(No Model.) 3 Sheets—Sheet 1.

B. A. WHEELER.

ENGINE LATHE.

No. 602,924. Patented Apr. 26, 1898.

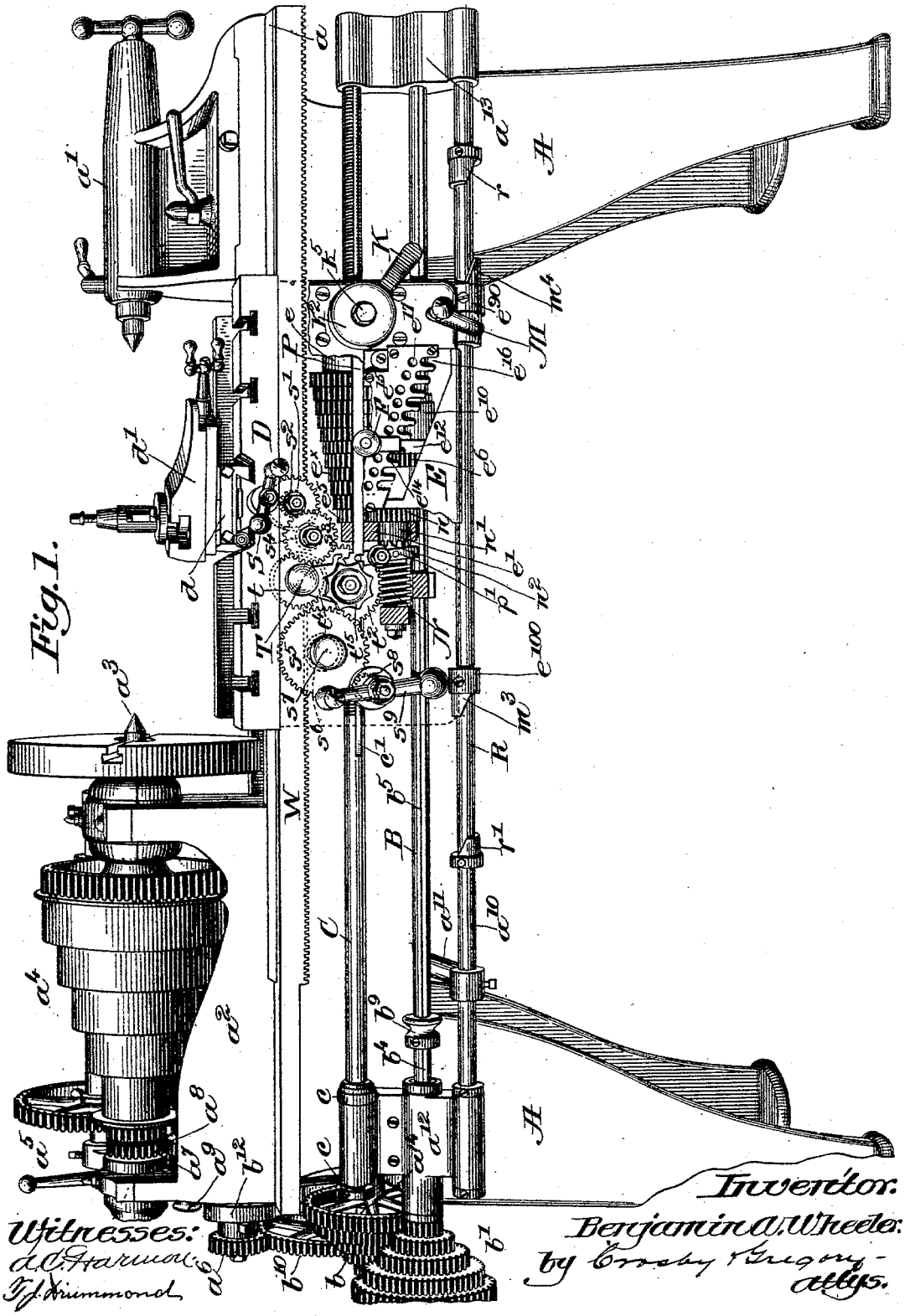


Fig. 1.

Witnesses:
A. D. Harwood
F. J. Drummond

Inventor:
Benjamin A. Wheeler.
by Crosby Gregory
attys.

(No Model.) 3 Sheets—Sheet 2

B. A. WHEELER.

ENGINE LATHE.

No. 602,924. Patented Apr. 26, 1898.

Fig. 3.

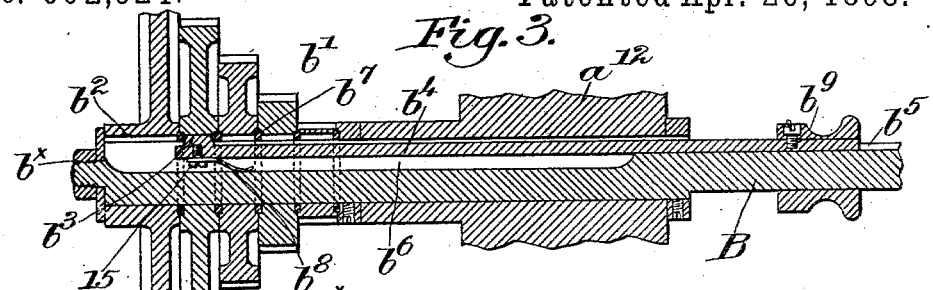


Fig. 7.

