No. 660,200. Patented Oct. 23, 1900.

G. RICHARDS.

MILLING MACHINE.

(Application filed Mar. 16, 1900.)

(No Model.) 3 Sheets—Sheet 1.

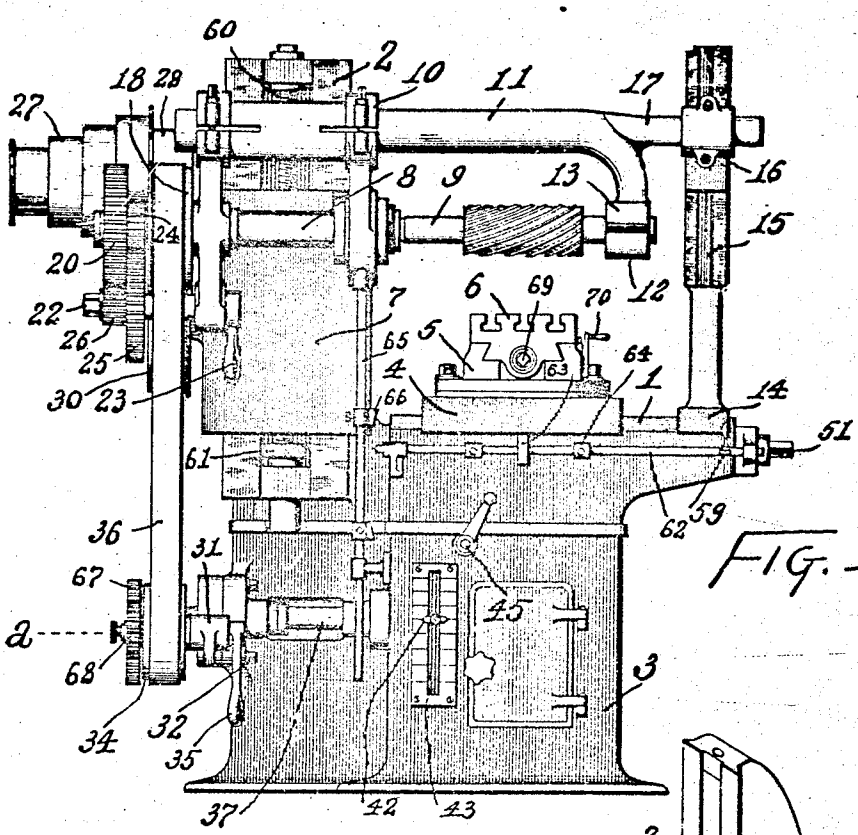


FIG. 1.

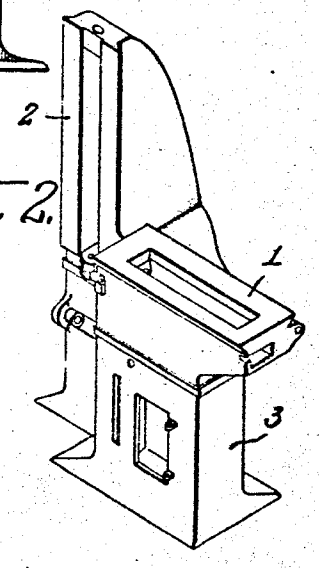


FIG. 2.

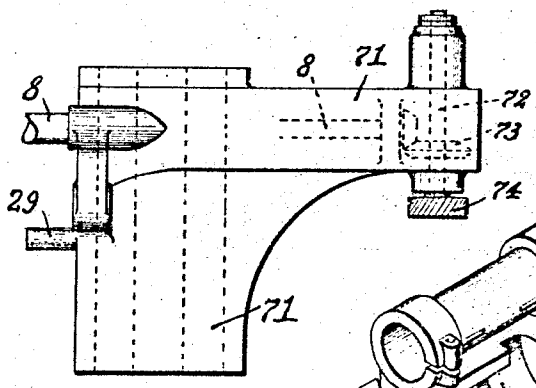


FIG. 4.

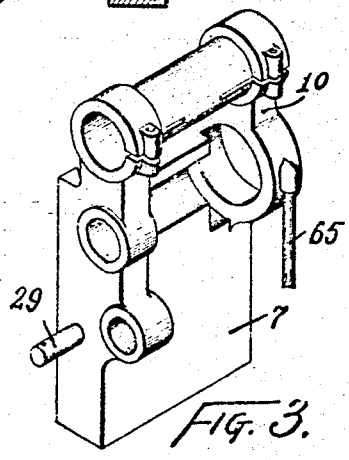


FIG. 3.

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3 Sheets—Sheet 2.

