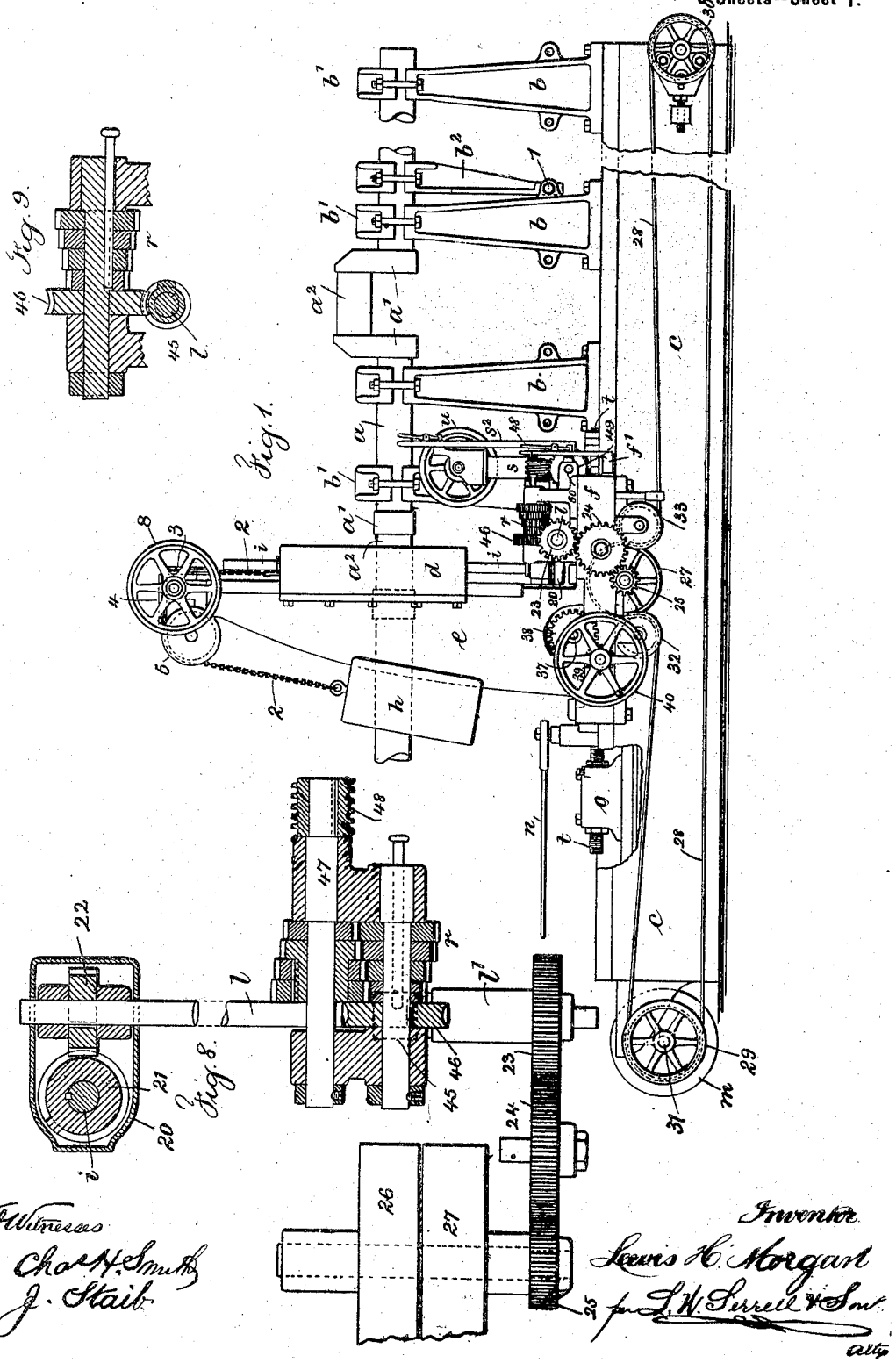
No. 656,903. Patented Aug. 28, 1900.

L. H. MORGAN.

QUARTERING AND TURNING MACHINE FOR CRANK PINS AND ECCENTRICS.

(Application filed Mar. 5, 1900.)

(No Model.) 5 Sheets—Sheet 1.



Witnesses
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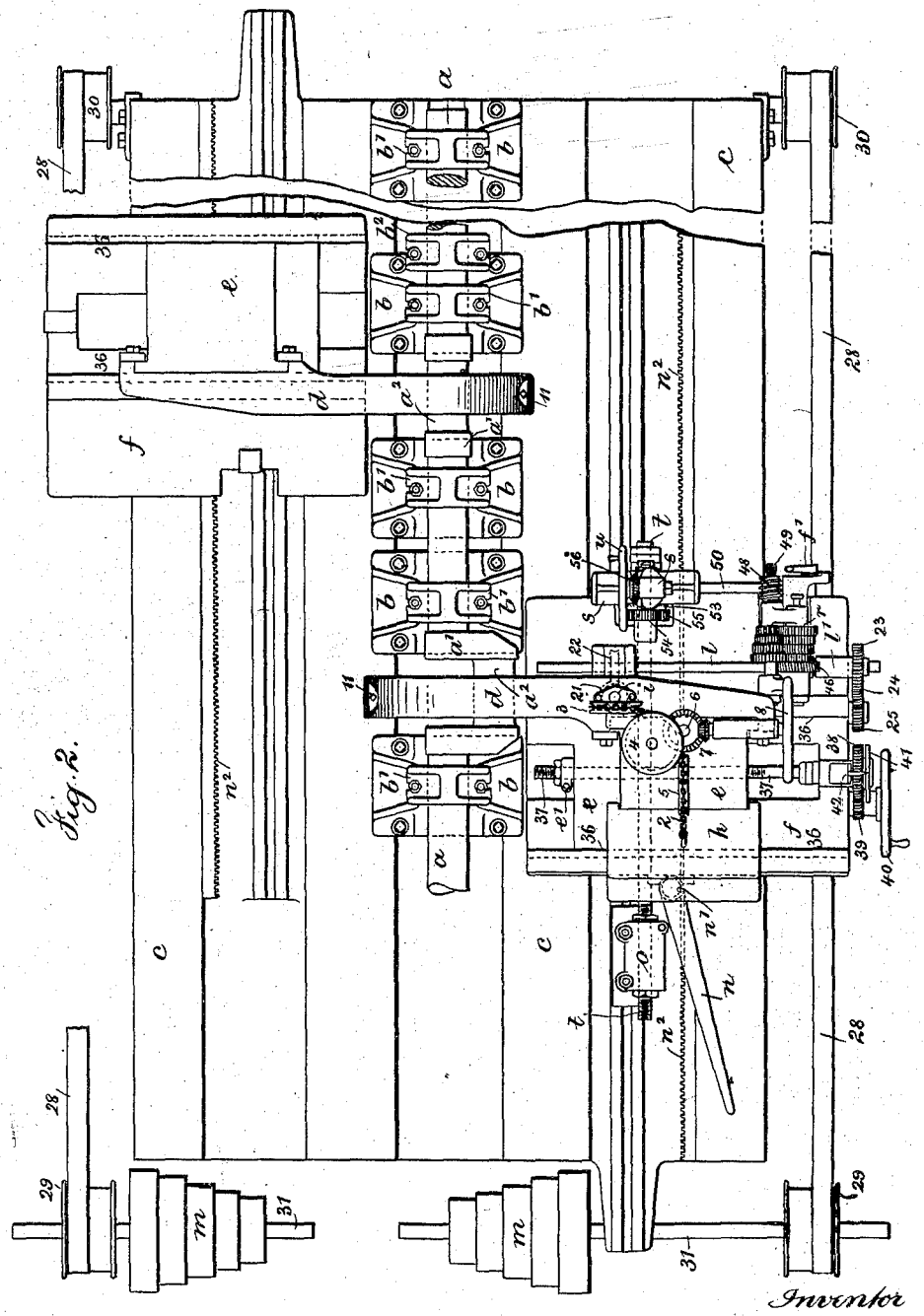