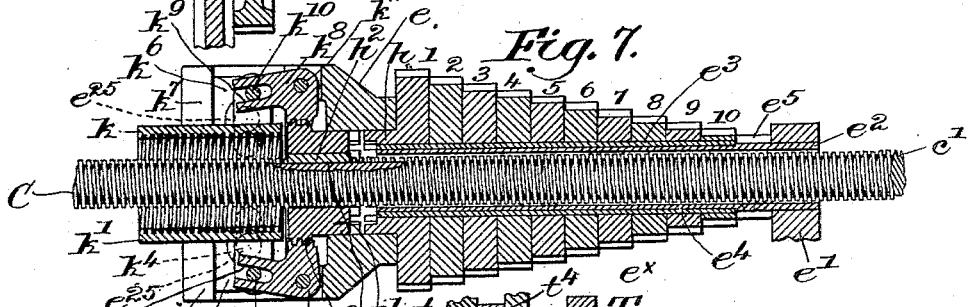


Fig. 9.

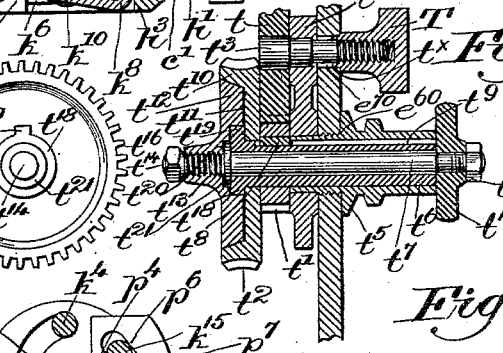


Fig. 10

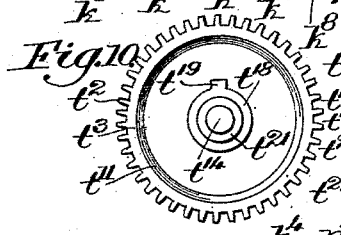


Fig. 8.

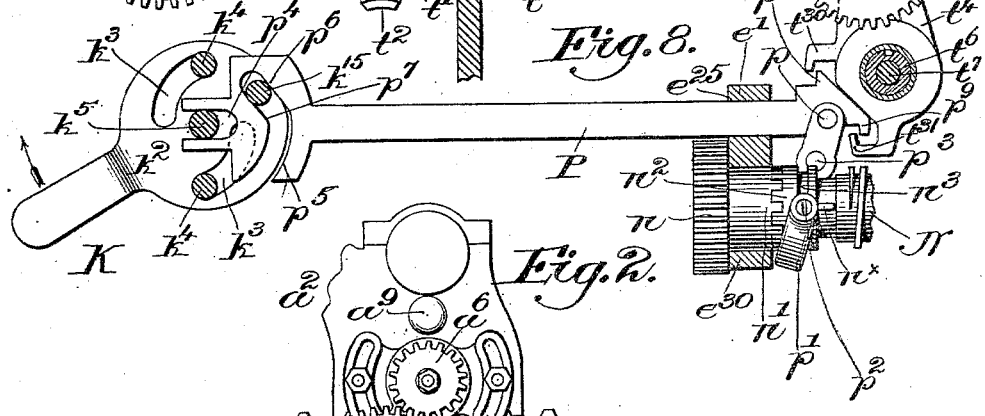
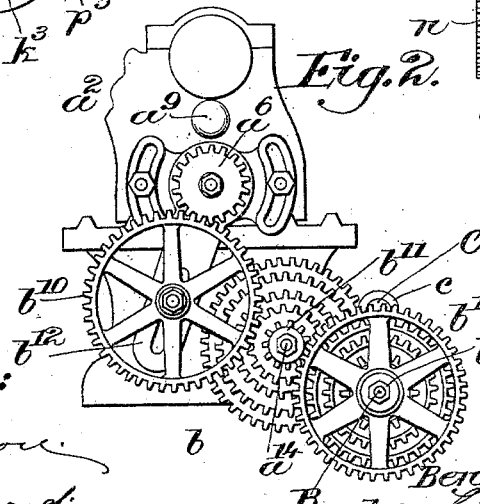


Fig. 2.



Witnesses:

A. C. Harmon

Thomas F. Drummond

Inventor.

Benjamin A. Wheeler.

by Crosby & Gregory

Attys.

(No Model.) 3 Sheets—Sheet 3.

B. A. WHEELER.

ENGINE LATHE.

No. 602,924. Patented Apr. 26, 1898.

Fig. 4.

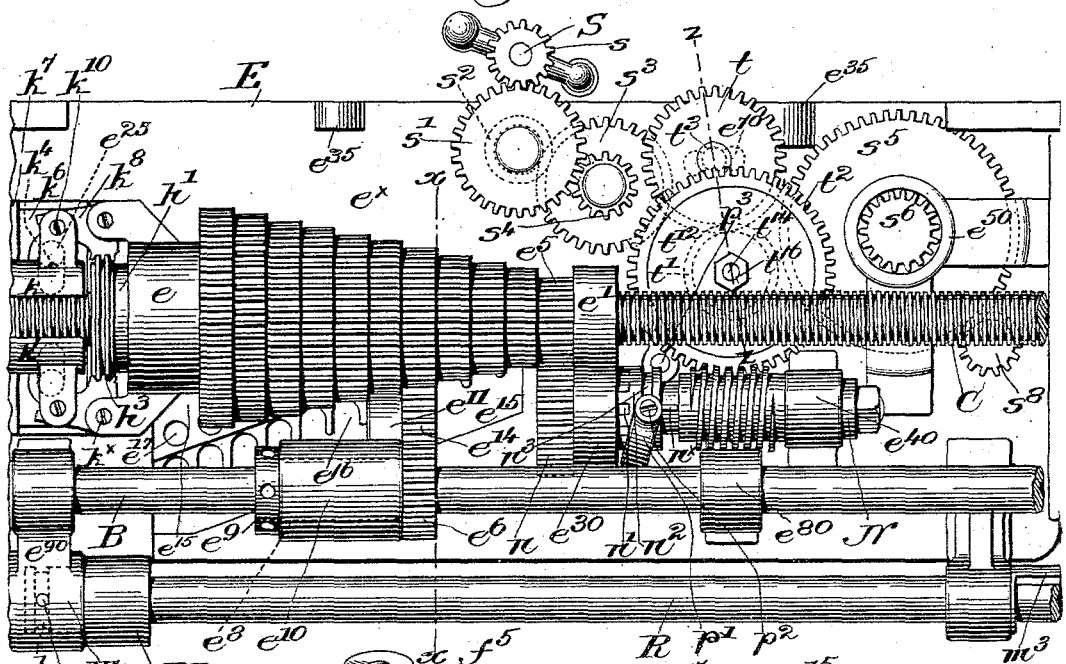


Fig. 5.

