No. 635,888.

Patented Oct. 31, 1899.

J. HARTNESS.

TURRET LATHE.

(Application filed Nov. 18, 1898.)

(No Model.)

7 Sheets—Sheet 1.

FIG. 1.

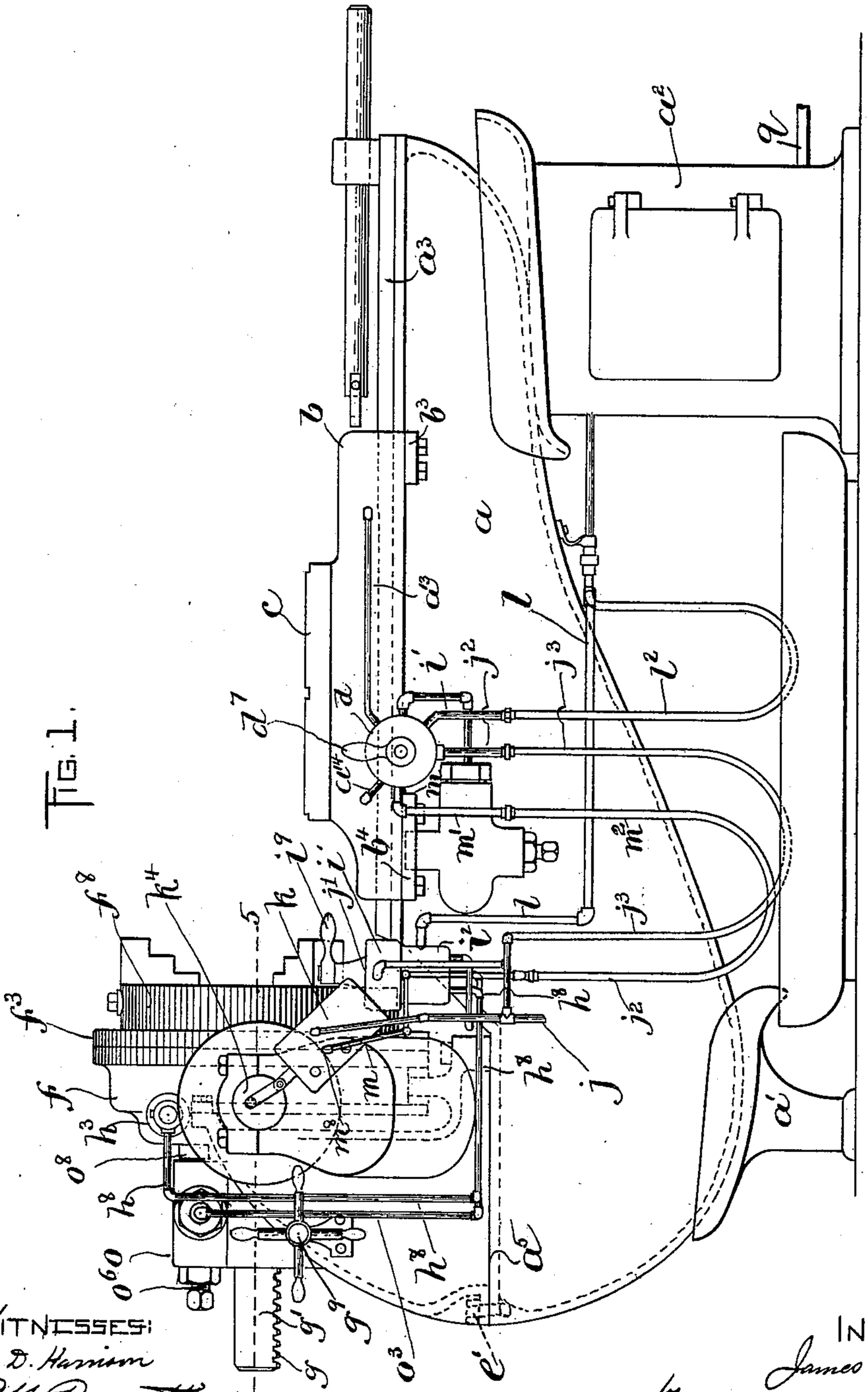

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FIG. 2.

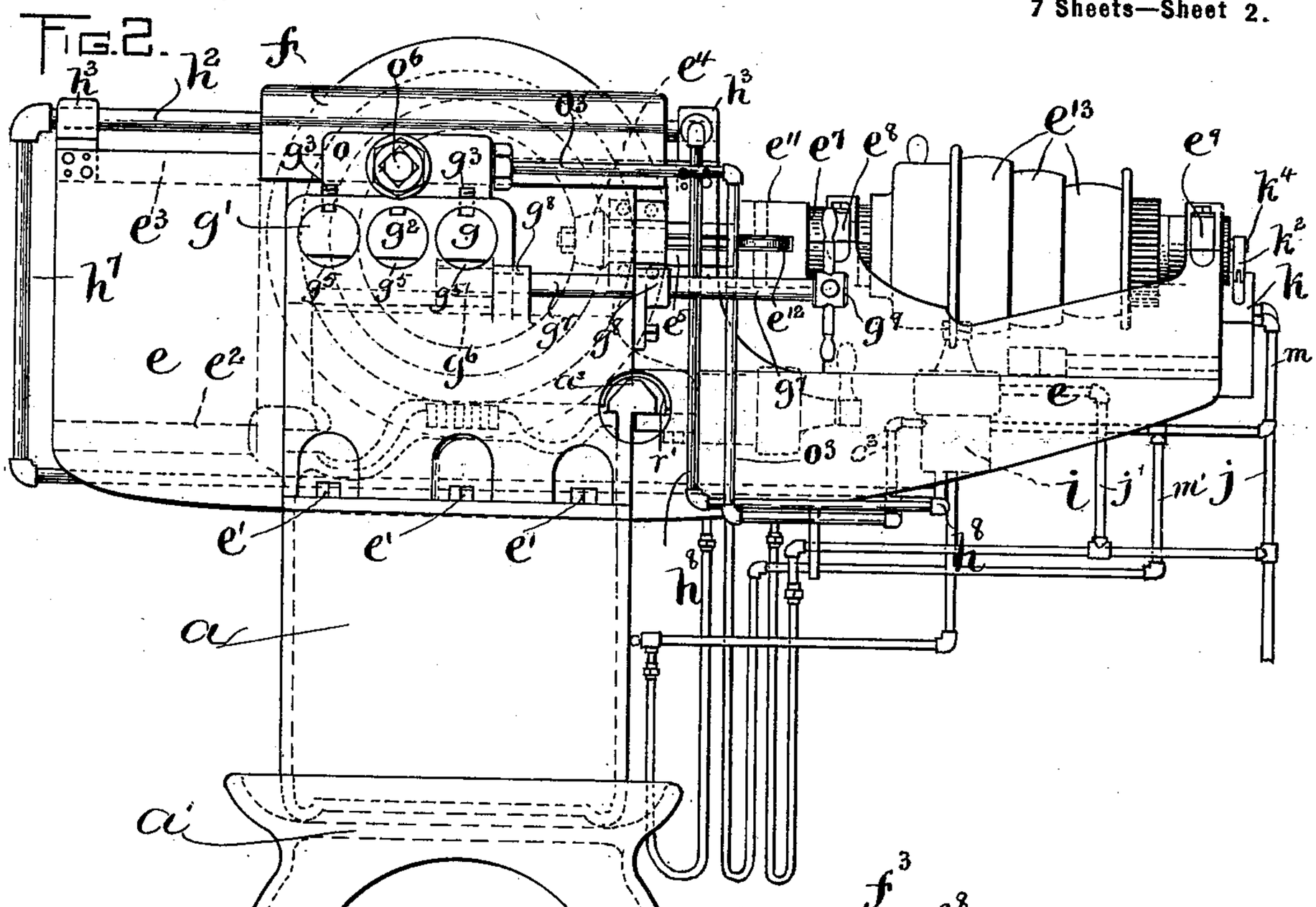
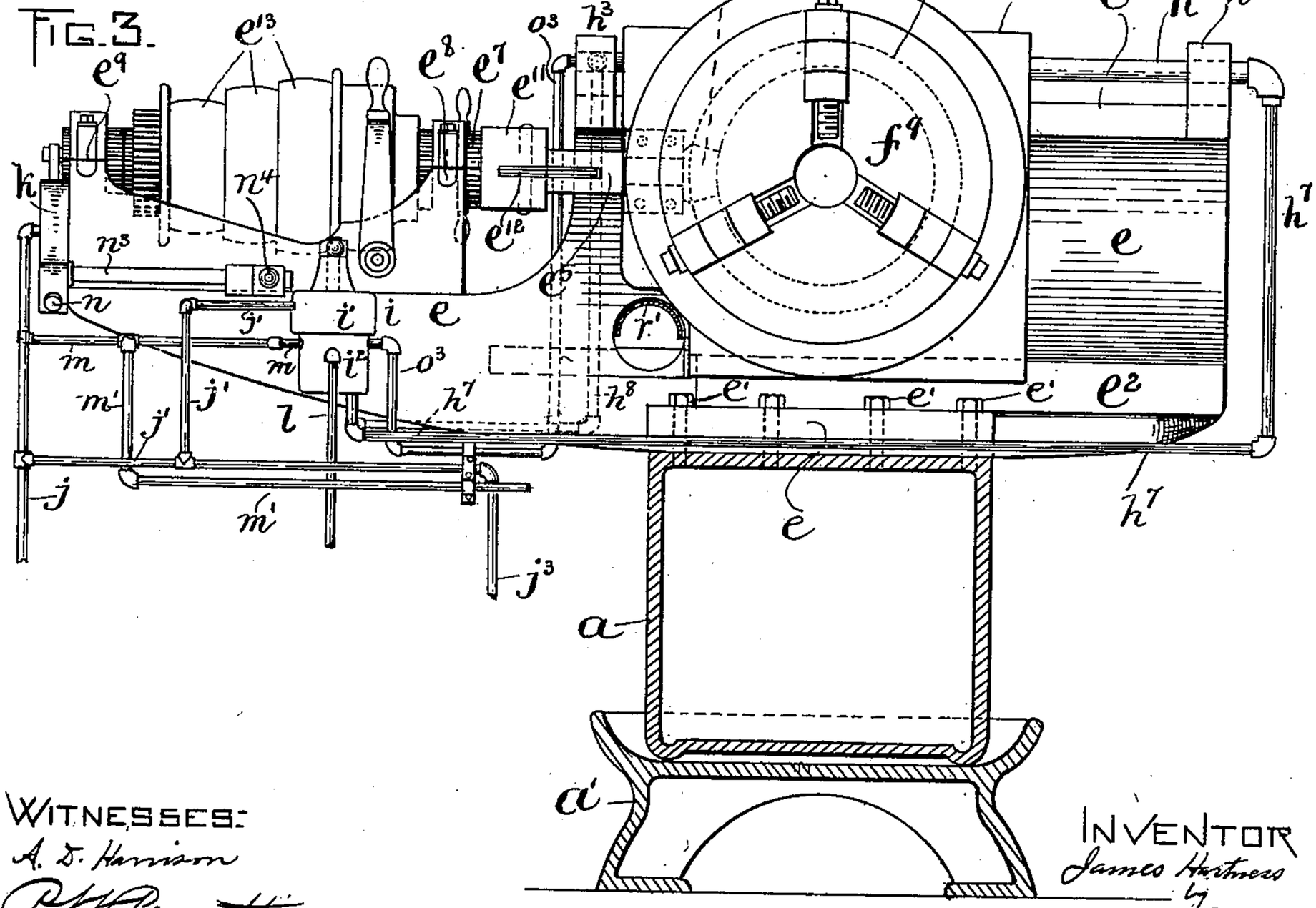


