R. T. HAZELTON.

MACHINE TOOL.

APPLICATION FILED JUNE 21, 1918.

1,315,722.

Patented Sept. 9, 1919.

6 SHEETS—SHEET 1.

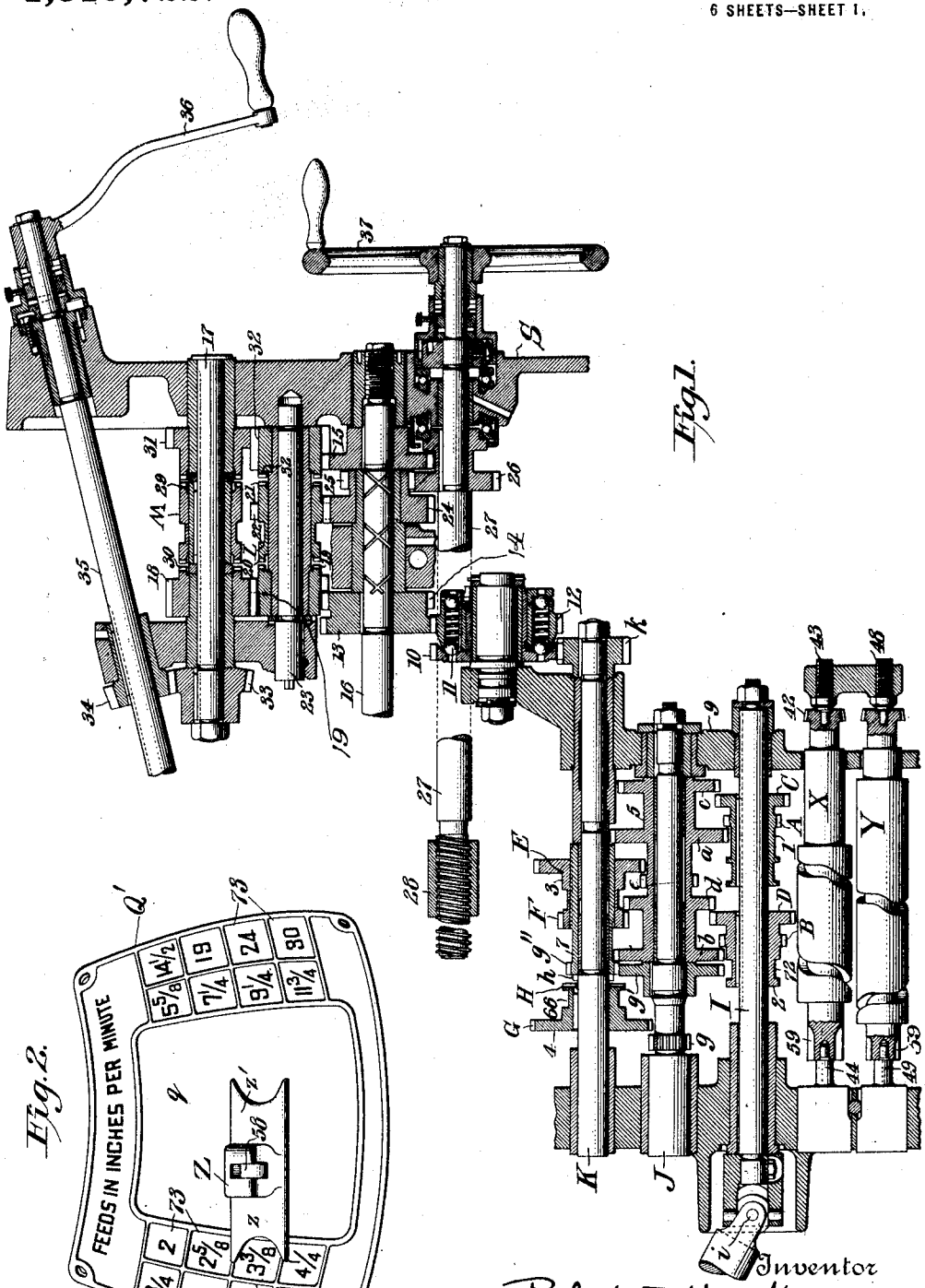


Fig. 1.

Fig. 2.

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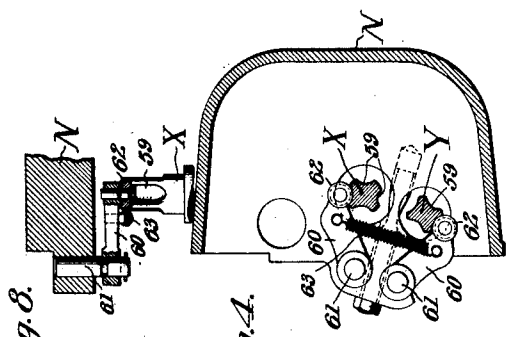


Fig. 8.

Fig. 4.

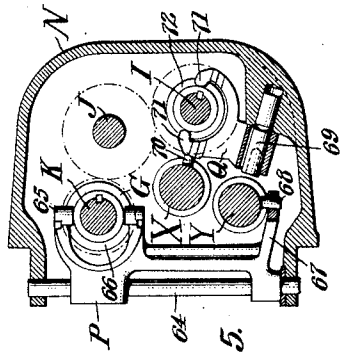


Fig. 5.

