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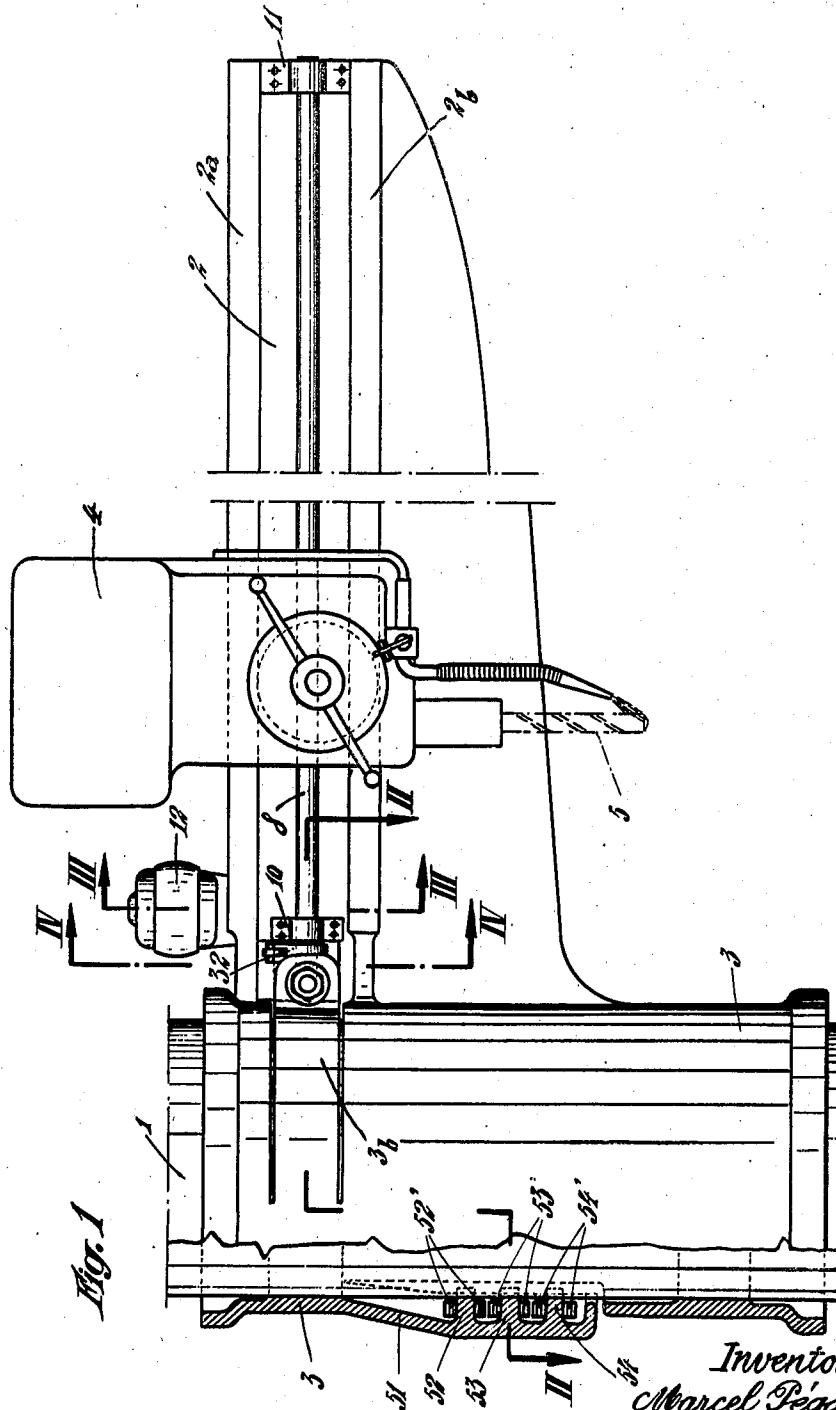
M. PÉGARD

2,290,766

MACHINE-TOOL AND ESPECIALLY RADIAL DRILLING MACHINE

Filed Jan. 4, 1940

5 Sheets-Sheet 1



Inventor:
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July 21, 1942.

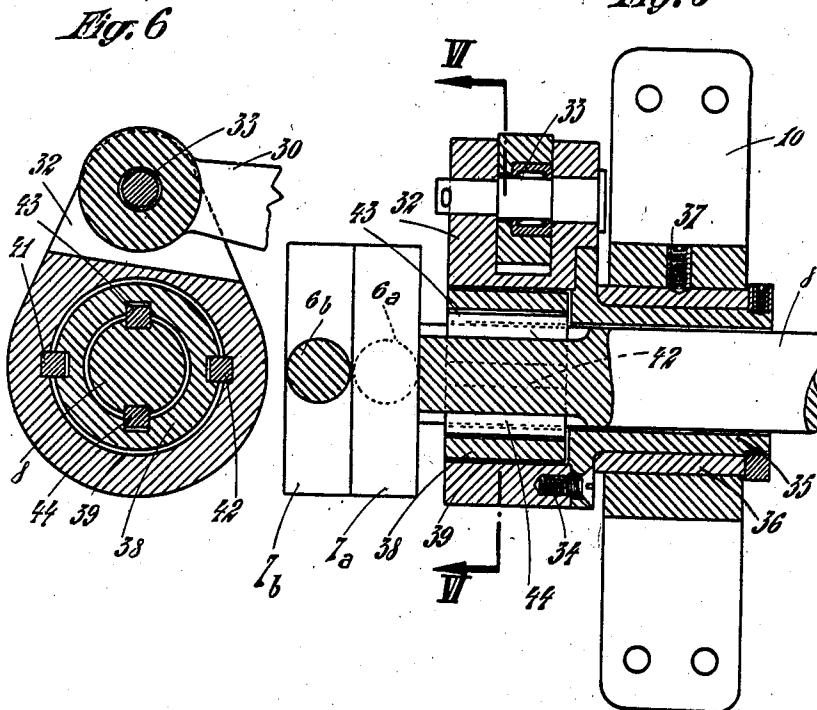
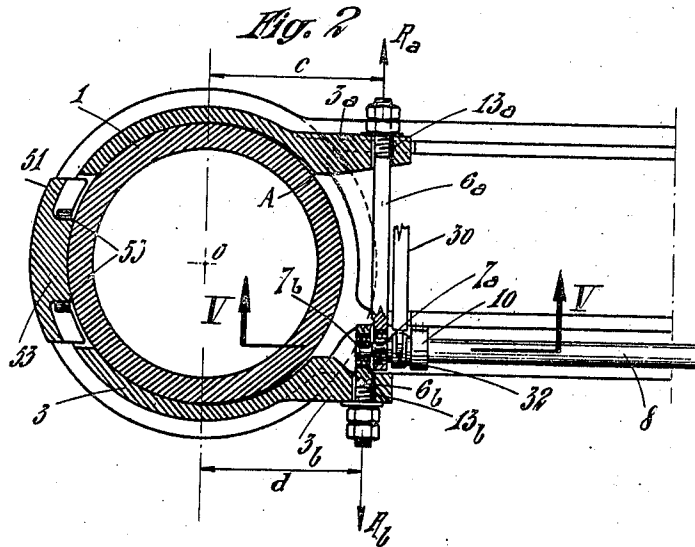
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5 Sheets-Sheet 2



