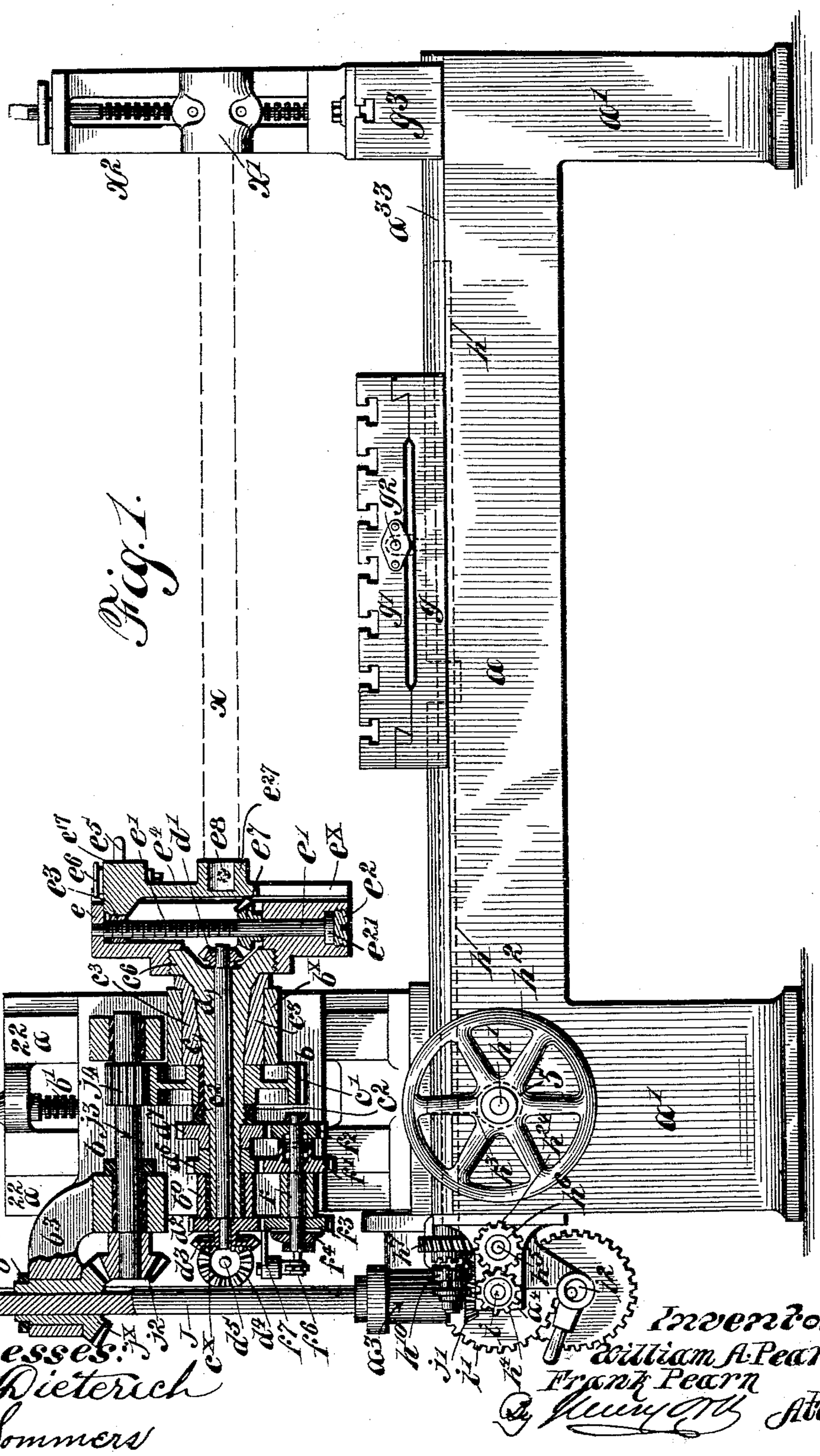
(No Model.) 3 Sheets—Sheet 1.

W. A. & F. PEARN.

MACHINE FOR BORING CYLINDERS AND TURNING THE FLANGES THEREOF.

No. 504,742. Patented Sept. 12, 1893.

Fig. 1.



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3 Sheets—Sheet 2.

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MACHINE FOR BORING CYLINDERS AND TURNING THE FLANGES THEREOF.

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Fig. 5.

