No. 633,419. Patented Sept. 19, 1899.

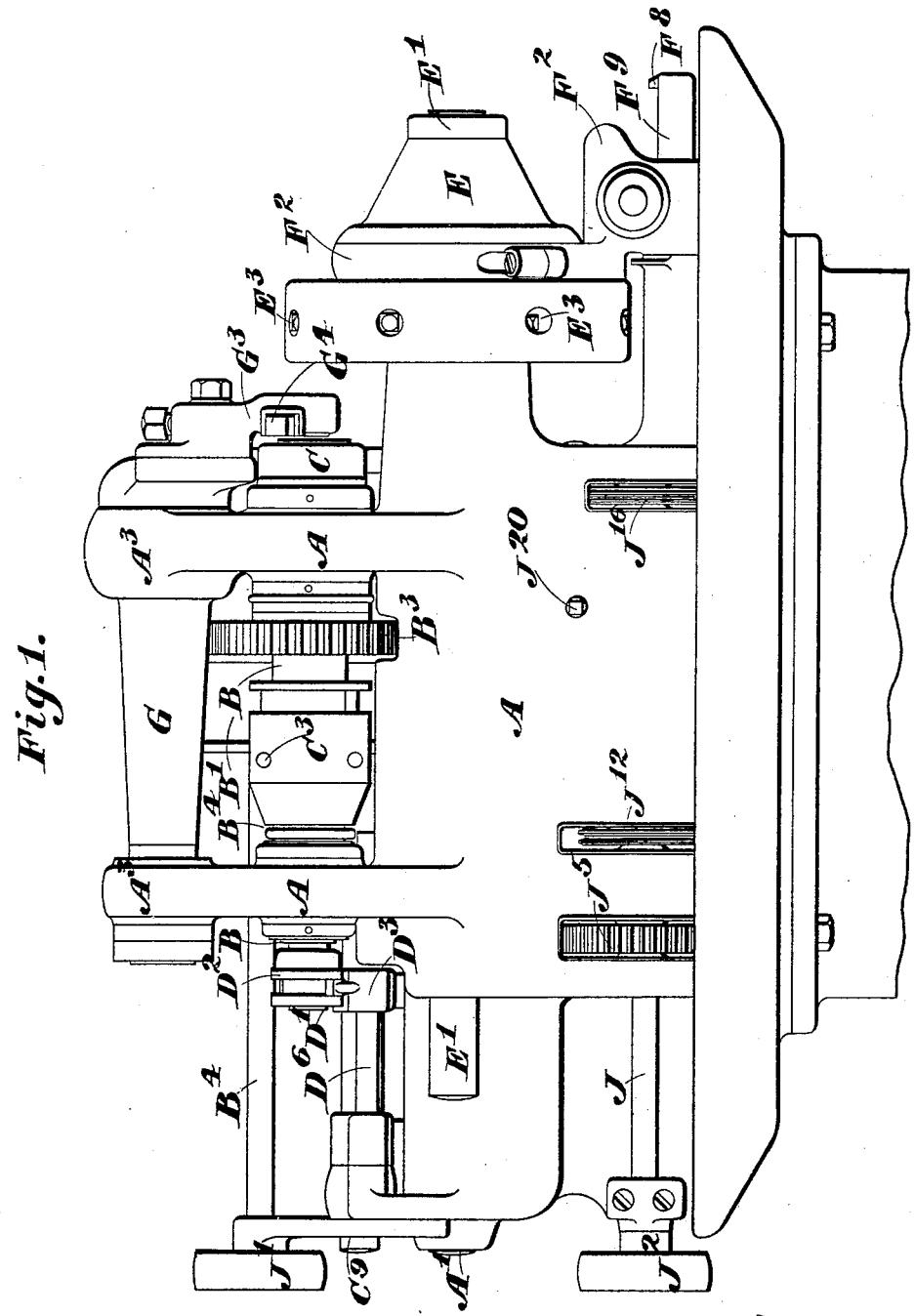
J. BROCKIE.

AUTOMATIC LATHE.

(Application filed Mar. 14, 1899.)

(No Model.) 11 Sheets—Sheet 1.

Fig. 1.



Witnesses

Inventor

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By James L. Norris.

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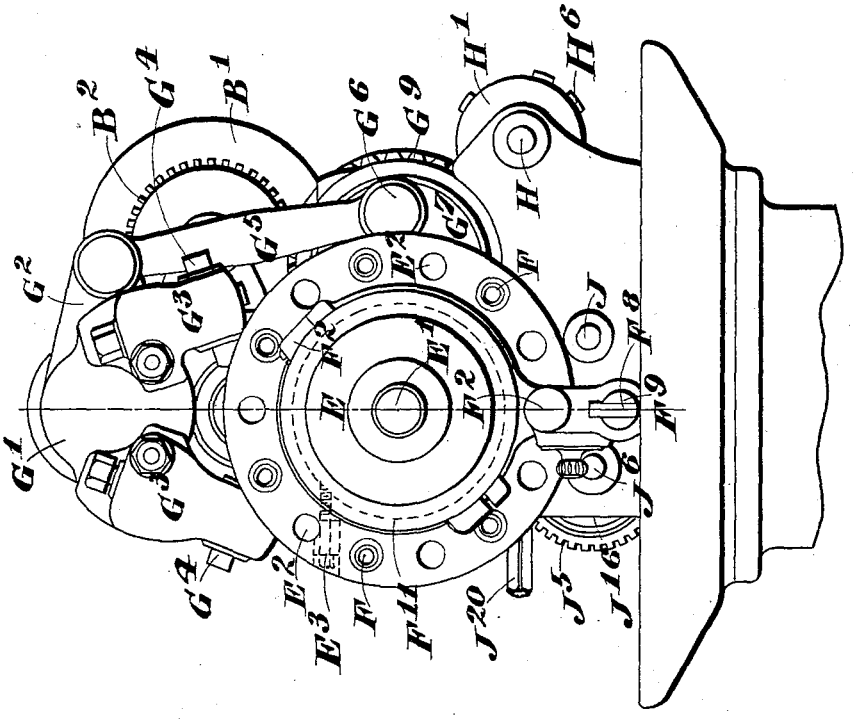
Fig. 2.



