(No Model.)

2 Sheets—Sheet 1.

A. JOHNSTON.

SCREW MACHINE.

No. 363,144. Patented May 17, 1887.

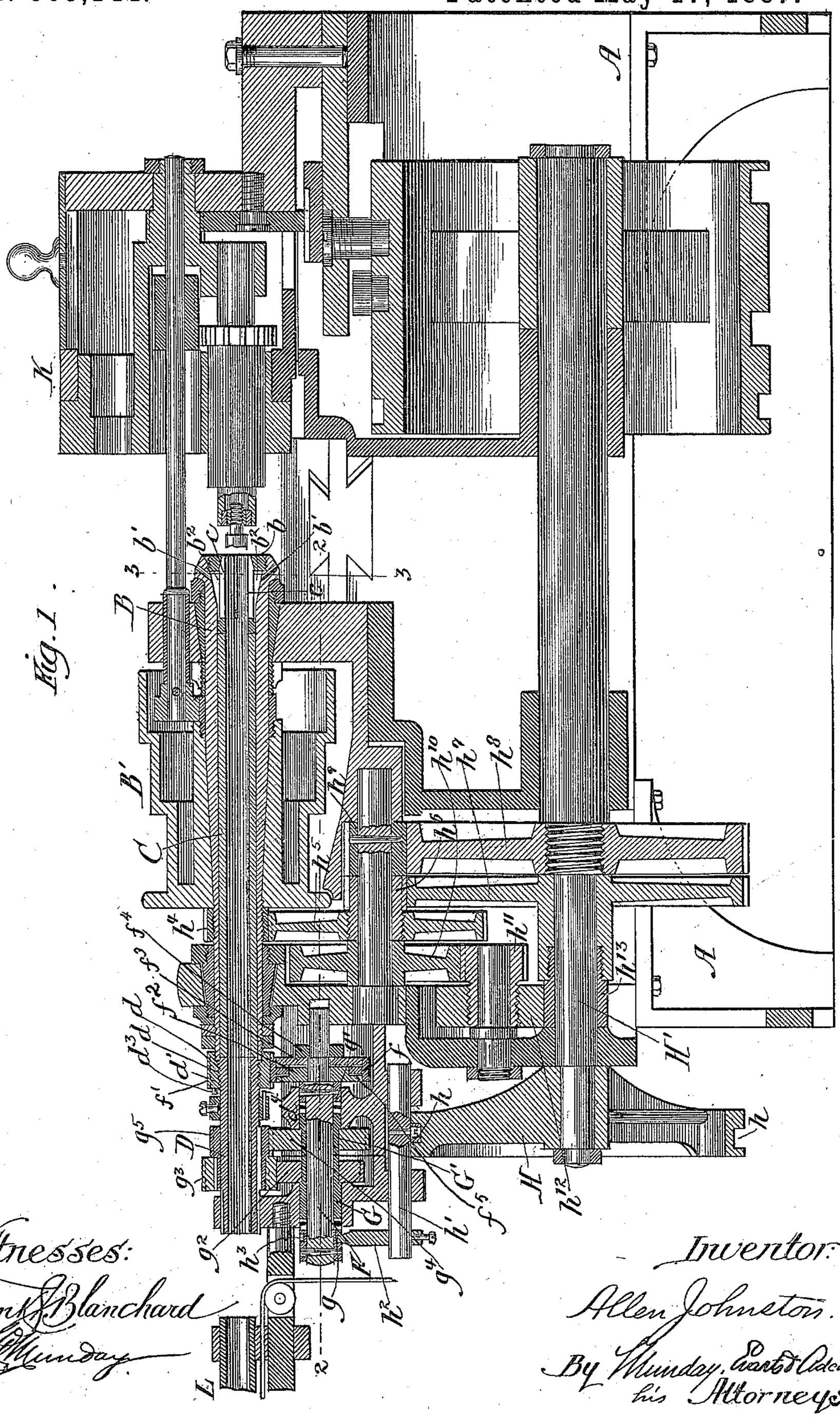

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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SCREW-MACHINE.