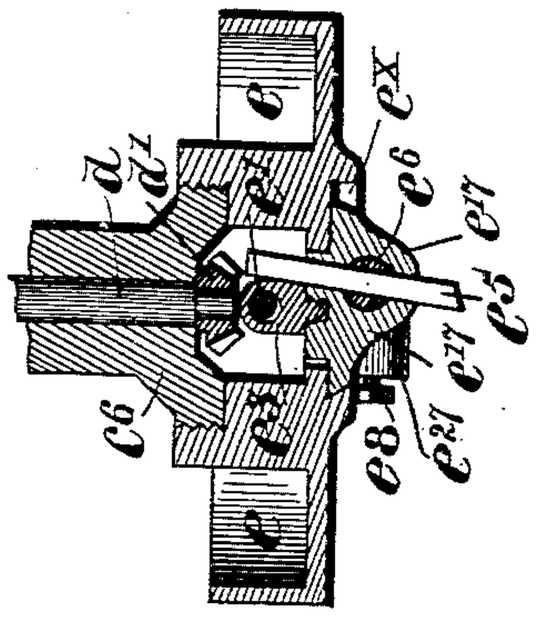

Fig. 4.

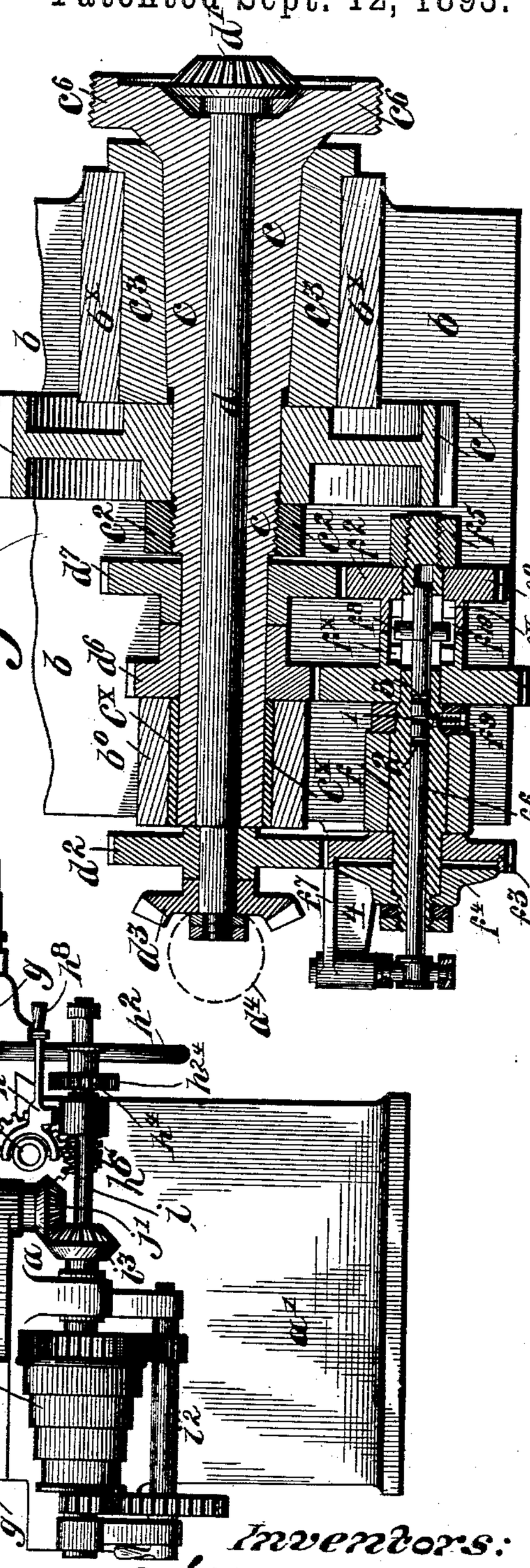

Fig. 6.

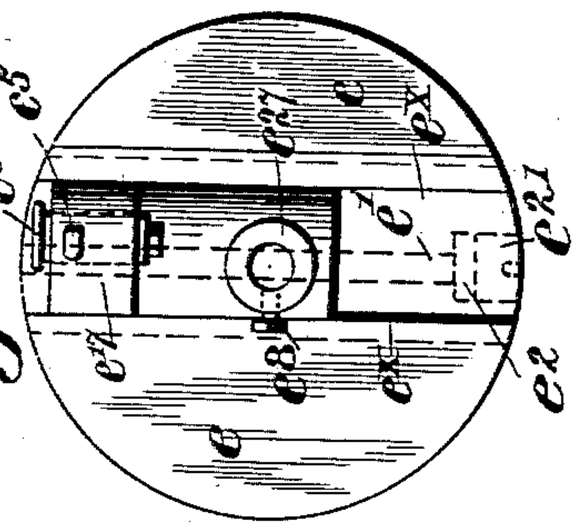

Fig. 2.

