No. 648,431. Patented May 1, 1900.

H. A. PORTER.

DRILLING MACHINE.

(Application filed Dec. 22, 1898.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.

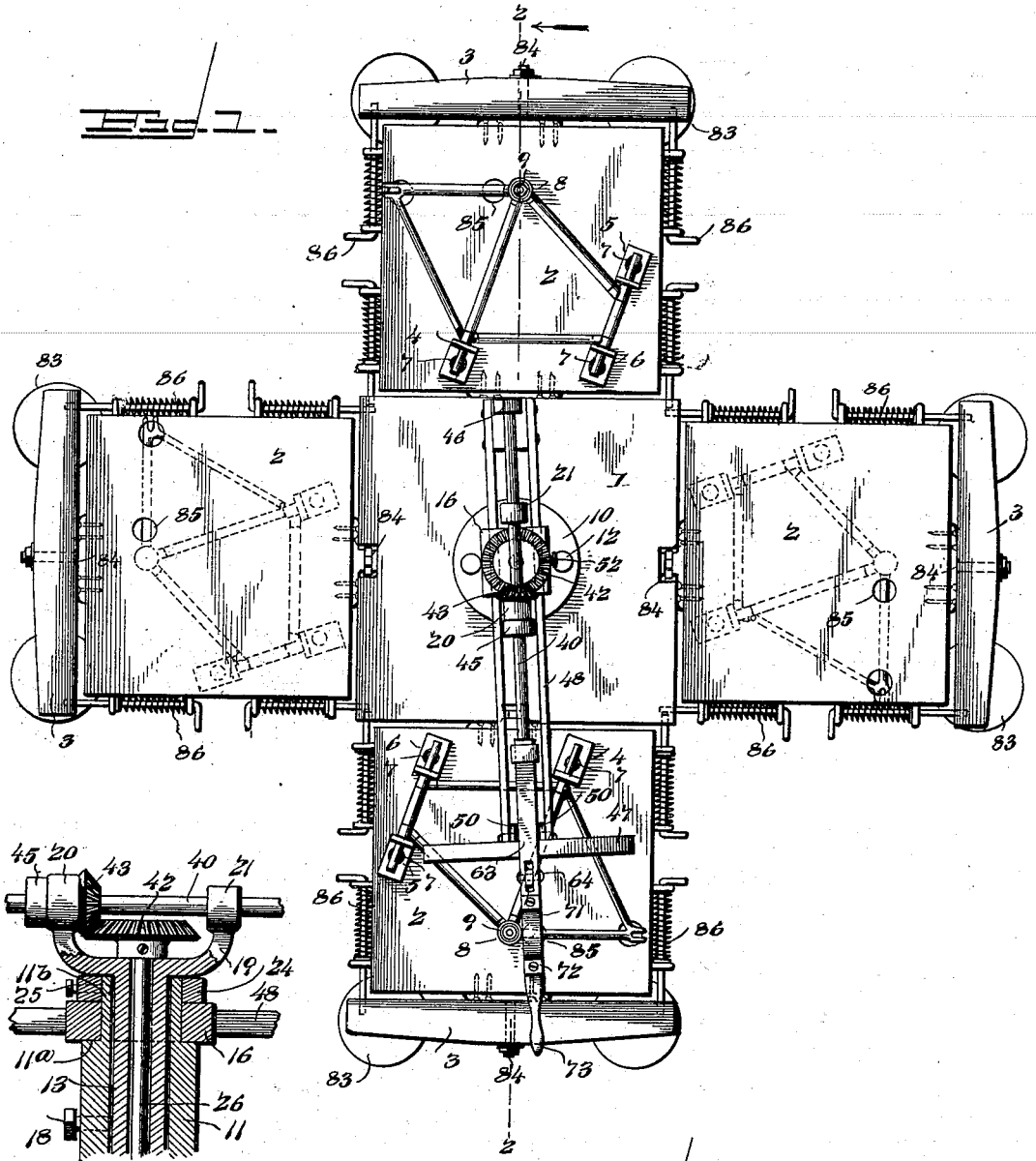
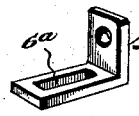


Fig. 11.

Fig. 6.



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No. 648,431. Patented May 1, 1900.

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(Application filed Dec. 22, 1898.)

(No Model.) 4 Sheets—Sheet 2.

Fig. 2.

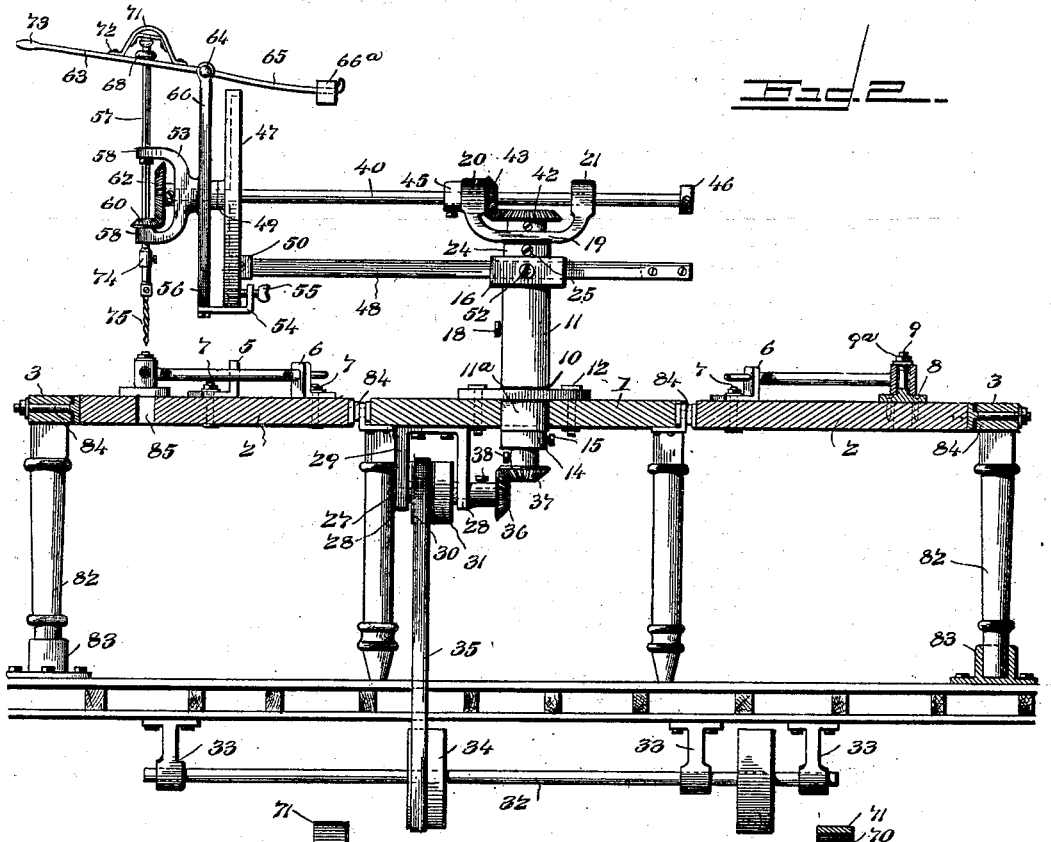


Fig. 5.