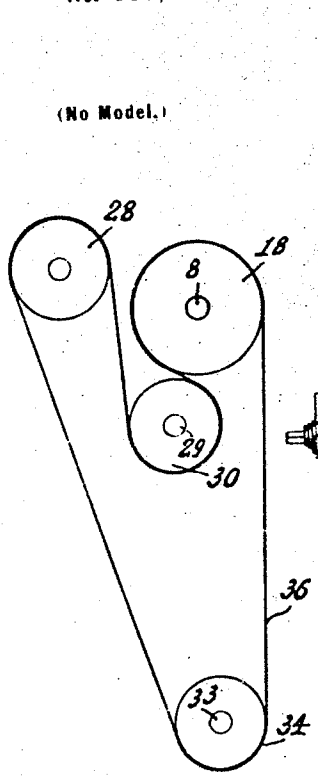


FIG. 8.

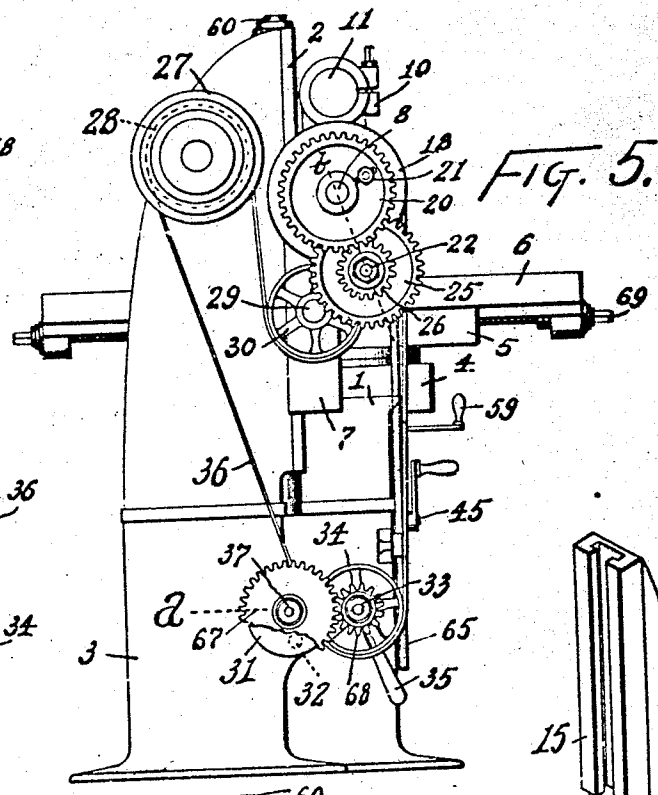


FIG. 5.

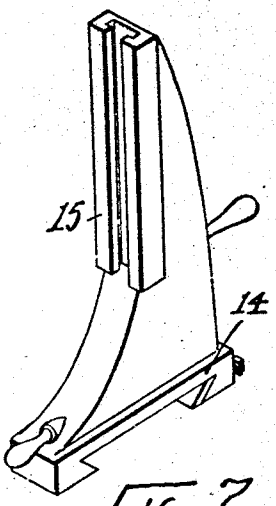


FIG. 7.

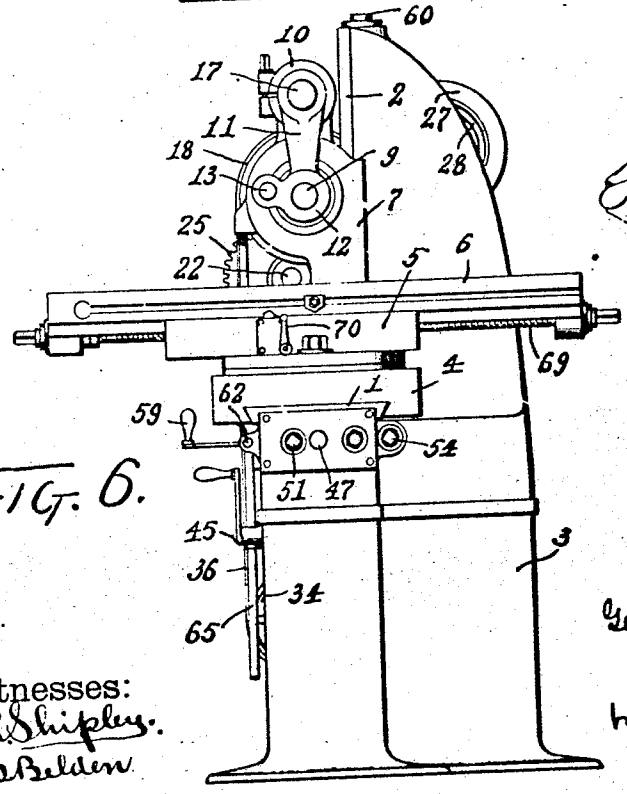


FIG. 6.

