Instructions
For Erecting and Operating
"AMERICAN"
Lathes, Planers, Shapers,
Radial Drills

Instructions
for Erecting and Operating
THE AMERICAN
Lathes, Planers, Shapers
Radial Drills

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THE AMERICAN TOOL WORKS CO.

Builders of Modern High Duty

LATHES, PLANERS
RADIAL DRILLS
SHAPERS

For Rapid Work Production

Main Office and Works

CINCINNATI, U. S. A.

Cable Address: LATHE, CINCINNATI

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Contents

Introduction

THE majority of machine tools installed in machine shops do not produce accurate work. This statement may seem rather startling to you, but nevertheless, it is an absolute fact. This condition is caused in a great majority of cases by the lack of realization on the part of the user of the importance of setting a machine tool level.

Simply because a machine is set upon a stone or concrete foundation is by no means assurance of its being level; nor is the fact that it is exceptionally heavy and rigid any reason for its being level. We have had customers exhibit considerable surprise when told to level a large lathe; they thought that, because the lathe was heavy and the bed contained lots of metal, the machine would naturally assume a level position. That idea or belief is absolutely wrong. Cast iron will deflect, will warp and twist, if set upon an unlevel foundation, and inasmuch as no foundation is absolutely level, the lathe bed will invariably assume the inaccuracies of the foundation, consequently the longer the bed the more liability to twist.

Some people are so skeptical about this that a plain statement of the fact does not seem sufficient to convince them. These are the people we are trying to reach by this effort, for they are the ones who have the most trouble, lose the most time, and put the manufacturer to considerable expense in convincing them. For example: A short time ago we had a complaint from one of our customers that the "American" lathe he had just received did not bore or turn true. Assuming what the trouble was, for we knew the machine was thoroughly accurate when it left our plant, and our test records substantiated this, we explained to our customer what we believed the trouble to be, and told him, in addition to the instructions sent with the lathe just how to level up his machine to overcome the difficulty. He wrote back that he knew how to level a lathe, the machine was in perfect level, and the trouble was caused by the lathe being improperly aligned. We knew, of course, that the lathe was in perfect alignment, for we had records to prove it, consequently, as a last resort,

we sent him one of our own leveling and testing equipments, with a repetition of the instructions already given, with the final result as indicated by the following paragraph from our customer's last letter on the subject:

> "In reply to yours of May 3rd we are pleased to inform you that we have tested out the 24″ "American" Lathe with the tools and equipment which you sent us, and find that the lathe comes up to your guarantee."
>
> "The trouble we found with this lathe was in leveling of same, there being a slight twist in the frame, which did not show up with the level which we had for setting this lathe."

Frequent tests of the alignment should be made, for vibration of buildings and the shifting nature of the soil under foundations often cause objectionable deflections in the machines after they are accurately installed, and on long or massive concrete foundations the drying out process often causes them to deflect, and to guard against this, the foundations should be prepared as far in advance of the machine delivery as possible.

We want to impress upon the minds of all lathe users the fact that we have been building machine tools for thirty years, and that our statements are backed up by a practical knowledge gained during this period. We have found from our long experience that the ones who have the most complaints to make are those who either think they know more than we do about machine tools, or do not take the trouble to read the instructions we furnish for setting up and operating our machines.

If our statements so far have been pointed and stripped of diplomacy, it is not from a desire to offend, but from our determination to bring the reader to a realization of the importance of the following suggestions to the satisfactory installation of a machine tool.

Unpacking and Cleaning

UPON arrival, the machine should be carefully uncrated or unboxed, as the case may be, by dependable workmen. Care should be exercised by them in removing the packing, to avoid scratching or otherwise marring the exposed bearing surfaces of the machine, and also to preserve the general finish, so as not to mar the appearance of the tool.

After being unpacked, the machine should be subjected to a thorough cleaning. The slush which is applied to all exposed finished surfaces, to protect them from rust in transit, should be thoroughly removed with gasolene or benzene. Under no circumstance should this slush be allowed to remain after the machine is put into service, for it will undoubtedly interfere with its operation.

