

(No Model.)

P. MITSCH.  
DIFFERENTIAL SCREW DRILL.

No. 589,848.

Patented Sept. 14, 1897.

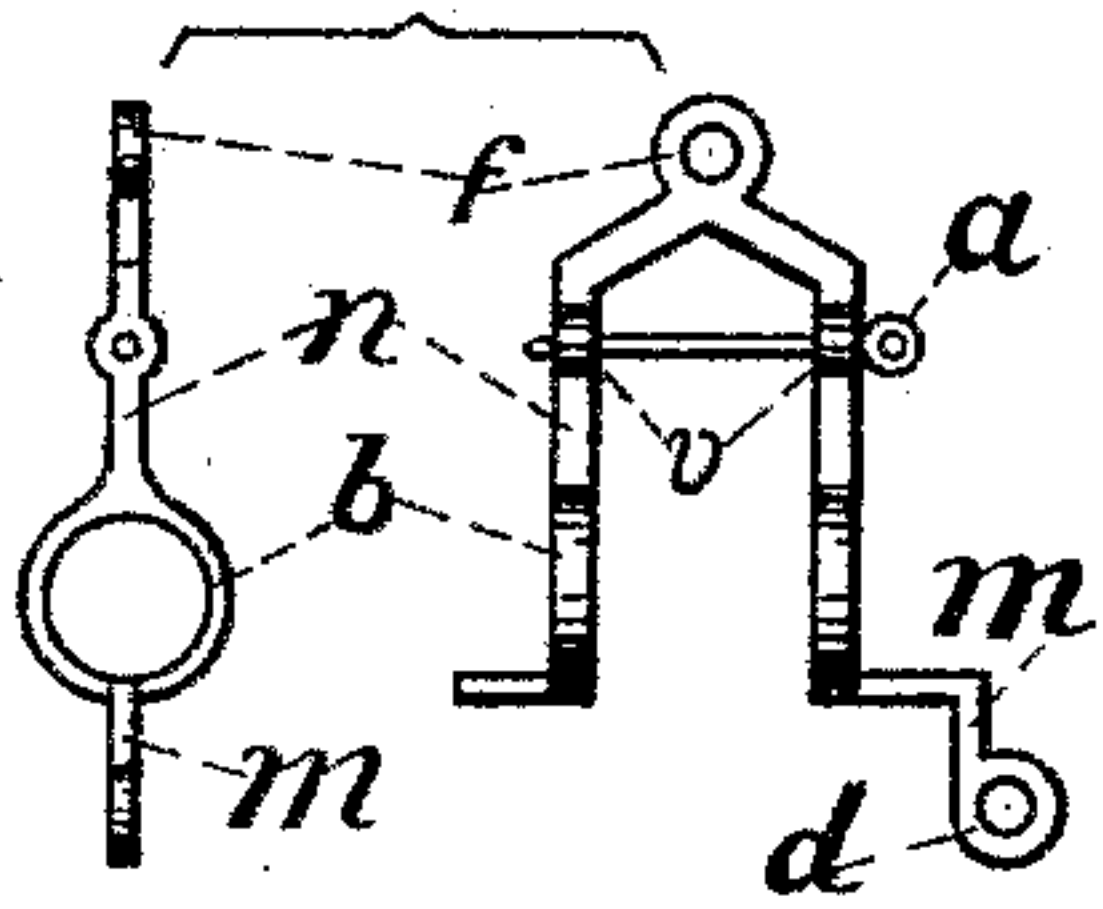


Fig. 1

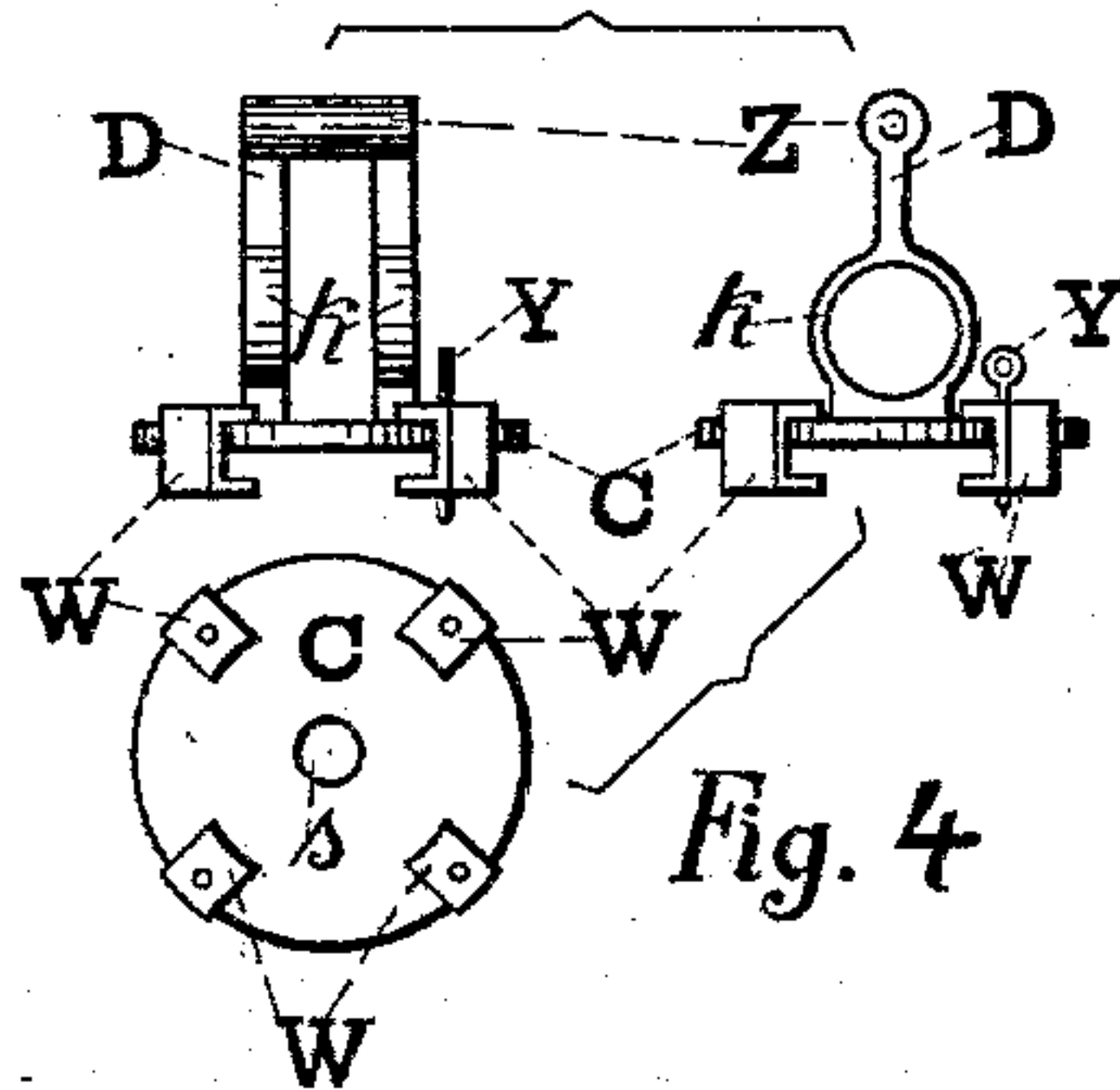


