

Aug. 21, 1934.

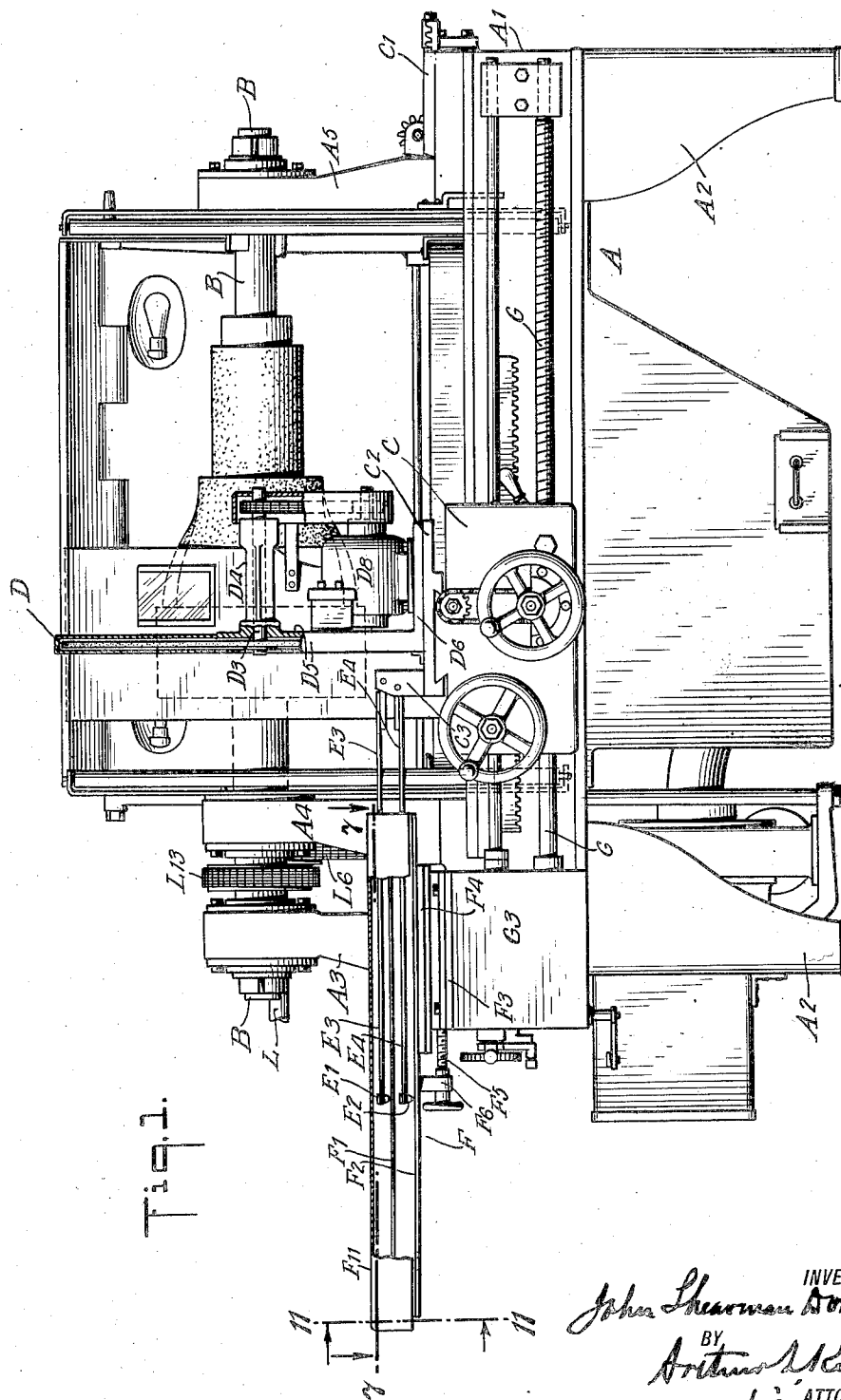
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1,971,297