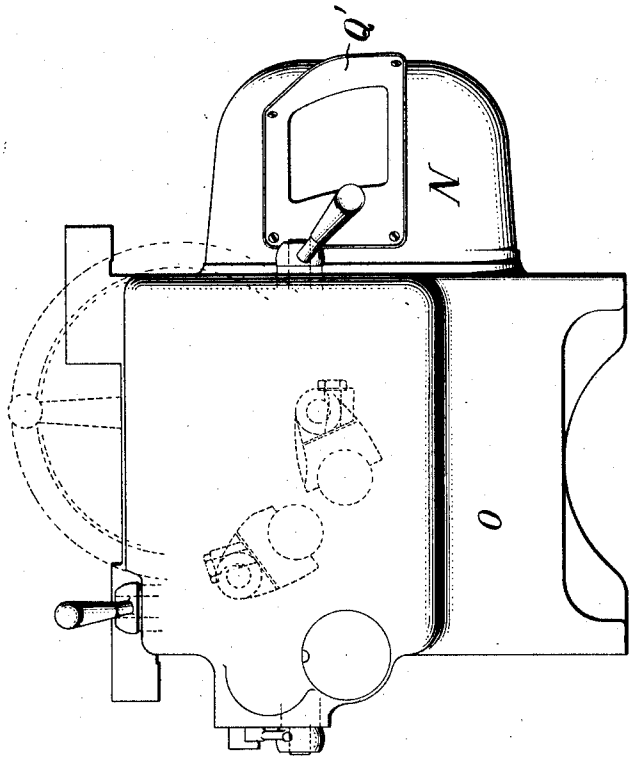


Fig. 3.

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6 SHEETS—SHEET 3.

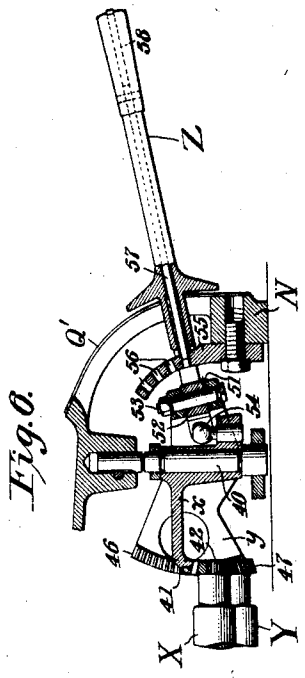


Fig. 6.

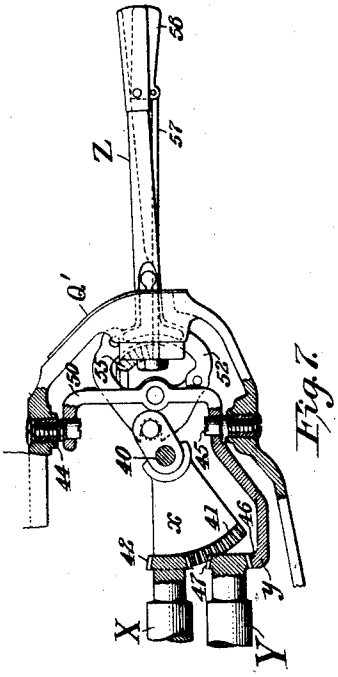


Fig. 7.

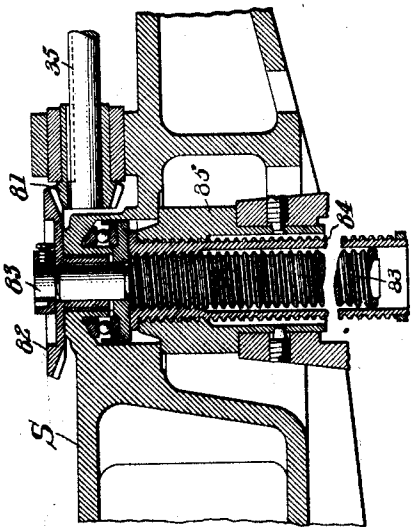


Fig. 12.

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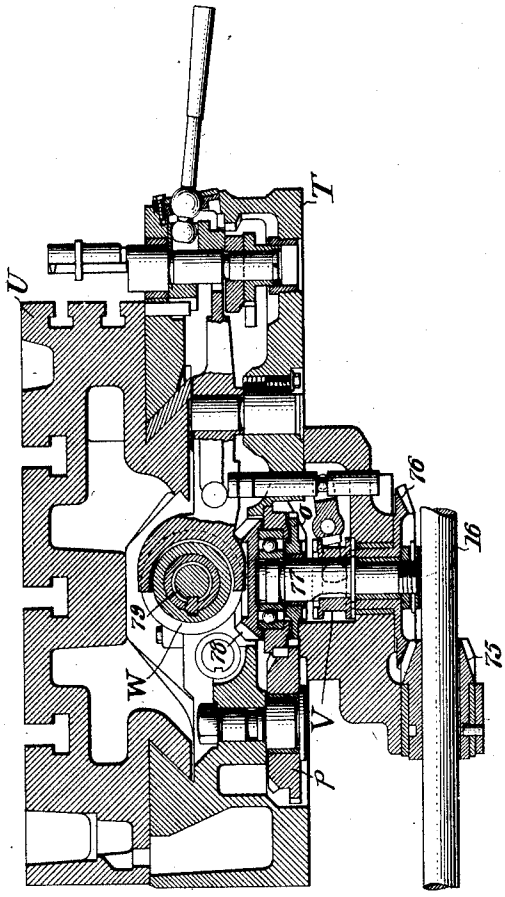


Fig. 9.