Fig. 4

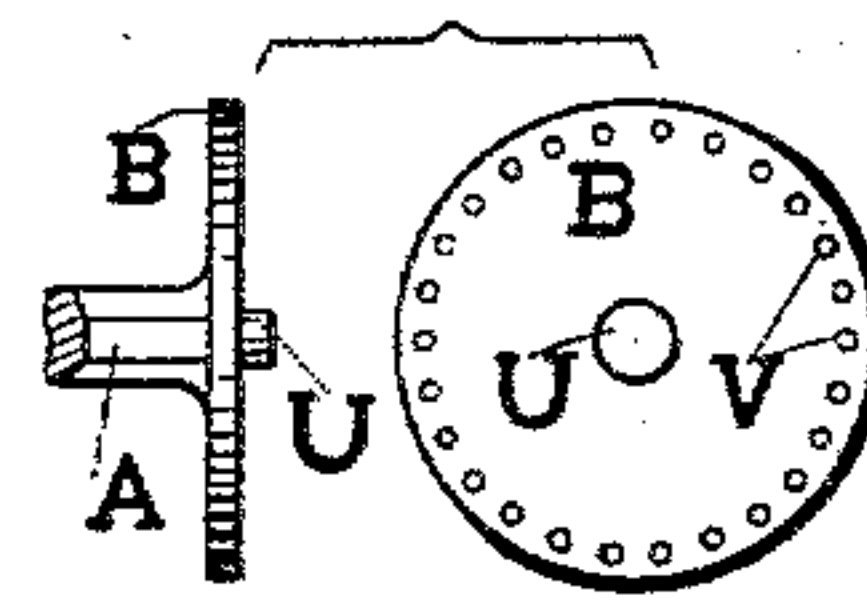


Fig. 5