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Atty.

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Fig. 4.

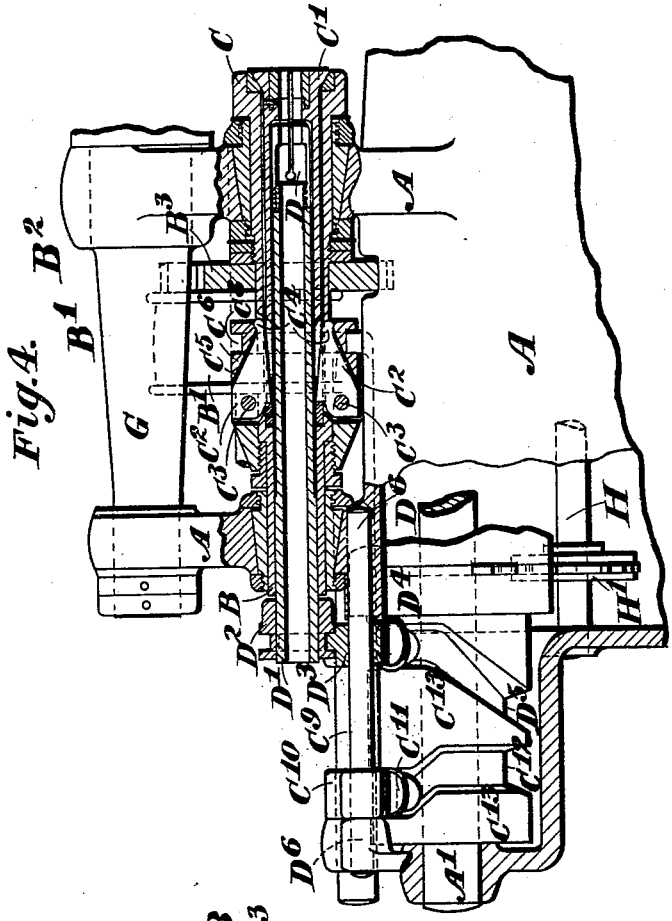

Fig. 3.

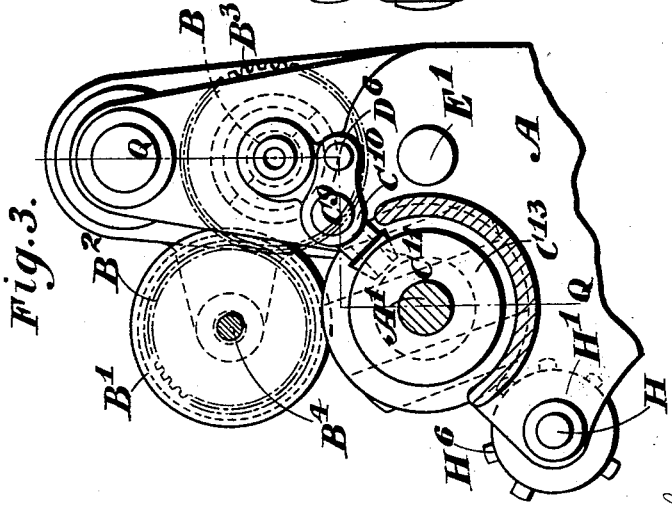

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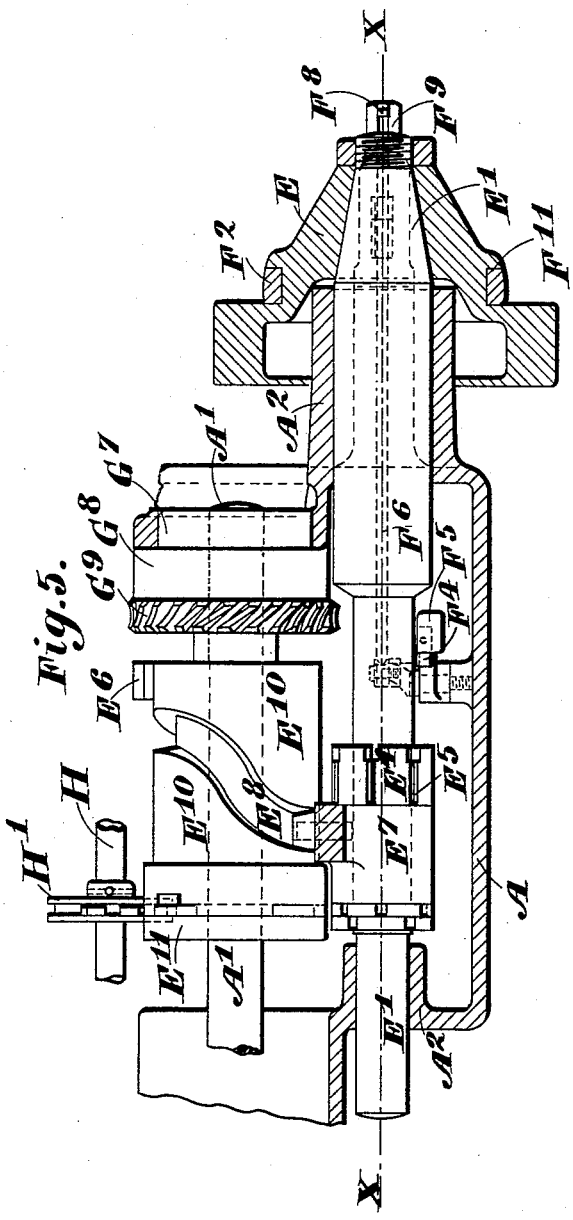
Fig. 5.



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By
James L. Norris.
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Fig. 6.