Fig. 2.

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(No Model.) 5 Sheets—Sheet 3.

Fig. 4.

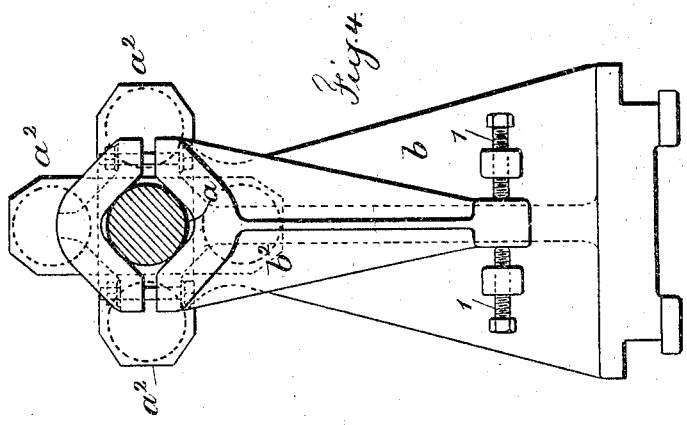
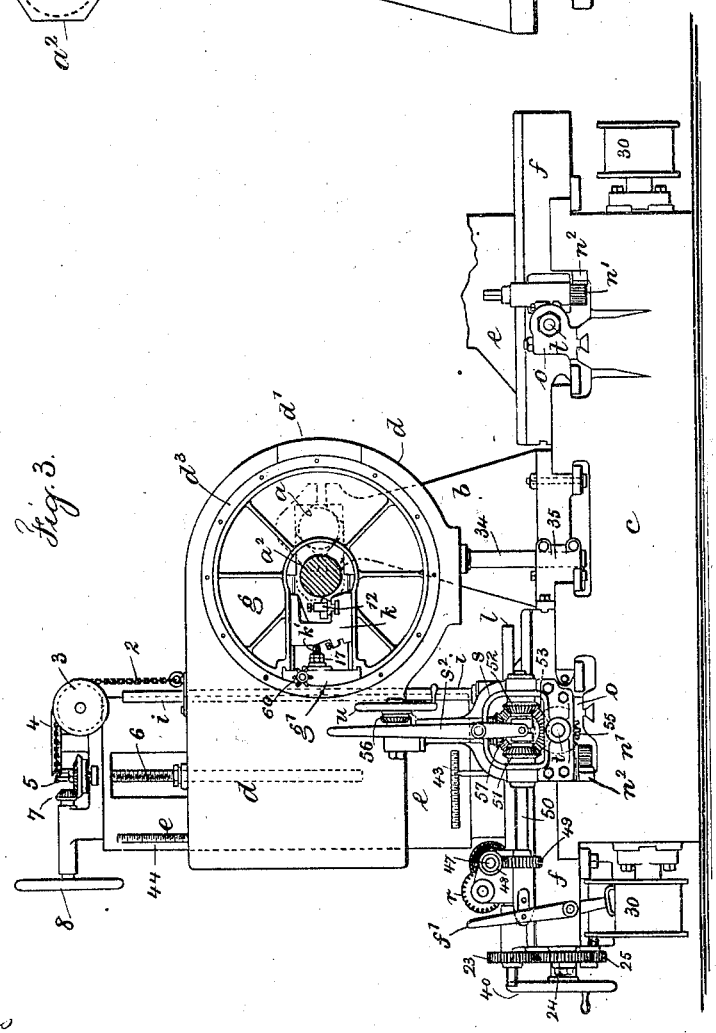


Fig. 3.



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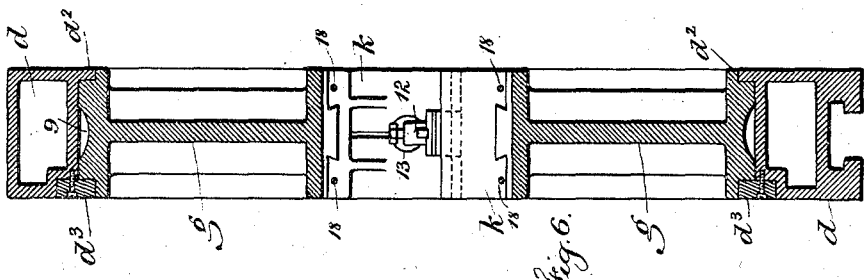

Fig. 6.