Be absolutely sure that every oil duct and chamber is perfectly free from dirt and that all ducts offer a clear passage for the oil. Wash every oil duct out with gasolene or kerosene. If there is any dirt or gummed oil in the ducts or bearings, the gasolene will remove it.

After thoroughly cleaning the oil passages and bearings, fresh, clean oil should be introduced.

Installation

THE proper installation of a machine tool is one of the prime essentials to its satisfactory operation. No machine, no matter how fine its workmanship, or how efficient its design, can produce results if installed upon a poor foundation, or if imperfectly leveled.

Foundation The best foundation is never too good for a high grade machine tool. Because of its extreme accuracy it is very sensitive to twists or winds, which invariably destroy the nicety of alignment and precision so essential to a high grade machine. Therefore install the machine on a good solid stone or concrete foundation, if possible, bearing in mind that the machine will remain true longer, and do better work, if placed on a thoroughly substantial foundation.

Leveling Leveling is unquestionably one of the most important features of proper machine tool installation. How can anyone expect a mechanism so extremely sensitive and accurate as a machine tool to retain its accuracy, if it is not perfectly level? One would imagine that every shop superintendent and every machine operator would realize the necessity of keeping machine tools level, but unfortunately such is not the case. It is astonishing the number of complaints machine tool builders receive from customers about their machines being inaccurate, when investigation proves that nothing under the sun is wrong with the machine except it is out of level.

Never try to level a machine tool with a short machinist's or carpenter's level. They are not sufficiently sensitive, and positively will not produce results. A first class metal level, about 18 inches long, with graduated glass (such as made by Queen & Co., of Philadelphia, Pa., Fig. No. 1), must be used.

In leveling machines it is usually the custom to use wooden wedges, which are driven under the legs until the correct results are obtained, then in order to maintain these results metal wedges or shims should be placed alongside of the wooden wedges to retain the level, because

the wood will become compressed, and is subject to the action of moisture and oil, which often deflects a machine which is carefully aligned, especially the heavy ones. When leveling a long bed, especially the two-piece machines, care must be used to prevent the distortion of the vees out of a straight line sidewise. The use of crow bars, and heavy sledge hammers on wedges is frequently responsible for this trouble, as cast iron is easily sprung out of shape, especially long pieces. The wedges should be driven in alternately, on opposite sides of the bed to reduce the twisting tendency, and lift the bed parallel.

Fig. No. 1—Queen Level

Lubrication an Absolute Necessity

KEEP YOUR MACHINE WELL OILED. If long life and satisfactory operation are expected of a machine tool it **must** be kept thoroughly lubricated. A dry bearing will run hot, cause delay and expense every time.

Impress upon your operator the absolute necessity of thoroughness in oiling his machine. If there are 50 oil holes provided be sure to oil 50 holes and not 49 or 48. Every oil hole is put there for a definite purpose and if one hole is slighted, some part of the machine will suffer as a consequence.

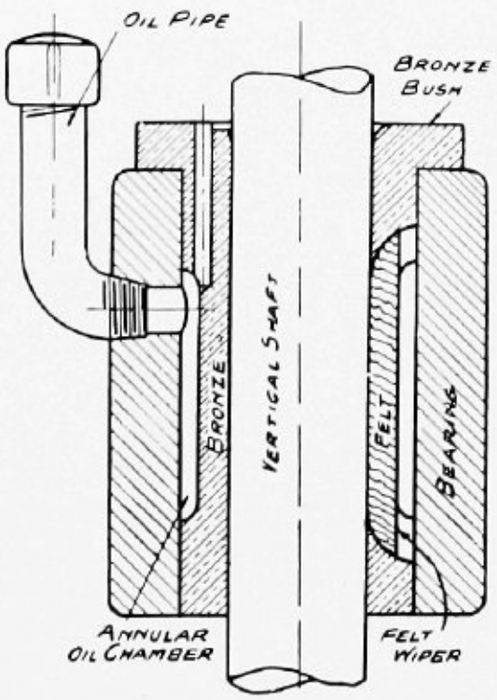

Fig. No. 2—Oiling Diagram

Proper lubrication does not consist only of supplying oil to the bearings at required intervals, but of supplying **Good Oil.** There is a vast difference in the lubricating efficiency of oils. High grade oils are rich in lubricating properties while the reverse is true of the inferior grades. **Therefore use good oil.** It is far more economical in the end.

