined cycle, a rheostat in the control box for regulating the speed of the second motor, and means operable by one or more of said dogs for operating said rheostat in the movement of the carriage for automatically operating said rheostat for a predetermined cycle.

2. In a machine tool feed mechanism, the combination with a bed and a carriage movable thereon, of a feed screw disposed parallel to the direction of carriage movement and supported at one end for rotation on the bed and having an elongated splined portion and an elongated threaded portion, a splined sleeve on the carriage slidable on the splined portion, a nut threaded on the threaded portion of the feed screw and mounted for rotation in fixed spaced relationship to the sleeve on the carriage, a motor on the carriage for driving the splined sleeve, another motor on the carriage for driving the nut, and means operable in the movement of the carriage for automatically controlling the operation of the motors and thereby the driving of the feed screw and nut through a predetermined cycle, said means including a rheostat for varying the speed of the second motor.

3. In a machine tool feed mechanism, the combination with a stationary bed member and a relatively reciprocable carriage member, of a feed screw disposed parallel to the direction of carriage movement and supported at one end for

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rotation on one of said members and having an elongated splined portion and an elongated threaded portion, a splined sleeve slidable on the splined portion and a nut threaded on the threaded portion of the feed screw, a reversible motor for driving the splined sleeve, another motor for driving the nut, a control box on the carriage movable with it relative to dogs on the bed, switches in the control box controlling the starting and stopping of said motors and the reversal of the first mentioned motor, and means operable by one or more of said dogs in the movement of the carriage for automatically operating said switches in a predetermined relationship for a predetermined cycle.

4. In a machine tool feed mechanism, the combination with a stationary bed member and a relatively reciprocable carriage member, of a feed screw disposed parallel to the direction of carriage movement and supported at one end for rotation on one of said members and having an elongated splined portion and an elongated threaded portion, a splined sleeve slidable on the splined portion and a nut threaded on the threaded portion of the feed screw, a reversible motor for driving the splined sleeve, another motor for driving the nut, a control box on the carriage movable with it relative to dogs on the bed, switches in the control box controlling the starting and stopping of said motors and the reversal of the first mentioned motor, means operable by one or more of said dogs in the movement of the carriage for automatically operating said switches in a predetermined relationship for a predetermined cycle, a rheostat in the control box for regulating the speed of the second motor, and means operable by one or more of said dogs for operating said rheostat in the movement of the carriage for automatically operating said rheostat for a predetermined cycle.

5. In a machine tool feed mechanism, the combination with a stationary bed member and a relatively reciprocable carriage member, of a feed screw disposed parallel to the direction of carriage movement and supported at one end for rotation on one of said members and having an elongated splined portion and an elongated threaded portion, a splined sleeve on the carriage slidable on the splined portion, a nut on the carriage threaded on the threaded portion of the feed screw, a motor on the carriage for driving the splined sleeve, another motor on the carriage for driving the nut, and means operable in the movement of the carriage for automatically controlling the operation of the motors and thereby the driving of the feed screw and nut through a predetermined cycle, said means including a rheostat for varying the speed of the second motor.

6. In a machine tool feed mechanism, the combination with a bed and a carriage movable thereon, of a feed screw disposed parallel to the direction of carriage movement and supported at one end for rotation on the bed, means adapted for driving the feed screw in either direction, a reversible motor for driving said means, a nut threaded on the feed screw, a motor for driving the nut, a control box on the carriage movable with it relative to dogs on the bed, switches in the control box controlling the starting and stopping of said motors and the reversal of the first mentioned motor, means operable by any one or more of said dogs in the movement of the carriage for automatically operating said switches in a predetermined relationship for a predetermined

cycle, a rheostat in the control box for regulating the speed of the second motor, and means operable by one or more of said dogs for operating said rheostat in the movement of the carriage for automatically operating said rheostat for a predetermined cycle.

7. In a machine tool feed mechanism, the combination with a bed and a carriage movable thereon, of a feed screw disposed parallel to the direction of carriage movement and supported at one end for rotation on the bed, means adapted for driving the feed screw in either direction, a reversible motor for driving said means, a nut threaded on the feed screw, a motor for driving the nut, and means operable in the movement of the carriage for automatically controlling the operation of the motors and thereby the driving of the feed screw and nut through a predetermined cycle, said means including a rheostat for varying the speed of the second motor.