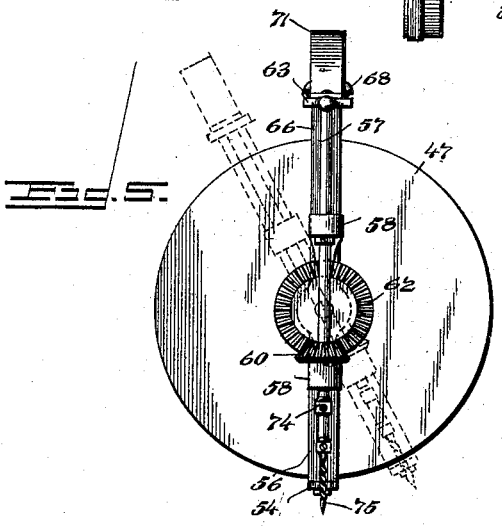
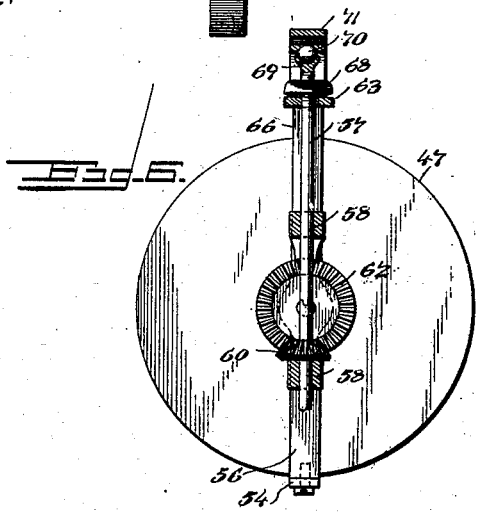


Fig. 6.



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No. 648,431. Patented May 1, 1900.

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DRILLING MACHINE.

(Application filed Dec. 22, 1898.)

(No Model.) 4 Sheets—Sheet 3.

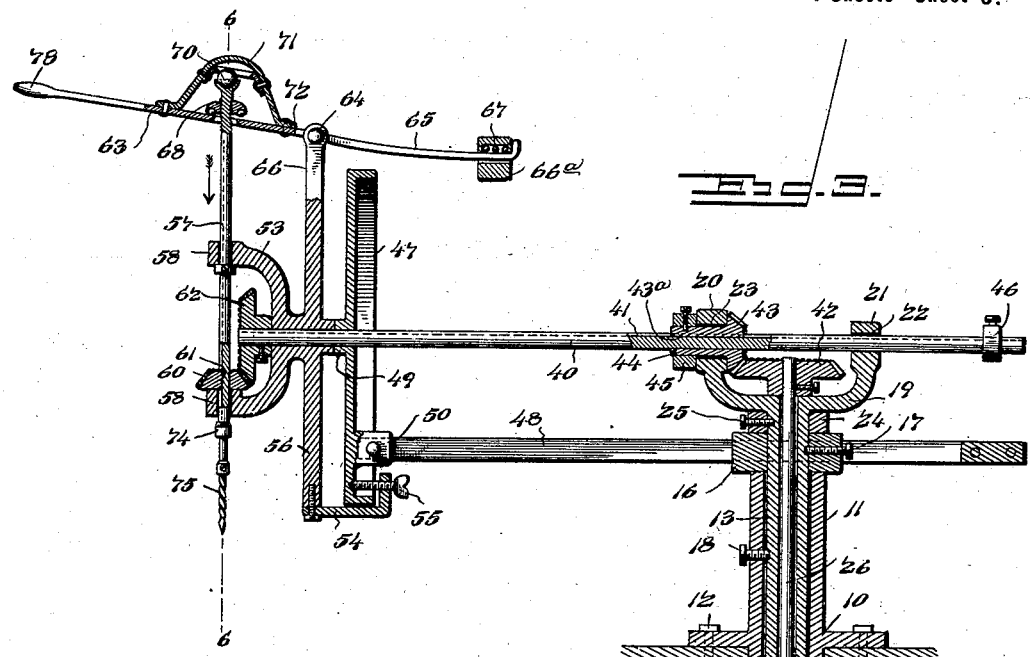

Fig. 3.

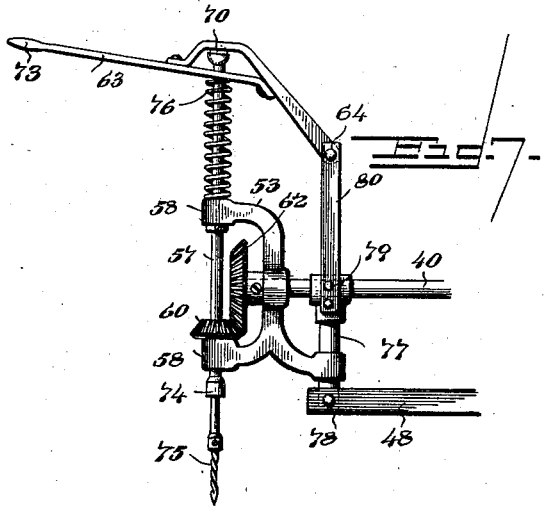

Fig. 7.