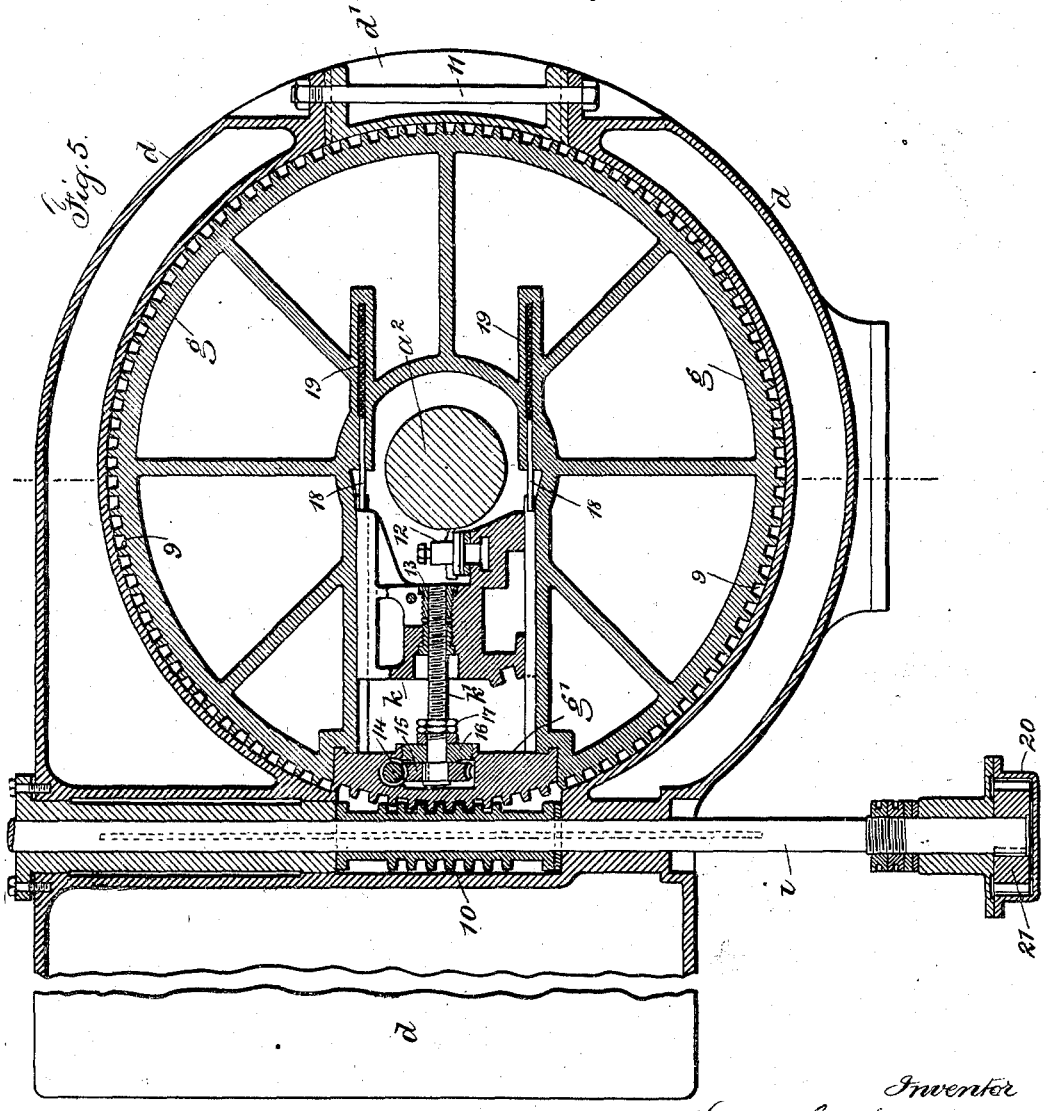

Fig. 5.

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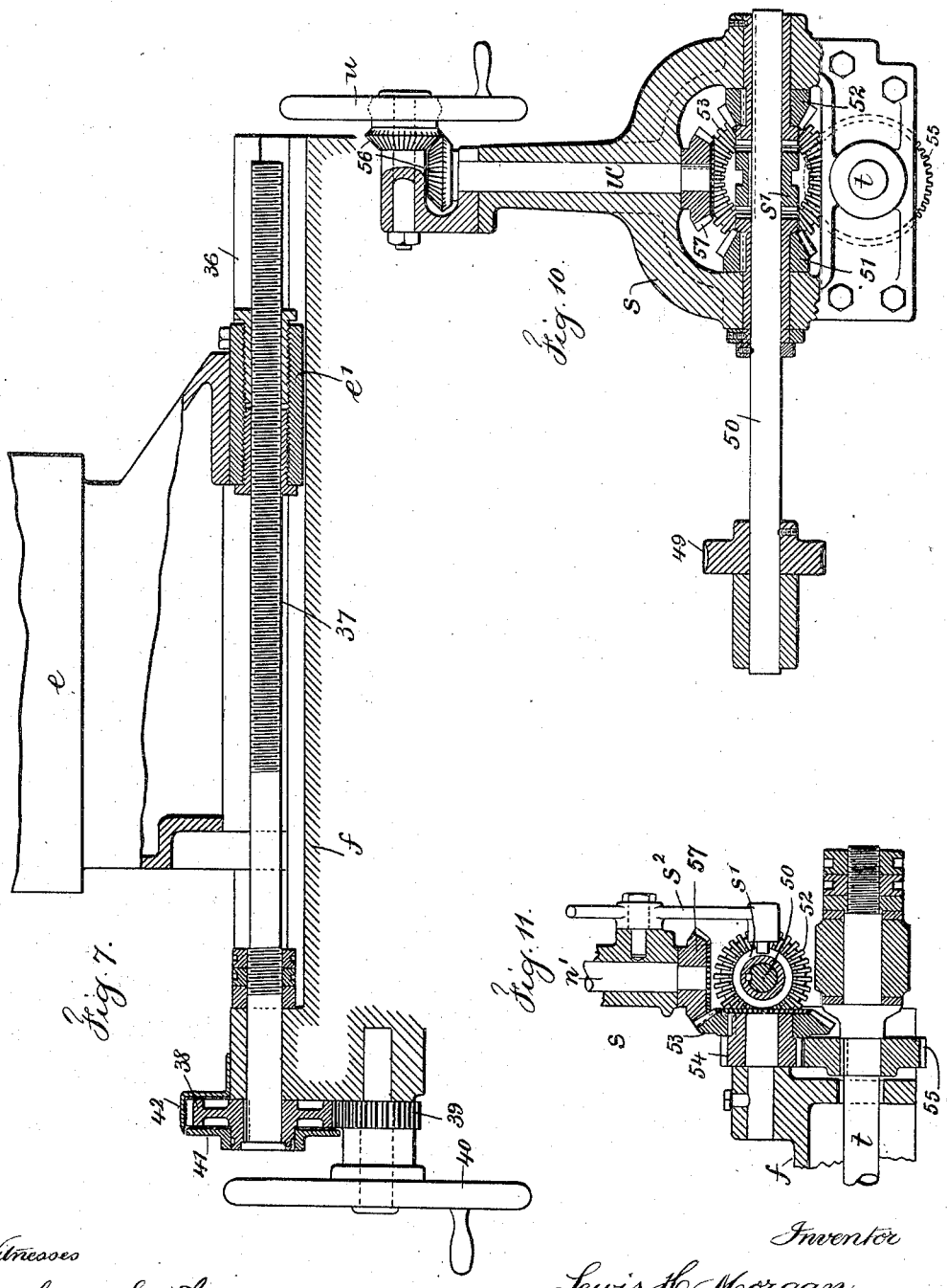

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UNITED STATES PATENT OFFICE.

LEWIS H. MORGAN, OF PLAINFIELD, NEW JERSEY.

QUARTERING AND TURNING MACHINE FOR CRANK-PINS AND ECCENTRICS.

SPECIFICATION forming part of Letters Patent No. 656,903, dated August 28, 1900.

Application filed March 5, 1900. Serial No. 7,258. (No model.)

To all whom it may concern:

Be it known that I, LEWIS H. MORGAN, a citizen of the United States, residing at Plainfield, in the county of Union and State of New Jersey, have invented a new and useful Improvement in Quartering and Turning Machines for Crank-Pins and Eccentrics, of which the following is a specification.