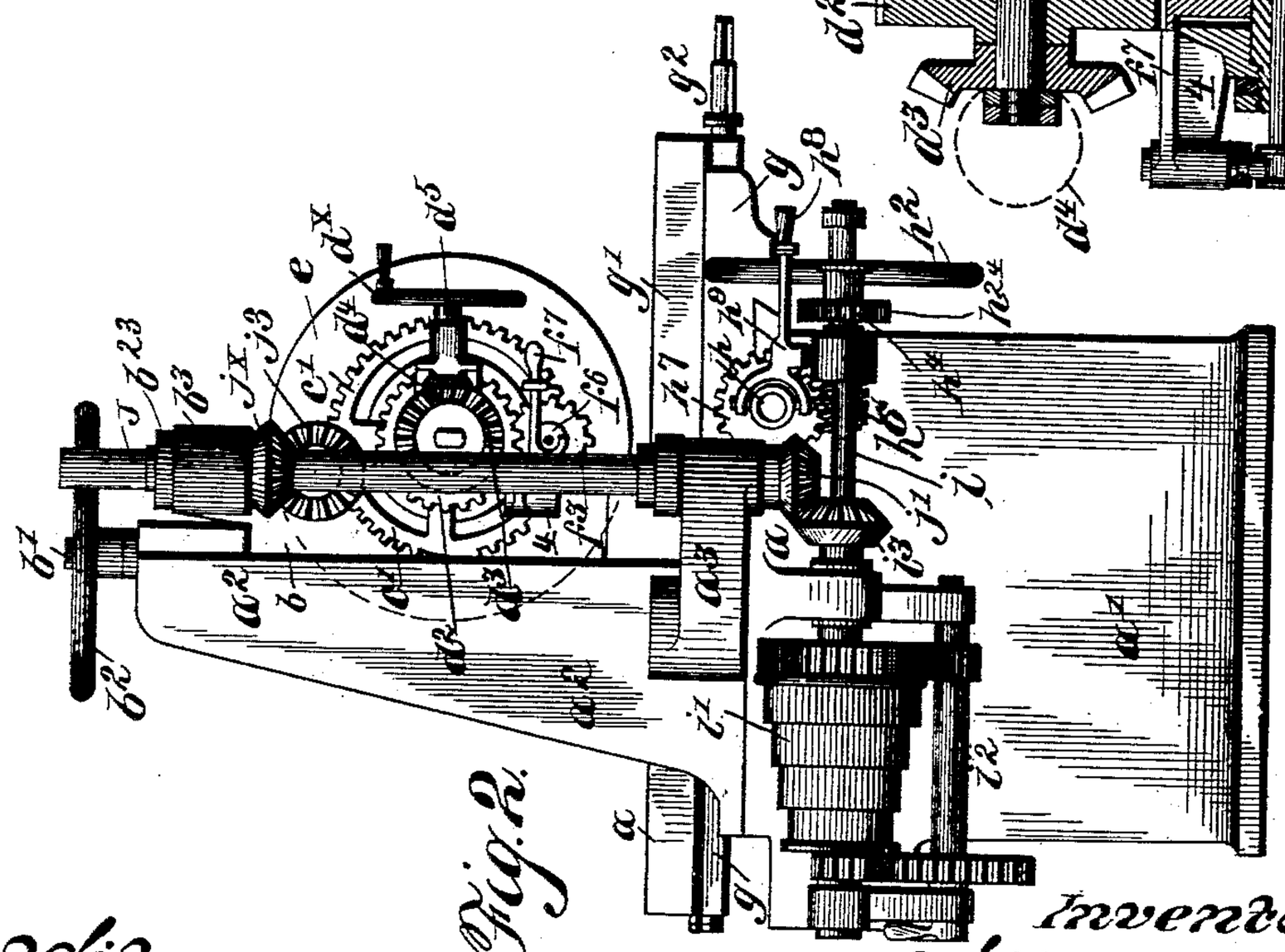

Fig. 1.