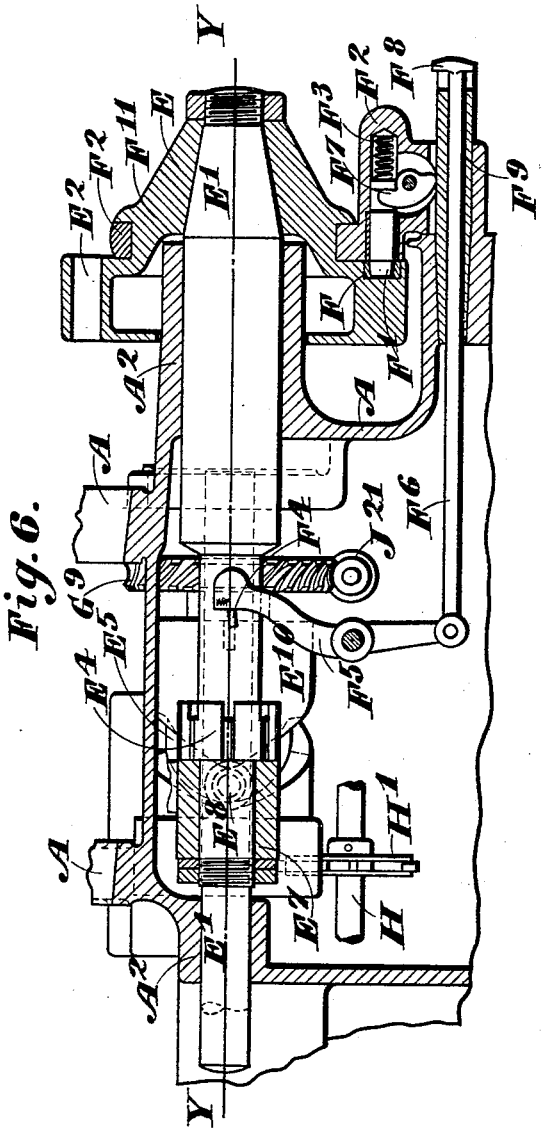

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Fig. 8.

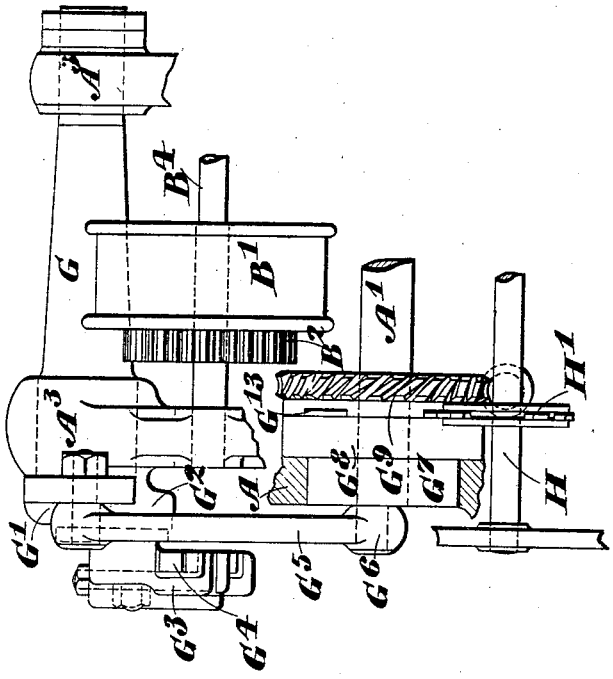
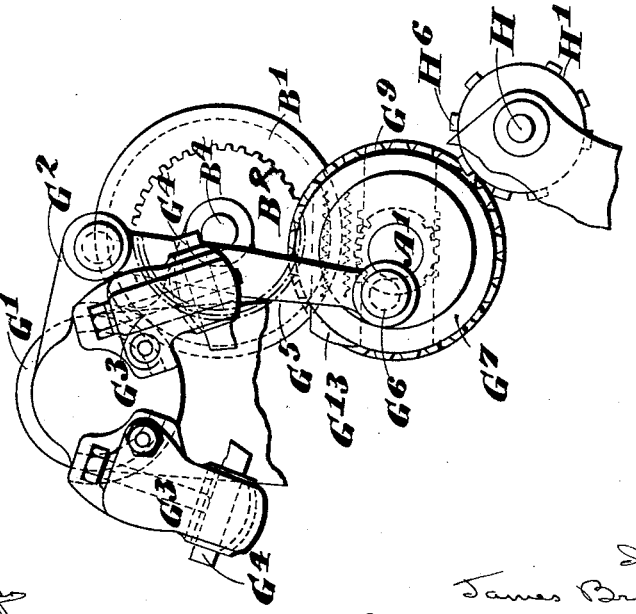


Fig. 7.



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James Brockie

By James L. Norris.

Attorney

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Fig. 10.

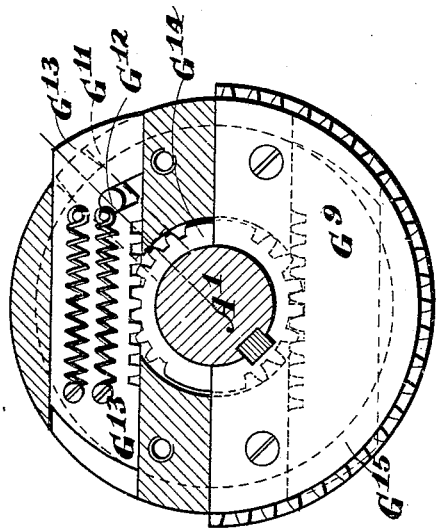
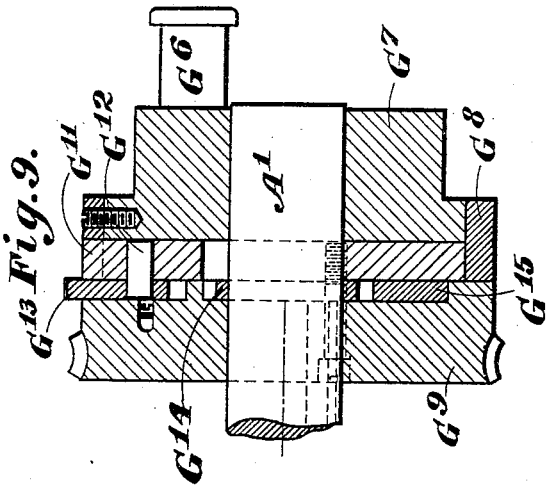


Fig. 9.



