E. C. HEAD.

MULTIPLYING GEARING.

APPLICATION FILED NOV. 10, 1917.

1,390,905.

Patented Sept. 13, 1921.

4 SHEETS—SHEET 1.

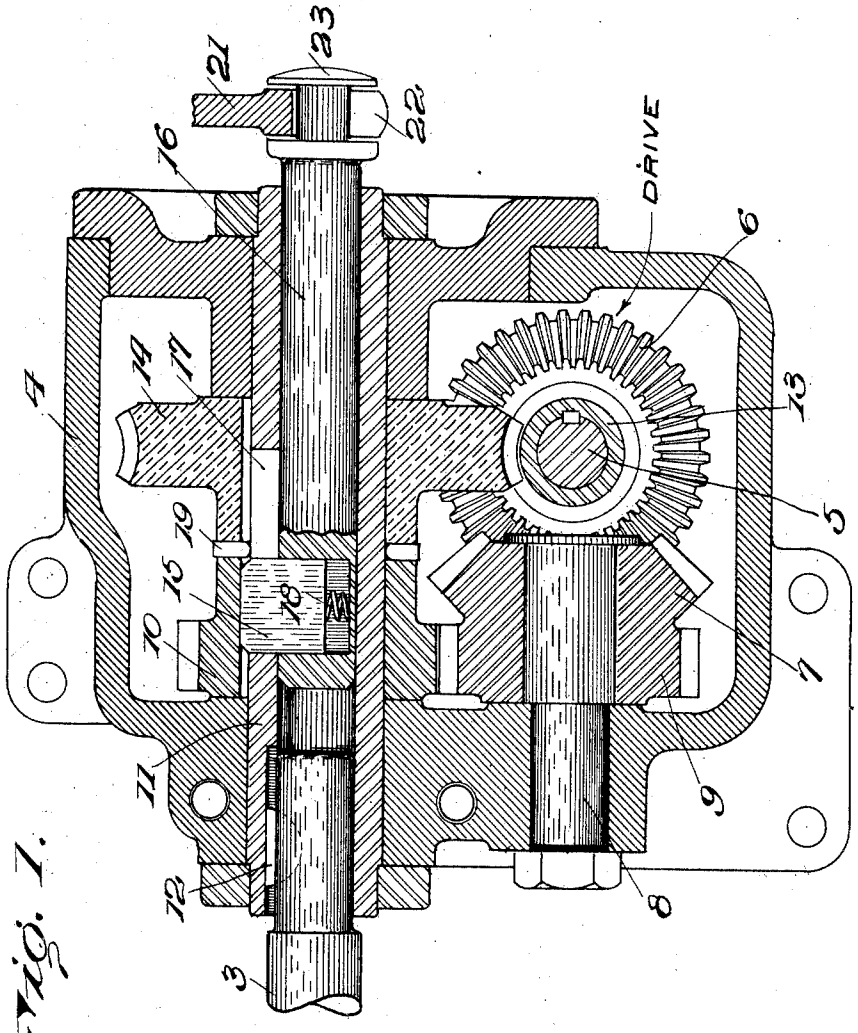


Fig. 1.

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4 SHEETS—SHEET 2.

Fig. 3.

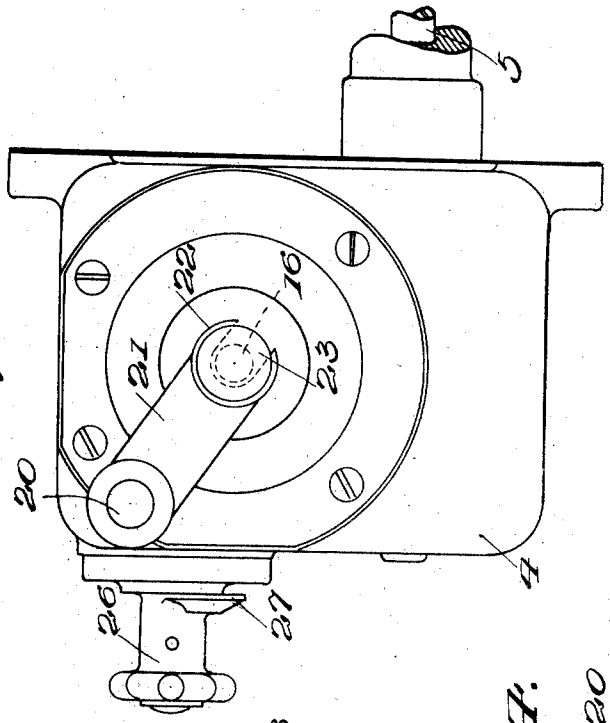


Fig. 4.

