(No Model.) 4 Sheets—Sheet 1.

E. L. STRIEGLER.

LATHE AND ATTACHMENT.

No. 597,303. Patented Jan. 11, 1898.

Fig. 1.

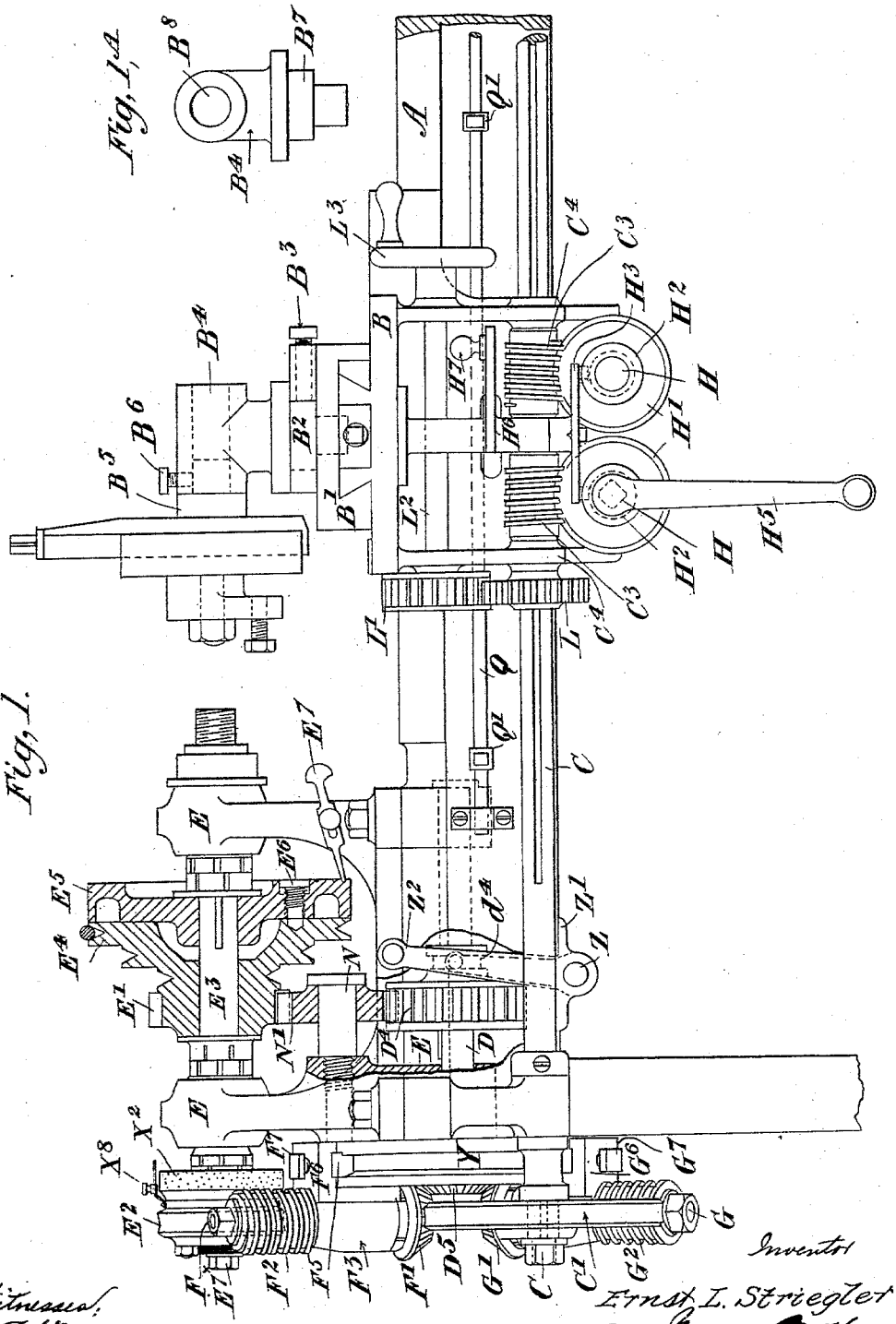

Fig. 1a.

Witnesses:
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(No Model.) 4 Sheets—Sheet 2.

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Fig. 3.