SHAPING MACHINE

Original Filed June 7, 1928

8 Sheets-Sheet 1



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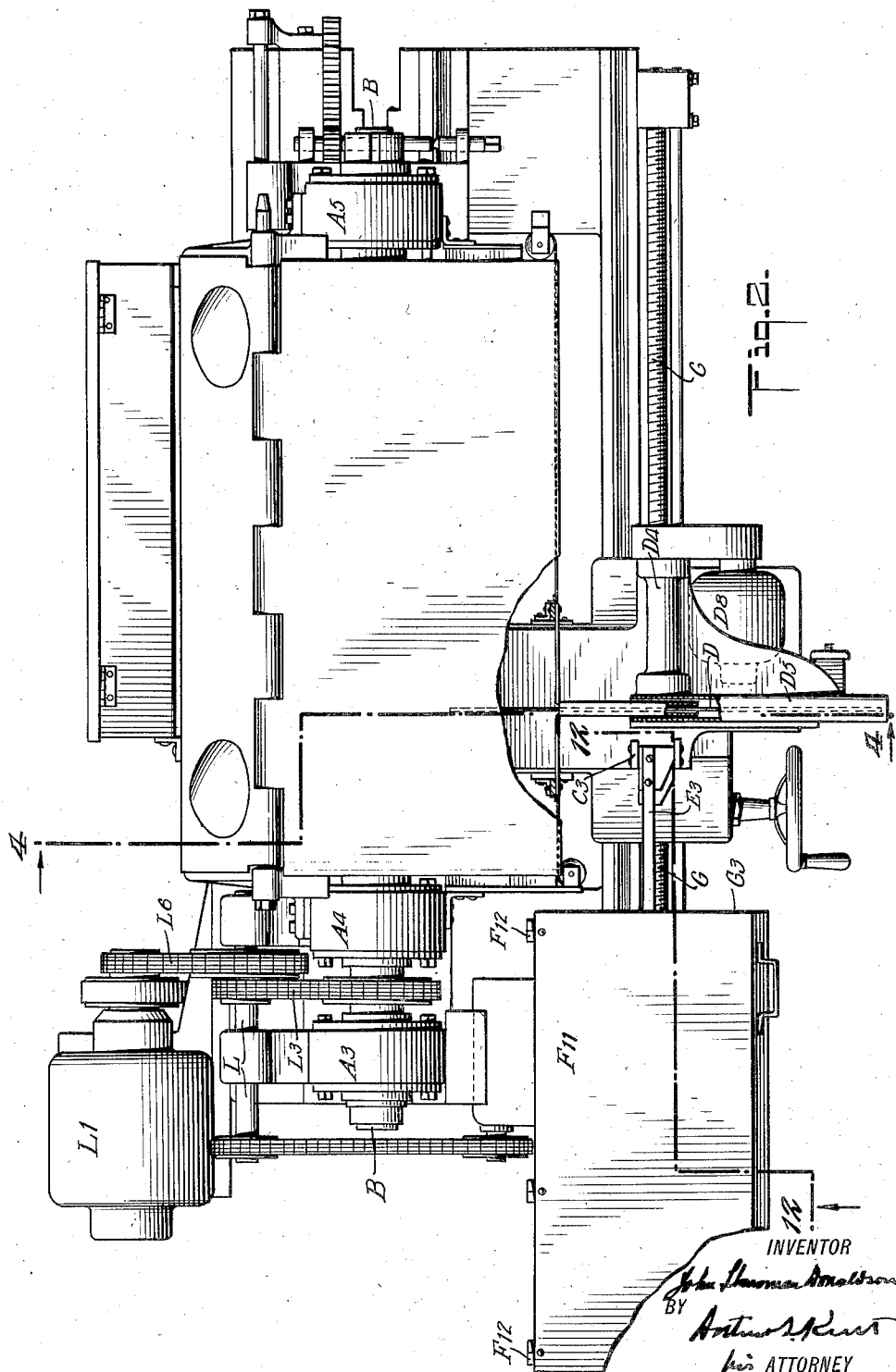
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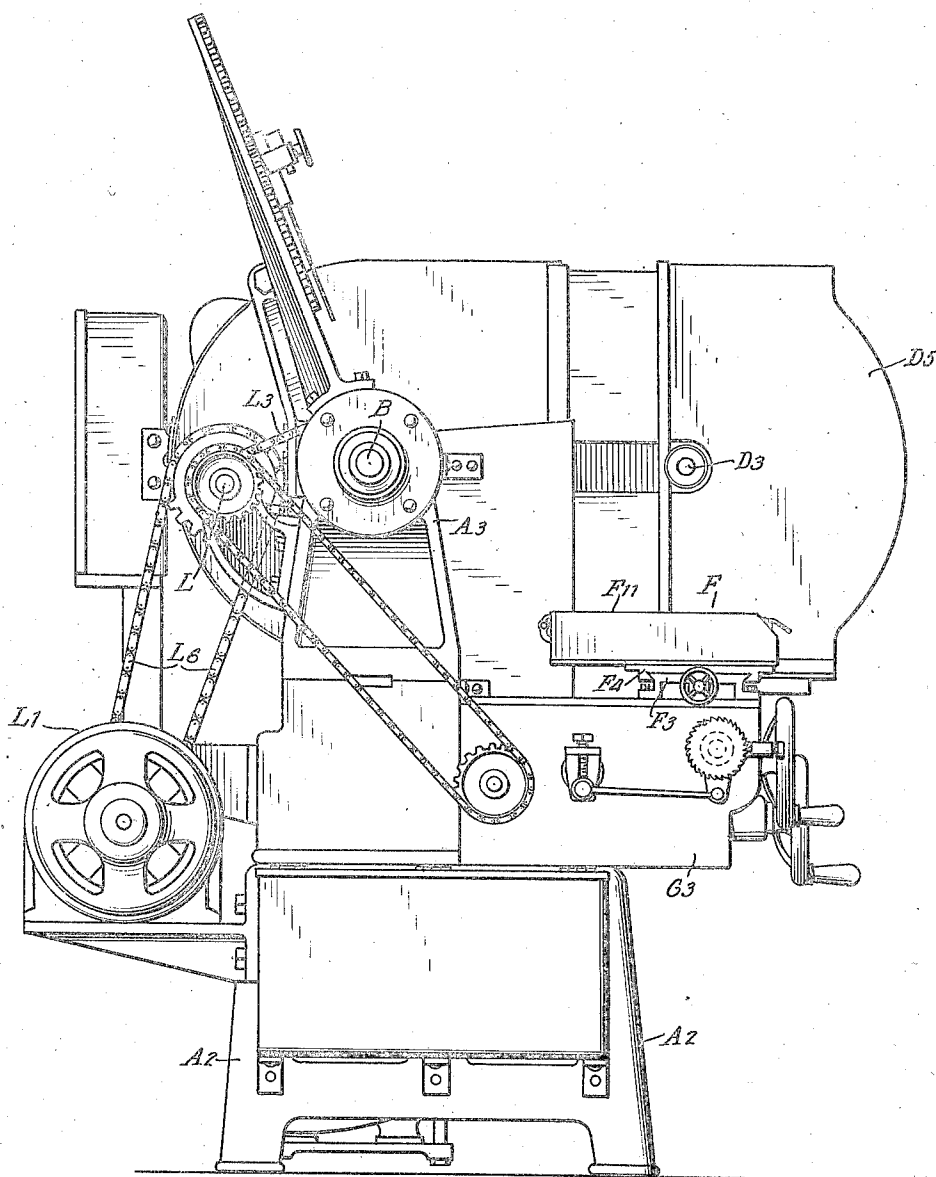


Fig. 3.

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SHAPING MACHINE

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8 Sheets-Sheet 4

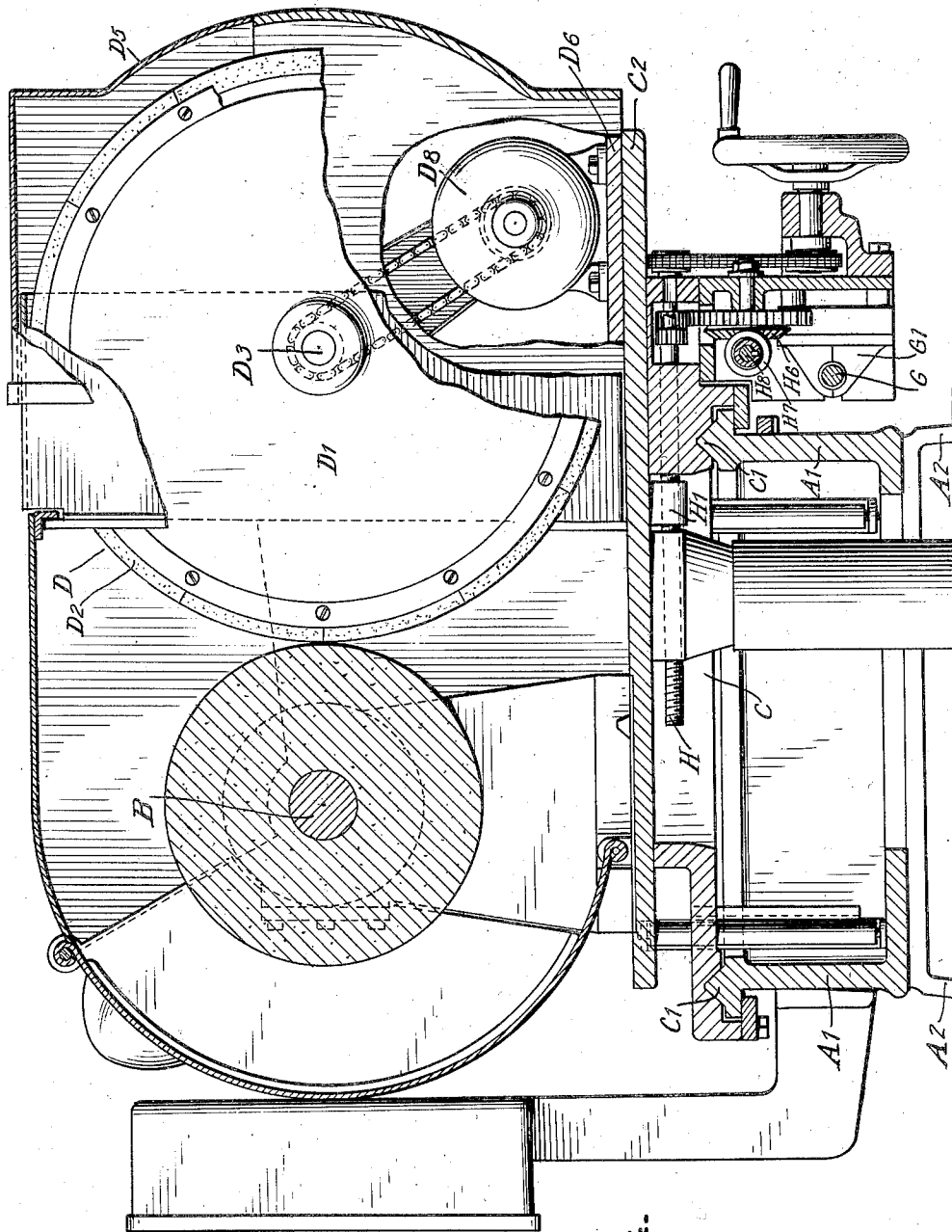


FIG. 4.