FIG. 3.



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(No Model.) 7 Sheets—Sheet 3.

FIG. 5.

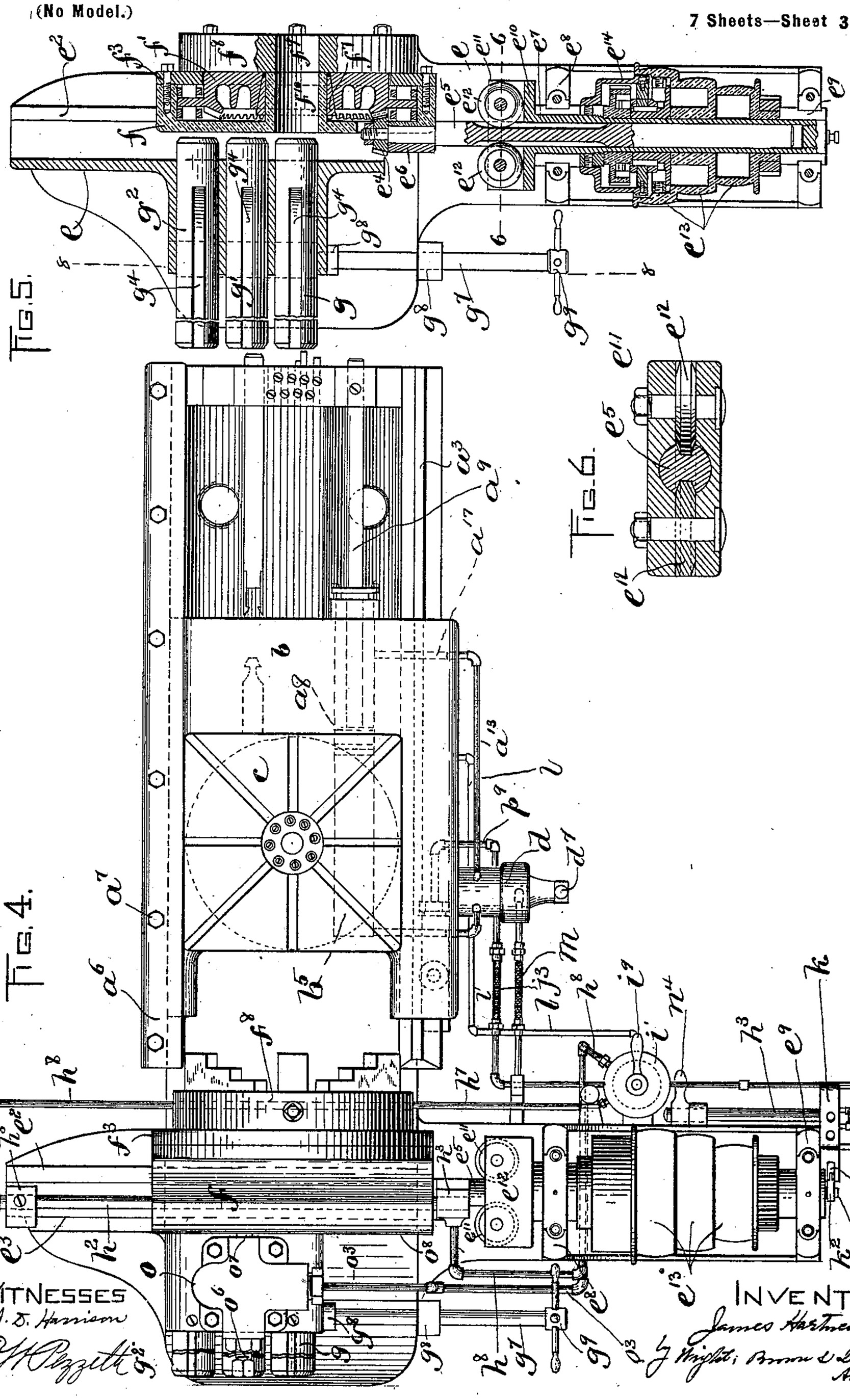

FIG. 6.

FIG. 4.

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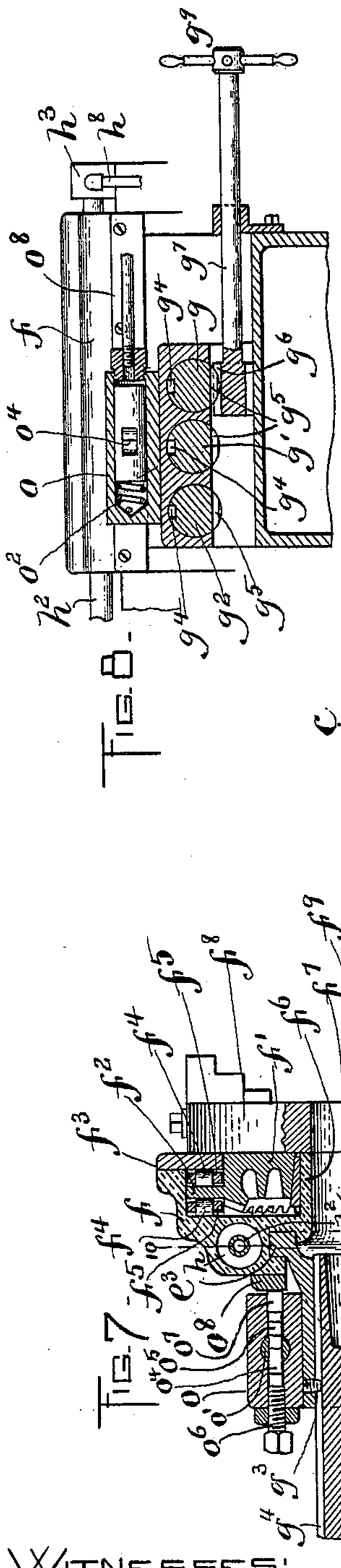

FIG. 8.

FIG. 7.

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(No Model.) 7 Sheets—Sheet 5.

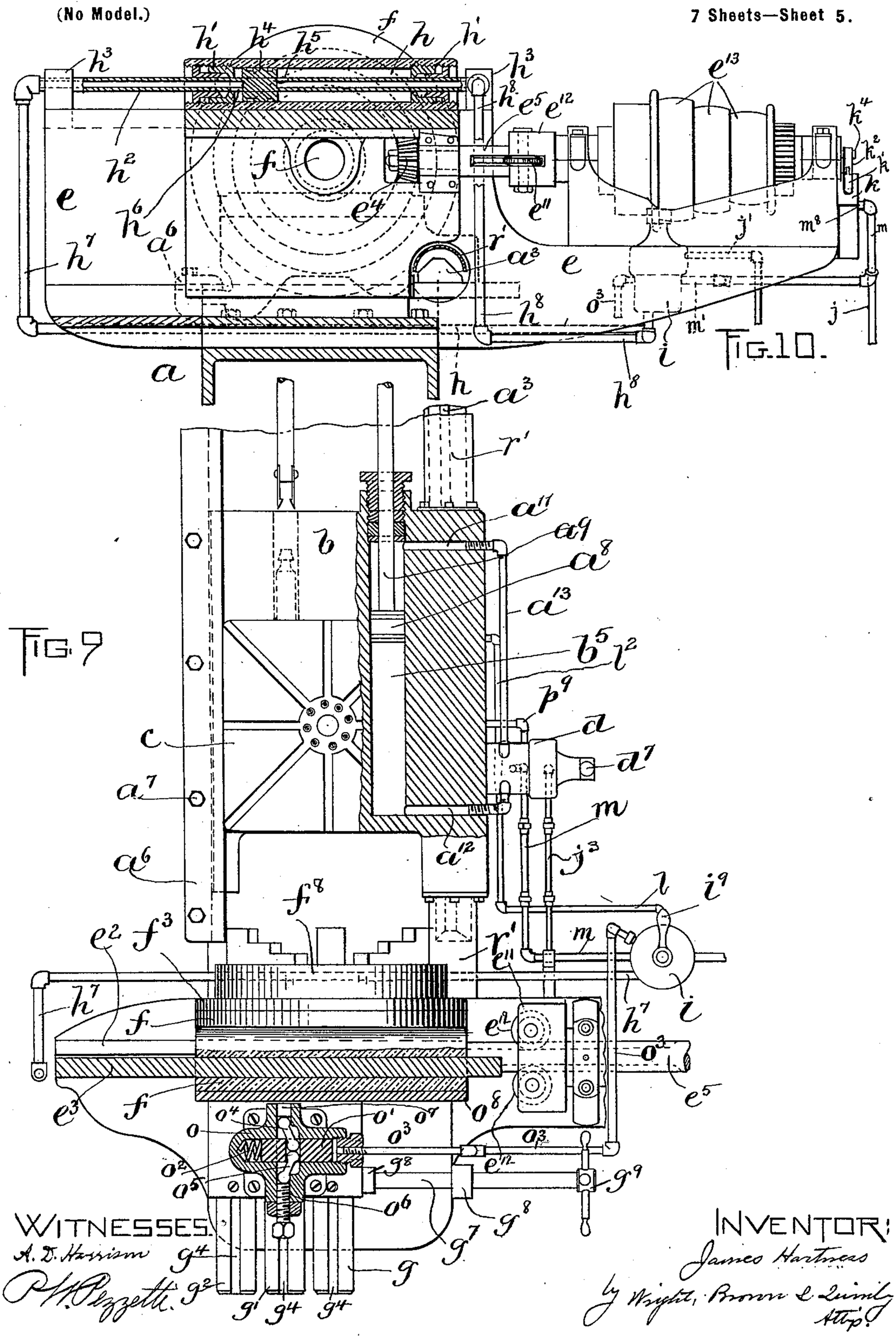

FIG. 10.