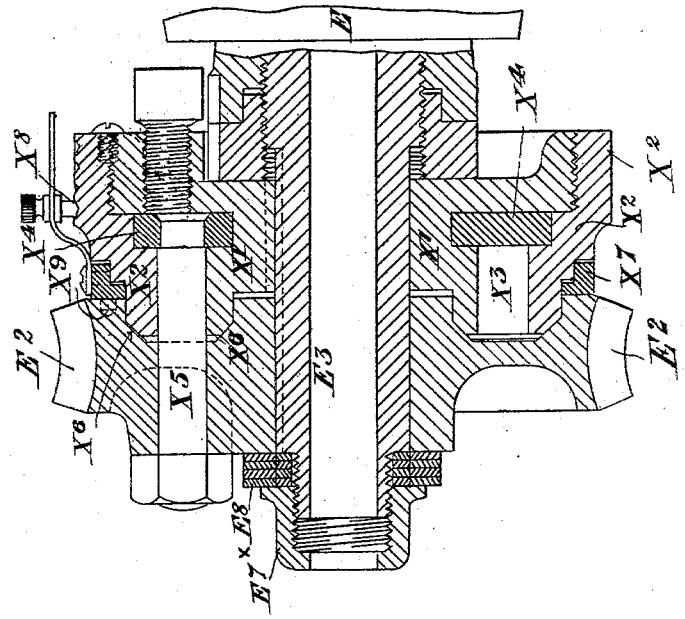
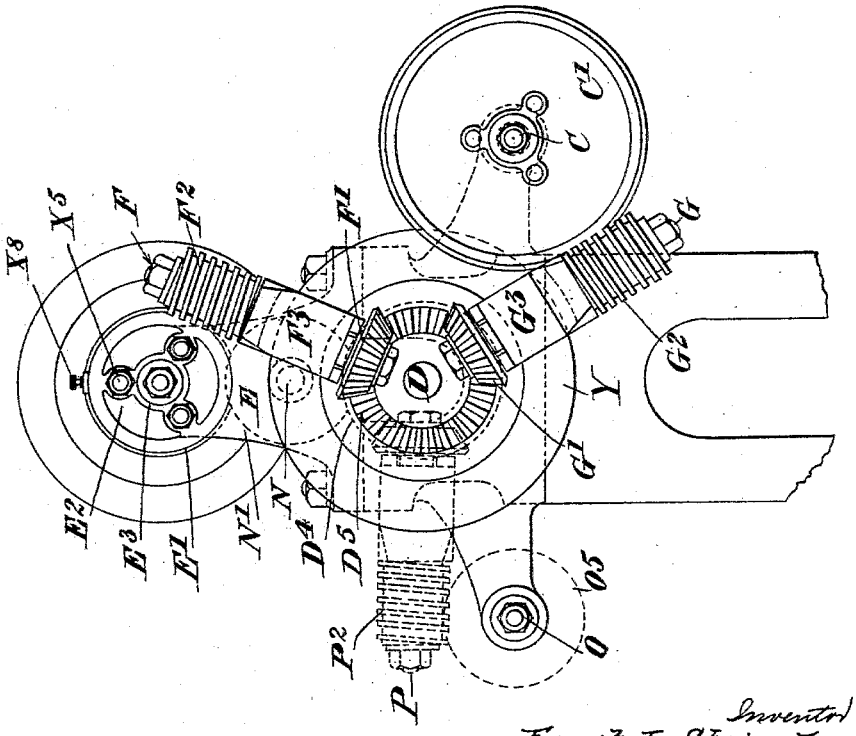


Fig. 2.



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(No Model.) 4 Sheets—Sheet 3.

E. L. STRIEGLER.

LATHE AND ATTACHMENT.

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Fig. 5.

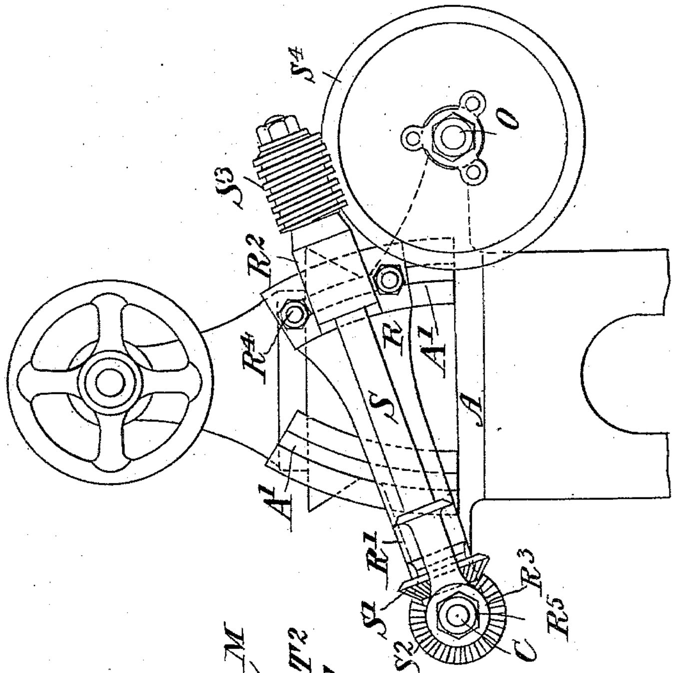
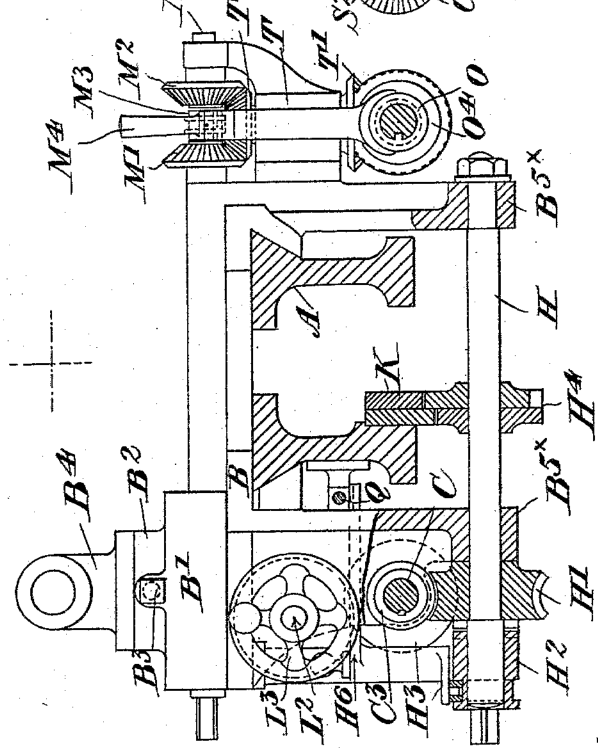