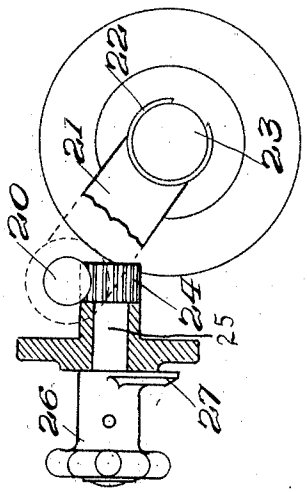
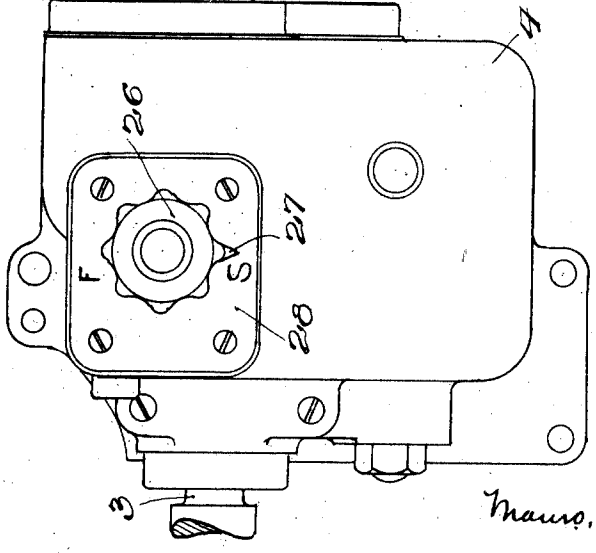


Fig. 2.



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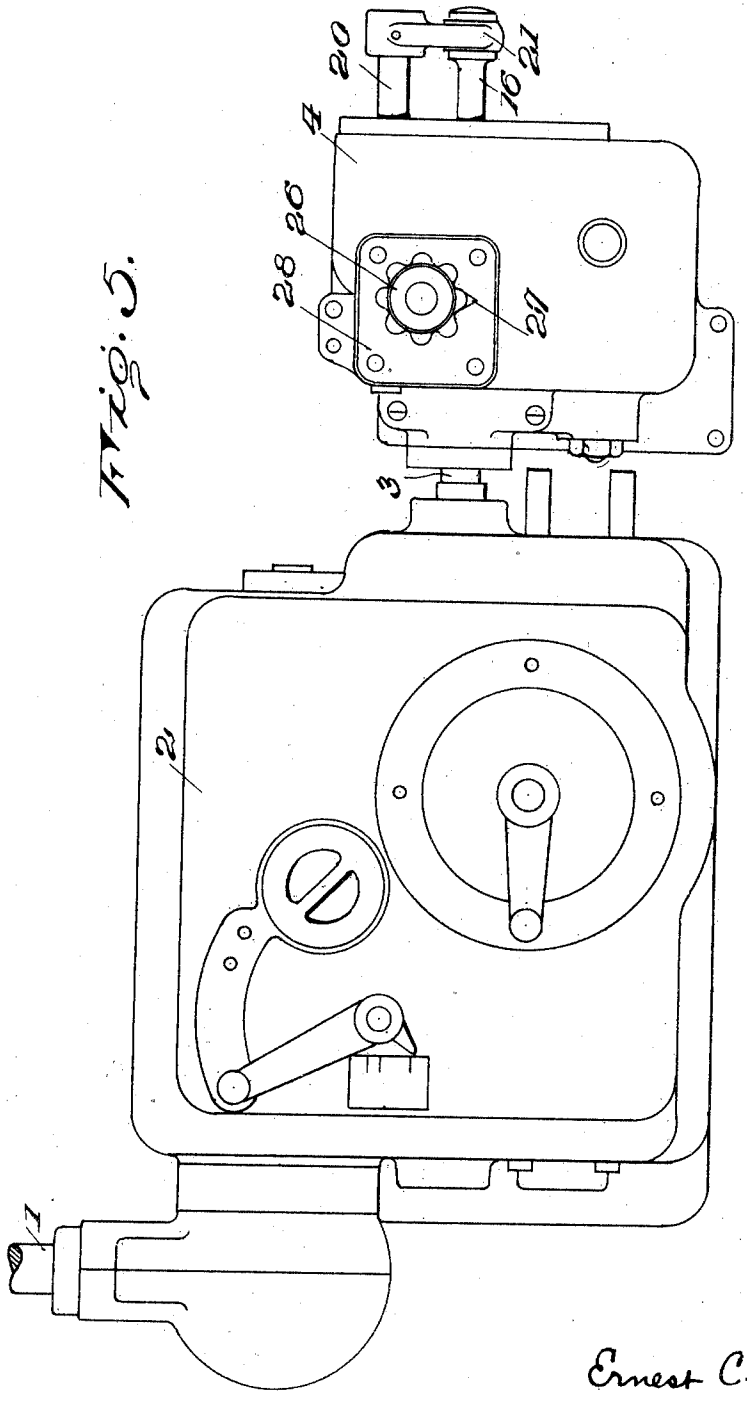
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4 SHEETS—SHEET 3.