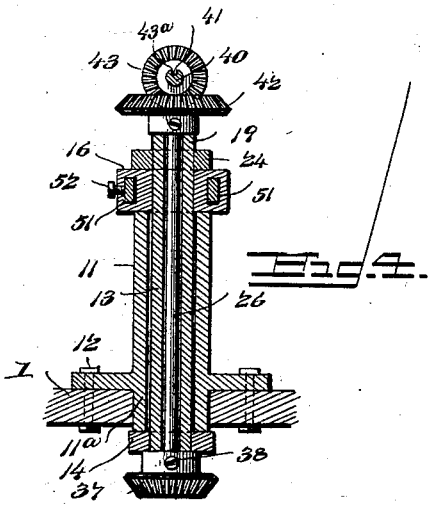

Fig. 4.

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DRILLING MACHINE.

(Application filed Dec. 22, 1898.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 9.

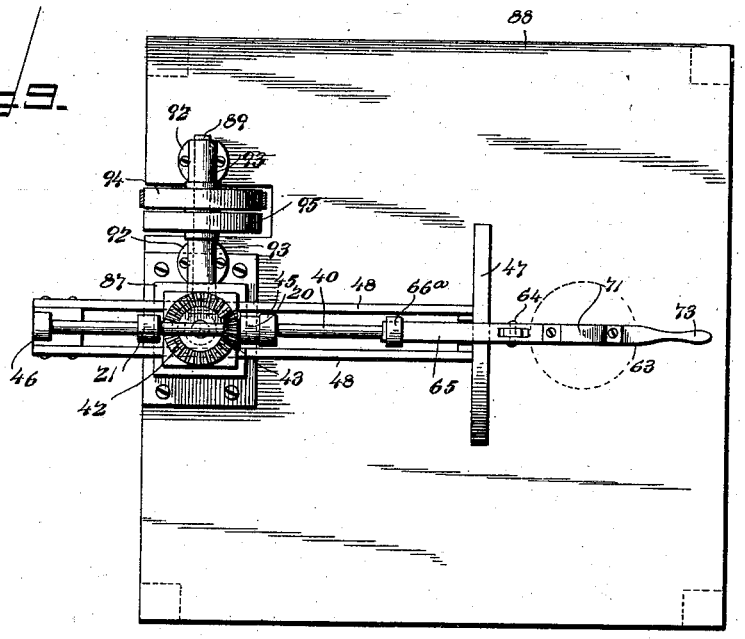
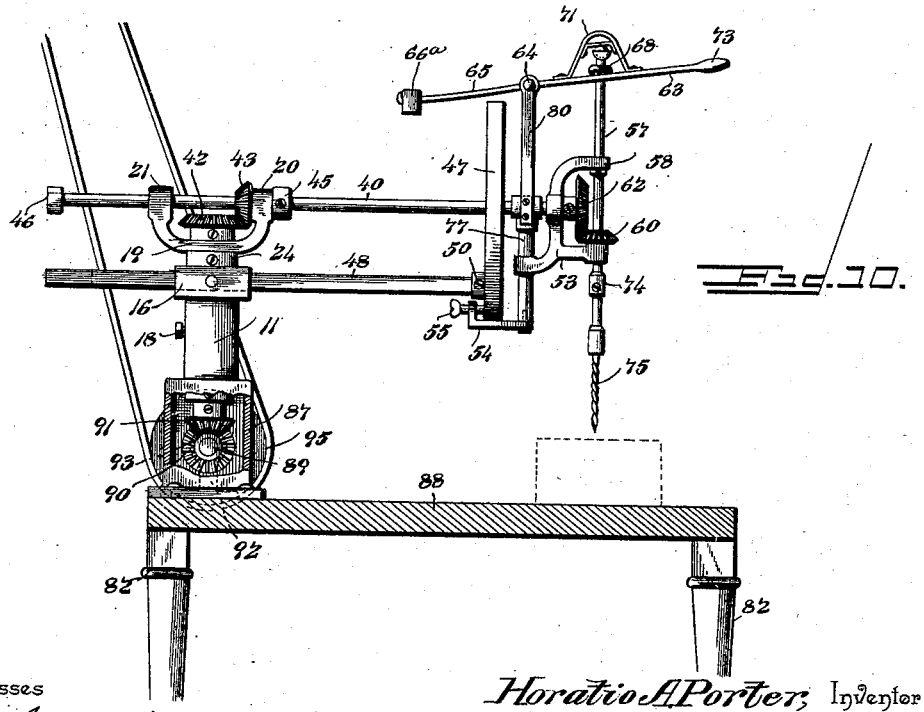


Fig. 10.



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UNITED STATES PATENT OFFICE.

HORATIO A. PORTER, OF HOLYOKE, MASSACHUSETTS.

DRILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 648,431, dated May 1, 1900.

Application filed December 22, 1898. Serial No. 700,087. (No model.)

To all whom it may concern:

Be it known that I, HORATIO A. PORTER, a citizen of the United States, residing at Holyoke, in the county of Hampden and State of Massachusetts, have invented a new and useful Drilling-Machine, of which the following is a specification.

My invention relates to improvements in drilling-machines; and the primary object is to provide a machine which may be adjusted to variable positions over the bed to suit the drill-bit to the position of the work thereon.

A further object is to provide means by which the drill-spindle may be adjusted horizontally to different positions with relation to the driving mechanism and by which said spindle may be driven in either of its adjusted positions without disturbing the connections with the driving-shaft.

A further object is to provide means by which the drill-spindle may be adjusted at different angular positions and in vertical planes to the bed and to the shaft which drives said spindle, so that the drill may operate in various radial positions and at different angles on the work.

A further object is to provide means by which the drill-spindle may be moved endwise in the drill-head without reference to the position of the latter to enable the drill-bit to be moved toward the work or to be retracted therefrom, and with this drill-spindle is combined means for adjusting the same endwise with very little friction between the spindle and the hand-operated adjusting mechanism.

With these ends in view the invention consists in the novel combination of elements and in the construction and arrangement of parts, which will be hereinafter fully described and claimed.