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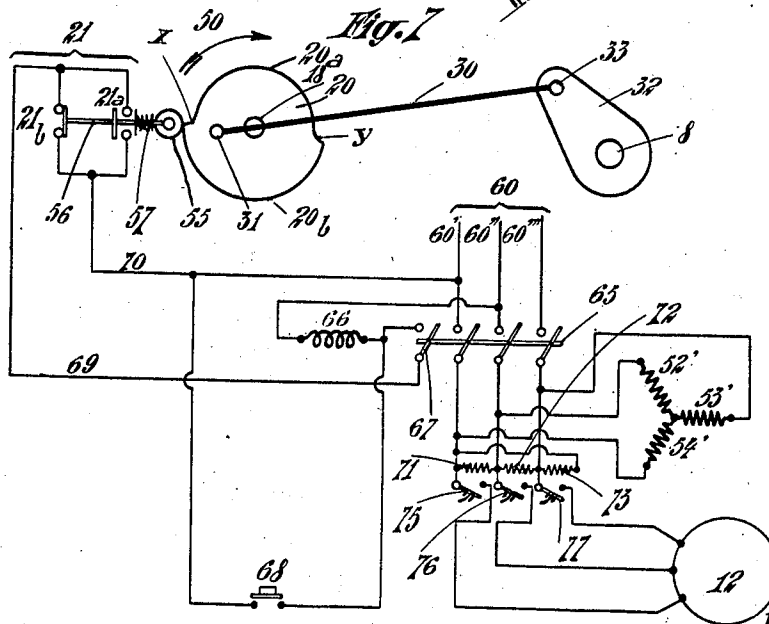
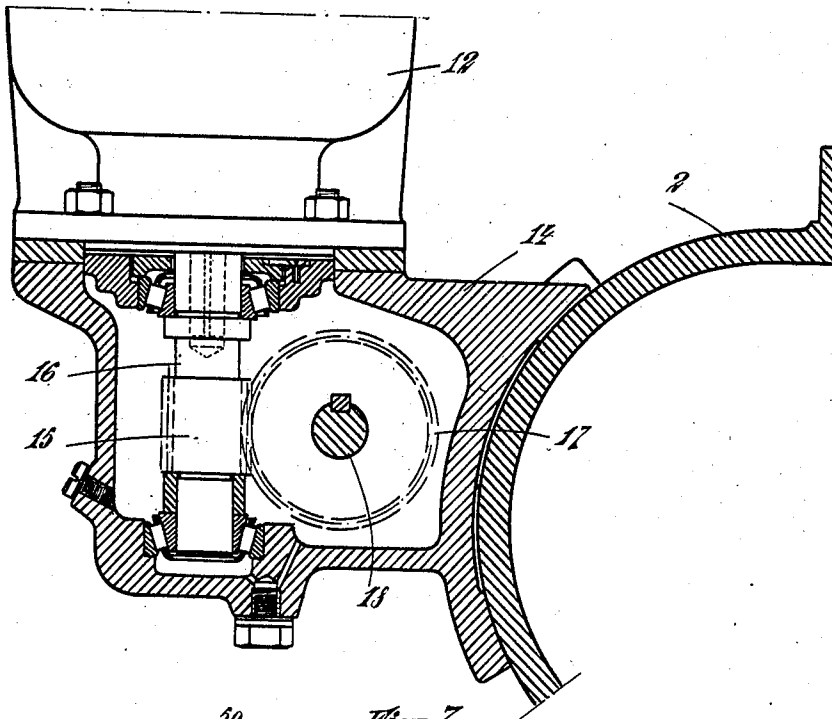
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MACHINE-TOOL AND ESPECIALLY RADIAL DRILLING MACHINE