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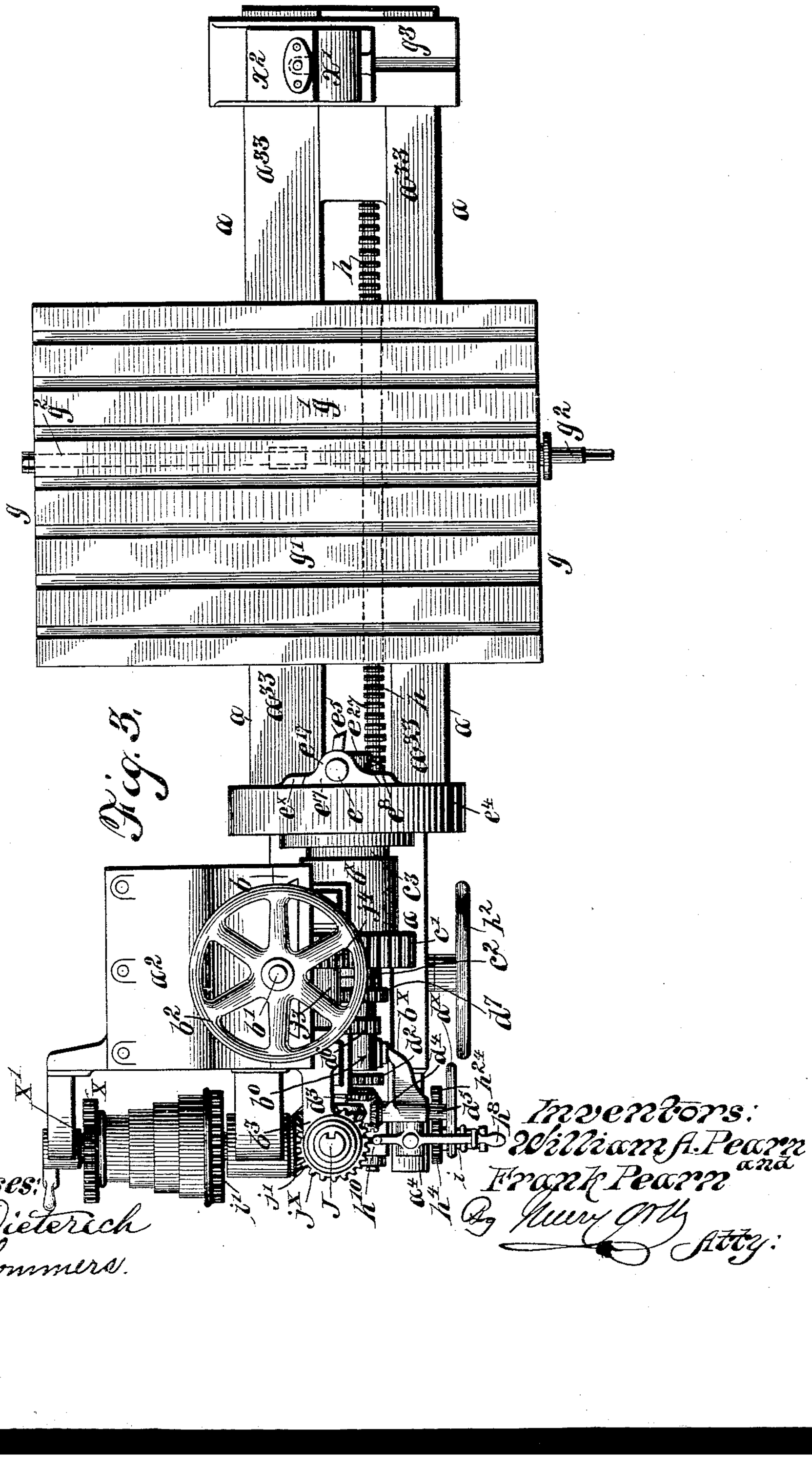

UNITED STATES PATENT OFFICE.

WILLIAM ALFRED PEARN AND FRANK PEARN, OF GORTON, ENGLAND.

MACHINE FOR BORING CYLINDERS AND TURNING THE FLANGES THEREOF.

SPECIFICATION forming part of Letters Patent No. 504,742, dated September 12, 1893.

Application filed January 13, 1893. Serial No. 458,277. (No model.) Patented in England November 25, 1891, No. 20,498.

To all whom it may concern:

Be it known that we, WILLIAM ALFRED PEARN and FRANK PEARN, subjects of the Queen of Great Britain, residing at Gorton, near Manchester, in the county of Lancaster, England, have invented certain new and useful Improvements in Machines for Boring Cylinders or other Castings and Facing or Turning and Boring the Flanges Thereof, (for which we have obtained Letters Patent in Great Britain, dated November 25, 1891, No. 20,498;) and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

Our invention has relation to metal working machines, and more particularly to machines for boring cylinders or other castings and facing or turning and boring the flanges thereof, and consists in structural features, and in combinations of co-operative elements as will now be fully described, reference being had to the accompanying drawings, in which—

Figure 1 is a sectional front elevation; Fig. 2 an end elevation, and Fig. 3 a top plan view of a machine embodying our invention. Fig. 4 is a face view of the face plate or tool carrier on the lathe spindle. Fig. 5 is a cross-section of the same, and Fig. 6 is a sectional detail view.

The machine, Figs. 1 to 3, comprises a suitable bed, a, supported by feet, a', which bed has at one end a standard, a^2 on which the head stock is adjustable. This head stock comprises a carriage, b, adapted to slide on ways, a^{22}, on standard a^2, and is adjusted vertically in said ways by means of an adjusting screw b', that revolves freely in a bearing on or in the standard, and works in a suitable screw-threaded bearing or nut in or on the carriage b, said adjusting screw carrying a hand wheel, b^2. The head stock further comprises a tubular live spindle, c, and a tool carrier or stock, both supported from the carriage, b, which is provided with suitable bearings, b^0, $b^\times$, the former containing a cylindrical bushing $c^\times$, and the latter a bushing c^3, the bore of which is conical or tapering, said bushes, $c^\times$ and c^3 constituting the bearings for a hollow live spindle c. As shown in Figs. 1 and 6, the right hand end of the live spindle c is conical and fits the corresponding bushing c^3, which has at its right hand end an annular flange that has bearing on the corresponding end of the spindle bearing $b^\times$ and serves as an abutment for a similar flange c^6 on the right hand end of the live spindle c. The annular flange c^6 on the spindle c is screw-threaded exteriorly, and to it is screwed the tool stock carrier e^4. To the spindle c is keyed or otherwise secured a gear wheel c', and said spindle is screw-threaded for the reception of a lock and jam-nut, as shown at c^2, Fig. 1, said lock nut having bearing on the hub or boss of the gear wheel, and by screwing up said nuts the wheel is caused to work close against the end of the bush c^3, while the annular spindle flange c^6 is drawn tight against the like flange of said bush, whereby endwise motion of the spindle c is prevented. If desired, a single lock-nut may be employed, as shown at c^2, Fig. 6.

