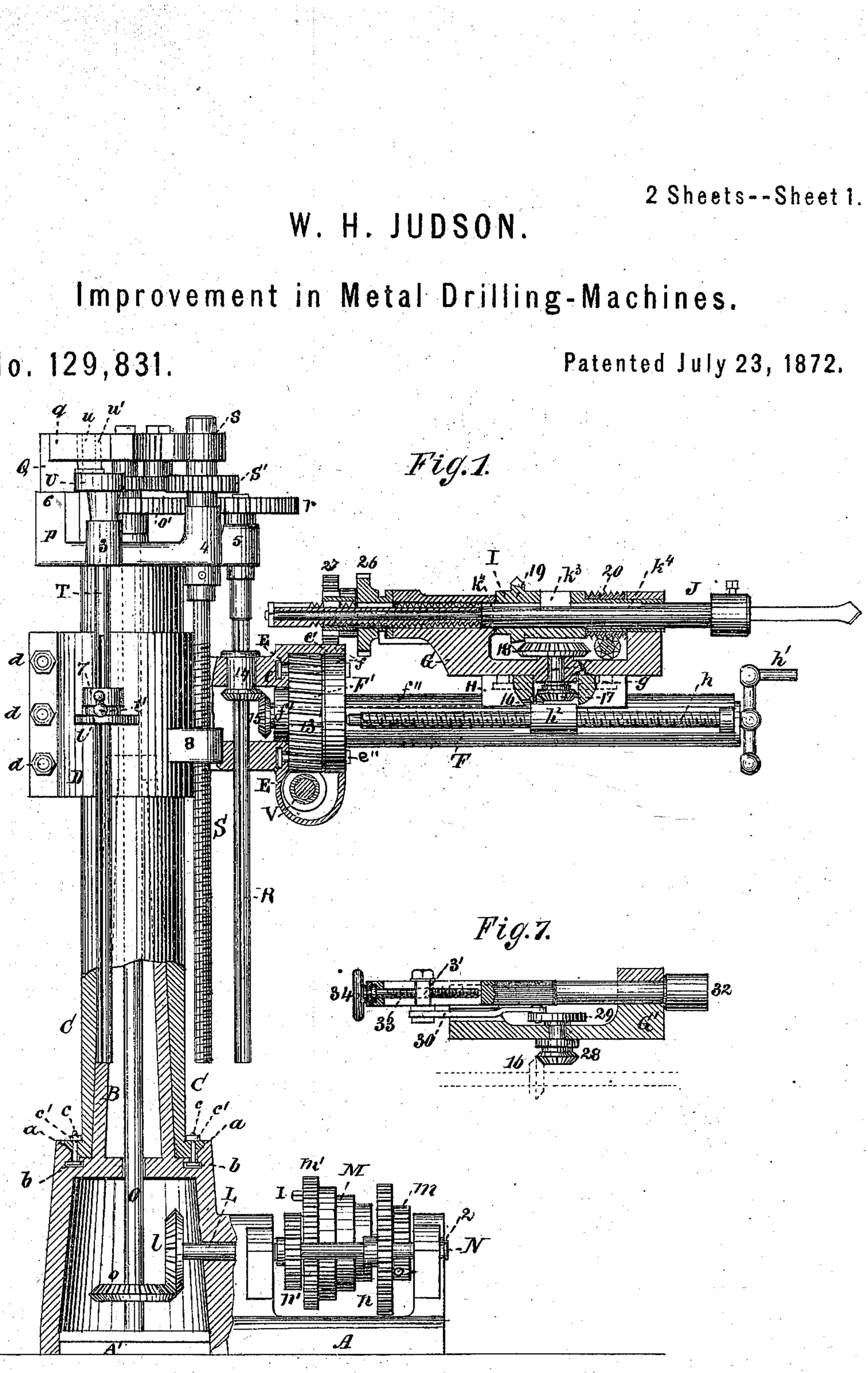
2 Sheets--Sheet 1.

W. H. JUDSON.

Improvement in Metal Drilling-Machines.

No. 129,831. Patented July 23, 1872.



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2 Sheets--Sheet 2.

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Fig. 2.