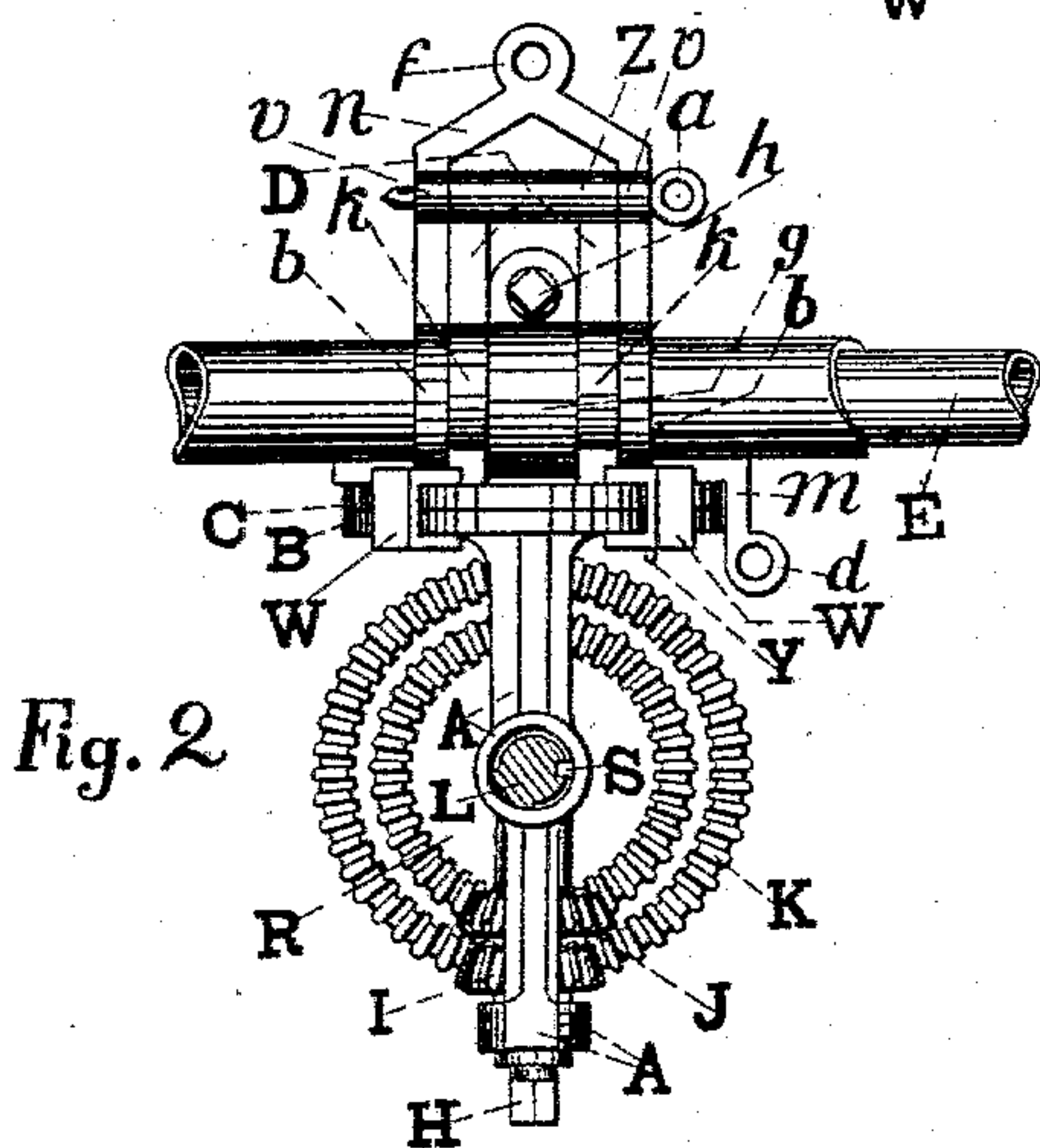


Fig. 2

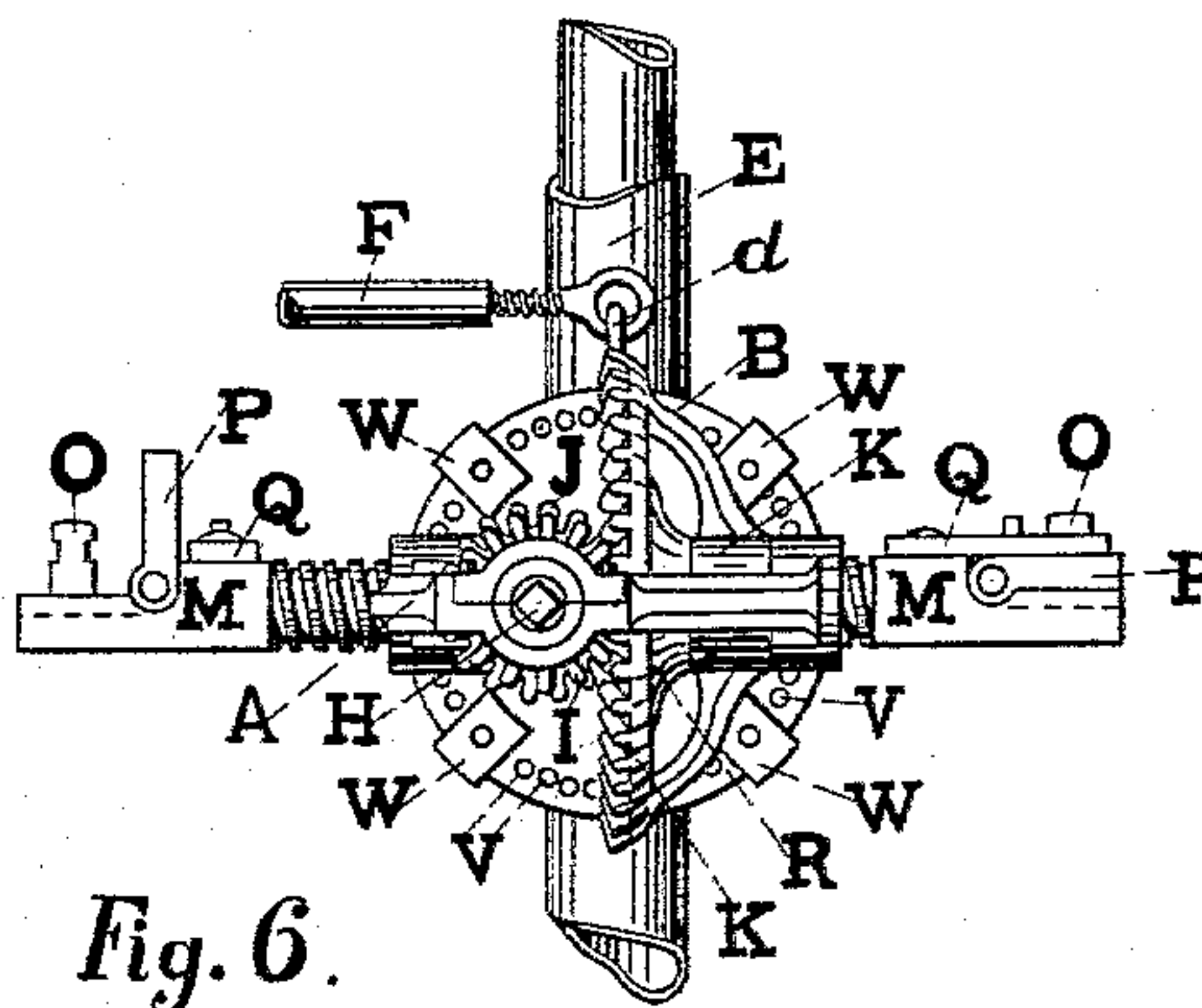


Fig. 6.

