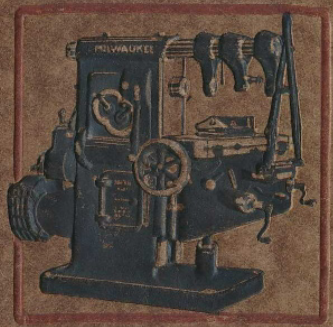
MILWAUKEE MILLING MACHINES



Catalogue No. 19

KEARNEY & TRECKER CO.
MILWAUKEE, WIS.

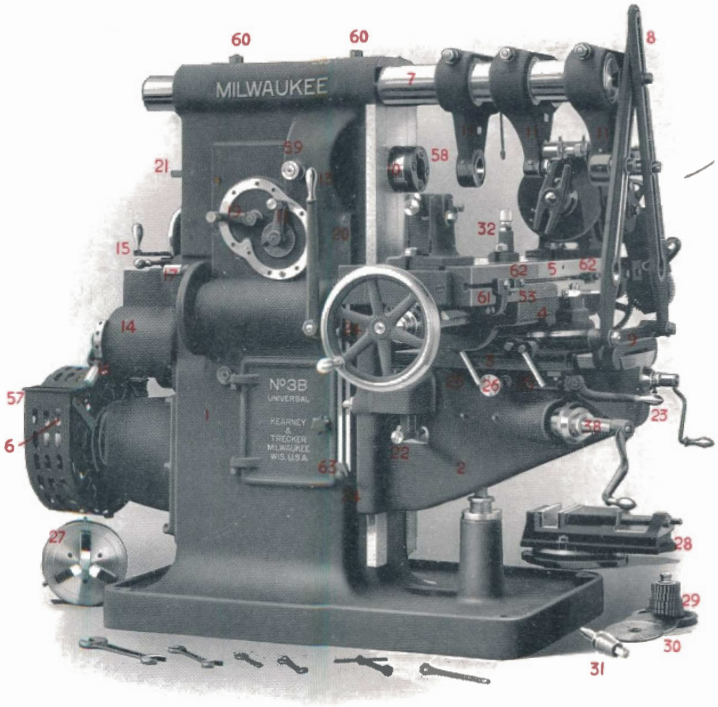
Why Milwaukee Millers Are Built Exactly as They Are

Kearney & Trecker Company build nothing whatsoever except milling machines and aim to make these machines as good as such machines may be made by the unfailing exercise of ingenuity and care and the employment of competent mechanics and up-to-date, efficient methods.

How well we have succeeded, you are to judge. In the following pages we take up, point by point, every part of our machines, emphasizing each detail of mechanical correctness and summarizing the many advantages of our unique and patented features.

KEARNEY & TRECKER COMPANY

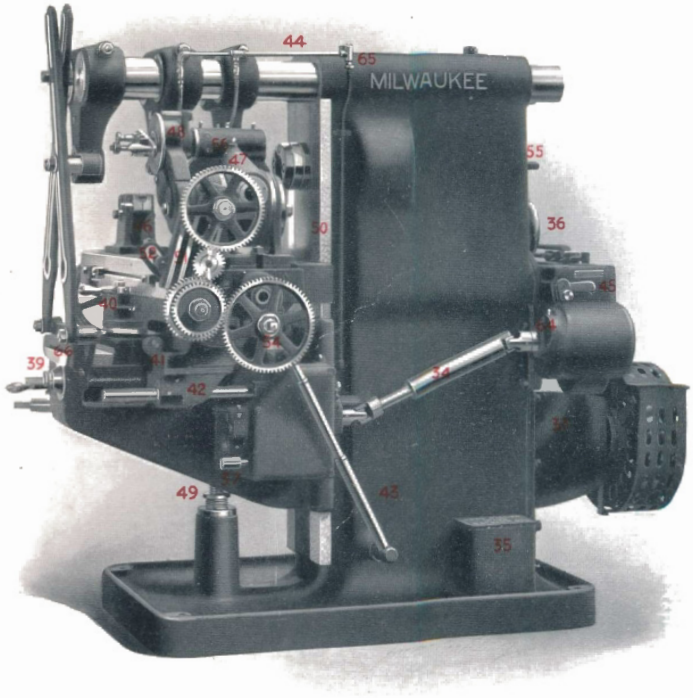
MILWAUKEE, WISCONSIN, U. S. A.



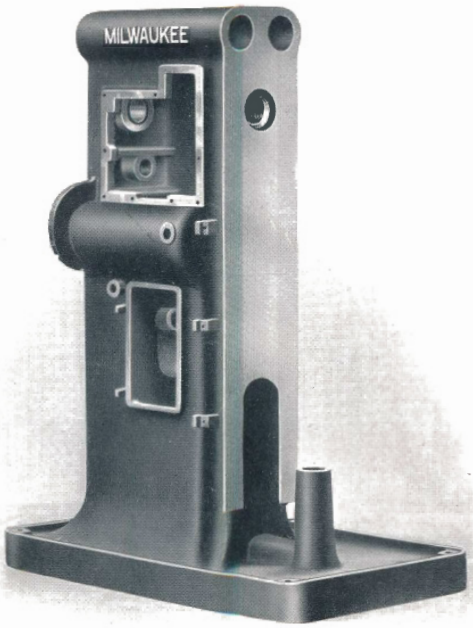
UNIVERSAL MILLING MACHINE—Front View

1—Column
2—Knee
3—Saddle
4—Swivel carriage
5—Table
6—Driving pulley
7—Over arms
8—Arm braces
9—Knee clamp
10—Spindle
11—Arbor supports
13—Starting lever
14—Feed box
15—Feed handles
16—Feed segment lifting lever
17—Speed segment lever
18—Speed lever
19—Sleeve gear lever
20—Column plate
21—Arbor rod
22—Feed interlocking lever
23—Cross and vertical trip lever
24—Knee clamp levers
25—Saddle clamp levers
26—Cross feed trip
27—Universal chuck
28—Swivel vise
29—Change gears
30—Index plates
31—Quick return shaft
32—Center rest
33—Pulley bracket

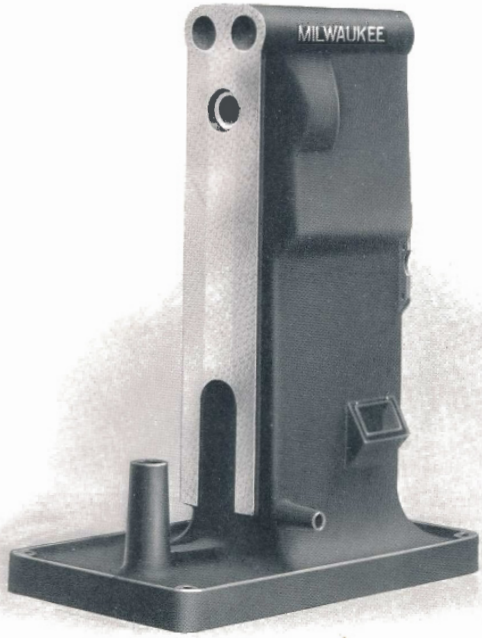
34—Universal feed shaft
35—Machine oil reservoir
36—Spindle hand wheel
37—Feed reverse
38—Elevating shaft
39—Cross feed screw
40—Table feed lever
41—Swivel carriage clamp screws
42—Cross feed bracket
43—Cutter lubricant return
44—Cutter lubricant supply
45—Spindle reverse lever
46—Elevating tail stock
47—Spiral universal dividing head
48—Index plate lock
49—Telescopic elevating screw
50—Knee slide
51—Change gear bracket
52—Change gear bracket brace
53—Table limit blocks
54—Table screw
55—Spindle take-up nut
56—Worm adjusting screw
57—Belt guard
58—Spindle drive collar
59—Spindle lock
60—Arm clamp nuts
61—Positive table stops
62—Adjustable table stops
63—Vertical feed limit blocks
64—Connection for driving rotary table
65—Swing valve
66—Saddle slide



UNIVERSAL MILLING MACHINE—Rear View



COLUMN—Front View



COLUMN—Rear View

The Column

The milling cutter is really a gang tool that finishes a piece at one pass, whereas planers, shapers and such machines operate with a single cutting tool and many passes are required to finish the cut. The rapid removal of metal by a milling cutter at a single pass requires that the work table and the parts that support it be so designed and constructed that there will be no springing away from the cutter when the cutting strain is applied. It naturally follows that the cutter must be carried in such a way that it will not spring away from the work. The construction all the way around from the work to the cutter must insure extreme rigidity and strength.

The securing of maximum rigidity and strength for the Milling Machine is no simple problem as the work table must have adjustment at right angles to the spindle and must also offer convenience for setting different classes of work as well as for supporting work of varying character. In addition, vertical adjustment must be provided and this necessitates a frame or column carrying a slide for vertical adjustment purposes.

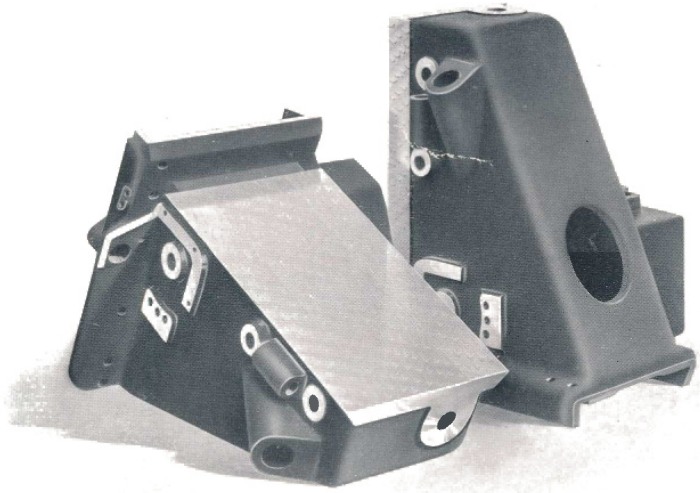
The column of Milwaukee Millers is a one piece, box section, semi-steel casting. On the right side there are two small openings, the larger giving access to the oil reservoir and the smaller being connected with telescopic tubing for the return of the cutter lubricant. The upper opening on the left side gives ready access to the mechanism that is carried inside the column. This opening is closed by a strong plate, securely screwed and accurately fitted to prevent leakage of any of the oil that is used so abundantly for lubricating the gears and bearings. Immediately below this opening is a horizontal wall that ties the walls of the column together at this point, making the column much stronger than it would be if the openings were uninterrupted.

The lower, rectangular opening gives access to the reservoir containing the cutter lubricant and to the pump for elevating this lubricant. Directly back of this opening may be seen the wall that separates the reservoir containing the cutter lubricant from the reservoir containing the lubricant for the gears and bearings. This wall also serves to strengthen the column. The bottom of these reservoirs is a horizontal wall immediately below the small round hole on the right side.

The base is made pan shape to catch oil and chips, thus assisting in keeping the floor clean. A wide margin is cast around the base for bearing on the foundation and the space back of this is occupied by numerous, well placed ribs running into and connecting with the horizontal wall that forms the bottom of the reservoirs.

The knee slide is finished slightly low in the middle to avoid a bearing at this point but not low enough to allow dirt or chips to pass through. The entire surface is finished by hand scraping to accurate surface plates. The holes for the spindle, over arms and shaft bearings are bored in accurate relation to the knee slide and are carefully tested by expert mechanics to insure perfect alignment.

There being a given relation between spindle diameter and length for maximum rigidity, we have carefully determined the depth of column to place the spindle bearings at the right distance apart.



THE KNEE

Box section, solid top, extended bearing

Patented February 9, 1904

The Knee

The careful thought given to the design and construction of the column would be just so much wasted effort if the knee were not made of proper proportions. The knee must offer great resistance to distortion in order that the table will be given sufficient rigidity.

Those who have made thorough and careful study of the strains that are set up in the knee by the operation of the cut have come to the conclusion that the torsional thrust caused by the weight of the saddle, table and work is not necessarily the greatest thrust. When the piece of work on the table is comparatively high so that the cutter is operating a considerable distance from the top of the table, the tendency of the work is to twist the knee as well as to press it downward. In many cases the tendency to twist is far greater than the thrust of the actual weight imposed. The knee, therefore, must be sufficiently rigid to withstand both heavy downward thrust and severe twisting strain.

It is well known among engineers and mechanics that a box form resists torsion better than any other form. Familiar examples are the hollow shafts used on steamship propellers, the box form girder, etc. For this reason we have adopted the box form knee. It is also well known that any slot destroys the efficiency of the box section form. A long slot in a hollow propeller shaft would immediately lead to disaster. For this reason we make our box form knee without any slots whatsoever, through the top or elsewhere.

The solid top form of knee has many advantages over the slotted top form. With the slotted top there will be an appreciable narrowing of the saddle slide when the clamps are set up. Moreover, there is sure to be a closing of the slot when the strain of the cut is applied. This is especially true if the cut be taken high above the table, as is frequently the case, because the leverage and consequently the torsional strains on the knee are increased. With the solid top form of knee it is, of course, impossible for the saddle slide to close when clamps are set up. The solid top knee also keeps dirt and chips from getting into the feed mechanism inside the knee.

The bearing of the knee on the column is carried generously above the top of the saddle slide. This gives the knee a more tenacious grip on the column and a much greater resistance to torsional strains. The knee of Milwaukee Millers, like the column, is a semi-steel casting.

The knee has been one of the very strongest points of Milwaukee Millers since we started building milling machines. Our first machines embodied the box section, solid top type of knee and it was a surprise to ourselves as well as to users to find what a great advantage this proved to be.

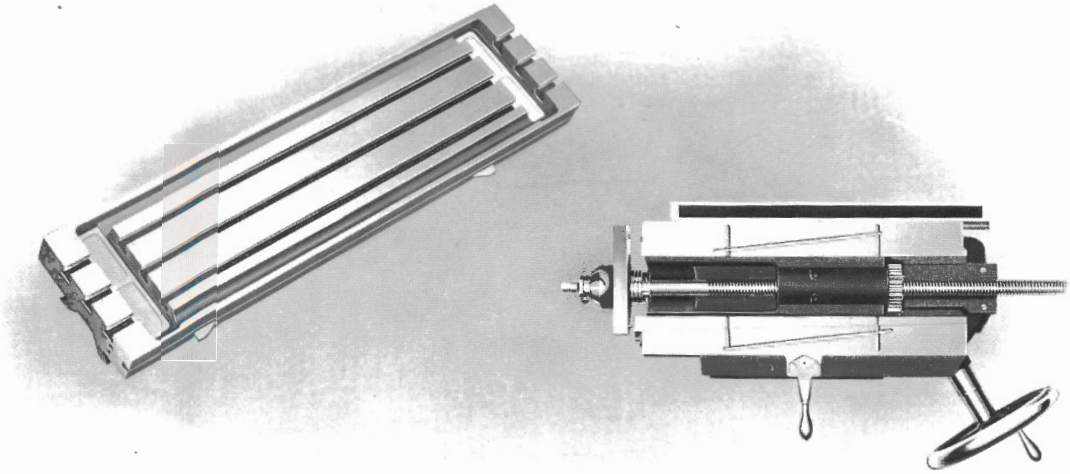


TABLE AND SADDLE

The Table and Saddle

With the table we begin to branch out a bit. Not only is rigidity and resistance to distortion to be considered but the convenience with which work may be attached must also be taken into account. The popularity of a milling machine with those who are to operate it depends in large measure upon the proportions and construction of the work table. The table for Milwaukee Millers is given a generous width that adds greatly to the convenience of attaching work.

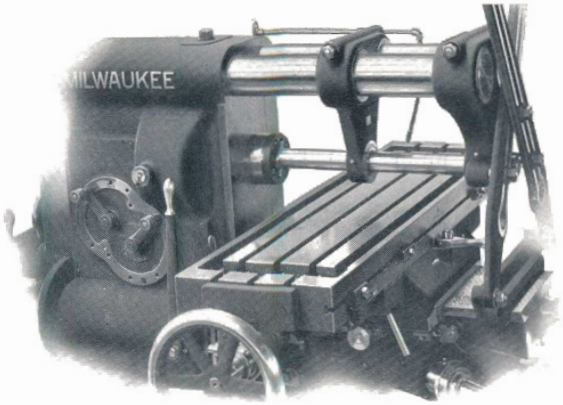
The semi-steel table, even on the largest Milwaukee Millers, is not cored out but is left solid and the entire bottom finished. It has been proven that where scale is left on one side, in due time the work table will be bent out of shape. Tables that were in use for a few years have been found to be bowed lengthwise as much as 1-16″ and crosswise in proportion. By finishing both sides of the table all possibility of distortion due to this cause is eliminated.

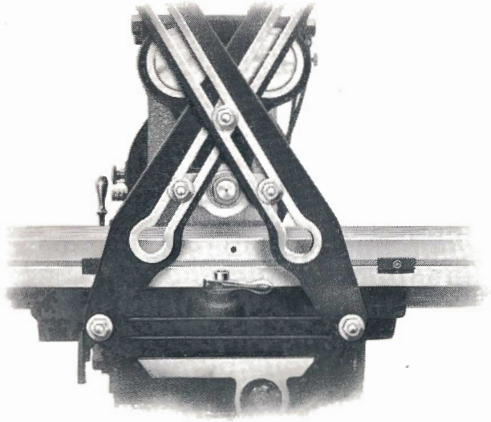
A common cause of springing of a milling machine table is the lack of sufficient metal between the T-slots and the underside. The thickness at this point must be considered when designing the machine for range. In Milwaukee Millers the vertical range is provided in such a way as to give adequate thickness to the table. There is an ample depth of metal between the bottom of the T-slots and the underside of the table to prevent undue springing. A generous depth is also allowed to the T-slots which insures against breaking out of the metal around the clamping bolts used for holding the work.

Thorough arrangements have been made in the design and construction of the table to take care of the cutter lubricant. (Every Milwaukee Miller is equipped with a pump and system for lubricating the cutters). The pockets at either end of the table are provided with screens that prevent chips running down with the cutter lubricant as it is returned to the reservoir. The groove at the front of the table is of ample proportions to convey the lubricant to the screened pockets. The groove at the back of the table is doubled-decked. That is to say, a strip of steel separates the groove which carries the oil to the screens from the groove which carries the oil to the center of the table where it empties into an adjustable slide shown at the back of the saddle. This slide is made adjustable that it may take care of any extra travel of the table.

The bearing of the table on the saddle is at the top of the saddle (see cut) rather than at the bottom of the dovetail. In this way larger bearing surfaces are secured and at the same time the bearings are located at a greater distance apart. This adds to the stiffness and stability of the construction. Oil grooves are provided in the top of the bearings to keep them thoroughly lubricated. Oil is supplied through a covered oil hole in the front of the table which leads into grooves in the table bearing.

The table is held in place by a taper gib. This gib is provided with an adjusting screw at each end which forms a means not only of adjusting the gib in either direction but of locking it solid so that it will not get out of adjustment.





DOUBLE OVER ARM

Patented February 18, 1913

The Double Over Arm

It is just as important that the cutter shall not spring away from the work as it is that the work shall not spring away from the cutter. We have said this before but we wish to emphasize it again before taking up a feature that has a great bearing on the relative stiffness between the cutter and the work.

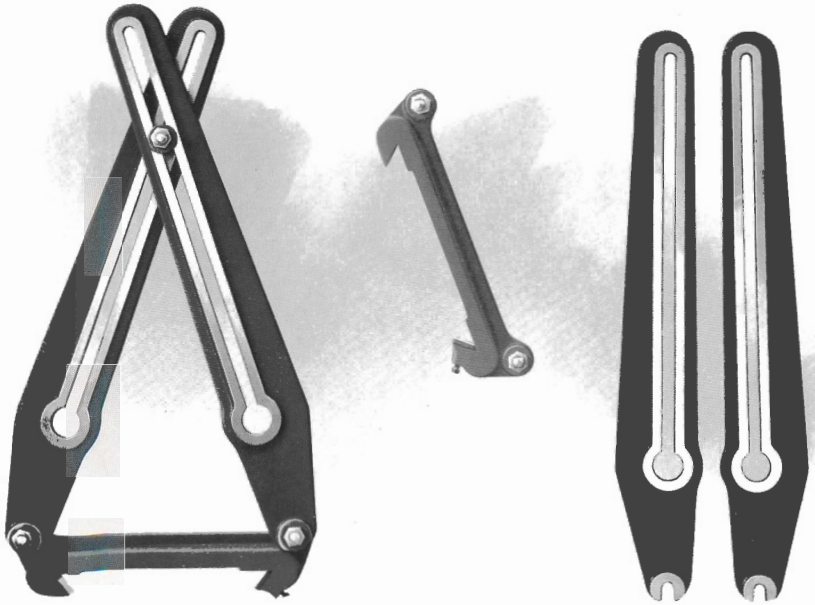
For years we thought and studied, devised and designed with a view to securing a knee, saddle and table that would insure maximum rigidity to the work. We have lately turned our attention to securing the cutter in such a manner that it would not spring away from the work. The results have been splendid and have been accomplished by the use of two parallel steel bars as an over arm in place of one that has heretofore been the general practice. The advantages that we obtain by this means could not be secured with a single over arm of any practical diameter.