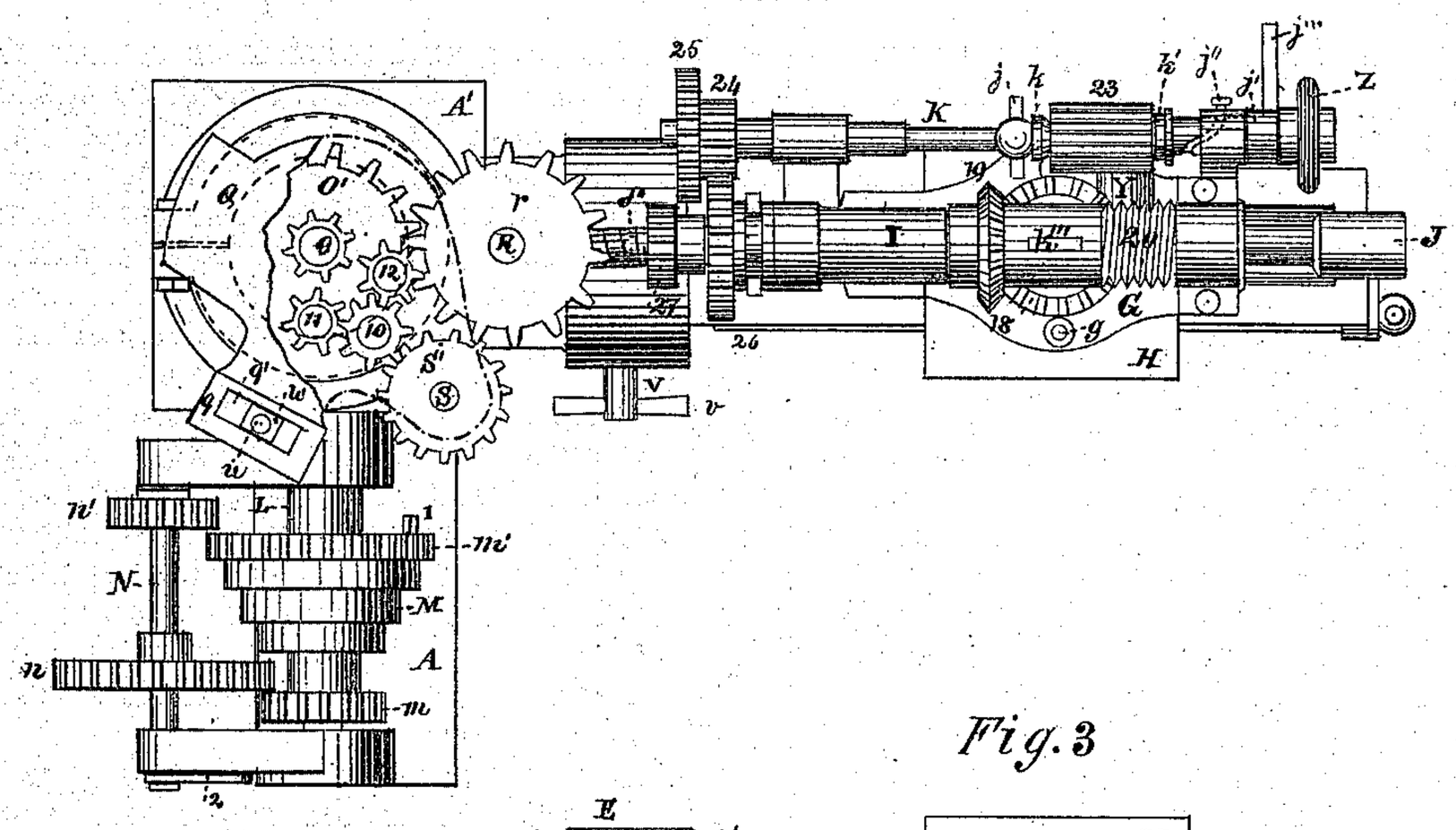


Fig. 3

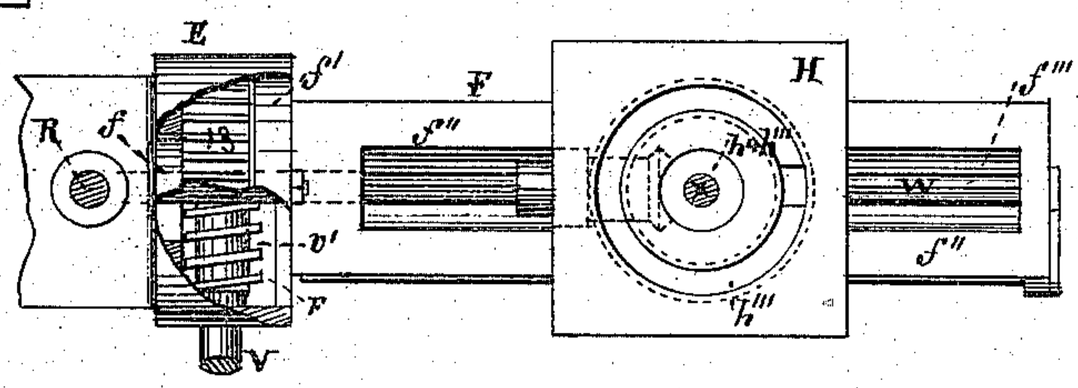


Fig. 4

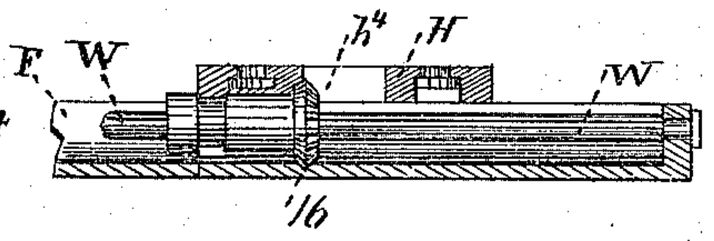


Fig. 6

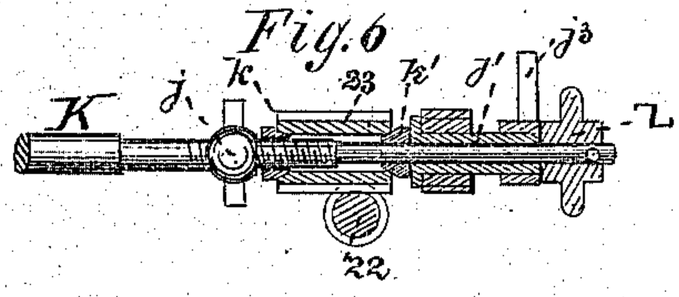
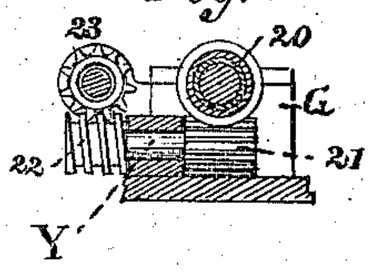


Fig. 5



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UNITED STATES PATENT OFFICE.

WILLIAM HENRY JUDSON, OF TITUSVILLE, PENNSYLVANIA.

IMPROVEMENT IN METAL-DRILLING MACHINES.

Specification forming part of Letters Patent No. **129,831**, dated July 23, 1872.

Specification describing certain Improvements in Universal Radial Drilling-Machines, invented by WILLIAM H. JUDSON, of Titusville, in the county of Crawford and State of Pennsylvania.