FIG. 9

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(No Model.) 7 Sheets—Sheet 6.

FIG. 11.

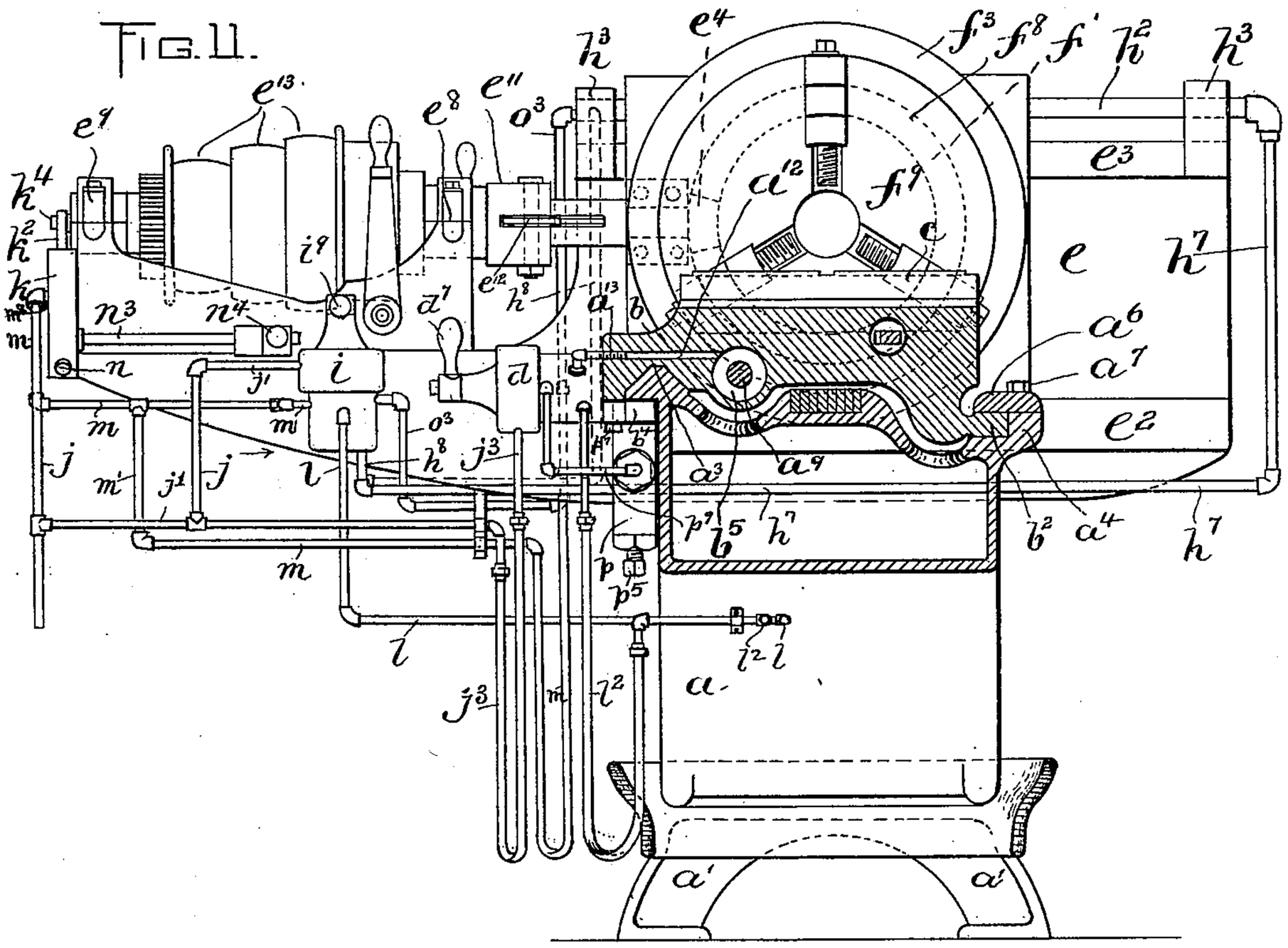


FIG. 12.

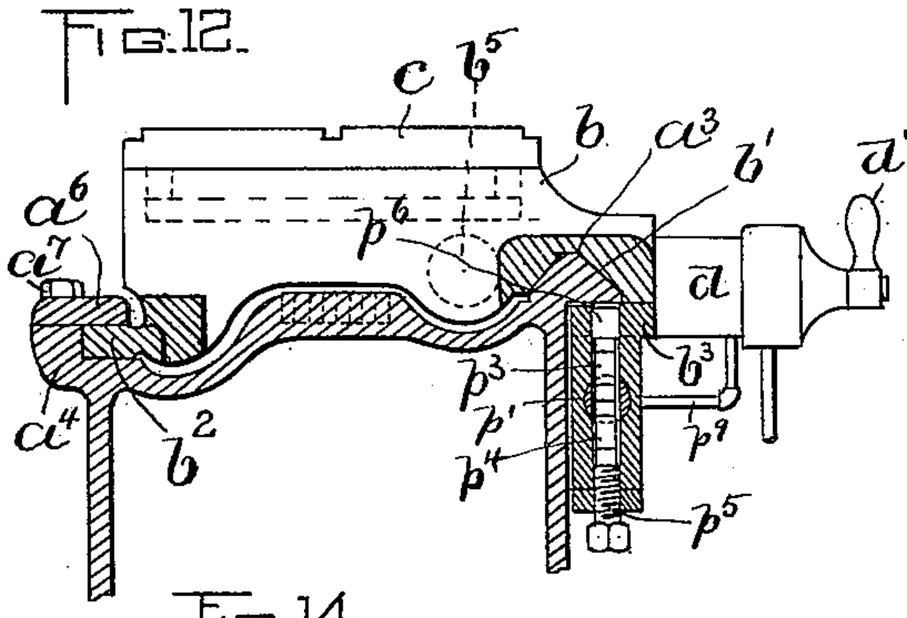


FIG. 13.

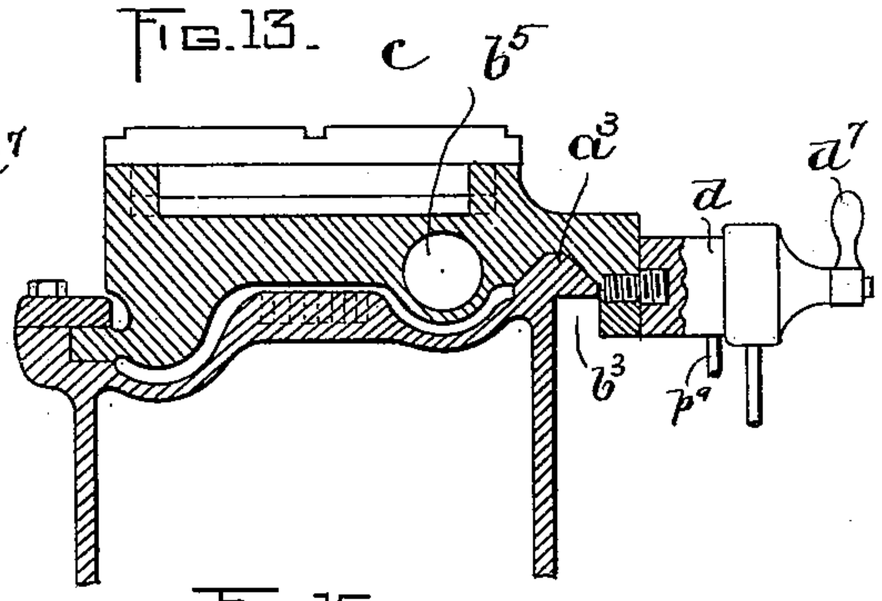


FIG. 14.