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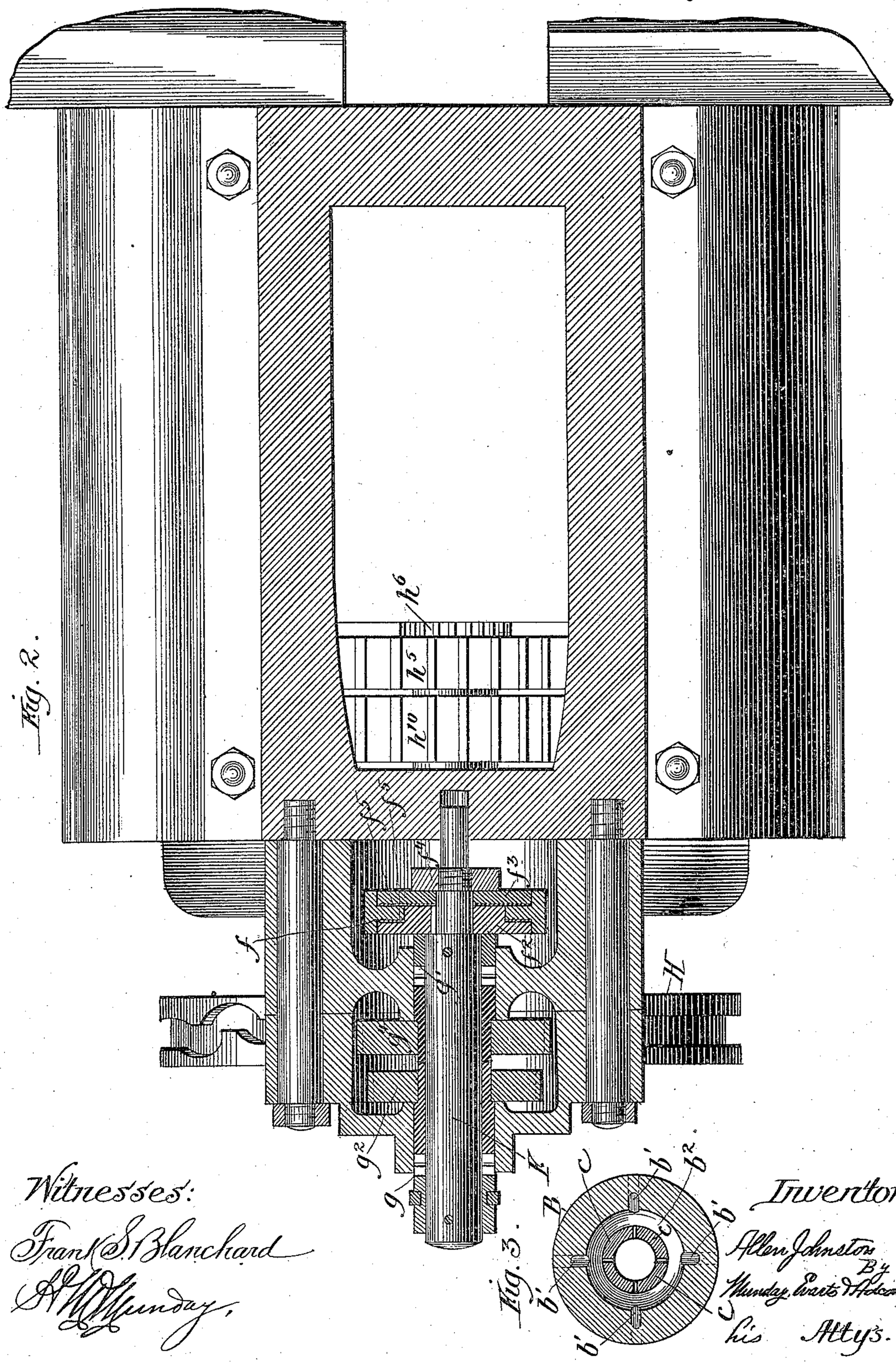

Fig. 2.