The double over arm provides for positive alignment of the arbors. With a single over arm the practice is to place the arbor in position, bring the arbor supports to it and then clamp the supports to the over arm. If the arbor is not exactly true it will be clamped out of line. If the arbor is true and if the work is heavy and the cutters coarse, the supports will be gradually pounded out of line in such a way as to create a constant deflection of the arbor. The work under these conditions is, of course, not as satisfactory as it would be if the deflection did not take place and in time the arbor breaks at the shoulder under the strain.

It is readily apparent that the double over arm does away with this source of trouble because it is more dependable for proper alignment than any device that may be used in connection with the single over arm. It is impossible for the operator to place the supports on the double over arm and on the arbor in any other way than exactly in line. Engineers and mechanics will recognize that a boring operation of utmost nicety and exactness is demanded in order to have the two over arms and the spindle parallel with practically no limit of error as, of course, the arbor supports must slide freely to any point on the arms. That we are able to accomplish this work commercially and within the required limits is evidence of our ability to turn out machines that will answer the most exacting demands as to accuracy.

The arbor supports are a vital part of the double over arm construction. They form not only a bearing for the arbor but also a lacing between the two over arms. They act in exactly the same manner as lacing in bridge trusses between the top and bottom cords, giving a degree of strength and stiffness that could not be obtained with two bars not so laced together. The arbor supports should always be used as lacing. Where only the outer one can be used to support the arbor, the others should be turned bottom side up and clamped. In this way maximum rigidity can be permanently maintained.

In addition to providing positive alignment for the arbor, lacing the over arms together and preventing the arbor supports from being pounded out of line, the double over arm construction makes it practical for large, coarse pitch cutters to be used on rough, heavy work at a greater distance from the column than has heretofore been possible. This permits of finishing a variety of work on Milwaukee Millers that would otherwise have to be taken to a planer.



ARM BRACES

The Arm Braces

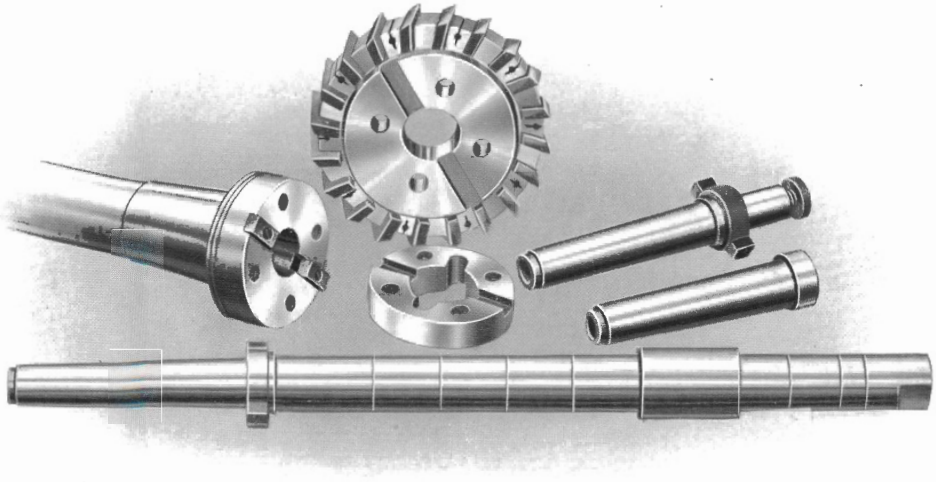
Some mechanics have expressed surprise that with so effective a construction as a double over arm, so strong a box section knee and so massive a column, it should be necessary to make any outboard tie between the knee and the outer arbor support.

This is very easily explained. Every extended member, from the prongs of a tuning fork to the extended end of a cantilever bridge, has a certain rate of vibration, due to its length and to the width of the construction at the base. Both the tuning fork and the extended end of a cantilever bridge are in the nature of a beam supported at one end. This is also true of the knee and over arm of a milling machine. The rate of vibration between the knee and over arm will be quite different because of the width of the construction at the base. A tie at the outer end, even though it be a light one, has a tendency to break up this vibration and is therefore of great value.

With the double over arm adding so great a degree of stiffness, it would be a serious mistake to use heavy arm braces. They would always be more or less in the way and would be difficult to apply. It would require considerable physical effort on the part of the operator and he would therefore be inclined to allow the job to run more slowly to avoid the trouble incident to putting them in place.

The arm braces for Milwaukee Millers are comparatively light. They are supplied with a quickly applied clamp that goes over the knee, fitting the saddle slide dove tail. By means of the holes at the lower end of the long slots and of the short slots at the lower end of the braces, the clamp and both braces can be applied or removed speedily without taking off a single nut or washer.

By making the braces light and conveniently handled, we eliminate the chief reasons why operators so frequently leave off the braces. As a consequence, the most effective rate of speed and feed is used in a greater number of cases than if the braces had been made heavy and cumbersome. This is because the operators will use the light braces where they frequently leave off the heavier ones and do not adjust the feeds and speeds to the maximum capacity for which the machine is designed. Used in connection with the double over arm of Milwaukee Millers (see page 10) these braces form an ideal construction, steadying the knee and the arbor supports and reducing vibration to a negligible minimum.



FLANGED SPINDLE

Patented February 18, 1913

The Flanged Spindle

A glance back over the early history of milling machines, or any other machine tool for that matter, will account for some of the features which, while still in use, have outlived their usefulness.

The milling cutter, as first invented, was something in the nature of a rotary file and served to substitute machine work for hand work in the making of gun parts and similar pieces. For years a thread on the end of the spindle of the milling machine was employed as the most convenient method of attaching face mills modeled after the file principle. The cutter arbor used had a tang fitting into a slot and a drift was employed for removing the arbor, this construction being much the same as is now used for driving drills. Later it was found necessary to make the spindle hollow for driving out the arbor because the tang slot was covered either by the bearing, pulley or back gear.

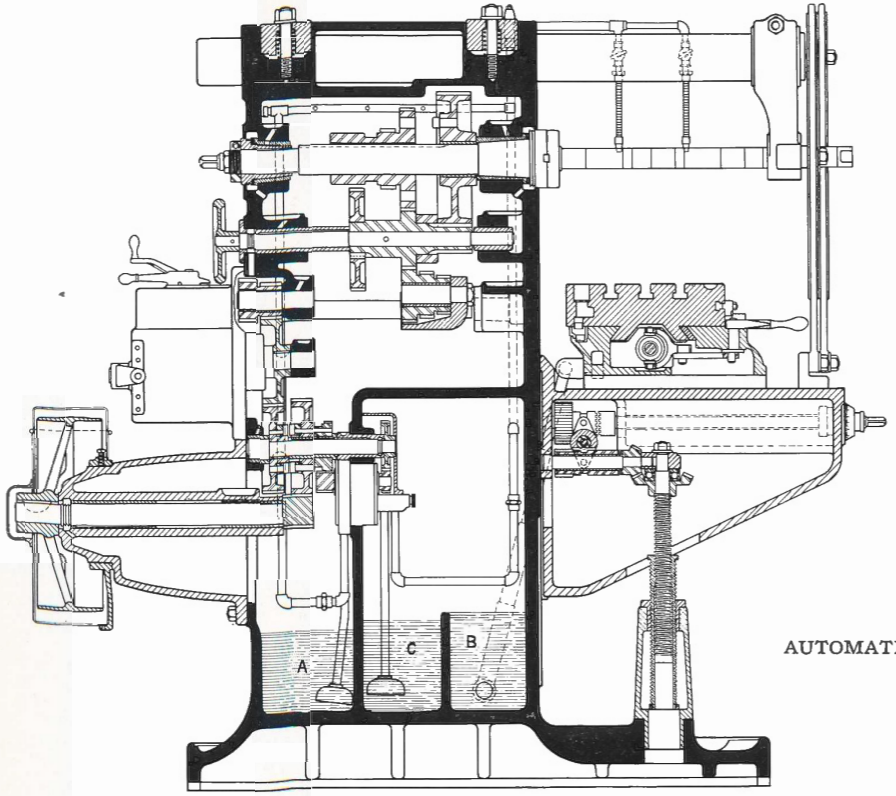
With the improvement in the design of milling cutters and the introduction of high speed steel, the field for the milling machine was greatly extended and it took its place in the front rank as a high production tool. With these changed conditions it became necessary to design a drive for the arbor that would be effective for cutters of any size or character. Accordingly we designed a collar that fitted the thread on the end of the spindle and carried a slot in its front end adapted to receive dogs on the cutter arbor, similar to the construction now used on our cutter arbors.

After we abandoned the manufacture of the cone pulley type miller and devoted ourselves to manufacturing constant speed drive type, we found that the great power of the machines had a decided tendency to drive the collars and face milling cutters tightly on the thread. As a result the collars and face milling cutters could not be removed except with great effort and frequently it was necessary to destroy the cutters in order to remove them. Furthermore, the threaded construction of the spindle permitted of the spindle running in only one direction because, as will be readily appreciated, anything screwed on a right hand thread would not do any driving when the spindle was run left hand.

To overcome these difficulties we designed and patented a spindle construction in which we use a flange of large diameter on the end of the spindle. The flange carries keys and we attach a collar to the face of this flange by means of four screws. The collar is made with recessed notches to receive the dogs on the arbor. This construction has proven ideal in every respect.

It not only furnishes an effective drive for the arbor but also forms a perfect shield for the end of the spindle, thus enabling the spindle to maintain its original accuracy so that when a face milling cutter is attached in place of the collar, it runs true.

The illustration on the opposite page shows the end of the spindle as well as the collar and face mill which interchange with each other on the flanged spindle. It also shows a centering plug that is used for centering face milling cutters and a standard arbor for spiral mills, side mills, etc. In addition there is an end mill arbor adapted for use in connection with this construction.



AUTOMATIC FLOODED LUBRICATION

Patented October 23, 1906

The Cascade System of Lubrication

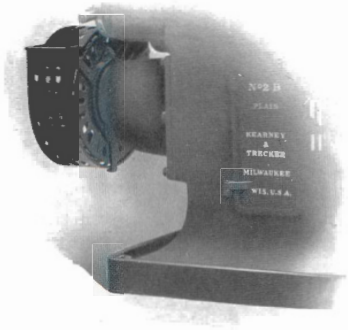
The cascade system of lubrication, a patented and exclusive feature of Milwaukee Millers, is one of the most potent factors in the excellent service and results given by our machines.

The first Milwaukee Miller had a geared feed box, a construction that marked a great step forward in milling machine design. It soon became apparent to us that some sort of continuous lubrication was necessary for the geared feed box with its greater power and rapid changes. Accordingly the boxes were constructed so that the gears dipped in oil, thus lubricating by the splash system. So satisfactory were the results that we turned our attention to the idea of a geared spindle drive. This offered some difficulties as it was not possible to locate the gears in a horizontal position nor make them as compact as is possible with the geared feed box. We overcame the difficulties by designing a machine in which the gears are arranged practically one above the other and provided a geared pump to keep the gears and bearings constantly lubricated.

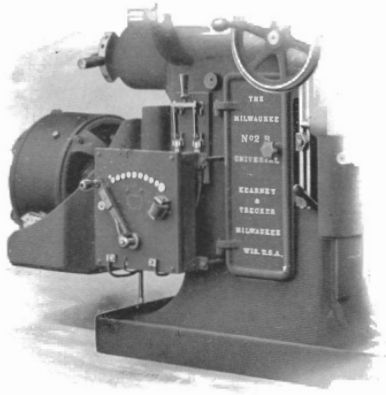
The lubricant is stored in reservoir "A" and is pumped to the top of the machine where it is distributed through a perforated pipe. While the machine is in operation more than a gallon of oil per minute cascades down over all gears and bearings. In ordinary construction, oil grooves are closed at the end to prevent oil escaping but we cut them through to permit the oil to flow freely, thoroughly lubricating and washing away all foreign substances that otherwise would cause heating and scoring of the surfaces. This continuous lubrication in connection with the use of highly-finished hardened steel gearing secures a speed arrangement that it is almost impossible to wear out.

The cutter lubricating system (patented) is also of great importance in these days of high speed steel and heavy, rapid milling. The cutter lubricant is stored in reservoir "C" and is pumped to the top of the machine and flooded over the cutters and work through adjustable nozzles. As stated in the description of the work table, the cutter lubricant is returned through screened pockets and telescopic tubing to reservoir "B". This reservoir acts as a settling tank so that no chips will be carried over into reservoir "C" and through the pump with a possibility of damaging it. An effective system of cutter lubrication, such as this, adds fully 40% to the productivity of the cutters, prolongs their term of usefulness and lengthens the intervals between sharpenings.

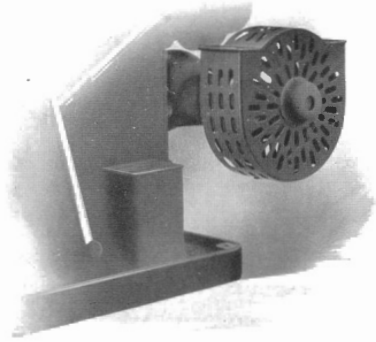
The geared pump used in the cascade system of lubrication is double, one side being used for internal lubrication of the gears and bearings and the other side for the lubrication of the cutters. The construction is such that the pump for lubricating the gears and bearings operates all the time that the pulley is running, whereas the pump for lubricating the cutters operates only when the spindle is running. The advantage of this is obvious. If the pump for lubricating the cutter ran all the time that the pulley was running, it would be necessary for the operator to shut off the flood of oil every time he stopped the cutter to change the work. The pump for lubricating the gears and bearings is kept constantly running so that the pulley shaft is always thoroughly lubricated even though the spindle is idle.



STANDARD DRIVE



ELECTRIC DRIVE



RIGHT ANGLE DRIVE

Number of attachment corresponds to number of machine to which it is applied.

When ordering give number stamped on front of knee.

The Constant Speed Drive

In the description of cascade lubrication we said that the success of our geared feed box started us to thinking about a geared spindle drive. This is true, but we were even more strongly impelled to the design and adoption of a geared or constant speed drive by the advantages that we saw possible.

In addition to lack of perfect convenience there are fundamental reasons why the cone pulley does not constitute an ideal arrangement for speed changes on a milling machine. As much power is required to drive a cutter of large diameter as to drive a cutter of smaller diameter. The torque or pull on the spindle necessary to drive a large cutter is, of course, much greater than it is to drive a smaller cutter. But the speed at the periphery of the cutter can be the same regardless of whether the cutter is large or small. That is to say, if high speed cutters will stand 80 feet per minute on a given material, then a cutter will stand this same rate of speed whether the cutter is 3 inches in diameter or 12 inches. The power consumed in both cases would be practically the same.

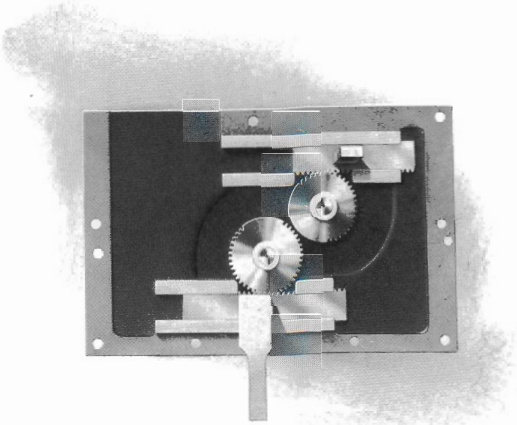
With the cone pulley type of drive, slower spindle speed means slower belt speed. A smaller amount of power is, therefore, transmitted. As a result the pull at the periphery of a cutter of large diameter is less than at the periphery of a cutter of smaller diameter. This manifestly is wrong in view of the fact that as much power is required for driving a large diameter cutter as for driving a smaller diameter cutter.

With the constant speed type drive the pulley runs at one constant speed. If the belt driving it is capable of delivering 10 H. P. to the machine, then it will deliver this power regardless of whether the cutter is large in diameter and running at low speed or small in diameter and running at high speed. The operator never knows, as far as belt slippage or other indications of the machine are concerned, whether he is using a large cutter or a small cutter. With the constant speed type drive the power delivered for a large, slow running cutter is just the same as it is for a small, fast running cutter. Maximum results can be obtained in either case.

Milwaukee Millers are all of the constant speed drive type. We are the only milling machine manufacturers who build constant speed drive type machines exclusively.

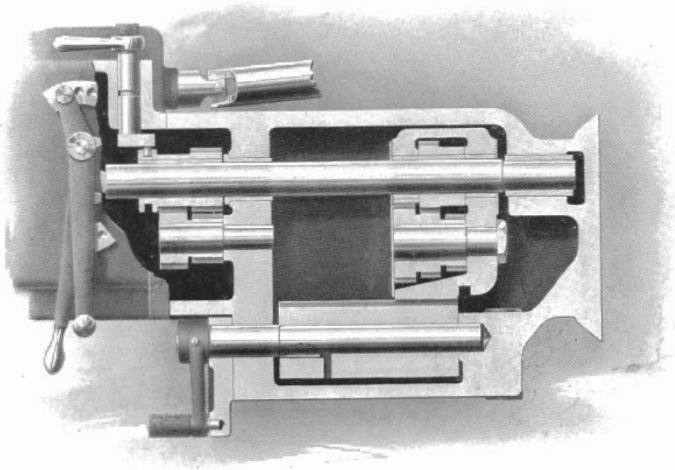
The constant speed type drive lends itself very readily to the use of electric motors. By our unit system design the purchaser is permitted to order when he makes his purchase any one of the three types of drive illustrated on the opposite page, or he may elect to make a change of this nature at a later date. This is quickly and easily accomplished by substituting one type of drive for another.

The electric motor is of the constant speed type and consequently of minimum size. It is attached to the machine by a simple, adjustable bracket which permits motors of any make to be used. The motor is direct connected to the machine through reduction gearing that runs in a special bracket. This bracket extends into the machine and connects with the automatic lubricating system in place of the pulley bracket used in the standard design. The right angle drive uses the same pulley as the standard drive. A pair of bevel gears connect with the lubricating system and form the method of bringing the pulley around at right angles to the position of the pulley in the standard drive.



COLUMN PLATE—Inside

SPEED INDEX PLATE



TUMBLER SUPPORT AND SPINDLE REVERSE

Patented Mar. 12, 1912

The Speeds

Milwaukee Millers are designed to drive efficiently milling cutters from ¼ inch and less up to 12 inches and more in diameter. They are so constructed that their efficiency is equally high whether using small, medium or large cutters.

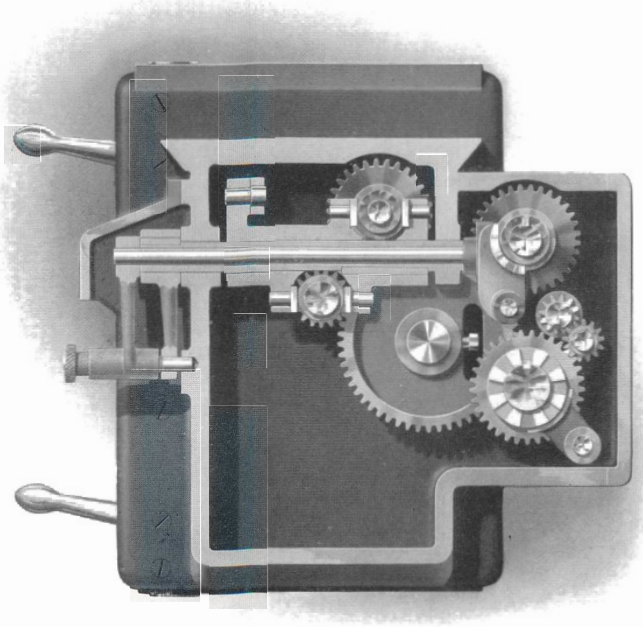
The machines are provided with 18 changes of speed in geometrical progression with a ratio of approximately 1.25 to 1. By the use of the geometrical ratio the correct speeds can be obtained on a percentage basis. For example, if a given surface speed is selected for a ¼ inch cutter, the next lower speed will give the same surface speed for a 5-16 inch cutter. The same ratio applied to a 4 inch cutter would mean that the next lower speed would give the same surface speed for a 5 inch cutter. If we had used the straight progression instead of the percentage or geometrical progression, the range of cutter diameters that could be covered by a given number of speeds would be very limited.

The 18 changes of speed are obtained with 10 gears. As far as we know, this is the smallest number of gears ever put together to secure so many changes. The sectional view on page 16 shows how these gears are arranged on the spindle and the train immediately below them. It also shows the three step tumbler gear but not the gear on the shaft towards the back of the machine that drives the three step tumbler gear. This latter construction is clearly illustrated on the opposite page. The three step tumbler gear is supported in a substantial frame and this frame is itself supported at both sides; at one side by a heavy shaft made of case hardened steel and at the other by the teeth of the long pinion meshing into gear teeth cut in a segment of the frame. This permits of the tumbler being adjusted endwise so that its three steps may be engaged with the two gears on the intermediate shaft between it and the spindle gear as shown on page 16.