Fig. 5.



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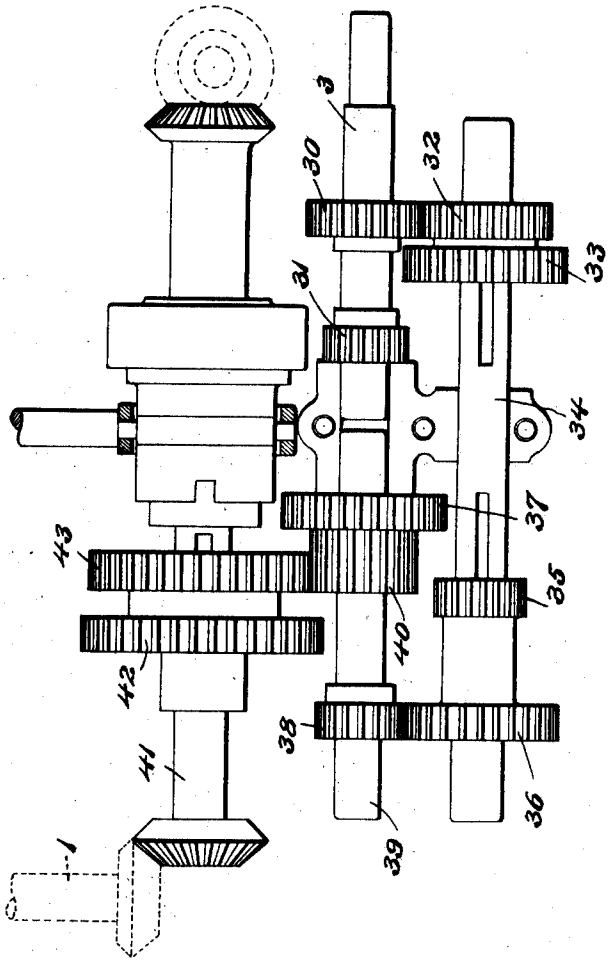
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4 SHEETS—SHEET 4.

Fig. 6.



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UNITED STATES PATENT OFFICE.

ERNEST C. HEAD, OF VAN WERT, OHIO, ASSIGNOR TO COLBURN MACHINE TOOL COMPANY, OF FRANKLIN, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

MULTIPLYING-GEARING.

1,390,905. Specification of Letters Patent. Patented Sept. 13, 1921.

Application filed November 10, 1917. Serial No. 201,243.

To all whom it may concern:

Be it known that I, ERNEST C. HEAD, a citizen of the United States of America, and a resident of Van Wert, Ohio, have invented a new and useful Improvement in Multiplying-Gearing, which invention is fully set forth in the following specification.

This invention relates to gearing for multiplying the ratios heretofore obtained by the use of change-speed gearing, and is of especial utility when applied to the multiplying of the feed ratios of a machine-tool.

An object of this invention is to provide, in combination with change-speed gearing, gearing for multiplying the ratios obtainable thereby which occupies but little space and is simple in construction, while obtaining a greater range of ratios or variations of speed than has heretofore been secured.

Another object of this invention is to provide gearing of the type characterized with readily-manipulated operating mechanism. Other objects will appear as the description of the invention proceeds.

Stated broadly, the invention comprises, in combination with a plurality of gears constituting change-speed gearing of any suitable construction and operatively related to produce a plurality of feed ratios or variations in speed, a worm and worm-wheel and means to selectively connect or interpose said worm and worm-wheel in train with said plurality of gears to multiply the feed ratios or variations of speed obtainable thereby. In its preferred embodiment, the invention is applied to the multiplying of the feed ratios of a machine tool by a relatively large ratio, and comprises alternative gear trains, one of which includes said worm and worm-wheel, together with means of any suitable construction for connecting either of said alternative gear trains in train with said change-speed gearing.