Fig. 3.

Witnesses:
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UNITED STATES PATENT OFFICE.

ALLEN JOHNSTON, OF OTTUMWA, IOWA.

SCREW-MACHINE.

SPECIFICATION forming part of Letters Patent No. 363,144, dated May 17, 1887.

Application filed November 11, 1886. Serial No. 218,571. (No model.)

To all whom it may concern:

Be it known that I, ALLEN JOHNSTON, a citizen of the United States, residing in Ottumwa, in the county of Wapello and State of Iowa, have invented a new and useful Improvement in Screw-Machines, of which the following is a specification.

My invention relates to metal-screw machines, and more particularly to the chuck and mechanism for operating the chuck by which the rod is held while the work is being done in such machines. In such machines the wedge or inclines at the end of the chuck-spindle, against which the chuck-jaws operate, usually or necessarily taper outward from a larger to a smaller diameter at the extreme end of the spindle, the interior surface of the wedges being ordinarily in the shape of a frustum of a cone with the small end outward. As the chuck-spindle usually revolves with great rapidity, this increased interior diameter of the spindle or wedges at a point back from the end of the spindle produces by centrifugal action a suction and tendency to draw air, dust, and small chips or metal particles, as well as the oil or lubricant, into and through the hollow chuck-spindle, and great difficulty has heretofore been experienced in the practical operation of such machines, owing to the metal chips and particles becoming jammed up and wedged in the chuck-spindle, so as to interfere with the feed of the rod through the same and with the operation of the chuck.

To overcome this difficulty—and herein my invention in part consists—I provide the chuck-spindle with one or more radial or lateral discharge-openings communicating with the interior of the chuck-spindle, through which any particles that may be drawn into the chuck-spindle may be discharged or thrown out by centrifugal action. These openings are preferably located back of the inclines or wedges which operate the chuck-jaws.

A further improvement of this feature of my invention consists in providing the interior of the chuck-spindle, just back of the inclines or wedges, with an enlargement, preferably a conical recess inclined in the opposite direction to the wedges or inclines, into which the discharge-openings lead at or near the point of largest diameter. By thus inclining the interior of the spindle in the opposite direction to the incline of the wedges the centrifugal action tends to collect the dirt and particles at the point of largest diameter, or near the discharge-openings, and thus facilitates their discharge from the spindle.

Another feature of my invention consists in the improved means I employ for operating the chuck, or for opening and closing the chuck-jaws upon the rod or stock. Heretofore, in order to allow and compensate for the inequalities in the size of the rod or stock, the chuck-jaws have usually been closed upon the rod by a spring; or, if the jaws have been closed by positive mechanism or a positive movement, as shown and described in my patent, No. 316,788, of April 28, 1885, a spring has been interposed to allow for the varying size of the rod or stock.

In the practical operation of these machines it is very important that the rod or stock be always and certainly held very tightly and firmly in the chuck-jaws, and that said jaws be compressed upon the stock with the proper degree of pressure every time, in order to prevent breakage, injury to the tools, &c. The rod or stock operated upon frequently varies from one sixty-fourth to one thirty-second of an inch in size. Where the degree of compression of the chuck-jaws depends, either directly or indirectly, upon a spring, it is always more or less unreliable, and necessarily exerts different degrees of pressure with every variation in the size of the stock; and if the variation in the size of the stock happens to be considerable, especially if the springs get a little out of their exact proper adjustment, injury is liable to occur to the machine or tools.

By my present improvement I close the chuck-jaws by positive mechanism, and no spring of any kind is interposed between the chuck-spindle and its operating-sleeve as a cushion for such sleeve, so that the jaws may be closed with precisely the same force upon the rod or stock whatever its size. In my present improvement the chuck-jaws are reciprocated lengthwise in the chuck-spindle by means of a positively-driven revolving screw-threaded sleeve, the threads of which engage corresponding threads in the chuck-spindle.

