No. 798,391. PATENTED AUG. 29, 1905.

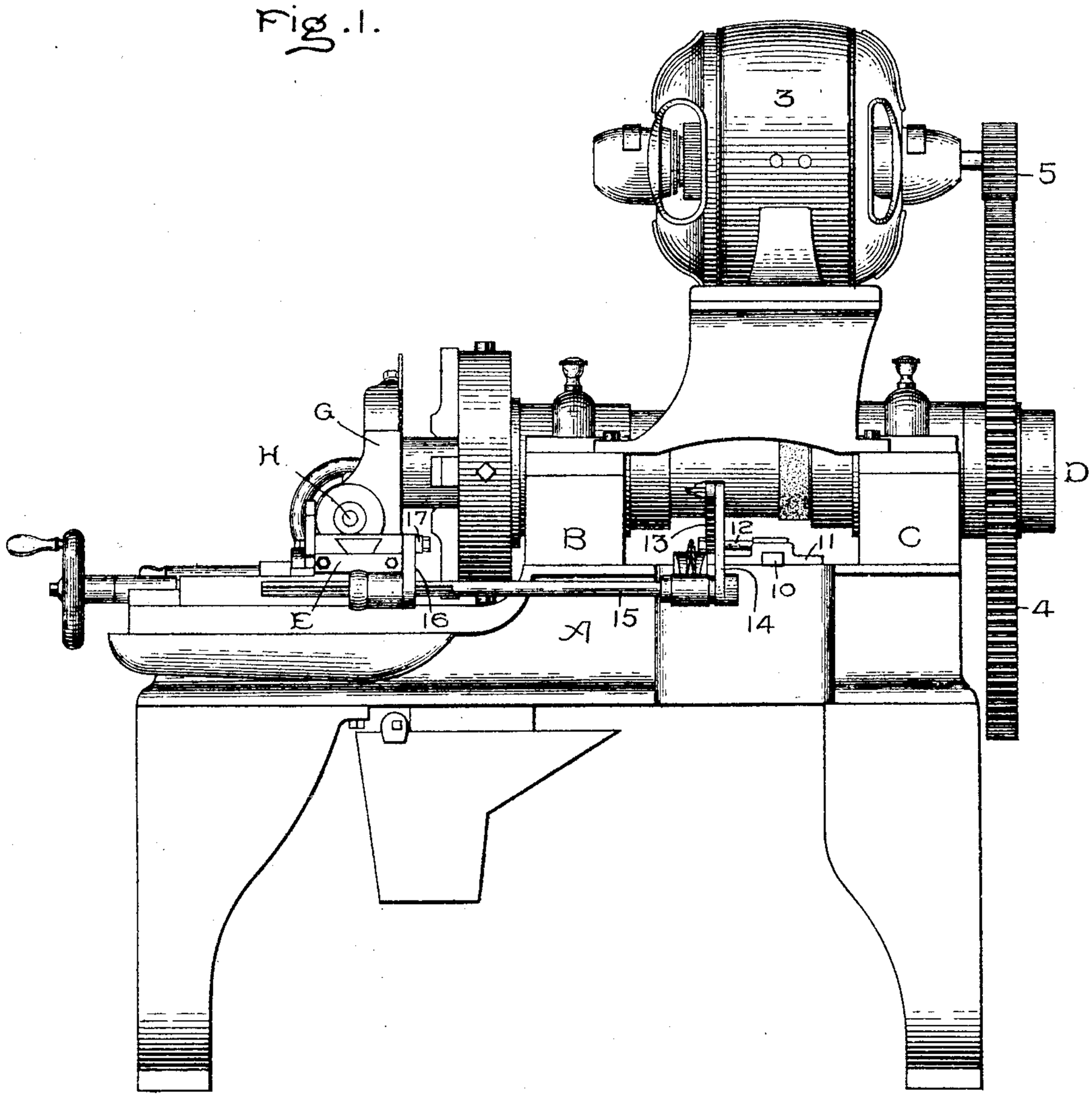
H. H. CLARK.