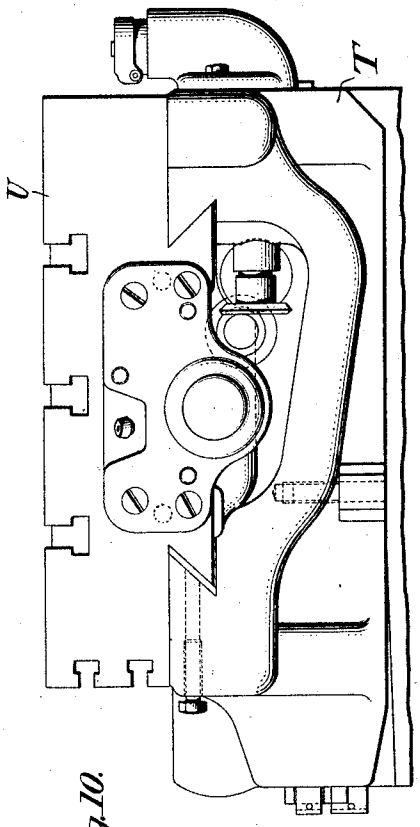


Fig. 10.

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6 SHEETS—SHEET 5.

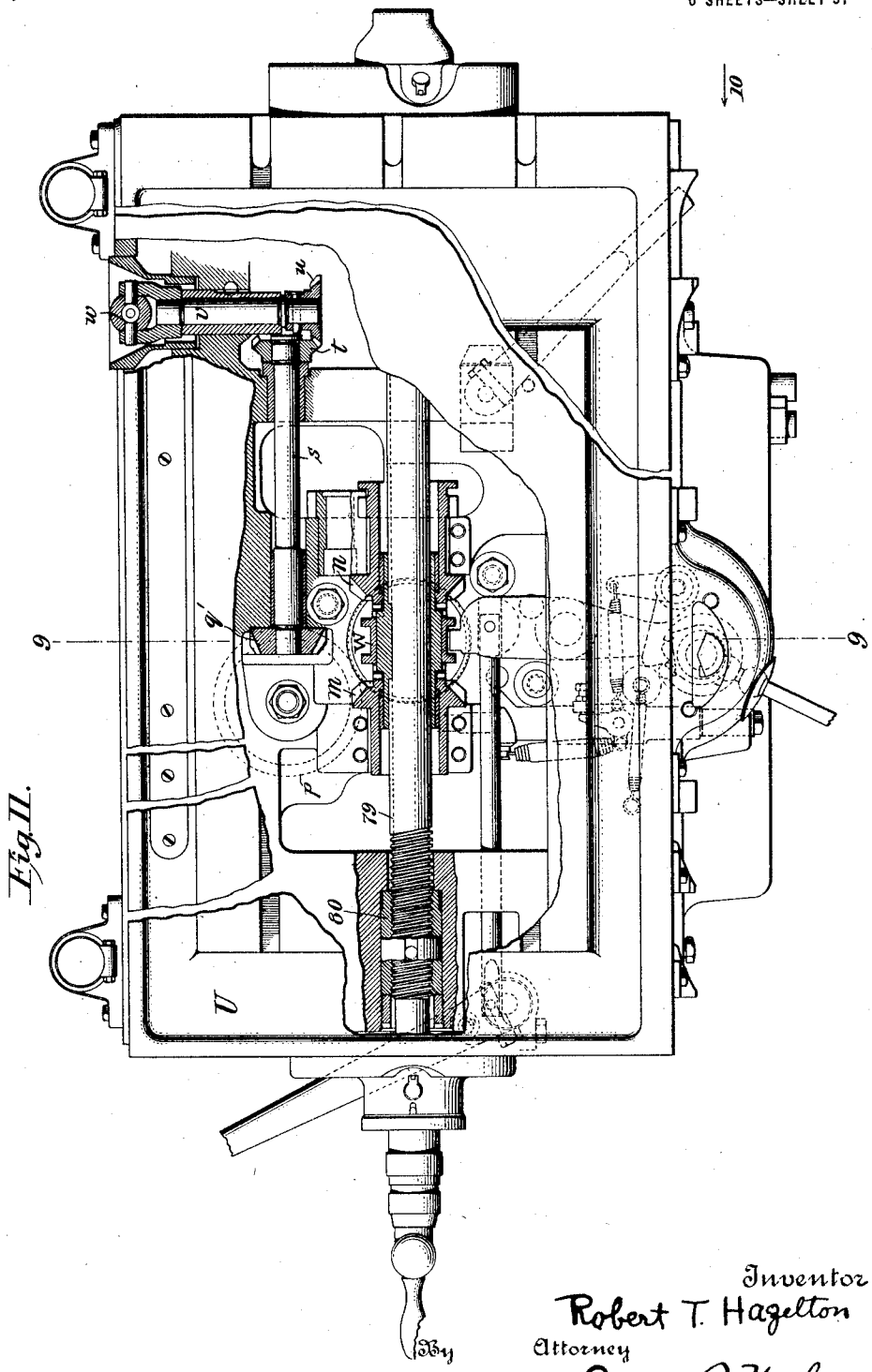


Fig. II.

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6 SHEETS—SHEET 6.