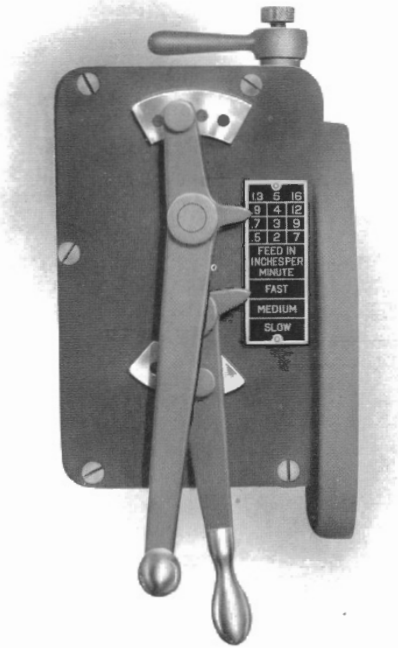
The column plate (see opposite page) is arranged with two gears operating in racks. By means of the lower one, the frame carrying the three step tumbler gear is adjusted to position. The upper one engages with the two step sleeve gear on the spindle and adjusts it into engagement with either the pin on the large gear on the spindle or with the two different size gears on the shaft immediately below the spindle.

The mechanism provided for reversing the rotation of the spindle is also illustrated on the opposite page. The sliding gear on the drive shaft engages, for right hand rotation, with the gear on the feed box that also engages the smallest step of the reversing idler. When the sliding gear is in mesh with the large step of the idler it is out of mesh with the main drive gear and the spindle rotates left hand. In this manner, with a single belt running from the line shaft, every Milwaukee Miller is provided with 18 speeds in either direction. The ratio of this gearing, on the slowest speed, from the pulley shaft to the spindle, varies on different size machines. It is about 17 to 1 on the No. 1 machines and about 27 to 1 on the No. 3 machines.

The extreme simplicity of the speed change mechanism as described above is apparent. All of the gears and bearings are of case hardened steel. This is, of course, made possible by our cascade lubrication. Hardened steel gearing, while undoubtedly the most suitable for this part of a miller, gives the best satisfaction only when effective provision is made for thorough lubrication and flushing away of all foreign matter.



FEED INTERLOCKING DEVICE
Plain and Universal Millers



FEED BOX—Top View

The Feeds

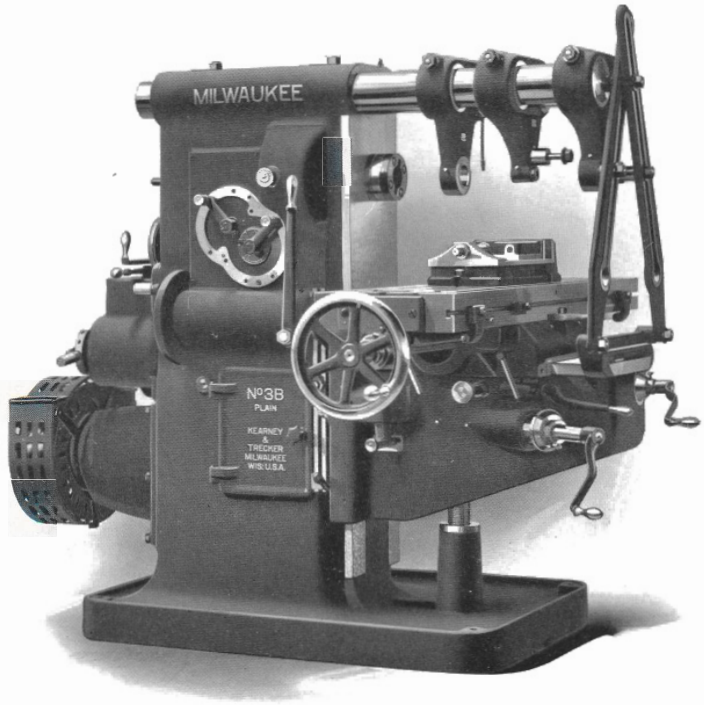
If proper provision has been made in a milling machine for rigidity under belt load, if correct spindle speed is accessible and if the power is ample to drive the cutter, then the question of selecting the right feed assumes prime importance. The feed mechanism must be so designed that the correct feed is readily accessible and it must also have sufficient power and strength to produce the feed selected unfalteringly over a long period of time and without undue wear.

The feed mechanism of Milwaukee Millers is arranged to provide 12 changes. These are in geometrical progression, starting with a minimum of ½ inch per minute and advancing in fixed geometrical ratio to 16 inches per minute.

The feed change gears are located in a box attached to the back of the machine. (See No. 14 on page 2). These gears are made of hardened steel and are mounted on hardened steel shafts. Like the speed gears they are constantly flooded with lubricant from the same pump that lubricates the speed change gearing and bearings. Two operating levers are located on top of the feed box, (see opposite page) and the box is provided with a plate that indicates the feed in inches per minute.

All Milwaukee type "A" Manufacturing Millers have power feed to the table only. The type "B" machines have power feed to the table, knee and saddle. The mechanism for controlling these feeds is shown on the opposite page. All Milwaukee Plain and Universal Millers are of the "B" type. The construction is practically "fool-proof", being so arranged that only one feed can be engaged at a time.

We always recommend starting a job with the feed set low and advancing the feed as it is seen that the cutter will stand the strain. Where it is desired to remove a large amount of stock rapidly, the job can generally be handled to better advantage by maintaining a moderate surface speed, safely below the point where the steel will break down, using coarse pitch cutters and coarse feed. However, the finish required sometimes makes it advisable not to use the maximum feed that the cutter and machine will stand. All this is a matter of judgment on the part of the foreman or superintendent in charge. Careful attention to this phase of milling will pay large returns. It is no unusual thing for an experienced milling mechanic to double or treble the output of a machine without spending more than a minute or two studying the conditions.


MILWAUKEE
Nº3B
PLAIN
KEARNEY
&
TRECKER
MILWAUKEE
WIS.U.S.A.

Convenience

Every machine manufacturer, milling machine or otherwise, will claim that his machine is a perfect ideal of convenience of operation. This one detail probably more than any other must be passed upon by the purchaser himself after due consideration of all claimants.

We believe that a study of the illustration on the opposite page can have no other effect than to prove the extreme simplicity of Milwaukee Millers. The number of operating levers is reduced to a minimum. The levers are in positions where they can be easily handled, particularly those that require frequent manipulation.

For instance, all the handles for operating the table can be reached from one operating position. These handles are furthermore arranged in such a way as to make confusion almost impossible. The feed levers, as pointed out on page 23, are so controlled that only one feed can be engaged at a time. Accidents from this source are impossible. The speeds are plainly marked in revolutions per minute and the feeds in inches per minute. The speed and feed plates read direct, and the levers indicate clearly just what feed and what speed are in use. The lever for starting and stopping the machine is attached to the machine.

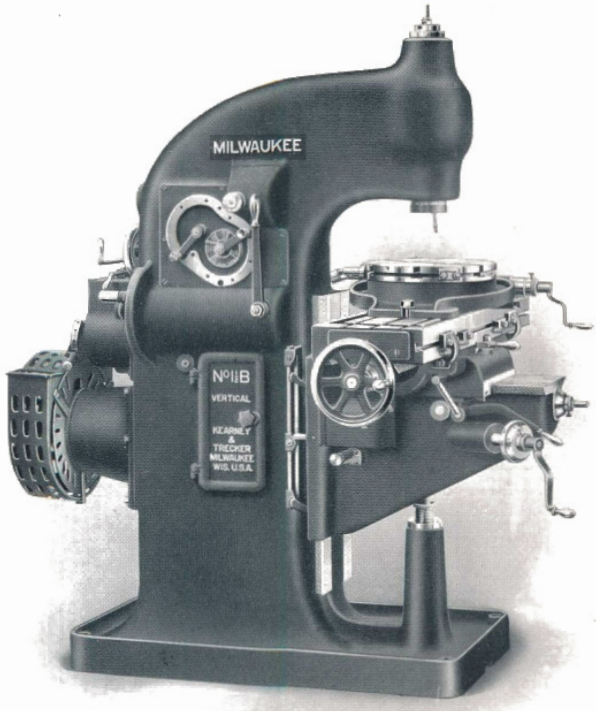
Careful provision has been made, wherever necessary, for adjustment for wear. These adjustments are all very easily and quickly attended to. To adjust the spindle bearing, for example, it is necessary only to take up one screw. This screw is located on the outside of the machine and is readily accessible.

A lock is provided for the spindle to prevent its turning when tightening up arbor nuts or removing the arbors from the spindle with the discharge rod. This lock is readily engaged or disengaged. Means are also provided to prevent the spindle while locked from being accidently engaged with the driving mechanism.

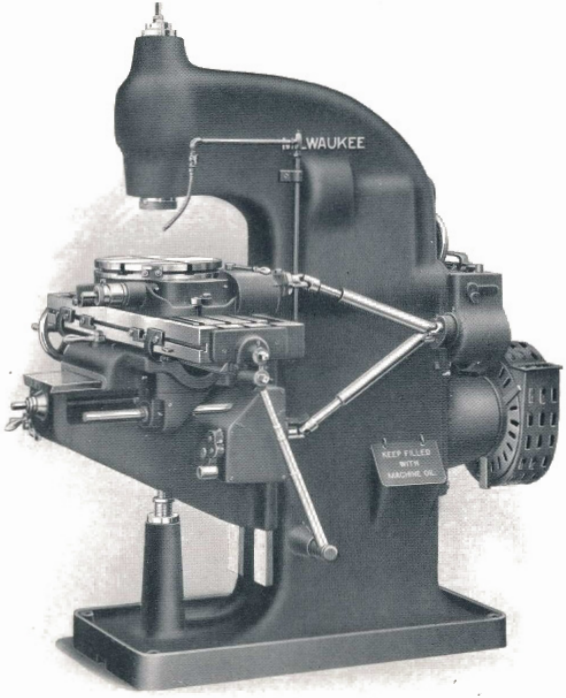
Fixed handles are also provided for locking the saddle to the knee and for locking the knee to the column. Graduated collars reading to 1–1000 of an inch are provided on all operating screws. Entire dependence can be placed in settings made to these micrometer dials because of the high degree of accuracy which characterizes the screws.

It is not necessary to put holes through the floor because the elevating screw is telescopic. Only a single pulley is required on the line shaft and consequently a Milwaukee Miller can be set up and put in to operation in an exceedingly short time. It is not uncommon for our machines to be running under cut in one hour after being delivered. This feature of getting quickly to work or of moving the machine from one place to another is a decidedly important advantage.

It is well to emphasize that operating levers not only should be in convenient locations, but must control mechanism so constructed that it will withstand hard usage and be easily operated under any conditions whatsoever. This is true convenience and Milwaukee Millers have it.



VERTICAL MILLING MACHINE—Front View



VERTICAL MILLING MACHINE—Rear View

Vertical Spindle Lubrication
Patented June 24, 1913

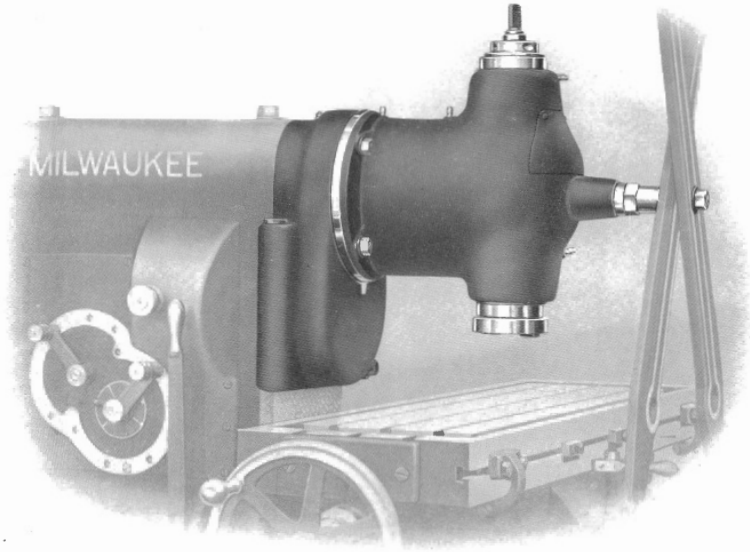
Vertical Milling Machines

We realized that the vertical milling machine construction in which both spindle and knee are adjustable had outlived its purpose. It is a relic of the old days when a milling cutter was regarded as scarcely more than a rough file and when machines were light and delicate. Naturally, the disadvantages of duplicated adjustment were not felt under such conditions. Today, however, a vertical milling machine is called upon to perform heavy work and duplication of adjustment is consequently detrimental to rigidity and is also needless. Adjustment sufficient for all purposes is secured by making the knee only adjustable.

In designing the Milwaukee Vertical Miller, we departed radically (and successfully) from ordinary practice. The knee alone is adjustable. The spindle is adjustable only to wear. This construction is decidedly rigid and can be relied upon to maintain correct alignment through many years of service. In this connection, note the solidity of the lines upon which these machines are built as shown on the opposite page.

In all other respects Milwaukee Vertical Millers embody the same excellent features of construction as the horizontal type. This includes box section column, heavily ribbed; box section, solid top knee; constant speed drive; flanged spindle; hardened steel gearing; cascade lubrication, etc. Our patented system of cascade lubrication is extended to the mechanism in the spindle head. More than a gallon of oil per minute is flooded over the gears and bearings in the spindle head, as well as in the rest of the machine, while the pulley is running. Our patented cupped collar construction prevents so much as a single drop of oil flowing over the end of the spindle. The oil is all returned to the reservoir in the base of the machine.

Although designed and built primarily for the regular line of work which is best adapted to the vertical miller because of the ease of chucking, the design of the machine takes into account the large quantity of work that can be milled in connection with the rotary table by the continuous milling process whereby the cutters are always in the cut. This includes many parts that can be finished with wonderful speed with the aid of simple, inexpensive, chucking fixtures and in such a way that the finished surface will bear a more constant and accurate relation to other selected points than is possible by disc grinding methods.



VERTICAL SPINDLE ATTACHMENT

Number of attachment corresponds to number of machine to which it is applied.

When ordering give number stamped on front of knee.

The Vertical Spindle Attachment

Roughly speaking, 75% of all milling can be performed to best advantage on a horizontal spindle milling machine and the remaining 25% on a vertical spindle machine. A large percentage of the work ordinarily performed on a vertical miller, however, can be done to just as good advantage on a horizontal milling machine with a vertical spindle attachment. This, of course, presupposes that the attachment is properly designed to form a rigid and effective unit with the machine.

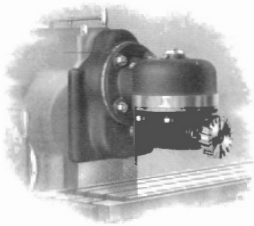
The dovetail of the knee slide on Milwaukee Millers is carried up past the end of the spindle to the over arm, thus affording a secure and convenient place to fasten the vertical spindle attachment and other attachments described hereafter. An attachment clamped to the dovetail is practically as rigid as though cast as an integral part of the machine.

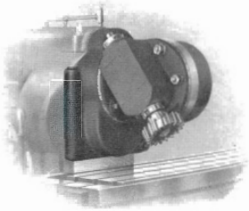
The vertical spindle is driven in the following manner. A spur gear is attached to the face of the horizontal spindle. This drives a second spur gear directly above. In this way, the spindle is carried upward, giving sufficient height between the end of the vertical spindle and the work table to enable work of large dimensions to be successfully handled. The vertical spindle is driven by a pair of bevel gears. These gears are coarse pitch and large diameter and will stand the maximum amount that the machine can pull without overloading. Both the spur and bevel gears, like the gears in the machine itself, are of hardened steel and practically indestructible.

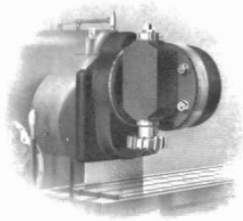
The vertical spindle runs in bronze bearings that are provided with adjustment for wear in exactly the same manner as the horizontal spindle bearings. The spindle head that carries these bronze bearings has a circular base and is bolted to a base casting having a circular T-slot. This design permits of the spindle head being set at any angle. This is an important matter as there are numberless operations possible with the cutter set at an angle that could not be performed if the spindle were rigidly set in a vertical position.

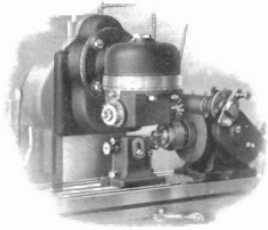
In any shop where the amount of work does not warrant installing both vertical and horizontal spindle millers or where it is more desirable to have one very flexible machine rather than two separate machines Milwaukee horizontal spindle Millers with vertical spindle attachment serve admirably. In a few minutes the machine can be changed from a horizontal to a vertical machine or vice versa and be equally efficient as either. All tools interchange between the vertical and horizontal spindle.

No.	B. & S. Taper Hole in Spindle	End of Spindle to Table in Lowest Position Plain Millers	Center of Spindle to Face of Column	Net Weight Lbs.	Code Word
1	10	16¾″	9¾″	190	Lime
1½	10	17¼″	12″	220	Limeal
2	11	17¾″	12¾″	300	Limit
3	12	18¾″	15″	470	Limbo









Number of attachment corresponds to number of machine to which it is applied.

When ordering give number stamped on front of knee.

UNIVERSAL MILLING ATTACHMENT

The Universal Milling Attachment

Few shops do not, at some time or other, run up against work that baffles the ingenuity of their best mechanics, and the universal milling attachment was designed for just such cases.

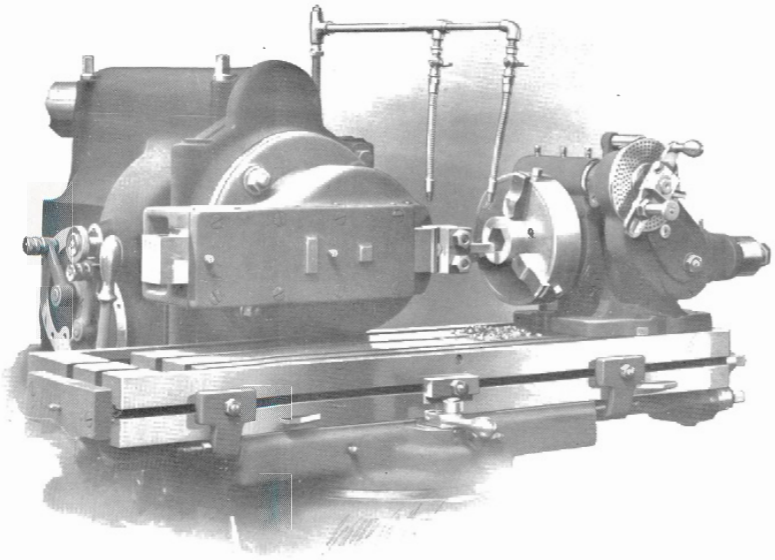
The universal milling attachment for Milwaukee Millers is rigid and heavy. This construction adapts it to more than very light work and enables it to withstand severe and constant usage. Not only is it suited to meet the unusual and occasional job but it may also be used to advantage on day-to-day work.

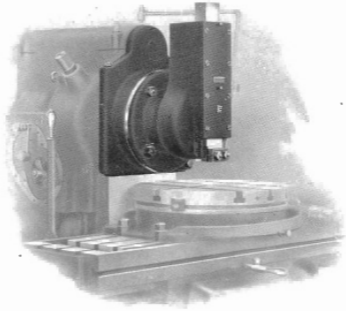
There are two circular bases, one imposed upon the other, the planes of which are at right angles to each other. Both bases can be revolved through 360 degrees, thus making the spindle which is carried on the second swivel piece, completely universal in its movements. There is no conceivable angle in a globe at which it cannot be set.

This attachment is driven by hardened steel bevel and spur gears. The shafts are also of hardened steel, including the spindle which is made clutch drive to receive standard milling cutter arbors.

Because of the short distance from the center of the spindle to the bottom of the casting that carries it, this attachment can be used for rack cutting. When used in connection with spiral universal dividing centers, it can also be used on plain millers for milling spirals at any angle. This is illustrated in the lower cut on the opposite page where the attachment is milling a steep angle spiral gear that could not be reached on an ordinary universal milling machine on account of the angle being greater than could be obtained by swiveling the table.

No.	B. & S. Taper Hole	Distance Center of Spindle to Bottom	Distance Center of Spindle to Face of Column	Net Weight Lbs.	Code Word
1	10	1-17/32″	11″	265	Ocelot
1½	10	1-17/32″	11″	285	Ocelotal
2	10	1-35/64″	11¼″	300	Ochre
3	10	1-9/16″	11½″	335	Ochery





Number of attachment corresponds to number of machine to which it is applied.

When ordering give number stamped on front of knee.

SLOTTING ATTACHMENT

The Slotting Attachment

Every shop, and especially every tool room, has some work for a slotter, not always, however, sufficient to warrant the expense of installing a slotting machine. Used on a Milwaukee Miller the slotting attachment will fill this purpose admirably.