To enable others to understand my invention, I have illustrated the preferred embodiment thereof in the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a plan view of a drilling-machine constructed in accordance with my invention. Fig. 2 is a side elevation thereof with the central bed and work-table in section, the plane of section being indicated by the dotted line 2 2 of Fig. 1. Fig. 3 is a vertical sectional elevation through the adjustable carrying means for the drill-spindle. Fig. 4 is an enlarged vertical section through the stand and the parts associated therewith. Fig. 5 is a face view or elevation of the drill-spindle and its supporting devices. Fig. 6 is a vertical sectional elevation through the drill-spindle operating and adjusting devices. Fig. 7 is a view of a modified construction for supporting the drill-spindle. Fig. 8 is an enlarged detail view of one form of the hinged bracket used in the machine represented by Figs. 1 and 2. Fig. 9 is a plan view of another embodiment of the invention in which the driving mechanism for the vertical shaft is arranged above the horizontal plane of the table or bed of the machine, the type of drilling-machine mounted by this figure being well adapted to operate upon any kind of work placed on the machine-body. Fig. 10 is a vertical sectional elevation through the machine represented by Fig. 9. Fig. 11 is a vertical sectional elevation of a modified construction of the column, the carrier-head, and the clamp-collar for holding said head in position on the column and the gearing.

Like numerals of reference denote like and corresponding parts in the several figures of the drawings.

The drilling-machine illustrated by the accompanying drawings is especially designed for drilling or boring holes in bicycle-frames, and in the preferred embodiment of the invention I construct the bed of the machine with a series of supplemental tables adapted to receive a number of bicycle-frames and mount the drilling mechanism proper in a way to insure its adjustment over either of the supplemental tables into proper position to the work thereon, said drilling mechanism being adapted for use in connection with the work on either table. As represented by Figs. 1, 2, and 3 of the drawings, the machine is equipped with a stationary bed 1, a series of four supplemental tables 2, and a series of head-blocks 3, said supplemental tables being arranged radially with respect to the bed 1, so as to extend from the four sides of the central bed. The tables 2 are supported independently of each other by horizontal pivots or trunnions connected to the bed 1 and the head-blocks 3 for the purpose of inverting the tables and

enabling the drill-bit to be used on either side of the work or bicycle-frame on the table; but I do not strictly confine myself to the employment of horizontally-pivoted and invertible tables for use in connection with the central machine-bed 1, because the tables may be in fixed relation to the bed, so as to form rigid extensions thereof on its several sides. The detailed construction of the supplemental tables, the head-blocks therefor, and the pivotal connections between the work-tables, the machine-beds, and the head-blocks will be hereinafter fully described.

On each work-table is applied a series of clamps 4, 5, 6, and 8, which are placed or positioned on the table to receive or engage with various parts of the work—such, for example, as a bicycle-frame—illustrated by dotted lines in Fig. 1 of the drawings. The work-clamps 4, 5, and 6 on each table are arranged to engage with the head and seat-post socket of a bicycle-frame substantially as represented by the drawings, and each of these clamps is provided with a slotted foot 6^a, through which passes a clamping bolt or bolts 7, that serve to rigidly hold the clamp in position on the table and permit said clamp to have a limited adjustment thereon when it is desired to detach or fasten a bicycle-frame on said table. The other clamp 8 of the series of clamps provided on each table is adapted to engage with the pedal-shaft bearing forming a part of the crank-hanger of an ordinary bicycle-frame, and said clamp 8 is provided with a bolt 9, adapted to pass through the shaft-bearing of the crank-hanger and to receive a nut 9^a, that serves to bind the crank-hanger firmly in place on the bed.

On the center of the machine-bed 1 is erected a base 10, and this base has as an integral part thereof a vertical tubular column 11, which is made to extend a suitable distance above the base and the lower end of which column is prolonged or extended, as at 11^a, through a hole in the machine-bed 1, so that said extended end of the tubular column protrudes below the lower face of the bed 1. (See Figs. 3 and 4.) In some styles of drilling-machines, particularly those adapted for drilling or boring holes in bicycles-frames, it is desirable to avoid the use of an angular or polygonal base as a support for the tubular column 11, and I prefer to make the column as of cylindrical form and to attach the same rigidly to the bed 1 by bolts 12, which pass through a flange or foot at the lower extremity of the column proper. Passing vertically through this tubular column is a vertical tubular standard 13, which is fitted loosely in said column for a movement of rotation therein, and the lower end of this tubular adjustable standard protrudes below the extended end or foot 11^a of the column to receive a collar 14, which is provided with a set-screw 15, by which the collar is rigidly clamped on the standard in a position to bear or ride against the protruding lower extremity of the column.

A carrier-head 16 is loosely sleeved on the vertical tubular standard 13 and arranged to rest upon the upper extremity of the vertical fixed column 11, and said carrier-head is provided with a threaded socket to receive a clamping screw or bolt 17, which is adapted to bind against the tubular standard 13, and thus clamp the carrier-head rigidly to the standard, whereby the carrier-head rides loosely against the fixed column 11 and is adapted to turn with the tubular standard 13 in the adjustment of rotation of said standard.

A set screw or bolt 18 is mounted in a suitably-threaded socket or opening in the vertical fixed column 11 to bind or impinge against the tubular standard 13, for the purpose of holding the latter rigidly in place within the column after the machine has been adjusted to its desired position with reference to the work; but normally the set screw or bolt 18 is free from contact with the tubular standard to permit the latter to rotate or turn freely within the column 11 when it is desired to adjust the drill-spindle from the work on one table to that on another table.

The upper part of the vertical tubular standard is extended a suitable distance above the carrier-head 16 to receive the forked or bifurcated bearing-head, which may be made a separate part from said standard and be rigidly united thereto in any suitable way, or said bearing-head may be integral with the tubular standard. The bearing-head 19 is forked or bifurcated to provide the branches or arms 20 21, one of which arms is provided with a shaft-bearing 22 to receive a horizontal endwise-movable shaft to drive the drill-spindle, as will presently appear, while the other arm has a bearing 23, the interior diameter of which is larger than the shaft-opening of the bearing 22, so that in the bearing 23 may be fitted the stub-shaft of one of the bevel-gears which connect the horizontal shaft with the vertical shaft 26.

A collar 24 is loosely fitted on the vertical tubular standard 13 at a point above the carrier-head 16 and below the bearing-head 19, and this collar 24 is provided with a set screw or bolt 25, which is adapted to bear against the tubular standard to clamp said collar rigidly to the standard. This collar rests upon the carrier-head 16 to support the standard loosely in position within the tubular column, and it will be observed that said standard is provided with two collars 14 and 24, which are rigidly clamped thereto and adapted to coöperate with the fixed column and the carrier-head to hold said standard 13 against endwise displacement in a vertical direction within the column 11.