It has heretofore been usual to form the shafts and cranks, especially for torpedo-boats and similar small vessels, from one casting suitably annealed and tempered. Some of these shafts are made with two cranks and others with three or four. It has heretofore been usual in shaping the shafts and cranks to turn the same in ordinary engine-lathes. This is a comparatively simple matter so far as the shaft itself is concerned; but great difficulty has heretofore been experienced in turning the crank-pins of the said shaft, as it has been necessary to mount the same in a lathe and turn the complete shaft and cranks around each crank-pin as a center, and in doing this great difficulty has arisen in so supporting the various parts as to prevent the same being turned untrue. In fact, it has been practically impossible heretofore to turn these crank-pins true for this reason; and my invention relates to a machine adapted to overcome these difficulties and in which machine the said crank-pins and the faces of the cranks are turned and trued and also in which eccentrics are turned and trued, the machine in its functions also being capable of placing with mathematical accuracy the positions or quartering of the various cranks.

In carrying out my invention I provide a main section-bed, preferably grooved, with three longitudinal ways forming slides, one being central of the bed. Upon this bed I mount suitable rests that are in perfect alinement and in which the shaft to be operated upon is supported and to which it is securely clamped and fixed, and I provide an adjusting-arm also clamped to the shaft and the movement of which assists in quartering the crank-pins. This quartering consists in placing the several cranks of a shaft in accurate horizontal and vertical positions—that is, if there are two opposite cranks they are placed horizontal, if four cranks at quarter-points two are placed horizontal and two vertical, and if there are three cranks one is placed vertical and the other two inclined at one hundred and twenty degrees—and the mechanism hereinafter described is capable of fine and accurate adjustment for predetermined and calculated positions, so that all the various crank-pins or eccentrics of the shaft as held in the supports can be operated upon progressively or collectively without once shifting the position of the crank-shaft. I provide one or more movable columns mounted upon a movable base, the said base having a longitudinal movement of the main bed and the column a transverse movement of the base, and I provide heads supported by the movable columns, and connected to each head is a revolving cutter-ring, a path being provided for the ring in the head. The head has a removable section and the cutter-ring also a removable section, so that the crank-pin to be turned can be passed through the opening formed in the head and ring to the center of the same. The head is balanced on the column by a counterweight, and I provide means for raising and lowering the head and means for supporting the same to overcome the effect of any possible vibration. I also provide means for rotating the cutter-ring by power and means for moving the column transversely of the base and other means for moving the base longitudinally of the main bed. Upon the main bed there may be several columns and bases and cutter-rings and the mechanism for operating the same, and as these parts will be duplicates of one another the description hereinafter will only relate to one complete device, the various parts and their operations being more particularly set forth.

In the drawings, Figure 1 is a side elevation representing my improvement. Fig. 2 is a plan of the same. Fig. 3 is an end view of the parts in Figs. 1 and 2. Fig. 4 is an end elevation of one of the rests and the adjusting-arm. Fig. 5 is a vertical longitudinal section representing a head and cutter-ring, and Fig. 6 is a vertical cross-section of the parts shown in Fig. 5. Fig. 7 is a vertical cross-section and partial elevation of the devices connected to the movable base for transversely moving the movable column. Figs. 8 and 9 represent details of the mechanism

for revolving the cutter-ring, and Figs. 10 and 11 are vertical sections in opposite directions, showing part of the mechanism for longitudinally moving the movable base. Figs. 4 to 11, inclusive, are shown of exaggerated size for clearness over Figs. 1 to 3, inclusive.

The shaft a, its crank-throws a', and the crank-pins a^2 to be operated upon are supported by rests b upon the bed c of the machine. These rests b have curved caps b', and bolts pass through the caps and through the upper part of the rests to clamp the parts together and firmly hold the shaft as supported by the rests. The lower ends of these rests are adapted to fit in the central slideway of the main bed, and they may be moved along the said central slideway to the desired places, where they are clamped firmly in place by bolts. (Shown especially in Fig. 3.) In connection with these rests b I provide an adjusting-arm b^2 with an upper end made similar to the rests, to be clamped to the shaft a, and the lower portion of said rests, at opposite sides, is provided with lugs and screws 1, and the said adjusting-arm may be fastened at any desired point to the shaft, with its lower end brought between the adjusting-screws at either side of any rest, the object of the said adjusting-arm b^2 being to slightly swing the shaft a and its cranks and crank-pins before these parts are firmly fastened, so that the same may be brought into an accurate quartering position, this swinging movement being effected by the screws 1 as one is loosened and the other tightened from either side.

The head d is fitted to slide vertically upon one face of the movable column e, the face of the column being made with a slideway and the edge of the head being provided with flanges or rollers, or both, in order to insure a close fit for the said head. This head is made with a circular hollow extension to one side for receiving the revolving cutter-ring g. The said column e is supported upon a movable base f, there being suitable slideways between the base of the column e and the movable base f and at the lower edge of the movable base f in relation to the bed c of the machine. A counterbalance sliding weight h is provided and adapted to move over the curved opposite side of the column e, and a chain 2 connects the head d and the weight h. This chain 2 passes around and over sheaves 3 4 5, supported upon the upper end of the column e, the sheave 4 being horizontal and the sheaves 3 and 5 vertical and at right angles to one another, so as to form a path for the chain and compensate for its direction of travel.

The head d and the cutter-ring g, carried thereby, are raised and lowered by a screw-rod 6, which passes through the said head and through the slotted portion of the column e, and at the upper end of said screw-rod I provide a pair of bevel-wheels 7 and a hand-wheel 8 on the shaft of one of the bevel-wheels. When this hand-wheel is turned and the bevel-wheels and the screw-rod rotated, the said head is raised and lowered, and no particular force is required, because freedom of movement is insured by the counterbalance-weight. The hollow extension of the head, and in which the cutter-ring revolves, is provided with a removable section d', which section is held in place by the bolt 11, and the cutter-ring is also provided with a laterally-removable section g', and there are teeth 9 upon the periphery of the cutter-ring and its section, which teeth are engaged by a worm 10 on the screw-rod i. This screw-rod passes vertically through the head d, and the worm 10 is connected to the same by a spline, so that the head can be raised and lowered with facility without disturbing the rod, its connection, however, with the worm being maintained through the spline. There is on the lower end of the rod i a spiral gear 21 in a frame 20. The said cutter-ring is preferably made with spokes and a central web connecting the peripheral ring carrying the teeth to an open hub or gap. A flange d^2 on one side of the hollow extension to the head acts as a guide for the cutter-ring, and a ring d^3 at the other side removably connected to the face of the hollow extension of the head forms a guide for the cutter-ring at the other side, so that the cutter-ring revolves between the flange d^2 and the ring d^3. The removable section g' closes the entrance to the open hub of the cutter-ring, and in this portion slideways are made for the sliding tool-rest k, the same at its forward end carrying the tool-clamp 12. A screw-shaft k' passes through nuts 13 in the sliding tool-rest k, and the said shaft k' has a worm-wheel 15 fixed on one end and received in a hollow portion of the removable section g', the said worm-wheel meshing with a worm 14, the shaft of which is at right angles to the worm-wheel and projects from the said removable section and carries a small hand-wheel 60, by which the said worm and worm-wheel are turned and with them the shaft k'. A disk 16 surrounds the shaft k' and screws into the opening in the inner face of the removable section g'. The disk 16 is fixed in its position in relation to the removable section g' by any desired mechanical device, and lock-nuts 17 are provided upon the screw-shaft k' to take up any slack, so as to keep the worm-wheel 15 snugly against the face of the disk to prevent lost motion. The rotation of the worm 14 and worm-wheel 15 and the screw-shaft k' move the sliding tool-rest k and feed the same with the tool carried thereby up to the work on the crank-pin a^2, and I provide push-rods 18, moving in openings in the cutter-ring, and springs 19 in said openings behind said pusher-rods, the same bearing against the opposite faces of the sliding tool-rest, so as to force the same backward, while the screw-shaft k' forces the same forward, the object being between these two forces to maintain