MOTOR DRIVEN MACHINE TOOL.

APPLICATION FILED APR. 9, 1903.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 2.

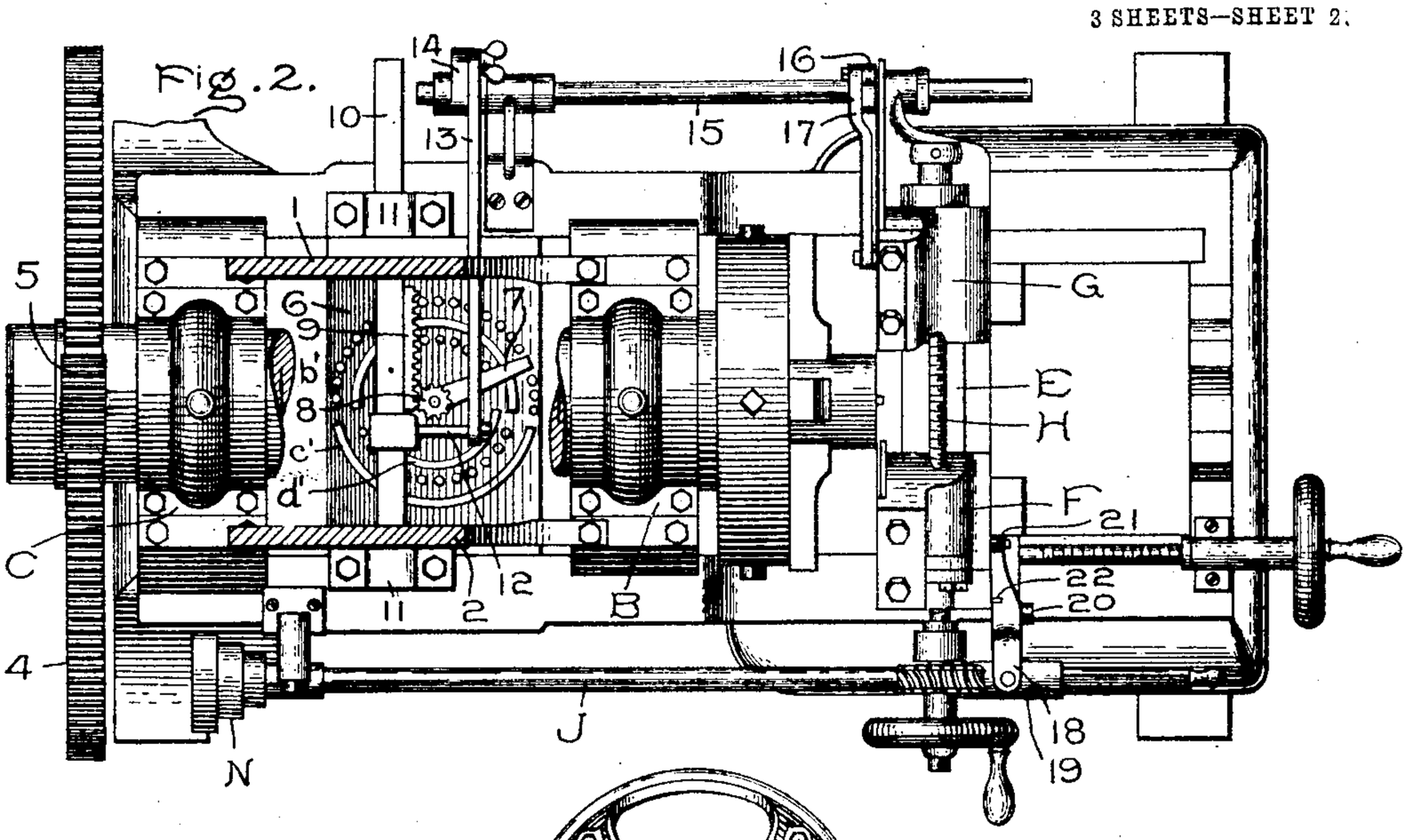
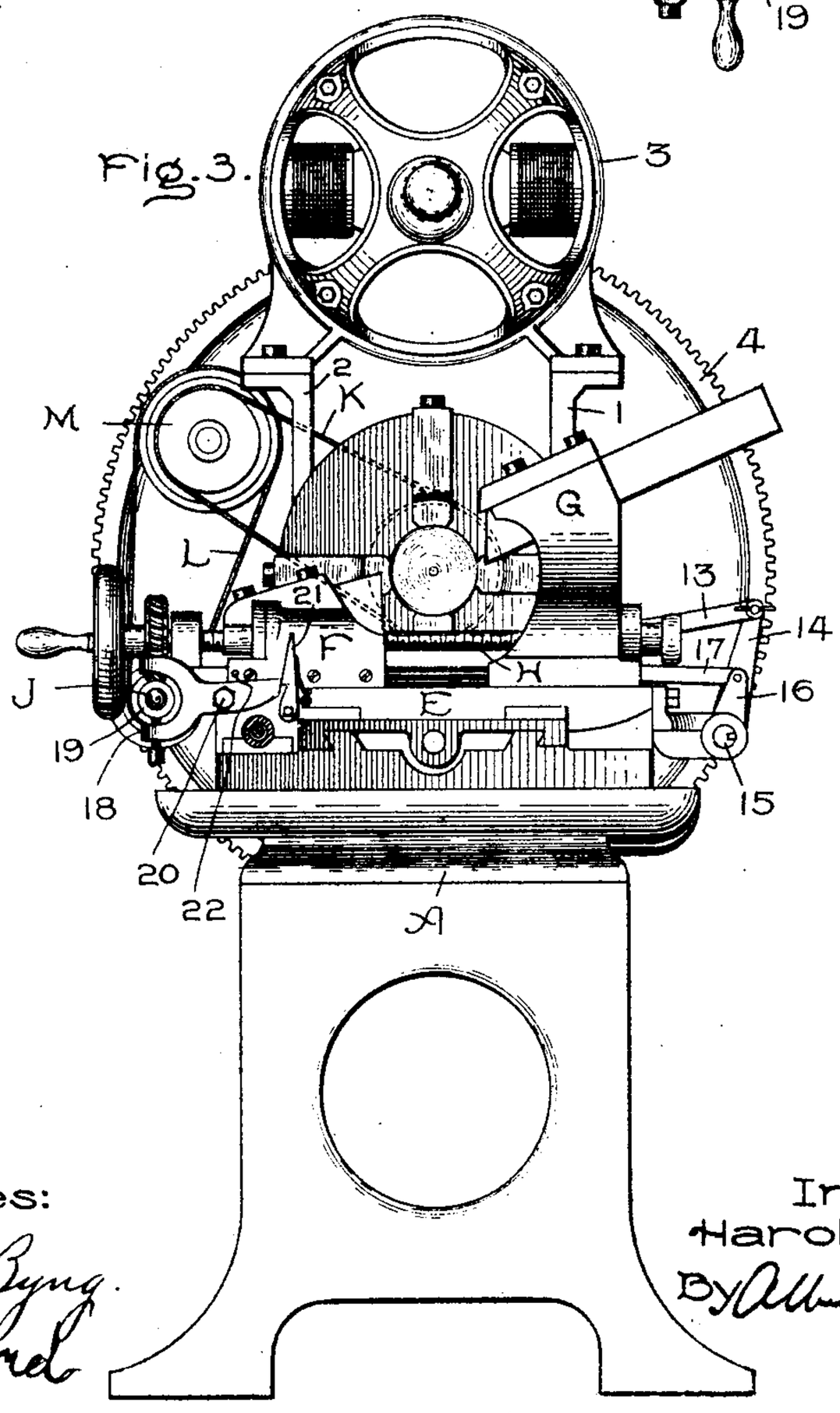


Fig. 3.