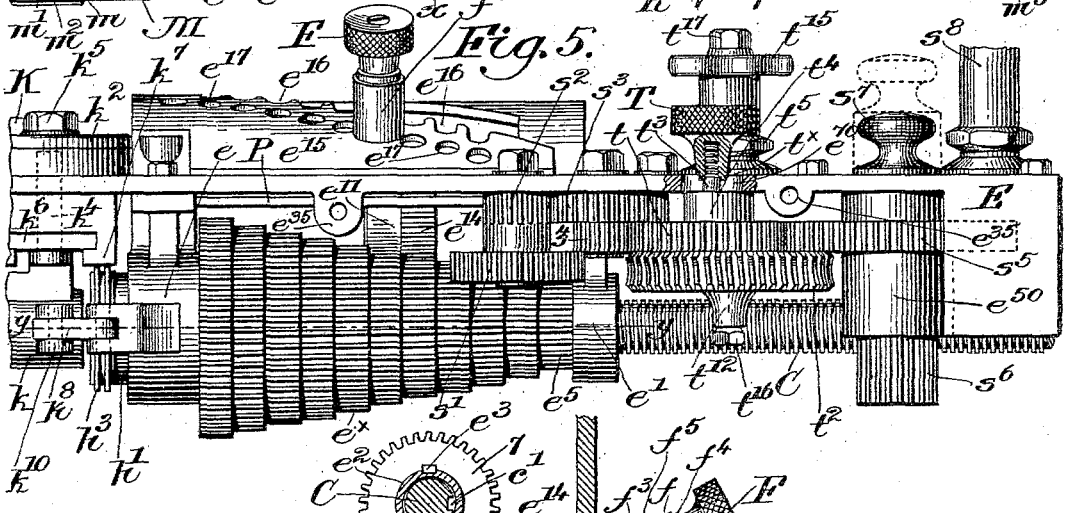
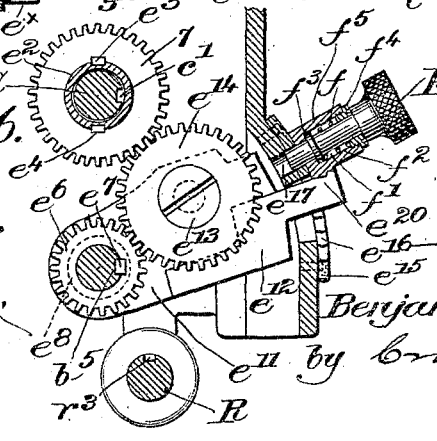


Fig. 6.



Witnesses:

A. C. Harmon

Thomas J. Drummond

Inventor:

Benjamin A. Wheeler.

by Crosby & Gregory

attys.

UNITED STATES PATENT OFFICE.

BENJAMIN A. WHEELER, OF WORCESTER, MASSACHUSETTS, ASSIGNOR TO THE DRAPER MACHINE TOOL COMPANY, OF SAME PLACE.

ENGINE-LATHE.

SPECIFICATION forming part of Letters Patent No. 602,924, dated April 26, 1898.

Application filed August 28, 1897. Serial No. 649,868. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN ALFRED WHEELER, of Worcester, county of Worcester, State of Massachusetts, have invented an Improvement in Engine-Lathes, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

In engine-lathes and similar machine-tools of modern construction the presence in a single machine of diverse attachments to which the attention of the operator must be constantly directed has become the source of considerable annoyance, preventing, as it does, due application of the operator to the work in hand, with consequent impairment in the quality of the latter, while the stoppage of the machine to make frequent substitutions of gear and the like cuts seriously into the time during which the machine is available for work and affects to a considerable extent the earnings of machines whose size and complexity entail a high initial expense. In recent types of lathes various expedients have been adopted to obviate the necessity for these interruptions; but the operator is still compelled at times to leave the point at which the work lies to adjust the regulating devices provided, and these accordingly fall short of affording the desired relief, especially in the case of the larger sizes of screw-cutting lathes, where often upon a single piece of work threads of different pitch must be formed and the adjustment should be effected instantly and at times without stopping the work.

Accordingly the object of this invention is to provide for increased flexibility of adjustment between the various mechanisms in machine-tools and to accomplish an efficient organization of the same with the regulating devices under the control of the operator at a central point adjacent the work and preferably upon the apron of the main carriage.

Figure 1 is a view in perspective of a screw-cutting engine-lathe equipped with mechanism embodying my invention, part of the apron being broken away to reveal the operating parts carried thereby. Fig. 2 is an elevation of the gearing at the head of the lathe. Fig. 3 is a vertical longitudinal section through the bearing a^{12} and adjacent operating parts, Fig. 1. Fig. 4 is a view in rear elevation of the apron and parts carried thereby, Fig. 5 being a plan of the same; and Fig. 6, a vertical transverse section on the line $x\,x$, Fig. 4, looking from right to left. Fig. 7 is a longitudinal vertical section of the stack of gears with the lead-screw shown in elevation, the view being taken on the line $y\,y$, Fig. 5, looking from rear to front of the apron; Fig. 8, a detail of the interlocking lever with the mechanism which it connects; and Fig. 9 is a vertical sectional detail on the line $z\,z$, Fig. 4, showing the controlling devices for the ordinary mechanical or power feed, longitudinal and cross, while Fig. 10 is a view in elevation of the worm-gear in place with the bevel-nut omitted, looking from left to right, Fig. 9.