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8 Sheets-Sheet 5

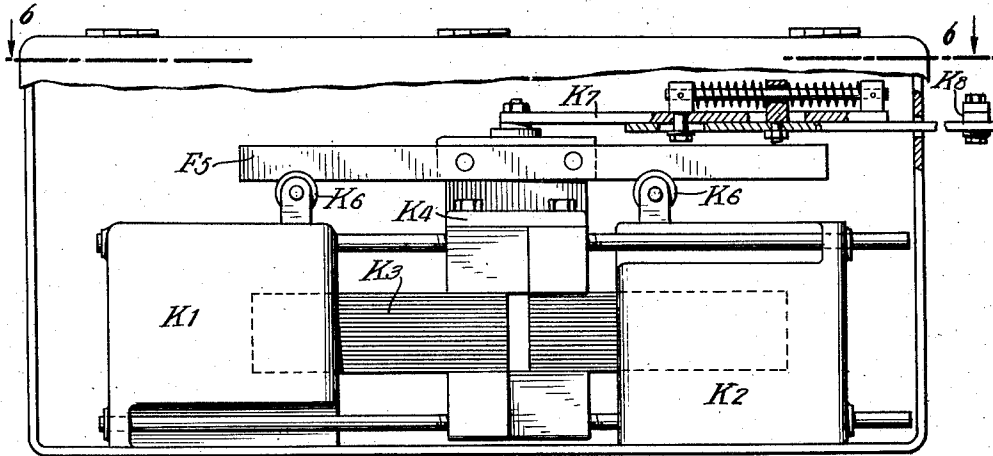


Fig. 5.

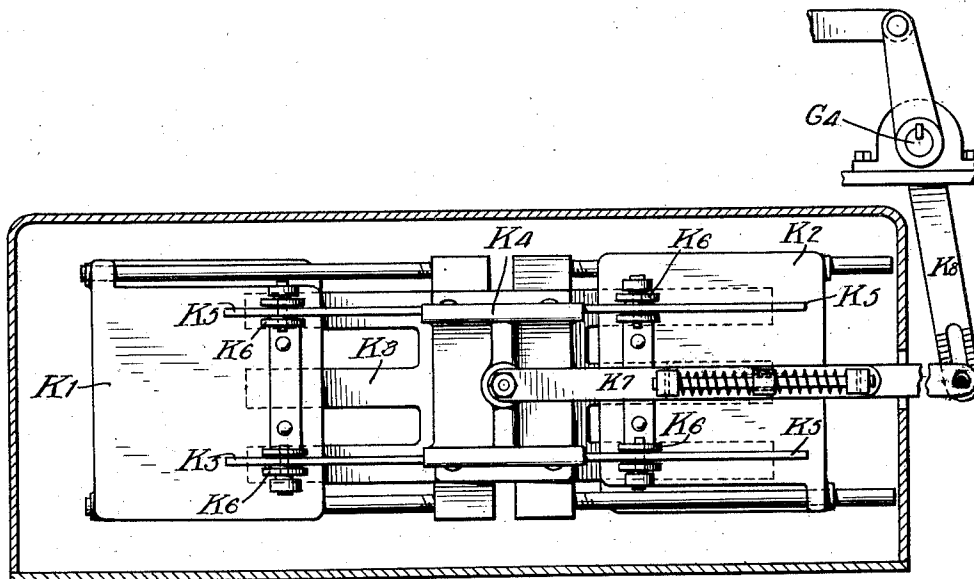


Fig. 6.

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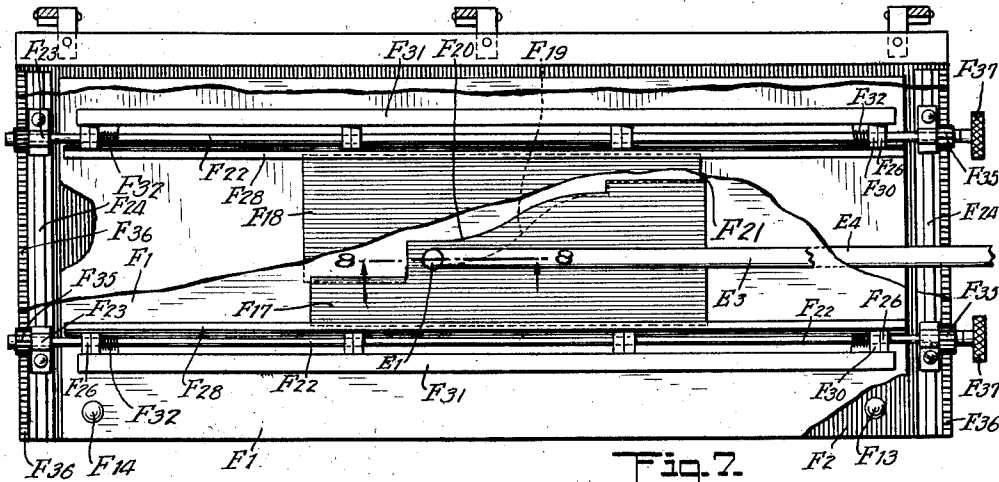


Fig. 7.

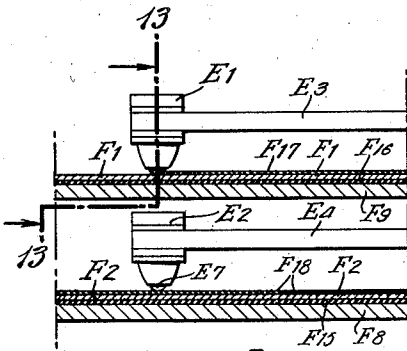


Fig. 8.

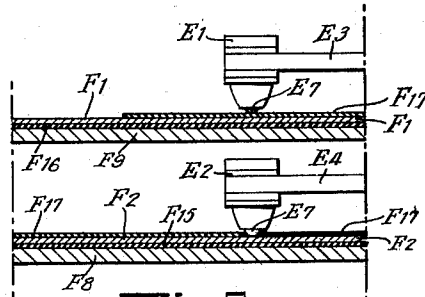


Fig. 9.

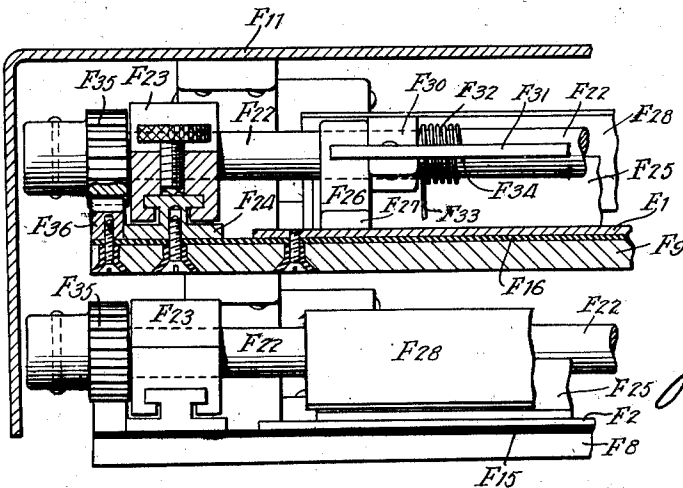


Fig. 10.