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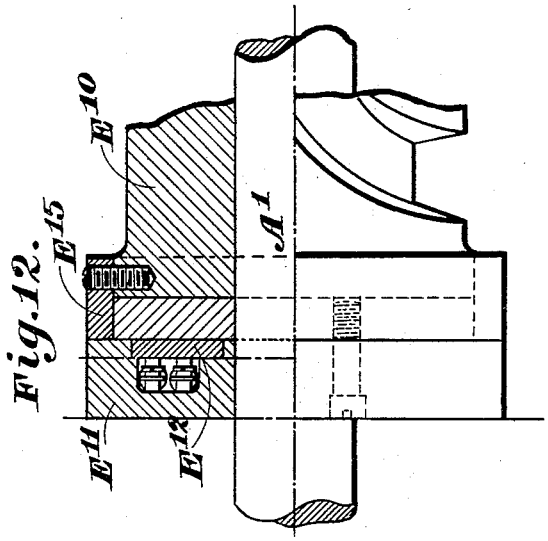

Fig. 12.

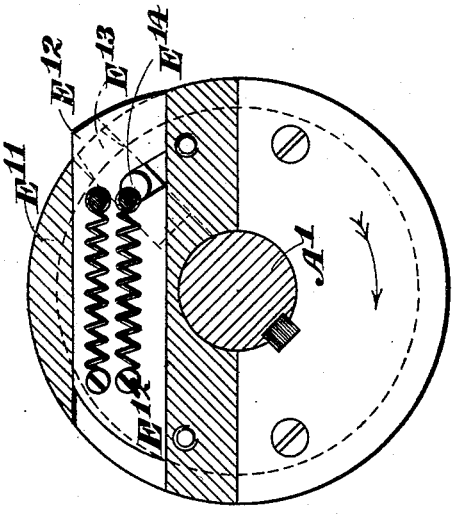

Fig. 11.

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Atty

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Fig. 14.

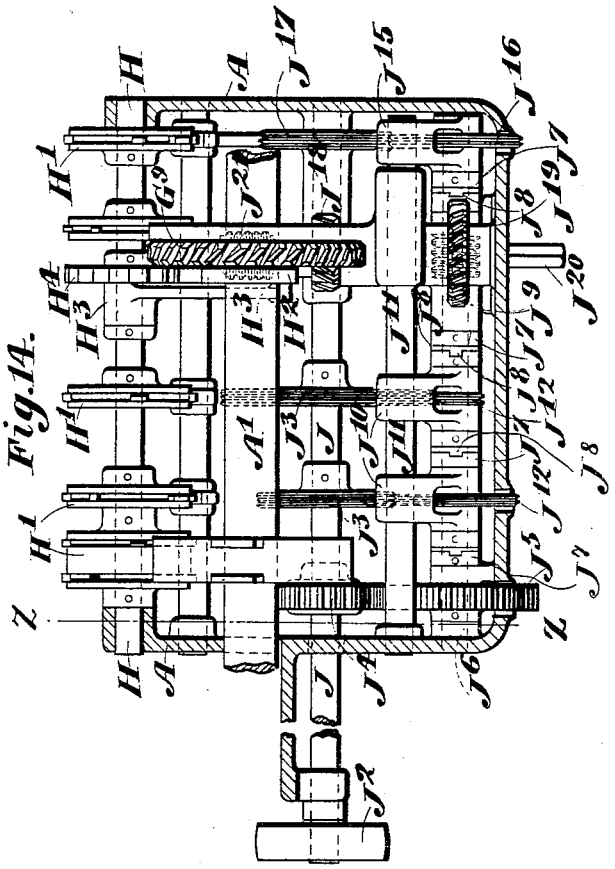

Fig. 13.

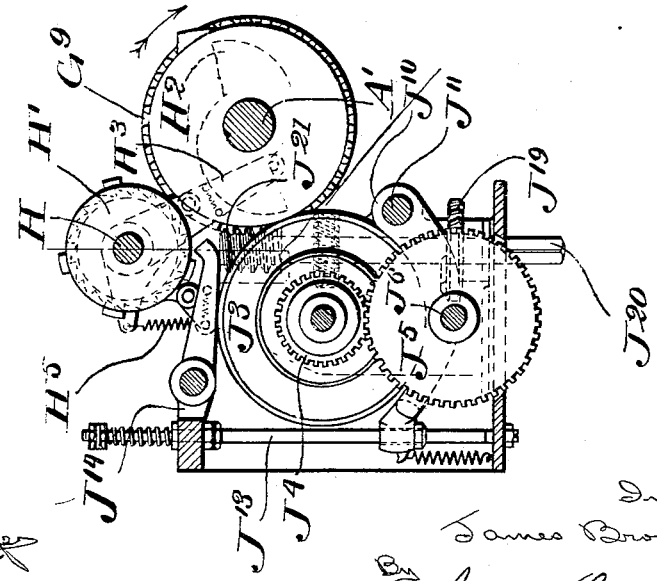

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Fig. 17.

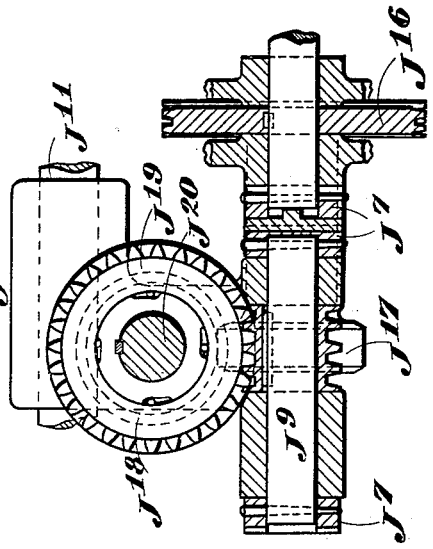

Fig. 19.