As an example of one class of machine-tool to which my invention may be applied with great advantage I have selected for illustration and description a screw-cutting engine-lathe of a well-known type equipped with mechanism embodying my improvements in their preferred form.

The base A, with its bed a, the tail-stock a', the head a^2, including live-spindle a^3, cone a^4 of belt-pulleys, and back gear a^5 may be of ordinary construction, as illustrated, or of suitable desired construction, the power for the feeding mechanism being led out in any suitable manner, preferably as usual, to a convenient feed-stud a^6 or its equivalent from a spindle-pinion a^7 by means of the usual train of gearing a^8, preferably including reversing-gears, chiefly inclosed in the ordinary manner within the head and for the sake of convenience preferably controllable by means of an ordinary intermediate pull-gear a^9 and a reversing-rod a^{10} and lever a^{11}, all connected to and coöperating with the mechanism already referred to in well-known fashion.

In suitable bearings a^{12} a^{13} on the base or frame A and extending across the front thereof longitudinally is mounted rotatably an actuating-shaft B, preferably projecting beyond its bearing at the head of the frame to receive gearing in train with the feed-stud a^6, from which the shaft derives its power, pref-

erably as illustrated, through auxiliary variable-speed-transmitting devices composed in this instance of coöperating multiple-speed cones of gears b b', any pair of which may be brought into action while the others run freely. As a convenient manner in which to regulate the rate of transmission at this point I mount the gears of the cone b' loosely on the shaft B, but retained thereon by a nut $b^{\times}$, as best seen in Fig. 3, grooving the interior of their hubs, respectively, as at b^2, to receive a feather b^3, carried by and projecting from a pull-spline b^4, which latter is seated in a longitudinal groove b^5 of the shaft B, enlarged at b^6 to permit lateral play of the spline as the feather b^3 dodges under the rings b^7, provided between the gears to normally prevent escape of the feather from the hub of the gear selected and also to prevent the spline from engaging with more than one gear at the same time, a spring b^8 and screw 15 or other suitable means serving to throw the feather into engagement properly and hold it up to its work. The spline is carried through the bearing a^{12} to suitable controlling means, as the handle b^9, located at a point to be conveniently reached by the operator, who can by it throw in any pair of the gears, of which five are shown in the drawings, permitting, consequently, five different rates of transmission from a given speed at the feed-stud a^6, or, rather, from an intermediate feed-gear b^{10} in this instance.

When coöperating with a cone of loose gears arranged as just described, the gears of the primary cone b may and should be fast either together or, preferably, to a common quill b^{11}, (see Fig. 2,) with which the outer gear may conveniently be formed as a quill-pinion, said quill being mounted rotatably on a stud a^{14} on the frame, preferably, while the intermediate driving-gear b^{10} I provide, as usual, to give greater possibility of adjustment, if desired, and for this reason it is preferably mounted on an adjustable support b^{12}, permitting substitution or interchange of gears in well-known manner, although it may be omitted entirely provided this connection between the feed-stud a^6 or its equivalent and the auxiliary multiple-speed-changing devices b b' can be properly effected by other means. Parallel with the actuating-shaft B, in this instance above and slightly behind it, extends the lead-screw C, rotatably mounted in suitable bearings, which for the sake of accuracy and ease of assemblage are preferably integral with the shaft-bearings a^{12} a^{13}, as illustrated.

In the preferred form of my invention the lead-screw is normally disconnected and at rest, terminating at the bearing a^{12}, with retaining-collars c, and only rotates while feeding during the operation of the tool, as will be more fully explained hereinafter.

On the bed a is fitted to slide longitudinally the tool-carrier D, shown as a "main carriage," of usual form and preferably having a cross-slide d with tool-block d' and any other attachments of usual or desired construction, while from the carriage and movable with it depends the apron E, secured by suitable means, as lugs e^{35}, and similar in general contour in the instance illustrated to those in use at the present day, though the term "apron" is used hereinafter in the specification and claims to designate any convenient portion of the tool-carrier to receive the devices and mechanisms set forth.

The actuation of the tool-carrier during and for purpose of the work, as well as at other times, and the organization of the various mechanisms by which this is accomplished, with centralization of the regulating devices under the control of the operator, constitute important features of my invention, and before describing in detail the mechanism which I have selected to illustrate my novel method of operation I desire to outline briefly the features wherein my invention departs radically from the principles of operation heretofore adopted by others in their efforts to accomplish the same end.

Of chief importance I deem the provision of regulating devices under the control of the operator at the tool-carrier to govern the operation of each of the various feed mechanisms, for by so locating these, whatever may be their construction, I obviate the necessity for departure of the operator from his work.

In a recent type of lathe possessing many advantages constant rotation of the lead-screw during actuation of the carriage or its slides, for whatever purpose and at many useless times, has resulted from the presence of gears on the lead-screw, with consequent severe and unnecessary wear and stress on this, the vital part, of the lathe, the part upon the absolute integrity of which depends the accuracy of the work performed by the tool. To obviate the necessity for this constant rotation, I prefer to refrain from the use of driven gears arranged on the screw-shaft and necessarily communicating their motion to it, even though by the provision of various sizes of gears the speed can be reduced to a comparatively low rate. In common with this type of lathe another type in which the screw is in gear with the variable-speed mechanism through a train of gear-wheels, and, so far as I am aware, all types extant having rotatable lead-screws are universally open to the additional objection that the lead-screw is actuated from its end and at such a distance from the point of driving engagement with the tool-carrier that a strong torsional force is exerted upon the intermediate portion of the screw, frequently destroying its ability to accurately guide the tool in cutting the finer pitches of screw-thread.