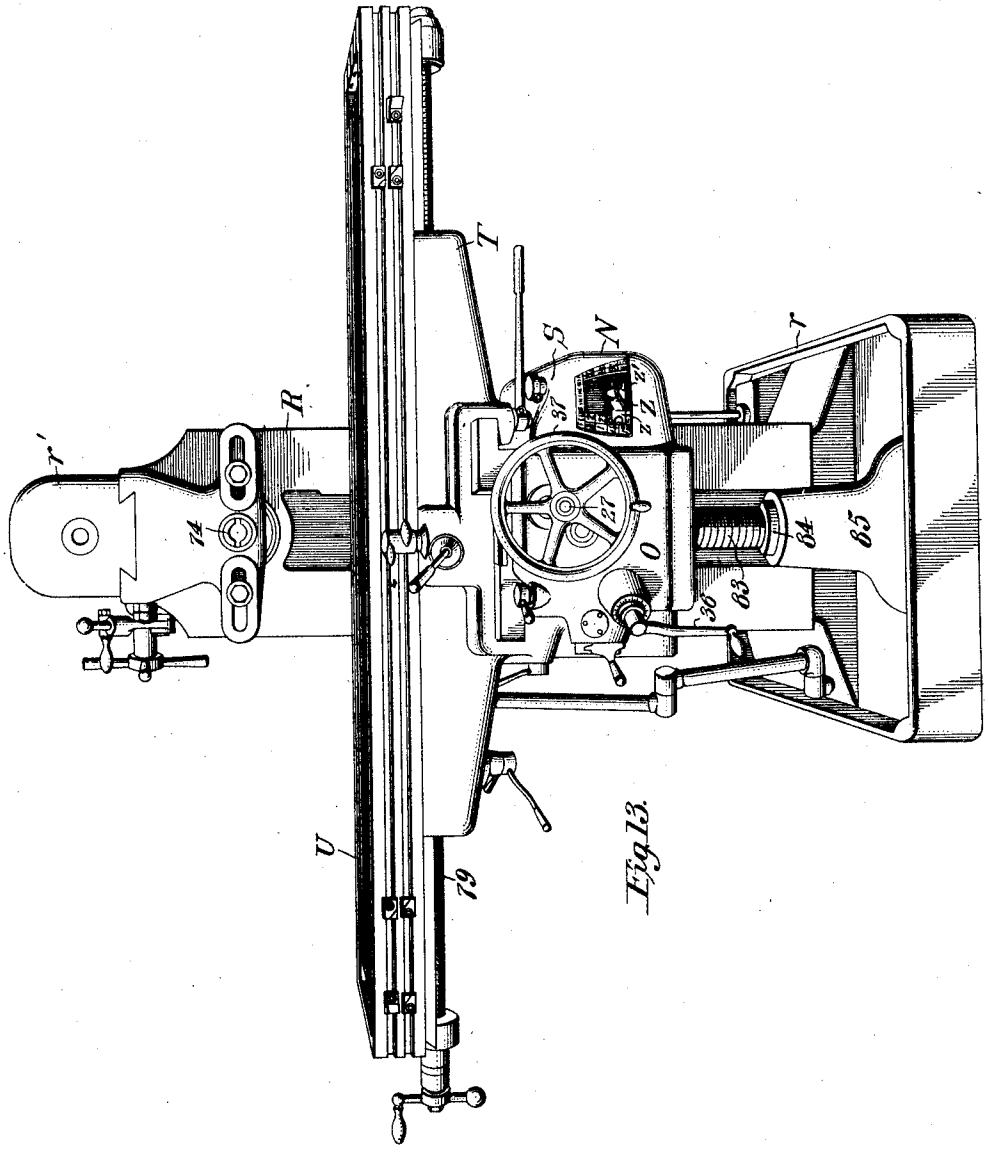


Fig 13.

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UNITED STATES PATENT OFFICE.

ROBERT T. HAZELTON, OF CINCINNATI, OHIO, ASSIGNOR TO THE CINCINNATI MILLING MACHINE COMPANY, OF OAKLEY, CINCINNATI, OHIO, A CORPORATION OF OHIO.

MACHINE-TOOL.

1,315,722. Specification of Letters Patent. Patented Sept. 9, 1919.

Application filed June 21, 1918. Serial No. 241,213.

To all whom it may concern:

Be it known that I, ROBERT T. HAZELTON, a citizen of the United States, and residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented a new and Improved Machine-Tool, of which the following specification is a full disclosure.

This invention deals with machine tools and it proposes sundry improvements imparting thereto a greater degree of facility in the manipulation and control thereof. The improvements constituting this invention are especially applicable to so-called milling machines and are of advantage in enhancing the simplicity of a mechanism which inherently possesses a more or less complex organization by reason of its wide range and universality of action.

One of the objectives of this invention is to coördinate with the traveling work or tool support an intermediate mechanism capable of being very easily adjusted to yield any one of a wide range of predetermined speeds. That is to say, it provides an intermediate feed changing mechanism which, in this instance, yields sixteen changes arranged in an arithmetical series extending from a predetermined minimum to a predetermined maximum equaling in magnitude about thirty times the minimum. This result is achieved by the employment of comparatively few elements arranged compactly and operated readily.

Another object is to render available an arrangement whereby a simple hand lever is enabled, in a direct manner, to effect a change from any one feed of the series to any other feed thereof in such a way as to combine the advantages of a so-called "selective" speed change mechanism with those of a so-called "progressive" speed change mechanism.

Other objects and advantages will be in part indicated in the following description, and in part rendered apparent in connection with the annexed drawings.

To enable others skilled in the art so fully to apprehend the underlying features hereof that they may embody the same by the numerous modifications contemplated by this invention, drawings depicting a preferred typical construction have been annexed as a part of this disclosure, and in such drawings, like characters of reference denote corresponding parts throughout all of the views, of which:

Figure 1 is a layout in a plane of the gears and clutches and certain operating elements forming a part of the feed change mechanism and transmission devices constituting this invention. Fig. 2 is a fragmentary view showing the index plate and operating lever somewhat enlarged. Fig. 3 is a front elevation of the knee detached from the column, saddle and knee. Fig. 4 is a vertical section through the casing inclosing the feed change mechanism showing the detent devices for definitely locating the various positions of the cam cylinders. Fig. 5 is an adjoining vertical section through the same casing showing the yokes for shifting the gear couplets to correspond with different feed change ratios. Fig. 6 is a vertical section through the same casing adjacent its forward end showing the means for differentially actuating the cam cylinders in correspondence with the actions of the mechanical analyzer. Fig. 7 is an underneath view of the mechanism shown in Fig. 6. Fig. 8 is a fragmentary plan of the detent device shown by Fig. 4. Fig. 9 is a vertical section through line 9—9 on Fig. 11 showing the transmission for propelling the table and the means for substituting the feed by a quick return movement. Fig. 10 is an end elevation of the table and saddle looking in the direction of the arrow 10 on Fig. 11. Fig. 11 is a plan partially broken away and partially in section of the table showing the transmission elements and the shifting clutch for causing it to travel to the right or left. Fig. 12 is a fragmentary vertical section through the elevating mechanism of the knee and Fig. 13 is a vertical perspective of the assembled machine.