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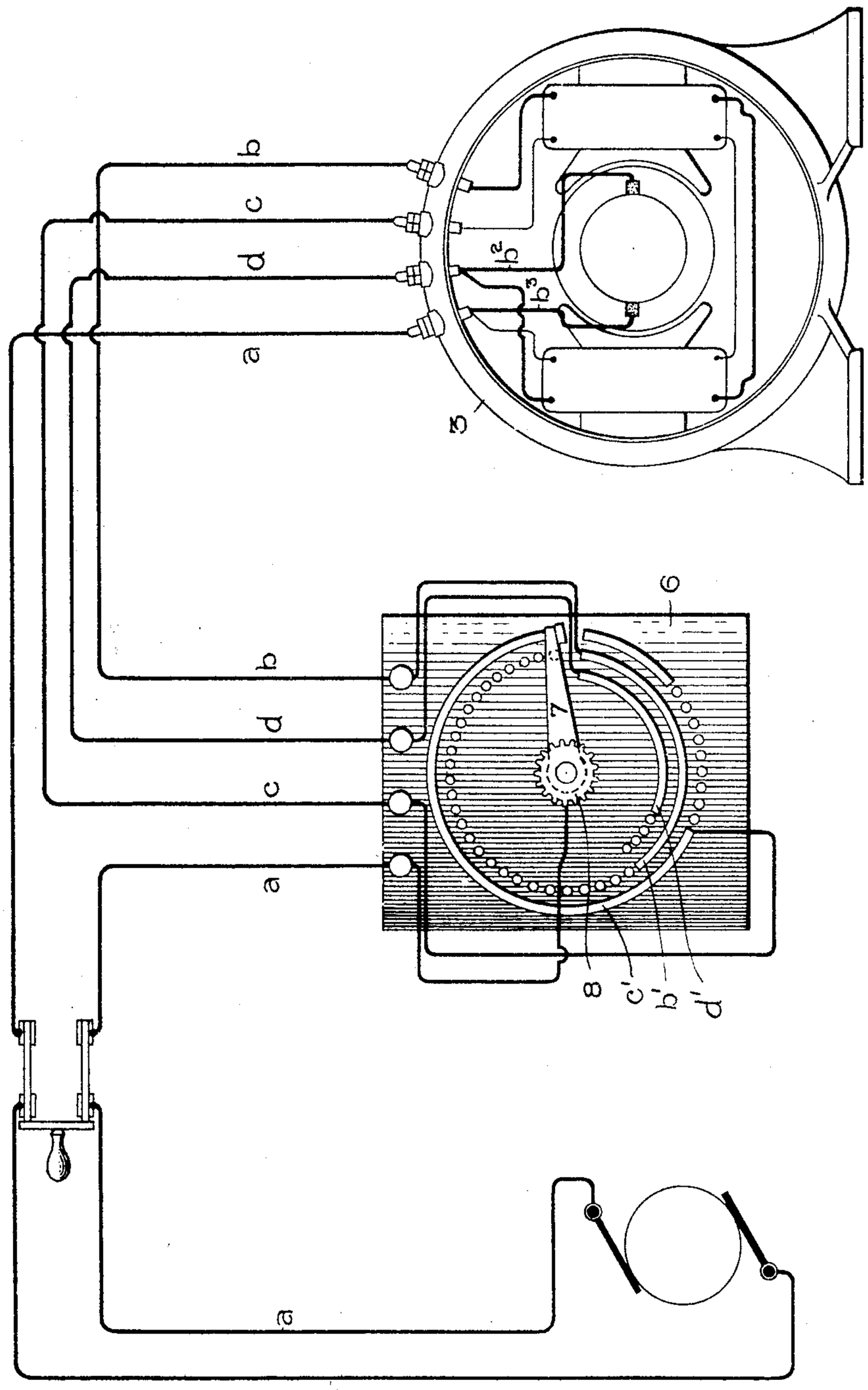
3 SHEETS—SHEET 3.