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(No Model.) 3 Sheets—Sheet 3.

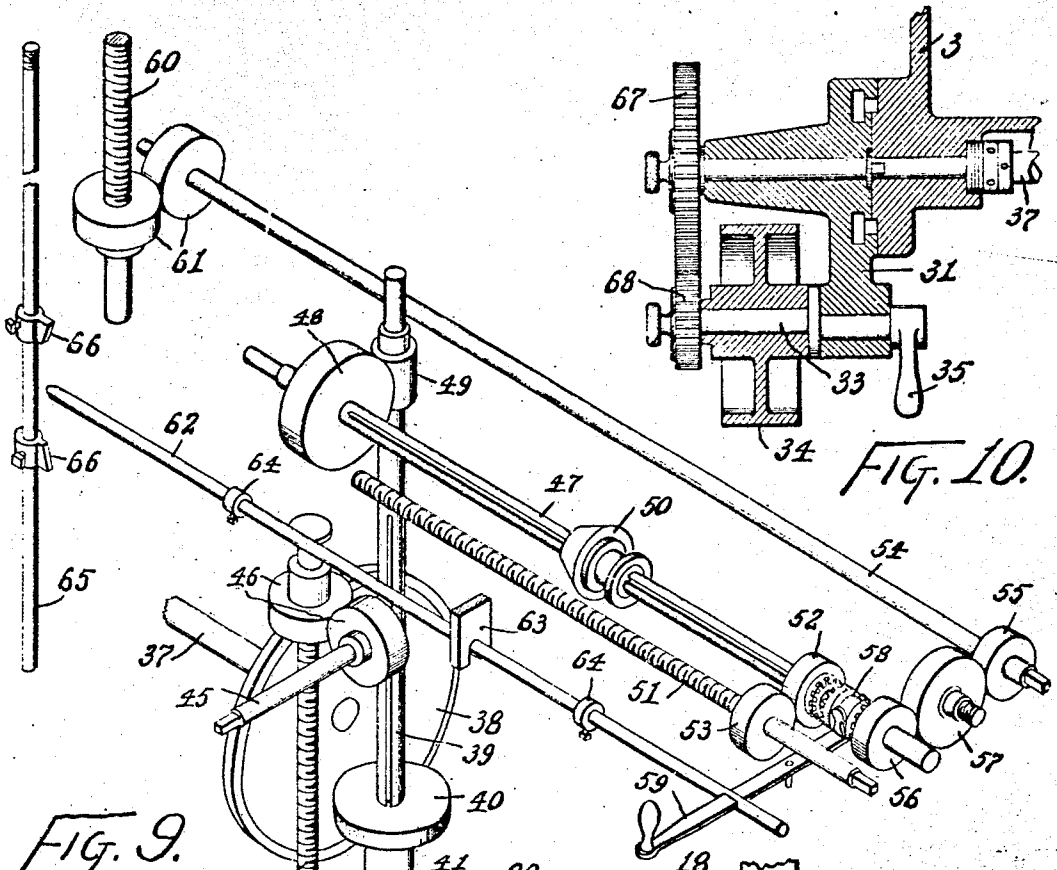


FIG. 9.

FIG. 10.

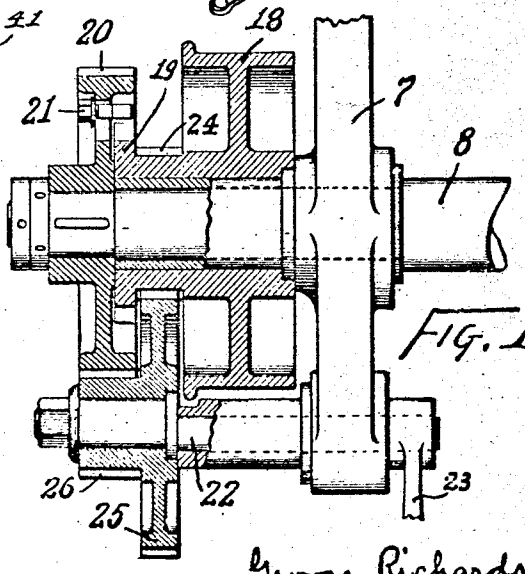


FIG. 11.

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UNITED STATES PATENT OFFICE.

GEORGE RICHARDS, OF BRUSSELS, BELGIUM.

MILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 660,200, dated October 23, 1900.

Application filed March 16, 1900. Serial No. 8,895. (No model.)

To all whom it may concern:

Be it known that I, GEORGE RICHARDS, a citizen of the United States, residing in Brussels, Belgium, (post-office address 102 to 104 Rue de Louvain, Brussels, Belgium,) have invented certain new and useful Improvements in Milling-Machines, of which the following is a specification.