Fig. 4.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 4 Sheets—Sheet 4.

E. L. STRIEGLER.

LATHE AND ATTACHMENT.

No. 597,303. Patented Jan. 11, 1898.

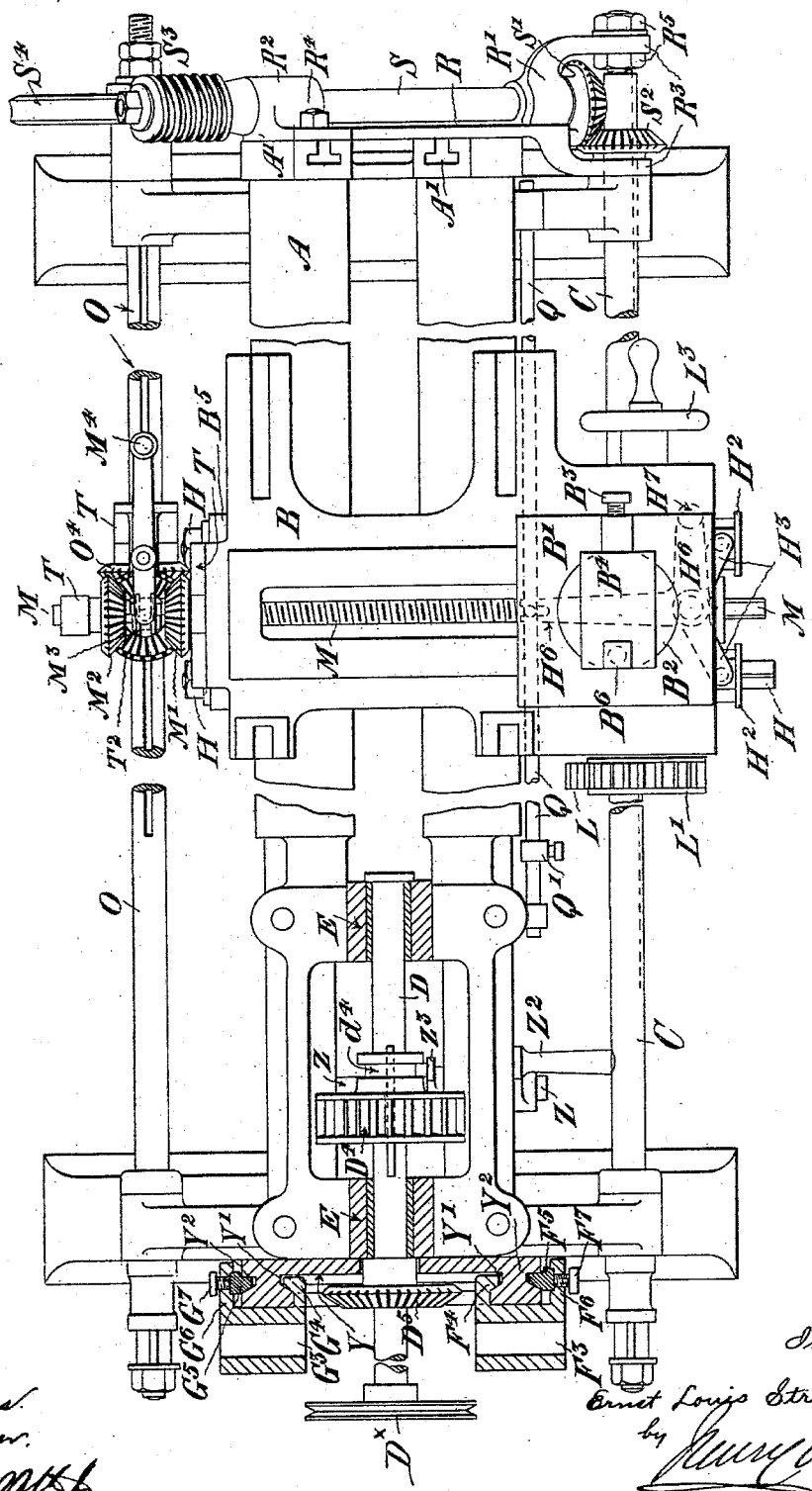

Fig. 6.

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UNITED STATES PATENT OFFICE.

ERNST LOUIS STRIEGLER, OF LONDON, ENGLAND.

LATHE AND ATTACHMENT.