My invention relates to improvements in the construction and operation of that class of machines known as radial drilling-machines, by means of which the drills can be made to operate in any direction without moving the base of the machine. The first part of my invention relates to improvements in the construction of the pillar and revolving cylinder or socket which carries the drill-arm; and the invention consists in constructing the pillar with a shaft of tapering or conical form, and the revolving socket with a correspondingly-shaped interior periphery, and also with a V-shaped flange or foot, which sets in a correspondingly-shaped groove in the base of the pillar, so that the socket will always have a solid bearing and be in proper working position, notwithstanding the wear consequent on friction. The second part of my invention relates to the adjustment of the head and drill-arm socket; and consists in a new and improved combination of devices for raising and lowering the same to any required height upon the revolving socket by means of power derived from the main shaft, as hereinafter fully set forth. The third part of my invention relates to the drill-arm; and the invention consists in a new and improved combination of devices whereby the arm is made to revolve on its longitudinal axis, and can be adjusted and securely held in position during the operation of the drills. The fourth part of my invention relates to the arrangement of the driving mechanism with relation to the revolving arm and socket, whereby the drill-spindle can be made to operate with equal facility in any direction without alteration of gearing in any particular and without moving the base of the machine, all as hereinafter more fully set forth. The fifth part of my invention relates to the bearings of the revolving arm; and consists in so constructing the arm-socket and revolving arm-head as to relieve the arm-shaft and its connecting mechanism of all strain, as hereinafter more fully set forth. The sixth part of my invention relates to the construction and operation of the drill-spindle socket; and consists in constructing the socket with a worm for operating the feed-shaft automatically by means of interposing mechanism, consisting of a solid shaft set at right angles to the spindle-socket, and formed as a gear-wheel at one end, engaging with the worm, and having a worm keyed on its other end, which engages with a gear-wheel on the feed-shaft. It also consists in securing the gear-wheel on the feed-shaft by friction through the agency of conical bosses secured by an adjustable lock-nut; and, also, in connection therewith, it consists in providing mechanism whereby the speed of the feed may be altered without having to stop the machine to effect the change, and so that it may be accomplished by hand or power, all as hereinafter more fully set forth.

In the accompanying drawing, Figure 1 is a side elevation of my improved drilling-machine with portions cut away, to show the interior arrangement of parts and operation of mechanisms. Fig. 2 is a top-plan view of same, with a portion of the adjustable cap removed to show the gearing. Fig. 3 is a top-plan view of the drill-arm and socket, with parts cut away to show the mechanism for revolving the arm, &c. Fig. 4 is a longitudinal sectional view, showing the pivot-plate and shafting of the arm. Fig. 5 is a cross-section. Fig. 6 is a sectional view; and Fig. 7 is a sectional view of the slotting-head.

A represents the base of the machine, the portion A′ being the base of the pillar on which the machine revolves, the other portions constituting the bearing-frame for the driving mechanism. This base or frame may be mounted on a truck, so that the machine may be moved from place to place or along a tram-way as desired. B is the pillar which supports the machine, and on which the cylinder or socket C is made to revolve. The pillar B is made tapering, or of conical form, as shown in Fig. 1 of the drawing, and the inner periphery of the socket C is also made tapering to correspond with the conical form of the pillar; the outer periphery of the socket C is cylindrical throughout its entire length, except at the bottom, where it is flanged outwardly with a V-shaped flange, which sets in a correspondingly-shaped groove formed in the base of the pillar, as shown at *a a*, Fig. 1