Referring now to the drawings, and especially to Fig. 1 thereof, there will be seen a flat layout or development of that portion of this invention constituting the feed change gears and the transmission elements connecting the same with the feed screws for propelling the table or for lifting the knee.

In such drawings, the casing or casting inclosing the change gears is indicated by 9 and in this casing are journaled three parallel shafts I, J, and K, the former deriving motion from the prime mover through the flexible joint coupling *i* and the latter

transmitting this motion, suitably modified, to the working elements from the gear *k*. The intermediate shaft J has keyed near one end thereof an intermediate gear *g'* (41 teeth) and a pinion *g* (14 teeth), and it also loosely carries a gear-sleeve 5 providing the several gears *e* (16 teeth), *d* (27 teeth), *b* (33 teeth), *a* (36 teeth), and *c* (22 teeth). One or the other of the gears on the sleeve 5 derives motion from gears shiftable on the shaft I.

Thus, splined to said shaft I is a first gear couplet 1 providing gear A (16 teeth) and gear C (22 teeth), and also the second gear couplet 2 providing gear D (25 teeth) and gear B (19 teeth); these two gear couplets being arranged to slide one way or the other on said shaft to bring into mesh gears A, C, B, or D with the above mentioned gears *a*, *c*, *b*, or *d*, respectively.

Loosely mounted on the shaft K is a sleeve 7, having a pinion *g''* (19 teeth) and splined on this sleeve 7 is a third gear couplet 3 providing the gears E (32 teeth) and F (21 teeth). The sleeve 7 also provides the teeth *h* forming part of a dog's tooth clutch; the other part being formed of the teeth H provided by the fourth gear couplet 4 splined to the shaft K and providing a gear G (46 teeth).

These couplets 3 and 4 are adapted to be shifted to intermesh gears E, F, G, or H with gears *e*, *d*, *g*, or *h*. It is noted that gear *d* may be meshed on the one hand with the gear F or with the gear D or with both simultaneously, and that gears *g'* and *g''* are permanently in mesh.

As a result of this arrangement, it is possible by meshing any one or more of said gears to obtain any of the following feed ratios:

Ratios.	Gears.	Teeth.	
3/4	A—E—G	16/36×16/32×19/41×14/46=	.0314
1	B—E—G	19/33×16/32×19/41×14/46=	.0405
1—1/4	C—E—G	22/30×16/32×19/41×14/46=	.0516
1—5/8	D—E—G	25/27×16/32×19/41×14/46=	.0653
2	A—F—G	16/36×27/21×19/41×14/46=	.0806
2—5/8	B—F—G	19/33×27/21×19/41×14/46=	.108
3—3/8	C—F—G	22/30×27/21×19/41×14/46=	.133
4—1/4	D—F—G	25/27×27/21×19/41×14/46=	.168
5—5/8	A—E—H	16/36×16/32×1/1	=.221
7—1/4	B—E—H	19/33×16/32×1/1	=.294
9—1/4	C—E—H	22/30×16/32×1/1	=.367
11—3/4	D—E—H	25/27×16/32×1/1	=.465
14—1/2	A—F—H	16/36×27/21×1/1	=.57
19	B—F—H	19/33×27/21×1/1	=.74
24	C—F—H	22/30×27/21×1/1	=.94
30	D—F—H	25/27×27/21×1/1	=.96

An analysis of this arrangement will show that by shifting gears A, B, C, and D on the one hand or gears E, F, G, and H on the other hand, a wide range of feeds becomes selectively or progressively available, dependent upon whether the shifting be done progressively through the series A, B, C, D in cycles or selectively by manipulation of gears E, F, G, and H. In other words, we have four different series of gears A, B, C, and D dominated by the different possible arrangements of gears E, F, G, and H; to wit, first E—G, second F—G, third E—H, fourth F—H. This makes it possible to utilize a single hand lever for the purpose of obtaining any one of the sixteen combinations available in accordance with the foregoing tabulation. Thus, the movements of the hand lever may be resolved into horizontal and vertical ordinates; the one controlling the combinations of the gears E, F, G, and H and the other determining the utilization of the gears A, B, C, or D.

In accordance with this invention, there is employed a hand lever movable in any direction and in combination with this lever is arranged what may be termed an analyzer or analyzing mechanism which functions to resolve the movement of the hand lever into its two components corresponding to the ordinate and abscissa or the vertical or horizontal component of the hand lever. The analyzer imparts the vertical movement to one member and the horizontal movement to another member and these two members in turn function to shift the gear sets 1 and 2 on the one hand and 3 and 4 on the other hand. This may most easily be done by providing these members with cam grooves properly proportioned, contoured, and timed and by arranging suitable yokes in intervening relation between these cam grooves and the gear couplets to be shifted.