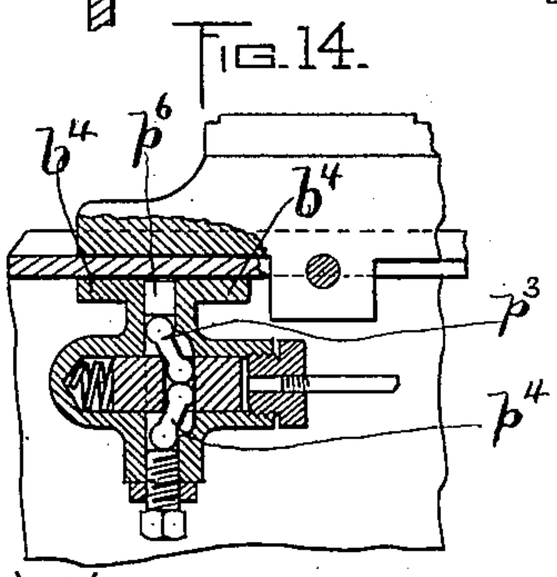
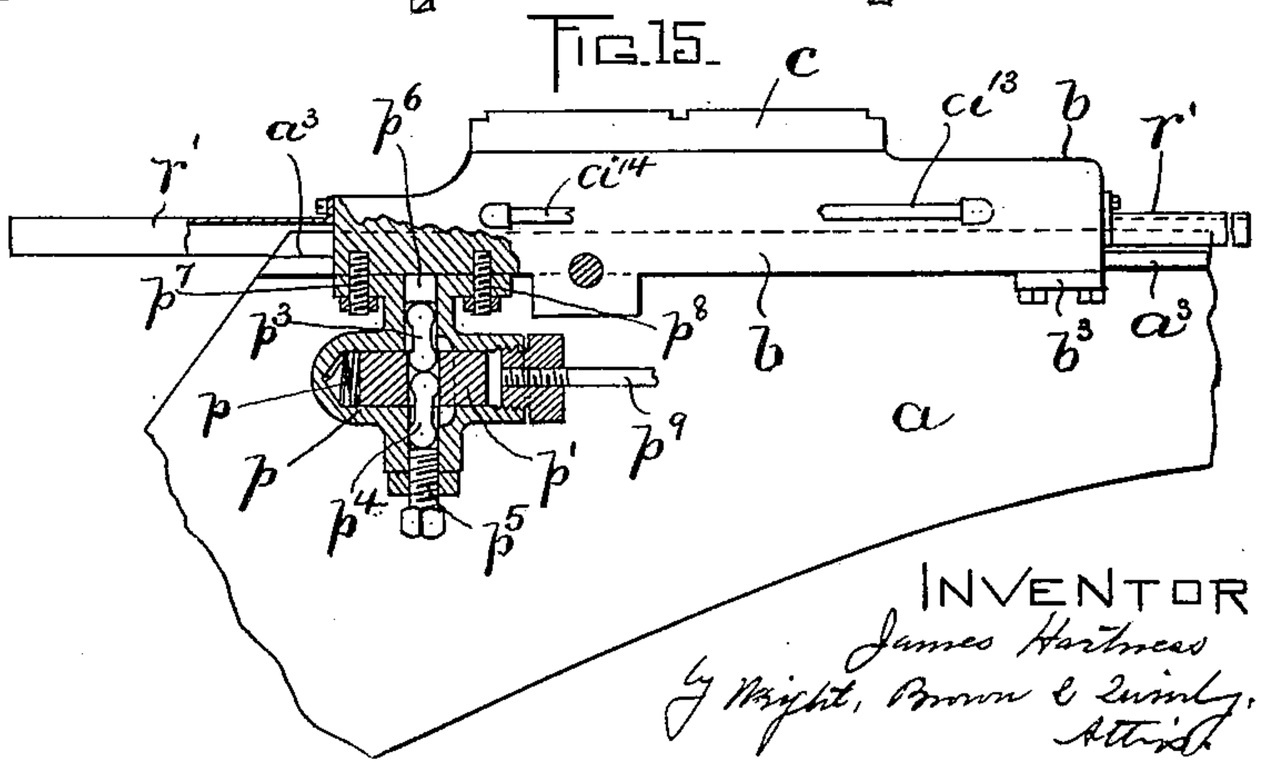


FIG. 15.



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(No Model.) 7 Sheets—Sheet 7.

Fig. 16.

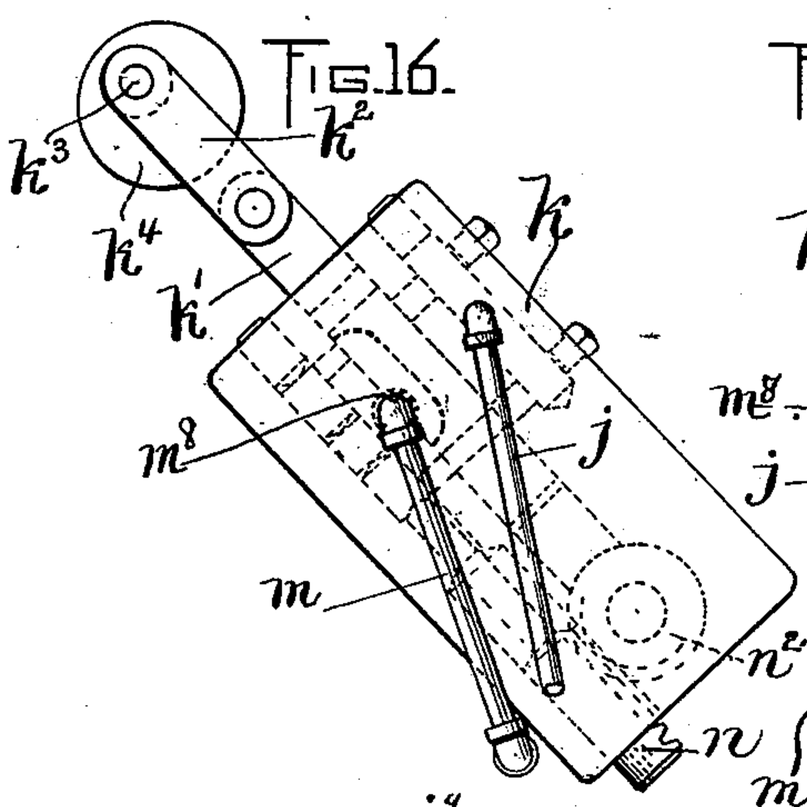


Fig. 17.

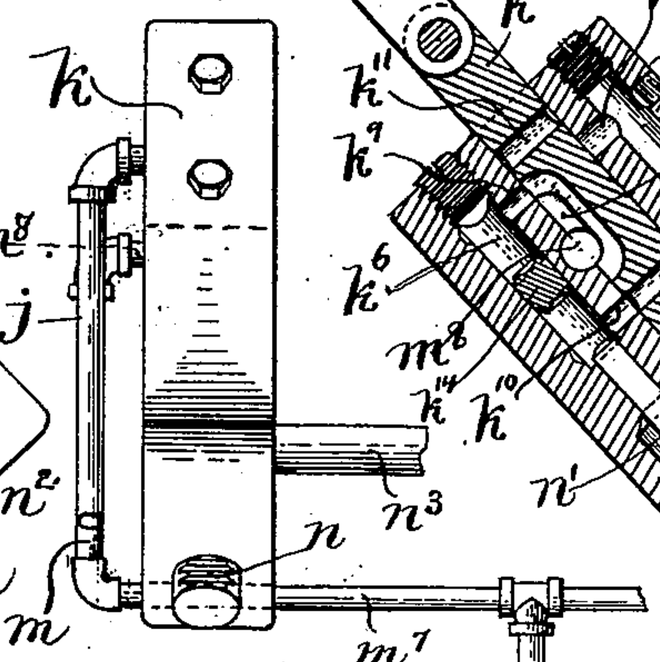


Fig. 18.

Fig. 19.

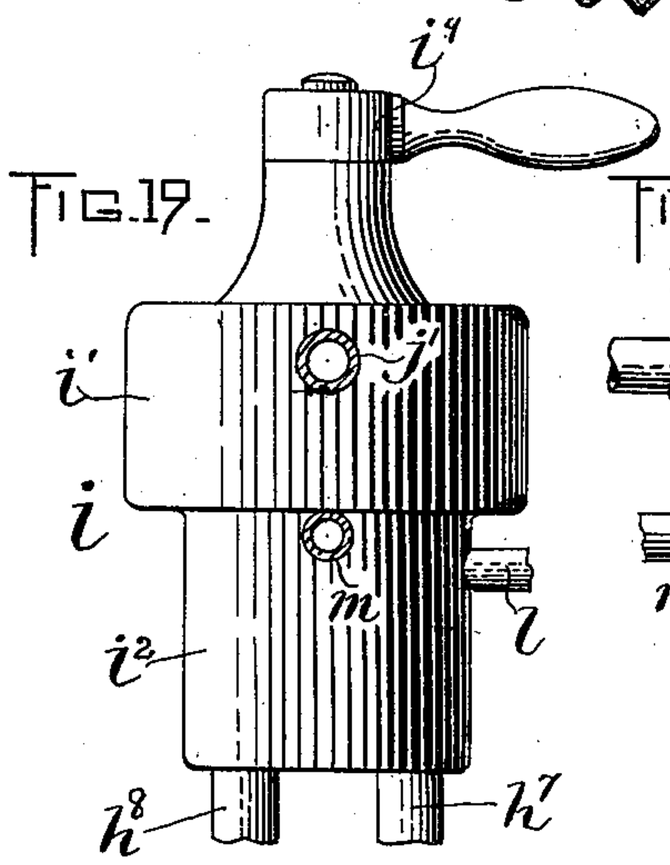


Fig. 20.

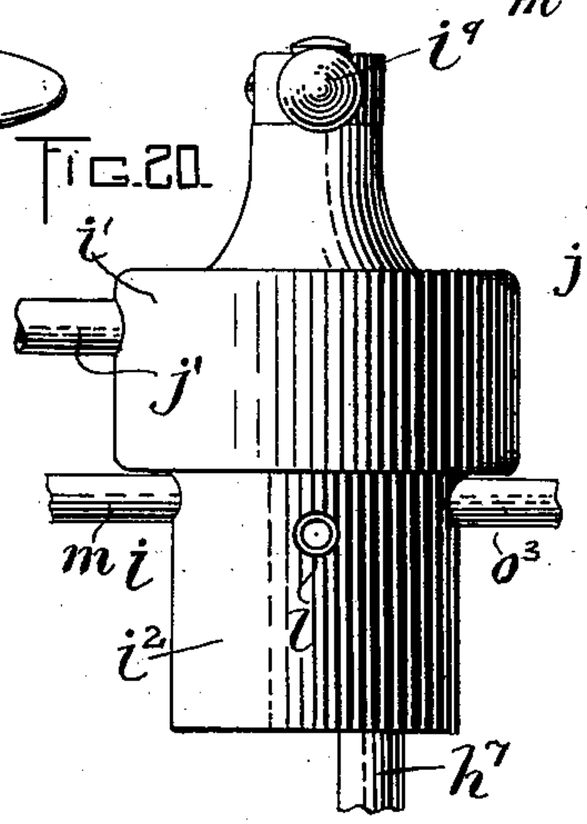


Fig. 21.