The shaft 26 passes vertically and loosely through the tubular standard 13, so that the upper extremity of the shaft extends above the bearing-head 19, while its lower extremity protrudes through the lower end of the vertical standard. This vertical shaft is driven by a horizontal driving-shaft 27, ar-

ranged at right angles to said vertical shaft and situated below the bed 1. Said driving-shaft 27 is journaled in bearings 28 of the hangers or boxes 29, which are rigidly secured to the under side of said bed, and on said shaft, between the hangers, are fitted the fast and loose pulleys 30 and 31. The main shaft, by which the machine is operated, lies below or above the floor of the room or apartment in which the machine is erected, and said main shaft is journaled in boxes of the hangers 33 and is provided with a driving-pulley 34 in the vertical plane of the fast and loose pulleys on the short driving-shaft 27. A belt 35 passes below or above the pulley 34 on the main shaft 32 and over one or the other of the pulleys 30 31 of the shaft 27, and this belt is adapted to be shifted by any suitable mechanical contrivance from the fast pulley to the loose pulley, or vice versa, according as it is desired to throw the drill-spindle into and out of service. The horizontal driving-shaft 27 is operatively connected with the lower extremity of the vertical shaft 26 by the intermeshing bevel-gears 36 and 37, the hubs of which are provided with clamping-screws 38 for the purpose of attaching said bevel-gears 36 and 37 to the shafts 26 and 27, respectively.

40 designates the horizontally-adjustable shaft, which is journaled in the bearing-head 19, carried by the axially-turning vertical standard 13, whereby said shaft is adapted to be adjusted over the bed 1 when said standard 13 is turned in the vertical fixed column 11. This shaft is supported directly by the bearing 22 on one of the arms of the bearing-head, and it is indirectly supported by the other arm of said bearing-head owing to the interposition between said shaft and the bearing 23 of the short tubular shaft 44 of the beveled gear 43, which beveled gear 43 is fitted on the horizontal shaft 40 and is arranged to mesh with a beveled gear 42, which is rigidly fixed in a suitable way to the upper extremity of the vertical shaft 26, which protrudes above the central part of the bearing-head 19 between the arms or branches thereof. It will thus be seen that the beveled gear 43 has its short tubular shaft 44 journaled in the bearing 23 of one arm or branch of the bearing-head 19 and that this short shaft 44 of the said bevel-gear is fitted loosely on the horizontal shaft 40. Said shaft 40 is designed for endwise or sliding adjustment through the tubular shaft 44 of the bevel-gear 43 and the bearing 22 of the head 19 for the purpose of adjusting the drill-spindle at different distances from the vertical column and standard of the machine; but said shaft 40 is operatively connected with the bevel-gear 43 under all endwise adjustments of said shaft, because the shaft 40 is provided with a longitudinal keyway 41 to receive the key or spline 43^a of the bevel-gear 43, whereby the shaft 40 may be adjusted to the required position without disconnecting the bevel-gear 43 from the shaft 40, and thus the vertical shaft 26 is adapted through the intermeshing gears 42 43 to rotate the endwise-adjustable horizontal shaft 40. The endwise adjustment of said shaft 40 is, however, limited by the stop-collars 45 46, which are suitably clamped on the shaft at points on opposite sides of the branched bearing-head 19, and in one adjustment of the shaft one collar is adapted to impinge against the arm 20, while the other collar impinges against the other arm 21 when the shaft is moved in the reverse direction, said collars serving also to prevent accidental detachment of the shaft from the bearing-head 19.

A horizontal frame 48 is arranged below the shaft 40 and is slidably fitted in the carrier-head 16, and this frame is operatively connected by a face-plate 47 with the shaft 40, so that the shaft 40 and the frame 48 are adjustable simultaneously in horizontal planes on the bearing-head 19 and the carrier-head 16, respectively. The horizontal frame is shown as composed of two arms or bars, of any suitable or appropriate form in cross-section, and said frame has its bars or rods slidably fitted in slots or openings 51 of the carrier-head 16, thus permitting the frame to be moved freely in the carrier-head. The bars or rods forming the horizontal frame 48 may be suitably connected together, as by a cross-bar, at the end opposite to the face-plate 47.

The face-plate 47 is arranged in a vertical position at one end of the horizontal frame 48, and said face-plate is provided with a hub 49 and with lugs 50. The hub 49 is sleeved or fitted on the horizontal shaft 40, while the lug or lugs 50 are attached rigidly to the bars or rods of the horizontal frame 48 by suitable bolts. In the carrier-head 16 is mounted a clamping screw or bolt 52, which is adapted to bind against one of the bars or rods of the horizontal frame 48 to hold the latter in fixed relation to the carrier-head, and as the horizontal shaft 40 is coupled by the face-plate 47 with said frame 48 said shaft is caused to assume a relatively-fixed position to the standard 13 when the frame 48 is held by the set-screw 52.

The face-plate 47 serves the important purpose of holding the drill head and spindle at any desired angular position to the horizontal shaft 40, and said face-plate is of disk form to enable a clamping-screw on the drill-head to engage with the face-plate at any position within the range of angular adjustment of the drill-head to the horizontal shaft 40. The drill-head 53 is sleeved loosely on the shaft 40, and said head is provided with an arm 54, which extends outwardly therefrom adjacent to the edge of the face-plate 47, and in said arm is mounted a binding-screw 55, which is adapted to impinge against the face-plate to hold the drill-head in the required position, said drill-head being furthermore provided with a standard 56 opposite to the arm 54, which carries the binding-screw. The drill-