Fig. 4.



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UNITED STATES PATENT OFFICE.

HAROLD H. CLARK, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

MOTOR-DRIVEN MACHINE-TOOL.

No. 798,391. Specification of Letters Patent. Patented Aug. 29, 1905.

Application filed April 9, 1903. Serial No. 151,744.

To all whom it may concern:

Be it known that I, HAROLD H. CLARK, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Motor-Driven Machine-Tools, of which the following is a specification.

My invention relates to motor-driven machine-tools, and has for its object to provide means to so regulate and apply the electric current that a single motor of ordinary construction will operate to drive a machine-tool at a substantially uniform cutting speed and with a torque proportional to the cutting radius.

My invention comprises a compound-wound motor suitably supported and connected to the spindle of a machine-tool and a rheostat of peculiar construction connected in circuit therewith and having its operating-arm connected to some part, as the tool-carriage, whereby the position of the arm is determined by the position of the cutting-tool.

A more complete understanding of my invention may be had upon reference to the following description, taken in connection with the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a back elevation of a disk cutting-tool having a motor connected and regulated according to my invention. Fig. 2 is a top plan of the same with the motor and headstock shown broken away. Fig. 3 is a tail end elevation, and Fig. 4 is a conventional diagram of the electrical connections.

In the arrangement shown in the drawings, A is the bed of the machine, B and C are the bearings for the hollow spindle D, and E is the tool-carriage, upon which are mounted the oppositely-movable tool-holders F and G, connected by the common feed-screw H. The feed-shaft J is connected to the screw H by a worm-and-gear connection and is driven from the spindle D by belts K and L and cone-pulleys M and N. These parts may be of the ordinary construction and need not be described here in detail.

In applying a motor to be driven according to my invention to a machine-tool of this type I secure upwardly-extending brackets 1 and 2 to the ends of the respective bearings B and C and bolt the feet of the motor 3 directly to their upper edges and connect the shaft of the motor to the hollow spindle D by means of reducing-gears 4 and 5. The controlling-rheostat 6 is mounted in the bed A of the machine and under the head-stock, as shown in Fig. 2. The contact-arm 7 is provided with a pinion 8, which meshes with a rack 9, carried on a reciprocating rod 10, which is held in operative position by guide-blocks 11, bolted to the bed A of the machine. The rod 10 is provided with a crank-pin 12, which is connected by a link 13 to a crank 14 on a horizontal shaft 15, carried in bearings at the back of the bed. The shaft 15 is feathered and carries at its forward end a short crank 16, longitudinally movable thereon and connected by a link 17 to some part of the cross-feed tool-holder G. The arrangement of these parts is such that the reciprocating rod 10 moves in or out simultaneously with the movement of the rear holder G, but with greater speed, causing the contact-arm 7 of the rheostat to move to a determinate contact corresponding to the position of the cutting-tool. In order to automatically arrest the tool-holders F and G at the end of their inward travel, I provide a lever-support 18 for the sleeved bearing 19, which supports the right-hand end of the feed-shaft J. The lever-support 18 is fulcrumed upon a set-bolt 20 on the tool-carriage, and the rear end of the lever is normally held in depressed position by a spring-pressed latch 21, also carried by the tool-carriage E. The front tool-holder F carries a projection 22, which comes in contact with the latch 21 as the holder approaches the inward limit of its travel and releases the lever-support 18, permitting the worm carried by the feed-shaft to drop out of engagement with its wheel.

The method of applying electrical power under automatic control to the driving of machine-tools has been heretofore by means of motor-generator sets or by series motors with the controlling resistance in the armature-circuit. The motor-generator sets are objectionable on account of their great first cost, and the series motors have been found impracticable, for the reason that when an increased load was thrown upon the motor, as by the cutting-tool encountering a hard spot in the metal operated upon, the electromotive force across the armature-terminals was decreased at the same time that the counter electromotive force dropped and resulted in the motor being brought to a standstill, and

as the starting load is greater than the running load it is impossible to start again without first removing the tool from the work.