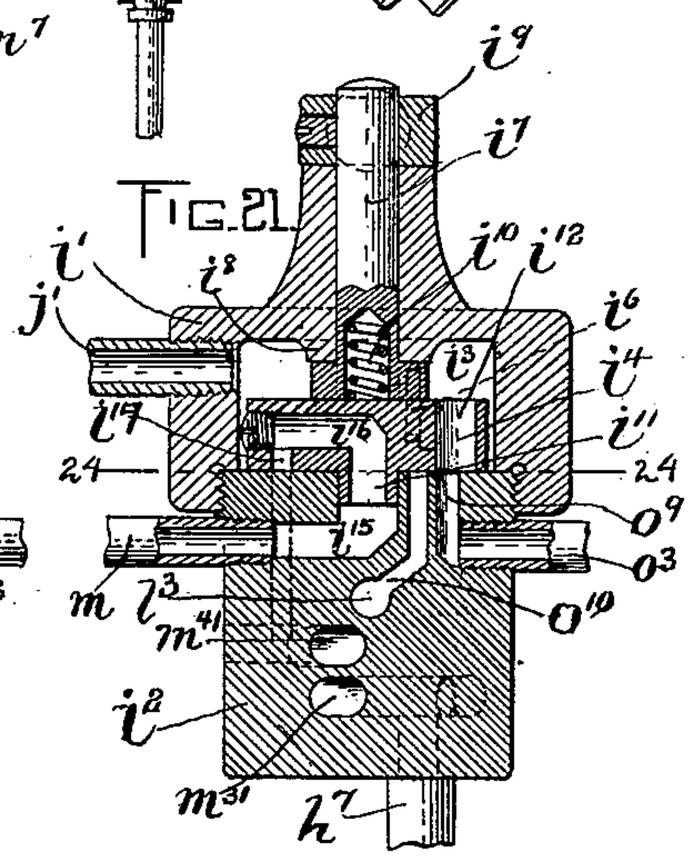


Fig. 22.

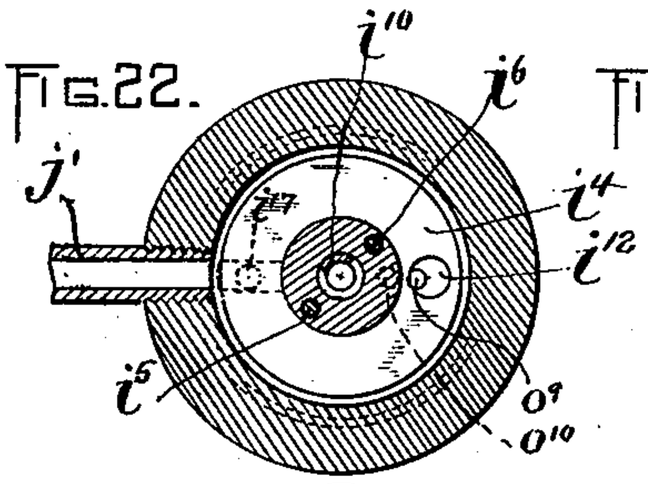


Fig. 23.

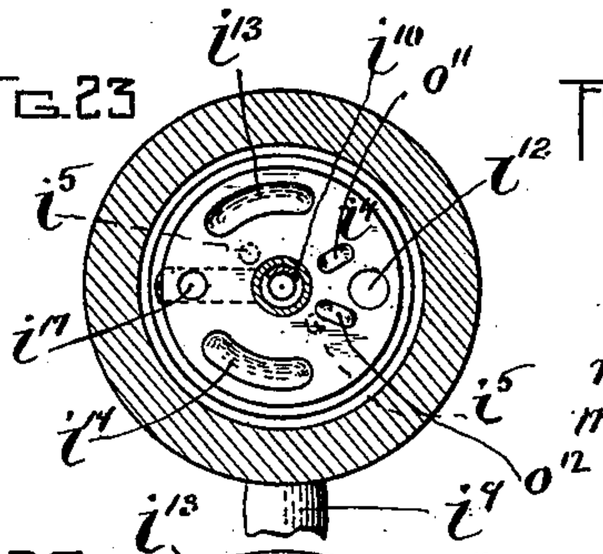


Fig. 24.

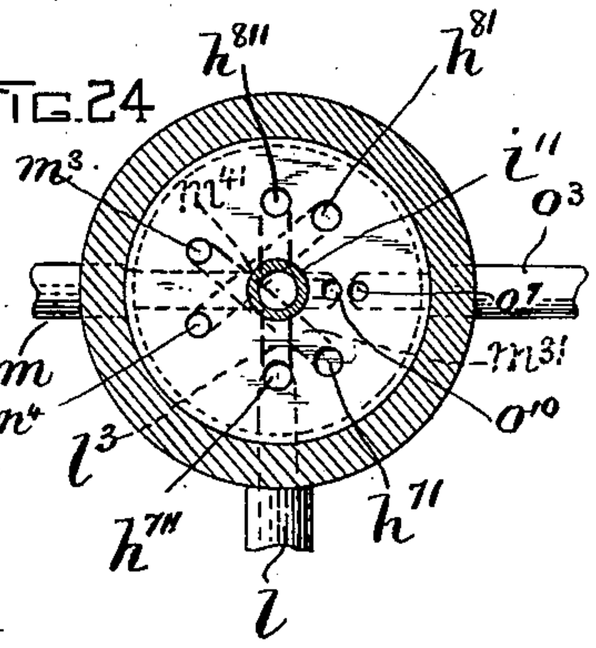


Fig. 26.

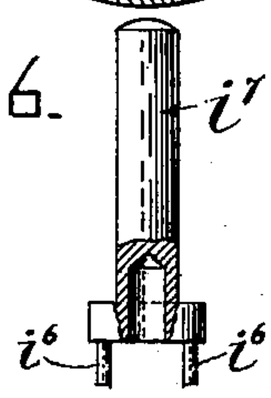
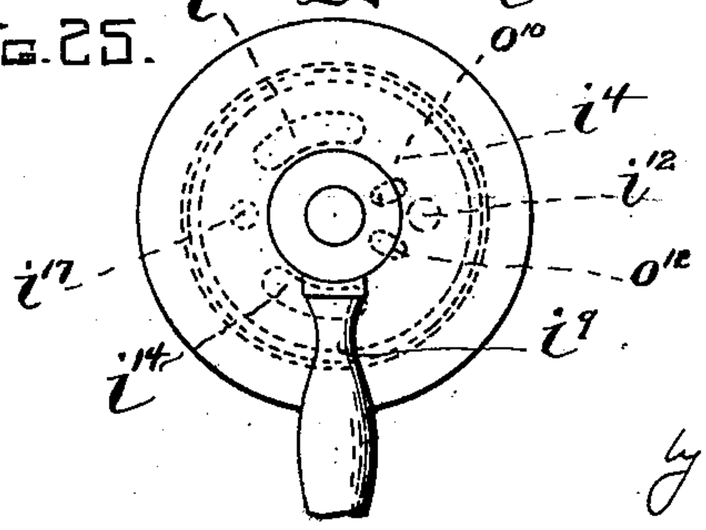


Fig. 25.



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UNITED STATES PATENT OFFICE.

JAMES HARTNESS, OF SPRINGFIELD, VERMONT.

TURRET-LATHE.

SPECIFICATION forming part of Letters Patent No. 635,888, dated October 31, 1899.

Application filed November 18, 1898. Serial No. 696,770. (No model.)

To all whom it may concern:

Be it known that I, JAMES HARTNESS, of Springfield, in the county of Windsor and State of Vermont, have invented certain new and useful Improvements in Turret-Lathes, of which the following is a specification.

This invention has relation to turret-lathes of the type illustrated in my copending application, Serial No. 689,961, filed August 31, 1898, and has for its object to provide improvements thereupon whereby the work-holder and work may be moved laterally for various purposes.

Another object of the invention is to provide fluid-operated mechanism and improved devices for governing and controlling it, by means of which the turret or the work-holder, or both, may be moved at different speeds, and hence the said parts may be moved slowly while the tools are operating upon the work and rapidly when said parts are moving the tools or the work toward or from operative position.

Another object of the invention is to provide certain improvements in the machine whereby it will be rendered capable of performing a greater variety of work and whereby it may be controlled more accurately and with less muscular effort than heretofore.

To these ends the invention consists in a machine possessing certain features of construction and relative arrangements of parts, all as illustrated upon the drawings now to be described in detail and finally pointed out in the claims hereunto appended.

Reference is to be had to the accompanying drawings, and to the letters marked thereon, forming a part of this specification, the same letters designating the same parts or features, as the case may be, wherever they occur.

Of the drawings, Figure 1 represents in side elevation a turret-lathe embodying my invention. Fig. 2 represents a front elevation of the machine. Fig. 3 represents a transverse sectional view looking at the front end of the machine from the rear. Fig. 4 represents a plan view of the machine. Fig. 5 represents a horizontal section on the line 5 5 of Fig. 1 of the front end of the machine. Fig. 6 represents a section on the line 6 6 of Fig. 5. Fig. 7 represents a longitudinal section through the machine. Fig. 8 represents a partial sectional view on the line 8 8 of Fig. 5. Fig. 9 represents a plan view, partially in section, of the machine. Fig. 10 represents in sectional view on the line 10 10, Fig. 7, the feeding-cylinder for the work-holder. Fig. 11 represents a rear end elevation of the machine, the rear end of the machine being in section. Figs. 12 and 13 represent transverse sections through the rear end of the machine. Figs. 14 and 15 represent the hydraulic clamp for locking the turret-carriage against movement. Figs. 16, 17, and 18 represent what I term the "escapement" or "regulating" device for regulating the volume of fluid admitted to the cylinders to feed the work-holder or the turret-carriage. Figs. 19 to 26, inclusive, represent the valve adapted to be operated by the machine attendant for controlling the movements of the head-stock, the valve for the turret-carriage-moving devices being substantially similar thereto.

Referring to the drawings, which show one form of the invention which I have selected for the purpose of illustration and disclosure, a indicates the bed of the lathe, which is mounted upon suitable legs or standards a' a^2 and is provided with ways or guides a^3 a^4 for the carriage b, upon which the rotary turret c is mounted. So far as the general characteristics of the bed, the carriage, and the turret are concerned they are no different from those in my application Serial No. 689,961, to which I have previously referred, the carriage sliding upon ways or guides and the turret rotating upon the carriage to present tools successively to the work in accordance with a preconceived arrangement or plan. The bed is hollow, as shown, and at its front end is provided with a flat portion a^5 in a plane below that of the rear portion to receive the transverse or lateral guides or ways for the sliding head-stock and the rotary work holder or carrier, as best shown in Fig. 7.