This screw-threaded sleeve is revolved in the same direction as the chuck-spindle, but at different rates of speed—that is to say, it is driven faster than the chuck-spindle when operating to close the chuck-jaws and slower than the chuck-spindle when operating to release them, or vice versa, according as the screw-threads connecting said sleeve with the chuck-spindle are left-hand or right-hand threads. Rotary motion is communicated from the chuck-spindle to this threaded sleeve by means of suitable gears and clutch mechanism, or other equivalent or substitute mechanism for communicating rotary motion to the threaded sleeve from the chuck-spindle to drive said sleeve at different rates of speed when operating to close and when operating to release the chuck-jaws. This connecting mechanism, or that part thereof which operates the revolving threaded sleeve to close the chuck-jaws, is furnished at some point therein or at some part thereof with a friction device or connection—such as a friction-gear, friction-wheel, or an ordinary belt and pulley—which will slip as soon as the chuck-jaws are closed with the sufficient or required degree of force upon the stock, and thus compensate for variations or inequalities in the size of the stock.

My invention also consists in the novel devices or parts and novel combination of devices or parts herein shown and described, and more particularly set forth in the claims.

In the accompanying drawings, which form a part of this specification, and in which similar letters of reference indicate like parts, Figure 1 is a central vertical longitudinal section of a machine embodying my invention, and Figs. 2 and 3 are sections on lines 2 2 and 3 3 of Fig. 1.

In said drawings, A represents the frame of the machine.

B is the hollow chuck-spindle, suitably journaled thereon; and B′, the driving-belt pulleys. The chuck-spindle is furnished at its outer end with wedges or inclines *b* for operating the chuck-jaws *c*, consisting, preferably, of an interiorly-cone-shaped thimble screwed in the end of the spindle.

The chuck-jaws are or may be of the ordinary construction, consisting, preferably, of a spring-metal sleeve split longitudinally the greater portion of its length and fitting in the hollow chuck-spindle B.

The chuck-spindle B is furnished with one or more, preferably several, holes or other openings, *b′*, extending laterally therethrough, through which particles drawn into the chuck-spindle will be thrown out by centrifugal action. In addition to the openings *b′*, I also provide the chuck-spindle with an enlarged conical bore or other recess, b^2, back of the wedges *b* and inclined in the opposite direction to said wedges. This oppositely-tapered recess tends to cause the particles to collect by the centrifugal action of the revolving spindle at or near the base of the discharge-openings *b′*. It is preferable that the diameter of this recess b^2 should exceed the interior diameter of the wedges or cone-thimble *b* at its inner or larger end, as thereby any tendency of metal particles to lodge in or upon the face of the wedges *b*, and thus interfere with the operation of the chuck, is avoided.

C is a sleeve fitting within the chuck-spindle B, and by which longitudinal movement is communicated from the positively-driven revolving threaded sleeve D to the chuck-jaws *c*, and the latter forced against the wedges or inclines *b* to close the jaws upon the stock. The threaded sleeve D abuts against the end of the sleeve C, and it is connected by screw-threads *d d* with the spindle B, or with a nut or sleeve, *d′*, rigidly secured on the end of said spindle. By this means, while the operating sleeve or screw D may revolve independently of the chuck-spindle B and of the chuck-jaws *c* or their sleeve C, the chuck-jaws have a perfectly rigid and unyielding longitudinal connection with said operating sleeve or screw D, so that the chuck-jaws must necessarily have the same longitudinal movement imparted to them as is imparted to said sleeve D. I do not here refer to the return movement of the chuck-jaws, but to their forward movement, by which they are closed upon the rod or stock and kept closed while the work is being done.

It will be observed that the end of the independently-revolving operating-sleeve D abuts directly against or is in contact with the end of the sleeve C, by which the longitudinal motion of the sleeve D is communicated to the chuck-jaws *c*, thus making a positive and unyielding connection between the chuck-jaws and the operating screw or sleeve D. This abutting of the end of the sleeve D against the chuck-jaw sleeve C is a simple form of rigid connection between the two, and by which the forward movement of said sleeve D will be positively imparted to the chuck-jaws without alteration or diminution. Any other suitable form of rigid and unyielding connection between the sleeve D and the chuck-jaws *c* may, however, be employed. In this way, when the chuck-jaws are once closed upon the stock or rod, as the mechanism which holds the jaws closed is of a rigid, positive, and unyielding character, without springs of any kind, the rod will be firmly held while the work is being done.

