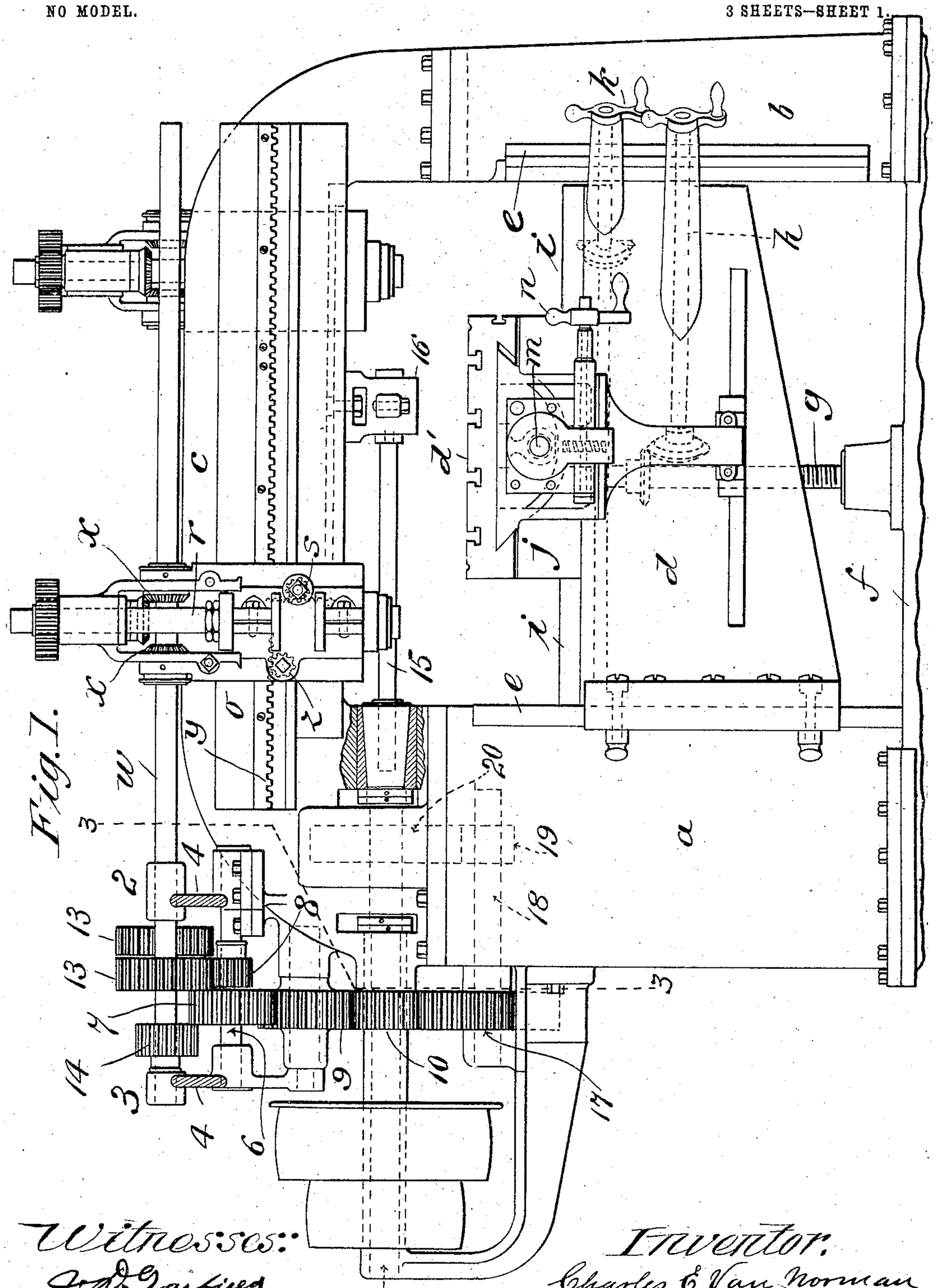
No. 765,447. PATENTED JULY 19, 1904.

C. E. VAN NORMAN.

MILLING MACHINE.

APPLICATION FILED FEB. 16, 1903.

NO MODEL. 3 SHEETS—SHEET 1.



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M. L. Crozier.

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NO MODEL. 3 SHEETS—SHEET 2.