Referring to Figs. 11, 12, and 13, it will be noted that the shear or way a^3 is in a plane above that at a^4, and that whereas the former is substantially prism-shaped and undercut the latter is rabbeted or cut away and is provided with a longitudinally-extending gib a^6, secured thereto by bolts a^7.

The carriage b is provided with a V-shaped groove b' in its under surface near one edge

to receive the shear a^3 and with a laterally-extending tongue b^2 to rest upon the shear or way a^4, and to hold the carriage from vertical movement on the side containing the V-shaped groove gibs b^3 b^4 are secured to it by bolts and project under the prism-shaped way or shear a^3, the latter being undercut for this purpose.

To move the carriage longitudinally of the bed toward and from the head-stock, I employ fluid-operated devices consisting of a cylinder b^5, formed in the carriage, and a piston a^8 on the end of a piston-rod a^9, passed through a stuffing-box b^6 at the end of the cylinder and firmly secured in the cross-bar a^{10} on the rear end of the bed. Fluid is admitted alternately to the opposite sides of the stationary piston a^8 by ports or ducts a^{11} a^{12}, respectively, which communicate with a valve-casing d by means of tubes or pipes a^{13} a^{14}. The valve which controls the passage of fluid through these ducts or pipes will be described presently, it being sufficient to state at this time that when the valve lever or handle is thrown to the left in Fig. 1 the carriage is fed to the left or toward the head-stock, and when the said lever or handle is thrown to the right the carriage is fed in that direction, the speed of movement being regulated or determined by the position of the handle—that is to say, when the handle is thrust a short distance to the right or left the carriage is fed slowly; but when the handle is moved through an arc of sixty degrees the carriage is fed rapidly, all as will be hereinafter explained in detail.

On the flat front portion a^5 of the bed I place a hollow casting or frame e, which is bolted in place by bolts e' e', as illustrated in the several figures. This frame, as shown in Fig. 3, is considerably longer than the cross-diameter of the bed, and consequently extends laterally beyond it for a considerable distance. It is formed with parallel ways or shears e^2 to receive the head-stock f, which is formed to slide upon them. Said head-stock is substantially square when viewed in front elevation and is adapted to slide on said ways or shears to the right in Fig. 3, so as to move the work relatively to the operating-tool. Said head-stock is recessed to receive a work-carrier f', which consists of a bevel-gear having a peripheral flange f^2. A ring or circular gib f^3 is secured to the rear face of the head-stock f and overlaps the flange f^2, there being inserted between said flange and the gib and the flange and the head-stock a series or plurality of rolls f^4 f^4, held apart by separators f^5 f^5, substantially similar to those in the machine shown in my copending application. The head-stock is provided with an annular rearwardly-projecting flange or bearing f^6, on which the work-carrier f' is journaled, there being between the two a frusto-conical bushing f^7. A chuck, which is indicated as a whole at f^8, is secured to the rear face of the work-carrier and overlaps the gib f^3, and it is provided with a central aperture f^9, registering with an aperture f^{10}, extending through the head-stock, whereby a back-facing or other tool may be inserted through said apertures from the front to operate upon the interior of the work. Power is imparted to said work-carrier through the medium of a bevel-pinion e^4, rigidly secured to a telescoping shaft consisting of a spindle e^5, having its reduced end e^6 journaled in a bearing carried by the head-stock and having its end inserted into a sleeve e^7, journaled in bearings e^8 e^9, supported by the laterally-extending frame e. The inner end of the sleeve is formed with a flange e^{10}, carrying oppositely-arranged radially-extending lugs e^{11}, in which diametrically opposite rollers e^{12} are journaled, said rollers being beveled, as seen in Fig. 6, and extending into longitudinal grooves or keyways in the shaft or spindle e^5. Hence when the hollow shaft or sleeve e^7 is rotated it causes the rotation of the spindle e^5, although the latter is free to be moved longitudinally with the head-stock. The sleeve e^7 may be driven in any suitable way, as by a cone-pulley e^{13}, adapted to be connected to the shaft by clutching devices, (illustrated as a whole at e^{14},) but which I shall not describe, as they may be of any type now known, and their peculiar structure does not form an essential feature of my invention, it sufficing to state that the spindle or shaft e^5 is driven or stopped at will and that the speed of rotation of the work-carrier depends upon the character of tool that is operating upon the work and other conditions which are to be met.

I have stated that the work-carrier and the head-stock are provided with registering apertures to receive a tool and tool-holder projecting rearwardly from the front of the machine. By examining Fig. 7 in connection with Fig. 5 it will be observed that I provide a plurality of tool-holders (indicated at g g' g^2) arranged in the same horizontal plane and adapted to successively register with the said apertures f^9 f^{10} as the head-stock is fed laterally of the machine. They are mounted in guides in the frame e and are held against rotation, respectively, by screw-pins g^3, extending into grooves g^4, as best shown in Fig. 7. Each tool-holder is provided on its under side with rack-teeth g^5, and they are adapted to be successively engaged by a pinion g^6 on the end of a longitudinally-movable shaft g^7, journaled in bearings g^8 and having on its end a pilot-wheel g^9. By moving the shaft g^7 longitudinally the pinion g^6 may be brought into engagement with the teeth of any one of the tool-holders, and then by rotating the shaft said tool-holders may be projected through the apertures f^9 f^{10}, so as to bring the tool into operative position relatively to the work, and in order that each holder may receive a tool it is provided on its rear end with a conical socket g^{10} for the shank thereof.

For the purpose of moving the head-stock and the work-holder laterally of the main

frame of the machine I employ fluid-operative devices which, as shown in Fig. 10, consist of a cylinder h, bored in the upper portion of the head-stock and having its ends closed by stuffing-boxes h' h', through which a hollow piston-rod h^2 projects, the ends of said rod being rigidly secured in lugs h^3, projecting upward from the stationary transverse frame e on the front of the bed a. About midway between its ends the hollow piston-rod is provided with a stationary non-perforated piston h^4, which forms an abutment when fluid is let into the cylinder on either side thereof to move the head-stock in one direction or the other. Hence the hollow piston-rod is provided with two ports h^5 h^6, one on each side of the piston, for the purpose of supplying fluid to the cylinder to move it and the head-stock, and communicating with the outer ends of said piston-rod are pipes or ducts h^7 h^8, which lead to a valve-casing i, supported by the transverse frame e and similar to that at d. Fluid is admitted to the valve-casings i and d through a main supply-pipe j, which extends from a pump or other supplying device to an escapement or regulating device k, said pipe j having a branch j' leading to the valve-casing i and a branch j^2 leading to the valve-casing d, the branch j^2 being composed in part of the flexible tube j^3, this being necessary, as the carriage travels relatively to the valve-casing i and the main supply-pipe j. The liquid which escapes from the dead side of the piston passes through a pipe l, which leads from the casing i to a reservoir in the leg or standard a^2, there being a similar pipe l' extending from the valve-casing d and communicating with the pipe l through the medium of a flexible hose or tube l^2. Through the valves in said casings, which I shall presently describe, the operating fluid may be fed to either side of the pistons in the carriage or sliding head-stock to feed them in either direction, it being so arranged that when the fluid passes into said casings directly from the main supply-pipe j said parts are moved at their maximum speed, and hence in order to move them slowly I have provided the regulating devices interposed between the main supply-pipe and the casings, whereby a limited volume is supplied to said valve-casings. To this end a pipe m connects the outlet from the escapement device k with the valve-casing i, there being a branch m', consisting partially of a flexible hose which communicates with the valve-casing i. As the valve-casings are substantially similar, I have illustrated and shall describe only the one which controls the passage of the fluid to the head-stock-operating cylinder.

Referring to Figs. 19 to 26, inclusive, the casing i is formed in two portions i' i^2, the former having a chamber i^3, into which the high-pressure or full-volume pipes j' or j^2 lead. The part i^2 of the casing is formed on its inner face as a valve-seat, and it is exteriorly threaded, whereby it can be screwed into the chambered portion i', as best shown in Fig. 21. The valve i^4 consists of a circular disk having in its upper face apertures i^5 to receive dowel-pins i^6, projecting downwardly from the valve-stem i^7, said valve-stem being projected through an annular flange i^8, formed on the chambered portion i' of the valve and having secured to its end a handle or lever i^9, whereby it may be rotated. A spring i^{10} is inserted in a socket in the inner end of the valve-stem i^7 and holds the valve i^4 firmly against its seat. The valve has a trunnion i^{11}, which fits in a socket in the valve-seat of the valve-casing. The full-pressure pipe j' leads into the chamber i^3, so that the chamber is always full of fluid under a high pressure, and the pipes h^7 h^8, which supply fluid to the opposite ends of the cylinder on the traveling head-stock, lead into the portion i^2 of the valve-casing, as shown in Figs. 19 to 21, there being ports h^{81} and h^{71} in the valve-seat, which communicate directly with the pipes h^7 and h^8. The valve i^4 has an aperture i^{12}, which may be registered with either of the ports h^{71} or h^{81} to cause the moving of the head-stock in one direction or the other, and in order to permit the fluid to exhaust from each one of the pipes, as h^7, while the liquid is being introduced from the other one, as pipe h^8, to the duct h^{81} the valve-seat is provided with two ports h^{811} and h^{711}, which communicate by a transverse duct l^3 with the exhaust-pipe l, and the valve is provided with two concentric chambers or grooves i^{13} i^{14}, so located that when fluid is passing through the port i^{12} into the port h^{11} the duct i^{13} will register with the ports h^{71} and h^{711} to permit of the exhaust of the fluid from the port h^{71} into the discharge-pipe l, and vice versa. In order, however, that the head-stock or carriage may be fed slowly while the tools are operating, I provide the limited operating volume, which passes through the regulator or escapement device k and through the pipes m m'. The said pipe m' communicates by a duct i^{15} in the valve-casing with a duct i^{16}, which extends through the trunnion in the valve and ends at a port i^{17} in the lower face of the valve. This port i^{17} may be registered with ports m^3 m^4 in the valve-seat, which communicate by ducts m^{41} and m^{31} with the ports or ducts h^{71} and h^{81}, respectively, as illustrated in Fig. 24. It will be seen by examining the last-mentioned figure that the ports h^{81}, h^{811}, m^4, m^3, h^{711}, and h^{71} are all located in a circle concentric with the trunnion i^{11} and that the ports h^{81} h^{71} are separated considerably farther than the ports m^3 m^4, so that inasmuch as the ports i^{12} i^{17} in the valve are diametrically opposite on swinging the valve-lever to one side or the other the port i^{17} will be caused to first register with one of the ports m^3 m^4 before the port i^{12} can register with the ports h^{71} h^{81}. Therefore in order to move the head-stock slowly the valve-handle i^9 is turned at an angle of thirty degrees, at which

time the port h^{17} will register with the port m^3 or m^4, and the fluid will flow through said port and through one of the ducts m^{31} or m^{41} into the pipes h^8 or h^7, as the case may be. Then in order to admit the high-pressure fluid into the cylinder the valve-handle i^9 is turned to an angle of sixty degrees, so that the port i^{12} registers with the ports h^{71} or h^{81}. The ducts or grooves i^{13} and i^{14} in the under surface of the valve are long enough so that they will connect the ports h^{81} h^{811} or the ports h^{71} h^{711} whether the valve be turned to admit the limited volume fluid or the high-pressure fluid, and consequently the fluid will be exhausted from the dead side of the cylinder at all times when fluid is being admitted to the other side thereof.