I find it a material convenience in matter of construction to cut the female threads *d* upon a separate nut, *d′*, detachably secured to the spindle B, instead of directly upon the spindle. As I ordinarily build the machines, and as indicated in the drawings, the screw-threads *d d* are left-hand threads. Right-hand threads may, however, be employed; but in such case the sleeve D should be driven faster than the spindle B to release the chuck-jaws, and slower to close them. As illustrated in the drawings, with left-hand threads *d d* the

sleeve D is driven faster than the chuck-spindle to push the sleeve forward and close the chuck-jaws, and slower than said spindle to release them or withdraw the sleeve B from the end of sleeve C as the spindle B revolves from left to right.

F is a shaft having a friction-gear, *f*, which meshes with a gear, *f'*, on the chuck-spindle B, and by or through which friction-gear motion is communicated to the rotary threaded sleeve D when the same is operating to close the clutch-jaws.

The gear *f'* may preferably be cut upon the outer surface of the threaded nut or sleeve *d'*. The friction-gear *f* is adjustably clamped between the friction-disks f^2 f^3 on the shaft F by means of the threaded nut f^4, and disks of papier-maché or other material, f^5, should be interposed between disks f^2 f^3 and wheel *f*. The disk f^2 is keyed rigidly to the shaft F.

G G' are clutch-sleeves, having ordinary clutch faces or notches at their outer ends adapted to engage corresponding clutches, *g g'*, secured rigidly to the shaft F. The clutch-sleeves G G' are suitably journaled on the frame of the machine, and the shaft F fits loosely in said sleeves, so that it may slide longitudinally thereon and rotate freely therein when neither of the clutches G *g* or G' *g'* is engaged. The clutch-sleeve G is furnished with a gear, g^2, which meshes with a gear, g^3, on the screw-threaded sleeve D. The size of the gears g^2 g^3 is such in relation to the size of the gear *f f'* that the sleeve D will be driven slower than the spindle B when the sleeve G is clutched to the shaft F, and thus operate the left-hand screw-threads *d d* to open the chuck-jaws. The clutch-sleeve G' is furnished with a gear, g^4, which meshes with a gear, g^5, secured to the threaded sleeve D. The size of the gears g^4 g^5 is such in relation to the size of the gears *f f'* that when the sleeve G' is clutched to the shaft F the threaded sleeve D will be driven faster than the spindle B, and thus cause the left-hand screw-threads *d d* to force forward the same and close the chuck-jaws. The shaft F is reciprocated longitudinally to bring the clutches *g g'* alternately into engagement with one or the other of the clutches G G', or into engagement with neither of said clutches, at intervals, as required, in the operation of the machine, by means of a cam-wheel, H, on the shaft H', which cam-wheel has a peripheral groove, *h*, that operates a sliding bar, *h'*, connected by an arm, h^2, to the shaft F. The shaft F, or the clutch-sleeve *g* secured thereto, is provided with a circular groove, h^3, in which the end of the arm h^2 fits. The cam-shaft H' is driven from the chuck-spindle through a train of reducing intermeshing gears, h^4, h^5, h^6, h^7, h^8, h^9, h^{10}, h^{11}, h^{12}, and h^{13}, or other suitable or equivalent mechanism.

The spindle B, or the threaded nut *d'* secured thereto, and the sleeve D, or a collar, *d'*, secured thereto, are each provided with projecting stop-pins d^3 d^4, to limit the extent the sleeve D may revolve in relation to the spindle B to a little (or the thickness of the stop-pins) less than one complete revolution.