The invention is capable of receiving a variety of mechanical expressions, one of which is shown on the accompanying drawings, but it is to be expressly understood that the drawings are for purposes of illustration only and are not to be construed as a definition of the limits of the invention, reference being had to the appended claims for that purpose.

In said drawings:—

Figure 1 is a vertical section through a gear box containing multiplying gearing in accordance with the present invention;

Fig. 2 is a front elevation of said box;

Fig. 3 is an end elevation of said box;

Fig. 4 is a detail of the key operating mechanism;

Fig. 5 is a front elevation of an assembly of said gear box with a feed box containing change-speed gearing of a machine-tool.

Fig. 6 is a diagrammatic view of said change-speed gearing.

Referring in detail to said drawings, wherein the same reference characters are used to designate corresponding parts in the several figures, 1 is a driven shaft, as a shaft in the train of feed gearing of a machine-tool. This shaft may correspond, for example, with the shaft designated 12 in my application Serial No. 208,129, filed December 20, 1917, but it is to be expressly understood that the invention is not restricted in use to multiplying the feed ratios of a vertical boring and turning mill, as it is capable of use wherever the multiplying of speed or feed ratios is desirable.

2 designates a feed box containing a train of change-speed gearing of any suitable construction, such for example as that disclosed in my application Serial No. 201,245, filed November 10, 1917, wherein a plurality of gears are operatively related to produce eight variations of feed. The driving shaft for said change-speed gearing is indicated at 3 and, in the form shown (Fig. 6), a pair of gears 30, 31 are mounted thereon in position to mesh selectively with shiftable gears 32, 33 on a shaft 34. Also mounted on shaft 34 is a second pair of shiftable gears 35, 36 adapted to mesh selectively with gears 37, 38 on shaft 39. Shaft 39 also carries a third gear 40, and mounted on a shaft 41 in position to mesh selectively with gears 38 and 40 are a pair of shiftable gears 42, 43. Shaft 41 drives the shaft 1 heretofore referred to.

4 designates a housing for the multiplying gearing of this invention, and within said housing 4 and mounted upon the driving shaft 5 is the drive gear 6 for transmitting motion to the coöperating gear 7 mounted on the shaft 8. Gears 6 and 7 are shown as miter gears, but this type of gear is used for convenience only and may, if desired, be substituted by spur or any

other suitable type of gears. Connected to or integral with said gear 7 is a spur or other suitable gear 9 which meshes with a second similar gear 10 mounted upon the tubular shaft 11 for free rotation thereon. Shaft 11 is connected to the shaft 3 in any suitable way, as by a spline or feather 12 engaging a seat in the shaft 3. Also mounted on shaft 5 is a worm 13 which meshes with a worm-wheel 14 also mounted for free rotation upon the tubular shaft 11. Spur gear 10 and worm-wheel 14 are adapted to be selectively connected with the shaft 11, to drive the same, by any suitable device. In the form shown, a sliding key 15 is mounted in a recess in the stem 16 and can reciprocate in the longitudinal slot 17 provided in the shaft 11. Said key 15 is normally urged outwardly, to engage in either one or the other of the keyways provided in spur gear 10 and worm-wheel 14, by the spring 18, and to prevent said key from engaging in more than one of said keyways at once, said key is beveled at its corners and a ring 19 is provided intermediate the gear members 10 and 14 to cam said key against the tension of the spring 18 to a position flush with the surface of the shaft 11 until said key is in alinement with the keyway of one or the other of said gear members.

Suitable mechanism is provided to shift the stem 16 and thereby reciprocate the key 15 and, in the form shown, a longitudinally slidable rod 20 is mounted in the box 4 and connected to said stem 16 by an arm 21, the forked end 22 of which engages a head 23 on said stem 16. Said rod 20 is provided upon one side thereof with teeth to constitute a rack, and a pinion 24 in mesh therewith is carried by the stem 25 of a hand-wheel 26. Hand-wheel 26 is shown as provided with a pointer 27 adapted to coöperate with suitable indicia on a face plate 28 mounted on said box.

The spur gears 9 and 10 are here shown as being of equal pitch diameter, thereby having a ratio of one to one, but this ratio may obviously be varied as conditions require. The worm transmission has a ratio of one to sixteen, but this ratio has been selected only as being suitable to a particular case and may be varied as desired.