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SHAPING MACHINE

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Fig. 11.

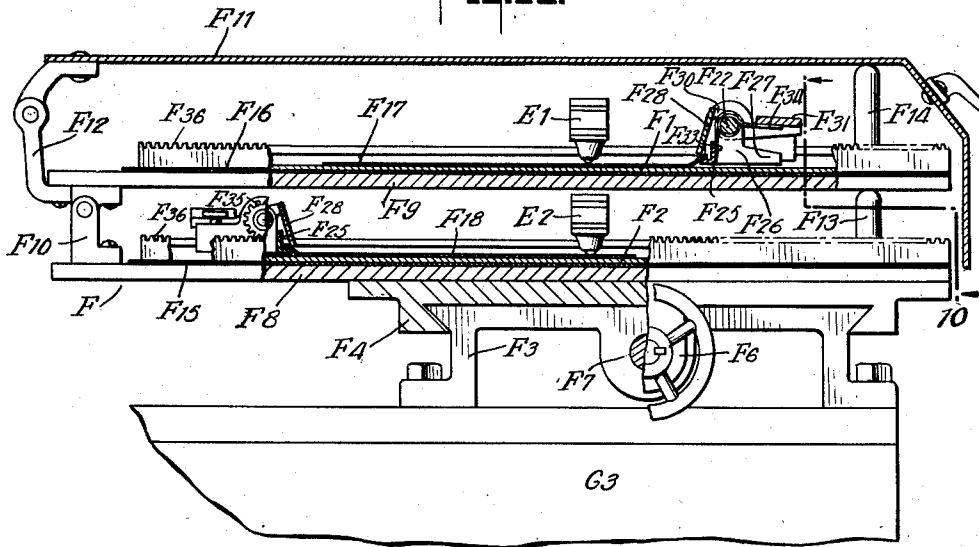
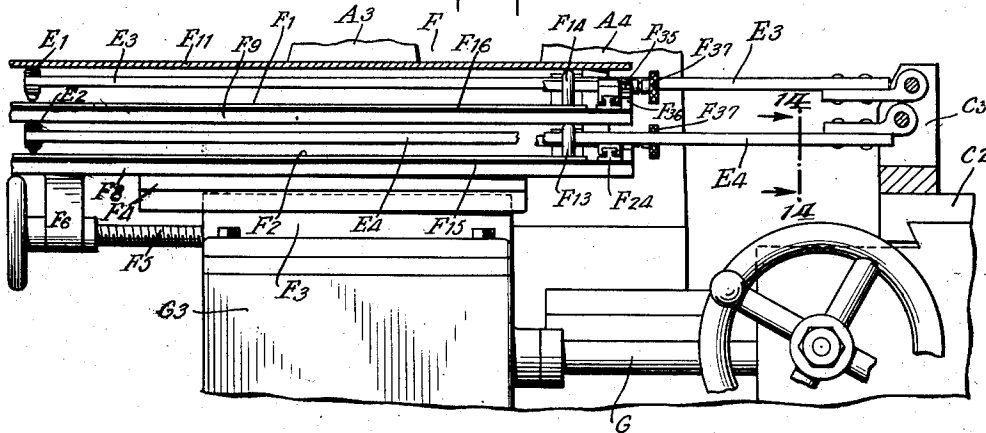
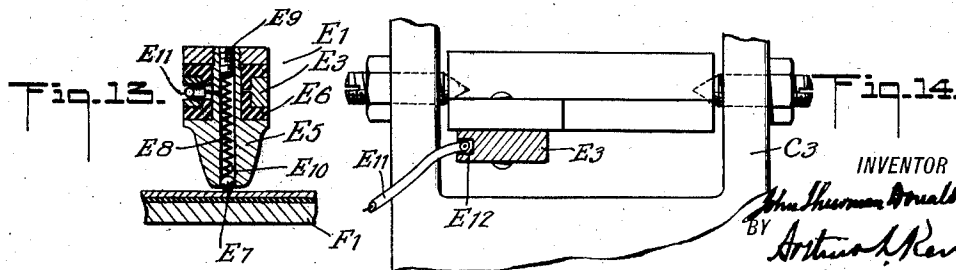


Fig. 12.



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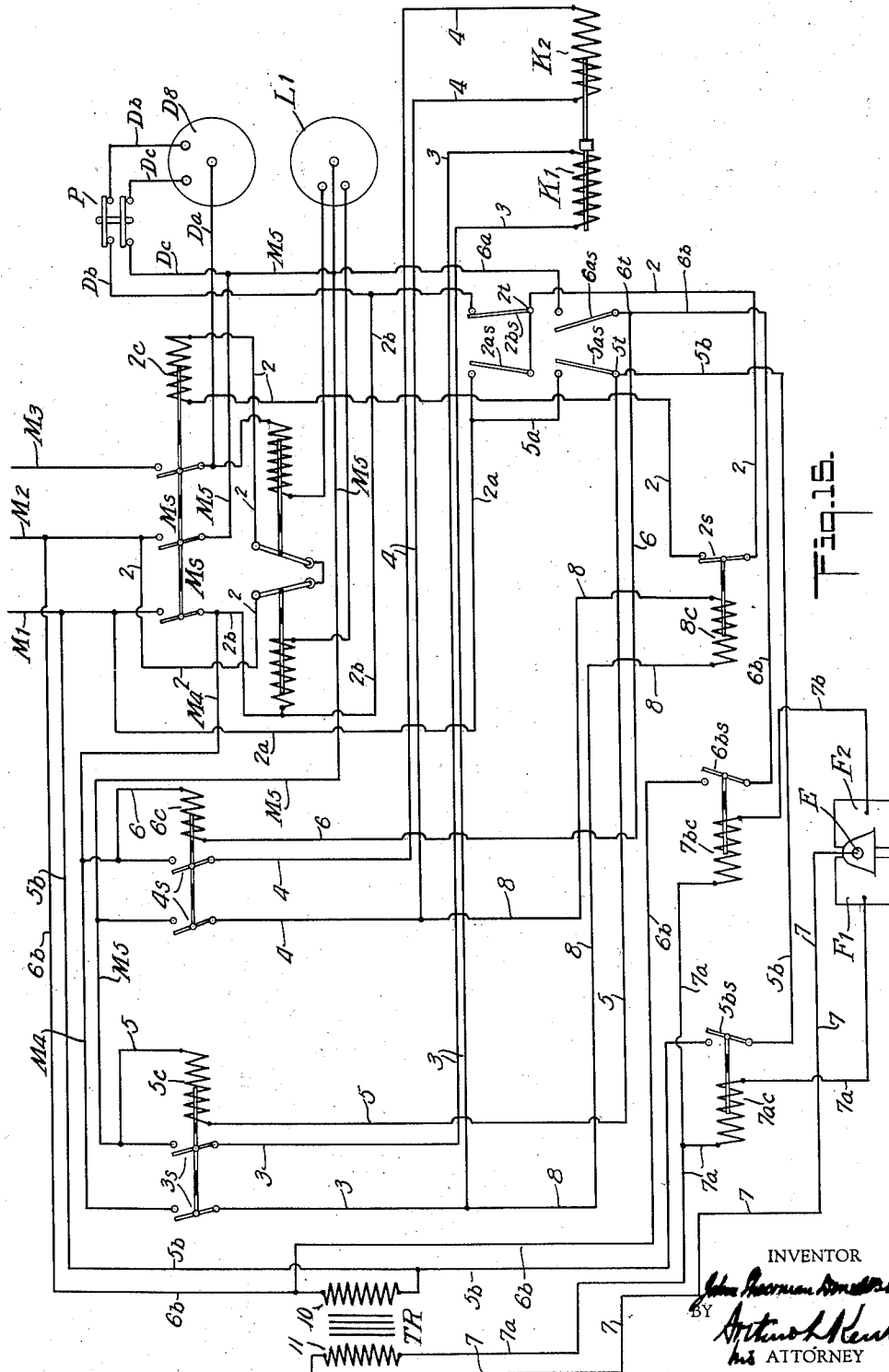
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SHAPING MACHINE

Original Filed June 7, 1928

8 Sheets-Sheet 8



UNITED STATES PATENT OFFICE

1,971,297

SHAPING MACHINE

John Shearman Donaldson, New York, N. Y.