head is forked or bifurcated to enable its branches to be provided with alined bearings which receive a drill-spindle 57, capable of free rotation in said alined bearings 58 of the drill-head and also of an endwise or sliding adjustment in said bearings. On one of the bearings of the branched drill-head is fitted a bevel-gear 60, which is provided with a key or spline 61, that fits in a longitudinal groove or keyway provided in the drill-spindle 57 to operatively connect the bevel-gear 60 to the drill-spindle in all positions of the latter in its endwise adjustment, and with this gear 60 meshes a bevel-gear 62, which is fixed to the shaft 40, thus connecting the shaft 40 and the drill-spindle together for the shaft to drive the spindle. In the upper extremity of the drill-spindle is provided a socket 69, and on said spindle at a point below said socket is secured in any suitable way a bearing-nut 68, adapted to confine a ball-bearing which rides upon the adjusting-lever 63. This adjusting-lever is arranged above the drill-head, and it is preferably provided with a curved arm 65 to receive a shiftable weight 66ª. The lever is fulcrumed at a point intermediate of its length, as at 64, to the standard 66 of the drill-head 53, and said lever is slotted or provided with a transverse opening at a point one side of its fulcrum for the purpose of fitting the lever loosely to or around the drill-spindle at a point below the bearing-nut 68, which is attached rigidly to the spindle. To the lever is rigidly secured a cap 71, which has its ends flanged, as at 72, to receive bolts or screws that fasten the cap to the lever, and said cap is arched or raised to enable it to fit over the upper extremity of the drill-spindle. This cap is recessed, slotted, or offset at a point in vertical alinement with the spindle, thus forming a seat for the bearing-ball 70, said seat in the lever being coincident with the socket 69 in the spindle to enable the bearing-ball 70 to fit in the lever-seat and the spindle-socket. The bearing-nut 68 may be constructed in any suitable way to retain the ball-bearings—that is to say, the lower edge of the bearing-nut may be flanged or provided with a ball-retainer plate arranged to hold the bearing-balls against dropping out of the nut when the lever 65 assumes an angular position relatively to the nut, so that some of the bearing-balls do not ride thereon. The single large bearing-ball 70 is confined in place on the upper end of the drill-spindle by fitting said ball in a flared socket on said spindle, so that the upper face or side of the ball will play loosely in a flanged part 72 of the cap 71 on the lever 65. It will thus be observed that the lever has ball-bearing connection at two points with the spindle, one of which ball-bearings is formed between the extremity of the spindle and the cap which is secured to the lever, and the other ball-bearing is provided between the fixed bearing-nut 68 and the lever 63. The described construction permits the operator to adjust the spindle endwise by raising or depressing the free end of said lever, and as the connections between the lever and spindle contain the loose ball-bearings the spindle is adapted to rotate with great freedom on its connection with the lever, thus reducing the friction on the lever connections to a minimum. The shiftable weight 68ª is fitted on the curved arm 65 of the lever to ride freely back and forth thereon, and to attain this end to better advantage I provide said weight with the ball-bearing 67, adapted to travel on the curved arm of the lever. The ends of the weight are flanged, as shown by Fig. 3, to hold the bearing-balls against dropping out of the weight as it slides or travels along the lever. This weight is adapted to travel on the arm of the lever toward the fulcrum or the rear extremity of said arm, according to the position of the lever, and when the latter is raised by hand to elevate the drill-spindle and retract the same from the work said weight travels toward the extremity of the lever-arm until arrested by a suitable stop thereon, thus enabling the weight to hold the lever and the drill-spindle in the raised position. The weight may be so constructed and arranged with relation to the pivot or fulcrum of the lever that said weight may travel over the lever-fulcrum, whereby the gravity of the weight may be exerted on the lever to hold the spindle and lever in their depressed positions. As shown by the drawings, the weight is adapted to travel on the lever at one side of the fulcrum thereof, so that the weight holds the spindle in its raised position and dispenses with the employment of a spring.

The end of the lever which projects beyond the drill-spindle is provided with a suitable handle 73, by which said lever may be conveniently grasped and operated. The lower extremity of the drill-spindle is provided with a chuck 74 of any suitable construction to receive suitable sizes of drill-bits 75.

In some types of drilling-machines it is not desirable or necessary to provide the means for supporting the drill-spindle at variable angular positions to the shaft 40, and in Fig. 7 of the drawings I have represented one means by which the drill-spindle may be supported on the frame 48 to occupy normally a vertical position thereon and at right angles to said shaft 40. In this construction I dispense with the face-plate and the means for clamping the drill-head at different angular positions, and in lieu of the face-plate I employ a vertical post 77, which is attached rigidly at its lower end, as at 78, to the extremity of the horizontal frame 48, the upper end of said post being provided with a bearing 79 for the outer extremity of the shaft 40. The drill-head 53 is united rigidly to or made a part of this post 77, and said drill-head is equipped with the vertically-alined bearings to receive the drill-spindle. From the post 77 rises a standard 80, which extends above the shaft 40 and in which is fulcrumed the

adjusting-lever 63. As in the construction heretofore described, the lever is provided at a point to one side of its fulcrum with a ball-bearing connection with the drill-spindle, and around the upper part of said drill-spindle is coiled a spring 76, one end of which is seated on the drill-head and its other end against the lever. This spring has a tendency to normally lift the lever and spindle, so that it is necessary for the operator to hold the lever in a depressed position in order that the drill may operate on the work; but I may dispense with said spring and use in lieu thereof a shiftable weight, which is adapted to slide on the lever when the latter is adjusted toward and from the lever-fulcrum, and thereby hold the lever and the drill-spindle in their raised or lowered positions, as in the preferred embodiment of the invention hereinbefore described.

When the drilling-machine is equipped with the series of work-tables 2 at the respective sides of the bed 1, I provide a head-block 3 for each work-table. This head-block is parallel to the edge of the bed 1, and it is maintained in a fixed position by the vertical standards 82, which are stepped at their lower ends in the step-bearings 83, thus supporting the head-block in fixed parallel relation to one edge of the bed. The table 2 is situated between the bed and the head-block, and it is pivotally connected thereto by the horizontal pivots 84. These pivots consist of angular slotted plates fixed to the edges of the table and bolts or pins which are secured in slots in the opposing edges of the bed and the head-block. Each table supported by the horizontal pivots is adapted to be inverted by turning the same in a vertical plane, and thus either face of the table may be brought uppermost and opposite to the drill-spindle. The work-table is provided at a suitable point with two or more transverse apertures 85, through which the bit of the drill-spindle may be thrust when the work-table is inverted to drill the work on the lower side of the table, and thus the table is adapted to present the work to the drilling mechanism so that the bit may bore in opposite sides of the frame. The work-table is adapted to be held in position when adjusted by means of the spring-controlled locking-rods 86, which are fitted in suitable keepers on the table and adapted to be projected into sockets in the bed 1 of the head-block 3. The described construction of the table is especially useful when the machine is to be used for drilling bicycle-frames. The work may be confined by the clamps on the table and the drill lowered to operate on one side of the frame to drill a hole therein. The locking-rods may then be retracted, the drilling mechanism swung to one side of the table, the table then inverted to turn the work to the under side thereof and to present the other face of the table to view, the locking-rods again engaged with the bed and head-block, and the drill again brought into position to be lowered through one or the other of the apertures 85, so as to contact with the work on the under side of the table, thereby adapting the machine to drill holes in opposite sides of a bicycle-frame. My construction of the machine with a plurality of work-tables each independently adjustable while the work is contained thereon enables a series of bicycle-frames to be applied to the machine, and the construction of the drill mechanism adapted to be turned on a vertical axis provides for bringing the drill-bit into proper position to the work on either of the work-tables, because the drill mechanism may be swung around over each work-table successively. As the drill-spindle is sustained by horizontally-adjustable means, the spindle may be moved back and forth in a horizontal plane to present the bit to different parts of the work on each table, and the described adjustment of the drill mechanism provides practically for universal adjustment of the drill-spindle, so that it can operate under any and all conditions of service. It will be observed that the driving mechanism by which the horizontally-adjustable shaft and the drill-spindle are driven is contained wholly below the supporting means for said drill-spindle, and thus the drill mechanism is capable of a wide range of adjustment without hindrance from or interference with the driving mechanism. I do not desire, however, to strictly confine myself to the location of the driving mechanism below the bed of the machine, because in some types of machines it may be desirable to place the driving mechanism above the bed of the machine, in which event parts of my improvement may be used, if not the whole.