Applications for foreign patents on this invention have been applied for as follows—viz., in Great Britain, filed February 16, 1900, No. 3,091.

This invention, pertaining to improvements in milling-machines, will be readily understood from the following description, taken in connection with the accompanying drawings, in which—

Figure 1 is a front elevation of a milling-machine embodying my improvements, this view showing the machine provided with a vertical saddle adapted for horizontal milling; Fig. 2, a perspective view of the frame; Fig. 3, a perspective view of the vertical saddle employed for horizontal milling; Fig. 4, a front elevation of the vertical saddle employed for vertical milling; Fig. 5, an elevation of the driving end of the machine; Fig. 6, an elevation of the outboard end of the machine, the outboard-housing being omitted; Fig. 7, a perspective view of the outboard-housing; Fig. 8, a diagram illustrating the arrangement of the driving-belt; Fig. 9, a perspective view, of somewhat diagrammatic character, of the moving parts pertaining to the transmission of the various feed motions; Fig. 10, a horizontal section in the plane of line *a* of Figs. 1 and 5 through certain members of the driving and feeding mechanism; and Fig. 11, a substantially vertical section through the back-gear mechanism in the plane of line *a* of Fig. 5.

In the drawings, quite ignoring Fig. 4 for the present, 1 indicates a horizontal bed provided with a longitudinal slide, preferably of dovetail section, for a saddle; 2, a column rising from one end of the bed and integrally formed therewith and provided with a vertical slide, preferably of dovetail section, for a saddle; 3, a hollow body disposed below and serving to support the bed and column structure and to give support and inclosure for various elements of the driving and feed mechanism; 4, a saddle gibbed to and sliding on the bed, this saddle being hereinafter termed the "horizontal" saddle; 5, a turn-table swiveled on the top of the horizontal saddle, as usual in universal milling-machines; 6, the work-table gibbed to and sliding horizontally in the turn-table and adapted to receive the work or the work-holding fixtures, the entire arrangement of turn-table and work-table being as usual in universal milling-machines; 7, a saddle gibbed to and sliding upon column 2, this saddle being hereinafter termed the "vertical" saddle; 8, a spindle journaled horizontally in bearings carried by the vertical saddle and having at its inner end the usual socket or other arbor-receiving feature; 9, the usual mill-arbor carried by and projecting from the inner end of spindle 8; 10, a cylindrically-bored socket rigidly connected with the vertical saddle and disposed above spindle 8, with its axis parallel therewith; 11, a cylindrical steady-bar fitting socket 10 and adapted to turn and slide therein and project therefrom outwardly over the milling-arbor and having a downwardly-projecting arm; 12, an eye formed in the extremity of the arm of the steady-bar, the axis of this eye being horizontal and at a distance from the axis of the steady-bar equal to that between the axis of the steady-bar and the axis of spindle 8; 13, a second eye carried by the arm of the steady-bar at the same distance from the axis thereof as eye 12, this second eye 13 being preferably of smaller bore than eye 12; 14, a clamp gibbed to and adapted for sliding adjustment on bed 1; 15, a rigid column rising from the clamp to the rear of the axial line of spindle 8; 16, a bearing secured firmly but adjustably to column 15, so as to be adjusted vertically thereon, the axis of this bearing being horizontal and in the vertical plane of the axis of steady-bar 11; 17, a cylindrical prolongation of steady-bar 11 outwardly beyond the arm-supporting eyes 12 and 13, this prolongation of the steady-bar fitting the bearing 15; 18, a pulley mounted loosely on the outer end of the spindle 8 or, what is the same thing, on an outwardly-projecting portion of the outer bearing of the spindle, as shown in Fig. 11; 19, a disk carried by pulley 18 and having one or more locking-notches in its