In operation the machine is set or adjusted so that one turn of the sleeve D will move the sleeve C sufficiently to close the chuck-jaws properly upon the rod or stock, even if the same is comparatively small in size. If the stock is somewhat larger, the sleeve D makes correspondingly less than a complete revolution, the friction-wheel *f* slipping as soon as the required force is exerted upon the chuck-jaws. After the stock or rod has been fed forward, the chuck-jaws being then open, the cam H moves the shaft F in the direction to clutch the gear g^2 thereto, and thus drive the threaded sleeve D in the direction necessary to move the sleeve C forward and close the chuck-jaws upon the stock. The cam H holds the clutches G *g* thus in engagement until the sleeve D makes about one complete revolution, the friction-wheel *f* slipping after the jaws are closed with sufficient force. After the sleeve D has thus made one complete revolution to close the chuck-jaws, the cam H moves the shaft F into its midway position, as indicated in Fig. 1, so that neither of the clutches G *g* G' *g'* is engaged, and holds said shaft in this position while the work is being done by the tools upon the end of the rod or stock. At this time, while the work is thus being done, the shaft F is free to revolve, and the chuck-spindle receives little retardation from the mechanism. After the work is completed upon the end of the rod, the cam G moves the shaft F so that the clutches G' *g'* are engaged, and the sleeve D thus revolved to unthread or withdraw itself from the spindle B and permit the clutch-jaws to open. The clutch-jaws *c* and the sleeve C are retracted by the spring action of the jaws as soon as the threaded sleeve D is withdrawn.

While the friction-gear *f* or other equivalent friction device may be located at any point in the connecting mechanism by or through which motion is communicated from the spindle B to the sleeve D, it is, however, preferable to and one minor feature of my invention consists in locating or combining this friction device, whether it be friction-gear, friction-wheel, friction belt and pulley, or other friction mechanism, in direct connection with the revolving spindle itself, so that there will be as little as possible intermediate friction of parts to overcome before the friction device is reached in communicating motion from the spindle to the sleeve D. By this means the friction device is made more sensitive to act the moment the chuck-jaws exert the proper pressure upon the stock.

In the drawings, K represents the tool-holder turret, slides, and mechanism for bringing the several tools successively into operation, and L represents a feed tube or device for feeding the rod or stock forward through the chuck. This tool-holder mechan-

ism may be of any ordinary or desired construction, and as my present invention does not relate particularly thereto this part of the machine need not be described in detail. Its construction is well known, and one form of the same is fully shown and described, for example, in my prior patent before referred to, No. 316,788.

It will of course be observed that the discharge-openings *b* in the spindle may extend outward through the spindle or its parts in any desired direction. I prefer to incline them more or less forward, so as to direct the metal particles forward away from the spindle as they are thrown out by the rapid revolution of the spindle.

The stops d^3 d^4 on the spindle B and screw-sleeve D serve to make the reverse or unscrewing revolution of the sleeve D on the spindle B always equal to its forward revolution. If these stops were not there, the screw would, in running out, run a whole revolution or more, and if the next time the rod or stock were a little smaller it would only close down one complete revolution, and would not close on the smaller stock. These pins or stops are not so much for the purpose of limiting the inward as the outward travel of the screw.

My present invention is not only applicable to metal-screw machines, but also to other machines wherein a revolving chuck is employed—as, for example, in machines for turning or forming various shaped articles from the end of a metal rod or bar.

I wish it to be distinctly understood that in the specification and claims I mean by use of the phrase "said screw D, having a rigid or unyielding connection with said chuck-jaws," or similar phrases, in referring to the screw or sleeve D, that the connection or device which is interposed between said screw and said chuck-jaws, or used to communicate motion from said screw to said chuck-jaws, must be a rigid or non-yielding connection or device, as contradistinguished from a spring or yielding device. The end of the screw-sleeve D might abut directly against the end of the chuck-jaws *c*, and thus, by this direct abutting of the one against the other, there would be a non-yielding or rigid connection between the two, so that the motion communicated to the screw would be communicated positively and unyieldingly to the chuck-jaws; or, as shown in the drawings, a sleeve, as C, may be interposed between the screw and chuck-jaws, and thus form a rigid and unyielding connection between the screw and chuck-jaws; or any suitable equivalent device may be employed in place of the sleeve C for communicating motion positively and unyieldingly from the screw to the chuck-jaws, so that after the chuck-jaws shall be once firmly closed upon the rod or stock they will be so held firmly and rigidly without possibility of yielding while the rod or stock is being operated upon by the tools.