This arrangement may be put into practical effect in various ways and, as an illustration thereof, reference is made to Figs. 3, 4, and 5 which show the knee O of the milling machine, mounted on one side of which is an auxiliary casing N, here used to inclose the working elements of one embodiment of the foregoing mechanism. Figs. 4 and 5 show the several shafts I, J and K assembled in compact relation with the cam cylinders X and Y. Two gear segments *x* and *y* (see Figs. 6 and 7) are arranged in mesh with the aforesaid cam cylinders and are so mounted that the one may oscillate about a vertical axis and the other about a horizontal axis; *e. g.*, about axes arranged at an angle to one another. This may be done in any convenient mechanical manner as by providing a vertical pivot 40 in the casing N and mounting the gear segment *x* to swing about this pivot so as to maintain teeth 41 of the segment in mesh with the beveled pinion 42 provided at one end of the cam cylinder X. This cam cylinder may be supported by the two end pivots 43 and 44 so as easily to turn.

The other gear segment *y* is approximately L-shaped in contour and is pivoted at the points 44 and 45; said points being

co-axial with an axis arranged transversely to the axis of the pivot 40. This gear segment is thereby positioned to keep its teeth 46 permanently in mesh with the teeth 47 of the gear pinion on the end of the other cam cylinder Y; said cylinder being mounted between pivots 48 and 49 in a manner similar to that of the cam cylinder X.

It will be seen that these gear segments *x* and *y* oscillate in transverse planes and they are so connected with a hand lever Z as to resolve the movements thereof into its rectilinear components. This is achieved by pivoting the hand lever Z to the gear segment *y* so that it may swing within the plane containing the axis of the pivots 44 and 45 without turning the segment *y*, but not otherwise. Thus, the segment *y* is provided with a yoke-like portion 50 providing slot 51 parallel with the axis of the segment *y*. The hand lever Z has a portion 52 extending through this slot and it is pivotally secured therein by means of a pin 53.

It will be seen that all vertical movements of the hand lever Z result in a corresponding oscillation of the yoke *y;* whereas transverse movements of the lever Z have no effect on the segment *y*. The lever Z is connected to the segment *x* in an analogous manner so as to have a converse effect on said segment. Thus, the segment *x* provides an extension terminating in a spherical head 54 centrally coinciding with the axis of the segment *y*. The portion 52 of the lever Z provides a slot for receiving the ball 54. It will be seen that, by virtue of this arrangement, when the lever Z is swung about the axis of the segment *y*, it will have no effect on the ball 54 since it contacts therewith only at points co-axial with the axis of the segment *y;* but, by reason of the off-set position of the pivot 53, any transverse movement will cause the extended portion containing the slot to move substantially in the direction of the axis with the result that the ball 54 will be shifted along the axis and thereby rotated about its pivot 40. The sides of the slot are perpendicular to the axis of the segment *y*.

In consequence of this arrangement, the cam cylinders X and Y will be rotated proportionately to their respective components of the movement of the hand lever Z. In order that this lever may be retained in any of its predetermined positions, the spherical plate 55 is bolted to the casing N and is provided with tabulated apertures 56 converging according to the pivotal positions of the lever Z. A lock-pin 57 is mounted in the lever Z to plug these various apertures and a hand grip 58 is provided to facilitate the withdrawal of the pin 57 to permit the position of the lever Z to be changed.

In order that the various angular positions of the cam cylinders X and Y may be maintained without back-lash, the means illustrated in Figs. 4 and 8 may be employed. Adjacent one end, the cam cylinder X is provided with as many concavities 59 as there are combinations available for the gear couplets 1 and 2; *e. g.*, in this case, four are provided. An arm 60 is pivoted at 61 to the casing N and carries a roller 62 snugly interfitted with these concavities 59.

A similar construction is employed for the other cam roller Y and a spring 63 may be conveniently employed to draw the rollers 62 resiliently into interfitting relation with the concavities. This device will accurately position the cam rollers so that the cam slots thereby provided will be properly positioned to maintain the correct mesh of the appropriate gear couplet.

Suitable clutch shifting yokes intervene between the cam cylinders and the various gear couplets, as shown best by Fig. 5. Thus, a couplet shifter P is pivoted to a rod 64 and, at its upper end, is provided with a fork 65 entering the annular groove 66 of the gear couplet G and, at its lower end, it has an arm 67 having a finger 68 which enters the cam slot in the cam cylinder Y and has the effect of swinging or shifting the couplet shifter P in accordance with the conformation of the cam groove. A similar shifter intervenes between the second cam groove on the cylinder Y and the gear couplet E.

An analogous construction obtains for communicating the motions from the cam grooves on the cylinder X to the two gear couplets on the shaft I. For example, a shifter Q is pivoted about a pin 69 projecting from the casing N and said shifter has a finger 70 entering the cam slot in the cylinder X. It also has two fingers 71 entering the annular groove 72 of the gear couplet 2 so as to shift the latter in accordance with the positions of the cam cylinder X. These cam grooves are of a simple nature, merely providing straight neutral portions for determining the neutral positions of the gear couplets and their portions off-set to the right or left of the neutral position at appropriate points in the circumference of the cam cylinders for the purpose of effecting the right or left shifting of the various cam shifters, as will be readily understood.

An important feature of this arrangement resides in the index plate pointers provided by the lever Z whereby the operator is enabled, at a glance, to set the mechanism to transmit any predetermined feed ratio, without consulting tables or making estimates. The arrangement is such as to permit of the use of large sized figures so as to avoid any error due to inconspicuousness.