The valve-casing b and its parts, as I have previously stated, are so similar to that at i and its parts that I have not illustrated them, the only difference between the two being that whereas the pipes h^7 h^8 lead from the valve-casing i from the end the corresponding pipes a^{14} a^{13} for the carriage-feeding means lead into the side of the casing d; but that is a mere matter of detail and will be easily understood without further illustration.

Next referring to Figs. 16, 17, and 18, which illustrate a regulating or escapement device for regulating the low-pressure or limited supply of fluid to the carriage or head-stock moving devices, it will be seen that I provide a casing k, having therein a slide-valve k', connected by a link k^2 with a crank k^3, extending out from a disk k^4 on the end of the telescoping or extensible shaft e^5 e^7, as shown in Fig. 5. The main supply-pipe j leads into a chamber k^5 in the valve-casing on one side of the valve, there being a similar chamber k^6 on the other side of said valve. Extending inward from each of said chambers are ports k^7 k^8 k^9 k^{10}, the ports k^7 k^9 registering with each other, and the ports k^8 k^{10} also being in alinement with each other. The valve k' is provided with two transverse ports k^{11} k^{12}, the former being adapted to register with the ports k^7 k^9 and the latter being adapted to register with the ports k^8 k^{10}, said ports k^{11} k^{12} being so located that when the valve is at one extreme of its movement fluid will enter one end of the chamber k^6 and when at the other extreme of its movement fluid will enter the other end of said chamber. The pipe m^7, which conveys the limited-volume or low-pressure fluid to the carriage or head-stock moving cylinders, enters the front of the casing, as shown at m^8, and communicates with a chamber or duct k^{13}, formed in the under side of the valve, said chamber or duct alternately connecting the ports k^9 k^{10} with the port m^8, substantially as an engine-valve connects the ends of a cylinder with the exhaust-port. The chamber k^6 is substantially cylindrical, and in it is placed a loose piston k^{14}, which is driven from end to end of the chamber as the valve k' is reciprocated. Consequently only so much fluid can enter the exhaust-duct m^8 as is in front of the piston each time it reciprocates, and hence the liquid is introduced into the pipe m at a constant pressure and in a constant volume.

In order to vary the volume to increase or decrease the speed of the carriage or head-stock, I provide a rack n, having a pin n' extending into the end of the chamber k^6 to limit the movement of the piston. The rack is engaged by a partial pinion n^2 on the end of a shaft n^3, mounted in suitable bearings in the rear of the frame e and having a handle n^4, as shown in Figs. 3 and 11. Thus it will be seen that it makes no difference at what pressure the fluid is delivered to the regulating device, as it will flow therefrom in a predetermined volume, said volume being increased or decreased at will by turning the shaft n^3.

The working resistance varies in accordance with the particular work being accomplished by the tools, the character of the stock being operated on, and other conditions, and the pressure on the delivery side of the regulator accordingly varies therewith, and, on the other hand, the pressure in the source of supply while always sufficient to operate the machine is likely to vary for a number of reasons. In spite of these variations, however, the regulator delivers a predetermined volume of fluid to the cylinder by reason of the fact that the valve is operated at a certain rate of speed by the power devices, and hence the volume of fluid delivered by the regulator is constant irrespective of the pressure on either side thereof.

I specify in some of the appended claims that the "tool-slide" is controlled by the regulator; but I desire to be understood as covering thereby a slide carrying the work or a fluid-operated slide in any other form of machine.

It is evident that by connecting the valve k' in the regulator with the power devices, by means of which the chuck or work-holder is rotated, a variation in speed of rotation of the chuck is immediately followed by a proportional variation in the feeding movement of the turret, as the fluid which is delivered to the turret-feeding means is proportional to the speed of rotation of the work.

In addition to these features which I have described I provide means for immediately locking the head-stock and the turret-carriage against movement as soon as or slightly before the feeding fluid is cut off from their respective cylinders, so that there is no chance of a thrust of the work moving either the carriage or the head-stock when the pressure is taken off the cylinder. The clamp for the head-stock is best shown in Figs. 8 and 9. o represents a cylinder having a piston o', which is held in inoperative position by a spring o^2, there being a pipe o^3, which supplies fluid to the cylinder to move the piston whenever desired. o^4 o^5 indicate toggle-levers, having their knuckle or inner ends extending into a

transverse aperture in the piston. The outer end of the lever o^5 bears against an adjusting-screw o^6, while the outer end of the lever o^4 bears against a clamping-block o^7, adapted to be thrust against a wearing-strip o^8, secured to the traveling head-stock. When fluid is admitted through the pipe o^3 to the cylinder o, the piston straightens out the toggle-levers and forces the clamping-block o^7 firmly against the wearing-strip o^8 on the head-stock, so as to clamp it firmly against movement. The pipe o^3 leads from the valve-casing i and communicates with a port o^9 in the valve-seat therein, said port o^9 being so located that when the handle i^9 is in neutral position the port i^{12} in the valve will register therewith, so as to admit fluid to the cylinder o. By reason of the size of the port i^{12} fluid will be admitted to the port o^9 before the feeding pressure is entirely cut off from the ports m^3 m^4. There is an exhaust-port o^{10}, which communicates with the duct l^3, and when the valve lever or handle i^9 is thrown out of its neutral position ducts o^{11} o^{12} in said valve will connect the ports o^{10} o^9, so as to permit the escape of the fluid in the cylinder o and allow the spring o^2 to return the piston to its normal inoperative position.

The clamp for the turret-carriage is illustrated in Figs. 12 to 15, inclusive, and it does not differ from that which I have just described. It comprises a cylinder p, a piston p', a spring p^2, toggle-levers p^3 p^4, an adjusting-screw p^5, and a clamping-block p^6. The cylinder is secured to the carriage b by screws p^7 p^8, so that the clamping-block will be forced upwardly against the undercut shear a^3. The pipe which supplies fluid to the cylinder o is indicated at p^9, and it leads from the valve-casing d. The ports in the valve-casing b are substantially similar to those described in the valve-casing i, so that turning the valve-handle d^7 to neutral position permits the flow of fluid into the cylinder p to clamp the carriage against movement.

The exhaust-pipes l l^2, as I have previously said, lead into a reservoir in the standard a^2, and the liquid-supply to said reservoir may be again utilized by withdrawing it from the pipe q.

From the foregoing it will be seen that I have provided a highly efficient apparatus, whereby I am enabled to perform upon the lathe a greater amount and greater variety of work than heretofore. The controlling devices for causing the travel of the carriage or head-stock are operated easily and without any effort, the valve-handle being so arranged that upon turning them in the direction of desired movement of the carriage or head-stock the latter will immediately move in that direction, and when the carriage approaches the end of its movement the handle may be held stationary, and the continued travel of said carriage will shut off the feed-supply. It will be understood that the regulator or escapement absolutely regulates the flow of fluid so long as the pressure is greater on the supply-pipe than the resistance on the pipe m; but when the turret slide or carriage comes to a standstill by reason of its being arrested by one of its stops (not shown in detail in this application, but illustrated in my said co-pending application, Serial No. 689,961) then the regulator or escapement no longer supplies the fluid, for the pressure in pipe m will be equal to that in pipe j. By providing the transversely-movable head-stock and means for feeding it I am enabled to introduce tools into the interior of the work and to employ a plurality of different "back-facing" tools to perform different kinds of work upon the stock on the work-carriage. The shear a^3 is in a plane above the guide a^4, which latter is dropped far enough to permit the passage of an inverted-V-shaped shear-protector r, secured to the head-stock in such way as to cover the lower shear or guide e^2, and the said head-stock is also cut away, as shown in Fig. 10, to permit the passage of a protector r' for the shear a^3. Hence cuttings and dirt cannot drop upon the shears, so as to cause undue friction when the sliding parts are in movement.

Having thus explained the nature of the invention and described a way of constructing and using the same, though without attempting to set forth all of the forms in which it may be made or all of the modes of its use, I declare that what I claim is—

1. A turret-lathe, comprising a bed, a turret adapted to receive a plurality of tools and movable longitudinally on the bed, and a rotatable chuck or work-holder movable transversely on the bed.

2. A turret-lathe, comprising a bed, a tool-holding turret adapted to slide longitudinally of the bed, transverse guides on said bed, and a rotatable chuck or work-holder arranged to slide on said transverse guides.

3. A lathe comprising a horizontally-arranged bed having longitudinal guides, and also transverse guides, a tool-holding turret movable on said longitudinal guides, a rotary work-holder movable on said transverse guides, and rotatable about an axis longitudinal of said machine, and a power-shaft arranged parallel to said transverse guides for rotating said work-holder.

4. A lathe comprising a horizontally-arranged bed having longitudinal guides, and also transverse guides, a tool-holding turret movable on said longitudinal guides, a head-stock movable on said transverse guides, and a rotary work-holder on said slide rotatable on an axis parallel to the longitudinal guides.

5. A lathe comprising a bed having longitudinal guides and transverse guides, a tool-holding turret movable on said longitudinal guides, and a work-holder movable on said transverse guides and rotatable on an axis parallel to the longitudinal guides.