SPECIFICATION forming part of Letters Patent No. 597,303, dated January 11, 1898.

Application filed December 28, 1896. Serial No. 617,252. (No model.)

To all whom it may concern:

Be it known that I, ERNST LOUIS STRIEGLER, gentleman, a citizen of the United States of Brazil, residing at No. 5 Madeley Road, Ealing, London, in the county of Middlesex, England, have invented new and useful Improvements in Lathes and in Attachments to be Used Therewith, of which the following is a specification.

My invention refers to lathes, which I so construct as to make the tool-holder or work on the slide-rest capable of motion automatically in a longitudinal or a transverse direction at right angles to the first and also transverse motion at any desired angle. To these motions can be added a sweep of the tool-holder in a vertical plane at various and varying radii.

In the accompanying drawings, Figure 1, Sheet 1, is a broken side view, partly in section. Fig. 1^A is an elevation of a slide-rest attachment B^4. Fig. 2, Sheet 2, is an end elevation of the lathe at the left hand of the operator. Fig. 3 is a detail view of a mandrel-clutch and dividing-plate to a larger scale. Fig. 4, Sheet 3, is an irregular cross-section. Fig. 5 is an end elevation at the right hand of the operator; and Fig. 6, Sheet 4, is a broken plan, partly in section.

The bed A of the lathe is of the usual construction, and has mounted thereon a saddle B, capable of longitudinal or traversing motion. The saddle-slide B′ is provided with a recessed part B^2, into which fits the lug B^5 of the slide-rest, and a set-screw B^3 or other convenient means of fixing is utilized for attaching the slide-rest directly thereto for ordinary work.

In order that the slide-rest may be used for holding the work at right angles—vertically, for instance—to the saddle-slide B′, as in milling, in which case the milling-tool is secured to the lathe-centers, I provide a separate slide-rest holder or attachment B^4, provided with a bearing for the stud B^5 of the slide-rest, in which bearing B^8 the said stud or lug B^5 is secured by means of a set-screw B^6, the attachment being likewise provided with a lug B^7, that fits the slide-rest recess B^2 in the saddle-slide B′, in which it is secured by the aforementioned set-screw B^3, as shown in Fig. 1.

The milling-tool being mounted in a suitable holder and provided with driving-pulleys receiving motion from any convenient source of power may also be attached to the slide-rest.

A counter-shaft D is mounted inside the bed A, or, as shown upon the drawings, in lugs on the under side of the head-stock E. This counter-shaft D may be driven directly from any convenient source of power—for example, by simply extending the shaft sufficiently to the left hand to receive speed-pulleys or a pulley D^X, Fig. 6, or it may be driven indirectly from the mandrel E^3 by means of two or more spur-wheels, such as E′, N′, and D^4. The wheel N′ is an idle-wheel, and is mounted freely on a pin N, mounted in the head-stock E. The pin N is of sufficient length to permit of the spur-wheel N′ being moved out of gear with the spur-wheel E′.

The spur-wheel D^4 drives, by means of a feather, the counter-shaft D, along which it can be readily moved, and is provided with cheeks which serve to retain the idle-wheel N′ always in gear. Thus by moving the wheel D^4 along the shaft D the idle-wheel N′ may be thrown into and out of gear with the spur-wheel E′. To effect this, the spur-wheel D^4 is provided with a grooved collar d^4, into which gears a lever Z^3, mounted on a spindle Z in bearings Z′, secured to the under side of the bed A. The spindle Z may conveniently be operated by a reversing-lever Z^2. The wheel E′, which is not keyed on the mandrel, is secured to or forms part of the speed-pulleys E^4, which drive the mandrel directly by means of any suitable coupling—such as E^5—keyed on the mandrel E^3 and screwed to the pulleys by means of a screw or pin E^6. When it is desired to drive the mandrel indirectly through the counter-shaft D, the coupling E^5 is disengaged from the speed-pulleys E^4. On this counter-shaft D, to the left hand of the operator, is mounted a bevel-wheel D^5. Gearing with this bevel-wheel are two bevel-wheels F′ G′, mounted at one end, respectively, of two radial shafts F and G, which have likewise mounted on the other ends, respectively, two worms F^2 G^2, communicating motion to worm-wheels C′ E^2, mounted on a feed-shaft C and mandrel E^3, respectively.

In order to allow for different-sized worm-

wheels being used, the shafts F and G are mounted in bearings F^3 G^3, which are capable of being revolved around the center of the counter-shaft D. To attain this movement and at the same time to insure that the shafts F and G radiate from the center of the counter-shaft D, the bearings F^3 G^3 slide upon and are secured to a grooved circular ring or slide Y. The groove Y′ on the inside of the ring Y receives lips F^4 G^4 on the bearings F^3 G^3. The outer side of the groove Y′ is beveled to receive a corresponding bevel on the lips F^4 G^4. The groove Y^2 on the outside of the ring Y is similarly beveled to receive beveled keys F^5 G^5, which also fit into grooves in lugs F^6 G^6 on the bearings F^3 G^3. The lugs F^6 G^6 carry set-screws F^7 G^7, which bear on the keys F^5 G^5 and force them into the groove Y^2, at the same time drawing the lips F^4 G^4 more deeply into the groove Y′, and by reason of the said beveled edges the bearings F^3 G^3 onto the face of the ring Y.