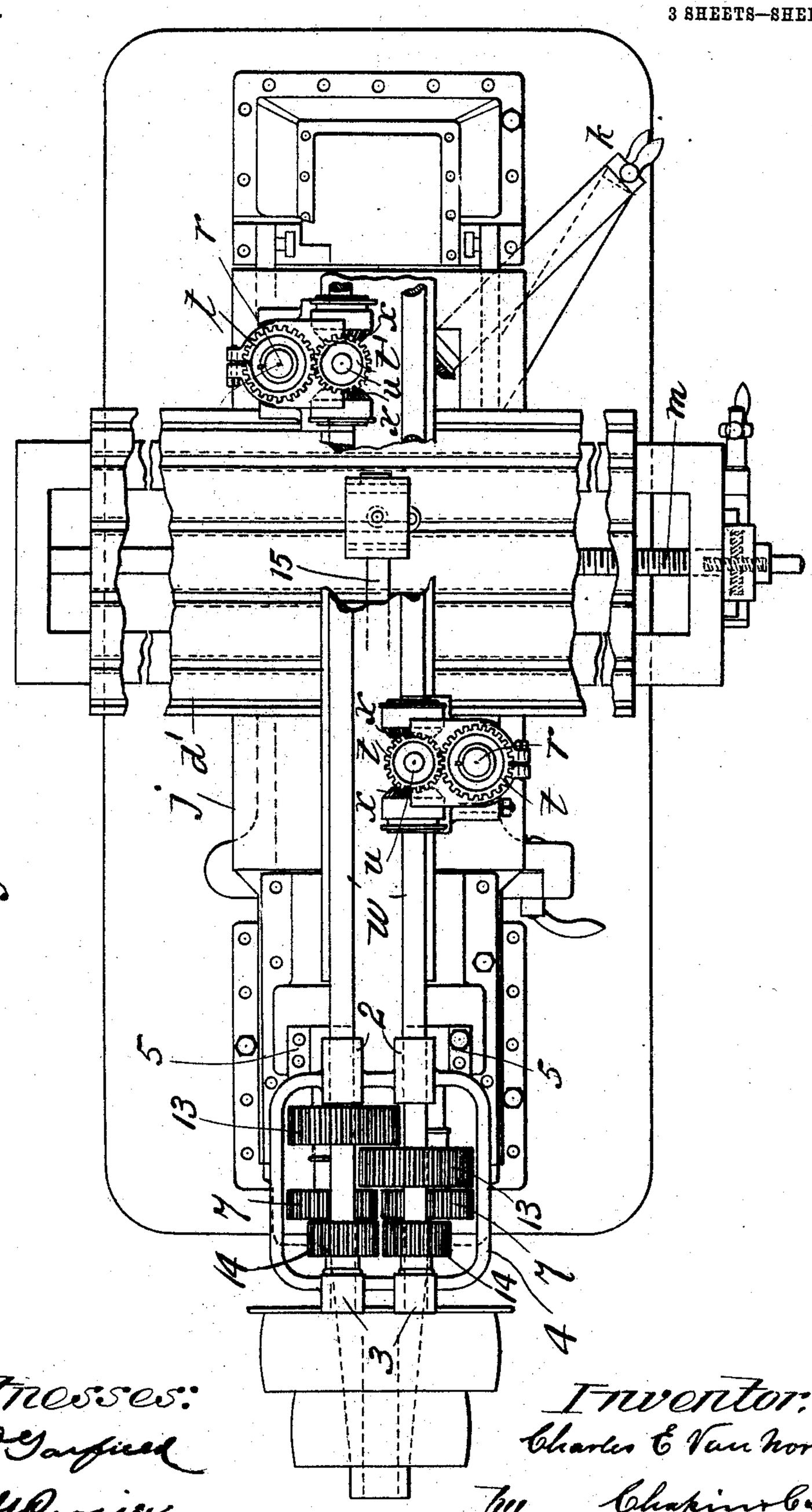

Fig. 2.

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NO MODEL. 3 SHEETS—SHEET 3.