6. A lathe comprising a bed having longitudinal guides and transverse guides, a tool-holding turret movable on said longitudinal

guides, a work-holder movable on said transverse guides and rotatable on an axis parallel to the longitudinal guides, and fluid-operated mechanism for moving said work-holder.

7. A lathe comprising a bed having longitudinal guides, and transverse guides, a tool-holding turret movable on said longitudinal guides, a work-holder movable on said transverse guides and rotatable on an axis parallel to the longitudinal guides, and power devices mounted on said bed and connected to said work-holder to cause its rotation.

8. A lathe comprising a bed, a tool-holder, a frame on said bed having lateral guides, a head-stock movable on said guides, a rotary work-holder journaled in said head-stock and means including an extensible shaft for rotating said work-holder.

9. A lathe comprising a bed, a tool-holding turret movable longitudinally of said bed, a head-stock movable transversely of said bed, and a plate-shaped work-holder mounted rotatably in said head-stock and journaled at its outer edges therein.

10. A lathe comprising a bed, a turret movable longitudinally of said bed, and adapted to present a plurality of tools in succession to the work, stationary transverse guides arranged in different horizontal planes extending across said bed, a vertical plate-shaped head-stock mounted to slide on said guides, and a work-holder journaled on said head-stock.

11. A lathe comprising a movable head-stock, a tool-holding turret journaled on said head-stock, a bed, and stationary transverse guides on said bed for said head-stock, said guides being respectively above and below the axis of rotation of said work-holder.

12. A lathe comprising a bed, a tool-holder movable longitudinally on said bed, fluid-operated means for moving said tool-holder, a work-holder adapted to move transversely of said bed, fluid-operated means for moving said tool-holder, and devices for regulating the supply of fluid to both of said means.

13. A lathe comprising a bed, a tool-holder movable longitudinally on said bed, fluid-operated means for moving said tool-holder, a work-holder adapted to move transversely of said bed, fluid-operated means for moving said tool-holder, and a common source of fluid-supply for both of said means.

14. A lathe comprising a bed, a tool-holder movable longitudinally on said bed, a work-holder movable transversely of said bed, fluid-operated means for moving said work-holder, a source of fluid-supply, and a valve for controlling the passage of fluid from said source of supply to the said means.

15. A lathe comprising a bed, a tool-holder, a work-holder movable transversely on said bed, fluid-operated means for moving the work-holder, and devices for delivering different predetermined volumes of fluid to said means whereby the work-holder may be moved at different speeds.

16. A lathe comprising a bed, a tool-holder movable longitudinally, a work-holder movable transversely on said bed, fluid-operated means for moving said work-holder, and stationarily-mounted devices for controlling the passage of fluid to said means.

17. A lathe comprising a bed, a tool-holder, a work-holder movable transversely on said bed, fluid-operated means for moving said work-holder, a source of full-volume fluid-supply, a regulator for delivering a limited volume of liquid, and devices for connecting the fluid-operated means with the source of full-volume fluid-supply or with the regulator.

18. A lathe comprising a bed, a tool-holder, a work-holder movable transversely on said bed, fluid-operated means for moving said work-holder, a source of full-volume fluid-supply, a regulator for delivering a limited volume of liquid, and a valve arranged to deliver full-volume or limited-volume fluid to said means.

19. A lathe comprising a bed, a work-holder, a tool-holder movable on said bed, fluid-operated means for moving said tool-holder, a source of full-volume fluid-supply, a regulator for delivering limited-volume fluid, and devices for connecting the fluid-operated means directly with said source of supply or with said regulator.

20. A lathe comprising a bed, a work-holder, a tool-holder movable on said bed, fluid-operated means for moving said tool-holder, a source of full-volume fluid-supply, a regulator for delivering limited-volume fluid, and a valve arranged to deliver full-volume or limited-volume fluid to said means.

21. A lathe comprising a bed, a tool-holder, a work-holder, one, at least, of said holders being movable, fluid-operated means for moving said movable holder, and devices for delivering a predetermined volume of fluid to said means regardless of the resistance of the work.

22. A lathe comprising a bed, having transverse guides, a tool-holder movable longitudinally of the bed, a work-holder movable on said guides, belt-driven power devices for rotating said work-holder, a piston and cylinder, one connected to the bed and the other to the work-holder, and means for delivering fluid to said cylinder on either side of said piston.

23. A lathe comprising a bed, a work-holder, a tool-holder movable on said bed, fluid-operated means for moving said tool-holder, and devices located upon said tool-holder for controlling the delivery of fluid to said fluid-operated means.

24. A lathe comprising a bed, a work-holder, a tool-holder movable on said bed, fluid-operated means for moving said tool-holder, a

valve for controlling the delivery of fluid to said fluid-operated means, and a valve-handle adapted to be turned in the direction of desired movement to cause said tool-holder to move in said direction.

25. A lathe comprising a bed, a work-holder, a tool-holder movable on said bed, fluid-operated means for moving said tool-holder, a valve for controlling the delivery of fluid to said fluid-operated means, a valve located upon said work-holder for controlling the delivery of fluid to said fluid-operated means, and a valve-handle adapted to be turned in the direction of desired movement to cause said tool-holder to move in said direction.

26. A lathe comprising a bed, a tool-holder movable longitudinally on said bed, a work-holder, means for moving said tool-holder longitudinally, and a clamp supplemental to said means for intermittingly locking the tool-holder against such movement.

27. A lathe comprising a bed, a work-holder movable transversely on said bed, a tool-holder longitudinally movable on said bed, means for moving said work-holder, and a clamp supplemental to said means for intermittingly locking the work-holder against such transverse movement.

28. A lathe comprising a support, a fluid-operated slide on said support, a fluid-operated clamp for said slide, and means for supplying fluid to the slide and clamp alternately.

29. A lathe comprising a bed, a slide movable on said bed, a fluid-operated clamp for said slide, and a valve arranged to deliver fluid to the said slide and the said clamp.

30. A lathe comprising a support having guides, a slide movable on said guides, a cylinder having a piston for moving said slide, a clamp for locking said slide to the support, a cylinder having a piston adapted to actuate the clamp, and means for supplying a pressure medium to the cylinders.

31. A lathe comprising a support, a slide movable on said support, a clamp consisting of a toggle and a clamp-block, and fluid-operated means for straightening said toggle to thrust the clamp-block into operative position.

32. A lathe comprising a support, a slide, movable on said support, fluid-operated means for moving said slide, fluid-operated means for clamping said slide against movement, devices for delivering full-volume fluid to said slide-operating means, devices for delivering limited-volume fluid to said slide-operating means, devices for delivering fluid to said clamping means, and a controllable mechanism for permitting the passage of fluid alternately to the clamping means, and the slide-operating means, said mechanism also permitting the passage of full-volume or limited-volume fluid to the slide-operating means.

33. A lathe comprising a bed, a tool-holder slidable on said bed, and fluid-operated means for clamping said tool-holder against movement.

34. A lathe comprising a bed, a tool-holder slidable on said bed, fluid-operated means for moving said tool-holder, fluid-operated means for clamping said tool-holder against movement, and a device for supplying fluid to said means alternately.

35. A lathe comprising a plurality of tool-holders arranged side by side, a bed having guides and a work-holder movable on said guides transversely of said tool-holders and having an axial aperture to bring the rear of the work into operative relation to any one of them.

36. A lathe comprising a plurality of tool-holders and a rotatory work-holder adapted to be brought to register with any one of said tool-holders, said work-holder having an aperture to receive the said tool-holder to permit the tool to operate upon the work.

37. A turret-lathe comprising a bed, a turret movable longitudinally on said bed, a plurality of supplemental tool-holders, and a work-holder arranged between said movable tool-holder and the supplemental tool-holders.

38. A lathe comprising a bed, a tool-holder movable on the bed, a plurality of supplemental tool-holders, and a laterally-movable rotatory work-holder arranged between the movable tool-holder and the plurality of tool-holders, said tool-holder having provisions for permitting the passage therethrough of any one of said plurality of tool-holders.

39. A lathe comprising a bed having guides, a plurality of parallel tool-holders, a rotatory work-holder movable transversely of said tool-holders, means for moving said work-holder on said guides, and means for moving said tool-holders longitudinally into operative position.

40. A lathe having a rotary chuck or work-holder, a slide, fluid-operated means for moving said slide, and a means for delivering fluid to said fluid-operated means proportionally to the speed of rotation of said work-holder.

41. A lathe having power devices, and a work-holder or chuck driven thereby, a slide, fluid-operated means for moving said slide, and a regulator operated by said power devices for delivering fluid to said fluid-operating means, said regulator being constructed and arranged to deliver a predetermined volume of fluid irrespective of the net difference between the working resistance and the pressure in the source of fluid-supply.

42. A lathe having power devices, and a work-holder or chuck driven thereby, a slide, fluid-operated means for moving said slide, and a regulator having a chamber or cylinder, and a piston controlled continuously by said power devices for delivering a predetermined volume of fluid irrespective of the net difference between the working resistance and the pressure on the inlet side of the regulator.

43. A lathe comprising a bed, a rotatory

chuck or work-carrier, a tool-holder movable on said bed, fluid-operated means for moving said tool-holder, automatic mechanism for regulating the delivery of the fluid to said means, and connections between the chuck or work-holder and said mechanism whereby the fluid is delivered to said means proportionally to the speed of rotation of the chuck or work-holder.

44. A lathe comprising a bed, a rotatory chuck or work-holder, a tool-holder movable on said bed, fluid-operated means for moving said tool-holder, and an automatic regulator interposed between the source of fluid-supply and the fluid-operated means, said regulator having a piston operated by the pressure in the source of fluid-supply.

45. A lathe comprising a bed, a rotatory chuck or work-holder, a tool-holder movable on said bed, fluid-operated means for moving said tool-holder, an automatic regulator interposed between the source of fluid-supply and the fluid-operated means, said regulator having a piston operated by the pressure in the source of fluid-supply, and means for conducting the fluid from said source of fluid-supply directly to said fluid-operated means or through said regulator.

In testimony whereof I have affixed my signature in presence of two witnesses.

JAMES HARTNESS.

Witnesses:

PETER P. SHERRY,

JOSEPH C. REEHILL.