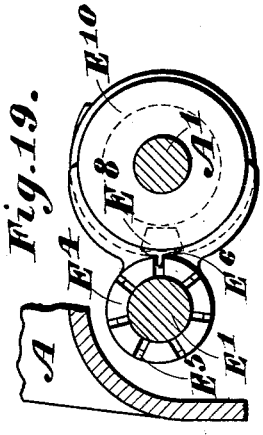

Fig. 18.

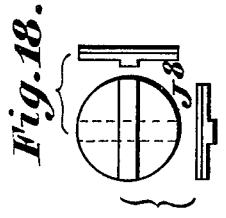

Fig. 15.

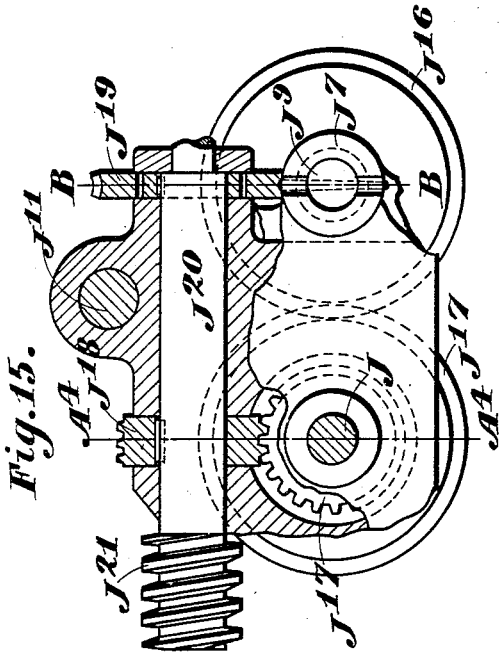

Fig. 16.

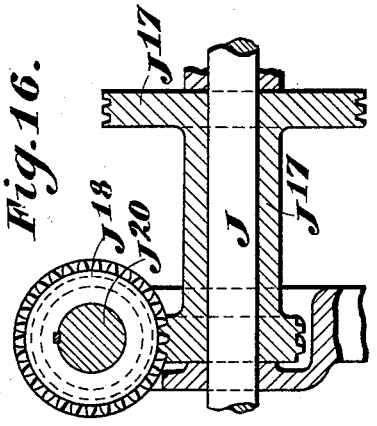

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Fig. 20.

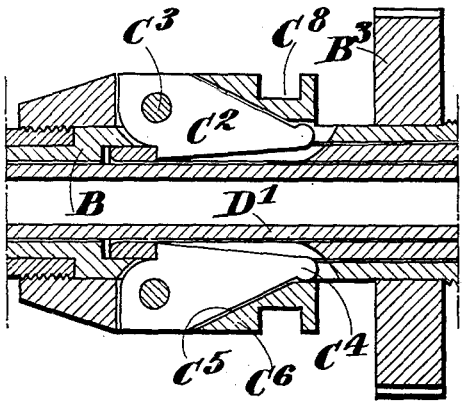


Fig. 21.

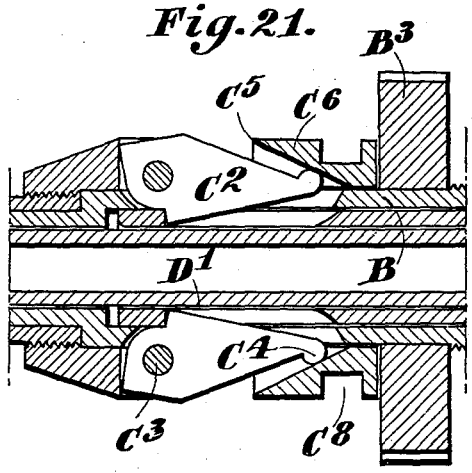


Fig. 22.

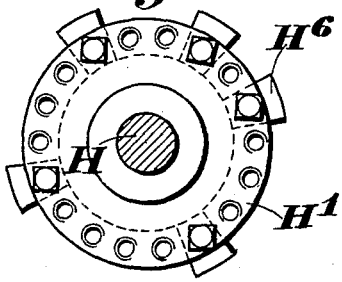


Fig. 23.

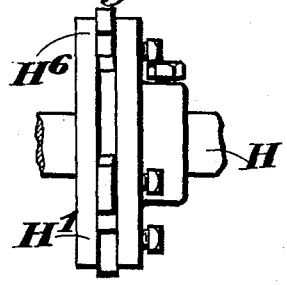


Fig. 24.

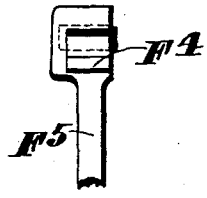
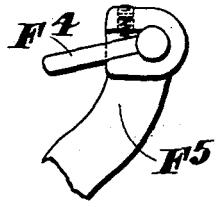


Fig. 25.



Witnesses

Inventor

James Brockie

By James L. Norris.

Atty.

UNITED STATES PATENT OFFICE.

JAMES BROCKIE, OF LONDON, ENGLAND.

AUTOMATIC LATHE.

SPECIFICATION forming part of Letters Patent No. 633,419, dated September 19, 1899.

Application filed March 14, 1899. Serial No. 709,050. (No model.)

To all whom it may concern:

Be it known that I, JAMES BROCKIE, engineer, a citizen of England, residing at No. 12 Tyson road, Forest Hill, London, in the county of Kent, England, have invented certain new and useful Improvements in Automatic Lathes, (for which I have applied for patents in Great Britain, dated December 19, 1898, No. 26,785; in France, dated December 19, 1898, No. 272,086, and in Belgium, dated December 19, 1898, No. 109,581,) of which the following is a specification.