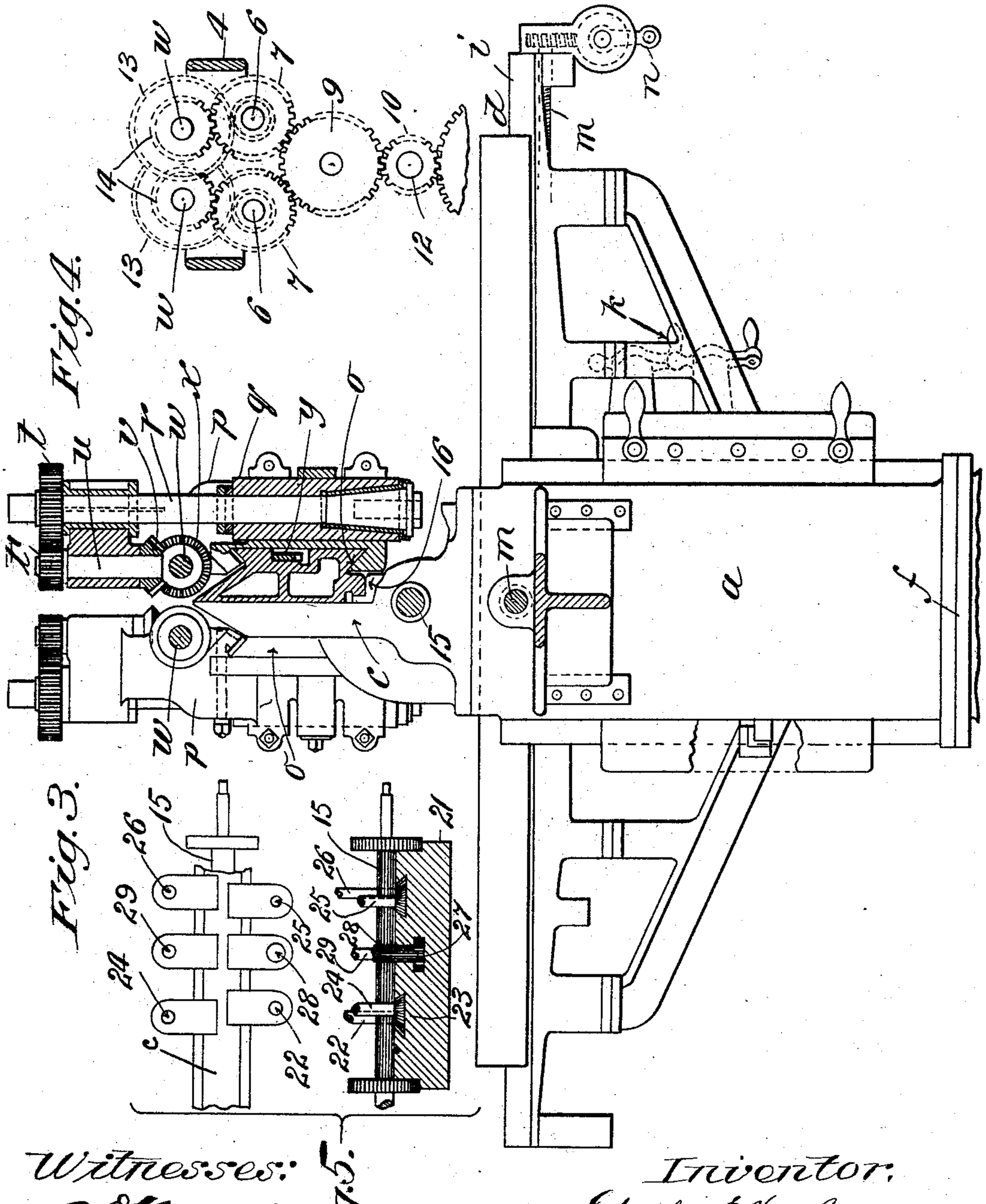

Fig. 4.

Fig. 3.

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Fig. 5.

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No. 765,447. Patented July 19, 1904.

UNITED STATES PATENT OFFICE.

CHARLES E. VAN NORMAN, OF SPRINGFIELD, MASSACHUSETTS.

MILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 765,447, dated July 19, 1904.

Application filed February 16, 1903. Serial No. 143,732. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. VAN NORMAN, a citizen of the United States, residing at Springfield, in the county of Hampden and State of Massachusetts, have invented new and useful Improvements in Milling-Machines, of which the following is a specification.

This invention relates to machine-tool constructions, and has special reference to improvements in the construction of milling-machines and tools of the type represented by the milling-machine, the object of the invention being to provide a machine of this type on which may be mounted a plurality of milling-cutter heads so arranged that the cutters may be brought to bear on the work simultaneously at points located at different distances from one end of the work—that is to say, the cutters are located in different transverse planes relative to the direction of the feeding movement of the work—to the end that a much greater surface may be operated upon at one time than would be possible if the cutter-heads were all located in the same transverse plane. The reason for this increased efficiency is because the described location of the cutter-heads permits the periphery of one cutter to overlap the periphery of another, whereby the entire surface of a piece of work may be operated on by the cutters by passing the work through the machine once.