This index plate is shown best in Fig. 2 and it consists of a spherical dished plate

Q′ having a rectilinear outline and providing a large central opening q for receiving the hand lever Z and permitting free movement thereof in any lateral direction. The vertical side margins of this index plate are each subdivided into appropriate divisional blocks 73 so as to provide on each side two vertical rows each consisting of a series of four blocks. These blocks or tablets are comparatively large and are each provided with an appropriate legend in large numerals indicating the rate at which the table will feed in inches per minute. The ratios are those tabulated in the preceding portion of this specification and correspond with the particular number of teeth used in the gearing. Of course, these ratios may be given any desired absolute values and they may be selected either in a purely arithmetical series or in any other mathematical series desired. The figures used in the blocks or tablets 73 will, however, read directly in terms of the rate of feed of the table so as to spare the operator the necessity of making mental calculations and thereby avoiding any error likely to arise therefrom. The lever Z is provided with two oppositely extending wings or pointers z and z' and preferably these wings have bifurcated ends adapted to span the block sections of the index plate, rendering the registration of the lever Z more certain. The parts are so proportioned that when the lever Z is moved to register with any one of the blocks on the left side of the index plate, its right hand pointer will entirely clear the blocks on the right hand side of the index plate and vice versa, thereby avoiding any possibility of a misunderstanding on the part of the user. This proportioning is made feasible by the use of the cam grooves on the cam cylinders X and Y inasmuch as a cam groove permits conformation to any predetermined movement within a wide limit. The index plate and the lever aforesaid are preferably mounted on a front face of the knee so as to be immediately within observation and reach of the user standing in the position best enabling him to observe the working of the machine. This is shown best by Fig. 13.

In the foregoing mechanism, the control elements thereof may be incorporated into any conventional machine tool so as to control movements of the work or tool supporting member, as, for example, the table, saddle or knee of a universal milling machine such as herein shown.

Referring to Fig. 13, there will be seen a universal milling machine consisting of a so-called column R extending upwardly from a suitable bed-plate r and having at its upper end a so-called overarm r' which supports a rotary spindle 74 which carries a conventional milling cutter. In this type of machine, the cutter is rotated but not translated, and the object to be machined is bolted to a so-called table which is bodily moved so as to bodily move the object and present it progressively to the action of the cutting tool. In a universal machine it may be desirable to move the object either vertically or right and left or in and out and to permit this to be done the frame of the general mechanism for supporting the object is subdivided into three components termed a knee, which moves vertically on the column; the saddle, which moves in and out on the knee; and a table, which moves right and left on the saddle. The knee is indicated here by S; the saddle by T; and the table by U.

In order to impart the necessary movements to either of these three elements, appropriate gearing extends to each and is adapted to be connected kinetically with some element deriving motion through the feed change mechanism aforesaid.

The table U derives its motion (see Fig. 1) from the shaft 16 driven by a gear 13 meshing with another gear 12 connected through a yieldable friction-clutch 11 with a gear 10 meshing with a pinion k keyed to the shaft K propelled by the gear G splined thereto.

Referring to Fig. 9, this shaft 16 is shown extending parallel with the direction of movement of the saddle T on the knee S and transversely to the direction of slide of the table U to the saddle T. The shaft 16 extends through a beveled pinion 75 which is journaled in a portion of the frame of the saddle T so as to permit a shifting of the saddle relatively to the knee without interfering with the shaft 16. The bevel gear 75 meshes with another bevel gear 76 which idles on the stub-shaft 77 but which may be mechanically connected therewith whenever it is desired to feed the table by shifting the clutch V into the lower position shown by Fig. 9. This causes the stub-shaft 77 to rotate and thereby drive the bevel gear 78 and rotate the two beveled gears m and n in opposite directions. These beveled gears m and n are sleeved around the feed screw 79 of the table U and are normally disconnected therefrom but, by shifting the clutch W either one or the other may be caused to rotate the feed screw 79 either to the right or the left, as the case may be. This feed screw engages a nut 80 fixed to the saddle T and at its ends is non-translatably journaled to the table so that, as it rotates, it will cause the table to travel to the right or the left. Since the parts thus described all receive their motion through the feed change mechanism previously disclosed, it will be perceived that the table will feed at the predetermined rate and that this rate may be changed very easily and quickly by merely shifting the hand lever Z.

Clutch V, when shifted to its upper position to engage a gear *o* will disconnect the table from the aforesaid feed change mechanism and will substitute a connection with a fast return transmission consisting of the gear *o*, meshing with a bevel *p* geared to another bevel gear *q'* (see Fig. 11) secured to a shaft *s* carrying another bevel gear *t* meshing again with another bevel gear *u* secured to a shaft *v* driven by a universal joint *w* which receives motion from the prime mover of the machine in any appropriate manner.

The knee may be caused to feed up or down, if desired, by shifting the clutch M (see Fig. 1) either to the right or to the left. This clutch is splined to the shaft 17 and when shifted one way, it will engage the gear 18 through the teeth 30 and drive the shaft 17 in one direction; or, when shifted to the other side, it will connect the gear 31 through the teeth 29 with the same shaft 17 and drive it in the opposite direction. The gears 18 and 31 rotate oppositely because gear 18 meshes directly with gear 14 fixed to shaft 16, whereas gear 31 receives its motion through an idler 32 meshing with gear 15, also fixed to shaft 16. Shaft 17 carries a bevel 33 which meshes with a bevel 34 fixed to the shaft 35. When the clutch M is thrown out, the shaft 35 may be rotated manually by turning the crank 36.

Referring to Fig. 12, it will be seen that the shaft 35 carries a bevel gear 81 meshing with a corresponding bevel gear 82 secured to the vertical feed screw 83 non-translatably journaled in the frame of the knee S. This vertical feed screw 83 passes through a tubular screw carried by the standard 85 uprising from the base *r*, thereby enabling the feed screw to raise and lower the knee.

The saddle in an analogous manner, may be caused to feed in and out by motion derived through the aforesaid feed change mechanism.