In carrying out my invention I provide means movable with the tool-carrier to rotate the lead-screw, and in the preferred form of construction illustrated this means is shown as comprising a plurality of different-

sized gears of the type common to a number of lathes of this class, preferably rotatable about a horizontal axis and for the sake of compactness assembled in the form of a stack upon a quill or support, on which they are all fast and which preferably surrounds the lead-screw, but preferably without deriving any support therefrom or in any manner interfering with normal isolation thereof, and suitable provision is made on the one hand for actuation of the stack at various speeds by the driving-shaft and on the other hand for connection of the stack at times with the lead-screw to drive the latter, and thereby feed the carriage. To more specifically describe the illustrated embodiment of this feature of my invention, upon reference to the drawings, especially Figs. 1 and 4 to 7, the apron E is seen to be provided with bearings $e e'$, carrying the rotatable quill e^2, upon which are coaxially assembled different-sized gears, fastened in the form of a stack $e^\times$ upon the quill by splines $e^3 e^4$, and in this instance ten in number and designated accordingly in Fig. 7, not including the quill-pinion e^5. As a convenient selector device or medium whereby to connect the actuating-shaft B with any of the gears that the speed of the quill may be thus varied I have adopted the well-known expedient of a selector-arm carrying an intermediate gear constantly in mesh with a pinion on the actuating-shaft, inasmuch as I have in this instance shown the stack opposite said shaft and adapted to be swung into coöperative engagement with any of the gears constituting the stack.

I have illustrated a form of selector-arm which slides with its pinion along the actuating-shaft to the desired point, and I prefer to use (see Fig. 6) a pinion e^6, splined at e^7 in the groove b^5 and having a hub e^8, upon which is seated and retained by a collar e^9 (see Fig. 4) the hub e^{10} of the arm e^{11}, and the latter I construct, preferably, for convenience of manufacture with an extension e^{12}, providing also a stud e^{13} to receive the intermediate gear e^{14}, and a locking-bolt F, the head of which serves as a controlling-handle for the arm e^{11} and the pitch-governing mechanism in general, while any suitable locking means may be employed, as the locking-plate e^{15} of ordinary or desired form, having positioning-notches e^{16} and locking-holes e^{17} in series corresponding, respectively, to the gears of the stack and to permit the arm to be locked, with its gear e^{14}, in engagement with any of the gears 1 to 10, as desired.

To draw the locking-bolt into locking position, a spring f may be provided, seated, (see Fig. 6,) preferably, in an enlargement f' of the bearing f^2 and pressing at one end against a shoulder f^3 on the bolt, while at its other end a bushing f^4, screwed into the arm member f^5, holds the spring up to its work.

To operate the arm for a change of gear, it is only necessary to grasp and pull out the handle F, withdrawing the bolt from the hole e^{17}, when the arm will be free to be depressed and thereby released from the corresponding notch, then moved laterally opposite the notch corresponding to the gear which will give the desired rate, when upon reversal of the operation the intermediate gear e^{14} will be fixed in adjusted position by locking of the handle.

Passing now to the connection between the stack and the lead-screw, this may be effected most conveniently by means of an intermediate member or clutch, and one form of such a connection accordingly I have shown in the drawings, where h (see Fig. 7) designates a suitable driving member formed for strength and compactness integral with the hub of the stack-gear l, while h' designates the driven member, splined at h^2 into a groove c' of, or otherwise suitably rotatively connected with, the lead-screw, upon which, however, it is free to move longitudinally both when being thrown in and when carried bodily by movement of the apron, the isolation of the lead-screw being preferably preserved absolutely, as illustrated, inasmuch as the member h' derives its support from the bearing e, though the mere presence directly on the lead-screw of a clutch member or its equivalent, if normally free, would not be sufficient to hamper it to a great degree. The members of this clutch are shown as both inclosed almost entirely within the bearing e, thus not only promoting stability, but also aiding to permit the confinement of the operating parts within the limits of a relatively small apron. Of greater advantage still is the close juxtaposition of the driven clutch member h' to the split or "open-and-shut" nut, absolutely eliminating, as I have already noted, all deleterious effects from torsion on an extended intermediate portion of the lead-screw, of which scarcely half an inch intervenes between clutch and nut in the instance illustrated. The clutch is thrown into operation to connect up the screw only when the feed is to begin, and its engagement is preferably effected concurrently with and by shutting of the nut members $k k'$, of ordinary or desired form, to grasp the lead-screw. To throw on the nut, I employ, preferably, the usual handle-disk k^2, (best seen in Fig. 8,) having cam-slots k^3 to receive and actuate pins or projections k^4, extending through slots e^{25} (see dotted lines, Figs. 4 and 7) in the face of the apron, outside which the handle-disk is free to rotate on a suitable post or support k^5. Rotation of the disk by raising the handle K from the position illustrated draws the pins k^4 toward the post k^5 and the nut members $k k'$ together, embracing the screw, the usual slides k^6 serving, in coöperation with undercut rabbets k^7, to maintain the nut members in parallelism.

As one form of suitable means to transmit the motion of the lever-handle K to the clutch member h' to secure the concurrent actuation mentioned shortly above, I provide bell-crank

levers k^8, carried pivotally on suitable supports $k^\times$ on the apron and having, respectively, one arm connected to one of the slides k^6 or other parts of the nut members k k', as by a slot k^9, receiving pins k^{10}, and the other arm respectively operatively connected to the clutch member h', as by teeth taking into or engaging a circular rack or similar peripheral projection h^3 on the enlargement, preferably made on the exposed portion of the clutch member. Simultaneous actuation of clutch and nut is thus insured, but no interference is made with rotation of the clutch member h' after it is thrown in, as the annular rack h^3 will run freely between the teeth of the bell-cranks k^8.