A further object of the invention is to provide, in combination with vertically-disposed cutter-heads located in different transverse planes relative to the work, a cutter-shaft located above the work and extending transversely of the line of movement thereof in a different transverse plane to that occupied by any of said heads, whereby provision is made for the application of cutters to the work having both horizontal and vertical axes, whereby both the vertical and the horizontal faces of a piece of work may be operated on simultaneously, provision being made to rotate the cutters in said cutter-heads each at any desired speed relative to its neighbor, and provision being also made whereby the direction of rotation of the cutters located in one plane may be reversed relative to the rotation of the cutters in another plane, and provision being also made to adjust the speed of rotation of any one series of cutters—that is, cutters located in the same transverse plane—at any desired speed relative to another series, suitable feeding devices, both horizontal and vertical, being incorporated in the machine.

In the drawings forming part of this application, Figure 1 is a side elevation of a machine embodying my invention, a portion thereof being in section. Fig. 2 is a top plan view of the same. Fig. 3 is an end elevation, shown partly in section, on line 3 3, Fig. 1, one of the spindles being shown in section in a different plane. Fig. 4 is an end elevation of the gear connections between the main driving-shaft and the shafts which actuate the cutters. Fig. 5 is a diagrammatic view of cutters, both in plan and side elevation, showing their arrangement relative to the work under certain conditions, a piece of work being shown in section in connection with said side elevation.

Referring to the drawings, the frame of the machine comprises two pedestals *a* and *b*, which are bridged by a head-piece *c*, secured to each pedestal, as shown in Fig. 1. On the inner edge of the pedestal *a* is mounted a bracket-arm *d* of sufficiently heavy construction to support the work-bed *d'*. The said inner edge of the pedestal *a* and also the inner edge of the pedestal *b* are provided with lateral flanges *e*, said bracket being fitted to slide vertically on said flanges on the pedestal *a;* but on the like flanges on *b* a clamp (not shown) may be applied to support and lock the free end of the bracket in any adjusted position. The two pedestals are secured to a bed-plate *f*, whereby the entire frame may have that rigidity which is essential to machines of this type, and on this bed-plate there is located the screw-shaft *g*, engaging the bracket and connected by gears (shown in dotted lines in Fig. 1) with a crank-operated shaft *h*, whereby the bracket may be raised and lowered. Running longitudinally of the bracket on the top of the latter are the slideways *i*, on which the base-plate *j* of the work-bed *d'* is mounted, said plate being provided with a suitable traverse-screw operated by the crank-arm *k* to

move it on the bracket, the work-bed proper being mounted on said base to slide endwise thereof by means of the feed-screw *m*, which may be rotated automatically in the well-known manner or by means of the crank *n*, as shown in Fig. 1.

All of the foregoing description relates to well-known mechanical constructions and forms *per se* no part of the invention, the latter residing solely in the construction of the devices shown in the drawings as located above the top of the pedestals *a* and *b*, although these well-known parts may enter as elements in certain novel combinations with those parts of the machine in which the invention particularly resides.

Referring to Fig. 3 of the drawings, it will be seen that the head-piece *c* is made with a slideway *o* on each side thereof extending practically from end to end of the head, said ways being identical one with the other. As shown in the drawings, these slideways are preferably made integral with the head-piece *c*, their upper and lower edges being undercut to receive the cutter-heads, which may be generically indicated by the letter *p*. Each of these cutter-heads consists in a suitable casting adapted to be fitted onto the slideways *o*, in which casting there is mounted a sleeve *q*, adapted to carry a spindle *r*, in the lower end of which a milling-cutter may be secured. This sleeve *q*, with its spindle, may be vertically adjusted by means of a rack-and-pinion contrivance. (Shown only in Fig. 1 in dotted lines and indicated by *s*.) This spindle is driven by suitable gears *t* and *t'*, the latter being mounted on a short vertical shaft *u*, on the lower end of which is a beveled gear *v*. Located directly under this short shaft *u* is the driving-shaft *w*, on which are mounted beveled gears *x*, which are slidable on said shaft within suitable bearings in the cutter-head casting, said gears having a spline-and-groove connection with said driving-shaft. It is clear that by means of these gears, which may be slid into mesh with the gear *v* on either side of the latter, rotative movements may be imparted to the shaft *u* in either direction, as desired, and consequently to the spindle. The gear *t* on the spindle has a spline-and-groove connection therewith to permit vertical adjustments of the spindle.