My invention relates to automatic lathes of the kind in which several tools are fixed in a turret or its equivalent which moves to and fro longitudinally and also turns step by step around, so that the tools carried by it are made to act successively on work held in the revolving mandrel, while laterally-moving tools serve to shape and cut off the work.

The chief object of my invention is to determine the movements of the tools in such a manner that their speed can be varied, that a certain cycle of these movements can be repeated as many times as desired, and that the cycle of movements can itself be varied as desired within wide limits, the mechanism being so arranged as to form a compact lathe occupying little space beyond that of the head-stock.

I will first describe the general character of the mechanism, which may be thus stated: The movements of the tool-holders are effected by cams or their equivalents which are loose on a continuously-revolving shaft, but are engaged with it and disengaged from it by clutch mechanism as determined by what may be termed a "mechanical commutator," having operating-studs which can be fixed in it in various positions, each position determining a certain cycle of movements. The speed of these movements can also be varied by the engagement of gearing of various proportions as determined also by the commutator. Thus when the commutator has its studs set in certain positions the lathe goes on automatically repeating the cycle of action determined by the commutator, producing any number of the articles turned all to the same pattern, and by changing the position of the commutator-studs and tools the movements are so varied as to produce articles of a different pattern. I shall describe the mechanism for this purpose, referring to the accompanying drawings.

Figures 1 and 2 are respectively a side and an end elevation of the head-stock of the lathe and tool-holders. Fig. 3 is an elevation, partly in section, of the rear of the head-stock; and Fig. 4 is a part vertical section of the tubular mandrel on the line Q Q of Fig. 3 and part side elevation of the head-stock, with its rear bracket shown in section. Fig. 5 is a sectional plan on the line Y Y of Fig. 6, which is a vertical section on the line X X of Fig. 5. Fig. 7 is a front view, and Fig. 8 a side view, of the forming and cut-off tools and their working connections. Fig. 9 is a longitudinal section, and Fig. 10 is a part transverse section and part front elevation, of the clutch mechanism for the crank which works the forming and cut-off tools. Fig. 11 is a part transverse section and part front view, and Fig. 12 is a part longitudinal section and part side view, of the clutch and cam for working the tool-holder or turret. Fig. 13 is a section on the line Z Z of Fig. 14, which is a side view of the gear shown in Fig. 13 for moving the commutator and varying speed. Both these figures are turned on their side. Figs. 15, 16, and 17 are enlarged views of the parts of Figs. 13 and 14 marked by corresponding letters, Figs. 16 and 17 being respectively sections on the lines $A^4 A^4$ and B B of Fig. 15. Fig. 18 is a front and side view and plan of the coupling-disk on the shaft J^6. Fig. 19 is a section showing the gear for turning the tool-holder or turret. Figs. 20 and 21 are part longitudinal sections of the mandrel, showing the clamping-levers in their two positions. Figs. 22 and 23 are respectively front and side elevations of the commutator-disks. Figs. 24 and 25 are respectively end and side views of the pawl F^4.

In the head-stock A, besides the usual bearings for the mandrel B, bearings are provided for other shafts hereinafter referred to. The mandrel B has fixed on it a toothed wheel B^3, gearing with a wheel B^2, fixed on a counter-shaft B^4, on which is fixed a pulley B', driven by a belt from any suitable motor. On the counter-shaft B^4 is also fixed a pulley J', con-

nected by a belt to a pulley J^2, fixed on another counter-shaft J, which is thus caused to revolve when the mandrel revolves.

A cam-shaft A′, which can be driven at various speeds, as will hereinafter be described, has on it, free to revolve, a crank-disk G^7 and two barrel-cams E^{10} and C^{13}. It has fixed upon it a clutch-disk and worm-wheel G^9, a clutch-disk E^{11}, and a clutch-disk D^4 for the barrel-cam C^{13}. Another shaft E′ is fitted to revolve and slide longitudinally in bearings A^2, formed in the head-stock A. It has fixed on its front end the tool-holder E, corresponding to a turret provided with a number of equidistant holes E^2, in each of which a tool can be fixed by screw-wedges E^3 or otherwise. It has also an equal number of equidistant bushed conical recesses F to receive the spring-bolt F′. On the shaft E′ is also fixed a boss E^4, having grooves E^5, corresponding in number and position with the tool-holes of the turret, and between the boss E^4 and a screw-collar and lock-nut is fitted, but not fixed, on E′, a boss E^7 carrying a conical roller E^8, which is engaged in the grooved path of the cam E^{10}, so that when this cam revolves the shaft E′, with the turret E, makes a forward-and-backward reciprocation for each revolution of the cam E^{10}. On the front end of the cam E^{10} is a single tooth E^6, which once in every revolution of the cam engages in one of the grooves E^5 (see Fig. 19) and turns the shaft E′ and turret E partly around, so as to bring a fresh tool into operating position. As the tooth E^6 is situated at the front end of the cam, the turning of the turret only takes place when the tool is away from the work held in the mandrel.

In order to prevent the boss E^7 from turning on or with the shaft E′, it is made with a fork partly embracing the cam E^{10}. Before the boss E^4 is turned by the tooth E^6 it encounters in its forward stroke a spring-pawl F^4, Figs. 24 and 25, on the end of one arm of a lever F^5, the other arm of which is jointed to a rod F^6, having a hook-head F^8. In the turret E is a groove F^{11}, occupied by a ring F^2, the lower part of which has a boss fitted to slide on a fixed sleeve F^9, and in the upper part of this boss is a recess containing the spring locking-bolt F′, its spring F^3, and its disengaging-lever F^7. As the turret moves to the right the lever F^7 approaches the head F^8, which at the same time is being moved to the left by the action of E^4 on the pawl F^4 and lever F^5, and thus F^7 rapidly meeting F^8 is moved so as to withdraw the bolt F′ and keep it withdrawn until the turret is turned one step around. The pawl F^4 then enters the next slot of E^4 and the rod F^6 moves rapidly to the right, withdrawing the head F^8 from the lever F^7, so that the spring F^3 causes the bolt F′ to enter rapidly the next recess of the turret and so lock it in its new position.