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5 Sheets-Sheet 3

Fig. 3



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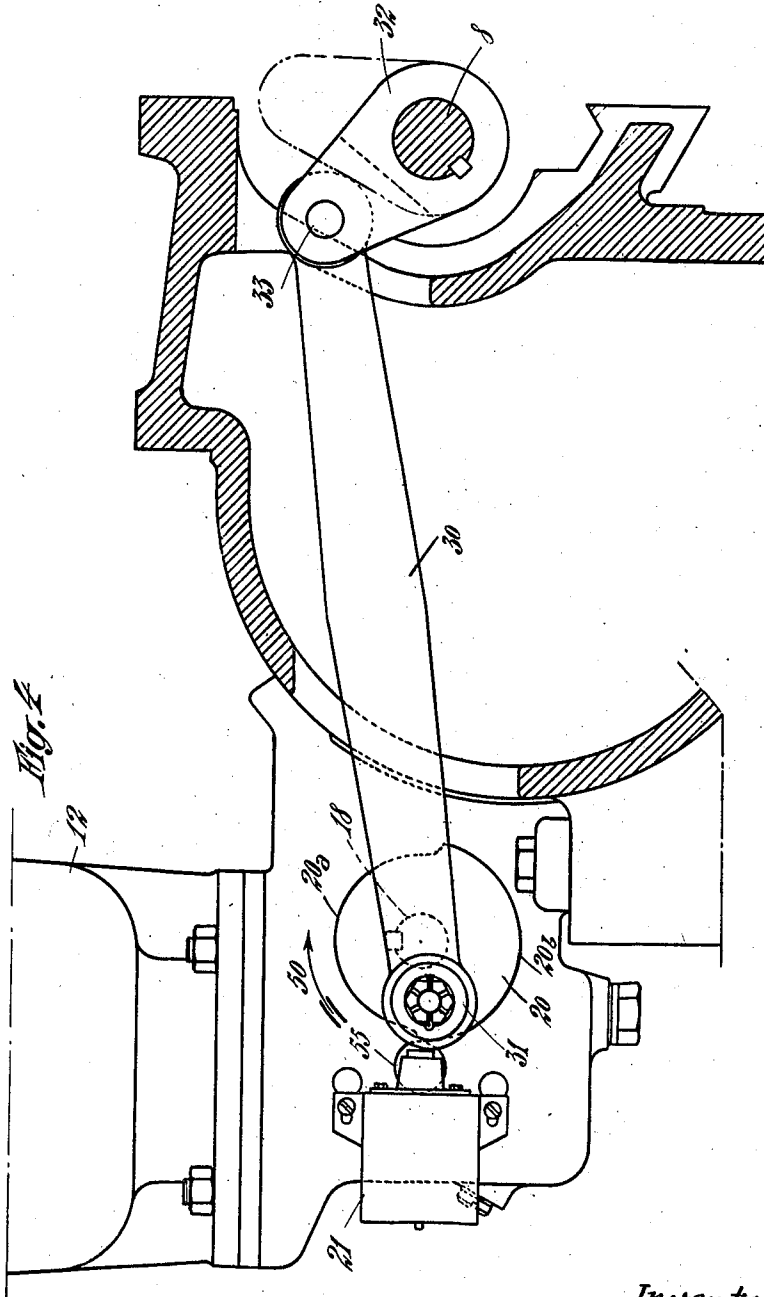
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MACHINE-TOOL AND ESPECIALLY RADIAL DRILLING MACHINE

Filed Jan. 4, 1940

5 Sheets-Sheet 4



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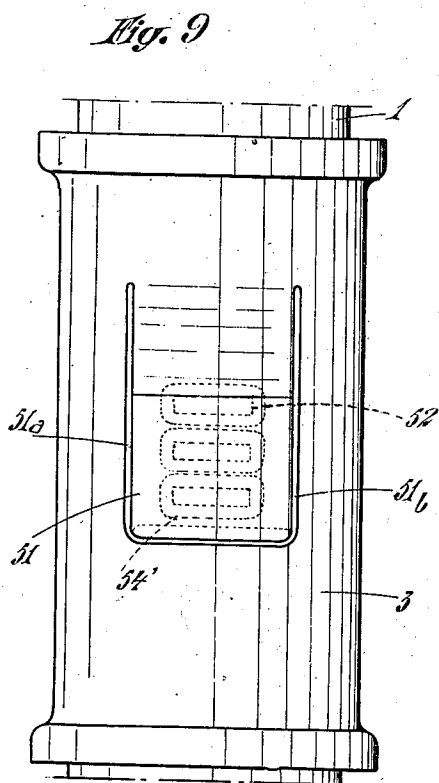
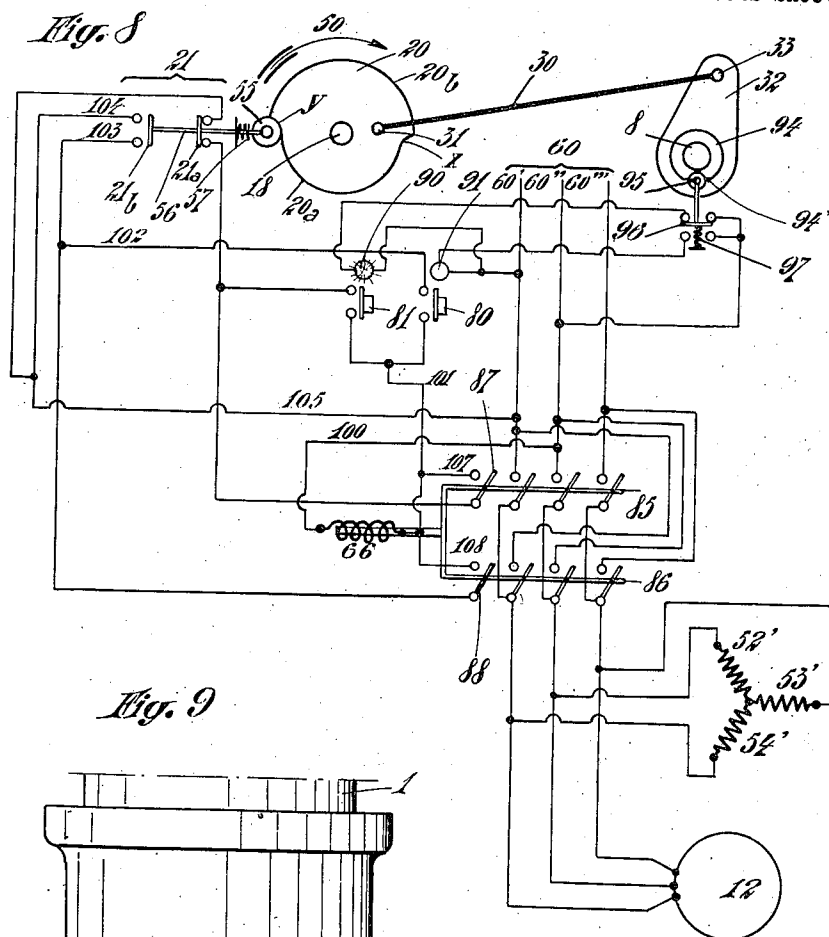
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MACHINE-TOOL AND ESPECIALLY RADIAL DRILLING MACHINE

Filed Jan. 4, 1940

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,290,766

MACHINE TOOL, AND ESPECIALLY RADIAL
DRILLING MACHINE

Marcel Pégard, Paris, France

Application January 4, 1940, Serial No. 312,371
In France September 2, 1939

17 Claims. (Cl. 77-27)

The present invention relates to machine-tools, such for instance as a radial drilling machine, including a drill carrying carriage adapted to move along a radial arm, pivotally mounted about a cylindrical column.