Fig. 3

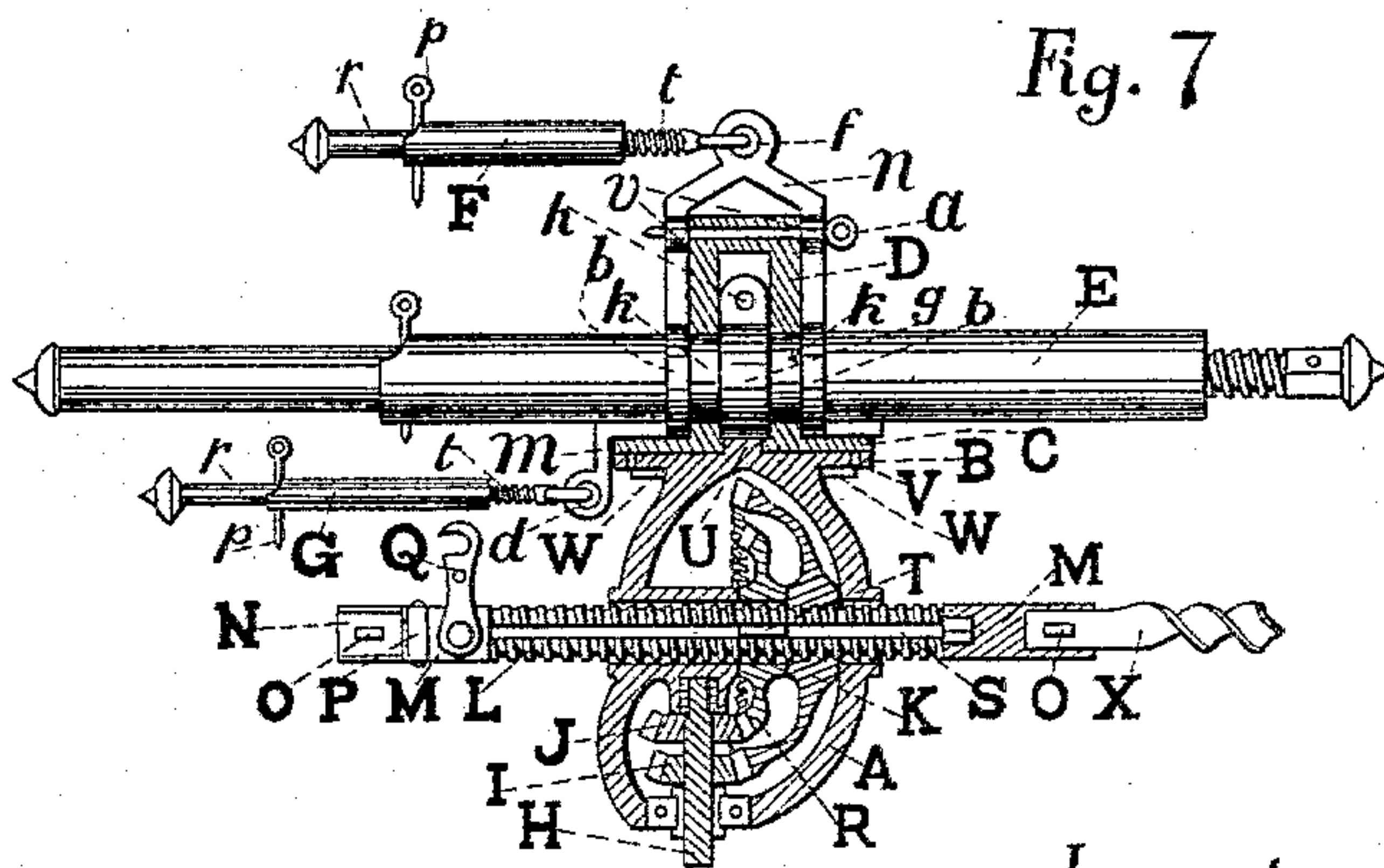
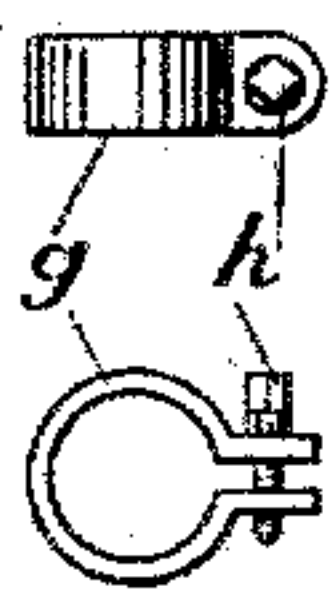


Fig. 7

Witnesses:  
*Joe N. Myers*  
*William F. Peters.*

Inventor:

*Peter Mitsch*



# UNITED STATES PATENT OFFICE.

PETER MITSCH, OF CHICAGO, ILLINOIS.

## DIFFERENTIAL-SCREW DRILL.

SPECIFICATION forming part of Letters Patent No. 589,848, dated September 14, 1897.

Application filed December 30, 1896. Serial No. 617,530. (No model.)

*To all whom it may concern:*

Be it known that I, PETER MITSCH, a subject of the Grand Duke of Luxemburg, residing at No. 637 Otto street, in the city of Chicago, county of Cook, and State of Illinois, have invented a new and useful Drilling-Machine, which I propose to call a Differential-Screw Drill, of which the following is a specification.

This machine is a combination of four distinct inventions, which are dependent upon each other and mutually contribute to produce one and the same result.

These inventions are:

a. *A differential screw.*—This differential screw consists of the combination of a thread-bar with cog-wheels, shaft, and frame. The principle of said differential screw lies in the fact of having a screw and its nut turning at the same time either in the same direction with a difference of speed, or in opposite direction with or without difference of speed, with the express end in view to arrange all the parts of the above-mentioned combination, and especially to arrange the size and the position of the cog-wheels in relation to one another, so as to produce by a minimum of means a differential screw which commands a maximum of power—that is to say, produce a differential screw which will be for a given purpose the most powerful possible, while using for its construction the least amount of material possible.

b. *The second invention is a socket.*—This socket is to be fastened at each end of the thread-bar of the differential screw and forms the medium by which the auger or drill is attached to said thread-bar. The principle of this socket lies in the fact of having an auger-holder that will be kept closed during the boring operation by the very force which is engendered by the resistance of the material to be bored into, but which auger-holder, when said boring operation stops, can be opened and closed instantly at the will of the operator without appliance of any force greater than can be exerted by the thumb of the operator's hand and without drawing back the thread-bar to which it is attached.