The machine represented by Figs. 9 and 10 is adapted for drilling purposes generally on any kind of work which may be placed and held on the work bed or table in a suitable position, or said work may be clamped to the bed in fixed position thereon by any suitable style of clamping devices. The vertical column 11 of the drilling-machine is provided at its lower end with an enlarged boxing or housing 87, which forms an integral part of said column, the said boxing serving to attach the column to the bed or table 88 and to inclose within itself the gearing by which the motion of the power-shaft is communicated to the vertical shaft of the drilling-machine proper. This power-shaft 89 is arranged in a horizontal position above the plane of the bed or table and at one side of the vertical column, except that the inner extremity of said power-shaft passes through a suitable opening in one side of the boxing or housing for the purpose of having the bevel-gear 90 on said inner end of the power-shaft mesh with a bevel-gear 91 of the lower extremity of the vertical shaft which drives the horizontal shaft that in turn actuates the drill-spindle. This horizontal power-shaft is supported above the machine-bed by short

standards 92, which have boxes or bearings 93 to receive said power-shaft, and on the shaft between the standards are fitted the fast and loose pulleys 94 95, respectively. These pulleys extend into a suitable recess in the machine bed or table; but they lie above the horizontal plane thereof, so that the power-shaft may be driven from overhead driving mechanism, such as a counter-shaft, through the medium of an endless belt. The power-shaft and its driving-belt should be arranged out of the path of the horizontally-adjustable frame 48 and the shaft 40, so that in the turning or swinging movement of said frame and shaft on the vertical driving-shaft as a center the belt will not interfere with or be struck by said horizontal frame 48, the shaft 40, or the drill-spindle. The work is fitted to or clamped upon the machine-bed at any suitable place outside of the vertical column and its boxing or housing, and the drill-frame, with the shaft 40, may be adjusted to any required position over the table and in proper relation to the work thereon. The column 11, the driving-shaft, the horizontal frame 48, the horizontal shaft 40, the drill-spindle, and the means for adjusting and supporting said drill-spindle are constructed substantially as hereinbefore described, and illustrated by Figs. 2, 3, 4, 5, and 6 or by Figs. 7, 9, and 10, and as the construction and operation of the drilling mechanism proper will readily be apparent from the foregoing description and the drawings I do not deem it necessary to again describe this drilling mechanism in connection with the construction of the machine illustrated by Figs. 9 and 10. I prefer to make the bars forming the frame 48 of rectangular form in cross-section, as shown by Fig. 4; but this particular shape of the bars is not material, as they may be of circular or polygonal form in cross-section without departing from the spirit of the invention.

The machine shown by Figs. 9 and 10 has the drilling mechanism mounted on a single table or bed of suitable dimensions and form, and I prefer to attach the vertical column to the table near one end or edge thereof and preferably in the central line of the table, thus exposing a large area of the table for the reception of work which may be placed in various positions on the table and held thereon by hand or by suitable mechanical devices. As the drilling mechanism is capable of a swinging adjustment on the vertical column, as well as of a horizontal sliding adjustment toward and from said column, the drill may be conveniently moved to any desired position within the area of the table, whereby the drilling mechanism is well adapted to operate on work placed in various positions on the table or to different parts of work which is clamped to the table in any suitable relation to the drilling mechanism.

I do not desire to strictly confine myself to the detail construction and arrangement of the parts shown by Figs. 3 and 4 of the drawings, because in Fig. 11 I have represented a modified construction of the standard for the application thereto of the carrier-head and the clamping-collar. By reference to said Fig. 11 it will be observed that the upper part of the column is reduced circumferentially to provide a shoulder 11^a and a projecting flange 11^b. The carrier-head 16 is fitted to the projecting flanged end of the column, so as to rest upon the shoulder 11^a thereof, and the clamping-collar 24 is fitted on the upper extremity of the reduced end 11^b of the column, so as to rest upon the carrier-head 16 and hold the same firmly to its place on the reduced end and shoulder of the column, such construction tending to make the parts more firm and rigid. The clamping-collar 24 is held in place by the set-screw 25, which impinges against the reduced end 11^b of the vertical fixed column, and the standard 13 passes through the column so as to have its guide-head 19 rest upon the upper protruding end 11^b of the column. As in the construction hereinbefore described, the lower end of the tubular standard 13 receives the clamping-collar 14 to prevent the tubular standard from vertical displacement within the column.

I am aware that changes in the form and proportion of parts may be made by a skilled mechanic without departing from the spirit or sacrificing the advantages of the invention, and I therefore reserve the right to make such modifications as clearly fall within the scope of the invention.

Having thus described the invention, what I claim is—

1. In a drilling-machine, the combination with a bed, of a series of adjustable work-tables arranged at the sides of the bed and each supported by horizontal pivots located at the sides of the table for inverting the latter in a vertical plane, and a drilling mechanism erected on the bed for adjustment over either of said tables, substantially as described.

2. In a drilling-machine, the combination with a bed, of a series of individually-reversible work-tables arranged radially with respect to the bed, in substantially the same horizontal plane therewith, and each table supported by horizontal pivots located at the sides of the table for inverting the latter in a vertical plane, means for locking each table in its adjusted position, and a drilling mechanism mounted on said bed at a point equidistant from all of the work-tables for presenting the drill-spindle over either of said tables, substantially as described.