The object of the present invention is to provide improvements in machines of this kind, and, in particular to provide devices, adapted to be used in connection with such machines, for producing, by the mere operation of push-buttons or the like, the locking and unlocking of the arm of the drilling machine with respect to the column and of the carriage with respect to said radial arm, these devices simultaneously ensuring the locking and unlocking of these various elements without the tool being displaced from its correct working position.

The present invention is chiefly concerned with a device for locking and unlocking the arm of the drilling machine with respect to the column by means of a control shaft parallel to the slideway of the carriage along the arm, the connection between said shaft and the arm of the drilling machine being designed in such manner as to be able to absorb, without transmitting them, the reactions that result from the locking and unlocking operations, in said shaft, whereby said reactions act practically neither on the arm nor on the carriage and consequently do not produce any displacement of the tool from its correct working position.

The driving of this shaft is advantageously ensured by an electric motor.

According to an interesting feature of the present invention, the immobilization of the arm on the column is prepared by producing a radial locking, which will be hereinafter called temporary locking, obtained by means of parts which are brought into play slightly before, and during, the final locking operation, whereby the arm is wholly immobilized during the arm locking and releasing operations. The temporary locking action may be supplied by an electromagnetic device connected in shunt with the final locking control motor, which ensures the quick and automatic succession of the two locking operations.

Other features of the present invention will appear from the following detailed description of some specific embodiments thereof.

Preferred embodiments of the present invention will be hereinafter described with reference to the accompanying drawings, given merely by way of example, and in which:

Fig. 1 is a side elevational view, with parts cut

away, of a radial drilling machine made according to the invention;

Fig. 2 is a sectional view in a horizontal plane, on the line II—II of Fig. 1;

Fig. 3 is a vertical section on the line III—III of Fig. 1;

Fig. 4 is a vertical section on the line IV—IV of Fig. 1;

Fig. 5 is a sectional view, on an enlarged scale, on the line V—V of Fig. 2;

Fig. 6 is a sectional view on the line VI—VI of Fig. 5;

Fig. 7 is a diagram of the electric connections of a locking device working in two steps, according to the invention;

Fig. 8 is a diagram of the electric connections of a locking device including automatic signaling means;

Fig. 9 is an elevational view of a detail of Figs. 1 and 2.

The radial drilling machine shown by the drawings includes the following essential elements: A fixed cylindrical column 1 supports a radial arm 2 pivotally mounted thereon and bearing on said column through its tubular sleeve 3. A carriage 4, movable along the slideways or tracks 2a, 2b of the radial arm, carries the drilling tool 5 and its driving motor, which is not visible on the drawings. The sleeve 3 of arm 2 is cut away transversely so as to constitute two arcuate bands, with lugs 3a and 3b at their ends, having a certain elasticity and the tight application of which against the cylindrical surface of the column produces the locking of the arm in any desired angular position.

These lugs 3a and 3b are interconnected, by means of individual connecting rods 6a, 6b, each with a crank pin 7a, 7b, respectively, said crank pins being mounted in opposition on a driving shaft 8 parallel to slideways 2a, 2b. These crank pins act, through the intermediate of needle bearings (or ball bearings) on annular parts rigid with connecting rods 6a, 6b which are engaged in the apertures 13a, 13b of lugs 3a, 3b.

A rotation of shaft 8 through a certain angle has for its effect to bring lugs 3a and 3b closer to each other and to apply the inner surfaces thereof against column 1, thus fixing the radial arm in position with respect to the column. If it is desired to avoid any displacement of the tool from its correct working position, the locking and unlocking of the radial arm with respect to the column must not produce any effort capable of producing a pivoting displacement, even through a very small angle, of the arm about the

axis O of the column. As arm 2 is mounted on ball bearings and therefore turns very freely about the column, the above mentioned condition involves neutralizing, during the locking operation, any force which would act on the arm and would not pass through the axis O of the column.

As a matter of fact, the two lugs 3a and 3b exert opposed reactions Ra and Rb on the control or driving shaft 8. The absolute value of these reactions depends upon the elasticity of the lug carrying portions formed by cutting in sleeve 3. It is practically impossible to comply, at any time, with the condition:

$$Ra \times c = Rb \times d$$

c and d being the respective distances of the lines of action of forces Ra and Rb from axis O. Neglecting the very small difference between these distances c and d, the reactions Ra and Rb, which are very variable during the locking, should at least remain constantly equal to each other in absolute value and opposed in direction. As this condition is not exactly complied with in the industrial construction of machine tools, there always remains a tangential resultant force in eccentrics 1a, 1b, which force is transmitted to the arm through the intermediate of bearing 10 in machine tools of the type known up to this time.

On the other hand, if lug 3a, for instance, comes into contact with the column before the inner edge of lug 3b has come into contact with said column, there is produced, at a point such as A, a reaction of the column which is added to the above considered system of forces. Portion 3a ceases to move, but the whole of the crank pins 1a and 1b must move the more as the portion 3b of the sleeve is farther from the column, and this will produce a movement of rotation of the arm around the column.

According to the invention, I avoid any detrimental displacement of the arm with respect to the column owing to the following arrangements, taken in combination:

Radial arm final locking device

This device includes a control motor 12 (Figs. 1, 3 and 4) fixed through its base on a bracket 14, carried by the rear part of the arm 2 of the drilling machine. This hollow bracket 14 constitutes a casing containing a speed reducing gear, with a tangential screw 15, mounted on the shaft 16 of the motor and meshing with helical wheel 17, which is keyed on an intermediate shaft 18. This shaft 18 carries, at its other end, a cam 20 which serves to control the rotation of said shaft through the medium of a switch 21 inserted in the circuit of the motor, as it will be hereinafter explained. A connecting rod 30 is interposed between a crank pin 31 projecting from the face of cam 20 and a crank arm 32, to which it is connected through articulation pin 33.