periphery; 20, a gear fast on the outer end of spindle 8 outwardly beyond disk 19; 21, a locking-bolt sliding radially in gear 12 and adapted to be adjusted into or out of engagement with a notch in the disk, so as to cause the gear 20, and consequently the spindle, to be locked to or released from pulley 18; 22, an eccentric stud mounted in a bearing carried by the vertical saddle 7 parallel with the axis of spindle 8; 23, a handle for turning this eccentric stud; 24, a pinion carried by pulley 18 between that pulley and disk 19; 25, a gear mounted loosely on eccentric stud 22 and adapted, when the stud is properly turned, to engage with pinion 24; 26, a pinion fast with gear 25 and adapted to engage with gear 20, gear 20, pinion 24, gear 25, and pinion 26, and notched disk 19 constituting the back-gear of the spindle-driving mechanism; 27, a cone-pulley mounted loosely on a stud projecting outwardly from column 2 to the rear of and parallel with spindle 8, this cone-pulley being adapted to receive the main driving-belt of the machine and provide for changes in driving speed; 28, a pulley fast with cone-pulley 27 and disposed in the vertical plane of pulley 18, so that a belt may engage both pulleys; 29, a stud projecting outwardly from the side of vertical saddle 7; 30, an idle pulley mounted on this stud below pulley 18 and in the vertical plane thereof; 31, Fig. 10, a swinging arm mounted on the body 3 below vertical saddle 7, the axis of swinging motion of this arm being parallel with spindle 8; 32, bolts uniting arm 31 to the body and serving to clamp the arm in adjusted angular position; 33, an eccentric stud mounted in arm 31 parallel with the axis of swinging motion of the arm; 34, a pulley mounted loosely on eccentric stud 33 in the vertical plane of pulleys 18, 28, and 30, so that one belt may engage the four pulleys; 35, a handle for turning eccentric stud 33; 36, a belt engaging pulleys 18, 28, 30, and 34; 37, the main feed-shaft, the same being journaled in the body in the axis of swinging motion of arm 31 and being geared to pulley 34, as hereinafter explained; 38, Fig. 9, a disk secured upon the inner end of main shaft 37 and inclosed within the hollow body of the machine, this disk having preferably a yielding face, as of leather; 39, a splined shaft journaled in the body vertically alongside the face of disk 38, with its axial line intersecting that of shaft 37; 40, a bush-wheel splined to shaft 39 and having its periphery engaging the face of disk 38, so that motion will be transmitted from shaft 37 to shaft 39; 41, a vertically-sliding bearing, in which is journaled the hub of bush-wheel 40; 42, an index-pointer carried by an arm projecting outwardly from bearing 41, this pointer being exterior to the body of the machine, which is slotted to permit the vertical play of the arm carrying the pointer; 43, a graduated index at the margin of the slot just referred to, the graduations indicating the vertical position of bush-wheel 40 relative to the axis of the disk which drives it; 44, a screw mounted vertically in the body of the machine parallel with bush-wheel shaft 39 and engaging bearing 41 as a nut, so that the turning of the screw will serve in adjusting the bush-wheel diametrically across the disk which drives it; 45, a shaft journaled in the body of the machine and projecting exterior thereto to receive a hand-crank; 46, gearing connecting the inner end of shaft 45 with screw 44, whereby the manipulation of the hand-crank may serve in turning the screw and adjusting the bush-wheel, spiral gearing being employed in the exemplification; 47, a splined shaft journaled longitudinally in bed 1; 48, a worm-wheel fast on this shaft; 49, a worm fast on bush-wheel shaft 39 and engaging worm-wheel 48, whereby the turning of main feed-shaft 37 imparts rotary motion to bed-shaft 47 in a direction and at a speed dependent on the adjustment of the bush-wheel; 50, a bevel-pinion splined on bed-shaft 47 and serving to transmit motion to the feed-screw of work-table 6 in a manner and by the means usual in universal milling-machines; 51, the bed-screw journaled in bed 1 and engaging horizontal saddle 4 and serving in traversing that saddle along the bed, the outer end of this screw being adapted for the reception of a hand-crank; 52, a gear loose on bed-shaft 47 and having a clutch-face; 53, a gear fast on bed-screw 51 and meshing with gear 52; 54, a back shaft journaled longitudinally in the bed and having its outer end arranged to receive a hand-crank; 55, a gear fast on back shaft 54; 56, a second clutch-faced gear loose on bed-shaft 47; 57, an idle intermediate gear engaging gears 55 and 56; 58, a clutch splined to bed-shaft 47 between gears 52 and 56 and adapted, according as thrown, to lock either one of those gears to shaft 47; 59, a lever for throwing clutch 58 and having a handle exterior to the bed of the machine; 60, a vertical screw mounted in column 2 and engaging the vertical saddle and serving for the vertical adjustment of the saddle upon the column; 61, gearing connecting the inner end of back shaft 54 with screw 60, the gearing shown in the exemplification being of the spiral type; 62, a horizontal trip-rod sliding in bearings in front of the bed and connected with clutch-lever 59; 63, a tappet carried by horizontal saddle 4 and traversing trip-rod 62; 64, adjustable dogs upon trip-rod 62, adapted to be engaged by the tappet; 65, a vertical trip-rod carried by vertical saddle 7 and sliding with it, the axis of the vertical trip-rod intersecting the axial line of horizontal trip-rod 62; 66, adjustable dogs upon vertical trip-rod 65, adapted to engage the end of horizontal trip-rod 62 and slide the horizontal rod endwise; 67, Fig. 10, a change-gear removably secured to the outer end of main feed-shaft 37; 68, a change-pinion removably secured on the hub of pulley 34 and adapted when eccentric stud 33 is properly adjusted to mesh with gear 67, gear 67 and pinion 68 being interchangeable,