The slotting attachment for Milwaukee Millers was designed with a view to thoroughness and efficiency and we have embodied in it features that adapt it to rapid production just as though it was a complete standard machine to be used continuously on this class of work.

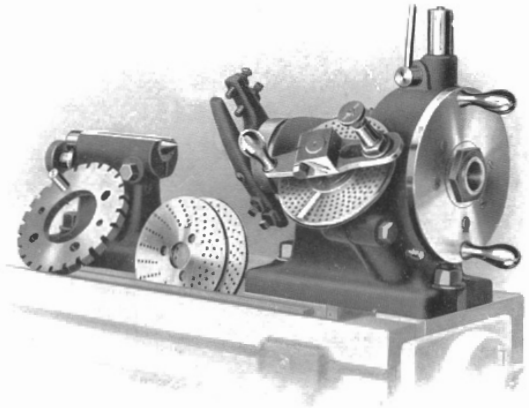
The ram is a rectangular steel bar, ground to size. It carries hardened steel V-jaws at the end for clamping the tool, a construction much preferable to round hole and set screw in that the tool can be any size from ¼ inch to ¾ inch and any shape, rough or finished. This advantage is most appreciated when the machine is set up and waiting for some special tool that can be quickly improvised in place of waiting for it be turned and finished to fit a certain hole.

The stroke of the ram can be adjusted anywhere from 0 to 4 inches. The cutting stroke is one-half the speed of the return, thus increasing output over a one to one stroke and return.

The ram can be swiveled through the entire 360 degrees. It can be used in a vertical position for slotting large dies, using the rotary table in connection with it where necessary. It can be used in a horizontal position, as shown in the cut, for cutting internal gears or for other work requiring the indexing feature of the dividing centers. In fact, it can be used in a host of different ways as circumstances demand and the mind of the mechanic suggests.

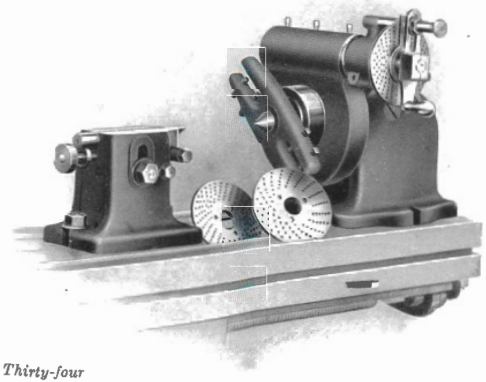
No.	Distance Center of Tool to Face of Column	Adjustment of Stroke	Net Weight Lbs.	Code Word
1	10½″	0 to 4″	195	Mortar
1½	10½″	0 to 4″	210	Mortaral
2	11″	0 to 4″	230	Mortier
3	11¾″	0 to 4″	300	Morus

Number of attachment corresponds to number of machine to which it is applied. When ordering give number stamped on front of knee.

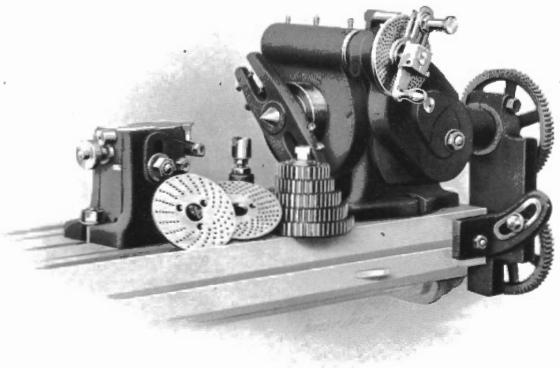


PLAIN CENTERS

UNIVERSAL CENTERS



SPIRAL UNIVERSAL CENTERS



The Dividing Centers

Dividing centers enter into milling machine practice wherever work must be milled in such a way as to require the dividing of circles into two or more equal parts. This includes the spacing of gears, ratchets, milling cutters, etc., the boring of interchangeable holes in jigs and many other classes of work. The accomplishing of accurate results in dividing the circle is one of the most difficult and delicate operations that the mechanic is called upon to perform.

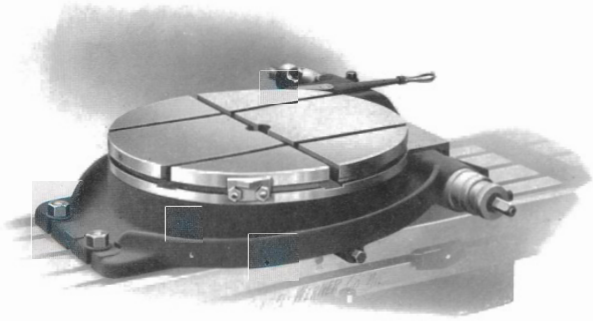
Each type of dividing centers for Milwaukee Millers has a worm wheel of nearly double the usual size, these worm wheels being made by a special process that insures great accuracy. It is no more difficult to make an accurate worm wheel of considerable size than it is to make one of small size. The degree of accuracy being the same, the use of the large worm wheel gives a greater degree of accuracy to the work. The index crank and plate are placed directly on the worm shaft, thus eliminating any inaccuracy that might accumulate if they were placed on a different shaft and intermeshing gears used. We believe in connecting as directly as possible to the worm shaft and in this belief we are borne out by the best mechanical experience.

The Plain Centers are for use in a horizontal position and on straight cutting work only such as spur gears, ratchets, etc. They are intended mainly for manufacturing work for dividing numbers from 36 down. This is done by means of a hardened steel, notched plate, the notches being ground to insure accuracy. One notched plate is furnished, this having 24 notches unless otherwise specified. Additional plates with any number of notches up to 36 can be supplied promptly. Index plates also supplied for making usual divisions through worm and worm wheel.

The Universal Centers are for all plain dividing and also for cutting bevel gears and taper work of any kind. The head has cross slots and side ears to facilitate setting across the table in line with the spindle. The tail center can be adjusted vertically for taper work by means of a rack and pinion and is graduated in degrees corresponding to graduations on the head.

The Spiral Universal Centers have all the features of the Universal Centers and in addition they are equipped with mechanism for connecting with the table screw through change gears so that spirals of a large number of leads and angles can be cut automatically. They are furnished regularly as part of the equipment of Universal Milling Machine but may be supplied with Manufacturing and Plain Millers, in which case spirals can be cut in connection with the Universal Milling Attachment shown on page 30.

No.	Swing	Take Between Centers	B. & S. Taper Hole in Spindle	Net Weight Lbs.	Code Word
		PLAIN CENTERS			
1	10″	22″	No. 10	95	Diamond
1½	10″	29″	No. 10	95	Diamondal
2	12″	27″	No. 11	140	Diagonal
3	14″	33″	No. 12	200	Diadem
		UNIVERSAL CENTERS			
1	10″	21″	No. 10	110	Delta
1½	10″	28″	No. 10	110	Deltal
2	12″	26″	No. 11	165	Deluge
3	14″	32″	No. 12	235	Delve
		SPIRAL UNIVERSAL CENTERS			
1	10″	21″	No. 10	155	Dehort
1½	10″	28″	No. 10	155	Dehortal
2	12″	26″	No. 11	240	Dehusk
3	14″	32″	No. 12	330	Delenda

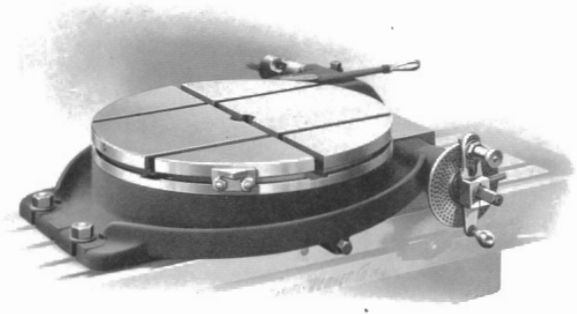


ROTARY TABLE

Showing graduated collar as regularly furnished.

Number of attachment corresponds to number of machine to which it is applied.

When ordering give number stamped on front of knee.



ROTARY TABLE

With index plates from dividing head in use.

The Rotary Table

The rotary table for use with Milwaukee Millers consists of a base and a circular work table. It is very ruggedly constructed and the base is made pan shape to catch oil and return it to the milling machine table. The rotary table is provided with T-slots of the same dimensions as those in the milling machine table. The table is also provided with a center hole for locating work, the hole being tapered from the bottom to within a short distance from the top. This permits the use of a taper arbor for centering gears and other work as well as for holding the work securely down on the table. The arbor for this purpose will be found listed on page 69.

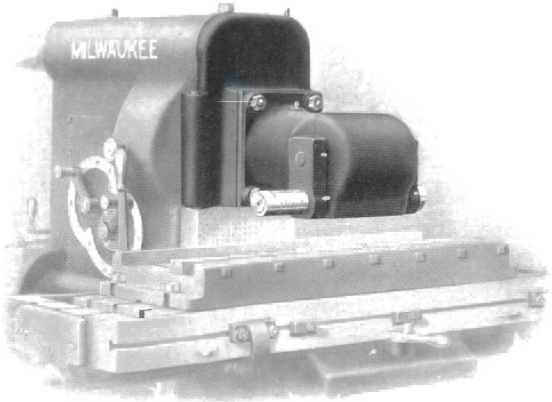
The worm wheel for table feed is practically as large in diameter as the table itself. It is made coarse pitch and is capable of withstanding continuous and severe duty. The table can be operated either by hand or power, the power feed being reversible. Automatic trip is provided to release the feed at any desired point. The table is made of minimum height consistent with strength. This brings the work down close to the top of the milling machine table, thus securing the greatest rigidity.

The rotary table is adapted for use with either the horizontal or vertical spindle milling machines. It may be used to especial advantage on the horizontal type in connection with Universal Milling, Vertical Spindle or Slotting Attachments and also for cutting large diameter gears, in which case index plates and crank are used for dividing. The index plates and cranks supplied with dividing centers (see page 34) are designed to interchange with the rotary table. In this way dividing can be done as successfully with the rotary table as with the ordinary centers. The advantage of this lies in the fact that large diameter gears can be handled in a horizontal position on the table and the vertical feed used for cutting the teeth, whereas with dividing centers, the size of gears that can be cut is limited by the swing of the centers.

Index plates and crank are not regularly furnished with the rotary table. They are furnished with all types of dividing centers and if the machine is equipped with centers no further expenditure is necessary. If the machine is not equipped with centers, index plates and crank for the rotary table will be furnished at additional cost.

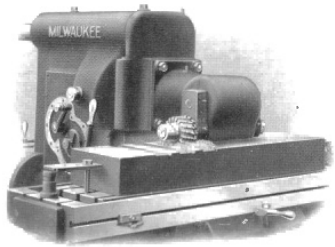
Another very popular and important use of the rotary table is for milling pieces that are finished in quantities by the continuous milling process. This process necessitates a fixture for clamping the pieces on the table. The pieces are operated upon by the cutter at one side or the back while the operator stands in front, removing finished pieces and clamping rough ones. In this way a truly phenomenal output is frequently obtained.

No.	Diameter of Table	Diameter Over Oil Pan	Height	Net Weight Lbs.	Code Word	Code Word Index Plates and Crank
1	14″	18″	5⅛″	270	Rotund	Raven
1½	14″	18″	5⅛″	270	Rotundal	Ravenal
2	17¼″	21¼″	5⅛″	370	Rouser	Rostrum
3	20½″	24½″	5⅛″	530	Royalist	Rotten

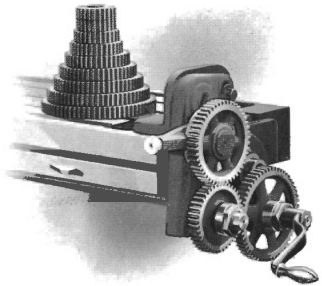


RACK CUTTING ATTACHMENT

When ordering give number stamped on front of knee of machine to which attachment is to be applied.



RACK CUTTING ATTACHMENT AT WORK



RACK INDEXING ATTACHMENT

The Rack Cutting Attachment

As the name implies, this attachment is designed primarily for the purpose of milling racks. However, it can be put to a number of other operations to advantage such as sawing off stock, cross milling on long pieces, etc. One of the special uses is illustrated on the opposite page. The work is a long piece, too long to be handled on the standard machine the other way around. Cross notches are being milled by means of the rack cutting attachment. In this instance the power cross feed of the machine is being used instead of the longitudinal feed of the table.

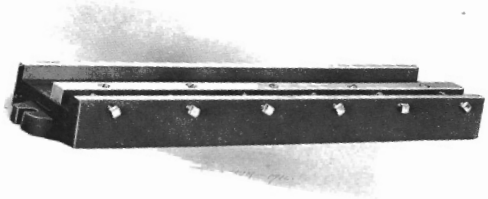
This attachment provides a spindle at right angles to the horizontal spindle and parallel to the top of the table. The spindle is driven by two wide face spiral gears cut on opposing angles. These gears are solid with the spindle and are of hardened steel the same as all gears in Milwaukee Millers and attachments. This constitutes the regular herringbone construction. Back of the herringbone gears is a pair of heavy bevel gears. This simple drive is thoroughly substantial all the way through. Large diameter cutters can be handled with a steadiness that is surprising, considering the extremely short distance from the bottom of the attachment to the center of the spindle. This steadiness is due to the wide herringbone gears that are used.

An indexing attachment for use in rack cutting is also shown on the opposite page. By withdrawing the plunger and turning the plate one turn, racks of English diametral pitch can be cut from 3 to 6 by half pitches and all pitches from 7 to 16. Racks may also be cut of even pitches from 18 to 32; circular pitch, 1″ to 1 15″ by sixteenths; metric, module 1 to 8; circular pitch, all pitches from 2 m/m to 16 m/m.

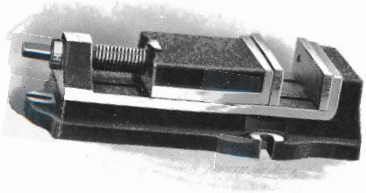
Rack cutting attachments for Milwaukee Millers are made in two sizes, either one of which can be used on the same base on any size machine. Each size machine, of course, requires a base to fit that particular size machine. These two sizes together give a sufficient range for any work, light or heavy, that would come within the range of milling machines of the sizes and power that we build.

A long vise is made for use in connection with the rack cutting attachment. This vise is shown in the shadow background of the left hand illustration on the opposite page. It is also illustrated and tabulated on pages 40 and 41.

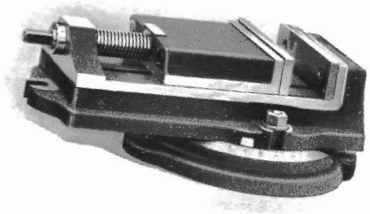
No.	Machine Where Used	Diameter of Cutter Spindle	Height from Center of Spindle to Bottom of Head	Distance from Column to Center of Spindle	Diametric Pitch Cutter Capacity	Wgt. Lbs.	Code Word
1	No. 1, No. 1½	1″	1 1/32″	11″	4 to 20	210	Raid
2	No. 2, No. 3	1½″	1⅝″	13½″	2 to 10	310	Raft



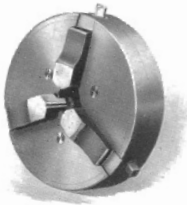
RACK VISE



PLAIN VISE



SWIVEL VISE



MILLING MACHINE CHUCK

Number of attachment corresponds to number of machine to which it is applied.

When ordering give number stamped on front of knee.

Vises and Chucks

MILLING MACHINE VISE—PLAIN

This vise is of improved flanged construction with cross slots and side ears so that it can be held either way on the work table. Furnished as part of regular equipment of Plain and Manufacturing Milling Machines.

No.	Width of Steel Jaws	Depth of Steel Jaws	Opens with Steel Jaws	Opens without Steel Jaws	Net Weight Lbs.	Code Word
1	6¼″	1½″	4⅛″	5⅛″	60	Locust
1½	6¼″	1½″	4⅛″	5⅛″	60	Locustal
2	7¼″	2″	5¼″	6¼″	95	Lofty
3	8¼″	2¼″	6¼″	7¼″	130	Lotus

RACK VISE

This is a vise intended to hold long pieces lengthwise of the table such as racks or any work that requires a long clamping jaw.

No.	Length	Opens with Steel Jaws	Opens Without Steel Jaws	Net Weight Lbs.	Code
1	29½″	4⅞″	6⅛″	100	Lunar
1½	29½″	4⅞″	6⅛″	100	Lunaral
2	29½″	4⅞″	6⅛″	100	Lunate
3	36″	8″	9¼″	210	Lupine

MILLING MACHINE VISE—SWIVEL

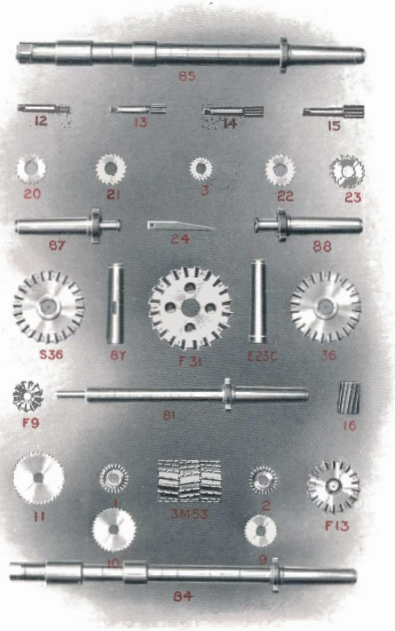
This is the plain vise with the addition of a circular base, graduated in degrees. It can be removed from the circular base and used as a plain vise if desired. Furnished as part of the regular equipment of universal milling machines.

No.	Width of Steel Jaws	Depth of Steel Jaws	Opens with Steel Jaws	Opens without Steel Jaws	Net Weight Lbs.	Code Word
1	6¼″	1½″	4⅛″	5⅛″	85	Lyceum
1½	6¼″	1½″	4⅛″	5⅛″	85	Lyceumal
2	7¼″	2″	5¼″	6¼″	130	Lydian
3	8¼″	2¼″	6¼″	7¼″	165	Lyric

MILLING MACHINE CHUCK

This is a universal chuck with three jaws, all of which are operated by application of wrench to one pinion. It is provided with face plate to fit dividing heads of corresponding numbers.

No.	Diameter	Net Weight Lbs.	Code Word
1	6″	16	Rosette
1½	6″	16	Rosetteal
2	8″	26	Rostral
3	9″	39	Rosin



SET OF TOOLS FOR
No. 3 MILLERS

Tools for the Milling Machine

We are, first and foremost, manufacturers of milling machines and we devote our energies to making these machines capable of producing maximum results. However, we recognize that the cutting tool is of paramount importance. With this in mind, we have selected certain classes of tools that are always useful and have divided these tools into sets that experience has taught us are suitable for each size of Milwaukee Millers. We do not seek orders for tools for the miller with a view to building up a business in this class of articles but we offer them only as a supplementary service and solely to aid our customers in obtaining the highest results. The selections that we have made furnish something of real and practical value.

It will be noted in examining the tabulation of the sets of tools in the rear of this catalogue that some of the cutters are made from carbon steel while the larger and more powerful ones are made from high speed steel. There is a good reason for this. High speed steel cutters are the most economical to employ where there is considerable use for a cutter. They far outlast carbon steel. will cut more rapidly and do not require as frequent sharpening. However, the carbon steel cutter, because of its cheapness, still has its place on special work where the amount of milling is small.

Our No. 3 set of tools is illustrated on the opposite page and to give a brief idea of the variety of purposes to which these tools may be put we will describe the cutters alone.

Nos. 1 and 2. Right and Left Hand Angular Cutters. Mainly used for the purpose of making additional cutters.

Nos. 3, 20, 21, 22 and 23. Narrow Face Plain Milling Cutters. Generally used for keyseating shafting. Also adapted to a great variety of other work.

Nos. 9, 10 and 11. Metal Slitting Saws. For cutting slots in castings and other metal or for sawing off a piece.

Nos. 12, 13, 14 and 15. Small End Mills. For facing bosses, cutting into recesses, making fillets, etc.