Between the lock and jam nuts, or between the lock-nuts c^0 and the left hand spindle bearing b^0, the spindle c carries two spur wheels, d^6 and d^7 secured to rotate with said spindle, the spur wheel d^7 being of larger diameter than said spur wheel d^6, and within the spindle is arranged a shaft d that carries at the right hand end a bevel pinion d', and at the left hand end a like pinion d^3 and a spur wheel d^2 for purposes presently explained.

As above stated, the tool stock carrier is screwed to the annular flange c^6, or head of the spindle c, and consists of a discoidal face plate e, the front face of which is provided with a slide way, $e^\times$, for the tool stock e^4. In the face plate e is stepped a screw spindle e', in a plane at right angles to the longitudinal axis of the live spindle c and shaft d, said screw spindle revolving freely in its bearings, but having no endwise motion, it being provided at one end with a head e^{21}, seated in an enlargement of one of the spindle bearings in the face plate, said spindle being held against displacement by a suitable plug e^2, which is

preferably screw-threaded and screws into said enlarged portion of one of the spindle bearings, as shown in Fig. 1. The screw spindle e' works in a nut e^3 that is screwed or otherwise secured to the movable tool stock e^4, see Fig. 4, and said spindle carries a bevel pinion e^7 that is in gear with the like pinion d' on the right hand end of the shaft d, contained in spindle c, and hereinbefore referred to. It is obvious that if the said shaft d is revolved in one or the other direction, the tool stock will be moved in a corresponding direction in a plane at right angles to the longitudinal axis of the shaft and spindle. The tool, as a cutter, for instance, is secured in a boss e^{17}, formed on a tool stock e^4 at one end thereof by means of a lock bolt e^6 provided with an opening in which the tool e^5 is seated, a corresponding opening at the proper angle being formed in boss e^{17} of said tool stock, as shown in Fig. 4, the retaining bolt e^6 being parallel with the screw spindle e'. At its opposite end the tool stock has a boss e^7 in which is formed a socket bearing for one end of a boring bar x shown in dotted lines in Figs. 1 and 3 secured in its bearing in any well known manner as by a bolt e^8, the other end of said bar having its bearing in a block x', vertically adjustable along standards x^2 adapted to be bolted to the auxiliary work rest g^3, as shown in Figs. 1 and 3, so that a casting requiring to be bored out can be secured to the carriage g, the boring bar x passed through the bore or opening in the casting to be bored true or enlarged, one end of the bar being secured in the boss e^7 of the tool holder and the other in bearing block x' after proper adjustment of the bar bearings by the means described.

The advantages of the combination of a boring tool with a cutter or facing tool will be readily understood, as either tool may be employed without a change of tool stock, or both may under certain circumstances be used simultaneously.

The radial adjustment of the tool stock e^4 on the face plate e, as well as the adjustment of the work carriages g, g' toward or from said face plate can be effected by hand; or a continuous radial motion within the limits of the ways on the said face plate may be imparted to the tool stock through the medium of the live spindle, c, and the speed of motion varied relatively to that of said live spindle, according to the nature of the work performed by the cutter e^5, as for instance, in facing cylinder flanges, while a continous or intermittent motion toward the head stock may be imparted to the work supports, g, g' either by hand or from the main driving shaft, i, as the work in hand may require.

The live spindle c is driven by a spur wheel j^4 on a countershaft j^3, mounted in suitable bearings on the carriage b, said spur wheel j^4 gearing with the spur wheel c', on said spindle. At its left hand end the shaft j^3 carries a bevel pinion j^2 in gear with a corresponding pinion $j^\times$, that has free endwise motion on but is caused to revolve with a vertical shaft j whose lower end has its bearings in a bracket a^3 on the bed a in which bearing the shaft is free to revolve but is held against endwise motion. At its upper end the shaft j has its bearings in the tubular hub of the bevel pinion $j^\times$ above referred to, said pinion being free to revolve in a bearing formed in an arm b^3 projecting from the carriage b, but is held in said bearing b^3 against vertical motion by a suitable screw collar b^{23}, said bevel pinion $j^\times$ being connected with shaft j by spline or feather, or other suitable means. At its lower end the shaft j carries a bevel pinion j', in gear with a corresponding wheel i^3 on the main driving shaft i, Fig. 2, said shaft carrying the usual speed pulley, i', and suitable gearing connecting shaft i with corresponding gearing on a slow motion shaft i^2, these parts being substantially similar in arrangement and operation to those ordinarily found in double geared power lathes, the shaft i corresponding to that of the ordinary live spindle.