so that, if desired, the pinion can be placed on shaft 37 and the gear on pulley 34; 69, Fig. 6, the usual longitudinal feed-screw of work-table 6, the same receiving its power feeding motion from pinion 50 in the manner usual in universal milling-machines; 70, the usual trip mechanism of the longitudinal feed motion of the work-table, whereby the longitudinal feeding motion of the work-table through the turntable is arrested at desired point by the operation of a dog on the work-table; 71, Fig. 4 only, a vertical saddle adapted to interchange with vertical saddle 7 and take the place of the latter upon the column of the machine when vertical milling is to be done, saddle 71 being provided with a rigid integral arm projecting out over the work-table; 72, a vertical spindle journaled in the outer end of the arm of saddle 71; 73, bevel-gearing connecting saddle-spindle 8 with vertical spindle 72, and 74 a vertical mill secured at the lower end of spindle 72.

The main description has been given upon the machine as adapted for horizontal milling. For vertical milling the saddle 71 displaces the saddle 7, the two being interchangeable upon the column.

The thrusts due to the strains of cutting are met by the rigid members and sliding surfaces of this machine in a particularly-advantageous manner, as will be obvious. Bed 1 may be of any length desired without in any degree impairing its capacity for resisting the cutting strains. Outboard-column 15 may be adjusted at any desired point along the bed, and it may be employed or dispensed with, according to the requirements of the work. Its bearing 16 may be employed in supporting steady-bar 11, or it may be lowered into line with spindle 8 and serve as the direct outboard-bearing for an arbor or boring-bar. Steady-bar 11 may be employed in furnishing the outboard-bearing for an arbor or a boring-bar, either alone or in conjunction with outboard-column 15 and its bearing 16. Either of the eyes 12 and 13 may be swung into the proper line for use, it thus being practicable to have a large bearing-eye for large arbors, &c., and a small one for small arbors or for a center.

Turning to Figs. 5 and 8, it will be obvious that belt 36 is maintained at constant tension throughout the vertical adjustment of saddle 7. By adjusting arm 31 on its axis the pulley 34 may be lowered to restore normal belt tension as ordinary stretching occurs. By turning eccentric stud 33 the gears 67 and 68 may be disengaged to arrest the motion of all the feed mechanism. When back-gears 25 and 26 are thrown out of engagement with gears 20 and 24, locking-bolt 21 being set to engage a notch of disk 19, then spindle 8 is driven at the speed of pulley 18, but with locking-pin 21 disengaged and the back-gears brought into action then spindle 8 turns very much slower and more powerfully.

Turning to Fig. 9, it will be obvious that vertical saddle 7 may be adjusted on its column by hand-crank on shaft 54, operated conveniently at the end of the bed of the machine and that the feed of saddle 4 on the bed can be operated from the same position by crank on the outer end of screw 51. It will also be obvious from Fig. 9 that all of the power feeding motions are derived from main feed-shaft 37, taking its motion through change-gears 67 and 68, Fig. 10, the interchangeability of which provides for a radical change in feeding rates. Manipulation of handle 35 disengages gears 67 and 68 and instantly arrests all the power feeding motions.

The vertical adjustment of the bush-wheel obviously provides for graduations of rate of all of the power-feeds and for a change in direction of all of the power-feeds. The direction and rate of feed can be readily judged from the exterior index, and the rate and direction of feed can be readily changed by crank on shaft 45 while the machine is in motion.

Bush-wheel shaft 39 gives motion to splined shaft 47, and by throwing clutch 58 into engagement with gear 52 feed motion may be imparted to screw 51 and to the horizontal saddle at rate and in direction depending on the adjustment of the bush-wheel. By throwing clutch 58 into engagement with gear 56 feed motion is similarly imparted to screw 60 and the vertical saddle. The feed motion of the horizontal saddle is tripped by the action of tappet 63 on the dogs 64 of the horizontal trip-rod, the result being the throwing of clutch 58 to idle position. Similarly the feeding motion of the vertical saddle is tripped by the action of the dogs on vertical trip-rod 65, which through rod 62 releases the clutch. The work-table is traversed through the turntable by screw 69 and tripped by trip mechanism 70, as usual.

Referring to Fig. 10, it may be stated that it is preferable to form main feed-shaft 37 in two sections clutched together, so as to permit endwise adjustment of the inner portion of the shaft, by means of screw thrust-collars, so as to maintain proper frictional contact between the bush-wheel and the disk which drives it, such adjustment being usual in bush-wheel devices.