Within a longitudinal recess in the slideways *o* a rack *y* is located, and by means of a pinion *z*, (see Fig. 1,) mounted on the cutter-head *p* and adapted to engage this rack, the heads may be shifted laterally on the slideways *o*, as desired, the driving-gears *x* for each head moving with the latter. These before-described cutter-heads may be mounted on each of the slideways *o* in any desired number which the ways may be capable of receiving, and the description of the cutter-head above given and of its driving mechanism and adjusting mechanism will apply to the cutter-heads and their associated parts, which may be located on either of the ways *o*.

While the head-piece *c* and the ways *o* are shown herein as of integral construction, it is obvious that this is a mere matter of convenience and not of necessity, for, if desired, the slideways *o* may be made in separate pieces from the head, and, furthermore, need not of necessity be oppositely located one relative to the other, for these ways may, if desired, be made adjustable vertically on the head-piece in any convenient manner whereby the cutter-heads supported thereon may be raised or lowered, and a construction embodying these minor changes would clearly fall within the scope of the invention.

The two driving-shafts *w* are, as seen in Fig. 2, supported near one end thereof in the bearings 2 and 3, which are incorporated, preferably, in a rectangular yoke-frame 4, which is bolted to the head-piece *c* at 5. Below these bearings 2 and 3 are other bearings for the short shafts 6, on which are mounted the gears 7 on the outer end thereof and the pinions 8 on the inner end thereof.

Located midway between the two gears 7 and below the latter is another gear 9, which meshes with a gear 10 on the driving-shaft 12. On each of the driving-shafts *w*, whereby the cutter-heads *p* are rotated, a gear 13 is secured, they being located in different planes to permit the use of as large a gear as is necessary.

On the outer end of each of the driving-shafts *w*, but inside of the bearings 3, is a sliding gear 14 in spline-and-groove engagement with the shaft. To drive one of the shafts *w* directly from the main shaft 12, the gear 14 is moved into mesh with the gear 7, and the pinion 8 is moved out of mesh with the gear 13; but if it is desired to run the shaft at a slower speed the gear 14 is thrown out of mesh with the gear 7 and the pinion 8 is moved into mesh with the gear 13. By referring to Fig. 4 it is thus clear that one of these shafts may be driven through the medium of the gears 7 and 14, while the other may be driven through the medium of the gears 7, 8, and 13, if desired. The driving-shafts *w* have no supports for their free ends except such as may be afforded by the cutter-heads, which obviously is ample.

From the foregoing description it is evident that a piece of work secured to the bed *d'* and passed transversely under the head-piece *c* may be operated on by a number of cutter-heads mounted on one of the slideways *o* and then as it passes on be operated on by a number of cutters located on the slideway *o* on the opposite side of the head-piece, and it will be observed that two cutters may be so located opposite one another (one on each side of the head-piece *c*) that they may overlap as viewed from the end of the work-table, whereby, if desired, the entire surface of the work may be

covered by once passing it through the machine. Again, cutters may be so arranged by reason of the adjustability of these heads that opposite walls of a rectangular depression in a piece of work may be each undercut at one operation. Obviously, also, cutters may be inserted in these various heads not only to cut the vertical sides of work secured to the bed d', but also to cut the horizontal surfaces, and it is therefore possible to set a number of cutter-heads in such position that the work may be secured to the bed d' and passed through the machine once, coming out finished to the last cut, which is of very great importance—for example, in the manufacture of machine parts on the interchangeable system—for the reason that error is practically eliminated where all of the finishing cuts are simultaneously made on a piece, whereas, if certain of the cuts have to be made on one side thereof and then either the work or the cutter-head has to be adjusted to make another cut, as is the case with milling-machines as usually constructed, it is much more difficult to attain practical uniformity of product.