The mandrel B is, as usual, tubular, so that a wire or rod which is to be operated on can pass through it and be clamped at its right hand or front end. The mechanism for feeding forward and clamping the wire or rod is arranged as follows: C is the chuck at the end of the mandrel, and C′ is the sleeve carrying the clamping-jaws at its front end. In slots of the sleeve C′ engage shoulders on levers C^2, which are pivoted at C^3 in a stationary boss, in front of which is a sliding piece C^6, moved to and fro by its groove C^8 being connected by a rod C^9 to a boss C^{10}, carrying a roller C^{11}, engaged in the cam-groove C^{12}. An inner sleeve D′ is attached to a block D^2, having a groove engaging a stud on a sliding piece D^3, which is guided on a rod D^6 and is caused to reciprocate by a roller mounted on it and engaged in the cam-groove D^5. When the sleeve C′ is drawn back, its front end being split is caused to clamp the wire or rod inside it owing to its coned end being drawn into a conical seating. While the wire or rod is so clamped, the sleeve D′ retreats, and when it has completed its back stroke the sliding piece C^6 retreats, allowing the ends C^4 of the levers C^2 to slide along the inclines C^5, opening the levers C^2 apart, so as to allow the sleeve C′ to advance a little, so that its front end no longer holds the wire or rod. The front end D of the sleeve D′ is split, and its segments clamp the wire or rod with certain force, so that when D′ advances it carries forward with it a length of the wire or rod, which is again clamped by C′, while D′ retreats for a fresh feed. The cam-grooves C^{12} and D^5 are formed in a sleeve which is free to revolve on the shaft A′, but is clutched to it as determined by the commutator, as will presently be described with reference to the cam E^{10}.

The forming and cutting-off tools are arranged and worked as follows: In bearings A^3 at the top of the head-stock is mounted a rocking shaft G, which has an arm G^2, connected by a link G^5 to a crank-pin G^6 on the disk G^7, so that at every revolution of this disk the shaft G is made to rock to and fro. On a disk G′ on the front of the shaft G are mounted two tool-holders G^3, holding suitable forming and cutting-off tools G^4, each of which can be set nearer to or farther from the work by moving the holders G^3 on the face of the shaft and clamping them in position by bolts passing through circularly-slotted holes.

It has been said above that the cam-shaft A′ has on it, free to revolve, the barrel-cam E^{10} and the crank-disk G^7, which therefore revolve only when they are clutched to the shaft. The cam E^{10} is clutched to the shaft as shown in Figs. 11 and 12. In the face of the clutch-disk E^{11}, which is fixed on the shaft A′, is a recess, in which is fitted a slide E^{12}, urged to the right, so that its curved end projects beyond the periphery of the disk, by two springs lying in a recess behind the slide, one end of each spring being attached to a pin on the slide and its other end to a pin on the disk itself. On the inner side of the slide E^{12} is an inclined notch engaging a pin E^{14}, pro-

jecting backward from a sliding bolt, (indicated by the dotted lines E^{13}.) Upon the cam E^{10} is fixed a ring E^{15}, which overhangs the rear of the cam and has in one part of its circumference a slot to receive the bolt E^{13}. While the bolt E^{13} is in the slot of E^{15} the cam E^{10} is made to revolve with the disk E^{11} and shaft A'; but if as the disk revolves in the direction of the arrow the sloped projecting end of the slide E^{12} encounters an obstruction fixed close to the periphery of the disk then the slide E^{12} is pushed in, withdrawing the bolt E^{13} from the slot in the ring E^{15}, so that the cam E^{10} no longer revolves with the shaft A'. The bolt E^{13} after being withdrawn from the slot cannot engage in it again until the shaft A' has made a complete revolution, and then only if the obstruction that caused its withdrawal is removed, in which case the slide E^{12} will spring outward, causing the bolt E^{13} to engage in the slot of E^{15}. The sleeve having the cam-grooves C^{12} and D^5 for feeding and clamping the wire or rod in the mandrel is clutched to the shaft A' in the same way as E^{10}. As shown in Figs. 9 and 10, the crank-disk G^7 is clutched to the shaft A' in a similar way; but in this case the clutching-bolt G^{11} can be withdrawn from the slot in the ring G^8 when the shaft A' has made half a revolution. For this purpose besides the slide G^{13} there is another slide G^{15}, which is connected to G^{13}, so that they must move together, but in opposite directions, both slides having rack-teeth engaging with a pinion G^{14}, free to revolve on the shaft A'.