According to my invention I provide a compound-wound motor by means of which a strong torque is obtained under all conditions. The torque increases with increase of load, and the amount of dead resistance is considerably reduced, and I connect the motor up with a rheostat having three circular rows of contacts, as shown in Fig. 4. The outer circle c' is continuous for the first two hundred and sixty degrees. In the next sixty degrees there are a series of resistance-contacts, and the remainder is continuous. The intermediate circle b' has a series of resistance-contacts for about two hundred and forty degrees, and the remainder is continuous. The inner circle d' is blank the first two hundred and forty degrees. Then for about twenty degrees it has a series of resistance-contacts, and the remainder is continuous.

It will be readily seen from Figs. 2 and 4 that with the cutting-tools in the outermost position or on the longest cutting radius the current delivered to the contact-arm 7 from feed-wire a will be divided between the shunt-circuit c with no external resistance and the series circuit b b^2 b^3 with all the resistance b' of the rheostat cut in, whereby the motor-field is made very strong and the armature-circuit relatively weak, giving the great torque and slow speed necessary. As the tools move inwardly the contact-arm 7 moves counter-clockwise, gradually cutting out the series resistance b' and causing the armature to speed up in proportion to the decrease in the cutting radius. After the contact-arm has traveled through an arc of two hundred and forty degrees and the series resistance is cut out it engages with the inner circle of contacts d' and gradually shunts the series field-circuit. When the contact-arm has traveled about twenty degrees further, or two hundred and sixty degrees in all, the resistances of the outer circle c' are brought into the shunt field-circuit, which still further reduces the field strength and causes more current to flow in the armature-circuit and the armature to speed up still higher.

My invention is applicable to a great variety of power-driven devices, and is in no way restricted to the machine shown in the accompanying drawings.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination with a machine-tool adapted to work at different radii, of electrically-actuated means for driving said tool, and automatically-controlled means for regulating the current of electricity whereby the machine-tool is driven at speeds inversely proportional to the working radii and the torques exerted thereon are directly proportional to the load.

2. The combination with a machine-tool adapted to work at different radii, of a compound-wound electric motor connected operatively therewith, and automatically-controlled means for regulating the current of electricity whereby the machine-tool is driven at uniform cutting speeds and with torques proportional to the load.

3. The combination with a machine-tool adapted to work at different radii, of a compound-wound electric motor connected operatively therewith, and an automatically-controlled rheostat adapted to regulate the electric current in the series and shunt field-windings of the motor whereby the machine-tool is driven at uniform cutting speeds and with torques proportional to the load.

4. The combination with a machine-tool adapted to work at different radii, of a compound-wound electric motor connected operatively therewith, and automatically-controlled means for gradually removing resistance from the series circuit, shunting the field-coils of the series circuit and introducing resistance into the shunt-circuit as the working radius of the tool decreases from its maximum to its minimum.

5. The combination with a machine-tool having a cross-feed, of a compound-wound electric motor connected with said machine-tool, a rheostat adapted to regulate the electric current in both the shunt and series circuits, and means connected to the cross-feed and to the movable part of the rheostat whereby the position of the movable member of the rheostat is determined by the position of the cutting-tool.

6. The combination with a machine-tool having a cross-feed, of an electric motor connected operatively with said machine-tool, a rheostat mounted upon the bed of the tool, a rock-shaft having crank-arms secured thereto, and links respectively connecting said crank-arms with the cross-feed and the movable member of the rheostat.

In witness whereof I have hereunto set my hand this 6th day of April, 1903.

HAROLD H. CLARK.

Witnesses:

DUGALD McK. McKILLOP,
JOHN J. WALKER.