I claim—

1. A revolving chuck-spindle having inclines or wedges for operating the chuck-jaws and furnished with a lateral discharge-opening, substantially as specified.

2. A revolving chuck-spindle having inclines or wedges for operating the chuck-jaws, an interior enlargement or recess back of said inclines or wedges, and one or more discharge-openings leading through the spindle into said recess or interior enlargements, substantially as specified.

3. A revolving chuck-spindle having inclines or wedges for operating the chuck-jaws and an oppositely-inclined or cone surfaced recess back of said inclines or wedges, and provided with one or more discharge-openings leading therefrom through the wall of the spindle, substantially as specified.

4. The combination, with a chuck-spindle, of inclines or wedges, chuck-jaws having an opening or openings between them, and one or more discharge-openings, through which dust or metal particles may be thrown out from the spindle by centrifugal action, substantially as specified.

5. The combination, with a revolving chuck-spindle and its inclines or wedges, of a sleeve provided with chuck-jaws, and a revolving sleeve loosely screwed upon the end of the chuck-spindle and in contact with the sleeve carrying the chuck-jaws, so that the chuck-jaws, after being closed by axial movement of the revolving sleeve, are firmly held thereby, substantially as specified.

6. The combination, with a revolving chuck-spindle and its inclines or wedges, of a sleeve provided with chuck-jaws, a revolving sleeve loosely screwed upon the end of the chuck-spindle and so geared thereto that its speed may be greater or less than that of the chuck-spindle, and in contact with the sleeve carrying the chuck-jaws, which, having been closed by axial movement of the revolving sleeve, are firmly held, and connecting mechanism, including a friction-gear, through which motion is communicated from the chuck-spindle to the said revolving sleeve, substantially as specified.

7. The combination, with a revolving chuck-spindle and its inclines or wedges, of chuck-jaws and a rotary screw, as D, having a longitudinally rigid or unyielding threaded bearing or nut, in which said screw turns and by which it is moved axially or longitudinally, as in the chuck-spindle, said screw communicating with the chuck-jaws through a rigid or unyielding device, so that the chuck-jaws, after being closed by the axial movement of said rotary screw, are firmly held thereby, substantially as specified.

8. The combination, with a revolving chuck-spindle and its inclines or wedges, of chuck-jaws and a rotary screw, as D, having a longitudinally rigid or unyielding threaded bearing, in which said screw turns and by which it

is moved axially or longitudinally, as in the chuck-spindle, said screw communicating with the chuck-jaws through a rigid or unyielding device, so that the chuck-jaws, after being closed by the axial movement of said rotary screw, are firmly held thereby, and mechanism for communicating rotary motion to said screw D, furnished with a friction or yielding device, substantially as specified.

9. The combination, with a chuck-spindle and its inclines or wedges, of chuck-jaws, a rotary screw for closing said chuck-jaws, and mechanism for revolving said screw, having a friction or yielding device, through which power is communicated to said screw, substantially as specified.

10. The combination, with a revolving chuck-spindle and its inclines or wedges, of chuck-jaws, a rotary screw for closing said chuck-jaws, and a train of gears for communicating motion from said spindle to said screw, said train being furnished with a friction-gear adapted to slip after the jaws have been closed with sufficient force upon the stock, substantially as specified.

11. The combination, with a revolving chuck-spindle and its inclines or wedges, of chuck-jaws, a rotary screw for closing said chuck-jaws, and a train of gears for communicating motion from said spindle to said screw, said train being furnished with a friction-gear adapted to slip after the jaws have been closed with sufficient force upon the stock, said friction-gear meshing directly with a gear on the said spindle, substantially as specified.