The obstructions which serve to unclutch the crank-disk G^7 and cam E^{10} from the shaft A' are studs H^6, fixed in the grooved peripheries of disks H', Figs. 13 and 14, fixed on a shaft H, these disks, with their studs H^6, constituting the mechanical commutator above referred to. On the shaft H is fixed a ratchet-wheel H^4, engaged by a spring-pawl on a lever H^3, which is moved in the one direction by the double cam H^2 on the shaft A' and is retracted by a spring, so that the shaft H is turned a step around twice in every revolution of the double cam H^2. A spring-pawl H^5 prevents the shaft H from turning backward. It has been stated above that the speed of the cam-shaft A' can be varied within certain limits to suit the nature of the work on which the tools act. The driving of A' is effected as will be described particularly with reference to Figs. 13 to 18, inclusive. The shaft J, driven by a band on its pulley J^2, from the pulley J', as above described, has on it a pinion J^4, gearing with a wheel J^5, fixed on a shaft J^6. The pinion J^4 is connected to the shaft J through a slip-clutch which may be like that shown in Fig. 17 for the wheel J^{19}, allowing the wheel to slip when it is driven faster than the shaft. The short shaft J^6 works in bearings provided on each side of the wheel J^5, and beyond the right-hand bearing it has fixed on it a face-disk J^7, made with a groove across it. Into this groove fits the rib of a coupling-disk J^8, such as is shown in Fig. 18, which is a disk with a rib projecting at each side, the one rib being at right angles to the other. The other rib fits a groove in the face-plate J^7 on a short shaft carrying a grooved friction gear-wheel J^{12}, which is thus caused to revolve when the wheel J^5 revolves. In a similar manner another grooved friction gear-wheel J^{12} is coupled, then a worm-shaft J^9, and, finally, the shaft of another grooved friction gear-wheel J^{16}, so that these three grooved wheels and the worm on J^9 all revolve with the wheel J^5. The bearings for the short shafts that carry the wheels J^{12} J^{12} and J^{16} are formed in levers J^{10} J^{10} and J^{15}, which are pivoted on a shaft J^{11} and have their ends held down by springs to the collar of rods J^{13}. These rods pass through other levers J^{14}, on which bear adjustable springs. Each of these levers J^{14} extends under one of the commutator-disks H', so that when a stud H^6 on one of these disks presses down the end of one of the levers J^{14} the lever J^{10}, connected to it, is raised, bringing one or other of the friction gear-wheels J^{12} J^{12} or J^{16} into close contact with a corresponding wheel J^3 J^3 or J^{17}, which is fixed on the shaft J, the degree of frictional pressure being determined by the springs bearing on the lever J^{14}. As the upward movement of J^{12} J^{12} or J^{16} to give driving pressure is very little, only a small fraction of an inch, the coupling-disks J^8 allow for this movement. The worm on J^9 gears with a worm-wheel J^{19}, free to move in one direction on a shaft J^{20}, which has a worm J^{21} gearing with the worm-wheel G^9 on the cam-shaft A'. The three wheels J^{12} J^{12} and J^{16} being of different diameters, the speeds imparted by them to the corresponding wheels J^3 J^3 and J^{17} to the shaft J, and thence through the shaft J^{20} to the cam-shaft A', are different; also, when none of the three wheels is brought into frictional contact with the corresponding wheel on the shaft J the cam-shaft is driven at a less speed than any of these wheels can give by a worm on the boss of J^{17} driving a worm-wheel J^{18} on the shaft J^{20}.

For producing a number of finished pieces from a wire or rod the first step is to turn the turret until a stop-piece held in one of its tool-holes is brought into line with the mandrel, in which position it remains during the movements of the feeding mechanism. These movements are effected by a complete revolution of the feeding-cams, during which first the jaws of the chuck are opened. Then the wire or rod is fed forward till it meets the stop held in the turret, (this determining the length projecting from the chuck,) and then the jaws of the chuck are closed, gripping the wire or rod. The turret-stop is then moved back and its register-pin is withdrawn, allowing a partial rotation, by which the tool which is to be first used is brought into line. The turret, with this tool, is moved at the proper rate determined by the speed-gear, and

the motion may be repeated, the turret being partly turned at every stroke, so that its six tools may act successively upon the material held in the chuck.

If it is desired to reduce a part of the wire or rod so as to leave a shoulder, a suitable tool is fixed in one of the tool-holders on the rocking shaft and the crank-disk is caused to make half a revolution, bringing this tool to act upon the work and returning it, and this may be done either during the operations of the turret or after they are completed. A cutting-off tool, also carried in one of the tool-holders of the rocking shaft, is brought down and returned by the second half-revolution of the crank-disk, cutting off the finished work. The stop in the turret may be then again brought into position, the machine beginning another cycle of operations.

Having thus particularly described and ascertained the nature of this invention and the best means I know for carrying the same into practical effect, I claim—

1. The combination of the counter-shafts J and J^6, the coupling-disks J^8, the friction gear-wheels J^{12} J^{12} and J^{16}, shaft J^9 and its worm-shaft J^{20} and the worm-gear J^{21} and worm-wheel G^9 for driving the cam-shaft A′ at various speeds, substantially as described.

2. The combination of the double cam H^2 on the cam-shaft A′ the pawl-lever H^3 and its spring-pawl the ratchet-wheel H^4 the shaft H and the commutator-disks H′, substantially as described.

3. In combination with studs on three of the commutator-disks the levers J^{14}, rods J^{13} and bearing-levers J^{10} for the shafts of the three friction gear-wheels J^{12} J^{12} and J^{16} substantially as described.

4. In combination the studs on the commutator-disks H′ the slide E^{12} in the disk E^{11}, the bolt E^{13} and the cam E^{10} and its ring E^{15} substantially as described.

5. In combination the studs on the commutator-disks H′, the two slides G^{13} G^{15} geared together in the disk G^9, the bolt G^{11} and the crank-disk G^7 substantially as described.

6. In combination with the cam E^{10} and its tooth E^6 the turret-shaft E′ connection E^4 between said cam and shaft and the turret E with its fittings, substantially as described.

7. The combination with a crank-shaft and a rocking shaft mounted in bearings in the head-stock an arm on said rocking shaft, a link connected therewith and connected with the crank-shaft, a disk on the end of the rocking shaft tool-holders on the disk on the rocking shaft, forming and cutting-off tools adjustably mounted in said holders, substantially as described.

8. In combination with a sleeve free to revolve on the cam-shaft and provided with the cams C^{12} and D^5 a sliding piece operatively connected with said cam D^5, a sliding piece connected with the other cam, and the tubular mandrel B with its feeding and clamping mechanism and a commutator and means for clutching said sleeve to the shaft, substantially as described.

9. In an automatic lathe, the combination in one lathe-head of a tubular mandrel, a reciprocating and rotating turret or tool-holder, and a rocking shaft carrying cutting-off and forming tools, and means for varying the speed of the tools whereby a certain cycle of movements may be repeated and the said cycle of movements varied substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

JAMES BROCKIE.

Witnesses:
GERALD L. SMITH,
E. GARDNER.