In operation, shaft 1 is driven through the change-speed gearing provided in the feed box 2, said change-speed gearing in turn being driven by shaft 3. When key 15 is engaged with spur gear 10, the drive of shaft 3 is from shaft 5 through miter gears 6 and 7 and spur gears 9 and 10. The interposition of these gears in the train of feed gearing secures the feed ratios normally obtainable by the change-speed gearing in the feed box. By rotation of the hand-wheel 26 so as to move pointer 27 from the position designated "F" on the face plate 28 to the position designated "S" on said plate, the pinion 24 will be rotated to reciprocate rack 20 and thereby stem 16 to engage key 15 with worm-wheel 14. The drive of shaft 3 will now be from shaft 5 through worm 13 and worm-wheel 14. Inasmuch as in the example taken said worm and worm-wheel have the ratio of one to sixteen, all of the feed ratios obtainable by actuation of the gears in the feed box 2 will now be multiplied by the same ratio of one to sixteen.

It will therefore be seen that a very simple structure has been provided for multiplying the feed ratios or variations of speed heretofore obtained by the use of change-speed gearing, and one that occupies a minimum of space. In fact, a pair of spur or other similar gears for multiplying by a relatively large ratio would occupy so much space as to prohibit their use, since the diameters of the gears would have to be in proportion to the multiplying ratio desired. It will also be observed that very simple and convenient means have been provided for interposing either of the alternative gear trains in the train of gearing.

While the multiplying gearing has been shown as interposed in the feed train on the driving side of the change-speed gearing, this position is not necessary and, in fact, said multiplying gearing could be interposed in the train of feed gearing on the driven side of the change-speed gearing with equal facility and with the securing of the same functions and advantages. Furthermore, it is to be expressly understood that the ratios of gearing illustrated on the drawings and referred to herein have been selected for purposes of illustration only.

While the embodiment of the invention shown on the drawings has been described with considerable particularity, it is to be expressly understood that the invention is not to be restricted to the form here shown for it is capable of receiving a variety of mechanical expressions, some of which will readily suggest themselves to those skilled in the art, while certain features of the invention are capable of use without other features thereof. Reference is therefore to be had to the claims hereto appended for a definition of the limits of the invention.

What is claimed is:—

1. In a train of feed gearing comprising a plurality of gears operatively related to produce a plurality of feed ratios, means to multiply said feed ratios comprising alternative gear trains one of which includes a worm and worm-wheel, a gear of each of said trains being freely rotatable on a common shaft, and a sliding key for connecting either of said last-named gears with said shaft to selectively interpose either of said gear trains in said train of feed gearing.

2. In a train of feed gearing comprising a

plurality of gears operatively related to produce a plurality of feed ratios, means to multiply said feed ratios comprising alternative gear trains one of which includes a worm and worm-wheel, a gear of each of said trains being freely rotatable on a common shaft, a sliding key for connecting either of said last-named gears with said shaft to selectively interpose either of said gear trains in said train of feed gearing, and means to prevent the engagement of said key with more than one of said gears.

3. In a train of feed gearing comprising a plurality of gears operatively related to produce a plurality of feed ratios, means to multiply said feed ratios comprising alternative gear trains one of which includes a worm and worm-wheel, a gear of each of said trains being freely rotatable on a common shaft, a sliding key for connecting either of said last-named gears with said shaft to selectively interpose either of said gear trains in said train of feed gearing, and a rack and pinion for reciprocating said key.

4. In a train of feed gearing for machine tools comprising a plurality of gears operatively related to produce a plurality of feed ratios, means to multiply said feed ratios by a relatively large ratio comprising alternative gear trains one of which includes a worm and worm-wheel, a gear of each of said trains being freely rotatable on a common shaft, and means for connecting either of said gears with said shaft to selectively interpose either of said gear trains in said train of feed gearing.

5. In a train of feed gearing comprising a plurality of gears operatively related to produce a plurality of feed ratios, means to multiply said feed ratios comprising alternative gear trains one of which includes a worm and worm-wheel, a gear of each of said trains being freely rotatable on a common shaft, a sliding key for connecting either of said last-named gears with said shaft, a rack parallel to said first-named shaft and connected to said sliding key, a pinion for reciprocating said rack, and an indicating hand-wheel for rotating said pinion.

In testimony whereof I have signed this specification.

ERNEST C. HEAD.