Having thus fully set forth the preferred arrangement of the lead-screw and the parts which coöperate with it in accordance with my novel arrangement to effect the feed proper, I will now describe the mechanism by which the "tool-carrier" (which term I use generically for the main carriage or its equivalent and the parts carried thereby) can be actuated in various directions and for various purposes by the same shaft which actuates the feed-screw, but without disturbance of the latter.

The construction and manner of operation of the gearing employed in general differ but little from the ordinary; but certain novelties of arrangement and actuation will emerge in the following description and their presence and advantage be fully apparent therefrom and from an inspection of the drawings to those skilled in the art.

The provision on the tool-carrier of means to actuate the power cross and longitudinal feed mechanism at different rates of speed constitutes the chief divergence from present usage, and while the worm may be placed on the actuating-shaft or in any other suitable place on the carriage I prefer to utilize a separate worm-shaft N, and by suitable connections secure for the worm the capability of actuation at all the different speeds transmitted by the stack $e^\times$, such connection being effected in this instance through the stack quill-pinion e^5 to a gear n, connected operatively with the worm-shaft, preferably as shown, by a clutch, of which the hub n', (best seen in Fig. 8,) seated in a suitable bearing e^{30}, may be and preferably is arranged to serve as a member. This clutch may be of any suitable form, and when constructed as illustrated the driven member may conveniently be formed as a sleeve n^2, splined at $n^\times$ to the worm-shaft N, and capable of axial movement thereon to permit engagement or disengagement with the member n' to throw the worm-shaft in or out of connection with the stack $e^\times$.

To avoid breakage, it is necessary that the lead-screw and the mechanical power-feed should not be in operation simultaneously at different speeds, and I prefer to obviate the chance for an accident through carelessness of the operator by interlocking the open-and-shut nut and a suitable part or parts of the power-feed-controlling means, in this instance the worm-shaft clutch, in such a manner that only one of them can possibly be closed at a time. To this end I preferably bring the worm-shaft clutch under control of the handle K, which may be accomplished to advantage by the use of an actuating or interlocking device, shown as a link or lever P, of suitable construction, connected near one end, as at p, (see Fig. 8,) to the controller of the worm-shaft clutch, shown as a yoke p', suitably connected to the clutch-sleeve n^2, as by a screw or projection p^2 taking into a groove n^3 of the sleeve and pivotally mounted at p^3 intermediate its connections with the sleeve and lever.

The interlocking lever P, as illustrated, has a bearing in a slot e^{25} of the bearing e' and extends beyond the same toward the handle-disk k^2, preferably having its end forked, as at p^4, to bear on the post k^5, while operating connection between the lever and disk may conveniently be effected by a pin and cam-slot union, whereby rotation of the disk will cause longitudinal movement of the lever one way or the other to throw the clutch member n^2. In Fig. 8 this form of connection will be seen, the disk having a lug or projection k^{15} taking into a cam-groove p^5, preferably formed in an enlargement or head p^6 of the lever P.

To insure complete disengagement of the clutch members n' n^2 before the open-and-shut nut can be closed, the slot p^5 has an inclined shoulder p^7, against which the lug k^{15} impinges with a quick throw of the lever P immediately upon the commencement of rotation of the disk and before the effect upon the pins k^4 has reached such a degree as to approach the nut members k k' to the point of engagement with the feed-screw C. Similarly upon reversal of the operation the lever "lags" until the nut members have been thrown free of the lead-screw.

To permit actuation of the cross-feed by power from the worm, a suitable train of gears and pinions s' s^2 s^3 s^4 is shown in mesh with a pinion s on the cross-feed shaft S, leading to a convenient point for engagement at times by a rock-gear t, itself in mesh with a pinion t', Fig. 4, which derives its power from a worm-gear t^2, meshing with the worm N. Similarly alternative engagement by the rock-gear t may be caused with an oppositely-placed gear s^5 in train with a longitudinal feed-rack W on the frame through suitable gearing, such as the pinion-stud s^6, splined to the gear s^5 and movable axially within a bracket-bearing e^{50} by suitable controlling means, as a handle s^7, which serves to enable the operator to throw the pinion-stud into or out of engagement with the rack, chiefly that the usual handle-pinion s^8 and its handle s^9, Fig. 1, may be disconnected when idle.

The rock-gear t, which constitutes part of

the controlling means for the power-feed mechanism, is shown in the figures in its intermediate position ready to be rocked into engagement with the pinion s^4 to give a power-feed to the cross-slide d or into engagement with the gear s^5 to cause longitudinal traverse of the carriage for feed or other purpose, as desired.

The preferred form of supporting means for the rock-gear and connection with the worm-gear t^2 is best illustrated in Figs. 8 and 9, wherein the gear t rotates upon a stud t^3, carried by a rocking plate or support t^4, which is seated upon and rotatable about a suitable projection from or part carried by the apron, in this instance an inward extension of a bearing-box t^5, screwed into an aperture e^{60} in the apron and traversed by a bushing or rotatable sleeve-like member t^6, in turn carrying a shaft t^7. Seated on the sleeve t^6 within the apron are the worm-gear t^2 and the pinion t', of which the first is free to rotate, while the pinion is splined at t^8 to a groove t^9 in the sleeve and, as before stated, is in mesh with the rock-gear t, which on its support t^4 is capable of limited revolution about the pinion, remaining always in mesh therewith.