Application June 7, 1928, Serial No. 283,480

Renewed January 22, 1934

12 Claims. (Cl. 51—48)

This invention relates to automatic shaping machines and aims to provide an improved machine for cutting, grinding, or otherwise forming the work automatically to the shape of a pattern.

The invention relates particularly to automatic controlling mechanism for such a machine and provides for guiding the tool of a machine in accordance with a pattern formed of one or more templets made of paper or other cheap and easily cut substance. By making possible the use of paper patterns or templets in such a machine, the invention does away with the trouble, delay and expense heretofore involved in providing metal patterns or templets for the control of automatic cutting machines.

In accordance with the invention, the controlling mechanism consists of a flat plate of conductive material and a feeler connected with the tool of the machine and movable over and in the plane of said plate. Means are provided for securing a paper pattern or templet cut to the form which is to be cut on the work over a portion of the surface of the plate. In the operation of the machine, the feeler moves over the paper pattern, thus being held out of contact with the plate until it reaches the edge of the pattern. As it moves over the edge of the pattern, it comes in contact with the plate, closing an electric circuit through the feeler and plate. The closing of this circuit is utilized to reverse or otherwise control the direction of movement of the tool.

In order to provide for reversal of the movement of the tool in two opposite directions, two conductive plates are provided. These plates are partially covered by a single pattern and associated with a single feeler which may move over the pattern and then into contact with one or the other plate as it passes over one or the other edge of the pattern, or, more desirably, each plate is partially covered by a separate pattern and separate but correspondingly moved feelers are provided to cooperate with the two plates.

In order to make plain the nature and the use of the invention, I will describe in detail an automatic machine for dressing grinding stones embodying the invention and of the same general type as that shown in my co-pending application Serial No. 139,587, filed October 5, 1926. Such a machine is shown in the accompanying drawings, in which:—

Fig. 1 is a front elevation of the whole machine showing portions of the pattern table cover and the tool cover broken away;

Fig. 2 is a plan view of the machine with parts of the work cover and tool cover broken away;

Fig. 3 is a left end elevation of the machine;

Fig. 4 is a transverse sectional view of the upper portion of the machine taken on the line 4—4 of Fig. 2 but on a larger scale;

Fig. 5 is a view on a larger scale and looking from the left hand end of the machine at the solenoid box with its hinged cover broken away and showing the parts within the box partly in section;

Fig. 6 is a plan view of the parts shown in Fig. 5 with the casing sectioned on the line 6—6 of Fig. 5;

Figs. 7 to 14 inclusive are details showing the pattern table and the feelers; Fig. 7 being a plan view of the pattern table with a portion of its upper plate broken away; Figs. 8 and 9 being fragmentary sections taken on the line 8—8 of Fig. 7 and showing the different positions of the feelers; Fig. 10 being an enlarged vertical section on the line 10—10 of Fig. 11; Fig. 11 being an end elevation of the pattern table partly sectioned on the line 11—11 of Fig. 1; Fig. 12 being a front elevation of the pattern table showing a part of the cross-slide and sectioned on the line 12—12 of Fig. 2; Fig. 13 being a fragmentary section of one of the feelers and pattern plates taken on the line 13—13 of Fig. 8; and Fig. 14 being a fragmentary section on the line 14—14 of Fig. 12, showing the hinge of one of the feeler arms; and

Fig. 15 is a diagram of the electrical circuits of the machine.

The dressing machine shown in the drawings is a machine of the lathe type. It has a framework A, comprising a hollow box-like table or bed A1 supported on legs A2. Standards A3, A4, A5 rising from the table carry bearings for a power driven mandrel or shaft B on which the work is carried. On the table A1 are two longitudinal ways C1 on which the tool carriage C is slidably mounted. The tool carriage extends across the table and carries a cross-slide C2. The tool D, which in the form shown consists of a power driven grinding wheel (hereinafter described in detail), is mounted on the cross-slide near the front of the machine. To the cross-slide are connected feeler arms E3, E4, carrying at their outer ends the feelers E1, E2, which cooperate with the upper and lower plates F1, F2 of an adjustable pattern table F mounted at the left end of the bed A1 of the machine. The usual traverse screw G extending lengthwise of the machine and cooperating with a nut G1 on the tool carriage is provided to cause the traversing movements of the tool. The usual feed screw H, carried by the carriage and cooperating with a nut H1 on the cross-slide, is provided to cause feeding move-

ments of the tool. The traverse screw G is driven from a power shaft L through a reversing clutch located in a clutch casing G3, and electrically controlled by a flow of current in circuits which include as contact terminals the feelers E1, E2 and the plates F1, F2 of the pattern table F, in such manner that the direction of movement of the carriage is reversed from left to right when the feeler E1 moves off the left hand edge of a paper templet on the plate F1 and comes into contact with this plate, and from right to left when the feeler E2 moves off the right hand edge from a paper pattern on the plate F2 and comes in contact with this plate. The feed screw H is driven from the power shaft L through a friction clutch and is held against movement except at the moment of the reversal of the traversing movement of the carriage. At each such reversal, the feed screw is turned an amount which may be adjusted so that at each cut the tool is slightly nearer the axis of the work than on the previous cut.

The pattern table F (Figs. 1, 7, 11, 12) is adjustably mounted on the gear case G3 by means of a slideway F3 secured to the gear case and a slide F4 on the bottom of the pattern table. A screw F5, journaled in a bracket F6 secured to the bottom of the table and engaging a nut F7 secured to the slideway F3, provides means for adjusting the pattern table F longitudinally of the machine, that is to say, parallel to the axis of the work. In the form illustrated, the pattern table F has a lower bed F8 mounted on the slide F4 and an upper bed F9 hinged to a bracket F10 extending upward from the lower bed. A cover F11 is similarly hinged to a bracket F12 extending upwardly from the upper bed F9. In its normal position, the upper bed F9 rests on a stud F13 projecting from the lower bed and is thus held horizontal and parallel to the lower bed. A similar stud F14 projecting from the upper bed is provided to hold the cover F11 parallel to the upper bed when the cover is closed as shown in Fig. 11.

The lower and upper beds F8, F9 are covered with sheets of insulating material F15 and F16 upon which the conducting plates F1, F2 are mounted. These insulated plates F1, F2 are connected by wires so that each of them forms one of the contact terminals of an electric circuit which, when energized, serves to reverse the direction of the traversing movement of the tool in one or the other direction. The opposite terminal of each circuit is one of the feelers E1, E2.