the sliding tool-rest positively in position, so that the same will not shift or vary as the cutter-ring is revolved and the crank-pin turned.

I provide an adjustable post 34, passing through a split sleeve 35, formed as a part of the movable base *f*, the said post 34 having a head coming against the under flat surface of the extension of the head *d*. This post is clamped by the screws passing through the split sleeve 35. The post is to be adjusted immediately after the head *d* and the cutter-ring are brought to the exact position desired and before the cutter-ring is revolved against the work, the object of the said post being to prevent any possible vertical vibration incident to the revolution of the cutter-ring and the altered position of the sliding tool-rest therein as the same revolves around the crank-pin.

The spiral gear 21 at the lower end of the shaft *i* meshes with a spiral gear 22 also in the same frame 20 and upon the shaft *l*. (See Fig. 8.) The opposite end of the shaft *l* is provided with a hub *l'*, on which is a gear 23. The gear 23 meshes with a gear 24 and a third gear 25, the gear 25 being on the same shaft as are the fast and loose pulleys 26 27. The power-belt 28 passes around the said fast or the loose pulley and around a pulley 29 on a shaft 31 at one end of the bed of the machine, and which shaft 31 carries the cone-pulleys *m*, to which power is communicated at the desired speed. The belt at the other end of the main bed passes around an adjustable pulley 30 and beneath the loose pulleys 32 33. The belt 28, the pulleys 26 and 27, the gears 23, 24, and 25, and the shaft *l* are the power devices not only for rotating the cutter-ring *g*, but for moving the base *f* longitudinally of the bed of the machine and therewith carrying the column *e* and the head *d* and the parts connected therewith, the said pulleys 32 33, as well as the pulleys 26 27 and the gears 23 24 25, being connected to and supported from the movable base *f*, and I provide a belt-shifter *f'* for moving the belt between the fast and loose pulleys.

The transverse movement of the movable column *e* in relation to the movable base *f* is effected by the following devices: A slideway 36 is formed in the face of the said base, and the base of the column *e* is made with a threaded sleeve *e'*, having nuts with which the screw-shaft 37 is in engagement. (See Fig. 7.) One end of the screw-shaft 37 passes through a bearing in the movable base *f*, and on the end thereof is a gear 38, meshing with a gear 39 on the shaft of the hand-wheel 40. A dial 41 is mounted on the outer face of the gear 38, and a pointer 42, fastened to the upper face of the base *f*, extends over the periphery of the gear 38, with the point thereof in proximity to the edge of the dial 41, thus forming a vernier to indicate to a nicety the extent to which the movable column *e* is transversely adjusted.

The movable base *f*, provided with guides and moving in the slideway in the surface of the main bed *c* and which carries the movable column *e* and the various devices hereinbefore described, is itself moved longitudinally of the bed in one way by hand to effect a quick change of position, so that the said devices may be located at any desired place along the bed, and the same is also moved progressively along the crank-shaft as the cutting is effected. This movement is produced by power devices, or the same may be performed by hand-operated devices, as follows: The said devices are operated and shifted by hand by a ratchet-lever *n*, of ordinary construction, upon the upper end of a shaft passing vertically through a portion of the said base *f*, and at the lower end of the said base *f* and on the lower end of the said ratchet-lever shaft is a pin *n'*, meshing with a rack n^2, the rack running lengthwise of the main bed upon one of the vertical faces of the slideway, as will be seen more particularly from Fig. 2. The pawl device of this ratchet of usual construction may be operated in either direction to turn the pinion *n'* and move the base *f* along upon the main bed *c*, the disengagement of the pawl in the ratchet-lever permitting the pinion and its shaft to run free when the devices are otherwise operated.

The base of the longitudinal slideway in the main bed *c*, along which the base *f* is moved, is provided with a dovetailed way along which the head *o* is adapted to be moved, the said head *o* having a dovetailed slide in the said way and bolts passing through the head, Figs. 1, 2, and 3, to clamp the said head immovably to the said bed. This head is loosened when it is desired to move the base and the devices connected thereto and supported thereby longitudinally of the bed by means of the ratchet-lever *n*, pinion *n'*, and rack n^2, the said head being always clamped rigidly to the bed during the turning of a crank-pin and while the power devices are moving the cutter progressively along for turning the said crank-pin.

The lead-screw shaft *t* passes through the head *o*, and there are adjusting-nuts in the said head *o* similar to those in the threaded sleeve *e'* of Fig. 7 for the purpose of taking up slack or wear in the screw-shaft. This device is not new with me, but is made use of in this machine for the purpose of taking up all wear to obtain a fine adjustment of the parts. The lead-screw shaft *t* passes through the movable base *f*, and its end opposite to the head *o* is in a bearing in the base of the yoke-frame standard *s*, there being a gear 55 on this end of the shaft *t* adjacent to its bearing, with a collar between the gear 55 and the standard and nuts on the outer screw-threaded end of the said shaft (see Fig. 11) for firmly connecting the said shaft to the said standard, so that there will be no lost motion where the shaft is connected to the standard. The power for moving this screw-shaft *t* is communicated through the belt 28 to the fast

pulley 27 through the gears 25 24 23, from the gear 23 through the hub l' and shaft l, from the shaft l by a worm 45 on said shaft to a worm-wheel 46 to the shaft of a set of pull spline-gears r, (see Fig. 8,) and from them to a shaft 47, on which is a worm 48, the worm 48 meshing with a worm-wheel 49 on the shaft 50. This shaft 50 passes through bearings in the base of the yoke-frame standard s, and on said shaft, between the yoke-frame, are small bevel-wheels 51 52, with a clutch s' between the bevel-wheels, the said bevel-wheels more properly surrounding sleeves connected to the said shaft 50, and which sleeves have clutch-faces adapted to engage with the faces of the clutch s', the said clutch s' being operated by a hand-lever s^2, (see Figs. 10 and 11;) the said hand-lever being pivoted to the face of the yoke-frame standard s and adapted to swing the clutch either to one side or the other, so as to engage either the bevel-wheel 51 or the bevel-wheel 52. The bevel-wheels 51 52 and the clutch-sleeves on which they are mounted are loose upon the said shaft 50, while the clutch s' is connected to the shaft by a spline, the clutch always turning with the shaft and when in engagement with either clutch-sleeve causing the same and its bevel-wheel also to rotate. The said bevel-wheels 51 52 are in engagement with a larger bevel-wheel 53, mounted back of the shaft 50 upon a short shaft in the base f. This bevel-wheel 53 is connected to a gear 54, also on the same shaft back of the bevel-wheel, the said gear 54 meshing with the hereinbefore-named gear 55 on the lead-screw shaft t.