c. *The third invention is a chair.*—This chair has the double purpose of, first, being the medium by which the above-mentioned

frame hinges on the "main supporting apparatus," hereinafter described, and, secondly, affording, in connection with a disk on said frame, facilities for reversing the differential screw or setting up the same for boring under any angle.

d. *The fourth invention is a main supporting apparatus.*—This main supporting apparatus consists of the triple combination of a "suitable post" with a movable "collar" and a "prop-carrier" to which two props are linked, one at each side of the post. Said collar is to be fastened by means of a set-screw at a given height of said post in order to maintain at such height the above-mentioned "chair" and prop-carrier. The principle of the main supporting apparatus constructed in this manner and connected with said chair lies in the fact of counterstaying and thus transmitting to the center of said post any back pressure acting on the differential screw as a result of the resistance of the material to be bored into, and, further, of preventing any disturbing oscillations which might be caused by the operation of the machine. Thus in whatever position or inclination the main supporting apparatus be set after it is laterally propped up and the chair connected one can bore under any angle, one can reverse the differential screw and change the augers for boring to any depth without delay or interruption whatever. Furthermore, my differential screw allows the use of a large thread on its thread-bar which will be able to withstand all the unavoidable causes of deterioration brought about by sand, dust, &c. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 shows, as appears separated, an element called "prop-carrier" comprised in Figs. 2, 6, and 7. Fig. 2 is an enlarged scale of a front view of the machine, the lateral props left off and the thread-bar cut flush with the frame. The machine is supposed to be set up for boring in a direction perpendicular to the position of the post of the main supporting apparatus. Fig. 3 shows, as appears separated, two views of an element called "movable collar" comprised in Figs. 2, 6, and 7. Fig. 4 shows, as appears separated, three views of an element called "chair"



comprised in Figs. 2, 6, and 7. Fig. 5 shows two views of a "disk," which forms part of the frame of the machine, as said disk appears when imagined separated from the frame. Said frame is comprised in Figs. 2, 6, and 7. Fig. 6 is an enlarged scale of a general "side view" of the machine, which is supposed to be set up the same as in Fig. 2. Fig. 7, partly in section and partly in plan, shows the whole drilling-machine as arranged for mining purposes and supposed to be set up for boring in a direction parallel with the post of the main supporting apparatus.

Similar letters refer to similar parts throughout the several views.

a. *First invention.*—Among the many ways of arranging the cog-wheels and combining the same with the thread-bar and frame in order to make up the "differential screw" according to the principle laid down in the foregoing general description I choose the following method, which will give a clear illustration of said principle.

Two pinions I and J, Figs. 2, 6, and 7, are connected with the same shaft H, the latter receiving the motive power and transmitting the same to the machine—viz., I driving the cog-wheel K, and J the cog-wheel R. The hub of K forms or contains a nut for the screw or thread-bar L. The latter is provided with a groove S, which has to take up the tongue T, provided in the center hole of the wheel R. By means of said tongue and groove the wheel R imparts the rotary motion to the thread-bar L. The latter, together with said pinions I and J, said shaft H, and said cog-wheels K and R, by means of proper bearings, are supported and held in position by the frame A. Said frame A is provided on one side, parallel with the thread-bar, with a disk B, which disk is furnished with a journal U and with a series of holes V, placed diametrically, one opposite the other, Fig. 5. Said journal is located in the center of the disk and said holes on a concentric circle, either at a suitable distance from its outer circumference, as shown by Fig. 5, or on the outer circumference itself, giving to the latter a dented appearance.

Any construction that complies with the provisions made in the foregoing description for the construction and the principle underlying the combination of the cog-wheels K and R with the thread-bar L, the pinions I and J with the shaft H, and the frame A, bearing the disk B, will answer the purpose irrespective of the shape or the particular execution of the parts, both being dependent, as a matter of course, on the degree of longitudinal motion given to the screw during one revolution.

When the machine is in operation, the cog-wheels K and R are turning in the same direction, R causing the screw L to rotate and thus to turn in its nut K. If during such rotation K were standing still, the longitudinal motion of L during one revolution would be equal to the distance between the threads

thereon; but the simultaneous rotation of the nut K in the same direction as L retards the progress of the latter, viz: it makes the longitudinal motion or linear advance of the screw L entirely dependent on the difference of speed between the screw L and the nut K, which produces one of the desired results—viz., use a large and strong thread on the screw and yet have the linear advance produced by one revolution of said screw just as small as desired in order to suit the density of the material to be bored into. Furthermore, according to the principle underlying the construction of a screw in general the power of a screw is the greater the smaller the distance is between the threads thereon—that is, the smaller the longitudinal motion or linear advance of said screw is made to be during one revolution; but as, on the other hand, the whole instrument is made the weaker the finer the thread of the screw is made there is evidently a limit to the increase of power in this way. In my differential screw this limit is done away with, as said longitudinal motion during one revolution can be made infinitely small, irrespective of the pitch of the screw's thread and of its strength. Still, considering the fact that the friction generated by its operation is capable of being reduced to a proportionately very small one, this differential screw is one of the greatest mechanical powers now known to science. Said power as applied to my machine being many times multiplied by the resulting facilities of leverage, it follows that the motive power for the operation of the differential-screw drill will be reduced to a minimum, which gives another of the desired results.