As will be readily seen, by means of the construction and arrangement of live spindle driving mechanism, the carriage b can be adjusted vertically along shaft j and standard a^2 without disconnecting the driving gearing i^3, j', and $j^\times$, j^2.

The work support consists of two carriages, one of which is adjustable on the other, both being adjustable toward and from the head stock. To this end, the bed a is provided with a longitudinal track or slide way, a^{33}, on which the carriage g is adapted to slide to and from the head stock, and said carriage has a transverse track or slide way for a second carriage g' that is adjustable transversely of carriage g by means of a screw shaft g^2, that is adapted to revolve in suitable bearings in carriage g', and in a nut or nuts on carriage g in a well-known manner.

The radial adjustment of the tool stock e^4 relatively to the axis of its carrier e and that of the live spindle c is effected by hand by means of a short shaft d^5 mounted in bearings in a bracket $b^\times$, Fig. 3, formed on or secured to the carriage b, and carrying a hand wheel $d^\times$, and a bevel pinion d^4 in gear with the like pinion d^3 on the left hand end of shaft d so that when said short shaft d^5 is revolved in one or the other direction, the movement will be transmitted to the screw spindle e' through the medium of the shaft d, and bevel pinions d^3, d', and e^7, and through said screw spindle a motion across the face plate e will be imparted to the tool stock, e^4 by the nut e^3. On the other hand, a continuous or intermittent motion may be imparted to the tool stock e^4 across the face plate e from the main driving shaft i through the medium of the live spindle c by means of the following instrumentalities.

The carriage b is provided with a bearing for a tubular shaft f parallel with the live

spindle c, and on said shaft are loosely mounted two spur wheels, f', f^2, the spur wheel f' being of greater diameter than the spur wheel f^2. The larger spur wheel f' meshes with the smaller spur wheel d^6 on live spindle c while the smaller spur wheel f^2 meshes with the larger spur wheel d^7 on said live spindle.

On the left hand end of the tubular shaft f is loosely mounted a spur-wheel f^3 that meshes with the spur wheel d^2 fast on shaft d, and said wheel f^3 has its outer face dished for a friction disk or washer f^4 fast on said shaft f, said disk being held in contact with the spur wheel by means of a nut f^5 on the right hand end of the shaft f, which nut also serves to hold the contiguous faces of the hubs of the spur wheels f', f^2 against each other, as shown in Figs. 1 and 6.

Any suitable means may be provided to lock either wheel f' or f^2 to shaft f, as an ordinary friction or toothed clutch ring. We prefer, however, to form teeth $f^\times$ within the hubs of said wheels, and provide the shaft f^6 with a cross pin f^8 projecting therefrom on opposite sides and adapted to engage said teeth when the shaft is moved in one or the other direction. As more clearly shown in Fig. 6, the teeth $f^\times$ do not extend the full length of the hubs so as to form a space f^{10}, in which the clutch pin f^8 normally lies. The shaft f^6 has three peripheral grooves, 1, 2, 3, Fig. 6, engaged by a spring-actuated conical locking pin f^9, that projects through the tubular shaft f. In Fig. 6 the shaft f^6 is shown in its normal position, the pin engaging with the groove 1, but when said shaft is moved toward the left until the pin engages the groove 3, the clutch pin will have been moved between the teeth $f^\times$ within the hub of wheel f'; when, on the contrary, said shaft is moved to the right until pin f^9 engages groove 2, the clutch pin will lie between two teeth in the hub of wheel f^2, whereby either of the said wheels may be locked to the shaft f. The shaft receives endwise motion through the medium of a forked clutch operating lever f^7 that has its fulcrum in or on a bracket 4 on the carriage b, as shown in Fig. 2.

The mechanism by means of which the live spindle c, is driven has been described; consequently if either of the spur wheels f' f^2 is locked or coupled with the tubular shaft f, the said shaft will be revolved through the medium of the spur wheel d^6 or d^7, according as the spur wheel f' or f^2 is locked to shaft f, while the latter shaft will revolve idly when driven by the spur wheel d^2 on shaft d when the said shaft d is revolved by the hand operated mechanism above described, at which time neither of the spur wheels f' or f^2 is locked or coupled to shaft f. Inasmuch as the wheels d^6, d^7 on spindle c, and the wheels f', f^2 on shaft f differ in diameter, the speed of rotation of shaft d can be varied, a slower rotation being imparted to said shaft when wheel f' is made to drive shaft f than when wheel f^2 drives said shaft, by reason of the difference in diameter of wheels f', d^6, and f^2, d^7, as will be readily understood.