The yoke-frame standard s is hollow, and a shaft u' passes vertically through the same. On the lower end of the shaft u' is a bevel-wheel 57, meshing with the bevel-wheel 53, and on the upper end of the said shaft u' there is a small bevel-wheel, and adjacent thereto, on a horizontal shaft connected to the said standard, is another bevel-wheel forming the pair of bevel-wheels 56, on the shaft of one of which is the hand-wheel u. The turning of the hand-wheel u operates the pair of bevel-wheels 56, the shaft u', the bevel-wheels 57 and 53, and by the bevel-wheel 53 the gears 54 and 55 are operated to turn the lead-screw shaft t. The rotation of the shaft t in the fixed head o moves the base f longitudinally of the bed c, so as to feed by hand the cutter-ring carried on the movable column e upon the base f along, the crank-pin being turned by the tool carried by the revolving cutter-ring g. A hand-feed is thus effected, or the said devices may be operated to bring the cutting-tool to the correct starting-point, so that the cutting movement is thereafter effected by the power means hereinbefore described. With reference to these power devices it will be noticed that when the clutch s' is in engagement with the clutch-face and bevel-wheel 52 the bevel-wheel 53 and gears 54 55, with the shaft t, are turned in one direction and that when the clutch s' is in engagement with the clutch-face and bevel-wheel 51 the bevel-wheel 53, the gears 54 55, and the shaft t are turned in the opposite direction, thus providing for the movement in both directions along the bed c of the base f, the movable column e, and the devices carried by the same.

Reference has hereinbefore been made to the vernier device 41 42 in connection with the transverse movement of the column e upon the base f, and I also provide vernier scales or devices 43 44, the vernier 43 having its dial or scale on the base of the column e and its pointer on the base f and the vernier 44 having its scale on the upper part of the column e and its pointer on the vertically-moving head d. These vernier devices make possible not only a fine adjustment of the parts in relation to one another, but make it possible to accurately and mathematically determine the correct quartering position for the cranks a^2 upon the shaft a. The same devices are also made use of in connection with the turning of eccentrics upon the shaft a adjacent to the crank-throws.

It will be evident in connection with the operation of the machine that the main bed c of the machine may be of any desired length to receive a shaft a of any desired length having any number of crank-throws and also that upon the bed c I may employ several complete turning devices, each comprising a base f, a column e, a revolving cutter-ring, and all the attendant devices necessary to move the said bed, the column, and revolve the cutter-ring, so that several of the crank-pins may be turned simultaneously. In Fig. 2 I have illustrated by a plan view one complete operative device for turning one of the crank-pins, the same being shown in Fig. 1 in elevation, while on the opposite side of the bed in outline is shown the position of a similar turning device reversed. Thus there may be two or more complete devices on either side of the bed for simultaneously effecting the turning of the crank-pins or eccentrics. I would further remark that it makes no difference with these devices whether the crank-pin be above the center of the shaft or below it or at either side of the shaft, because the head d can be raised or lowered upon the column to bring the horizontal center of the cutter-ring to coincide with the horizontal axial center of the crank-pin to be turned, and that the transverse movement of the column e upon the base f will bring the vertical center of the cutter-ring to coincide with the vertical center of the crank-pin to be turned, and that the devices on the opposite sides of the bed are adapted to reach the crank-pins in their position above or below or at either side of the center of the shaft, and I would further remark that the rests b are to be so placed with reference to the turning of the crank-pins or eccentrics as to hold the parts rigidly in po-

sition and provide room for the action of the revolving cutter-ring. In its action the tool of the cutter-ring is not only adapted to turn the crank-pin so that its axial center may be parallel with the axial center of the shaft, but so that the said crank-pin is absolutely true and cylindrical. The tool of the said cutter-ring is also adapted to turn the adjacent opposite faces of the crank-throws, also the faces and surfaces of eccentrics, the various movements of the base *f*, the column *e*, and the head *d* providing for determining the position for cutting and the movement of the sliding tool-rest *k* in the revolving cutter-ring, providing for the extent of radial movement from the center of the object being operated upon.

I claim as my invention—

1. The combination in a turning and quartering machine, with the bed and movable rests for supporting the crank-shaft and in which rests the cranks are fixed and their position accurately determined, of a series of revolving cutter-rings, means for imparting to said rings vertical, longitudinal and lateral movements, and means for calculating and adjusting the said cutter-rings to a predetermined position whereby the cranks can all be turned without disturbing or shifting the same and their shaft, substantially as set forth.

2. The combination with the main bed having a longitudinal slideway, of rests fitting and movable in said slideway and adapted to receive and support the said crank-shaft, of clamps connected to the said rests for securing the shaft and an adjusting-arm clamped to the crank-shaft, and means for holding and moving the same to slightly swing the shaft and bring the same into an accurate predetermined position, substantially as set forth.

3. The combination in a turning and quartering machine with a revolving cutter-ring surrounding and operating upon the fixed crank-pin, a vertically and laterally movable head having a hollow extension for the cutter-ring, a section separable and removable from the hollow extension of the said head and means for securing the same in place, a ring removable from one side of the hollow extension and head and a section separable laterally from the cutter-ring whereby the removal of said sections provides for the insertion of the crank-pin, substantially as specified.

4. The combination with the bed and movable rests for supporting the crank-shaft and to which the same is clamped, of a revolving cutter-ring surrounding and operating upon the fixed crank-pin, a movable support for the cutter-ring, means for passing the said support and cutter-ring over the crank-pin, teeth surrounding the periphery of the cutter-ring, a worm-wheel meshing with said teeth, a shaft on which the said worm-wheel is mounted, a horizontal shaft adjacent to the lower end of the aforesaid shaft, spiral gears connecting the two shafts and power devices for rotating the latter shaft and revolving the cutter-ring, substantially as set forth.