The worm-wheel E^2 drives the mandrel for slow speeds by means of a clutch X′ X^2, provided with a feather which takes into a feather-way on the mandrel. (See Fig. 3.) This clutch is so arranged as to be readily removed from the mandrel, with the worm-wheel attached, by simply removing the nut $E^{7\times}$ and washers E^8, and also is so arranged as to be readily connected and disconnected from the worm-wheel for the purpose of dividing. The clutch may conveniently be formed of two rings X′ X^2, so shaped that when secured together by a screw-thread, as shown, or by other suitable means they afford an annular T-shaped slot X^3, into which is inserted in segments, before the said rings X′ X^2 are so secured, a ring X^4, having one or more bolts X^5 attached thereto.

Either of the two rings X′ X^2, or both, as shown, may be beveled, so as to form a projecting cone X^6, which takes into a corresponding coned recess in the worm-wheel E^2, so that when the bolts X^5 are tightened up the worm-wheel E^2 may be firmly secured to the clutch X′ X^2.

Riding over the clutch X′ X^2, and between the same and the worm-wheel E^2, is a ring X^7, which carries a spring-pointer X^8. In order that the ring with its pointer may indicate the relative positions of the worm-wheel and the clutch, and therefore the mandrel, there is provided on the ring X^7 a pin or other projection X^9, which takes into a hole or slot in the worm-wheel E^2, and the face of the clutch X′ X^2 is suitably divided by holes or slots to receive the pointer X^8. With a view of offering further facilities for dividing, the front side face of the coupling E^5 is subdivided and an adjustable pointer E^7 is mounted on the head-stock in connection therewith.

Feed-shafts C and O, provided each with a feather-way, are mounted in brackets on the front and back of the bed A, respectively. Motion may be communicated to either or both of these feed-shafts from the counter-shaft D by means of the worms F^2 G^2 on the radial shafts F and G gearing with worm-wheels C′ O^5 on the feed-shafts C and O, or when found more convenient by a worm G^2 on the radial shaft G and a worm P^2 on a third radial shaft P. (Shown in dotted lines in Fig 2.) The arrangement of such a third radial shaft P would be similar in every respect to the radial shafts F and G, already described.

When desirable, one only of the two feed-shafts C and O may be driven directly by a radial shaft from the counter-shaft D, the remaining feed-shaft being driven indirectly by suitable gearing which connects the two feed-shafts to the right hand of the operator. Such gearing as shown upon the drawings may consist of a bracket R, Figs. 5 and 6, having two bearings R′ R^2 for carrying a radial connecting-shaft S and having also at one end a collar or collars R^3 to take over either of the shafts C or O and at the other end lugs carrying T-headed bolts R^4, which take into T-slots A′ on the end of the bed A.

These T-slots are segments of a circle struck from the centers of the shafts C and O. Thus the bracket R can be moved radially to either shaft C or O and secured within certain limits in any desired position. On one end of the connecting-shaft S is mounted a bevel-wheel S′, which gears into a bevel-wheel S^2, capable of being mounted on either shaft C or O. On the other end of the shaft S is mounted a worm S^3, which gears into a worm-wheel S^4, capable of being mounted on either shaft C or O.

Nuts R^5 are provided to retain the collar or collars R^3 in position, both shafts C and O being threaded to receive said nuts. As shown upon the drawings, the feed-shaft C is driven from the counter-shaft D, the feed-shaft O being driven from the feed-shaft C by means of the gearing just described to the right hand of the operator; but it is evident that the bracket R being reversible the shaft O may drive the shaft C.

The longitudinal or traversing self-acting motion of the saddle B is effected by means of right and left handed worms C^3, having feathers which take into the feather-way in the shaft C, and these worms are held between brackets C^4, projecting from the saddle in such manner that as the feed-shaft C revolves and with it the worm C^3 motion is transmitted from the worms C^3 to two worm-wheels H′, mounted loosely on two shafts H, running in bearings in brackets $B^{5\times}$, forming a portion of the saddle B and projecting downward below the bed A on each side thereof. The worm-wheels H′ are provided with jaws into which take coupling sleeves or clutches H^2, provided with corresponding jaws. These coupling-sleeves H^2 are provided with feathers which take into feather-ways on the shafts H, and both can be moved out of gear with their corresponding worm-wheels H′, or either sleeve may be coupled with its correspond-

ing worm-wheel by means of a lever H^3, pivoted centrally between the two shafts H on the saddle B or a bracket attached thereto.