8. In a machine tool, the combination with a bed and a carriage movable thereon, of a feed mechanism, a reversible motor and a driving train for driving the feed mechanism in either direction at traverse speeds, another motor and an independent driving train for driving the feed mechanism at variable speeds, and means operable in the movement of the carriage for automatically controlling the starting and stopping of the two motors and the reversal of the first motor and the speed of operation of the second motor through a predetermined cycle.

9. In a machine tool, the combination with a bed and a carriage movable thereon, of a feed mechanism, a reversible motor and a driving train for driving the feed mechanism in either direction at traverse speeds, another motor and an independent driving train for driving the feed mechanism at variable speeds, a control box on the carriage movable with it relative to dogs on the bed, switches in the control box controlling the starting and stopping of said motors and the reversal of the first mentioned motor, and means operable by one or more of said dogs in the movement of the carriage for automatically operating said switches in a predetermined relationship for a predetermined cycle.

10. In a machine tool, the combination with a bed and a carriage movable thereon, of a feed mechanism, a reversible motor and a driving train for driving the feed mechanism in either direction at traverse speeds, another motor and an independent driving train for driving the feed mechanism at variable speeds, a control box on the carriage movable with it relative to dogs on the bed, switches in the control box controlling the starting and stopping of said motors and the reversal of the first mentioned motor, means operable by one or more of said dogs in the movement of the carriage for automatically operating said switches in a predetermined relationship for a predetermined cycle, a rheostat in the control box for regulating the speed of the second motor, and means operable by one or more of said dogs for automatically operating said rheostat in the movement of the carriage for a predetermined cycle.

11. An electrical control device for use on a machine tool carriage or the like comprising a housing, a plurality of switches in said housing having push buttons arranged in a row, a cam plunger reciprocable in said housing relative to said push buttons, said switches being adapted for controlling the starting and stopping of a plurality of motors and the reversing of at least one

motor, and said plungers being adapted to be reciprocated by dogs in the movement of the carriage, a rheostat in said housing for controlling the speed of operation of at least one motor, said rheostat having a rotary shaft, rack and pinion means for turning said shaft, and another plunger reciprocable in said housing carrying said rack, said last mentioned plunger being adapted to be reciprocated by dogs in the movement of the carriage.

12. An electrical device as set forth in claim 11 wherein said last mentioned plunger normally tends to gravitate toward one extreme position and is moved by dogs in the opposite direction, said device including a screw threaded adjustment for predetermining the limit position of said plunger in its movement by gravity whereby to accordingly predetermine the extreme motor speed.

13. In a machine tool, the combination with a bed and a carriage movable thereon and carrying a motor driving a work spindle, of a feed mechanism, a rapid reversible motor and a driving train for driving the feed mechanism in either direction at traverse speeds, dogs on the bed for operating control means on the carriage for automatically controlling the starting, stopping and reversing of said motor in a predetermined cycle, another motor and an independent driving train for driving the feed mechanism in feed movements of the carriage, and dog means on the bed operating control means on the carriage in the movement of the carriage for automatically controlling the starting, stopping and variation in speed of operation of the last mentioned motor in a predetermined cycle.

14. In a machine tool, the combination with a bed and a carriage movable thereon and carrying a motor driving a work spindle, of a feed mechanism, a rapid reversible motor and a driving train for driving the feed mechanism in either direction at traverse speeds, dogs on the bed for operating control means on the carriage for automatically controlling the starting, stopping and reversing of said motor in a predetermined cycle, another motor and an independent driving train for driving the feed mechanism in feed movements of the carriage, means controlling the starting and stopping of said last mentioned motor, and a single elongated dog on the bed for operating control means on the carriage in the movement thereof for automatically varying the speed of the last mentioned motor in a predetermined cycle.

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JOHN NELSON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
142,966	Thorne	Sept. 16, 1873
492,567	Worcester	Feb. 28, 1893
687,674	Buhne and Ritz	Nov. 26, 1901
792,684	Watson	June 20, 1905
2,023,841	Kingsbury	Dec. 10, 1935
2,054,760	Oberhoffen	Sept. 15, 1936
2,114,389	Kingsbury	Apr. 19, 1938
2,176,606	Cregar	Oct. 17, 1939
2,333,341	Scrivener	Nov. 2, 1943
2,405,709	Olsson	Aug. 13, 1946

Certificate of Correction

Patent No. 2,520,014

August 22, 1950

AXEL F. REHNBERG ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 5, line 36, after the word "motor" insert *on the carriage*;
and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 5th day of December, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.