5. The combination with the bed and movable rests for supporting the crank-shaft and to which the same is clamped, of a revolving cutter-ring surrounding and operating upon the fixed crank-pin, a movable support for the cutter-ring, means for passing the said support and cutter-ring over the crank-pin, teeth surrounding the periphery of the cutter-ring, a worm-wheel meshing with said teeth, a shaft on which the said worm-wheel is mounted, a horizontal shaft adjacent to the lower end of the aforesaid shaft, spiral gears connecting the two shafts and power devices for rotating the latter shaft and revolving the cutter-ring, a gear upon the end of the latter shaft, gears meshing with the said gear, pulleys upon the shaft of one of the gear-wheels and a belt operated by a source of power for effecting the movement of the said parts and through them revolving the cutter-ring, substantially as set forth.

6. The combination with the bed and movable rests for supporting the crank-shaft and to which the same is clamped, of a movable column, a support therefor and means for progressively moving the said column, a head, a revolving cutter-ring connected thereto, the said head being on one side of the column, a counterbalance-weight on the other side of the column, a chain and sheaves upon the top of the column around which the chain passes in connecting the head and the counterbalance-weight, and means for raising and lowering the head and cutter-ring, substantially as set forth.

7. The combination with the bed and movable rests for supporting the crank-shaft and to which the same is clamped, of a movable column, a support therefor and means for progressively moving the said column, a head, a revolving cutter-ring connected thereto, the said head being on one side of the column, a counterbalance-weight on the other side of the column, a chain and sheaves upon the top of the column around which the chain passes in connecting the head and the counterbalance-weight, a screw-rod passing through the head and through part of the column, a horizontal shaft in bearings on the top of the column and a hand-wheel thereon, and bevel-wheels connecting the said shaft and the said screw-rod for raising and lowering the head and revolving cutter-ring by hand, substantially as set forth.

8. The combination with the column, its support and means for moving the same, of the head *d* having a ring-like extension and sliding upon one face of the column, means for balancing and for moving the said head vertically, a cutter-ring revolubly mounted in the extension of the said head, said cutter-ring having a gap and a removable section and a removable section to the extension of

the head, a sliding tool-rest and a slideway therefor in the gap of the revolving cutter-ring and means for moving the said tool-rest in opposite directions along the said slideway and for holding the same in place, substantially as set forth.

9. The combination with the column, its support and means for moving the same, of the head *d* having a ring-like extension and sliding upon one face of the column, means for balancing and for moving the said head vertically, a cutter-ring revolubly mounted in the extension of the said head, said cutter-ring having a gap and a removable section and a removable section to the extension of the head, a sliding tool-rest and a slideway therefor in the gap of the revolving cutter-ring and means for moving the said tool-rest in opposite directions along the said slideway and for holding the same in place, a split sleeve connected to the supporting-base of the column and an adjustable post passing through the split sleeve and adapted to come against the under surface of the extension to the movable head, substantially as set forth.

10. The combination in a turning and quartering machine, with the crank-shaft and its supports, of a vertically-movable head having a hollow ring-like extension, a revoluble cutter-ring mounted in said extension, a removable section to the said cutter-ring and a removable section to the extension of the said movable head, the said cutter-ring having a gap, a slideway in said gap, a movable tool-rest and tool-support, a screw-shaft and worm-wheels for feeding the same, whereby the said sections and the tool-rest may be removed for passing the crank-pin to be turned to the axial center of the revoluble wheel and the parts replaced, substantially as set forth.

11. The combination in a turning and quartering machine with the column, its support and a means for moving the same, of a vertically-movable head, a ring-like extension thereto having a removable section and a flange on one side, a removable ring forming a flange on the other side of the said extension, a cutter-ring mounted revolubly in the said extension and traveling between the said flanges, the said ring having an open center gap and a removable section, teeth upon the periphery of the said cutter-ring and its removable section, a shaft passing vertically through the movable head, a worm-wheel on said shaft engaging the peripheral teeth of the revoluble cutter-ring, a sliding tool-rest and ways therefor in the gap of the revoluble cutter-ring, and means for moving the same, substantially as set forth.

12. The combination in a turning and quartering machine, with the column, its support, and a means for moving the same, of a vertically-movable head, a ring-like extension thereto having a removable section and a flange on one side, a removable ring forming a flange on the other side of the said extension, a cutter-ring mounted revolubly in the said extension and traveling between the said flanges, the said ring having an open center gap and a removable section, teeth upon the periphery of the said cutter-ring, and its removable section, a shaft passing vertically through the movable head, a worm-wheel on said shaft engaging the peripheral teeth of the revoluble cutter-ring, a sliding tool-rest and ways therefor in the gap of the revoluble cutter-ring, means for moving the same, and spring-actuated devices in the said cutter-ring acting against the advancing face of the tool-rest as end thrusts to maintain the tool-rest positively in position, substantially as set forth.

13. The combination in a turning and quartering machine, with the movable column, of a movable head sliding upon one face thereof and having a ring-like extension with side flanges, and means for moving the said head vertically on the face of the said column and for counterbalancing the same, a shaft passing vertically through the said movable head, and means for rotating the shaft, a worm-wheel surrounding the shaft and a spline connecting the shaft and the worm-wheel and providing for the vertical movement of the head and worm-wheel, a cutter-ring revolubly mounted in the extension of the said movable head and between the flanges thereof and having peripheral teeth meshing with the teeth of the worm-wheel, a removable section to the said cutter-ring also having teeth, the said cutter-ring having a gap for receiving the work, and ways in the opposite faces thereof, a sliding tool-rest on said ways, a tool-clamp thereon, a screw-shaft passing through the tool-rest and engaging threaded devices connected therewith, a hand-operated shaft passing across through the removable section of the cutter-ring and having a worm thereon in the said removable section, a worm-wheel on the screw-shaft engaging the said worm and received in a cavity in the said removable section, a removable disk surrounding the said screw-shaft and connected with the removable section and nuts on the screw-shaft for clamping the same to the removable disk, the nuts being on one side of the disk and a worm-wheel on the oposite side, substantially as set forth.

14. The combination in a turning and quartering machine, with the movable column and the bed having a longitudinal slideway, of a base having a slideway for the movable column, and means for moving the base longitudinally of the bed, a screw-shaft 37 at one end passing through part of the said base and also passing through a threaded portion of the base of the movable column, a hand-operated wheel, a gear on the shaft of said wheel and a gear on the screw-shaft meshing therewith for moving the column transversely of the base-support therefor, substantially as set forth.

15. The combination in a turning and quartering machine, with the movable column, of

a base having a slideway for the movable column, a screw-shaft at one end passing through part of the said base and also passing through a threaded portion of the base of the movable column, a hand-operated wheel, a gear on the shaft of said wheel and a gear on the screw-shaft meshing therewith for moving the column transversely of the support therefor, a dial upon the face of the gear of the screw-shaft, and a pointer connected to the support of the column and extending over the gear with its point in proximity with the dial forming a vernier for indicating to a nicety the extent of movement of the said column by the said screw-shaft, substantially as set forth.