For the purpose of still further increasing the efficiency and adaptability of this machine I extend the main shaft 12 through to the inner face or side of the pedestal a in suitable bearings and adapt it to receive a horizontal cutter-shaft 15, and to support the outer end of this shaft a longitudinal T-groove is formed in the under side of the head-piece c, as shown in Fig. 1, whereby a block 16, having a bearing therein for the said shaft 15, may be bolted in any desired position to the under side of the head-piece c. On this shaft 15 may be mounted long horizontal milling-cutters, which may be used to finish a surface of the work much more perfectly than would be possible with a mill secured in one of the vertical heads, or, if desired, a series of narrow mills may be mounted upon said shaft 15 to cut a series of parallel grooves in the work.

Provision is made for driving the spindle 15 directly at the same speed as that of the main driving-shaft 12, or, if desired, it may be driven through the gear 17 and the shaft 18, (shown in dotted lines, Fig. 1,) on which there may be mounted a shiftable gear 19, which may be moved into and out of mesh with the gear 20 on the driving-shaft 12, all of which is of course common construction.

While I have shown and described herein a work-bed which may be vertically adjustable toward and from the cutter-head, a reversal of these functions would obviously come within the scope of the invention—that is, the work-table may be non-adjustable and the cutter-heads be adjusted toward and from it.

Besides the means for varying the speed of the shafts w, and consequently the speed of rotation of the spindles r, a further variation of this speed may be effected by a changing of the gears t and t', the relative diameters of which may be varied, though as a rule all of the ranges of speed required in a machine of this character are provided for by the shiftable gear connections between the driving-shafts w and 12.

For the purpose of more clearly illustrating the capabilities of this machine reference may be had to Fig. 5, in which a top plan view of the head-piece c and several spindles are indicated in a diagrammatic form, together with a portion of the horizontal shaft 15. Below this view the ends of several spindles are shown having cutters thereon, and a portion of said horizontal shaft is also shown, all in operation on a piece of work which may be indicated by 21. This Fig. 5 shows that the two outside edges of a piece of work and the entire upper surface thereof may be operated on by mills on the horizontal shaft, that two dovetailed grooves, the outer and inner edges of which have different angles, and a T-slot parallel with said grooves may all be cut by passing the work once through the machine. To accomplish this result, the disposition of the mills on the horizontal shaft of course is obvious. This disposition of the cutter-heads to apply them properly to the above work would be as follows, assuming that the work is being fed away from the observer: The cutter on the spindle numbered 22 would first cut the outer edge of one of the dovetailed grooves 23, and the spindle 24 following it would cut the opposite edge at a different angle, the same arrangement of spindles 25 and 26 effecting the cutting of the edges of the other dovetailed grooves.

To cut the T-slot 27, the end mill 28 first cuts a rectangular groove through the work, and as the work approaches the other side of the machine the spindle 29 will cut the head of the slot. It is thus apparent that piece after piece of work may be put through this machine without changing the position of a cutter, thereby insuring absolute uniformity of product.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a milling-machine or the like, a work-bed, two or more cutter-spindles supported in operative relation thereto on opposite sides of a line drawn transversely of the feed-movement, and means to adjust the spindles to bring the cutters thereon into overlapping relation.

2. In a milling-machine or the like, a suitably-supported head-piece, slideways on opposite sides thereof, a plurality of cutter-spindles mounted on said slideways, means to rotate all of the spindles, and devices to independently adjust each cutter-spindle on either side of the head-piece in vertical and horizontal planes.

3. In a milling-machine or the like, a suitably-supported head-piece, slideways on opposite sides thereof, a plurality of cutter-spin-

dles vertically disposed on said slideways, together with a horizontally-disposed cutter-spindle located beneath said head-piece, a separate driving-shaft for each set of the cutter-spindles disposed along each side of said head-piece, and another driving-shaft for said horizontal spindle.

4. In a milling-machine or the like, a work-bed and means to feed the latter, a plurality of cutters located in different vertical transverse planes relative to the direction of feed of the work-bed, and another cutter on a horizontal axis located in a different vertical plane from the other cutters, also transversely of the direction of feed-movement.

5. In a milling-machine or the like, a work-bed, and a plurality of spindles supported in operative relation thereto on opposite sides of a line extending transversely of the feed-movement; means to move the work and the spindles relative to each other, and means to slidably adjust each of the spindles on opposite sides of said line to bring the cutters thereon into overlapping relation.

6. In a milling-machine or the like, a work-bed, two or more cutter-spindles supported in operative relation thereto, and means to slidably adjust the spindles in opposite directions past one another, transversely of the feed-movement of the work.

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