To connect the worm-gear with the sleeve at such times as the operator may elect, thus placing under his control the instantaneous starting and stoppage of the power-feeds even during constant rotation of the worm N, I interpose a clutch, following in its general features a well-known form in which the web t^{10} of the worm-gear is recessed at t^{11} to receive a bevel-nut or clutch member t^{12}, the latter having a central threaded aperture t^{13} to receive the threaded end t^{14} of the shaft t^7, which is further provided at its outer end with suitable controlling means, as the handle t^{15}, and at both ends with retaining-nuts t^{16} t^{17}. The immediate connection between the sleeve t^6 and bevel-nut t^{12} is accomplished in this instance by providing the sleeve with a terminal shoulder or ring t^{18}, preferably integral with the material of the sleeve and having a lug or projection t^{19}, the shoulder and lug entering a correspondingly-shaped recess t^{20} in the bevel-nut t^{12}, which upon turning of the handle t^{15} one way or the other is drawn against or forced away from the worm-gear t^2, the general relative position of the sleeve, bevel clutch-nut, and shaft being preferably maintained by an annular shoulder t^{21} on the shaft or by equivalent means.

For convenience in manipulation of the rock-gear support t^4 the stud t^3 is shown as extended through a curved slot e^{70} in the apron, threaded, and provided with a controller nut or handle T, which may be reduced a trifle at its inner end, as at $t^{\times}$, to enter when screwed in and to be locked within any one of the three intersecting circular holes forming the slot e^{70}, as best seen in Fig. 4 in dotted lines and in Fig. 5, where the adjacent parts are slightly broken away.

M (see Fig. 1) is a lever of usual construction splined to a groove n^8 (only shown in Fig. 6) in the reversing-shaft R, its hub m entering the apron-bearing e^{90} and having a groove m', Fig. 4, to receive a pin m^2, by which it is caused to travel with the carriage and is always at hand for reversal of the carriage or stoppage thereof in well-known fashion.

I preferably furnish also cams m^3 m^4, coöperating with adjustable cam-stops r r' to cause automatic stoppage or reversal of the carriage at the respective ends of its predetermined range of movement.

I regard the provision of interlocking means between the power-feed mechanism and open-and-shut nut, or the equivalent of the latter, as an important feature of my invention, and various connections may be made therewith in addition to that described above—as, for example, the connection I have illustrated in Fig. 8; but the claims upon the interlocking means are not limited to the specific mechanism illustrated in Fig. 8. As illustrated, this portion of the interlocking mechanism is applied in part to the lever P in the form of shoulders p^8 p^9 and partly to the rocking plate t^4 in the form of arms or projections t^{30} t^{31}, extended from the plate adjacent to and adapted to coöperate at times with the shoulders. In the position illustrated (the lead-screw being thrown out and the worm-shaft connected) the projections will clear the shoulders if the plate be rotated either to the right or to the left, so that either the power cross-feed or longitudinal feed may be thrown in. When, however, the handle K is turned to throw on the open-and-shut nut, the movement of the lever P to the left will carry its shouldered portion to such a position that upon an attempt to rock the plate t^4 to the left the arm t^{30} will engage the shoulder p^8, and rocking movement in the opposite direction will be prevented by engagement of the arm t^{31} and shoulder p^9, thus effectually stalling the rock-gear t and power-feeds when the lead-screw is in mesh.

Having thus fully described my invention, I wish it understood that I do not limit myself to the exact construction and arrangement of parts shown, since the same may be widely varied and remain within the spirit of my invention.

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

1. In a lathe; a traveling tool-carrier; a lead-screw and power-feed mechanism adapted respectively to actuate said carrier, each independently of the other, and devices, under the control of the operator at the tool-carrier, to regulate the rate of longitudinal feed of said tool-carrier by said power-feed mechanism, substantially as described.

2. In a lathe; a traveling tool-carrier; its apron; a lead-screw and power-feed mechanism adapted respectively to actuate said carrier, each independently of the other, and means movable with said tool-carrier and con-

tinually under the control of the operator at said apron, to regulate the rate of travel of said tool-carrier and apron, when actuated by said power-feed mechanism, substantially as described.

3. In a lathe; a traveling tool-carrier; actuating mechanism therefor, including power-feed mechanism and a lead-screw adapted to operate independently of each other; and devices under the control of the operator at the tool-carrier, to regulate the rate of actuation of said tool-carrier by said power-feed mechanism and lead-screw respectively, substantially as described.

4. In a lathe; an apron; a lead-screw; power-feed mechanism; and variable-speed mechanism movable with, and to permit the actuation of, said apron by said lead-screw and power-feed mechanism respectively, at different rates of speed, substantially as described.

5. In a lathe; a traveling tool-carrier; actuating means therefor, including power-feed mechanism and variable-speed mechanism; and means, under the control of the operator at the tool-carrier to regulate the speed transmitted to the latter through said mechanisms, substantially as described.

6. In a lathe; a traveling tool-carrier; actuating means therefor, including power cross and longitudinal feed mechanism and variable-speed mechanism carried by said tool-carrier; and a selector device to govern the speed transmitted by said variable-speed mechanism and power cross and longitudinal feed mechanism to the tool-carrier, substantially as described.

7. In a lathe; the bed; a rotatable lead-screw extended in parallelism with said bed; a tool-carrier adapted to traverse said bed and screw longitudinally; and means movable with said carrier and operative during traversing movement of the same to rotate said lead-screw.

8. In a lathe; a rotatable lead-screw; an apron adapted to be actuated by rotation of said screw to traverse longitudinally; variable-speed mechanism carried by said apron; and means to permit rotation of said lead-screw at times by said mechanism, substantially as described.

9. In a lathe; a rotatable lead-screw; an apron adapted to traverse said lead-screw longitudinally; variable-speed mechanism carried by said apron and adapted to be operatively connected with said lead-screw at times to rotate the same and cause the apron to traverse; and a selector device for said variable-speed mechanism, substantially as described.

10. In a lathe; a rotatable shaft or screw; an apron adapted to traverse said shaft longitudinally; a plurality of different-sized gears surrounding said shaft coaxially, movable with said apron, and adapted respectively to be connected operatively with said shaft to rotate the same at times, substantially as described.

11. In an apparatus of the class described; a rotatable lead-screw; a stack of gears surrounding said screw coaxially and normally free to rotate independently thereof; an intermediate member adapted when rotated to rotate said lead-screw; and means to govern actuation of said intermediate member by said gears, substantially as described.