3. In a drilling-machine, the combination with a bed, of a series of reversible work-tables arranged at the sides of the bed and each supported by horizontal pivots, located at opposite sides of said table, latches on each work-table for engagement with the bed to hold the table in its adjusted position, and a

drilling mechanism mounted on the bed for adjustment over either of said tables, substantially as described.

4. In a drilling-machine, the combination with a central bed, of a horizontally-adjustable drilling mechanism erected on said bed and capable of swinging and slidable adjustment thereon, and a series of independent apertured work-tables situated contiguous to the several sides of the bed and each adjustable on a horizontal axis for inverting the same and its work, substantially as described.

5. In a drilling-machine, the combination with a central bed and an adjustable drilling mechanism erected thereon, of a series of pivoted, invertible work-tables situated adjacent to the bed, in the path of the drill mechanism, and provided with apertures or slots for the passage of a drill-tool and means for locking said tables in their inverted or adjusted positions, substantially as described.

6. In a drilling-machine, the combination with a bed and an adjustable drilling mechanism, of a series of head-blocks adjacent to the sides of the bed, a series of work-tables pivotally supported on the bed and said head-blocks and each provided with a transverse opening and with work-clamps, and locking devices for holding each work-table independently of every other work-table, substantially as described.

7. In a drilling-machine, the combination of a fixed hollow column, a hollow standard having a bearing-head projecting above said column, a frame-supporting collar provided with guide-openings in planes on opposite sides of said standard, a spacing-collar intermediate the bearing-head of said standard and the frame-supporting collar, a horizontal frame having connected parallel side bars fitted slidably in and supported by said fixed collar, a vertical shaft passing through said standard, a drill-spindle, and a horizontal shaft mounted partly on the horizontal frame and partly in the bearing-head of the hollow standard, said shaft being geared to the drill-spindle and to the vertical shaft, substantially as described.

8. In a drilling-machine, the combination of a stationary hollow column, a hollow standard passing therethrough and provided with a bifurcated bearing-head which is located above the column, a frame-supporting collar arranged below the bearing-head and provided with parallel guide-openings arranged on opposite sides of the standard, a horizontal frame having parallel side bars fitted slidably in the openings of the collar, a horizontal shaft supported partly by the frame and arranged above the latter for a part of said shaft to be fitted slidably in the bifurcated head, a vertical shaft, direct gear connections between the horizontal shaft and vertical shaft, and a drill-spindle driven by the horizontal shaft, substantially as described.

9. In a drilling-machine, the combination of a hollow fixed column, a hollow standard provided with a bifurcated head having horizontally-alined shaft-bearings and projecting above the fixed column, a tubular shaft having a beveled gear and journaled in one bearing of said head, a horizontal drill-driving shaft keyed to said tubular shaft in one bearing of the head and passing slidably through the other bearing of the head, a vertical shaft passing through the hollow standard and terminating below the bearings of the head, a beveled gear fixed to the vertical shaft and meshing directly with the bevel-gear of the tubular shaft, a frame-supporting collar seated on said fixed column, a horizontal frame fitted slidably in said collar and supporting the horizontal drill-driving shaft, and a spacing-collar interposed between the frame-supporting collar and said bifurcated head, substantially as described.

10. In a drilling-machine, the combination of a hollow fixed column, a frame-carrying collar resting on said column and having parallel guide-openings, a frame with parallel side bars fitted slidably in the collar, a standard having movement of rotation in the column and provided with a surface adapted to rest on the collar and with a bifurcated bearing-head projecting above the collar, a horizontal shaft supported by said frame and the bearing-head, a vertical shaft extending through the standard, and intermeshing gears fitted directly to the vertical shaft and to the horizontal shaft, respectively, substantially as described.

11. In a drilling-machine, the combination of a vertical column, a hollow standard mounted to have movement or rotation therein, a carrier-head fitted to said standard and the column, a horizontal frame fitted slidably in said carrier-head, a horizontal shaft supported partly by the horizontal frame and journaled in the carrier-head for slidable movement therein with said horizontal frame, a drill-head mounted on said frame at its free end and adjustable on a horizontal axis independently of any movement of the frame, a drill-spindle supported by the drill-head and geared to the horizontal shaft, and a vertical shaft passing through said hollow standard geared to said horizontal shaft, substantially as described.

12. In a drilling-machine, the combination of a fixed vertical column, a tubular standard fitted in said column and having a bearing-head, a vertical shaft passing through said column and provided with a beveled gear, another bevel-gear mounted in one of the bearings of said bearing-head, a horizontal shaft passing through the bearing-head and the last-named bevel-gear and keyed to said bevel-gear to permit endwise adjustment of said shaft, a horizontal frame slidably connected with said vertical standard and column and adjustable axially thereon, a drill-head carried by said frame, and a spindle mounted in the drill-head and geared to the horizontal shaft, substantially as described.

13. In a drilling-machine, the combination of a vertical fixed column, a tubular standard fitted therein and provided with a bearing-head, a carrier-head fitted to said column and standard, the collars clamped on the standard or column and bearing against the column and the bearing-head, respectively, a horizontally-adjustable frame fitted slidably in the carrier-head, an endwise-movable shaft journaled in the bearing-head, a drill-head carried by said frame, a spindle mounted in the drill-head and geared to the horizontal shaft, and a vertical shaft passing through the standard and geared to the horizontal shaft, substantially as described.

14. In a drilling-machine, the combination with a drill-head and a spindle, of a lever fulcrumed to said head, a cap carried by the lever and having ball-bearing connection with the end of the spindle, and a nut carried by the spindle and riding upon the lever, substantially as described.

15. In a drilling-machine, the combination with a drill-head and spindle, of a lever fulcrumed to said head, a ball-bearing nut mounted on the spindle and having traveling contact with the lever, a cap which straddles the extremity of the spindle and is fixed to the lever, and a bearing-ball seated in the spindle and said cap, substantially as described.

16. In a drilling-machine, the combination with a drill-head and a spindle, of a lever fulcrumed on the drill-head and having an arm projecting beyond said lever and the spindle, and a shiftable weight fitted on the arm of the lever and provided with ball-bearings which have traveling contact with said lever-arm, substantially as described.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

HORATIO A. PORTER.

Witnesses:
FRED. F. PARTRIDGE,
LEROY G. DOANE.