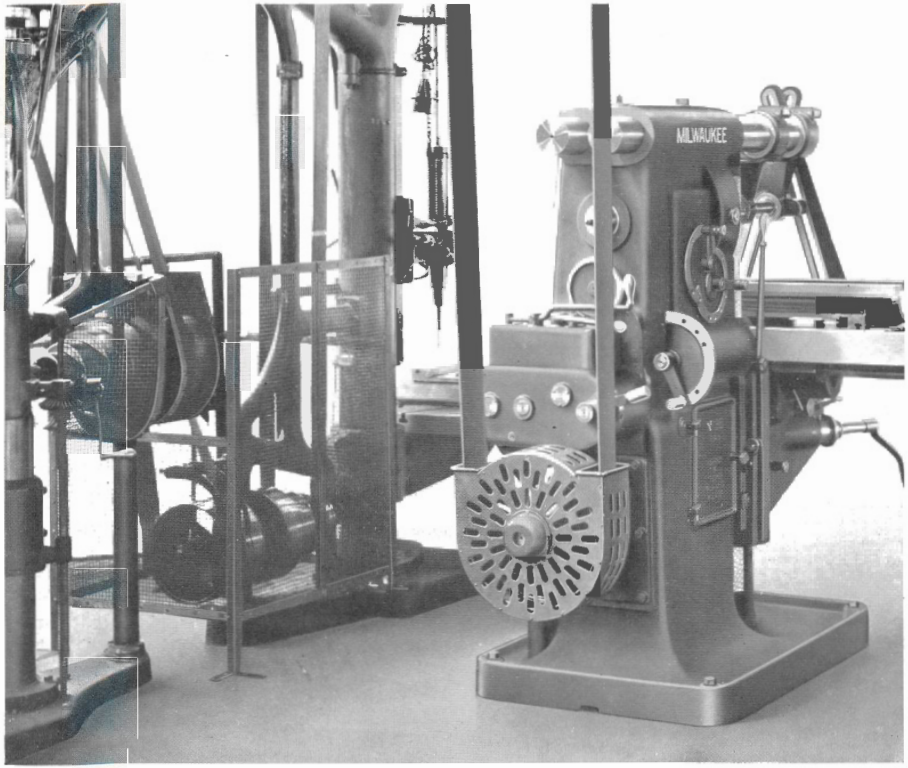
No. 16. Spiral Milling Cutter. For milling flat surfaces.

No. 36 and S-36. Duplicate Side Cutters with inserted teeth. Used extensively on straddle and gang milling work.

No. 3M53. Slab Milling Cutter with inserted nicked teeth. For extra heavy duty in milling flat surfaces or slabs. These cutters are alternately right and left hand spiral when set up in gangs to secure greater width of cut.

No. F9 and F13. Face Milling Cutters with inserted teeth. For finishing flat surfaces.

No. F31. Large Face Milling Cutter. Adapted to be attached to the face of the spindle, a rigid construction previously explained on page 15.


MILWAUKEE

Safety

We hold that an engineer who designs a machine under modern conditions and does not take into account the proper safeguarding of all the moving parts has only partially finished his work. Better provision can be made in the original design for protecting the moving parts than can be made later by the purchaser. It is not right that the purchaser should be obliged to improvise and patch to complete the work that should have properly been done by the manufacturer. Efforts to protect employees have led to some very unsightly work where pulleys, gears and belts are guarded with sheet metal, wire screens, wooden fences and every conceivable kind of make shift.

The photograph on the opposite page illustrates our point. On one side are some very well made guards on drill presses. They are as good examples of their kind as can be found but they were erected at additional expense, after the purchase of the machines, by the safety organization of the factory where they are used. On the other side is a No. 3B Plain Milwaukee Milling Machine. With the exception of the belt, it stands exactly as it is made. There is not an exposed gear on any part of the machine. All the gears in the main drive are inclosed within the column that is made oil-tight. The gears are not only removed from any possibility of contact with the operator but they are also continuously flooded with oil, a feature that could not be secured had the inclosing of these gears not been provided for in the original design of the machine.

An extremely practical pulley guard is furnished as a regular part of the machine without additional expense to the purchaser. This guard is adjustable so that the belt running to the line shaft may be angled in any direction. In order to adjust the guard it is necessary to adjust only one screw.

A very important feature of Milwaukee Millers is the absence of countershaft, none being needed for any purpose, the reverse being self-contained in the machine. Were it not so, a countershaft would be required, necessitating two belts from the line shaft to the countershaft and one from the countershaft to the machine.

This is contrary to the very self-evident truth that safety and common sense demand the elimination of as many belts and pulleys as possible. Countershafts are made with friction clutches that have dangerous projections and as countershafts are ordinarily of such construction as to require frequent oiling, this means great danger to the men when they climb up the ladder to oil. With Milwaukee Millers no countershaft is necessary. The belt runs directly to a single pulley on the line shaft.

The care given to details of safety illustrates the thoroughness with which Milwaukee Millers are designed. No detail is too small to receive complete attention and all the necessary elements are well taken care of, leaving nothing for the purchaser to improvise after the machine has been received. Thoroughness coupled with ability explains the success of Milwaukee Millers.

Summary

Every part and detail of Milwaukee Millers has been exposed to you in the previous pages.

There has been no mystery. No features have been left unexplained. No information has been held back. No claims have been made without mechanical facts to back them up.

On the strength of the points shown and their evident advantages, we solicit your business.

We believe that whatever the viewpoint—close accuracy, speedy production or long, satisfactory service—your milling requirements are fulfilled most completely by Milwaukee Millers.

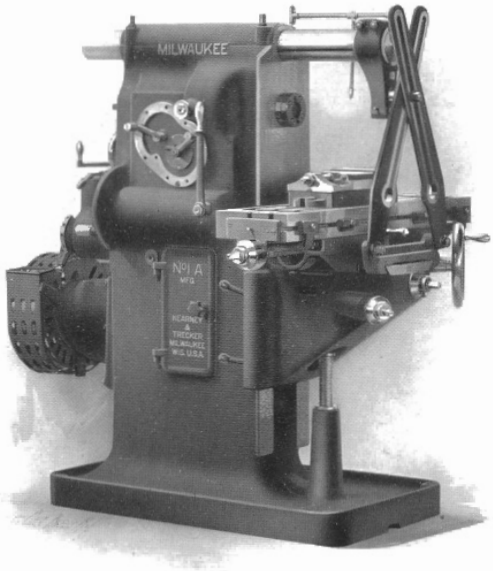
If there is any point not thoroughly clear to you, we will appreciate your asking us about it.

If there is any milling problem that is perplexing you, we will gladly give you the benefit of our advice.

In the following pages we give the detailed information necessary to selecting the machine and equipment for your work.

Kearney & Trecker Company

MILWAUKEE WISCONSIN U. S. A.

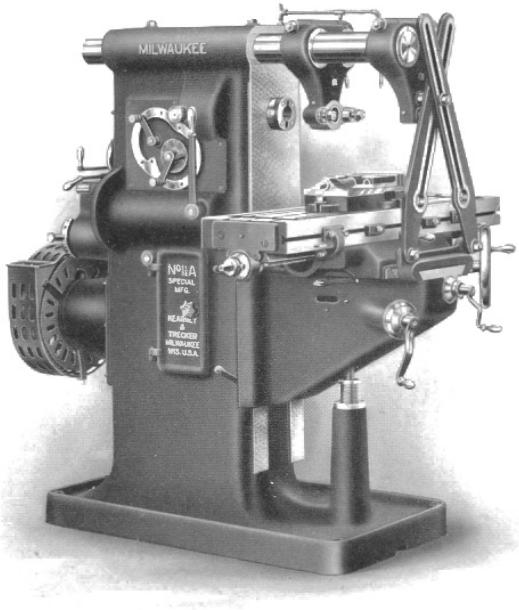


No. 1A MANUFACTURING MILLING MACHINE

Range

Table	25″
Cross	8″
Vertical	18″
Code Word	Enforce

(See pages 50 and 51)

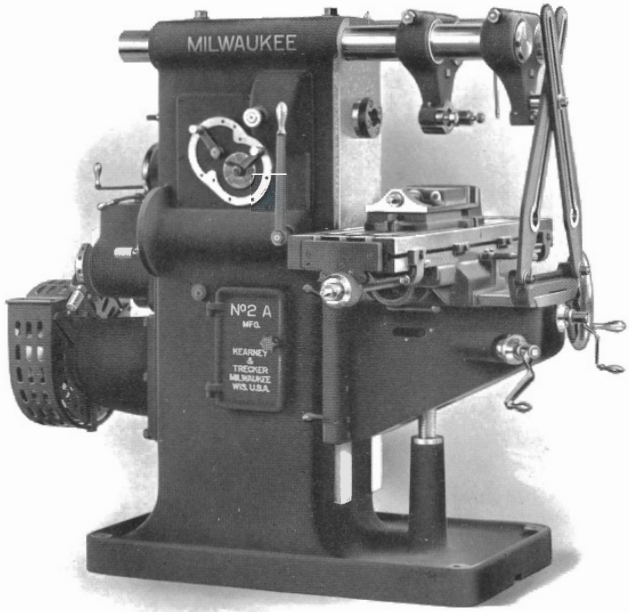


No. 1½A SPECIAL MANUFACTURING MILLING MACHINE

Range

Table	30″
Cross	10″
Vertical	18½″
Code Word	Enfilade

(See pages 50 and 51)

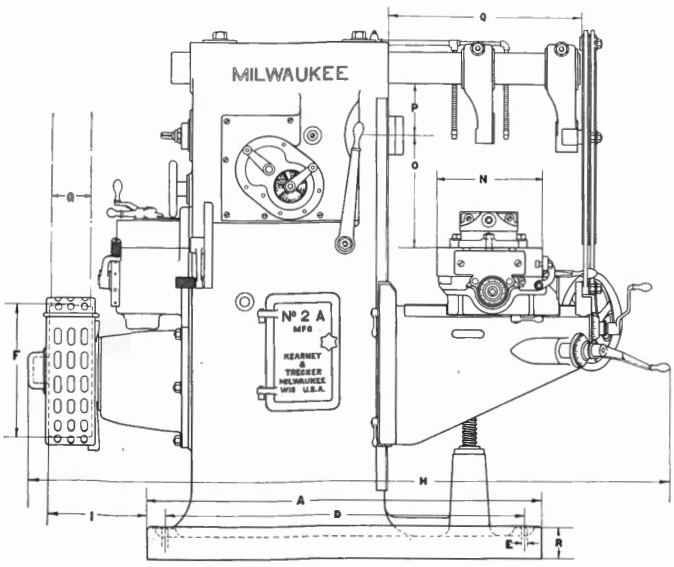


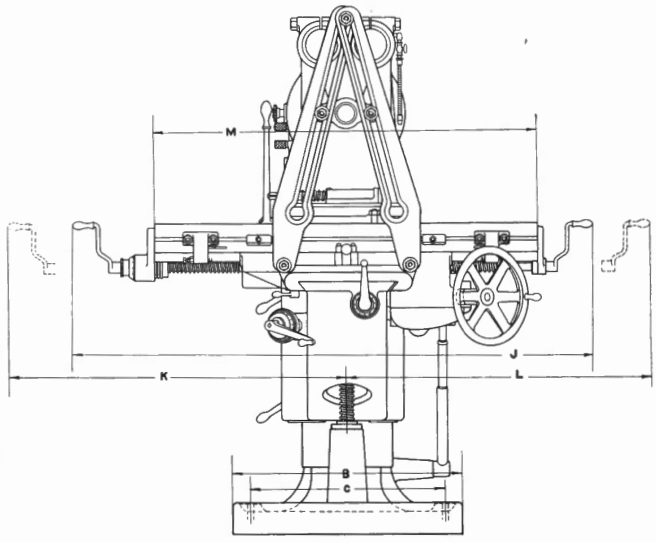
No. 2A MANUFACTURING MILLING MACHINE

Range

Table	30″
Cross	10″
Vertical	19″
Code Word	Endeavor

(See pages 50 and 51)





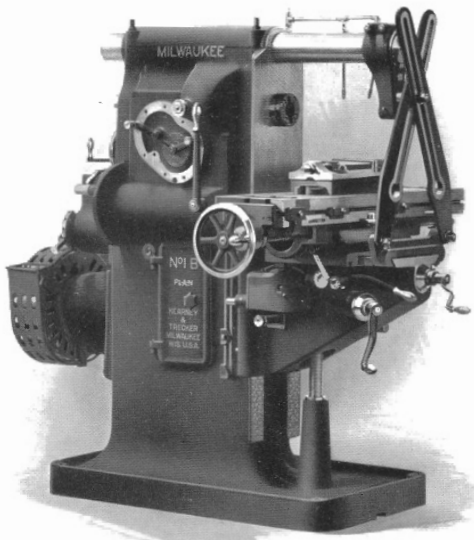
PLAN DIMENSIONS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
No. 1 A Manufacturing.....	42″	24″	20″	38″	1¼″	14″	4″	67½″	8¾″	54⅞″	41½″	39¼″	38⅜″	9½″	18″	5⅝″	17½″	3¼″
No. 1½A Manufacturing.....	45″	24″	20½″	41½″	1¼″	15″	4″	70⅜″	8″	62″	48½″	46¼″	45½″	11½″	18½″	6⅛″	21¾″	3½″
No. 2 A Manufacturing.....	48″	28″	23¾″	43¾″	1¼″	16″	4½″	79¼″	12″	64¼″	49¾″	45¾″	47″	13″	19½″	6⅛″	24″	4″

Dimensions of Milwaukee Manufacturing Millers

No. of Machine	1A	1½A	2A
Table feed—automatic	25″	30″	30″
Cross adjustment	8″	10″	10″
Vertical adjustment	18″	18½″	19″
Working surface of table	38⅜″ x 9½″	45½″ x 11½″	47″ x 13″
Over-arm	Single	Double	Double
Number of arbor supports	1	2	2
Center of spindle to over-arm	5⅝″	6 7/16″	6-15/16″
B. & S. taper hole in spindle	No. 10	No. 10	No. 11
Width of vise jaws	6¼″	6¼″	7¼″
Depth of vise jaws	1½″	1½″	2″
Vise opens without steel jaws	5⅛″	5⅛″	6¼″
Number of speed changes	18	18	18
Range of speed (R. P. M.)	15 to 354	15 to 354	15 to 360
Number of feed changes	12	12	12
Range of feed (in inches per minute)	½ to 16	½ to 16	½ to 16
Diameter of driving pulley	14″	15″	16″
Width of driving belt	4″	4″	4½″
Speed of driving pulley (R. P. M.)	250	250	300
H. P. of motor for electric drive	3	4	5
Net weight (in pounds) about	2850	3550	4500
Shipping weight (domestic) about	3050	3850	4800
Shipping weight (foreign) about	3400	4250	5300
Number of boxes (foreign)	1	1	1
Cubic feet (foreign) about	74	85	104
Code word	Enforce	Enfilade	Endeavor

Equipment:—Vise, belt guard, oil pump for lubricating cutters and necessary wrenches.

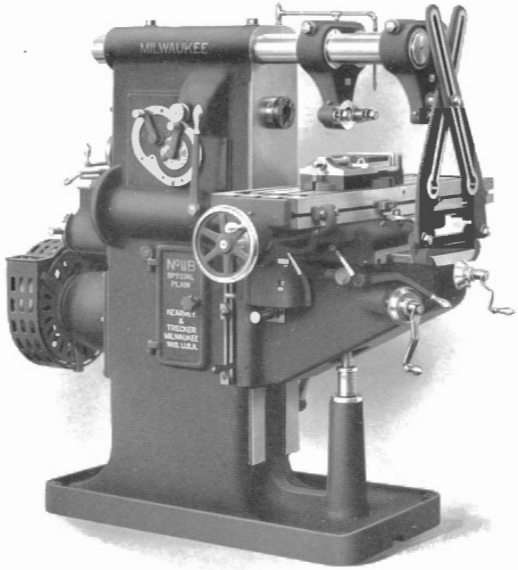


No. 1B PLAIN MILLING MACHINE

Automatic Feeds

Table	24″
Cross	8″
Vertical	18″
Code Word	Ensign

(See pages 56 and 57)

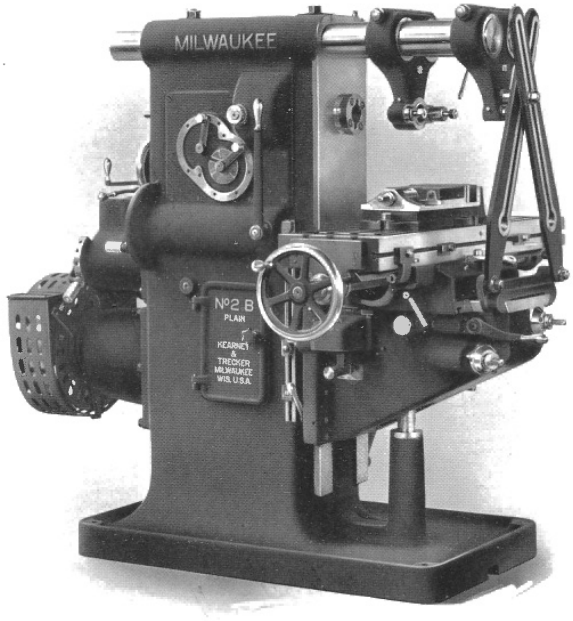


No. 1½B SPECIAL PLAIN MILLING MACHINE

Automatic Feeds

Table.....30″
Cross.....10″
Vertical.....18½″
Code Word.....Enrap

(See pages 56 and 57)

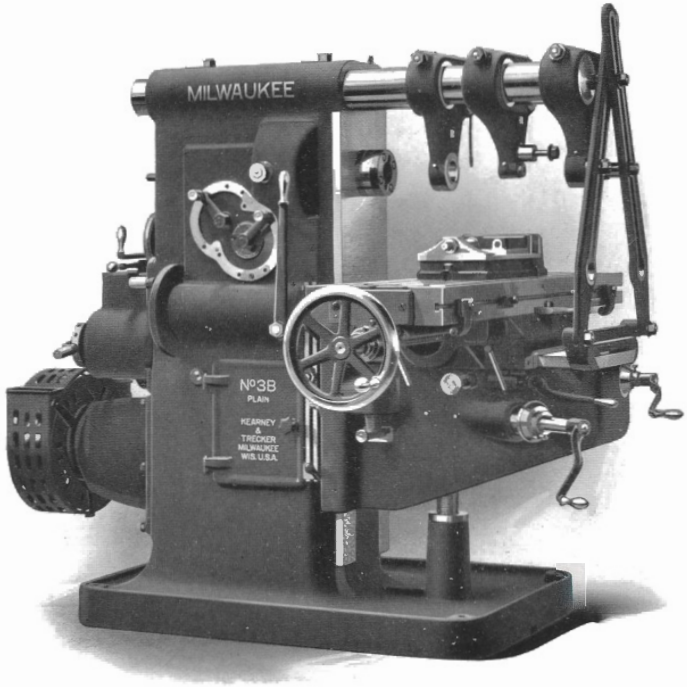


No. 2B PLAIN MILLING MACHINE

Automatic Feeds

Table	30″
Cross	10″
Vertical	19″
Code Word	Envoy

(See pages 56 and 57)

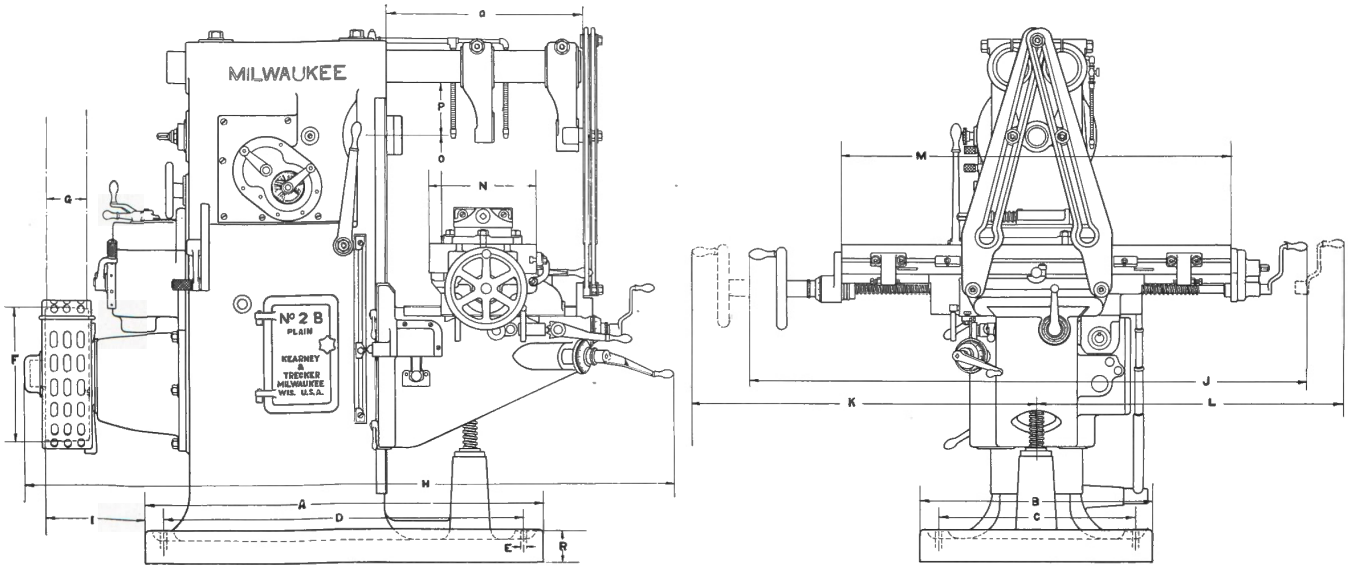


No. 3B PLAIN MILLING MACHINE

Automatic Feeds

Table	36″
Cross	12″
Vertical	20″
Code Word	Energy

(See pages 56 and 57)