12. In an apparatus of the class described; a lead-screw; a stack of connected, varisized gears surrounding said shaft coaxially; a clutch member adapted when actuated to operate said screw; a coöperating clutch member adapted to be driven by said stack; and means to operate said clutch, substantially as described.

13. In an apparatus of the class described, the frame; a lead-screw rotatably mounted in suitable bearings on said frame and an apron free to travel on the frame lengthwise of the screw; a quill mounted in suitable bearings on said apron and provided with a stack of varisized gears; said quill being of suitable internal diameter to receive said lead-screw and permit free relative axial movement between screw and quill, during travel of the apron lengthwise of said screw; an annular clutch member coaxially arranged with respect to said screw and connected rotatively therewith, but capable of free axial movement with said apron; a coöperating clutch member connected with said stack; and means to operate said clutch, substantially as described.

14. In an apparatus of the class described, a rotatable lead-screw; an apron having a device adapted to be operatively connected with said lead-screw, to permit the apron to be fed thereby; and means mounted on said apron, to engage and rotate said lead-screw to feed said apron; said means being arranged in close juxtaposition to said device, substantially as described.

15. In a lathe; a rotatable lead-screw; an actuating-shaft; an apron arranged to traverse said screw and shaft longitudinally; and means carried by said apron to connect said screw and shaft operatively, at times, substantially as described.

16. In a lathe; a rotatable lead-screw; an actuating-shaft; an apron arranged to be actuated by said screw; and means carried by said apron to permit rotation of said screw by said shaft, at different rates of speed, substantially as described.

17. In a lathe; a rotatable lead-screw; an actuating-shaft; an apron adapted to traverse said screw and shaft longitudinally; and means to permit actuation of said apron by said actuating-shaft both by rotation of said lead-screw, and independently thereof, substantially as described.

18. In an apparatus of the class described, an actuating-shaft; an apron adapted to traverse said shaft longitudinally; a lead-screw actuated from said shaft through the medium of means movable with said apron and adapted

to actuate said apron; means to permit actuation of said apron by said shaft independently of said lead-screw; and interlocking devices to prevent concurrent operation by said shaft of said lead-screw and said independent means, substantially as described.

19. In a lathe; a lead-screw; an apron adapted to be actuated by said lead-screw and also by independent actuating means; controlling devices to govern respectively the actuation of said apron by said lead-screw and by said independent actuating means; and interlocking devices intermediate said controlling devices to prevent concurrent operation by said shaft of said lead-screw and said independent means, substantially as described.

20. A controller of the class described, comprising a disk, provided with a suitable handle and having slots to serve as actuating means for nut members; said disk being also provided with a projection to receive and cooperate with a slotted portion of an interlocking lever to actuate said lever directly, substantially as described.

21. In a lathe; a lead-screw; an apron adapted to be fed thereby and provided with power-feed mechanism; an open-and-shut nut for said lead-screw, and a nut-controller; a clutch device for said power-feed mechanism; and an interlocking lever or link connecting said nut mechanism and clutch, to permit the said clutch to be governed and operated by movement of said nut-controller, substantially as described.

22. In a lathe; an apron; power-feed mechanism and variable-speed mechanism both movable with said apron and adapted to be connected operatively at times to permit actuation of said power-feed mechanism at different rates of speed, substantially as described.

23. In a lathe; an apron, and power-feed mechanism carried thereby, including a worm; variable-speed mechanism also carried by said apron and adapted to be connected operatively with said worm at times to permit actuation of said power-feed mechanism at different rates of speed, substantially as described.

24. In a lathe; an apron; variable-speed mechanism and power-feed mechanism carried thereby; a clutch intermediate said mechanisms, and a controller for said clutch; and an actuating-shaft connected operatively with said variable-speed mechanism, substantially as described.

25. In a lathe; a rotatable lead-screw; an apron; variable-speed mechanism carried thereby and adapted to rotate said lead-screw at times; and actuating mechanism connected operatively with said variable-speed mechanism, and including coöperating cones of auxiliary multiple-speed gears, any coöperating pair of which may be made effective by the operator, at will, substantially as described.

26. In a lathe; an apron; a shaft; gears and independent separating-rings thereon; a feathered spline carried thereby; and a handle for said spline, said handle being extended toward and arranged to move near the path of said apron; all constructed and arranged to operate in the manner and for the purpose set forth.

27. In an apparatus of the class described; a rotatable lead-screw; an apron having a device adapted to be operatively connected with said lead-screw, to permit the apron to be fed thereby; actuating mechanism for said lead-screw, movable with said apron, and means intermediate said device and mechanism to insure concurrent operation of the same, substantially as described.

28. In a lathe; an apron; an actating-shaft; a rotatable lead-screw, and power-feed mechanism, actuated respectively from said shaft, and adapted respectively to actuate said apron; and interlocking means to prevent concurrent actuation of said apron by said lead-screw and power-feed mechanism, substantially as described.

29. In an apparatus of the class described; a tool-carrier; an actuating-shaft; a rotatable lead-screw, and power-feed mechanism, actuated respectively by said shaft, and adapted respectively to actuate said tool-carrier; controlling means for said power-feed mechanism; and interlocking devices coöperating with said controlling means, to prevent concurrent actuation of said apron by said lead-screw and power-feed mechanism, substantially as described.

30. In an apparatus of the class described; a rotatable lead-screw; an apron having a device adapted to be connected operatively with said lead-screw to permit said apron to be fed by rotation thereof; actuating mechanism movable with said apron, to rotate said lead-screw; and means to control the actuation of said lead-screw by said mechanism, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

BENJAMIN A. WHEELER.

Witnesses:
ALEX. C. PROUDFIT,
GEO. W. GREGORY.