On each of the shafts H is keyed a pinion H^4, which gears with a rack K, bolted to the bed A. By this arrangement the saddle can be moved in either direction. Both the rack and the pinions may be composed of two or more similar sections arranged and secured together so that the pitch of the teeth may overlap or be subdivided into as many portions as there are sections forming the rack and pinions. Rapid movement of the saddle in either direction, both sleeves being out of gear with their respective worm-wheels, may be obtained by hand by means of a handle H^5, fitted to either of the shafts H. Slow motion of the saddle in either direction may be obtained by hand, either sleeve H^2 being coupled to its corresponding worm-wheel by means, for example, of a pinion L, loosely mounted on the feed-shaft C and gearing with a wheel L', with which it is retained in gear by means of cheeks on either side of the said wheel L', this wheel L' being mounted on a spindle L^2, running in bearings in the bracket C^4 and provided with a handle or hand-wheel L^3. It will readily be understood that to obtain this slow motion of the saddle by hand when the worm-wheel C' is mounted on the shaft C it will be necessary to move the worm on the radial shaft out of gear with the worm-wheel C'.

Motion is communicated from the feed-shaft O to the surfacing feed-screw M by means of a bevel-wheel O^4, provided with a feather which takes into the feather-way in the shaft O. The wheel O^4 is provided with a neck which revolves within a bearing provided in a bracket T, bolted to the saddle B, so that the wheel O^4 is compelled to slide along the shaft O in accordance with the movement of the saddle B. Into this wheel O^4 gears a bevel-wheel T', keyed on a vertical spindle running in the bracket T. At the upper end of the spindle is keyed a second bevel-wheel T^2, which gears into two bevel-wheels M' M^2, mounted loosely on the surfacing feed-screw M. Between the two wheels M' M^2 is mounted a sliding sleeve M^3. This sleeve is provided with a feather which slides in a feather-way on the surfacing feed-screw M.

Both the wheels M' M^2 and the sliding sleeve M^3 are provided with jaws, so that motion from the bevel-wheel T^2 may be communicated to the feed-screw M in either direction, as desired. To facilitate the movement of the sleeve M^3, a groove is provided in the sleeve, into which takes the end of a reversing-handle M^4, pivoted on the bracket T.

The longitudinal traverse of the saddle can be stopped automatically by means of adjustable stops Q' on a rod Q, fixed to the bed A. The adjustable stops Q' operate a lever H^6, which is pivoted at the same point as the lever H^3, which operates the couplings H^2, already described.

The lever H^6 may be made bell-cranked, as shown, to provide a handle H^7, by means of which the longitudinal traverse of the saddle may be stopped at any point without stopping the automatic surfacing motion or otherwise.

I claim—

1. In a lathe, the combination with the mandrel, means for driving the same, a counter-shaft geared to said mandrel and two feed-shafts; of gearing geared to and adjustable about the axis of said counter-shaft and adapted to be geared to one or the other or both feed-shafts, for the purpose set forth.

2. In a lathe, the combination with the mandrel, means for driving the same, a counter-shaft geared to said mandrel, two feed-shafts geared together and means for throwing said gearing into and out of operation; of gearing geared to and adjustable about the axis of the counter-shaft and adapted to be geared to one or the other or both feed-shafts, for the purpose set forth.

3. In a lathe, the combination with the mandrel and a counter-shaft geared together and adapted to be driven independently of each other, means for throwing said gearing into and out of operation, and a feed-shaft; of gearing geared to and adjustable about the axis of said counter-shaft and adapted to be geared to the mandrel or feed-shaft or both, for the purpose set forth.

4. In a lathe, the combination with the mandrel and a counter-shaft geared together and adapted to be driven independently of each other, means for throwing said gearing into and out of operation, and two feed-shafts; of gearing geared to and adjustable about the axis of said counter-shaft and adapted to be geared to the mandrel and to one or the other or both feed-shafts, for the purpose set forth.

5. In a lathe, the combination with the mandrel and a counter-shaft geared together and adapted to be driven independently of each other, means for throwing said gearing into or out of operation, two feed-shafts geared together and means for throwing the last-named gearing into or out of operation; of gearing geared to and adjustable about the axis of the counter-shaft and adapted to be geard to said mandrel and to one or the other or both feed-shafts, for the purpose set forth.

6. In a lathe, the combination with the mandrel, a driving counter-shaft geared thereto and two feed-shafts; of gearing geared to and adjustable about the axis of said counter-shaft and adapted to be geared to one or both feed-shafts, for the purpose set forth.

7. In a lathe, the combination with the mandrel, a driving counter-shaft geared thereto, two feed-shafts geared together and means for throwing the latter gearing into or out of operation; of gearing geared to and adjustable about the axis of said counter-shaft and adapted to be geared to one or the other or both said feed-shafts, for the purpose set forth.

8. In a lathe, the combination with the man-

drel and a counter-shaft geared thereto, said mandrel and shaft adapted to be driven independently of each other, mechanism for throwing said gearing into or out of operation, two feed-shafts, the saddle, the saddle-slide and its feed-screw, said saddle and feed-screw respectively geared to said shafts; of gearing geared to and adjustable about the axis of the counter-shaft and adapted to be geared to the mandrel and to one or the other or both said feed-shafts, for the purpose set forth.

9. In a lathe, the combination with the mandrel and a counter-shaft geared thereto, said mandrel and shaft adapted to be driven independently of each other, mechanism for throwing said gearing into or out of operation, two feed-shafts geared together, means for throwing said gearing into or out of operation, the saddle, the saddle-slide and its feed-screw, said saddle and feed-screw respectively geared to said shafts; of gearing geared to and adjustable about the axis of the counter-shaft and adapted to be geared to the mandrel and to one or the other or both said feed-shafts, for the purpose set forth.