By this means the socket C is always provided with a solid bearing, which is self-adjusting, notwithstanding the wear of parts consequent on friction. An annular slot, *b*, is also formed in the base of the pillar, and headed bolts *c c*, working in this slot, are passed through the flange of the socket, and, being provided with nuts *c' c'*, serve to secure the socket or cylinder C in any required position on the horizontal plane in which it turns; by loosening the nuts the socket is again free to turn on the pillar. D is the head or sliding frame which carries the drill-arm; it is made to slide up and down upon the socket C so as to work the drills at any height. When raised or lowered to the required height it may be securely clamped to the socket by tightening up the nuts *d*. E is the drill-arm socket, which forms a part of the sliding frame D. F is the drill-arm, which is made to revolve in a vertical plane around its longitudinal axis by mechanism to be hereafter described. It is secured to the socket E in the same manner as the socket C is secured to the pillar—viz., by headed bolts working in an annular slot in the socket, and secured by nuts to the arm. G is the drill-head, pivoted to the bearing-plate H, which is made to slide back and forth on the drill-arm, as hereafter described. The pivoting of the drill-head is also accomplished in the same manner as the socket C and the drill-arm—a device which permits of free rotation for the purpose of adjustment of the drills, and which retains them securely in position when adjusted. I is the drill-spindle socket, J the spindle, and K the feed-shaft, all operated as hereinafter set forth. L is the main driving-shaft, journaled in proper bearings in the base or frame of the machine, and operated by a cone, M, in the usual way. N is a movable shaft, provided with gear-wheels *n n'*, which are made to engage with corresponding gear-wheels *m m'* on the shaft L when increased power is required in drilling heavy work. This change is accomplisehd by removing the pin 1, which keys the wheel *m'* to the cone M and shaft L; the cone and wheel *m* (which is secured to and revolves with the cone) are then left free to revolve independent of the shaft L; the shaft N is then moved along until the wheels *n n'* engage with the wheels *m m'*, in which position they are secured by a catch, 2, engaging with a slot in shaft N. By this arrangement the driving-power is transmitted by wheels *m* and *n* to the shaft N, and by wheels *n'* and *m'* back to shaft L, thereby gaining an increase of power with reduced speed. By shifting back the shaft N and reinserting the pin 1 the cone again becomes keyed to the shaft L and the machine resumes its former speed. In drilling heavy and light work, alternately, this means of adjusting the power to the work is very desirable, and can thus be accomplished without adjusting any other part of the machine. The shaft L passes into the base of the pillar and is provided with a bevel-wheel, *l*, which engages with a bevel-wheel, *o*, secured to the vertical driving-shaft O, which is journaled in proper bearings and passes upward through the center of the pillar B and socket or cylinder C. On the top of the cylinder C a rigid cap-piece or frame, P, is secured, provided with three bearing lugs or projections, 3 4 5, and a bearing-plate, 6, on which rests one side of a movable cap-piece, Q, the other side being pivoted to a screw-rod which passes down through the journal-bearing 4, for the purpose to be described. This cap-piece Q is also provided with a projecting side, *q*, cut with a rectangular elongated slot, *q'*. *o'* is a gear-wheel secured to the main vertical shaft O between the cap-plates P and Q. This wheel *o'* engages with another gear-wheel, *r*, secured to the top of the vertical driving-shaft R, which passes down through the journal-bearing 5 and through the drill-arm socket E, as shown in Fig. 1. The sliding frame D is provided with bearing lugs or projections 7 and 8, arranged in a vertical plane with 3 and 4 on the cap-piece P. S is a vertical screw-rod, which is journaled in the bearings 4 and 8 and in the cap-piece Q at *s*. On this vertical screw-rod the drill-arm is raised or lowered automatically, when necessary, by means of the following-described mechanism: On the upper end of the shaft O is secured a small gear-wheel, *g*, and suspended from the under side of the cap-piece Q, in hanging bearings, are three small gear-wheels, 10 11 12, which gear with each other and with the larger wheel *s'* secured on the screw-rod S. T is a vertical rod journaled in bearings 3 and 7, and which passes downward through an adjusting lug or bracket, *t*, pierced with three holes. Between the lugs 7 and *t* is a sleeve-clutch, *t'*, having a tongue, which engages with a vertical groove or slot formed in the rod T, and having a handle, whereby the rod is turned in its bearings; it is also pierced with a hole, through which, and through one or other of the holes in bracket *t*, a pin is inserted to retain the rod T in the required position. On the upper end of the rod T an eccentric or cam, U, is secured. *u* is the cam-shaft, which passes up through the slot *q'* of the cap-piece Q in a loose journal-block *u'*, which slides back and forth in the slot. When the drills are in operation this automatic adjusting mechanism remains inactive, and is retained out of gear by passing the retaining-pin through the sleeve-clutch *t'* and the center hole of bracket *t*. When it is desired to lower the drill-head arm the rod T is turned to the left and secured in that position by passing the pin through the left-hand hole of bracket *t*. In turning the rod the cap-piece Q is moved by means of the cam so as to bring wheel 11 into gear with *g* of the driving-shaft, and thereby, through the communicating wheels 9, 11, and 10 and *s'*, operate the screw-rod S so as to lower the drill-arm by the power derived from the shaft O. When it is desired to raise the arm the rod T is turned to the right and

secured, as before. This, by the operations of the cam, reverses the gearing by bringing the wheel 12 in gear with 9, and, through 9, 12, 10, and *s'*, operates the screw-rod to raise the arms by the same means as before described. The rod T and shaft R, being slotted longitudinally, as before described, permit the arm to rise and fall without obstruction.

I do not limit myself to the herein-described method of turning the rod T in its bearings, or of throwing the wheels 11 and 12 in and out of gear by means of the cam. Any equivalent device which will operate the cap-piece Q in the manner described may be substituted.