Crank arm 32 is mounted in a particular manner on locking-control shaft 8, which controls the locking of arm 2. This mounting is visible on Fig. 5. Crank arm 32 is fixed by means of screws 34 on a ring 35 acting as journal and oscillating in a brass bearing 36 immobilized by means of studs 37 in a support 10 rigid with the arm of the drilling machine. The distance from crank pin 31 to the axis of shaft 18 is smaller than the radius of crank arm 32. Therefore, a continuous rotation of said intermediate shaft in the direction of arrow 50 produces oscillations of

crank arm 32 in bearing 10. The locking control shaft 8 extends with a certain play (which is rather considerable) through hollow journal 35 and an intermediate ring 38, itself housed with a certain play in an annular recess 39 provided in the central part of crank arm 32.

The connection between shaft 8 and crank arm 32 is obtained through a double system of keys. In a first diametral plane, keys 41 and 42 are housed with a certain radial play in corresponding grooves of the crank arm 32 and of the intermediate ring 38. In a second diametral plane, keys 43 and 44, extending perpendicularly to the first mentioned set of keys, are housed, with the same radial play, in grooves provided both in ring 38 and in shaft 8, longitudinally.

Owing to this arrangement, crank arm 32 can transmit its rotary motion to ring 38, while leaving it free to move to a certain extent in the diametral plane containing keys 41 and 42. Then, ring 38 in turn transmits the rotary movement to control shaft 8, while allowing the latter to assume slight transverse displacements in the plane of keys 43-44, with respect to ring 38. At the end of shaft 8, immediately close to crank arm 32, are mounted the two eccentrics 1a and 1b which control the connecting rods 5a and 5b serving to lock arm 2 on the column (Fig. 2).

This shaft 8 is guided, or journaled, at the other end of the arm of the drilling machine, in a bearing 11, which may, in some cases, be of the swivel type.

The deformable coupling system which has just been described therefore permits the locking control shaft 8 to move transversely with respect to the supporting bearing 10, when it is subjected to the action of forces resulting from a difference existing between the values of reactions Ra and Rb, produced by the lugs 3a and 3b, or from a premature contact of one of these lugs with the column during the locking operations. None of these forces is transmitted to bearing 10, and therefore to arm 2, excepting however the resistance forces developed by the friction of keys 41, 42, 43, 44 in their housings of the brass ring 38 and the elastic reaction of shaft 8 mounted at the other end of the arm in bearing 11 rigid with said arm.

It is clear that these resistance forces are very small, since the keys are suitably lubricated and the displacement of shaft 8 is very small in comparison to the considerable free length of this shaft. However, in cases when this is necessary, the action of these forces is nullified by means of an auxiliary device, called "temporary locking device" in the following description.

Temporary locking device

The left hand side of Fig. 1 shows, in axial section, the sleeve 3 rigid with arm 2 which is mounted on the column. Fig. 2 gives a transverse section of the system and Fig. 9 an elevational view thereof.

Sleeve 3 is provided, on the side opposed to the arm of the drilling machine, with a kind of tongue or projection 51, substantially rectangular, and the longer sides 51a, 51b of which are in axial planes. This tongue 51 is thus given a certain longitudinal flexibility, but it is rigid in any direction transverse with respect to the column. This part 51 is provided, on the inner face thereof, with three bosses or projections 52, 53, 54 the inner surfaces of which are made exactly of the radius of the column and are adapted

to act as locking shoes. These bosses constitute the cores of three electro-magnets the windings 52', 53', and 54' of which are energized, for instance, by three-phase current.

When current flows through the windings 52', 53', and 54' in question, the magnetic circuit of the corresponding electro-magnet cores is closed through the metal of the column and the shoes 52, 53 and 54 are tightly applied against the column. Most of the lines of force of the magnetic field which cause the shoes to adhere against the column are perpendicular to the air gap and are directed toward the axis O of the column. If F is the resultant of the forces of application produced in the three shoes, and δ the coefficient of friction of said shoes against the column when the electro-magnets are energized, the force opposing the rotation of the arm of the drilling machine is equal to $\delta \times F$. In order to obtain the desired result, the force F which produces the temporary locking of the arm on the column must act during the locking and unlocking operations and its intensity, multiplied by the coefficient of friction δ , must be greater than the resultant of the forces above mentioned, that is to say the elastic reaction of the locking control shaft 8 on the arm and the frictional resistance of the radially movable keys 41, 42, 43, 44.

Electric control of the two locking devices

Figs. 7 and 8 show the diagrams of the connections of two devices for electrically controlling the two-step locking above described.

In the arrangement of Fig. 7, the current from the feed system 60, which is supposed to be of the three-phase type in the example shown, is sent to the locking control motor 12 through a contactor 65 provided with an energizing electro-magnet 66 which serves to operate said contactor. A control button 68, preferably a push-button, permits of closing the circuit of electro-magnet 66, which closes the circuit of motor 12 by means of armature 65. At the same time, blade 67 closes the contact which maintains the energizing of the electro-magnet 66.

Cam 20, which is keyed on intermediate shaft 18, includes two circular arc portions 20a, 20b, of different radii, joined by inclined parts X and Y which, during the rotation of the cam, displace in opposite directions the sliding rod 56 of switch 21, through the medium of contact roller 55. A spring 57 is adapted constantly to urge roller 55 against the edge of cam 20. Rod 56 is provided with two transverse bars 21a and 21b which alternately establish a contact between conductors 69 and 70, according as roller 55 touches arc 20a or arc 20b.

Windings 52', 53', 54', corresponding to the electro-magnets associated with the shoes 52, 53, 54 serving temporarily to lock the arm, are connected in shunt with control motor 12.

The whole of the device works in the following manner:

If it is desired to produce the locking of the arm with respect to the column, the operator depresses button 68, connecting rod 30 and crank arm 32 then occupying the position shown by Fig. 7, in which crank pins 1a and 7b and the lugs 3a and 3b of the sleeve are in the disengaged state. Electro-magnet 66 is then energized, between the phases 60' and 60'' of the current, and contactor 65 is operated so as to close the circuit of the motor. Motor 12 starts running and electro-magnets 52', 53' and 54', placed

under tension, produce the temporary locking of sleeve 3, the locking shoes being applied against column 1. Contactor 65 remains in the closing position, owing to the fact that blade 67 is attracted. When cam 20, driven by motor 12, has turned through about 180° in the direction of arrow 50, crank arm 32 has come into the position of Fig. 8, which corresponds to the locking of the arm by the eccentrics 1a, 7b acting on lugs 3a, 3b (Fig. 2). From this time on, roller 55 starts running on the inclined portion Y of the cam 20. Rod 21b leaves the corresponding contacts, whereas rod 21a has not yet come on its respective contacts. Circuit 69—70 being opened, and button 68 being released, contactor 65 comes back to its inoperative position, thus opening the circuit of the motor. But motor 12 keeps running, by inertia, a time sufficient for causing roller 55 to run through the whole length of inclined surface Y, so that said roller comes into contact with the section 20a of the cam, which enables transverse rod 21a to close the contact between conductors 69 and 70. Then the motor stops, crank arm 32 remaining in the locking position.