12. In a chuck, the combination, with the chuck-jaws, of a rotary screw having a longitudinally rigid or unyielding threaded bearing, in which said screw turns and by which it is moved axially or longitudinally, said screw communicating with the chuck-jaws through a rigid or unyielding device, so that the chuck-jaws, after being closed by the longitudinal movement of said screw, are firmly held thereby, substantially as specified.

13. In a chuck, the combination, with the chuck-jaws, of a rotary screw having a longitudinally rigid or unyielding threaded bearing, in which said screw turns and by which it is moved axially or longitudinally, said screw communicating with the chuck-jaws through a rigid or unyielding device, so that the chuck-jaws, after being closed by the longitudinal movement of said screw, are firmly held thereby, and mechanism for driving said screw, furnished with a friction or yielding device, substantially as specified.

14. In a chuck, the combination, with the chuck-jaws, of a rotary screw having a longitudinally rigid or unyielding threaded bearing, in which said screw turns and by which it is moved axially or longitudinally, said screw communicating with the chuck-jaws through a rigid or unyielding device, so that the chuck-jaws, after being closed by the longitudinal movement of said screw, are held firmly thereby, and a train of gears furnished with a friction-gear for communicating motion to said screw, substantially as specified.

15. In a chuck, the combination, with the spindle and its inclines, of the chuck-jaws, a rotary screw, and a train of gears furnished with a pair of clutches and two gear-wheels of different sizes, one for revolving said screw faster and one slower than the spindle, said train being also furnished with a friction-gear, substantially as specified.

16. The combination, with a chuck-spindle having inclines b, of chuck-jaws c, sleeve C, screw-sleeve D, gear f', friction-gear f, shaft F, clutches G g and G' g', gears g^2 g^3 and g^4 g^5, and a cam, H, and connections for sliding said shaft F, substantially as specified.

17. The combination, with a chuck-spindle, B, of inclines or wedges b, chuck-jaws c, sleeve C, and screw-sleeve D, threaded upon said spindle B, and having its end in contact with the end of said sleeve C, substantially as specified.

18. The combination, with chuck-spindle B, of inclines b, chuck-jaws c, sleeve D, pins or projections on said spindle and said screw-sleeve to limit the relative movement of the latter in respect to the former, and mechanism for communicating motion to said sleeve from said spindle, substantially as specified.

19. The combination, with the chuck-spindle B, of inclines b, chuck-jaws c, sleeve C, screw-sleeve D, and pins or projections on said spindle and said screw-sleeve to limit the independent movement of the latter, and a train of gears furnished with two clutches and gears of different sizes for communicating a faster or slower motion to said screw-sleeve than said spindle, substantially as specified.

20. In an automatic screw-machine, the combination of chuck-jaws and a chuck-spindle with a screw for opening and closing the chuck-jaws, which screw is threaded into or carried by the chuck-spindle at the same speed as the chuck-spindle while it is holding the rod from which the screw is formed, and is adapted to be revolved slower or faster to open and faster or slower to close the chuck-jaws, stops to limit the travel of the screw in relation to the chuck-spindle, and mechanism for automatically revolving said screw, substantially as specified.

21. In an automatic screw-machine, the combination of a revolving chuck-spindle carrying chuck-jaws, a rotary screw for closing said chuck-jaws, and a train of gears for communicating motion from said spindle to said screw, substantially as specified.

22. In an automatic screw-machine, the combination of a revolving chuck-spindle carrying chuck-jaws, a rotary screw for closing said chuck-jaws, and a train of gears for communicating motion from said spindle to said screw, and stops to limit the rotation of the screw in relation to the chuck-spindle, substantially as specified.

23. The combination, with the chuck-spindle B, of inclines *b*, chuck-jaws *c*, sleeve C, screw-sleeve D, and pins or projections on said spindle and said screw-sleeve to limit the independent movement of the latter, and a train of gears furnished with two clutches and gears of different sizes for communicating a faster or slower motion to said screw-sleeve than said spindle, said train being also furnished with a friction gear or wheel, substantially as specified.

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