The carriage g may be adjusted relatively to the head stock longitudinally of the bed by hand, or a continuous motion toward the head stock may be imparted to said carriage g from the main driving shaft i, as follows:— The adjustment by hand is effected by means of tangent wheel 5, on a short shaft h', that has its bearings in the bed a, said tangent wheel 5 gearing with a like wheel h^3 on a longitudinally arranged screw shaft h that works in a suitable nut on the carriage g, and has its bearings also in the said bed a, said short shaft h' being rotated by means of a hand wheel h^2, said wheels 5 and h^3 being shown in dotted lines in Fig. 1, and the mechanism is one well known in the arts for transmitting motion.

A continuous motion may be imparted to the carriage g toward the head stock through the medium of the following instrumentalities:—The main driving shaft i carries a spur wheel h^4 connected therewith by spline or feather so as to slide longitudinally of said shaft and revolve with it, whereby said spur wheel can be moved out of gear with the spur wheel driven thereby. The spur wheel h^4 when in the position shown in Fig. 2, gears with a spur wheel h^{24} on a short shaft h^5 that has its bearings in the bracket a^4 on the bed of the machine; the said shaft h^5 also carries a worm h^6 that is in gear with a worm wheel h^7 Figs. 1 and 2, loose on the screw shaft h. The hub of the worm wheel h^7 is provided with clutch teeth adapted to be engaged by a correspondingly toothed clutch ring h^{10}, Fig. 1, connected by spline or feather with the screw shaft so as to slide thereon, said clutch ring being shifted into and out of gear with the clutch face of the worm wheel h^6 by means of a shifting lever h^8 fulcrumed to the bracket a^4, as shown in Figs. 2 and 3. It is obvious that whenever the spur wheel h^4 is brought into engagement with the spur wheel h^{24}, and the clutch ring h^{10} with the clutch face of the worm wheel h^7, the latter will be locked to the screw shaft h, whereby said shaft is revolved through the medium of the worm h^6 and spur wheels h^{24} and h^4, the short shaft h' revolving with said screw shaft, as it is geared thereto through the tangent wheels 5 and h^3 as above described. The movement of the carriage g may be reversed, or its speed changed relatively to that of the live spindle c through the medium of the driving shaft i by interposing suitable change wheels between the spur wheels h^4 and h^{24} in a well-known manner, or the movement of said carriage g may be reversed through the medium of the tangent worm gearing h^3, 5, and shaft h'. The carriage g' serves as a means for supporting the work, which may be secured thereto in any desired manner, and in practice we provide an additional support consisting of a slide carriage g^3, herein-

before referred to, in case large articles are to be operated upon, and for the purpose of securing the boring bar bearings. The tool, if desired, may be made to form cone work by giving the required movement to said tool and to the carriage *g*.

The advantages derived from the vertical adjustment of the head stock and the radial adjustment of the tool stock on the face plate *e* for certain kinds of work will be readily understood by those conversant with this class of machines.

Having thus described our invention, what we claim as new therein, and desire to secure by Letters Patent, is—

1. In a machine of the class described, the combination with the live spindle, a tool stock carrier revoluble with the spindle, and a tool stock having motion on the carrier in a plane perpendicular to the longitudinal axis of the spindle; of mechanism controlled by said live spindle adapted to impart a continuous rectilinear motion to the tool stock.

2. In a machine of the class described, the combination of a suitable bed, a driving shaft revoluble in bearings on the bed, a head stock adjustable vertically above the bed, a live spindle revoluble in bearings on the head stock, intermediate mechanism connecting the live spindle with the driving shaft, a tool carrier on said live spindle, a tool stock adapted to move on the tool carrier in a plane perpendicular to the longitudinal axis of the live spindle, and mechanism connecting the tool stock with the driving shaft through the medium of the live spindle.

3. In a machine of the class described, the combination with the bed and a driving shaft, of a head stock adjustable vertically on said bed, a live spindle revoluble in bearings on the head stock, a tool stock on said spindle, a tool carrier adapted to move in a plane perpendicular to the longitudinal axis of the spindle on the tool stock, driving mechanism connecting the live spindle with the driving shaft, and mechanism connecting the tool carrier with the live spindle, said mechanism adapted to convert the rotary motion of the spindle into rectilinear motion.

4. In a machine of the class described, the combination with the live spindle, means for revolving the same, and a tool stock connected with and having motion in a plane perpendicular to the longitudinal axis of said spindle; of mechanism for imparting motion to said tool stock, comprising a shaft revoluble within the spindle transmitting mechanism connecting said shaft with the tool stock, said transmitting mechanism constructed to convert the rotary motion of the shaft into rectilinear motion, and gearing connecting said shaft with the live spindle.

5. In a machine of the class described, the combination with the live spindle, means for revolving the same, and a tool stock connected with and having motion in a plane perpendicular to the longitudinal axis of said spindle; of mechanism for imparting motion to the tool stock and for varying the said motion relatively to the speed of the live spindle, comprising a shaft *d*, revoluble in said spindle, transmitting mechanism connecting shaft *d* with the tool stock, said transmitting mechanism constructed to convert the rotary motion of said shaft into rectilinear motion, a counter shaft geared to shaft *d*, variable speed gearing connecting the countershaft with the live spindle and mechanism for throwing the variable speed gearing into and out of operation.