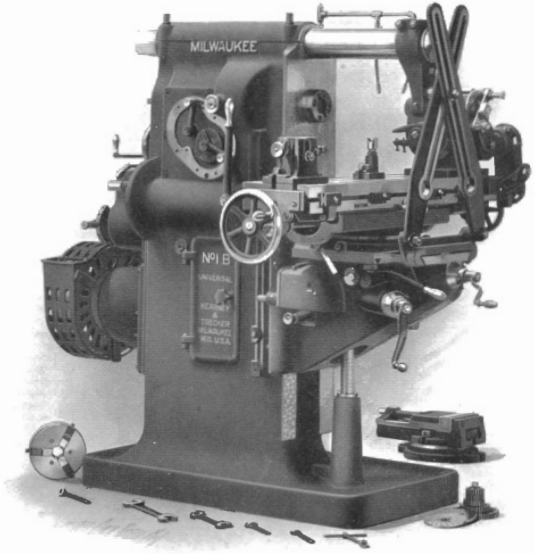
PLAN DIMENSIONS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
No. 1 B Plain	42″	24″	20″	38″	11/16″	14″	4″	67½″	8¾″	56½″	40¼″	40½″	38⅜″	9½″	18½″	5⅝″	20″	3½″
No. 1½B Plain	45″	24″	20½″	41½″	11/16″	15″	4″	71¾″	8″	63½″	47¼″	47½″	45½″	11½″	18⅞″	6 1/16″	23½″	3½″
No. 2 B Plain	48″	28″	23¾″	43¾″	11/16″	16″	4½″	79¼″	12″	67½″	48″	49½″	47″	13″	19½″	6⅛″	24″	4″
No. 3 B Plain	55″	32″	27½″	50½″	11/16″	16″	5″	88″	13″	78¾″	57½″	57¼″	55″	15″	20½″	7⅞″	28¾″	4″

Dimensions of Milwaukee Plain Millers

No. of Machine	No. 1B	No. 1½B	No. 2B	No. 3B
Table feed—automatic	24″	30″	30″	36″
Cross feed—automatic	8″	10″	10″	12″
Vertical feed—automatic	18″	18½″	19″	20″
Working surface of table	38⅜″ x 9½″	45½″ x 11½″	47″ x 13″	55″ x 15″
Over-arm	Single	Double	Double	Double
Number of arbor supports	1	2	2	3
Center of spindle to over-arm	5⅝″	6 7/16″	6 15/16″	7⅞″
B. & S. taper hole in spindle	No. 10	No. 10	No. 11	No. 12
Width of vise jaws	6¼″	6¼″	7¼″	8¼″
Depth of vise jaws	1½″	1½″	2″	2¼″
Vise opens without steel jaws	5⅛″	5⅛″	6¼″	7¼″
Number of speed changes	18	18	18	18
Range of speed (R. P. M.)	15 to 354	15 to 354	15 to 360	13 to 320
Number of feed changes	12	12	12	12
Range of feed (in inches per minute)	½ to 16	½ to 16	½ to 16	½ to 16
Diameter of driving pulley	14″	15″	16″	16″
Width of driving belt	4″	4″	4½″	5″
Speed of driving pulley (R. P. M.)	250	250	300	350
H. P. of motor for electric drive	3	4	5	7½
Net weight (in pounds) about	2900	3600	4600	6600
Shipping weight (domestic) about	3100	3900	4900	7100
Shipping weight (foreign) about	3500	4300	5400	7600
Number of boxes (foreign)	1	1	1	1
Cubic feet (foreign) about	74	85	104	147
Code word	Ensign	Enrap	Envoy	Energy

Equipment:—Vise, belt guard, pump for lubricating cutters and necessary wrenches.

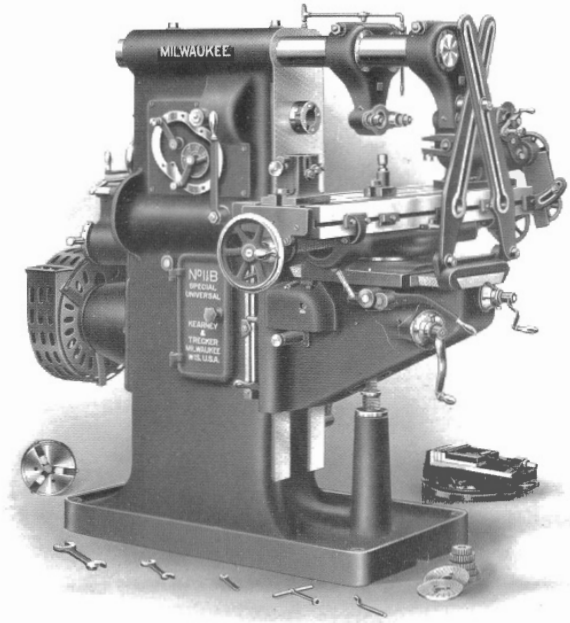


No. 1B UNIVERSAL MILLING MACHINE

Automatic Feeds

Table	24″
Cross	8″
Vertical	17″
Code Word	Falcon

(See pages 62 and 63)

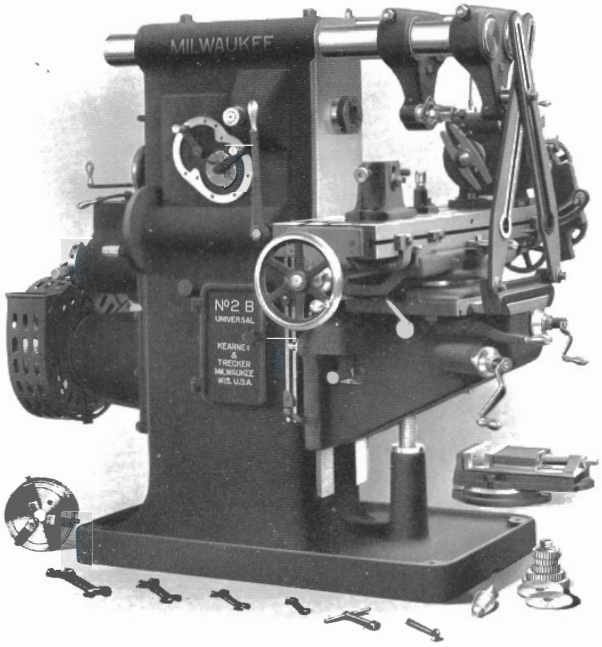


No. 1½B SPECIAL UNIVERSAL MILLING MACHINE

Automatic Feeds

Table	30″
Cross	10″
Vertical	18½″
Code Word	Facer

(See pages 62 and 63)

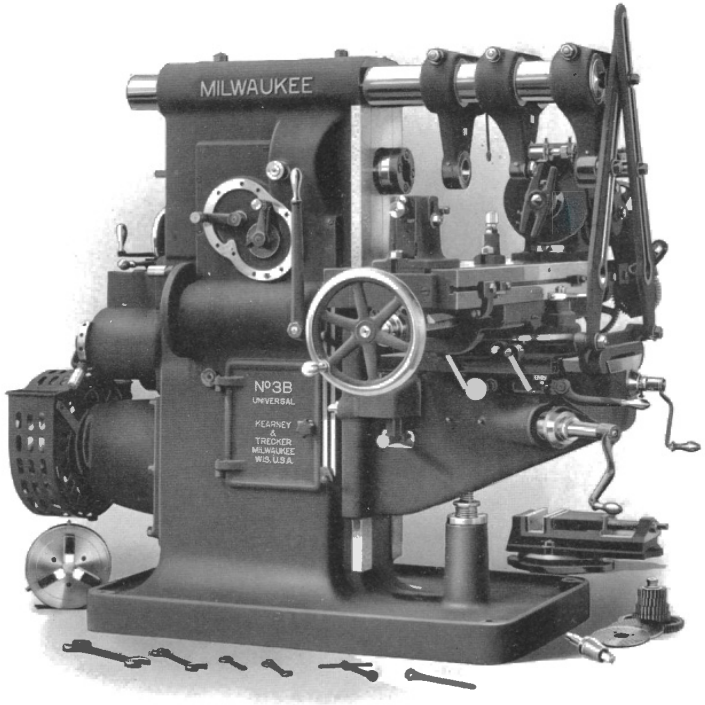


No. 2B UNIVERSAL MILLING MACHINE

Automatic Feeds

Table	30″
Cross	10″
Vertical	19″
Code Word	Famous

(See pages 62 and 63)

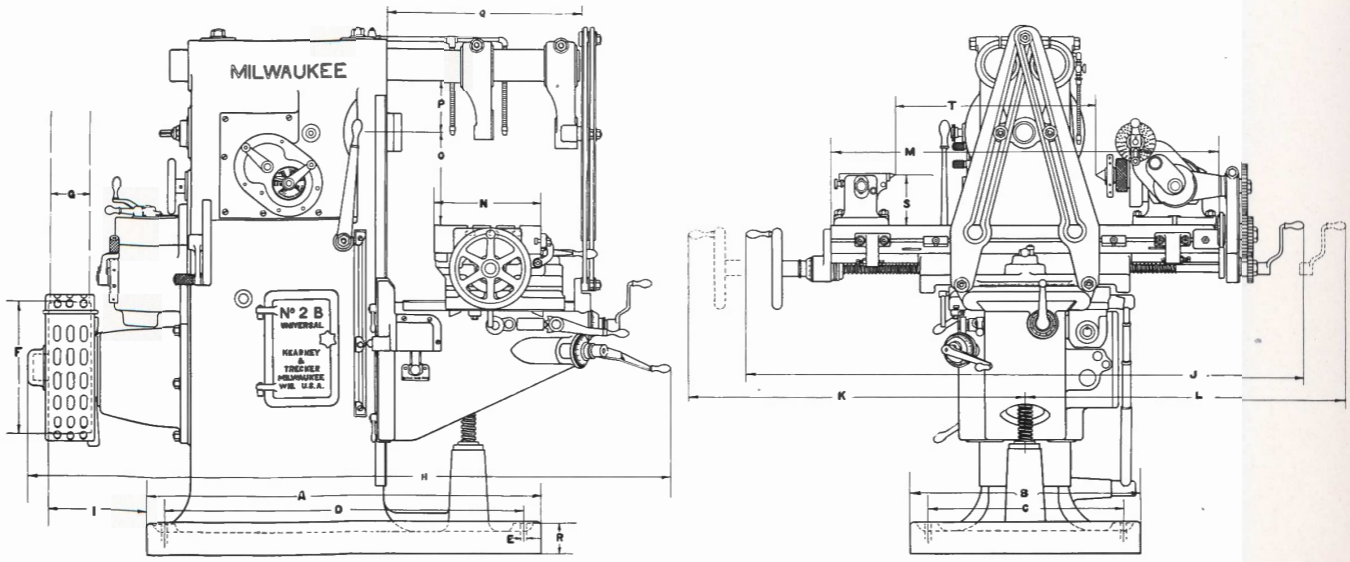


No. 3B UNIVERSAL MILLING MACHINE

Automatic Feeds

Table	36″
Cross	12″
Vertical	20″
Code Word	Favorite

(See pages 62 and 63)



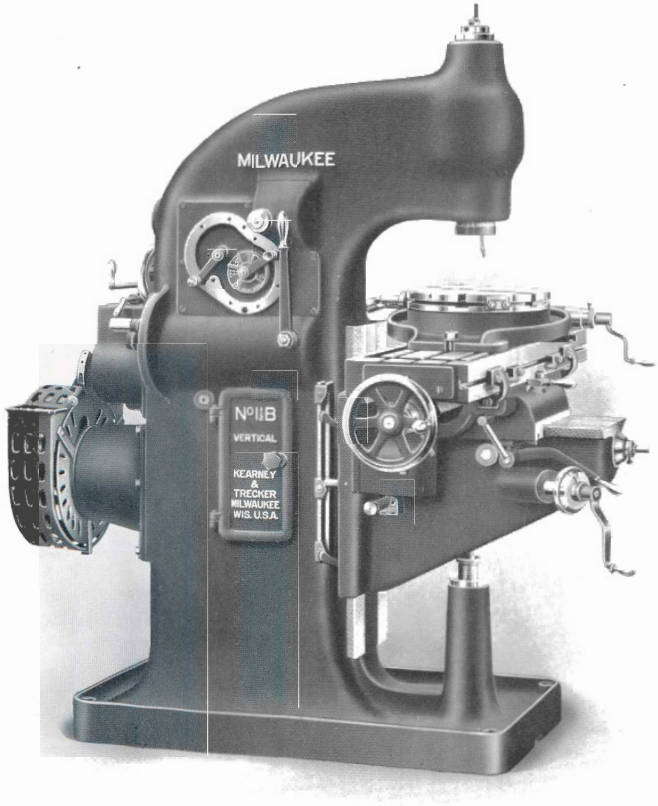
PLAN DIMENSIONS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
No. 1 B Universal.....	42″	24″	20″	38″	11/16″	14″	4″	67½″	8¾″	57½″	41½″	40¼″	38⅜″	9½″	17⅜″	5⅝″	20″	3½″	5 1/16″	21″
No. 1½B Universal.....	45″	24″	20½″	41½″	11/16″	15″	4″	71¾″	8″	64½″	48½″	47¼″	45½″	11½″	17¾″	6 1/16″	23½″	3½″	5 1/16″	28″
No. 2 B Universal.....	48″	28″	23¾″	43¾″	11/16″	16″	4½″	79¼″	12″	69″	50″	49½″	47″	13″	19½″	6 11/16″	24″	4″	6 1/16″	26″
No. 3 B Universal.....	55″	32″	27½″	50½″	11/16″	16″	5″	88″	13″	80½″	59½″	57¼″	55″	15″	20½″	7⅛″	28¾″	4″	7 1/16″	32″

Dimensions of Milwaukee Universal Millers

No. of Machine	No. 1B	No. 1½B	No. 2B	No. 3B
Table feed—automatic	24″	30″	30″	36″
Cross feed—automatic	8″	10″	10″	12″
Vertical feed—automatic	17″	18½″	19″	20″
Working surface of table	38⅜″ x 9½″	45½″ x 11½″	47″ x 13″	55″ x 15″
Over-arm	Single	Double	Double	Double
Number of arbor supports	1	2	2	3
Center of spindle to over-arm	5⅝″	6 7/16″	6 15/16″	7⅞″
B. & S. taper hole in spindle	No. 10	No. 10	No. 11	No. 12
Index centers swing	10″	10″	12″	14″
Index centers take in length	21″	28″	26″	32″
Three jaw universal chuck	6″	6″	8″	9″
Width of vise jaws	6¼″	6¼″	7¼″	8¼″
Depth of vise jaws	1½″	1½″	2″	2¼″
Vise opens without steel jaws	5⅛″	5⅛″	6¼″	7¼″
Number of speed changes	18	18	18	18
Range of speed (R. P. M.)	15 to 354	15 to 354	15 to 360	13 to 320
Number of feed changes	12	12	12	12
Range of feed (in inches per minute)	½ to 16	½ to 16	½ to 16	½ to 16
Diameter of driving pulley	14″	15″	16″	16″
Width of driving belt	4″	4″	4½″	5″
Speed of driving pulley (R. P. M.)	250	250	300	350
H. P. of motor for electric drive	3	4	5	7½
Net weight (in pounds) about	3100	3800	5100	7000
Shipping weight (domestic) about	3300	4150	5400	7500
Shipping weight (foreign) about	3800	4500	5900	8000
Number of boxes (foreign)	1	1	1	1
Cubic feet (foreign) about	74	85	104	147
Code word	Falcon	Facer	Famous	Favorite

Equipment:—Spiral dividing centers, center rest, index plates, change gears, index chart, three jaw universal chuck, swivel vise, belt guard, oil pump for lubricating cutters and necessary wrenches.

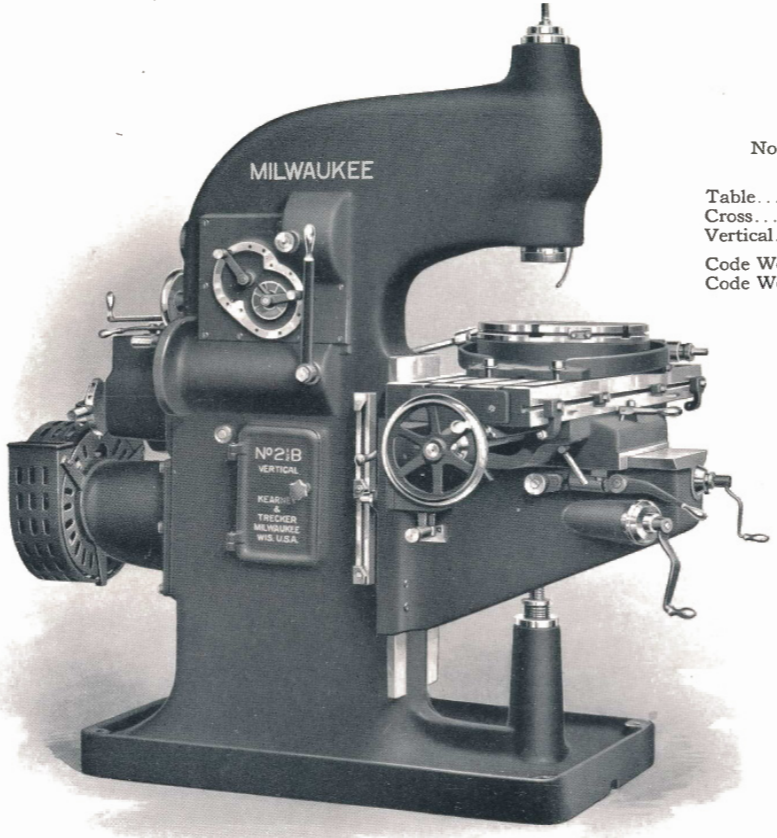


No. 1½B VERTICAL MILLING MACHINE

Automatic Feeds

Table	30″
Cross	12″
Vertical	18½″
Code Word—with Rotary Table	Vertexy
Code Word—without Rotary Table	Verbrate

(See pages 66 and 67)

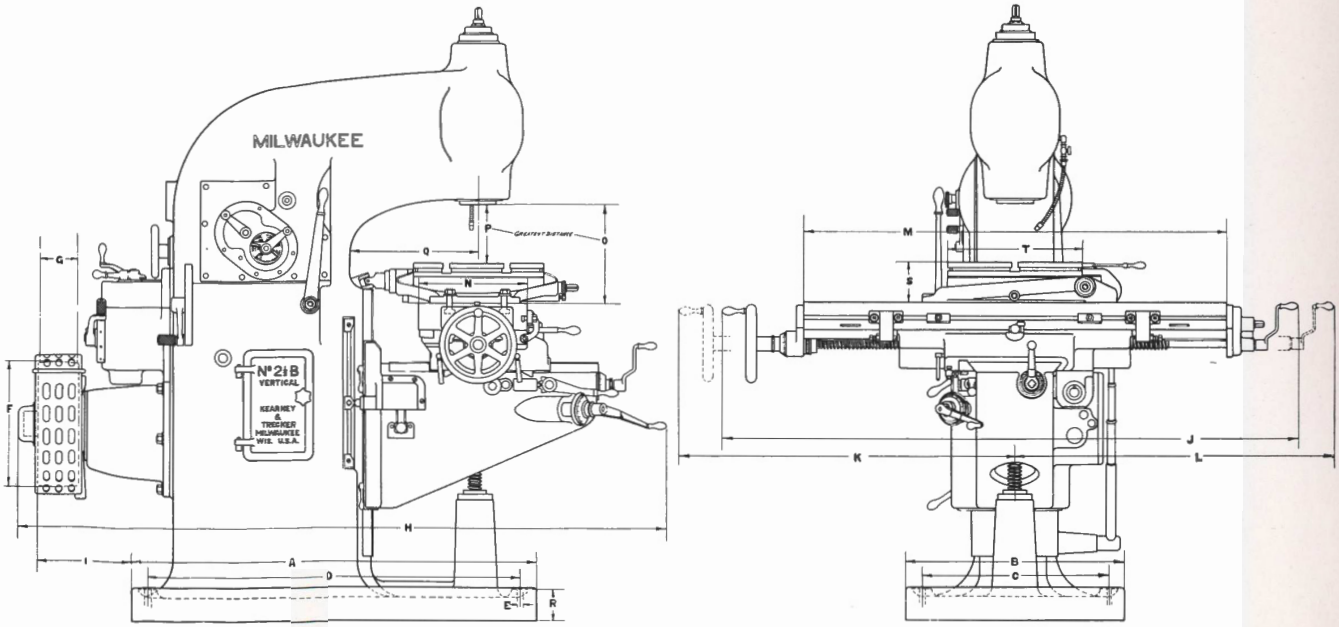


No. 2½B VERTICAL MILLING MACHINE

Automatic Feeds

Table	36″
Cross	15″
Vertical	20½″
Code Word—with Rotary Table	Vernate
Code Word—without Rotary Table	Vernal

(See pages 66 and 67)



PLAN DIMENSIONS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
No. 1¼A Vertical.....	45″	24″	20½″	41½″	11/16″	15″	4″	70¾″	8″	62″	48½″	46¼″	45½″	11½″	18¼″	13⅝″	12″	3½″	5⅛″	14″
No. 1½B Vertical.....	45″	24″	20½″	41½″	11/16″	15″	4″	71¾″	8″	63½″	47½″	47½″	45½″	11½″	18¾″	13⅝″	12″	3½″	5⅛″	14″
No. 2½B Vertical.....	52″	32″	27¾″	47¾″	13/16″	16″	5″	84″	12″	74½″	55″	56½″	54″	14″	20½″	15⅜″	16½″	4″	5⅛″	17¼″

Dimensions of Milwaukee Vertical Millers

No. of Machine	No. 1½A	No. 1½B	No. 2½B
Table feed—automatic	30″	30″	36″
Cross feed—automatic on B type	12″	12″	15″
Vertical feed—automatic on B type	18″	18½″	20½″
Working surface of table	45½″ x 11½″	45½″ x 11½″	54″ x 14″
Throat distance—column to center of spindle	12″	12″	16½″
B. & S. taper hole in spindle	No. 10	No. 10	No. 11
Diameter of rotary table	14″	14″	17¼″
Diameter of rotary table over oil pan	18″	18″	21¼″
Width of vise jaws	6¼″	6¼″	7¼″
Depth of vise jaws	1½″	1½″	2″
Vise opens without steel jaws	5⅛″	5⅛″	6¼″
Number of speed changes	18	18	18
Range of speed (R. P. M.)	15 to 354	15 to 354	15 to 360
Number of feed changes	12	12	12
Range of feed (in inches per minute)	½ to 16	½ to 16	½ to 16
Diameter of driving pulley	15″	15″	16″
Width of driving belt	4″	4″	5″
Speed of driving pulley (R. P. M.)	250	250	300
H. P. of motor for electric drive	3	3	6
Net weight (in pounds) about	3650	3700	5200
Shipping weight (domestic) about	3900	3950	5550
Shipping weight (foreign) about	4400	4450	6500
Number of boxes (foreign)	1	1	1
Cubic feet (foreign) about	95	95	163
Code word—with rotary table	Verte	Vertexy	Vernate
Code word—without rotary table	Vertigo	Verbrate	Vernal

Equipment:—Rotary table with automatic feed, vise, belt guard, oil pump for lubricating cutters and necessary wrenches.