The construction of the feelers is best illustrated in Fig. 13. The feeler E1 there shown has a body E5 of conducting material insulated by insulating material E6 from the end of the arm E3 which carries the feeler. In order to facilitate the movement of the feeler over the edge of a paper pattern on the conducting plate F1, the feeler is provided with a spring-depressed contact ball E7. Provision for this ball, for the spring E8 which depresses it, and an abutment E9 for the upper end of the spring is made by a central bore E10 in the body E5. The lower end of the bore tapers inward slightly so as to prevent the ball E7 from coming out. An insulated conductor E11 has one of its ends connected to the body E5 and thus through the body to the ball E7. This conductor E11 lies in a groove E12 in the arm E3 carrying the feeler.

The feeler E2 is precisely similar to the feeler E1 which has been described. This electrical conductor is directly connected at any convenient point to the conductor E11 of the feeler E1

so that while the two feelers are physically separate they constitute electrically a single terminal of the electric controlling circuit herein-after described.

To permit access to the conducting plates F1, F2 for the purpose of placing paper patterns thereon, the feeler arms E3, E4 are hinged to a bracket C3 on the cross slide C2. The form of the hinges is illustrated in Fig. 14 from which it will be seen that, while each feeler arm E3, E4 may be tipped upwardly to expose the plate on which a feeler rests, both arms are securely held against turning in a horizontal plane so that when the feelers are resting on their respective contact plates each of them has a horizontal movement corresponding exactly to that of the cross-slide C2 and the operative point of the tool D on the cross-slide.

To guide the movement of the tool, templets F17, F18 of insulating material such as paper or thin cardboard are placed on the contact plates F1, F2 so as to insulate the feelers from the plates during a part of their travel over the plates. The operative outline F19 of the templet F18 corresponds exactly to the outline to be cut on the work. The operative outline F20 of the templet F17 corresponds to an outline to be cut upon another part of the work, but in the particular machine illustrated serves merely to limit the length of the back cuts of the tool, that is, those cuts which the tool makes in traversing away from the final outline to be cut on the work. The templets F17, F18 are placed on their respective plates with their operative outlines F19, F20 turned in opposite directions and are so positioned that each of the feelers E1, E2 is upon one of the templets when the other feeler moves across the operative outline of the other templet into contact with one of the plates. When, as in the form illustrated, the length and position of the feeler arms E3, E4 are such that the feelers are located one directly over the other, the templets F17, F18 are so located that their operative outlines F19, F20 overlap, as best shown in Fig. 7.

During the operation of the machine, the feelers, sharing the movement of the tool, are traversed back and forth along the conducting plates of the pattern table in a series of parallel straight lines which are parallel to the axis of the work. The lengths of these traverse lines, and consequently the length of the cuts on the work, are determined by the position of the operative outlines F19, F20 of the templets, and particularly by the extent to which these outlines overlap. In each left hand traverse, the tool and the feelers continue to move until the feeler E1 moves across the outline F20 of the templet F17 and thus comes in contact with the conducting plate F1. This closes the circuit which effects a reversal of the traversing movement towards the right, bringing the feeler E1 again over the insulating templet F17. The traverse towards the right continues until the feeler E2 crosses the outline F19 of the templet F18 bringing it into contact with the conducting plate F2, as shown in Fig. 9. This effects a reversal of the traversing movement from right to left. The operation thus continues, maintaining the feelers always upon the overlapping portions of the templets until, at the conclusion of the cutting operation, the feelers reach the point F21 and both come in contact with the respective plates F1, F2. The closing of both reversing circuits at the same time by contact of both feelers with

their respective conducting plates effects a stopping of the entire mechanism of the machine in a manner hereafter described.

From the above description of the operation of the controlling mechanism, it will be seen that, while the direct superposition of the plates F1, F2 and feelers E1, E2 is desirable in order to secure compactness, it is not essential to the operation of the mechanism that the plates and feelers be directly superposed or even that the plates be located in different planes; in fact, by locating the two plates side by side in the same plane they may be used in connection with a single feeler and a one-piece pattern having its operative outlines located on each plate. This arrangement illustrated diagrammatically in Fig. 15 has, however, the disadvantage of greatly limiting the shape of the patterns which may be used.

Numerous different means may be provided for holding the insulating templets F17, F18 upon the conducting plates F1, F2 in such position that they cover and insulate the desired portions of the surfaces of these plates. Thus, for example, the templets may be secured to the plates by an adhesive. As, however, it is important that the position of the templets be nicely adjusted with respect to the work, a feature of the invention consists in providing adjustable means for securing the templets upon the conducting plates.

Templet-holding means of identical construction are provided for the two conducting plates F1, F2. The templet-holding means for the plate F1 include a shaft F22 extending lengthwise across the upper bed F9 of the pattern table and journaled in slides F23 engaging insulated slideways F24 extending across opposite ends of the bed F9. On the shaft F22 is mounted a clip for holding one edge of the templet F18. The lower gripping member of this clip is an angle-bar F25 carried by brackets F26 journaled on the bar F22 and having extended feet F27 resting against the plate F1 to prevent the brackets from turning about the shaft. The upper gripping member of the clip is a flat bar F28 carried by brackets F30 journaled on the shaft F22. These brackets carry also a substantially horizontal flat bar F31 for opening the clip. The upper engaging member of the clip, the bar F28, is urged towards the lower engaging member, F25, by means of a torsion spring F32 coiled about the shaft F22 and having one of its ends F33 reacting against the back of the angle-bar F25 and its other end F34 reacting against the under surface of the bar F31 as best shown in Fig. 11. It is apparent that, by depressing the bar F31, the bar F28 is separated from the angle-bar F25 permitting the insertion of the edge of a paper templet F18 between them so that this edge is firmly gripped when the bar F31 is released.

After a paper templet has thus been inserted, its position on the conducting plate may be adjusted by moving the slides F23 in their slideways F24. To facilitate such adjustment and to maintain parallelism between the gripped edge of the templet and the axis of the work during the adjustment, the shaft F22 is provided with a pair of gears F35 engaging insulated racks F36 extending across the ends of the bed F9 and the shaft is provided at one end with a hand wheel F37.

The electric circuits, which are closed by contact between the feelers and the upper and lower conducting plates, are utilized to control the energy supplying circuits of two aligned solenoids

K1, K2 (Figs. 5 and 6) so that a bar K3, the ends of which form the cores of these solenoids, is drawn in one direction when one feeler contacts with its plate and in the opposite direction when the other feeler contacts with its plate. The core-bar K3 is supported on a slide head K4 carried on parallel rails K5 which rest on grooved rollers K6. Movement of the head K5 is transmitted through a connecting rod K7 and arm K8 to a rockshaft G4. This shaft extends into the clutch casing G3, and its rocking movements are utilized to actuate the reversing clutch in said casing through which the traverse screw is driven. This reversing clutch may be of the same construction as that shown in my Patent No. 1,851,004, dated March 29, 1932, but, since the present invention is not concerned with a construction of the reversing clutch, and since numerous types of reversing clutch are well known and available, the reversing clutch is not illustrated and described herein.

Any appropriate form of mechanism such, for example, as that shown in my said Patent No. 1,851,004, may be used to cause a slight rotation of the feed screw H on each reversal of the traversing movement of the tool so as to cause a slight inward feeding movement of the tool at the moment of each such reversal. Thus the feed screw H may be connected through gearing with a bevel gear H6 which meshes with a bevel gear H7 travelling with the tool carriage C but splined to a longitudinal shaft H8 mounted in bearings in the bed of the machine. This shaft H8 may be driven from the power shaft L through a friction clutch contained in the gear casing G3 and an adjustable rigid reducing mechanism (Fig. 1), the driving member of the friction clutch being normally held against rotation and momentarily released for a limited movement on each shifting of the reversing clutch on the traversing mechanism.