F' is the drill-arm pivot, constructed with shoulders or disks *f f'*, which turn in corresponding grooves or shoulders *e e'* formed on the inner peripheries of the arm-socket E. These bearing disks or shoulders effectually support the arms, relieve the arm-shaft from all strain, and leave it free to revolve without any pressure on its bearings. The arm is made to turn or rotate by means of the screw-gearing 13 formed on the arm-pivot, engaging with the worm-shaft V journaled in horizontal bearings secured across the under side of the arm-socket E, and provided with a handle, *v*, by turning which the arm is made to revolve through the worm *v'* engaging with the gearing of the arm-pivot, as before stated. The arm F is made with a flat bearing-surface, *f'' f''*, and is provided with a longitudinal slot or opening, *f'''*, in which the arm-shaft W is journaled centrally in proper bearings, the shaft extending the whole length of the arm. The power is conveyed to the arm-shaft by means of a bevel-wheel, 14, keyed to the vertical shaft R, so as to permit the shaft to rise and fall. This wheel 14 is placed within the arm-socket E, and gears with another bevel-wheel, 15, secured on the inner end of the arm-shaft, also within the arm-socket, as shown in Fig. 1. The drill-head pivot-plate H is made to slide back and forth on the drill-arm, so as to operate the drill at a greater or less distance from the center or revolving socket C. This adjustment is accomplished by means of a screw-rod, *h*, provided with a handle, *h'*, and journaled to one side of the arm. It passes through a lug, *h''*, or portion of the plate H, which is cut with a screw-thread, which engages with the screw *h*. By turning the handle *h'* the plate, and with it the drill-head G and the mechanism for operating the spindle, are adjusted back and forth on the arm, the shaft W being cut with a longitudinal slot, in which the crown-wheel 16 is keyed, so as to slide back and forth with the plate H. The plate H is also cut with an annular slot, *h'''*, and centrally with a hole, *h''''*, for the passage of a short shaft, X. The power is transmitted from the arm-shaft W to the drill-spindle socket I by means of the bevel-wheel 16 gearing with the bevel-wheel 17 secured to shaft X within the plate H, and by the crown-wheel 18 secured on the other end of the shaft X, gearing with wheel 19 of the spindle-socket I. The drill-head or spindle-frame G is pivoted to the plate H by means of headed bolts *g*, which work in the annular slot *h'''*, as before described, and by this means the drills can be adjusted to operate in any direction on a horizontal plane on the arm, and in connection with the revolving arm in any direction on a vertical plane, and by this means of pivoting the frame G all strain is removed from the shaft and gearing. The drill-spindle socket I, in addition to the crown-wheel 19, is provided with a worm, 20, by means of which power is communicated to the feed-shaft K in the following manner: A short shaft, Y, is journaled to the frame G at right angles to and beneath the spindle-socket and feed-shaft. On the end next the spindle-socket it is provided with a gear-wheel, 21, which engages with the worm 20. On the other end it is provided with a worm, 22, which engages with a gear-wheel, 23, on the feed-shaft. This wheel 23 is adjustably secured on the feed-shaft K by friction by means of conical bosses *k k'*, secured by an adjustable lock-nut, *j*, working on a screw-thread formed on the feed-shaft J. By this means the friction on the wheel 23 may be increased or lessened, as desired. The feed-shaft K is journaled in bearings forming part of the drill pivot-frame G, and is provided with two gear-wheels, 24 and 25, of different sizes for different speed. These wheels gear with corresponding wheels 26 and 27 keyed to the screw-sleeve J'; 25 gearing with 27 for quick feed; 24 with 26 for slow. The change from slow to quick feed is effected by means of a sleeve, *j'*, having a worm or spiral slot, in which a pin, *j''*, secured to bearing-frame G, works. The sleeve *j'* is provided with a handle, *j'''*, which throws the feed-shaft K back and forth within its bearings.

This feeding apparatus may be operated either by hand or by power derived from the drill-spindle socket in the manner described—viz., through the worm 20, operating the shaft X, and the worm 22, operating the friction-wheel 23, which, when secured to the shaft K by bosses *k k'*, operate wheels 24 and 26, or 25 and 27, and thereby the screw-sleeve J', which pushes the drill-spindle forward or draws it back when the power is reversed. When it is desired to operate the feed by hand instead by of power, the wheel 23 is released from the shaft by unscrewing the lock-nut *j*, which relieves it from the pressure of the conical bosses *k* k^1, and allows it to turn freely on the shaft. A hand-wheel, Z, is keyed to the end of the feed-shaft, by means of which the feed can be operated without connection with the driving mechanism. The adjustment of the gearing for fast or slow feed is the same, whether the feed-shaft is operated by hand or by power. J is the drill-spindle, which revolves within the spindle-socket I, and within the screw-feed sleeve J'; it receives its motion from the spindle-socket by means of a

key or pin, k''', which engages with a longitudinal slot cut in the spindle, as shown at k^4, Fig. 1.