The unlocking or release of arm 2 is obtained by a new pressure exerted on control button 68, which causes contactor 65 to work and motor 12 to resume its movement in the same direction. Shaft 18 and cam 20 are given a further rotation through an angle of 180° in the direction of arrow 50, which brings back connecting rod 30 and crank arm 32 into the "released" position of the lugs 3a and 3b of the sleeve. As in the preceding case, shoes 52, 53, and 54 produce, by magnetic attraction on column 1, a temporary locking of the arm, whereby the mechanical releasing operation can take place without modifying the correct positioning of the tool.

The unlocking or release takes place automatically when roller 55 moves past inclined portion X, of the cam, when bar 21a opens circuit 69—70, which produces the opening of contactor 65. However, the inertia of motor 12 is determined in such manner that roller 55 hardly moves past the end of inclined portion X and permits the small bar 21b to re-establish the contact between 69 and 70.

Therefore a depressing of push-button 68 has for its effect to produce, successively, the temporary locking of the sleeve on the column and the final locking of the arm of the drilling machine, alternately with the releasing operations.

If it is desired to increase the period of time elapsing between the two operations, to wit the temporary locking or releasing, and the final locking or releasing, respectively, it suffices to interpose a time delay relay between contactor 65 and motor 12. This relay chiefly includes windings 71, 72, 73 which, once the contactor 65 has been brought into closing position, attract blades 75, 76, 77, respectively, the movement of which is suitably braked, until the latter close their respective contacts.

It is possible simultaneously to obtain the locking of the arm on the column and that of carriage 4 on the arm of the drilling machine. For this purpose, the oscillating control shaft 8 can be ribbed and it transmits its oscillations to an eccentric crank pin which shares the sliding displacements of carriage 4 along the arm. This eccentric crank pin will act on a device such as that described in the French Patent No. 845,093 of April 22, 1938, which ensures the locking of

the carriage on slideways 2a, 2b without producing reactions capable of causing the arm to pivot about the column.

The arrangement of Fig. 8 includes, in addition to the means illustrated by Fig. 7, push-buttons separately adapted to produce the locking and the releasing of the arm, and signal lamps which are switched on as soon as one or the other of these two operations has been completed.

The elements which exist already in the arrangement of Fig. 7 are designated by the same reference numerals in Fig. 8.

This device works, for the purposes just above set forth, in the following manner:

Cam 20 and switch 21 occupying the respective positions shown by Fig. 7, the operator depresses, for instance, push button 80, which corresponds to the locking operations. The circuit of the energizing electro-magnet 66 of the contactor of the motor 85-86 is closed through the following elements: conductor 100, winding 66, conductor 101, contact 80, conductors 102-103, bar 21b of switch 21, and return conductors 104-105 leading back to the feed system. Contactor 85-86 is brought into the closing position and motor 12 starts running.

The working of contactor 85-86, which is provided with a double armature, produces the simultaneous application of the plates 87 and 88 onto their respective contact studs 107 and 108. These blades are connected in shunt with each of the push-buttons 80, 81, and they maintain the energizing of the electro-magnet 66 when said above mentioned push-buttons cease to be depressed.

When cam 20, having turned through 180° in the direction of arrow 50, has nearly come into the position of Fig. 8, which corresponds to the locking of the arm on the column, as above, the bar 21b of the switch 21 leaves its contacts.

Same as push-buttons 81 and 80, blades 87 and 88 are each connected in series with the contact studs corresponding to the bars 21a and 21b of the switch 21. Consequently, bar 21b, when leaving its contact studs, cuts off the energizing circuit of the main contactor 85-86, which is brought into the opening position. Owing to the inertia of motor 12, the roller 55 of switch 21 can just move past the inclined portion Y of cam 20, bar 21a now establishing its contact and preparing the subsequent closing of the circuit of electro-magnet 66 (this position being that illustrated by Fig. 8).

After this, the releasing of the arm and the carriage of the drilling machine are obtained by depressing push button 81 and button 80, the circuit of which is now opened by bar 21b is no longer operative for the present time.

When the locking of the arm, and, eventually, of the carriage is finally obtained, a cam 94, rigid with crank arm 32, has its notch 94' located opposite a roller 95 mounted on the end of a two position circuit-breaker bar 96, a spring 97 constantly applying the roller against the outline of cam 94. Bar 96 then closes the circuit of the signal lamp 90, which is thus switched on, and indicates that the locking operation is completed.

When the carriage and the arm are released, roller 95 is applied against the circular outline of cam 94, the circuit-breaker bar 96 then closing only the circuit of the "release" indicating signal lamp 91, which is then switched on.

In a general manner, while I have, in the above description, disclosed what I deem to be

practical and efficient embodiments of the present invention as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the accompanying claims.

What I claim is:

1. A machine tool of the type described which comprises, in combination, a column, a radial arm carried by said column and pivotable about the axis thereof, two deformable jaws rigidly associated with said arm adapted to be applied on said column for locking said arm with respect to said column, a shaft mounted on said arm parallel thereto, two opposed crank pins carried by said shaft, connecting rods interposed between said crank pins and the ends of said jaws respectively, whereby rotation of said shaft in one direction or the other moves said jaws toward, or away from, each other and accordingly produces the locking of said arm on said column or its release, a crank arm journaled on said radial arm adapted to transmit rotary movement to said shaft, said crank arm being provided with a hole for the passage of said shaft coaxially therethrough, a ring mounted in said hole between said crank arm and said shaft, coaxially with both and with substantial play with respect to both said crank arm and said shaft, the inner face of said hole in the crank arm and the outer face of said ring being provided with corresponding grooves located in a given diametral plane, keys, slidable radially, engaged in said grooves for angularly interconnecting said crank arm and said ring, the inner face of said ring and the outer face of said shaft being provided with corresponding grooves located in a diametral plane at right angles to the first mentioned one, and keys, slidable radially, engaged in said last mentioned grooves for angularly interconnecting said ring and said shaft, whereby the reactions, produced in said shaft by the coaction of the crank pins with the said jaws, are substantially compensated by the said play between the crank arm and the shaft and are not communicated to any material extent from said shaft to the crank arm and thence to the radial arm of the machine.