I am aware that prior to my invention drilling-machines have been devised in which the thread-bar is simultaneously rotated and fed forward by gear connections with a single actuating-shaft; but my invention differs from all previous machines of its class by the following features, which form the base of my first claim, namely: first, the superior power of my differential screw, owing to the peculiar arrangement of the size and position of the cog-wheels in relation to one another; second, the superior simplicity and durability of its parts, owing to the circumstance that my structure provides all its parts to be light but solid, there being required no taking apart of either frame or nut or anything whatever in order to give course again to the thread-bar when the latter had been fed its entire length; third, the novel construction of my frame, especially in regard to a disk adapted thereto and regulating in a novel way the reversing of a differential screw or the setting up of the same for boring under any angle.

b. *Second invention—socket.*—This socket consists of a body-piece M, having on one end a device by means of which it is to be fastened to the ends of the thread-bar and having in the center of the other end an opening N, into



which is fixed a bolt O, and which is covered by a hinged lid P and a clasp Q. Both the mentioned lid P and the butt-end of the auger X (which auger forms no part of my invention) are provided with a hole giving passage to said bolt O. When the auger is put in place, the lid P is let down and the clasp Q is slid over the said lid under the head of the bolt O, thus easily and solidly connecting the auger with the socket and the thread-bar.

When the boring operation is going on, the resistance which the material to be bored into offers to said operation will tend to press one edge of the auger's butt-end against the bottom of the opening N of the socket, while the diagonally opposite edge is pressed against the lid P, which lid tends to yield, and thus presses the clasp Q, resting on top of it, against the ledge which forms the head of the bolt O. It follows that said clasp is held fixed, and consequently that the socket is held closed the firmer the stronger the force is which acts as resistance to the boring operation. When the said operation ceases and the auger is wanted out of the bore, after the pin Y is removed a slight exertion of the operator's thumb against the handle on top of the clasp Q suffices to push the latter open, whereupon the socket loosens itself from the auger by the weight of the thread-bar to which it is attached.

I am aware that prior to my invention "chucks" and "joints" of similar construction have been devised; but the construction of my socket distinguishes itself from all previous inventions of its class by the combination of its hinged clasp Q with its fixed bolt O, forming together an almost automatically working lock, as heretofore explained and set forth, which combination forms the base of my second claim.

*c. Third invention—chair.*—As shown in detail by Fig. 4, this chair consists of two main rings *k*, by means of which said chair hinges on the post of the main supporting apparatus, Fig. 7. Said rings are connected on one side with a disk C, having in its center a hole S and bearing a number of clamps W (four in the present instance) and a removable pin Y. Said rings *k* are provided on the opposite side of said disk each with a lever-arm D, which are coupled together by a tube Z. Between said rings *k* and, respectively, the lever-arms D proper space is left to take up the collar *g* which belongs to the main supporting apparatus. When the machine is mounted for operation, this chair is supported and held at a given height on the post of the main supporting apparatus by means of the above-mentioned collar *g*. The disk B, which forms part of the frame A, rests against the disk C. It can revolve around its center and is held in position by the journal U and the clamps W. The pin Y, capable of passing through one of the clamps W, through the disk C, and through one of the holes V of the disk B, holds the differential

screw in position for boring under any angle. In order to prevent the latter from yielding to the back pressure acting on the same and from receding while the boring operation is going on, the pin *a*, passing through the tube Z and through the arms *n*, counterstays said back pressure on the opposite side of the post of the main supporting apparatus. If a second auger is to be used, it suffices to open the socket as described to remove the pin *a* and to swing the whole drilling apparatus out of the way by causing it to turn on the hinges *k* of the chair. After the augers are changed (the latter are supposed to belong all to one set in which the length of the respective augers gradually increases to an amount equal to the exact length of the whole course of the thread-bar) the drilling apparatus is swung back to its first position, the differential screw reversed—that is, the thread-bar swung around end for end—and the corresponding socket connected with the new auger. It follows, as a matter of course, that by repeating the same operation a certain number of times the bore can be given any depth desired.