6. In a machine of the class described, the combination with a driving shaft, a live spindle, mechanism connecting the spindle with said shaft, a tool carrier on said spindle and a tool stock adapted to move on the tool carrier in a plane perpendicular to the longitudinal axis of the live spindle; of mechanism connecting the tool stock with the live spindle, said mechanism adapted to impart a continuous rectilinear motion to the tool stock.

7. In a machine of the class described, the combination with a live spindle, a tool stock carrier, a tool stock movable across the face of its carrier, a shaft *d* within the live spindle and carrying bevel gear d^3, transmitting mechanism connecting said shaft with the tool stock, said mechanism constructed to convert the rotary motion of the shaft into rectilinear motion of the stock, a transmitting shaft geared to shaft *d*, gearing connecting the transmitting shaft with the live spindle, and mechanism for throwing said gearing into and out of operation; of the short shaft d^5 and its bevel wheel d^4, for the purposes set forth.

8. In a machine of the class described, the combination with the live spindle, and a shaft contained therein and carrying a bevel pinion at each end, of a tool support comprising a disk or face plate connected with the spindle, a tool holder movable across the face plate and provided with a screw-threaded bearing, a screw spindle carried by the face plate and working in the threaded bearing of the tool support, said screw spindle provided with a bevel pinion in gear with that on one end of the shaft within the live spindle, and gearing connected with the bevel pinion on the opposite end of said shaft for revolving the same, for the purpose set forth.

9. In a machine of the class described, the combination with the live spindle, a shaft contained therein carrying a gear wheel at one end, the driving shaft and transmitting gearing connecting said driving shaft with the live spindle; of a tool support comprising a disk or face plate connected with the live spindle, a tool holder movable across the face plate and provided with a screw-threaded bearing, a screw spindle carried by the face plate and working in said screw-threaded bearing, said screw spindle provided with a pinion in gear with that on the shaft in the live spindle, and variable gearing connect-

ing the said spindle with its contained shaft for varying the speed of rotation of the last named shaft, for the purpose set forth.

10. In a machine of the class described, the combination with the live spindle *c*, the spur wheels d^5 and d^7 secured thereto, the face plate *e*, a tool holder movable across said face plate, the screw spindle, *e'*, carried by the face plate and working in a threaded bearing of the holder, the pinion e^7 on said screw spindle, the shaft *d*, contained in the live spindle, the pinion *d'* on shaft *d* in gear with that on screw spindle, and the spur wheel d^2 on said shaft; of the counter shaft *f*, the spur wheel f^3 in gear with spur wheel d^2, the spur wheels *f'*, f^2, loose on said shaft *f*, and in gear with spur wheels d^5, d^7, respectively, and a clutch coupling for coupling either spur wheel *f'*, f^2, to shaft *f*, for the purpose set forth.

11. In a machine of the class described, the combination with the bed, the head stock, the carriage *g* movable toward and from said head stock, the carriage *g'*, movable across carriage *g*, the screw shaft *h*, the worm wheel h^7, loose on said screw shaft, and a clutch coupling for coupling the worm wheel to its shaft; of counter shaft h^5, a worm h^6, and a spur wheel h^{24} thereon, said worm in gear with worm wheel on screw shaft, the main driving shaft, and a spur wheel thereon in gear with the spur wheel h^{24} on the countershaft, for the purpose set forth.

12. In a machine of the class described, the combination with the bed, the head stock movable vertically above said bed, a live spindle supported by the head stock, a spur wheel on said spindle, a counter shaft j^3 also supported on the head stock, a spur and a bevel wheel on the counter shaft, said spur wheel in gear with the like wheel on the live spindle, the main driving shaft supported on the bed of the machine, and a bevel pinion on said main driving shaft; of transmitting gearing, comprising a vertical shaft supported at one end by the bed of the machine, a bevel wheel on said shaft in gear with that on the main driving shaft, and a second bevel wheel, $j^\times$, revoluble with and having endwise motion on the vertical shaft, said bevel wheel $j^\times$ supported from the head stock and in gear with the like wheel on the countershaft j^3, for the purpose set forth.

13. In a machine of the class described, the combination with the live spindle; of a tool support adjustable in a plane at right angles to the longitudinal axis of said spindle, said tool support provided with a bearing for a cutter or the like, and with a bearing for a boring tool, for the purpose set forth.

14. In a machine of the class described, the combination with the vertically adjustable head stock, the live spindle, and the counter shaft j^3 supported from said head stock, said counter shaft geared to the live spindle; of a driving shaft, a vertical transmitting shaft geared to said driving shaft, a pinion revoluble with and having endwise motion on said transmitting shaft, said pinion geared to said counter shaft and having its bearings on the head stock.

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