Fig. 7 represents an attachment for slotting purposes or for striking intermitting blows. When used in the machine the drill pivot-frame G is removed, and the pivot-frame G′ is put in its place, and secured in the same way, by the headed bolts *g* of the plate H; the bevel-wheel 16 then engages with the bevel-wheel 28 of the slotting device, and operates the cam 29, which, through its connecting-rod 30 and pin or bolt 31, imparts an intermitting or striking motion to the slotting-shaft 32. The shaft 32 is made adjustable by means of a slot, 33, and a screw-rod, 34, which passes through the slot longitudinally, and through the pin or bolt 31, as shown in the drawing.

The operation of the machine is deemed sufficiently obvious from the foregoing description, and with a machine so constructed and operated it must also be obvious that the operation of drilling can be performed with like facility in any direction—vertical, horizontal, or to any point radiating from a given center—as from the center of a sphere, and that this universal adjustment of the drill can be accomplished without moving the base of the machine or the alterations of its driving mechanism in any particular. In metal-working, besides being adapted for all ordinary drill-work, it may be used for drilling heavy castings without requiring them to be moved around. In ship-building such a machine may be used for drilling and boring along the hull of the ship, and be made to conform to the curve or sweep of its lines with the greatest facility. In tunneling it can be made to drill at any point of the arch. In quarrying it may be moved to the edge and work the face of the rock beneath it; and for mining operations, from its universal adjustments and the protection afforded by the central arrangement of the shafts and gearing, it is deemed peculiarly adapted.

What I claim as my invention is—

1. Jointly, the tapering or conical form of the pillar B, the corresponding form of cylinder C, and the bevel form of the flanges *a*, as described.

2. The rod T, cam U, and pivoted cap Q, operating, in combination with the wheels S′, 9, 10, 11, and 12, as and for the purpose specified.

3. The arrangement and combination of the wheels 10, 11, and 12 and hinged cap Q with the wheel 9 and S′, for turning or revolving the screw-rod S to the right or left, in the manner and for the purpose set forth.

4. The combination of cylinder C, arm F, head F′, worm V, and screw-gear 13, substantially as and for the purpose specified.

5. The rotatable arm F and socket E, in combination with the socket or cylinder C and pillar B, and shafts R, W, L, and O, with their connecting-gearing, arranged for operation, without change of gearing, substantially as set forth, for the purpose specified.

6. The rotatable arm F and socket E, in combination with the head G and plate H, and shafts R, W, and X, with their connecting-gearing, arranged for operation substantially as and for the purpose specified.

7. The rotatable arm F and socket E, in combination with cylinder C and pillar B, head G, and plate H, and with shafts R, W, L, O, and X, with their connecting-gearing, arranged for operation substantially as and for the purpose specified.

8. The combination of the arm-socket E, constructed with shoulders *e e′*, and the arm-head F′, with bearing-disks *f f″* and the bolts *e″*, for the purpose of supporting the arm F without strain upon the arm-shaft, substantially as set forth.

9. The drill-spindle socket I having worm 20, the shaft Y having wheel 21 and worm-gear 22, and the shaft K having wheel 23, all operating in combination, for the purpose specified.

10. The wheel 23, conical bosses $k\,k^1$, and lock-nut *j*, operating, in combination with the feed-shaft K, for the purpose specified.

11. The sleeve j', having a handle, j''', and spiral slot, as described, in combination with the pin j'', shaft K, and wheels 24 and 25, for the purpose specified.

12. The combination of shaft K, having adjustable wheel 23 and sleeve j', and wheels 24 and 25, with screw-sleeve J′ and wheels 26 and 27 for the purpose of feeding the drill-spindle by power or by hand, and fast or slow, as desired.

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