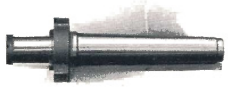
ROTARY TABLE ARBOR

CUTTER ARBOR (Style A)

COLLET

CUTTER ARBOR (Style B)

CHUCK COLLET



CUTTER ARBOR (Style C)

SPINDLE CENTERING PLUG

Arbors, Collets and Plugs

COLLETS

Collets are tapped to suit draw-in bar in spindle of Milling Machine and are furnished with either B. & S. or Morse taper holes.

No.	B. & S. Taper Outside	B. & S. Taper Inside	Machine Where Used	Code Word	Net Price
1	10	4	No. 1, No. 1½, No. 1½ Vertical	Hawk	$3.50
2	10	5	No. 1, No. 1½, No. 1½ Vertical	Hawser	3.50
3	10	7	No. 1, No. 1½, No. 1½ Vertical	Haze	3.50
4	10	9	No. 1, No. 1½, No. 1½ Vertical	Hazel	4.00
5	11	7	No. 2, No. 2½ Vertical	Hound	4.50
6	11	9	No. 2, No. 2½ Vertical	Hero	5.00
7	11	10	No. 2, No. 2½ Vertical	Helmet	5.50
8	12	7	No. 3	Hilt	5.50
9	12	9	No. 3	Hindoo	5.50
10	12	10	No. 3	Hive	6.50
11	12	11	No. 3	Hobby	6.50
12	7	4	Collets	Hovel	2.00
13	7	5	Collets	Hover	2.00

Morse Taper Holes.

No.	B. & S. Taper Outside	Morse Taper Inside	Machine Where Used	Code Word	Net Price
21	10	1	No. 1, No. 1½, No. 1½ Vertical	Haven	$3.50
22	10	2	No. 1, No. 1½, No. 1½ Vertical	Harbor	3.50
23	10	3	No. 1, No. 1½, No. 1½ Vertical	Hedge	4.00
24	10	4	No. 1, No. 1½, No. 1½ Vertical	Herb	4.50
25	11	1	No. 2, No. 2½ Vertical	Hone	4.50
26	11	2	No. 2, No. 2½ Vertical	Holly	4.50
27	11	3	No. 2, No. 2½ Vertical	Hood	5.00
28	11	4	No. 2, No. 2½ Vertical	Host	5.50
29	12	1	No. 3	Hoard	5.50
30	12	2	No. 3	House	6.00
31	12	3	No. 3	Hull	6.00
32	12	4	No. 3	Husk	6.50

CHUCK COLLETS

Three jaw universal *chucks* are made with threaded plate to fit on the spindle of dividing centers of various kinds. There is an occasional user who wishes to mount these on the main spindle of the machines. To do this we have provided a chuck collet that we can supply at any time for use in this connection.

No.	B. & S. Taper	Diameter and Pitch of Thread	Machine Where Used	Code Word	Net Price
Y20A	10	2¼″–10P	No. 1, No. 1½, No. 1½ Vertical	Hamlet	$2.00
Y20B	11	3″ – 8P	No. 2, No. 2½ Vertical	Hammock	2.50
Y20C	12	3″ – 8P	No. 3	Hamper	3.00

SPINDLE CENTERING PLUGS

Spindle centering plugs fit into the taper hole in the end of the spindle of machines or Vertical Spindle Attachments for the purpose of centering Face Milling Cutters F26 and larger, these cutters being carried directly by the flanged spindle.

No.	B. & S. Taper	Machine Where Used	Code Word	Net Price
E23A	10	No. 1, No. 1½, No. 1½ Vertical, No. 1 and No. 1½ Vertical Spindle Attachments	Handsel	$2.00
E23B	11	No. 2, No. 2½ Vertical, No. 2 Vertical Spindle Attachment	Halser	2.50
E23C	12	No. 3, No. 3 Vertical Spindle Attach.	Hanse	3.00

CUTTER ARBORS.

These arbors have clutch drive collars to engage with clutch collar on spindle of millers so that there can be no slip to damage the spindle or the arbor. The back end is tapped to suit draw-in bar in spindle. Style A arbors have bearing outside of nut and are made small so that the arm bracket will pass over the top of the vise or other work when using small diameter cutters. Style B arbors have hardened and ground bearing back of the nut that can be adjusted to any point to suit requirements.

No.	Diam.	Length from Shoulder to Nut	B. & S. Taper	Style	Machine Where Used	Code Word	Net Price
30	⅜″	3½″	10	B	Universal Milling Attachments, No. 1 and No. 1½ Vertical Spindle Attachments, No. 1½ Vertical Millers.	Cactus	$6.00
31	1″	3½″	10	B		Cage	6.00
32	1¼″	3½″	10	B		Calash	6.00
40	⅜″	8″	10	A	No. 1 and No. 1½	Calk	7.00
41	1″	8″	10	A	No. 1 and No. 1½	Cadet	7.00
42	1¼″	8″	10	A	No. 1 and No. 1½	Cake	7.00
50	⅜″	10″	10	A	No. 1½	Camp	8.00
51	1″	10″	10	A	No. 1½	Cape	8.00
52	1¼″	10″	10	A	No. 1½	Card	8.00
53	1″	18½″	10	B	No. 1½	Cabal	13.00
54	1¼″	18½″	10	B	No. 1½	Cabin	13.00
60	⅜″	10″	11	A	No. 2	Caliph	9.00
61	1″	10″	11	A	No. 2	Calf	9.00
62	1¼″	10″	11	A	No. 2	Cane	9.00
63	1″	18½″	11	B	No. 2	Chief	14.00
64	1¼″	18½″	11	B	No. 2	Chemist	14.00
65	1½″	18½″	11	B	No. 2	Cad	14.00
70	⅜″	3½″	11	B	No. 2 Vert. Spindle Attach.	Cambric	7.00
71	1″	3½″	11	B	No. 2½ Vertical Milling	Camel	7.00
72	1¼″	3½″	11	B	Machines.	Cannon	7.00
80	⅜″	12″	12	A	No. 3	Clay	10.00
81	1″	12″	12	A	No. 3	Clevis	10.00
82	1¼″	12″	12	A	No. 3	Cleave	10.00
83	1″	20″	12	B	No. 3	Cockle	15.00
84	1¼″	24″	12	B	No. 3	Comet	16.00
85	1½″	24″	12	B	No. 3	Conoid	16.00
86	1¾″	24″	12	B	No. 3	Clarion	20.00

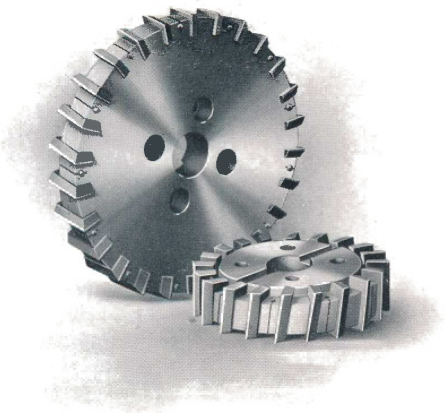
ARBORS FOR FACE MILLING CUTTERS—Style C.

No.	Diameter	B. & S. Taper Shank	Machine Where Used	Code Word	Net Price
43	1″	10	No. 1, No. 1½, No. 1½ Vertical	Cask	$5.50
44	1¼″	10	No. 1, No. 1½, No. 1½ Vertical	Casket	6.00
45	1½″	10	No. 1, No. 1½, No. 1½ Vertical	Casque	6.50
66	1″	11	No. 2, No. 2½ Vertical	Chisel	6.50
67	1¼″	11	No. 2, No. 2½ Vertical	Churn	7.00
68	1½″	11	No. 2, No. 2½ Vertical	Catnip	8.00
87	1″	12	No. 3	Cork	7.50
88	1¼″	12	No. 3	Coul	8.00
89	1½″	12	No. 3	Cream	8.50

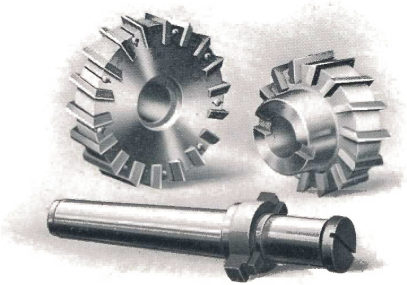
ROTARY TABLE ARBOR

This arbor is for holding and centering gears and similar work on Rotary Tables. The same arbor is used for all sizes of tables.

Diameter	Length from Shoulder to Nut	Code Word	Net Price
1″	6″	Rossel	$7.00



FACE MILLING CUTTERS
F26 and Larger



FACE MILLING CUTTERS
F15 and Smaller

Milling Cutters

Milling cutters with inserted teeth of high speed steel, adapted for use in connection with our Millers, have been a regular part of our product for some years. Their use has added to the popularity of our machines by increasing their output.

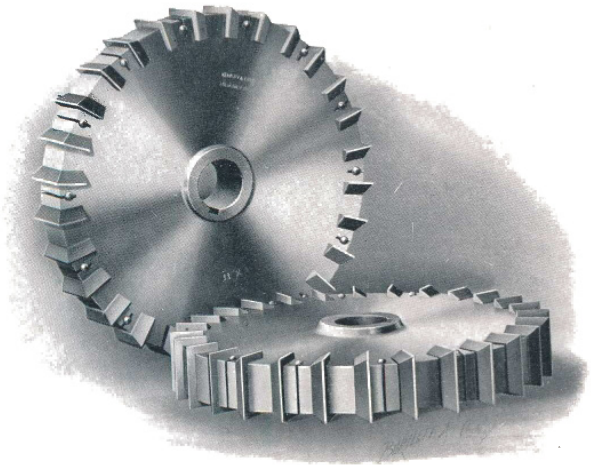
FACE MILLING CUTTERS—Use style C arbor, pages 68 and 69.

No.	Diameter	Face	Hole	Arbors for Millers			Code Word	Net Price
				No. 1, No. 1½, No. 1½ Vertical	No. 2, No. 2½ Vertical	No. 3		
F– 7	2½″	1½″	1″	43	66	87	Butter	$8.00
F– 8	2¾″	1½″	1″	43	66	87	Buttock	8.75
F– 9	3″	1½″	1″	43	66	87	Buxom	9.50
F–10	3½″	1½″	1″	43	66	87	Burg	10.25
F–11	4″	1½″	1¼″	44	67	88	Bumkin	11.00
F–12	4½″	1½″	1¼″	44	67	88	Bullion	11.75
F–13	5″	1½″	1¼″	44	67	88	Bumble	12.50
F–14	6″	1 9/16″	1½″	45	68	89	Bunion	14.00
F–15	7″	1 9/16″	1½″	.....	.....	89	Bureau	16.00

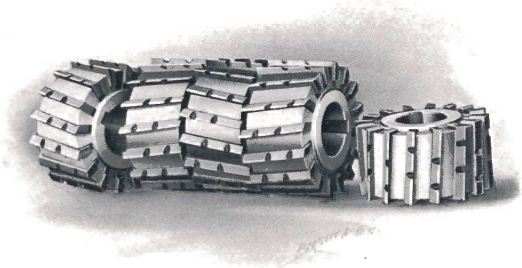
Face Milling Cutters

Carried directly by flanged spindle. Use spindle centering plugs, pages 68 and 69.

No.	Diameter	Face	Machine Where Used	Code Word	Net Price
F–26	6″	1 9/16″	No. 1, No. 1½, No. 1½ Vertical	Bumper	$14.00
F–27	7″	1 9/16″	No. 1, No. 1½, No. 1½ Vertical	Burgess	16.00
F–28	7″	1 9/16″	No. 2, No. 2½ Vertical	Bunch	17.00
F–29	8″	2″	No. 1, No. 1½, No. 1½ Vertical	Bunchy	18.00
F–30	8″	2″	No. 2, No. 2½ Vertical	Bulb	20.00
F–31	8″	2″	No. 3	Budget	20.00
F–32	10″	2″	No. 2, No. 2½ Vertical	Buckram	24.00
F–33	10″	2″	No. 3	Buffet	24.00
F–34	12″	2″	No. 3	Buckle	28.00



SIDE MILLING CUTTERS



SLAB MILLING CUTTERS

Side Milling Cutters

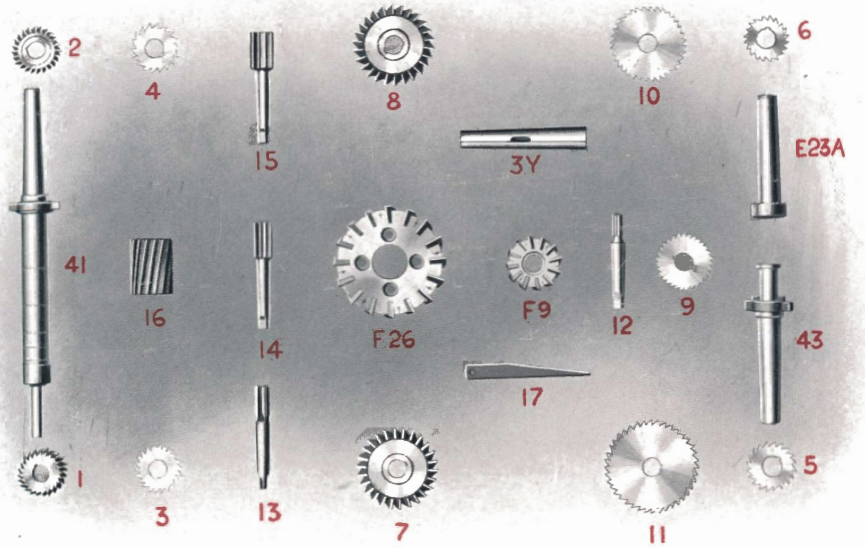
Side Milling Cutters are for use in facing both sides of a piece at once (in which case they are used in pairs), milling slots or for use in gangs. The hubs are 1-16″ shorter than the blades so that when used in connection with slab mills the blades will over-reach the smaller cutter producing a better result.

No.	Diameter	Face	Hole	Code Word	Net Price
S- 31	5″	1″	1″	Valor	$12.00
S- 32	5″	1″	1¼″	Valorous	12.00
S- 33	6″	1″	1″	Vanish	14.00
S-331	6″	1″	1¼″	Vanity	14.00
S-332	6″	1″	1½″	Vase	14.00
S- 34	7″	1⅜″	1″	Vanily	16.00
S- 35	7″	1⅜″	1¼″	Vandal	16.00
S- 36	7″	1⅜″	1½″	Vandalism	16.00
S- 37	7″	1⅜″	1¾″	Vane	16.00
S-371	8″	1⅜″	1″	Vaunt	18.00
S-372	8″	1⅜″	1¼″	Vell	18.00
S-373	8″	1⅜″	1½″	Vennel	18.00
S-374	8″	1⅜″	1¾″	Verger	18.00
S- 38	9″	1⅜″	1¼″	Valley	20.00
S- 39	9″	1⅜″	1½″	Valiant	20.00
S- 40	9″	1⅜″	1¾″	Vagrant	20.00
S-401	11″	1¾″	1¼″	Valance	24.00
S- 41	11″	1¾″	1½″	Vagary	24.00
S- 42	11″	1¾″	1¾″	Vale	24.00
S-421	13″	1¾″	1½″	Valencia	30.00
S- 43	13″	1¾″	1¾″	Vapor	30.00
S-431	15″	1¾″	1½″	Valerate	36.00
S- 44	15″	1¾″	1¾″	Vault	36.00

Slab Milling Cutters

These cutters are interlocking, each cutter being 1–16″ longer than the length given in the list so that if three cutters 2″ long were assembled on the arbor they would measure 6 1-16″ long over all and if a pair of our side cutters were used on each end the width of cut would be 6″. Where two or more are ordered they will be supplied alternately, right and left hand. Any exact length can be obtained by making one cutter special to fill out the required length.

No.	Diameter	Length	Hole	Code Word	Net Price
M-51	3¼″	1¾″	1″	Polygon	$7.50
M-510	3½″	1¾″	1″	Polemic	9.00
M-52	3½″	1¾″	1¼″	Polygram	9.00
M-520	4″	2″	1¼″	Potter	10.50
M-53	4″	2″	1½″	Pollard	10.50
M-530	4½″	2″	1¼″	Potony	12.00
M-531	4½″	2″	1½″	Pollux	12.00
M-54	4½″	2″	1¾″	Polyglot	12.00



SET OF TOOLS FOR No. 1 MILLERS

Set of Tools for No. 1 Milling Machines

The set of tools shown on the opposite page and listed below was selected with a view to an outfit that would be of real value and covers a wide range of work.

The larger cutters and those most likely to be used extensively are of special quality high speed steel. The balance are of carbon tool steel.

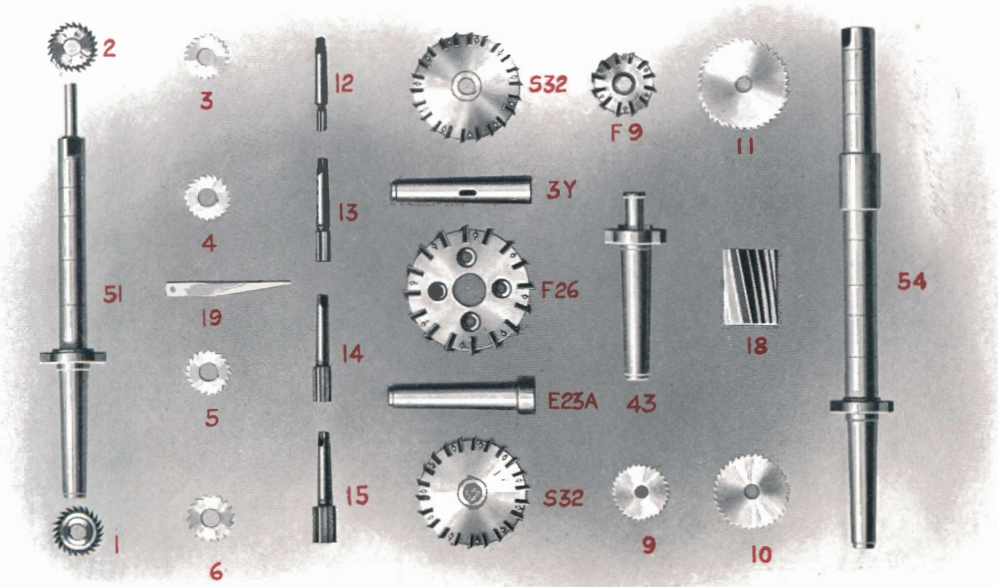
MILLING CUTTERS

No.	Style	Diameter	Face	Hole	Steel	Code Word	Price
1	60° L. H.	2¾″	½″	1″	Carbon	Hag	$2.00
2	60° R. H.	2¾″	½″	1″	"	Haft	2.00
3	Plain	2½″	¼″	1″	"	Hackney	1.00
4	"	2½″	⅜″	1″	"	Hackle	1.10
5	"	2½″	½″	1″	"	Hable	1.20
6	"	2½″	¾″	1″	"	Habnab	1.45
7	Side	4″	½″	1″	Speed	Habitat	6.65
8	"	4″	½″	1″	"	Haggard	6.65
9	Metal Saw	3″	1/16″	1″	Carbon	Haik	.70
10	"	4″	3/32″	1″	"	Hakot	.85
11	"	5″	⅛″	1″	"	Halcyon	1.00
12	End Mill	½″	1⅛″	No. 7 B.&S. Taper	"	Halibut	1.00
13	"	¾″	1⅝″	"	"	Halse	1.25
14	"	1″	1⅞″	"	"	Halter	1.45
15	"	1¼″	2″	"	"	Hamble	1.60
16	Spiral	2½″	3″	1″	Speed	Hallux	7.00
F 9	Face	3″	1½″	1″	"	Buxom	9.50
F26	"	6″	1-9/16″	1⅞″	"	Bumper	14.00

ARBORS, COLLETS, ETC.