2. A machine tool of the type described which comprises, in combination, a column, a radial arm carried by said column and pivotable about the axis thereof, temporary means for locking said arm with respect to said column, said means being adapted to exert a temporary locking force upon said column, effective in a line passing through the axis thereof, final locking means operable while said temporary locking means are effective, for fixing said arm with respect to said column, said final locking means being liable to cause pivotal movement of the radial arm about said column, the said temporary locking force being of sufficient magnitude to prevent pivotal movement of the radial arm about said column during the operation of said final locking means, and means for successively bringing into play said temporary locking means and said final locking means.

3. A machine tool of the type described which comprises, in combination, a column, a radial arm carried by said column, a sleeve rigid with said radial arm coaxially surrounding said column, whereby said radial arm is pivotable about the axis of said column, said sleeve being cut away so as to form a tongue deformable in the direction of the diametral plane of said column,

means for strongly applying said tongue against said column so as to lock said sleeve with respect to said column, said tongue and the means for applying it against said column forming temporary locking means developing a temporary locking force effective in a line passing through the axis of said column, final locking means for fixing said arm with respect to said column, said final locking means being liable to cause pivotal movement of said sleeve and radial arm about said column, the said temporary locking force being of sufficient magnitude to prevent pivotal movement of the sleeve and radial arm about said column during the operation of said final locking means, and means for successively bringing into play said temporary locking means and said final locking means.

4. A machine tool of the type described which comprises, in combination, a column, a radial arm carried by said column, a sleeve rigid with said radial arm coaxially surrounding said column, whereby said radial arm is pivotable about the axis of said column, said sleeve being cut away so as to form a tongue deformable in the direction of the diametral plane of said column, electro-magnets carried by said tongue for strongly applying it against said column so as to lock said sleeve with respect to said column, said tongue and said electromagnets forming temporary locking means developing a temporary force locking effective in a line passing through the axis of said column, final locking means for fixing said arm with respect to said column said final locking means being liable to cause pivotal movement of said sleeve and radial arm about said column, the action of said electromagnets being sufficient to prevent pivotal movement of the sleeve and radial arm about said column during the operation of said final locking means, and means for successively bringing into play said temporary locking means and said final locking means.

5. A machine tool of the type described which comprises, in combination, a column, a radial arm carried by said column and pivotable about the axis thereof, temporary means for locking said arm with respect to said column, said means being adapted to produce a temporary locking force effective in a line passing through the axis of said column, two deformable jaws rigidly associated with said arm adapted to be applied on said column for finally locking said arm with respect to said column, a shaft mounted on said arm parallel thereto, two opposed crank pins carried by said shaft, connecting rods interposed between said crank pins and the ends of said jaws, respectively, whereby rotation of said shaft in one direction or the other moves said jaws toward, or away from, each other and accordingly produces the final locking of said arm on said column or its release, means for driving said shaft, and means for connecting said shaft with said arm comprising a bearing on said arm having a hole for receiving said shaft therewithin, the said hole being of greater diameter than said shaft whereby to permit slight transverse displacement of said shaft with respect to said arm, and, hence, to compensate for transverse displacement of said shaft caused by the coaction of the crank pins with the said jaws, such compensation reducing the reactions, of the final locking of the arm, which must be overcome by the temporary locking means.

6. A machine tool of the type described which comprises, in combination, a column, a radial arm carried by said column and pivotable about

the axis thereof, temporary means for locking said arm with respect to said column, said means being adapted to produce a temporary locking force effective in a line passing through the axis of said column, final locking means for fixing said arm with respect to said column, said final locking means being liable to produce, when applied or released, tangential reactions of said column with respect to said arm, the temporary locking means being adequate to hold the arm against pivotal movement about the column in opposition to the said tangential reactions produced during the operation of the final locking means, and means for bringing into play said temporary locking means whenever said final locking means are to be applied or released.

7. A machine tool of the type described which comprises, in combination, a column, a radial arm carried by said column and pivotable about the axis thereof, temporary electro-magnetic means for locking said arm with respect to said column, said means being adapted to produce a temporary locking force effective in a line passing through the axis of said column, final locking means for fixing said arm with respect to said column, said final locking means being liable to produce, when applied or released, tangential reactions of said column with respect to said arm, the temporary locking means being adequate to hold the arm against pivotal movement about the column in opposition to the said tangential reactions produced during the operation of the final locking means, and a single electric control for operating successively said temporary locking means and said final locking means, both when said final locking means are to be applied and when they are to be released.

8. A machine tool of the type described which comprises, in combination, a column, a radial arm carried by said column and pivotable about the axis thereof, locking means for fixing said arm with respect to said column, said locking means being liable to produce, when applied or released, tangential reactions of said column with respect to said arm, a shaft for operating said locking means, means for connecting said shaft with said arm comprising a bearing in which said shaft extends, in a loose fit, permitting transverse movement of the shaft in said bearing substantially to the extent that such transverse movement may be induced in said shaft by said tangential reactions, a motor carried by said arm adapted to turn always in the same direction, means interposed between said motor and said shaft for causing said shaft to oscillate under the effect of the rotation of said motor, a cam driven by said motor, manual means for closing the circuit of said motor, and means operative by said cam for automatically stopping said motor at the end of the application or release of said locking means.