Referring to Fig. 1, 28 indicates a nut appropriately secured to the saddle T and adapted to be screwed in and out by the thread on the end of the shaft 27 which extends parallel to the direction of slide of the saddle T and the knee S. This shaft 27 is non-translatably journaled in the frame of the knee S and it is provided with a handwheel 37 whereby it may be manually actuated and also with gearing whereby it may be mechanically rotated in either direction. Thus, the gear 26 meshes with a gear 25 which is secured to a gear 24 meshing with the gear 22 on a shiftable clutch L. This clutch is freely sleeved to a shaft 23 and at its opposite ends is provided with clutch teeth 20 and 21 whereby it may be connected either with gear 19 or with gear 32. The former receives motion from the gear 18 which is driven oppositely to the shaft 16 by directly engaging with gear 14, whereas the gear 32 is driven directly by the gear 15 on the same shaft 16. Thus, gears 19 and 32 are both permanently driven in opposite directions by the shaft 16 and, by shifting the clutch L to engage the one or the other, the saddle T may be caused to feed either in or out as desired.

Without further elaboration, the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various applications without omitting certain features that, from the standpoint of the prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalency of the following claims.

Having thus revealed this invention, I claim as new the following combinations of steps and elements or equivalents thereof, and desire to secure the same by Letters Patent of the United States:

1. A machine tool combining two rotary cam cylinders; four gear sets shiftable thereby; intermediate gearing yielding a variety of speed ratios in coöperation with said gear couplets; a freely movable hand lever; a motion analyzer intervening between said hand lever and said cam cylinders for moving the latter proportionately to the corresponding component of the movement of the hand lever; and a work support actuated by the said gears.

2. A machine tool combining a traveling work support; a feed change gearing for propelling it at various speeds; two independently movable members for determining the feed ratio of said gearing; an index plate having tabulated vertically and horizontally thereon the feed ratios obtainable from said gearing; a hand lever movable vertically and horizontally to register with any one of said tabulations; and a mechanical analyzer between said lever and said members for causing the latter to move proportionately to the components of movement of said hand lever.

3. A machine tool combining a traveling support; a power driven shaft; two gear couplets splined thereto; an intermediate shaft supporting five gears arranged to rotate as a unit, four of said gears being engageable by the respective gears on said two couplets; a third shaft; a gear couplet shiftable thereon to engage the fifth gear on said intermediate shaft and also one of said four gears thereof; a speed change gearing deriving motion from said last mentioned gear couplet; a transmission connecting said

speed change gear with said support; and means for automatically shifting said gear couplets.

4. A machine tool combining a traveling support; a feed change mechanism embodying a plurality of gear couplets; a first couplet shifter connected with two of said couplets so as to cause only one of the gears thereof at a time to function; a second shifter connected with the remaining gear couplets to cause two of the gears thereof to function simultaneously; and a hand operated means for actuating said shifters independently.

5. A traveling work support; propelling means therefor; and a feed change mechanism for imparting motion at a predetermined rate to said means, said mechanism comprising a plurality of gears; means for selectively arranging any two of said gears in series; gearing for transmitting motion through said serially arranged gears; another plurality of gears; means for selectively utilizing any one of said last mentioned plurality of gears for imparting motion to said last mentioned gearing; and a single lever mechanically connected to both of said means for actuating the same in accordance with the position of said lever.

6. A traveling work-support; propelling means therefor; and a feed change mechanism for imparting motion at a predetermined rate to said means, said mechanism comprising intermediate gears; four shiftable gears; means for meshing said gears to arrange two of them in serial relation with said gearing; a plurality of gears; means for meshing any one of said gears in propelling relation with said gearing; a hand lever freely movable in different directions; and a motion analyzer intervening between said lever and said means to actuate the latter proportionately to the components of the motion of the hand lever.

7. A traveling work-support; propelling means therefor; and a feed change mechanism for imparting motion at a predetermined rate to said means, said mechanism comprising a first plurality of shiftable gears; a second plurality of shiftable gears; gearing intermediate the same; and means for simultaneously arranging in serial relation any two selected gears of said first plurality, the intermediate gearing, and any one selected gear of said second plurality.

8. A traveling work-support; propelling means therefor; and a feed change mechanism for imparting motion at a predetermined rate to said means, said mechanism comprising a first plurality of gears; a second plurality of gears; gearing intermediate the same; and a gear engaging mechanism comprising an operating lever adapted, when moved in one direction, to successively effect an engagement between the various single gears of said second plurality with said intermediate gearing, and when moved in a transverse direction, to simultaneously render effective different combinations of the gears of said first plurality.

9. A traveling work-support; propelling means therefor; and a feed change mechanism for imparting motion at a predetermined rate to said means, said mechanism comprising two cam cylinders; a first gear segment swinging in a horizontal plane for rotating one of said cylinders; a second gear segment swinging in a transverse plane for rotating the other cylinder; a hand lever freely movable in different direction and connected to actuate the one gear segment in proportion to its movement in the one direction and the other gear segment in proportion to its movement in another direction; and means for enabling said mechanism to control said feed change mechanism.

10. A traveling work-support; propelling means therefor; and a feed change mechanism for imparting motion at a predetermined rate to said means, said mechanism comprising first and second members separately pivoted to swing about different axes; a hand lever separately pivoted to each of said members whereby it may swing either one or both, in accordance with its direction of movement; an index plate denoting the various positions of said hand lever; and means for enabling said members to determine the operation of said feed change mechanisms.

11. A traveling work-support; propelling means therefor; and a feed change mechanism for imparting motion at a predetermined rate to said means, said mechanism comprising an index plate having a large central opening and provided with numerals indicating the rate of feed arranged on opposite sides of said opening; a lever having oppositely extending pointers; and a mechanism intervening between said lever and said feed change mechanism to control the functions of the latter in accordance with the position of said hand lever.

In witness whereof I hereunto subscribe my name as attested by the two subscribing witnesses.

ROBERT T. HAZELTON.

Witnesses:
SOL EINSTEIN,
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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."