17	Collet Drift	Haze	3.50
3Y	Collet, 7 x 10 B. & S. Tapers		
41	Style A Cutter Arbor, 1″ diameter, 8″ shoulder to nut	Cadet	7.00
43	Style C Face Mill Arbor, 1″ diameter	Cask	5.50
E23A	Spindle Centering Plug	Handsel	2.00

Price—Set complete....$70.00. Code Word.....Khanate. Unless whole set is taken, individual list prices apply.



SET OF TOOLS FOR No. 1½ SPECIAL MILLERS

Set of Tools for No. 1½ Special Milling Machines

The set of tools shown on the opposite page and listed below was selected with a view to an outfit that would be of real value and covers a wide range of work.

The larger cutters and those most likely to be used extensively are of special quality high speed steel. The balance are of carbon tool steel.

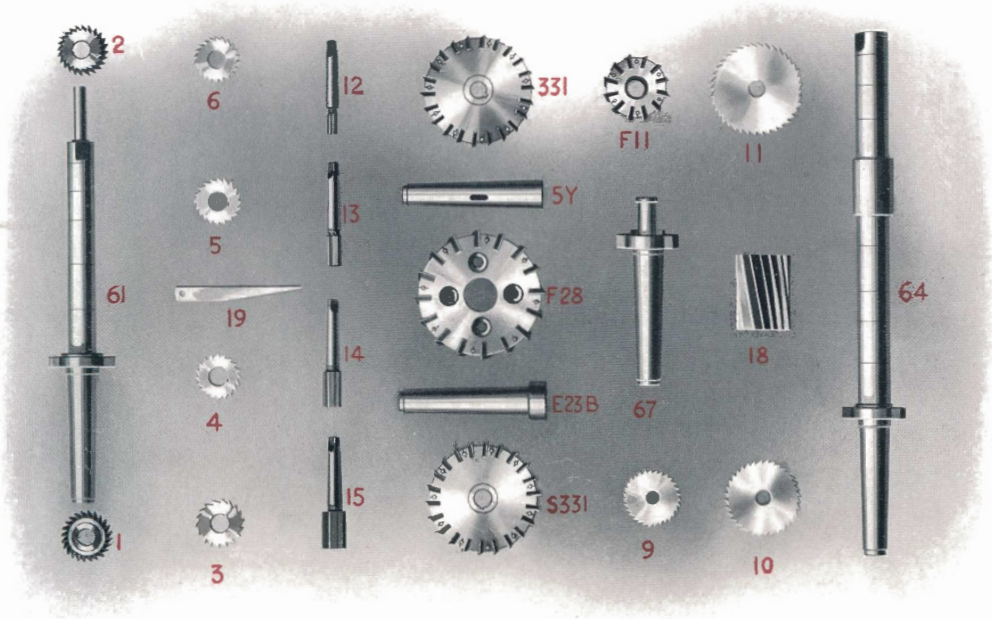
MILLING CUTTERS

No.	Style	Diameter	Face	Hole	Steel	Code Word	Price
1	60° L. H.	2¾″	½″	1″	Carbon	Hag	$2.00
2	60° R. H.	2¾″	½″	1″	"	Haft	2.00
3	Plain	2½″	¼″	1″	"	Hackney	1.00
4	"	2½″	⅜″	1″	"	Hackle	1.10
5	"	2½″	½″	1″	"	Hable	1.20
6	"	2½″	¾″	1″	"	Habnab	1.45
9	Metal Saw	3″	1/16″	1″	"	Haik	.70
10	"	4″	3/32″	1″	"	Hakot	.85
11	"	5″	⅛″	1″	"	Halcyon	1.00
12	End Mill	½″	1⅛″	No. 7 B.&S. Taper	"	Halibut	1.00
13	"	¾″	1⅝″	"	"	Halse	1.25
14	"	1″	1⅞″	"	"	Halter	1.45
15	"	1¼″	2″	"	"	Hamble	1.60
18	Spiral	2¾″	4″	1¼″	Speed	Hamate	10.00
S32	Side	5″	1″	1¼″	"	Valorous	12.00
S32	"	5″	1″	1¼″	"	Valorous	12.00
F 9	Face	3″	1½″	1″	"	Buxom	9.50
F26	"	6″	1 9/16″	1⅞″	"	Bumper	14.00

ARBORS, COLLETS, ETC.

17	Collet drift	Haze	3.50
3Y	Collet, 7 x 10 B. & S. Tapers		
51	Style A Cutter Arbor, 1″ diameter, 10″ shoulder to nut	Cape	8.00
54	Style B Cutter Arbor, 1¼″ diameter, 18½″ shoulder to nut	Cabin	13.00
43	Style C Face Mill Arbor, 1″ diameter	Cask	5.50
E23A	Spindle Centering plug	Handsel	2.00

Price—Set complete....$95.00. Code word.....Kraken. Unless whole set is taken, individual list prices apply.



SET OF TOOLS FOR No. 2 MILLERS

Set of Tools for No. 2 Milling Machines

The set of tools shown on the opposite page and listed below was selected with a view to an outfit that would be of real value and covers a wide range of work.

The larger cutters and those most likely to be used extensively are of special quality high speed steel. The balance are of carbon tool steel.

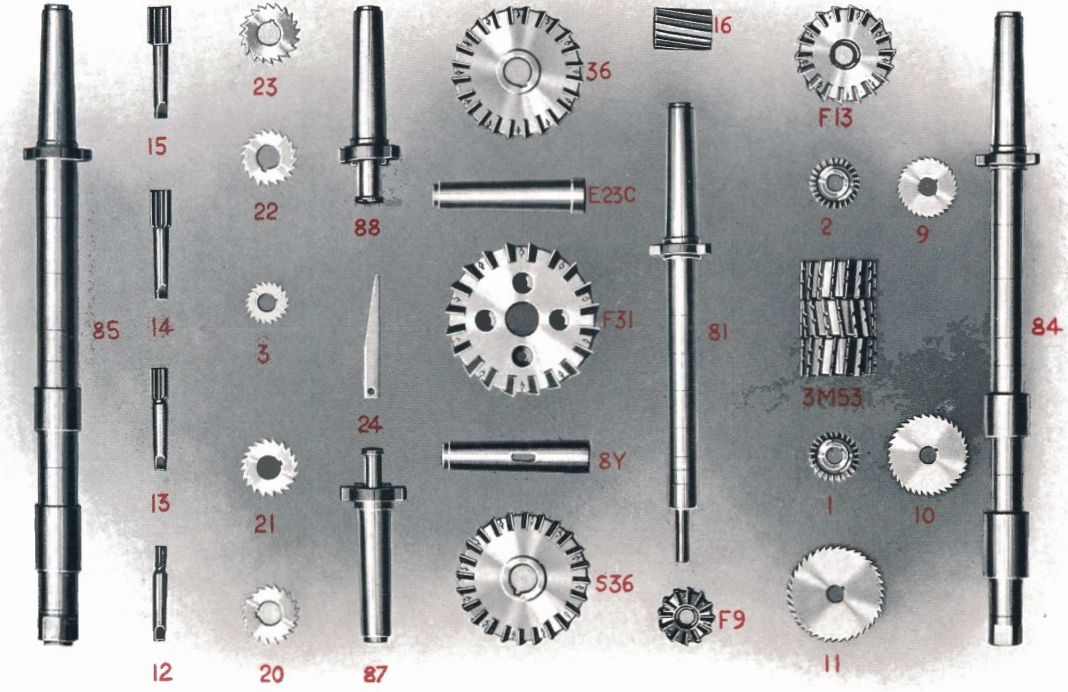
MILLING CUTTERS

No.	Style	Diameter	Face	Hole	Steel	Code Word	Price
1	60° L. H.	2¾″	½″	1″	Carbon	Hag	$2.00
2	60° R. H.	2¾″	½″	1″	"	Haft	2.00
3	Plain	2½″	¼″	1″	"	Hackney	1.00
4	"	2½″	⅜″	1″	"	Hackle	1.10
5	"	2½″	½″	1″	"	Hable	1.20
6	"	2½″	¾″	1″	"	Habnab	1.45
9	Metal Saw	3″	1/16″	1″	"	Haik	.70
10	"	4″	3/32″	1″	"	Hakot	.85
11	"	5″	⅛″	1″	"	Halcyon	1.00
12	End Mill	½″	1⅛″	No. 7 B.&S. Taper	"	Halibut	1.00
13	"	¾″	1⅝″	"	"	Halse	1.25
14	"	1″	1⅞″	"	"	Halter	1.45
15	"	1¼″	2″	"	"	Hamble	1.60
18	Spiral	2¾″	4″	1¼″	Speed	Hamate	10.00
331	Side	6″	1″	1¼″	"	Vanity	14.00
S331	"	6″	1″	1¼″	"	Vanity	14.00
F11	Face	4″	1½″	1¼″	"	Bumkin	11.00
F28	"	7″	1 9/16″	1⅞″	"	Bunch	17.00

ARBORS, COLLETS, ETC.

19	Collet Drift	Hound	4.50
5Y	Collet, 7 x 11 B. & S. Tapers		
61	Style A Cutter Arbor, 1″ diameter, 10″ shoulder to nut	Calf	9.00
64	Style B Cutter Arbor, 1¼″ diameter, 18½″ shoulder to nut	Chemist	14.00
67	Style C Face Mill Arbor, 1¼″ diameter	Churn	7.00
E23B	Spindle Centering Plug	Halser	2.50

Price—Set complete...$105.00. Code Word.....Khaya. Unless whole set is taken, individual list prices apply.



SET OF TOOLS FOR No. 3 MILLERS

Set of Tools for No. 3 Milling Machines

The set of tools shown on the opposite page and listed below was selected with a view to an outfit that would be of real value and covers a wide range of work.

The larger cutters and those most likely to be used extensively are of special quality high speed steel. The balance are of carbon tool steel.

MILLING CUTTERS

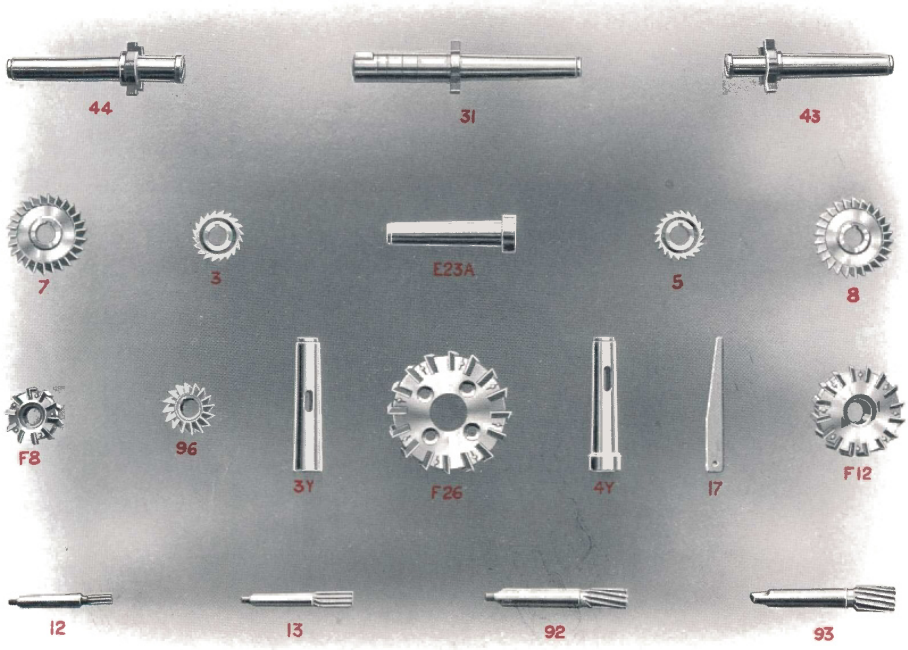
No.	Style	Diameter	Face	Hole	Steel	Code Word	Price
1	60° L. H.	2¾″	½″	1″	Carbon	Hag	$2.00
2	60° R. H.	2¾″	½″	1″	"	Haft	2.00
3	Plain	2½″	¼″	1″	"	Hackney	1.00
9	Metal Saw	3″	1/16″	1″	"	Haik	.70
10	"	4″	3/32″	1″	"	Hakot	.85
11	"	5″	⅛″	1″	"	Halcyon	1.00
12	End Mill	½″	1⅛″	No. 7 B.&S. Taper	"	Halibut	1.00
13	"	¾″	1⅝″	"	"	Halse	1.25
14	"	1″	1⅞″	"	"	Halter	1.45
15	"	1¼″	2″	"	"	Hamble	1.60
16	Spiral	2½″	3″	1″	Speed	Hallux	7.00
20	Plain	3″	⅜″	1¼″	Carbon	Haver	1.45
21	"	3″	½″	1¼″	"	Heath	1.65
22	"	3″	¾″	1¼″	"	Heben	2.00
23	"	3″	1″	1¼″	"	Helvine	2.50
36	Side	7″	1⅜″	1½″	Speed	Vandalism	16.00
S36	"	7″	1⅜″	1½″	"	Vandalism	16.00
3M53	Slab*	4″	6″	1½″	"	Pollage	31.50
F 9	Face	3″	1½″	1″	"	Buxom	9.50
F13	"	5″	1½″	1¼″	"	Bumble	12.50
F31	"	8″	2″	1⅞″	"	Budget	20.00

ARBORS, COLLETS, ETC.

24 8Y	Collet Drift Collet, 7 x 12 B. & S. Tapers	Hilt	$5.50
81	Style A Cutter Arbor, 1″ diameter, 12″ shoulder to nut	Clevis	10.00
84	Style B Cutter Arbor, 1¼″ diameter, 24″ shoulder to nut	Comet	16.00
85	Style B Cutter Arbor, 1½″ diameter, 24″ shoulder to nut	Conoid	16.00
87	Style C Face Mill Arbor, 1″ diameter	Cork	7.50
88	Style C Face Mill Arbor 1¼″ diameter	Coul	8.00
E23C	Spindle Centering Plug	Hanse	3.00

Price—Set complete....$175.00. Code Word.....Kiblah. Unless whole set is taken, individual list prices apply.

*This cutter consists of three M53 as listed on page 73 and additional units can be added if desired.



SET OF TOOLS FOR No. 1½ VERTICAL MILLERS

Set of Tools for No. 1½ Vertical Milling Machines

The set of tools shown on the opposite page and listed below was selected with a view to an outfit that would be of real value and covers a wide range of work.

The larger cutters and those most likely to be used extensively are of special quality high speed steel. The balance are of carbon tool steel.

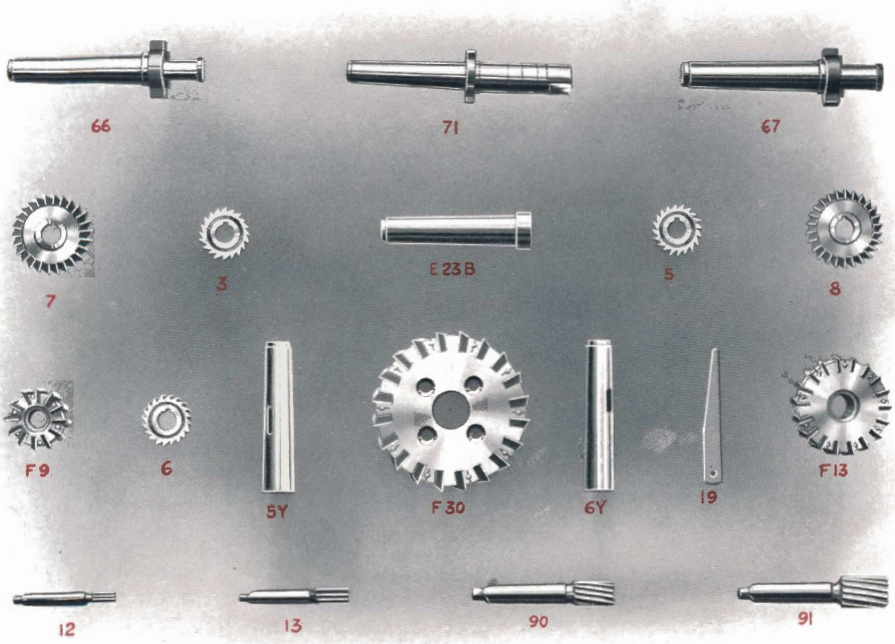
MILLING CUTTERS

No.	Style	Diameter	Face	Hole	Steel	Code Word	Price
3	Plain	2½″	¼″	1″	Carbon	Hackney	$1.00
5	"	2½″	½″	1″	"	Hable	1.20
7	Side	4″	½″	1″	Speed	Habitat	6.65
8	"	4″	½″	1″	"	Haggard	6.65
12	End Mill	½″	1⅛″	No. 7 B.&S. Taper	Carbon	Halibut	1.00
13	"	¾ "	1⅝″	"	"	Halse	1.25
92	"	1″	1⅞″	No. 9 B.&S. Taper	Speed	Halberd	3.50
93	"	1¼″	2″	"	"	Haddock	4.10
96	Shell End Mill	2¼″	2¼″	1″	"	Habit	6.50
F 8	Face	2¾″	1½″	1″	"	Buttock	8.75
F12	"	4½″	1½″	1¼″	"	Bullion	11.75
F26	"	6″	1 9/16″	1⅞″	"	Bumper	14.00

ARBORS, COLLETS, ETC.

3Y	Collet, 7 x 10 B. & S. Tapers	Haze	3.50
4Y	Collet, 9 x 10 B. & S. Tapers	Hazel	4.00
17	Collet Drift. Included with above collets		
31	Style B Cutter Arbor, 1″ diameter, 3½″ shoulder to nut	Cage	6.00
43	Style C Face Mill Arbor, 1″ diameter	Cask	5.50
44	Style C Face Mill Arbor, 1¼″ diameter	Casket	6.00
E23A	Spindle Centering Plug	Handsel	2.00

Price—Set complete....$85.00. Code Word.....Knack. Unless whole set is taken, individual list prices apply.



SET OF TOOLS FOR No. 2½ VERTICAL MILLERS

Set of Tools for No. 2½ Vertical Milling Machines

The set of tools shown on the opposite page and listed below was selected with a view to an outfit that would be of real value and covers a wide range of work.

The larger cutters and those most likely to be used extensively are of special quality high speed steel. The balance are of carbon tool steel.

MILLING CUTTERS

No.	Style	Diameter	Face	Hole	Steel	Code Word	Price
3	Plain	2½″	¼″	1″	Carbon	Hackney	$1.00
5	"	2½″	½″	1″	"	Hable	1.20
6	"	2½″	¾″	1″	"	Habnab	1.45
7	Side	4″	½″	1″	Speed	Habitat	6.65
8	"	4″	½″	1″	"	Haggard	6.65
12	End Mill	½″	1⅛″	No. 7 B.&S. Taper	Carbon	Halibut	1.00
13	"	¾″	1⅝″	"	"	Halse	1.25
90	"	1¼″	2″	No. 9 B.&S. Taper	Speed	Hand	4.10
91	"	1⅝″	2⅜″	"	"	Hank	5.95
F 9	Face	3″	1½″	1″	"	Buxom	9.50
F13	"	5″	1½″	1¼″	"	Bumble	12.50
F30	"	8″	2″	1⅞″	"	Bulb	20.00

ARBORS, COLLETS, ETC.

5Y	Collet, 7 x 11 B. & S. Tapers	Hound	4.50
6Y	Collet, 9 x 11 B. & S. Tapers	Hero	5.00
19	Collet Drift. Included with above collets		
71	Style B Cutter Arbor, 1″ diameter, 3½″ shoulder to nut	Camel	7.00
66	Style C Face Mill Arbor, 1″ diameter	Chisel	6.50
67	Style C Face Mill Arbor, 1¼″ diameter	Churn	7.00
E23B	Spindle Centering Plug	Halser	2.50

Price—Set complete....$95.00. Code Word.....Karob. Unless whole set is taken, individual list prices apply.

U. S. Patents

February 9, 1904—Box section knee without slotted top.
October 23, 1906—Automatic Lubrication.
June 13, 1911—Cutter lubricant return.
March 12, 1912—Spindle drive gearing.
February 18, 1913—Flanged spindle.
February 18, 1913—Double over arm.
June 24, 1913—Vertical spindle head lubrication.

Other Patents Pending