9. A machine tool of the type described which comprises, in combination, a column, a radial arm carried by said column and pivotable about the axis thereof, locking means for fixing said arm with respect to said column, said locking means being liable to produce, when applied or released, tangential reactions of said column with respect to said arm, a shaft for operating said locking means, means for connecting said shaft with said arm comprising a bearing in which said shaft extends, in a loose fit, permitting transverse movement of the shaft in said bearing substantially to the extent that such transverse

movement may be induced in said shaft by said tangential reactions, a motor carried by said arm adapted to turn always in the same direction, means interposed between said motor and said shaft for causing said shaft to oscillate under the effect of the rotation of said motor, a cam driven by said motor, a contactor inserted in the feed circuit of said motor including an energizing circuit adapted, when closed, to close the circuit of said motor, a switch operative by said cam, a circuit for maintaining the energizing of said contactor, two contacts in said switch, operative by said cam, both connected in shunt with said last mentioned circuit, said two contacts being arranged successively to cut off and alternately to prepare the closing of, said circuit, whereby the device is re-set for a new operation at the end of each operation.

10. A machine tool of the type described which comprises, in combination, a column, a radial arm carried by said column and pivotable about the axis thereof, locking means for fixing said arm with respect to said column, said locking means being liable to produce, when applied or released, tangential reactions of said column with respect to said arm, a shaft for operating said locking means, means for connecting said shaft with said arm comprising a bearing in which said shaft extends, in a loose fit, permitting transverse movement of the shaft in said bearing substantially to the extent that such transverse movement may be induced in said shaft by said tangential reactions, a motor carried by said arm adapted to turn always in the same direction, means interposed between said motor and said shaft for causing said shaft to oscillate under the effect of the rotation of said motor, a cam driven by said motor, a contactor inserted in the feed circuit of said motor including an energizing circuit adapted, when closed, to close the circuit of said motor, a circuit for maintaining the energizing of said contactor, a switch operative by said cam, two contact elements in said switch, movable in response to the rotation of said cam, both connected in shunt with said last mentioned circuit, said two contact elements being arranged to produce the cutting off, and alternately to prepare the closing, of said last mentioned circuit, whereby the whole system is re-set for a new operation at the end of each operation, the outline of the cam including two circular arcs of different respective radii, joined together by two portions oblique to the circumference of said cam, said switch including a roller rigidly connected to said contact elements and adapted to cooperate with the outline of said cam.

11. A machine tool of the type described which comprises, in combination, a column, a radial arm carried by said column and pivotable about the axis thereof, locking means for fixing said arm with respect to said column, said locking means being liable to produce, when applied or released, tangential reactions of said column with respect to said arm, a shaft for operating said locking means, means for connecting said shaft with said arm comprising a bearing in which said shaft extends, in a loose fit, permitting transverse movement of the shaft in said bearing substantially to the extent that such transverse movement may be induced in said shaft by said tangential reactions, a motor carried by said arm adapted to turn always in the same direction, means interposed between said motor, and said shaft, for causing said shaft to oscillate under

the effect of the rotation of said motor, a cam driven by said motor, a contactor inserted in the feed circuit of said motor including an energizing circuit adapted, when closed, to close the circuit of said motor, a circuit for maintaining the energizing of said contactor, a switch including two contact elements both connected in shunt with said last mentioned circuit, said two elements being adapted to produce the cutting off, and alternately to prepare the closing, of said last mentioned circuit, a roller rigidly assembled with both of said elements adapted to cooperate with said cam, temporary means for locking said arm with respect to said column adapted to develop only forces passing through the axis of said column, including electro-magnets, and means for electrically connecting said electro-magnets in shunt with the feed circuit of said motor between said contactor and said motor.

12. A machine tool of the type described which comprises, in combination, a column, a radial arm carried by said column and pivotable about the axis thereof, locking means for fixing said arm with respect to said column, said locking means being liable to produce, when applied or released, tangential reactions of said column with respect to said arm, a shaft for operating said locking means, means for connecting said shaft with said arm comprising a bearing in which said shaft extends, in a loose fit, permitting transverse movement of the shaft in said bearing substantially to the extent that such transverse movement may be induced in said shaft by said tangential reactions, a motor carried by said arm adapted to turn always in the same direction, means interposed between said motor and said shaft, for causing said shaft to oscillate under the effect of the rotation of said motor, a cam driven by said motor, a contactor inserted in the feed circuit of said motor including an energizing circuit adapted, when closed, to close the circuit of said motor, a circuit for maintaining the energizing of said contactor, a switch including two contact elements both connected in shunt with said last mentioned circuit, said two elements being adapted to produce the cutting off, and alternately to prepare the closing, of said last mentioned circuit, and being both operatively connected with said cam, temporary means for locking said arm with respect to said column adapted to develop only forces passing through the axis of said column, said temporary locking means including electro-magnets, means for electrically connecting said electro-magnets in shunt with the feed circuit of said motor between said contactor and said motor, and a delayed action electric transmission between said electro-magnets and said motor.

13. A machine tool according to claim 11 which comprises a first push-button inserted in said energizing circuit, for producing the application of said locking means, and a second push button, also inserted in said energizing circuit, in shunt with the first, for producing the release of said locking means.

14. A machine tool according to claim 11 further including means, operative by the working of said locking means, for signalling the end of the operation of said locking means.

15. A machine tool of the type described comprising a column, a radial tool supporting arm carried by said column and pivotable about the axis thereof, means for finally locking said arm against pivotal movement about said column, and separate means for temporarily holding said

arm in a desired position while said locking means are being operated, the said holding means being adequate to hold said arm immovable against forces, induced by the action of said locking means, tending to cause said arm to shift from a desired position.

16. A machine tool according to claim 15, the said holding means comprising portions of said column and of said arm, a holding device fixed upon one of said portions and adapted to exert a holding force upon the other of said portions effective in a line extending radially of said column, and means for establishing and disestablishing said force whereby, respectively, to hold said column and arm against relative pivotal movement and to free said column and arm for such movement.

17. A machine tool according to claim 15, the said holding means comprising portions of said column and of said arm, a holding device fixed upon one of said portions and adapted to exert a holding force upon the other of said portions effective in a line extending radially of said column, and means for establishing and disestablishing said force whereby, respectively, to hold said column and arm against relative pivotal movement and to free said column and arm for such movement, the said holding device comprising an electro-magnet and the said means comprising an electric circuit including means for opening and closing said circuit.

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