I claim as my invention—

1. In a milling-machine, the combination, substantially as set forth, of a vertical column, a vertical saddle fitted for sliding motion on the column, a spindle journaled in said vertical saddle, a pulley on said spindle, an idle pulley carried by said saddle below said spindle-pulley, a pulley supported below said idle pulley, a driving-pulley supported by said column, and a belt engaging all said pulleys.

2. In a milling-machine, the combination, substantially as set forth, of a bed, a column at one end thereof, a vertical saddle to slide on the column, a horizontal saddle to slide on the bed, a spindle journaled in the vertical saddle, a pulley on said spindle, a belt engag-

ing said pulley, a main feed-shaft actuated by said driving-belt, independent feed devices for said two saddles, a train of transmitting mechanism between said main feed-shaft and said feed devices, and a disk and bush-wheel in said train of transmitting mechanism.

3. In a milling-machine, the combination, substantially as set forth, of a bed, a column at one end thereof, a vertical saddle to slide on said column, a horizontal saddle to slide on said bed, a spindle journaled in the vertical saddle, a second column adjustably mounted on said bed, a cylindrical bearing carried by said second column, a steady-bar carried by said vertical saddle, an arm projecting from said steady-bar and having an eye adapted for alinement with said spindle, and an outward cylindrical prolongation from said steady-bar adapted for engagement with said bearing.

4. In a milling-machine, the combination, substantially as set forth, of a bed, a column at one end thereof, a vertical saddle to slide on said column, a horizontal saddle to slide on said bed, a spindle journaled in the vertical saddle, a clamp adapted to be secured adjustably along said bed, a column rising from said clamp, a bearing vertically adjustable on said clamp-column, a socket carried by said vertical saddle above and parallel with said spindle, a steady-bar having alining ends engaging said socket and said bearing respectively, and an arm projecting from said steady-bar and having an eye adapted for alinement with said spindle.

5. In a milling-machine, the combination, substantially as set forth, of a bed, a column at one end thereof, a vertical saddle to slide on said column, a horizontal saddle to slide on said bed, a spindle journaled in the vertical saddle, a cylindrical socket carried by said vertical saddle above and parallel with said spindle, a steady-bar engaging said socket, and an arm projecting from said steady-bar and carrying a plurality of eyes adapted for alternative alinement with said spindle.

6. In a milling-machine, the combination, substantially as set forth, of a horizontal bed, a column at one end thereof, a horizontal saddle to slide upon the bed, a vertical saddle to slide upon the column, a spindle journaled in the vertical saddle, a pulley on said spindle, an idle pulley carried by the vertical saddle below said spindle-pulley, a driving-pulley supported by said column, an adjustable eccentric spindle supported below said idle pulley, a pulley on said eccentric spindle, and a belt engaging all said pulleys.

7. In a milling-machine, the combination, substantially as set forth, of a horizontal bed, a column at one end thereof, a horizontal saddle to slide upon the bed, a vertical saddle to slide upon the column, a spindle journaled in the vertical saddle, a pulley on said spindle, an idle pulley carried by the vertical saddle below said spindle-pulley, a driving-pulley supported by said column, an adjustable eccentric spindle supported below said idle pulley, a pulley on said eccentric spindle, a gear fast with said last-mentioned pulley, a main feed-shaft parallel with said eccentric spindle, a gear on said main feed-shaft and engaging the before-mentioned gear, and a belt engaging all said pulleys.

8. In a milling-machine, the combination, substantially as set forth, of a horizontal bed, a column at one end thereof, a horizontal saddle to slide upon the bed, a vertical saddle to slide upon the column, a spindle journaled in the vertical saddle, a pulley on said spindle, an idle pulley carried by the vertical saddle below said spindle-pulley, a driving-pulley supported by said column, a swinging arm mounted on a horizontal axis below said idle pulley, a clamp for securing said arm in adjusted position, a pulley carried by the free portion of said arm, and a belt engaging all said pulleys.

9. In a milling-machine, the combination, substantially as set forth, of a horizontal bed, a column at one end thereof, a horizontal saddle to slide upon the bed, a vertical saddle to slide upon the column, a spindle journaled in the vertical saddle, a pulley on said spindle, an idle pulley carried by the vertical saddle below said spindle-pulley, a driving-pulley supported by said column, a swinging arm mounted on a horizontal axis below said idle pulley, a clamp for securing said arm in adjusted position, a main feed-shaft at the axis of said arm, a gear on said main feed-shaft, a pulley carried by the free portion of said arm, a gear carried by said last-mentioned pulley engaging the before-mentioned gear, and a belt engaging all said pulleys.