10. In a lathe, the combination with the mandrel, a driving-pulley and gear loose thereon, a clutch-coupling for coupling said pulley and gear to the mandrel, a counter-shaft, means for driving the same, gearing from said shaft to the gear on the mandrel, means for throwing said gearing into and out of operation, two feed-shafts, the saddle, the saddle-slide and its feed-screw, and mechanism operated by said shafts and imparting motion to said saddle and screw respectively; of spindles adjustable about the axis of the counter-shaft, said spindles carrying gear-wheels geared to said shaft and gears adapted to be geared to the mandrel and to one or the other or both feed-shafts, for the purpose set forth.

11. In a lathe, the combination with the mandrel, a driving-pulley and gear loose thereon, a clutch-coupling for coupling said pulley and gear to the mandrel, a counter-shaft, means for driving the same, gearing from said shaft to the gear on the mandrel, means for throwing said gearing into and out of operation, two feed-shafts geared together, means for throwing said gearing into or out of operation, the saddle, the saddle-slide and its feed-screw, and mechanisms operated by said shafts and imparting motion to said saddle and screw respectively; of spindles adjustable about the axis of the counter-shaft, said spindles carrying gear-wheels geared to said shaft and gears adapted to be geared to the mandrel and to one or the other or both feed-shafts, for the purpose set forth.

12. In a lathe, the combination with the front and back feed-shafts, carrying a bevel-wheel and worm-wheel respectively, of a spindle carrying a bevel-wheel and worm adapted to respectively gear with said bevel and worm wheels on said shafts, and a support for and on which said spindle is adjustable in an arc of a circle, for the purpose set forth.

13. In a lathe, the combination with the front and back feed-shafts carrying a bevel and worm wheel respectively, said wheels removably secured to their respective shafts; of a spindle carrying a bevel and a worm wheel at opposite ends respectively, and a support for and with which said spindle is reversibly connected and adapted to be adjusted in an arc of a circle, for the purpose set forth.

14. In a lathe, the combination with the mandrel and a counter-shaft geared together and adapted to be driven independently of each other, means for throwing said gearing into and out of operation, a bevel-wheel on said counter-shaft, a toothed rack on the lathe-bed, the saddle, two spindles having bearing in said saddle, said spindles geared to the toothed rack, and carrying each a worm-wheel; of a feed-shaft carrying a right and left hand worm in gear with said worm-wheels, means for throwing one or the other of the worm-gears into and out of operation, and a worm-wheel at one end thereof, and a spindle carrying a worm in gear with said worm-wheel, and a bevel-wheel in gear with the like wheel on the counter-shaft, said spindle adjustable about said counter-shaft, for the purpose set forth.

15. The combination with the toothed rack K, the saddle, the shafts H, H, revoluble in bearings on said saddle, and carrying each a pinion in gear with said rack, and a worm-wheel revoluble with and having sliding motion on their respective shafts, and a hand-operated spindle revoluble in bearings on the saddle and carrying a pinion L'; of the feed-shaft, driving mechanism therefor, means for throwing said mechanism into and out of operation, said feed-shafts carrying the pinion L geared to pinion L' and a right and left hand worm in gear with the worm-wheels on the shafts H H, and means for throwing one or the other of the aforesaid worm-gears into and out of operation, for the purpose set forth.

16. The combination with the lathe-mandrel and a counter-shaft geared together and adapted to be driven independently of each other, a bevel-wheel on said counter-shaft, the saddle, the surfacing-screw revoluble therein and carrying two bevel-wheels, a vertical spindle carrying a bevel-wheel at each end, the bevel-wheel at the upper end adapted to be geared with one or the other bevel-wheel on the feed-screw, a feed-shaft, a bevel-wheel thereon in gear with the one on the lower end of the aforesaid vertical spindle, and a worm-wheel at one end of said feed-shaft; of a spindle arranged radially relatively to and adjustable about the aforesaid counter-shaft and carrying a bevel-wheel and a worm, the former in gear with the bevel-wheel on the counter-shaft and said worm adapted by adjustment of the spindle to be geared to the worm-wheel on the feed-shaft, for the purpose set forth.

17. The combination with the lathe-mandrel and a counter-shaft geared together and adapted to be driven independently of each

other, a bevel-wheel on said counter-shaft, the saddle, the saddle-slide and feed-screw revoluble therein, two bevel-wheels loose on said screw, clutch mechanism adapted to lock one or the other of said bevel-wheels to said screw, a vertical spindle, a bevel-wheel at each end thereof, one of said wheels in gear with the bevel-wheels on the screw, a feed-shaft, a bevel-wheel thereon in gear with the other like wheel on the aforesaid vertical spindle and a worm-wheel on said feed-shaft; of a spindle geared to and adjustable about the aforesaid counter-shaft, said spindle carrying a worm adapted to be geared to the worm-wheel on the feed-shaft, for the purpose set forth.