The power shaft L and the work shaft B are most desirably both driven from a single electric motor L1 so that the rotation of the work shaft, as well as that of the power shaft, may be stopped by merely cutting off the the supply of current to this motor. The motor L1 is connected to the power shaft by a chain L6 and the work shaft is connected to the power shaft L by a chain L3.

Different arrangements of electric circuits may be provided in order to control the position of the solenoids K1, K2 by means of the flow of current between the feeler E1 and the plate F1 and between the feeler E2 and the plate F2. The circuits may be arranged for either direct or alternating current.

An illustration of a practical arrangement of the circuits is shown diagrammatically in Fig. 15. The arrangement shown is designed for use with a three-phase alternating current supplied over lines M1, M2, M3. The three lines are connected with the motor L1 through a normally open triple switch Ms operated by a relay coil 2c in a motor control circuit 2. The circuit 2 extends from the line M2 through the coil 2c to a terminal 2t where it divides into two branches 2a and 2b. The circuit 2 between the line M2 and the branching point 2t contains a normally closed switch 2s connected to be opened by a relay coil 8c in a circuit to be described. The branch 2a extends to the line M1 and contains a normally open manually operated switch 2as. The branch 2b connects through the switch Ms to the line M1.

The current for operating the solenoids K1 and K2 is taken from the lines M1 and M2

through leads M4 and M5 respectively, to which are connected the circuit 3 of the solenoid K1 and the circuit 4 of the solenoid K2. The leads M4 and M5 are desirably connected to receive their current through the main switch Ms so that this switch may serve as a master switch controlling the supply of current to all parts of the machine. The supply of current to the two solenoids is controlled by two normally open double switches 3s and 4s respectively. The switch 3s is controlled by a relay coil 5c in a control circuit 5 which extends from the lead M5 (which is connected with the line M2) through the coil 5c and to a terminal or branching point 5t from which the circuit extends in two branches. One branch 5a extends through a normally open manually operated switch 5as and is connected with the branch 2a of the circuit 2 through which connection is made to the line M1. The manually operable switch 5as thus provides means whereby the solenoid K1 may be energized independently of the feeler E. The other branch 5b of the circuit 5 extends from the terminal 5t to a normally open switch 5bs controlled by a relay coil 7ac in a control circuit hereinafter described, and thence to the line M1.

The switch 4s which controls the supply of current to the solenoid K2 is controlled by a relay coil 6c in a control circuit 6 which extends from the lead M4 (which is connected with the line M1) through the coil 6c and to a terminal or branching point 6t from which the circuit extends in two branches. One branch 6a extends through a normally open manually operated switch 6as and through M5 to the line M2, so that the solenoid K2 may be energized independently of the feeler E by closing the manually operable switch 6as. The other branch 6b of the circuit 6 extends from the terminal 6t through a normally open switch 6bs controlled by a relay coil 7bc in a control circuit hereinafter described, and thence to the line M2.

The circuits thus far described, all being directly connected between two of the lines M1, M2, M3 are operated at a relatively high voltage, for example, 220 volts, so that any slight dust or corrosion which collects on the terminals of the switches is immediately burned off and does not interfere with the operation. The relay coils 7ac and 7bc which control the switches 5bs and 6bs in the solenoid control circuits are operated by circuits 7, 7a and 7, 7b each of which includes the feeler E and one of the two plates F1 and F2. A comparatively low voltage, for example, 10 volts, is used in these circuits so as to prevent arcing between the feeler and the plates. The low voltage current is supplied by a transformer TR. The high voltage primary coil of this transformer is connected between the branches 5b and 6b of the solenoid control circuits, so that it will receive high voltage current directly from the supply lines M1 and M2. One terminal of the secondary coil 11 of the transformer is connected to the feeler E by the lead 7, while the other terminal of this coil is connected by 7a to the plate F1 and by 7b to the plate F2. The branch 7a contains the relay coil 7ac, while the branch 7b contains the relay coil 7bc, so that contact between the feeler E and the plate F1 closes the switch 5bs and operates the solenoid K1, while contact between the feeler E and the plate F2 closes the switch 6bs and operates the solenoid K2.

The relay coil 8c which opens the switch 2s in the motor control circuit 2 is connected in a shunt 8 between the solenoid circuits 3 and 4,

so that if both the switches 5bs and 6bs are closed at the same time, this shunt circuit will be connected directly with the supply lines M1 and M2 through leads M4 and M5, and the coil 8c will be energized to open the switch 2s and thereby cause the main switch M2 to open, stopping the motor and also cutting off the supply of current to the solenoid energizing circuits 3 and 4.

The machine is started in operation by closing the hand switch 2as, thereby closing the motor control circuit 2 through the branch 2a and energizing the coil 2c to close the main switch Ms to supply current to the motor L1 and to the solenoid energizing circuits 3 and 4. By the closing of the main switch, the circuit 2 receives current through the branch 2b and the coil 2c then continues to be energized to hold the main switch closed so long as the switches 2s and 2bs remain closed. The starting switch 2as opens automatically when released by an operator, so that the main switch Ms will be opened and operation of the machine stopped if either of the switches 2s or 2bs is opened. The main switch being closed, the solenoid K1 will be energized to reverse the direction of traversing movement of the tool carriage, and to cause a feeding movement, whenever the feeler E makes contact with the plate F1, and the solenoid K2 will be energized to make opposite reversal of the traversing movement of the tool carriage, and to cause a feeding movement, whenever the feeler E makes contact with the plate F2. The solenoids may also be energized at will by means of the manually operable switches 5as and 6as by which the control circuits 5 and 6 are closed through the branches 5a and 6a. Unless otherwise stopped, the machine will continue to operate, the tool being fed forward at each reversal of traverse of the carriage as hereinbefore explained, until the feeler reaches the deepest point of the pattern and makes simultaneous contact with both plates F1, F2, whereupon the two switches 5bs and 6bs in branches 5b and 6b of the two solenoid control circuits will be closed and the coil 8c will be energized to open the switch 2s to cause the main switch Ms to open, thereby stopping the machine, and the machine may be stopped at any time at will by opening the hand switch 2bs.

An automatic control mechanism which has been described is capable of general application in automatic shaping machines regardless of whether the shaping is accomplished by cutting or grinding or other known means of operating upon the work to be shaped in accordance with the pattern. It is apparent also that a single controlling mechanism such as that described may be utilized by means of proper electrical connections to operate a number of shaping machines when it is desired to shape a number of pieces of work simultaneously in accordance with a single pattern.

Another feature of the invention is of especial value in machines for dressing grinding wheels and may be used in such machines even when operated manually.

In dressing machines it has been customary to use as the operative part of the dressing tool a diamond or other very hard substance which is maintained stationary during the cutting operation, except for the ordinary traversing and feeding movements thereof. A tool of this character is very expensive, particularly as it requires frequent replacement. A feature of the present invention consists in eliminating this expense and making possible the use of a dress-

ing tool which need not be materially harder than the grinding wheels to be dressed. In accordance with this feature of the invention, the dressing tool consists of a grinding wheel D which may be of the same material as the grinding wheels mounted on the shaft B, although it is preferably a little harder. The tool wheel D is very narrow and has a large diameter. It most desirably consists of a circular metal plate D1 having detachably secured to its periphery narrow arcuate pieces D2 of carborundum or similar grinding material. The tool wheel D is fixed on a shaft D3 which is journaled in a bearing member D4 on a standard D5 rising from a horizontal plate D6 secured on the cross-slide C2 of the machine. The standard D5 is formed of a double casing completely enclosing the wheel D except at its inner edge. The plate D6 on the cross-slide C2 also carries the shaft D3 of the tool wheel D driven through a chain by a motor D8. The motor D8 operates at a much higher speed than the motor L1 and this fact combined with the large diameter of the tool wheel D gives it a peripheral velocity greatly in excess of that of the grinding wheels carried on the shaft B.