10. In a milling-machine, the combination, substantially as set forth, of a horizontal bed, a column at one end thereof, a horizontal saddle to slide upon the bed, a vertical saddle to slide upon the column, a spindle journaled in the vertical saddle, a pulley on said spindle, an idle pulley carried by the vertical saddle below said spindle-pulley, a driving-pulley supported by said column, a swinging arm mounted on a horizontal axis below said idle pulley, a clamp for securing said arm in adjusted position, an eccentric spindle carried by the free portion of said arm, a pulley on said eccentric spindle, a gear on said last-mentioned pulley, a feed-shaft at the axis of said arm, a gear on said feed-shaft and engaging the before-mentioned gear, and a belt engaging all said pulleys.

11. In a milling-machine, the combination, substantially as set forth, of a horizontal bed, a column at one end thereof, a horizontal saddle to slide upon the bed, a vertical saddle to slide upon the column, a spindle journaled in the vertical saddle, a pulley on said spindle, an idle pulley carried by the vertical saddle below said spindle-pulley, a driving-pulley supported by said column, a swinging arm mounted on a horizontal axis below said

idle pulley, a clamp for securing said arm in adjusted position, a feed-shaft at the axis of said arm, a pulley mounted on the free portion of said arm, interchangeable gears on said feed-shaft and said last-mentioned pulley, and a belt engaging all said pulleys.

12. In a milling-machine, the combination, substantially as set forth, of a bed, a column thereon, a horizontal saddle to slide on the bed, a vertical saddle to slide on the column, a screw in the column for adjusting the vertical saddle, a screw in the bed for adjusting the horizontal saddle, a bed-shaft journaled in the bed, means for rotating said bed-shaft, a pair of clutch-gears loose on said bed-shaft and facing each other, gearing connecting one of said clutch-gears with the bed-screw, gearing connecting the other of said clutch-gears with the column-screw, a single clutch splined to the bed-shaft and adapted to engage either of said clutch-gears, and a lever for shifting said clutch.

13. In a milling-machine, the combination, substantially as set forth, of a bed, a column thereon, a horizontal saddle to slide on the bed, a vertical saddle to slide on the column, a screw in the column for adjusting the vertical saddle, a screw in the bed for adjusting the horizontal saddle, a bed-shaft journaled in the bed, means for rotating said bed-shaft, a pair of clutch-gears loose on said bed-shaft and facing each other, gearing connecting one of said clutch-gears with the bed-screw, gearing connecting the other of said clutch-gears with the column-screw, a single clutch splined to the bed-shaft and adapted to engage either of said clutch-gears, a lever for shifting said clutch, a horizontal trip-rod mounted on the bed and engaging said lever, and a tappet carried by said horizontal saddle and engaging said trip-rod.

14. In a milling-machine, the combination, substantially as set forth, of a bed, a column thereon, a horizontal saddle to slide on the bed, a vertical saddle to slide on the column, a screw in the column for adjusting the vertical saddle, a screw in the bed for adjusting the horizontal saddle, a bed-shaft journaled in the bed, means for rotating said bed-shaft, a pair of clutch-gears loose on said bed-shaft, gearing connecting one of said clutch-gears with the bed-screw, gearing connecting the other of said clutch-gears with the column-screw, a clutch splined to the bed-shaft and adapted to engage either of said clutch-gears, a lever for shifting said clutch, a horizontal trip-rod mounted on the bed and engaging said lever, a tappet carried by said horizontal saddle and engaging said trip-rod, a vertical trip-rod carried by said vertical saddle, and a dog carried by said vertical trip-rod and adapted to engage said horizontal rod.

15. In a milling-machine, the combination, substantially as set forth, of a bed, a column thereon, a horizontal saddle to slide on the bed, a vertical saddle to slide on the column, a screw in the column for the adjustment of the vertical saddle, a screw in the bed for the adjustment of the horizontal saddle and fitted for a crank at its outer end, a back shaft journaled in the bed and fitted for a crank at its outer end, gearing connecting the inner end of said back shaft with the column-screw, a bed-shaft mounted in the bed, means for rotating said bed-shaft, and gearing connecting said bed-screw and bed-shaft and back shaft.

16. In a milling-machine, the combination, substantially as set forth, of a column, a vertical saddle sliding thereon, a spindle journaled in said saddle and projecting endwise therefrom, a gear fast on the projecting end of said spindle, a locking-bolt carried by said gear, a pulley loose on said spindle, a pinion and notched plate fast together and mounted on the axis of said spindle between said gear and pulley, an eccentric stud carried by said saddle parallel with said spindle, and a gear and pinion fast together and mounted on said eccentric stud.

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