16. The combination in a turning and quartering machine, with the base *f* having a transverse slideway in its upper surface, of the column *e* resting upon the base and adapted to move in the slideway thereof, a sleeve upon the base of the column, nuts in the said sleeve, a screw-shaft passing through the said sleeve and nuts and at one end through a bearing formed in the base *f*, a gear on the outer end of the said shaft and nuts on the said shaft on the opposite sides of its bearing in the base *f*, a short shaft and a hand-operated wheel mounted thereon, a gear on the short shaft meshing with the gear on the screw-shaft whereby with the turn of the screw-shaft by the hand-wheel, the column *e* is moved transversely of the base *f*, substantially as set forth.

17. The combination in a turning and quartering machine, with the bed having a slideway and a rack n^2 upon the vertical face at one side of the slideway; of a base *f* fitting the said slideway and movable longitudinally of the bed of the machine, a tubular part connected to the said movable base, a shaft passing through the same, a pinion on the lower end of the shaft meshing with the teeth of the rack and a ratchet-lever *n* on the upper end of the shaft for turning the shaft and pinion in either direction for moving the base forward and backward on the bed, substantially as set forth.

18. The combination in a turning and quartering machine, with the bed having a longitudinal slideway and a central dovetailed slideway therein, of the head *o* and means for clamping the same to the bed at any desired place, a lead-screw shaft passing through the said head, a movable base *f* adapted to fit upon the bed and to be moved along the said slideway, a yoke-frame standard connected to said movable base, a gear upon the end of the said lead-screw shaft distant from the head *o*, and means for engaging the said gear and rotating the said lead-screw shaft for progressively feeding along the movable base, substantially as set forth.

19. The combination in a turning and quartering machine, with the bed having a longitudinal slideway and a central dovetailed slideway therein, of the head *o* and means for clamping the same to the bed at any desired place, a lead-screw shaft passing through the said head, a movable base *f* adapted to fit upon the bed and to be moved along the said slideway, a yoke-frame standard connected to said movable base, a gear upon the end of the said lead-screw shaft distant from the head *o*, a shaft passing vertically through the yoke-frame standard, a bevel-wheel on the lower end of the shaft, a short shaft connected to the base *f*, a gear thereon meshing with the gear on the lead-screw shaft, a bevel-wheel also on the said short shaft meshing with the bevel-wheel at the lower end of the shaft passing vertically through the yoke-frame, a horizontal shaft on the upper end of the yoke-frame, a hand-wheel thereon and bevel-wheels connected respectively to the shaft of the hand-wheel and to the shaft passing vertically through the yoke-frame whereby a feed of the base *f* along the slideway is progressively effected, substantially as specified.

20. The combination in a turning and quartering machine, with the bed having a longitudinal slideway and a central dovetailed slideway therein, of the head *o* and means for clamping the same to the bed at any desired place, a lead-screw shaft passing through the said head, a movable base *f* adapted to fit upon the bed and to be moved along the said slideway, a yoke-frame standard connected to said movable base, a gear upon the end of the said lead-screw shaft distant from the head *o*, a short shaft in the movable base *f*, a gear thereon meshing with the gear on the end of the lead-screw shaft, a bevel-wheel also upon the said short shaft, a shaft passing horizontally across through the base of the yoke-frame standard, a clutch surrounding the said shaft and movable upon a spline therein, clutch-faces and bevel-wheels surrounding the said shaft at opposite sides of the said clutch, a lever for moving the said clutch in either direction for connecting the same with either bevel-wheel, means substantially as specified for rotating the said horizontal cross-shaft, the said bevel-wheels on the cross-shaft meshing with the bevel-wheels on the short shaft of the movable base for operating the lead-screw shaft through the devices set forth in either one direction or the other, substantially as set forth.

21. The combination in a turning and quartering machine, with the bed having a longitudinal slideway, a base *f* fitting the bed and movable along the said slideway, of a yoke-frame standard connected to the movable base, a short shaft connected to the said base and having thereon a gear and a bevel-wheel, the bevel-wheel coming adjacent to the yoke-frame standard, a lead-screw shaft in line with the slideway of the bed and passing through the movable base *f*, a gear on one end of the lead-screw shaft meshing with the gear on the short shaft in the movable base, means connected with the bed at the other end of the lead-screw shaft and through which the same moves, a shaft 50 passing horizon-

tally across through the yoke-frame standard, sleeves with clutch-faces surrounding the shaft and passing through the said standard and bevel-wheels surrounding the said clutch-sleeves, the bevel-wheels meshing with the bevel-wheels upon the short shaft in the base *f* and the bevel-wheels and clutch-sleeves surrounding the shaft 50 and loose thereon, a spline centrally on the shaft 50 and a clutch slidable thereon and means for operating the same, and means connected to the shaft 50 and interposed between the same and the power devices for effecting a variable speed of the shaft 50, substantially as and for the purposes set forth.

22. The combination in a turning and quartering machine with the bed having a longitudinal slideway, a base *f* fitting the bed and movable along the said slideway, of a yoke-frame standard connected to the movable base, a short shaft connected to the said base and having thereon a gear and a bevel-wheel, the bevel-wheel coming adjacent to the yoke-frame standard, a lead-screw shaft in line with the slideway of the bed and passing through the movable base *f*, a gear on one end of the lead-screw shaft meshing with the gear on the short shaft in the movable base, means connected with the bed at the other end of the lead-screw shaft and through which the same moves, a shaft 50 passing horizontally across through the yoke-frame standard, sleeves with clutch-faces surrounding the shaft and passing through the said standard and bevel-wheels surrounding the said clutch-sleeves, the bevel-wheels meshing with the bevel-wheel upon the short shaft in the base *f* and the bevel-wheels and clutch-sleeves surrounding the shaft 50 and loose thereon, a spline centrally on the shaft 50 and a clutch slidable thereon, and means for operating the same, a set of pull spline-gears, a worm and worm-wheel connecting the same to the shaft 50, a power-belt and gears therefrom and a shaft from the last of the gears and worm-wheel connecting the same to the pull spline-gears, whereby the power is communicated and transferred in a variable ratio to the shaft 50, substantially as set forth.

23. The combination in a turning and quartering machine, with the column, its support and means for moving the same transversely of the support, of a vertically-movable head, a ring-like extension thereto, a cutter-ring revolubly mounted in the said head, and means for raising and lowering the said head upon the column, a vernier at the base of the column for accurately measuring the transverse movement of the column upon the base, and a vernier upon the upper portion of the column for accurately measuring the rise and fall of the vertically-movable head, substantially as set forth.

24. The combination in a turning and quartering machine with the revolving cutter-ring, of a support therefor, means for raising and lowering the cutter-ring and means for moving the same lengthwise of the machine and transversely of the machine and means for calculating and accurately gaging the movements imparted to the said cutter-ring so as to determine the respective positions thereof, substantially as set forth.

Signed by me this 24th day of February, 1900.

LEWIS H. MORGAN.

Witnesses:
GEO. T. PINCKNEY,
S. T. HAVILAND.