*d. Fourth invention—main supporting apparatus.*—A tubular support or post E, capable of being elongated and of being fixed by means of a jack-screw, is furnished with a movable collar *g*, which can be fastened to said post by means of a set-screw *h*. The purpose of this collar is to hold at a given height the chair described in the preceding part of this specification and, further, to support together with this chair the following apparatus, which for the sake of simplifying explanations I call "prop-carrier." This prop-carrier hinges on the same post E by means of two rings *b*, located one directly above and the other immediately underneath the above-mentioned chair-rings. Said rings *b* are coupled together by means of two lever-arms *n*, which run together, say, in the shape of an angle, having on its summit the hole *f*, through which is linked the counterstay or prop F. Both lever-arms *n* are further provided each with a hole *v*, which holes are centered over one another in order to give passage to a pin *a*, by means of which the tube Z of the above-mentioned chair is to be connected with said lever-arms *n*. Said counterstay or prop F can be elongated by means of the rod *r*, sliding in the main tube F' and being maintained at a desired length by means of a pin *p*, which passes through the tube F' and through one of a series of holes provided throughout the length of said rod *r*. Said prop can further be regulated and fixed by means of the screw *t*. The purpose of this prop is to be placed with the protruding end of its rod *r* against the material to be bored into in order to counterstay the pressure forced upon the differential screw by the resistance which said material offers to the boring operation, and which resistance in the absence of said prop would cause the drilling



apparatus to turn on its hinges and to recede. The above-described construction of said prop merely forms part of the practical illustration of the principle laid down in the foregoing general description. Any construction that answers the above-mentioned purpose will be convenient, regardless of its shape or the particular construction of its parts. In order to secure proper fillers between the disk C and the post of the main supporting apparatus, two arms *m* are connected, respectively, with the two rings *b*, one of said arms *m* carrying further the prop *G*, which is similar to *F*, and which is linked to said arm *m* through the hole *d*. Said prop *G* has the double purpose, first, of counterstaying and maintaining the prop *F* in position while the augers are being changed—that is, while the auger is disconnected from the socket—and thus the back pressure caused by the boring operation has ceased to act on the differential screw, and consequently on said prop *F*; secondly, of preventing, in conjunction with the first prop *F*, any disturbing oscillations of the machine while the boring operation is going on, especially when such operation is being done in a direction parallel with the post of the supporting apparatus.

The extension-post (furnished with pin and jack-screw) used in the above-described main supporting apparatus forms no essential part of my invention. Any suitable support will answer the purpose. Hence I do not claim such support broadly, but only in combination with collar *g* and the apparatus carrying the props *F* and *G*, as explained and set forth in the foregoing description.

Having thus fully illustrated and described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a drilling-machine, a differential screw, said differential screw consisting of a combination of a thread-bar *L*, having an auger-holder at each end, with cog-wheels *R* and *K*, a shaft *H* with pinions *I* and *J*, and a frame *A*, said cog-wheel *R* and said thread-bar *L* being respectively provided with tongue and groove, while the hub of said cog-wheel *K*

forms or contains a nut for said thread-bar *L*, said frame *A* being provided with a disk *B*, which disk is furnished with a journal *U* and with a series of holes *V*, located as described and placed diametrically one opposite the other, all substantially as described, according to the principle set forth and for the purpose specified.

2. In a drilling-machine, the combination with the bar *L*, the socket *M* provided at one end with means for securing it to the said bar, and at the other end with an opening *N*, into which a bolt *O* is fixed, and which opening is covered by a hinged lid *P* and a hinged clasp *Q*, substantially as shown and described according to the principle set forth, and for the purpose specified.

3. In a drilling-machine, a chair, said chair consisting of a disk *C*, said disk *C* provided with clamps *W*, a hole *S*, and a removable pin *Y*; said disk *C* fastened to two rings *k*; said rings provided with a lever-arm *D*, and said lever-arms coupled together by a tube *Z*, all substantially as described according to the principle set forth and for the purpose specified.

4. In a drilling-machine, a main supporting apparatus, said main supporting apparatus consisting of a suitable support, which support is furnished with a movable collar *g*, and an apparatus called "prop-carrier," said collar *g* provided with a set-screw *h*, said prop-carrier consisting of two rings *b*, which are coupled together by two lever-arms *n*, said lever-arms run together, say in the shape of an angle having on its summit a hole *f*, through which is linked a prop *F*, said lever-arms *n* having further two holes *v* centered over one another and giving passage to a removable pin *a*, said rings *b* provided further with two arms *m*, one of which having a hole *d*, through which is linked a prop *G*, all substantially as described, according to the principle set forth and for the purpose specified.

PETER MITSCH.

Witnesses:

JOE H. MYERS,

WILLIAM F. PETERS.