18. In a lathe, the combination with the saddle, the saddle-slide and the slide-rest, the latter provided with a cylindrical lug adapted to fit a like seat in said saddle-slide; of an attachment provided with a cylindrical lug fitting the aforesaid seat in the saddle-slide, and with a cylindrical bearing at right angles to its vertical axis for the lug on the slide-rest, and means for locking the attachment to the saddle-slide, and the slide-rest to said attachment, for the purpose set forth.

19. In a lathe, the combination with the mandrel and a worm-wheel thereon provided in one of its faces with an annular recess, substantially conical in cross-section; of a clutch consisting of the clutch-ring constructed with an annular projection fitting the aforesaid recess in the worm-wheel, and with an annular seat, said clutch-ring keyed to the mandrel, a circular bolt-carrier seated in the aforesaid clutch-ring seat, the bolts of said carrier projecting through the clutch-ring projection and the worm-wheel, and suitable nuts on the outer ends of said bolts, for the purpose set forth.

20. In a lathe, the combination with the mandrel and a worm-wheel loose thereon and provided in one of its faces with an annular groove having inwardly-converging walls, of a clutch composed of the separable clutch-rings X' X^2 keyed to the mandrel and constructed to form between them a circular groove T-shaped in section, a sectional bolt-carrier ring seated and locked in the wider portion of said groove, the bolts on said ring projecting through the narrower portion and through a circular rib having outwardly-converging walls and fitting the annular groove in the worm-wheel, said bolts passing through said worm-wheel, and suitable nuts at the other ends of said bolts, substantially as and for the purpose set forth.

21. The combination with the mandrel E^3 and the worm-wheel E^2 loose thereon and provided in one of its faces with an annular coned groove; of the clutch-ring composed of two rings X' X^2 provided with annular coned projections or ribs X^6 fitting the aforesaid coned groove in the worm-wheel, the ring part X^2 having peripheral divisions and said rings X' X^2 constructed to form between them the T-groove X^3, the segmental ring X^4 seated in the vertical portion of said T-groove and carrying bolts X^5 projecting through said worm-wheel, and suitable lock-nuts on said bolts, and the movable ring X^7 adapted to revolve with the worm-wheel and carrying a spring stud or pointer X^9 adapted to engage a peripheral division in the clutch-ring part X^2, substantially as and for the purpose set forth.

22. In a lathe, the combination with the mandrel carrying a worm-wheel, a counter-shaft carrying a bevel-wheel, said shafts geared together, means for throwing said gearing into and out of operation, a front feed-shaft geared to the bevel-wheel on the counter-shaft, and a back feed-shaft carrying a worm-wheel; of a radial spindle adjustable about the axis of rotation of the counter-shaft and carrying a bevel-wheel in gear with the like wheel on said shaft, and a worm adapted to gear with the worm-wheel on the mandrel or with that on the back feed-shaft, for the purpose set forth.

23. In a lathe, the combination with the mandrel and a counter-shaft geared together and adapted to be driven independently of each other, means for throwing said gearing out of operation, and a worm-wheel on said mandrel, and a bevel-wheel on said counter-shaft; of a feed-shaft, a worm-wheel thereon and a radial spindle adjustable about the axis of rotation of the counter-shaft, said spindle carrying a bevel-wheel in gear with the like wheel on said counter-shaft, and a worm adapted to gear with the worm-wheel on the mandrel or with the one on the feed-shaft, for the purpose set forth.

24. The combination with the mandrel and a counter-shaft geared together and adapted to be driven independently of each other, means for throwing said gearing into and out of operation, a feed-shaft geared to said counter-shaft, means for throwing the last-named gearing into and out of operation, the saddle and gearing from said feed-shaft to said saddle; of a second feed-shaft likewise geared to the aforesaid counter-shaft, means for throwing such gearing into and out of operation, the saddle-slide, its feed-screw, and gearing from said second feed-shaft to said feed-screw, substantially as and for the purpose set forth.

25. The combination with the mandrel, a gear loose thereon, a clutch-coupling for coupling said gear to said mandrel, a counter-shaft, gearing from said shaft to the gear on the mandrel, means for throwing said gearing into and out of operation, means for driving the mandrel and counter-shaft independently of each other, a feed-shaft geared to said counter-shaft, means for throwing said gearing into and out of operation, the saddle, and gearing from said feed-shaft to said saddle; of a second feed-shaft likewise geared to the counter-shaft, means for throwing said gearing into or out of operation, the saddle-slide, its feed-screw, and gearing from said second

feed-shaft to said feed-screw, substantially as and for the purpose set forth.

26. The combination with the mandrel and a counter-shaft geared together and adapted to be driven independently of each other, and means for throwing said gearing into and out of operation; of two feed-shafts geared together and to the counter-shaft, means for throwing the gearing between the feed-shafts and the gearing between them and the counter-shaft into or out of operation, the saddle, gearing from one of said feed-shafts to said saddle, the saddle-slide, its feed-screw, and gearing from the second feed-shaft to said screw, substantially as and for the purpose set forth.

ERNST LOUIS STRIEGLER.

Witnesses:
FRED C. HARRIS,
W. M. HARRIS.