I have discovered that the relatively high peripheral velocity of the tool wheel D causes it to cut into the grinding wheels on the shaft B without material wear on its own grinding surface, even though it consists of material no harder than the wheels which are being dressed. While I have not definitely ascertained the reason for this, I believe that it may be found in the fact that the high peripheral velocity and large circumference of the tool wheel causes effective cooling of its cutting surface, while parts of the larger wheels of the shaft B which are brought into contact with the tool wheel are heated and torn away. Whether or not this be the correct explanation, there is no doubt but that the tool wheel D affords an effective, accurate and inexpensive means for dressing the wheels on the shaft B.

In the particular machine illustrated, the tool motor D8 is so connected that the supply of current to it is cut off at the same time that the supply of current to the motor L1 is cut off by having the feelers E1, E2, or the single feeler E, come into contact with both the plates F1 and F2.

The connections of the motor D8 are shown in the wiring diagram Fig. 15. The motor is connected to the lines M1, M2, M3 through the switch Ms by three leads Da, Db, Dc. The lead Da runs directly from the motor D8 to the switch Ms connecting the motor with the line M3. The lead Db extends from the motor to the branch 2b of the circuit 2. The lead Dc extends from the motor to the lead M5. The snap switch P is inserted in the leads Db and Dc so that the motor D8 may be stopped independently of the rest of the machine if desired.

What is claimed is:

1. In an automatic forming machine having a work holder, a tool, and means for causing relative movement between the tool and the work on the holder, controlling mechanism for causing the tool to reproduce on the work the outline of a paper pattern, comprising an electric circuit containing means for controlling the direction of the relative movement of the tool and work, a conducting plate forming one terminal of said circuit and carrying the paper pattern, a conducting feeler forming the other terminal of said circuit, and means for causing between said plate and said feeler a relative movement correspond-

ing to the relative movement between the tool and the work.

2. In an automatic forming machine having a work holder, a tool, and means for moving the tool with respect to the work, the combination of a conducting plate, a pattern of thin insulating material covering a portion of the surface of said plate and having an outline to be reproduced on the work, a conducting feeler movable over the surface of the pattern and plate, a connection between the feeler and the tool causing the feeler to have a movement corresponding to that of the tool, and electrical means operated by contact between the feeler and the plate when the feeler moves across the outline of the pattern into contact with the plate for changing the direction of the movement of the tool and feeler so as to move the feeler on to the pattern and thus out of contact with the plate.

3. Controlling mechanism for an automatic forming machine, comprising a conducting plate forming one terminal of an electric controlling circuit, a thin insulating pattern covering a portion of the surface of said plate, and a conductive feeler forming the other terminal of said electric circuit and movable over the surface of the pattern and conducting plate so that it contacts with said plate only when outside the outline of said pattern.

4. In an automatic forming machine having a work holder, a tool, and means for causing movement of the tool with respect to the work on the holder, controlling mechanism for reproducing on the work the outline of a pattern, comprising two electric circuits containing respectively means for changing the direction of the movement of the tool in opposite directions, two conducting plates insulated from one another and each forming one terminal of one of said circuits, thin insulating means covering a portion of the surface of each of said plates, and contact means forming a terminal of both said electric circuits and movable over the surfaces of said plates and said pattern.

5. Controlling mechanism for an automatic forming machine having electric tool reversing mechanism, comprising two conductive plates insulated from one another, two conductive feelers movable respectively over the surface of said two plates, a connection between each of said feelers and the tool of the machine causing each of said feelers to share the movements of the tool, electric reversing circuits connecting each plate with its feeler, and templates of thin insulating material covering parts of the surfaces of said plates and having operative outlines turned in opposite directions.

6. Controlling mechanism for an automatic forming machine having electric tool reversing mechanism, comprising two conductive plates insulated from one another, two conductive feelers movable respectively over the surface of said two plates, a connection between each of said feelers and the tool of the machine causing each of said feelers to share the movements of the tool, electric reversing circuits connecting each plate with its feeler, and templates of thin insulating material covering parts of the surfaces of said plates and having operative outlines turned in opposite directions, the templates being so positioned on their respective plates that the two feelers cannot come into contact with their plates at the same time during the forming operation.

7. Controlling mechanism for an automatic forming machine having electric tool reversing

- mechanism, comprising two conductive plates insulated from one another, two conductive feelers movable respectively over the surface of said two plates, a connection between each of said feelers and the tool of the machine causing each of said feelers to share the movements of the tool, electric reversing circuits connecting each plate with its feeler, and templets of thin insulating material covering parts of the surfaces of said plates and having operative outlines turned in opposite directions, the templets being so formed and so positioned on their plates that the two feelers cannot come into contact with their respective plates at the same time until each feeler reaches the end of the operative outline of the templet on its plate, and electrical means for stopping the operation of the machine when the two feelers come in contact with the two plates simultaneously.
8. Controlling mechanism for an automatic machine, comprising two conductive plates having plane surfaces lying in spaced parallel planes, means for securing a paper templet to the surface of each plate, mechanically connected feelers movable over the two plates and templets respectively, and two controlling circuits respectively connected between the plates and their feelers.
9. A controlling mechanism for an automatic machine, comprising superimposed spaced conductive plates, means for securing paper templets on said plates respectively, two feelers movable over the surfaces of the two plates respectively, a mechanical connection between the feelers maintaining them in vertical alignment, and two electric controlling circuits respectively extending between each plate and its feeler.
10. Controlling mechanism for an automatic machine having electric tool reversing mechanism, comprising two superimposed spaced horizontal conductive plates, two feelers movable respectively over the surfaces of said plates, a mechanical connection between said feelers maintaining them in vertical alignment, templets of thin insulating material located on said two plates respectively and having portions which are directly superimposed, the upper templet having an operative outline at one side of the portion thereof which is directly over a part of the lower templet, and the lower templet having an operative outline at the opposite side of the part thereof which is directly under a part of the upper templet, and two electric reversing circuits connected between the plates and their feelers respectively.
11. Controlling mechanism for an automatic machine, comprising a horizontal contact plate, means for securing a paper templet thereon, a second contact plate located above the first plate and hinged so that it may be tipped up to expose the first plate, means for securing a paper templet on the hinged plate, a horizontally movable member, an arm hinged to said member on a horizontal hinge line and normally lying between the contact plates, a feeler on said arm movable over the lower contact plate, a second arm hinged to said member on a horizontal hinge line and normally lying above the upper plate, a feeler on said arm movable over the upper plate, and the electric controlling circuits connected respectively between each plate and its feeler.
12. In controlling means for an automatic machine, a contact plate, a feeler movable over said plate in a series of parallel lines, a clip on said plate for engaging one edge of a paper templet, an abutment on said clip parallel to the lines of movement of the feeler, and means for adjusting the position of the clip of the plate while maintaining the abutment of the clip parallel to said lines of movement.
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