Many important cylindrical bearings of "American" Tools are designed with an oil reservoir, to store a large quantity of oil. (See Fig. No. 2.)

The oil is introduced into the gravity pipe, frequently located a considerable distance from the bearing proper, consequently some little time is required for the oil to reach its reservoir. We must therefore caution operators not to introduce the oil too freely, because, if they do, it will likely fill up the oil passage and overflow before the oil has a chance to reach the reservoir; then the operator thinking the bearing is full of oil, will pass on to the next one, when in reality only a very small amount of oil reaches the reservoir, and does not fill it up by any means.

The best way to avoid such an occurrence is to put as much oil as you think possible into a bearing, then pass on to the next one, and when you think that is full return to the first bearing and see if it will hold any more.

The operating parts of any new machine do not work as freely at first as they will later on, after the machine has been in use for a while. There is a certain stiffness of movement which appears in the operation of all new machines, and while such stiffness will gradually disappear, yet the attainment of a perfect working condition will be hastened by the constant application of oil to the moving parts and by careful operation of the machine under easy working conditions during the first few days after it has been installed.

Upon its arrival, the machine should be **properly cleaned,** every oil hole should be washed out with gasolene or kerosene, and then every oil hole and running bearing should be thoroughly filled with a first class grade of engine oil. Not only at the installation, but at intervals later on, it is necessary to clean out the oil holes and give them an entirely fresh supply, as the old oil becomes clogged and gummed and its passage is impeded. Lard oil should not be used on internal parts, but is satisfactory for use on exposed surfaces.

On gearing, such as feed gears, motor drive connecting gears, etc., a heavy grease should be used to reduce noise and produce smooth running gearing under high speeds and heavy duty. The lighter oils quickly run off and the gears running in a dry state soon wear on the teeth unless oiled occasionally.

Tool Grinding

TOOL Grinding is a subject which, due to its magnitude, cannot possibly be treated in a pamphlet of this kind, but is of such vast importance to the machine tool user that we feel a paragraph should be devoted to cautioning them to be sure their cutting tools are properly ground.

Many evils result from improper grinding, chatter, waste of power, breakage of tools, gouging of work, spoling of threads, and many other such disasters are constantly occurring from improperly ground cutting tools.

If not thoroughly familiar with the angles of rake and clearance required for cutting various metals, a careful study should be made of this subject before attempting to operate a machine tool. If any user, desiring specific information in regard to the grinding of tools for any certain job will explain the conditions to us, we shall be glad to give him the information he desires.

Repair Parts

THE installation of repair parts should be very carefully made, and at that time, an inspection of the adjacent parts should be made to ascertain whether they are in the proper shape to work in conjunction with the new part, because when one part breaks, it frequently strains another part and cracks develop which later cause the breakage of the part under heavy service.

How to Install a Lathe

THE first and most important thing to be done is to **set the lathe level.** To do this it is absolutely essential to use a good, accurate level. If you don't use the right kind of level, you can't possibly obtain the results you must have to secure accurate work. A short machinist's or carpenter's level will not answer; a sensitive metal level at least 18 inches long, with a graduated glass, such as made by Queen & Company, of Philadelphia, must be used. After the lathe is placed in position it must be leveled both lengthwise and crosswise, as a slight twist in the bed will deprive the carriage of its proper bearing thereon, thereby causing chatter and the production of inaccurate work. To do this a level reading must be taken in at least two positions crosswise to the bed, at both head and tail end, and one reading parallel to the Vees at about the center. (See illustration No. 3.) If the level shows the lathe to be low at the front head end, then a wooden wedge must be forced under the front leg to raise that part of the bed to the proper height. (See illustration.) The number of points where wedges must be used depends entirely upon how the lathe rests upon the foundation. Sometimes only one wedge is required, while at others wedges may be necessary under all four legs.

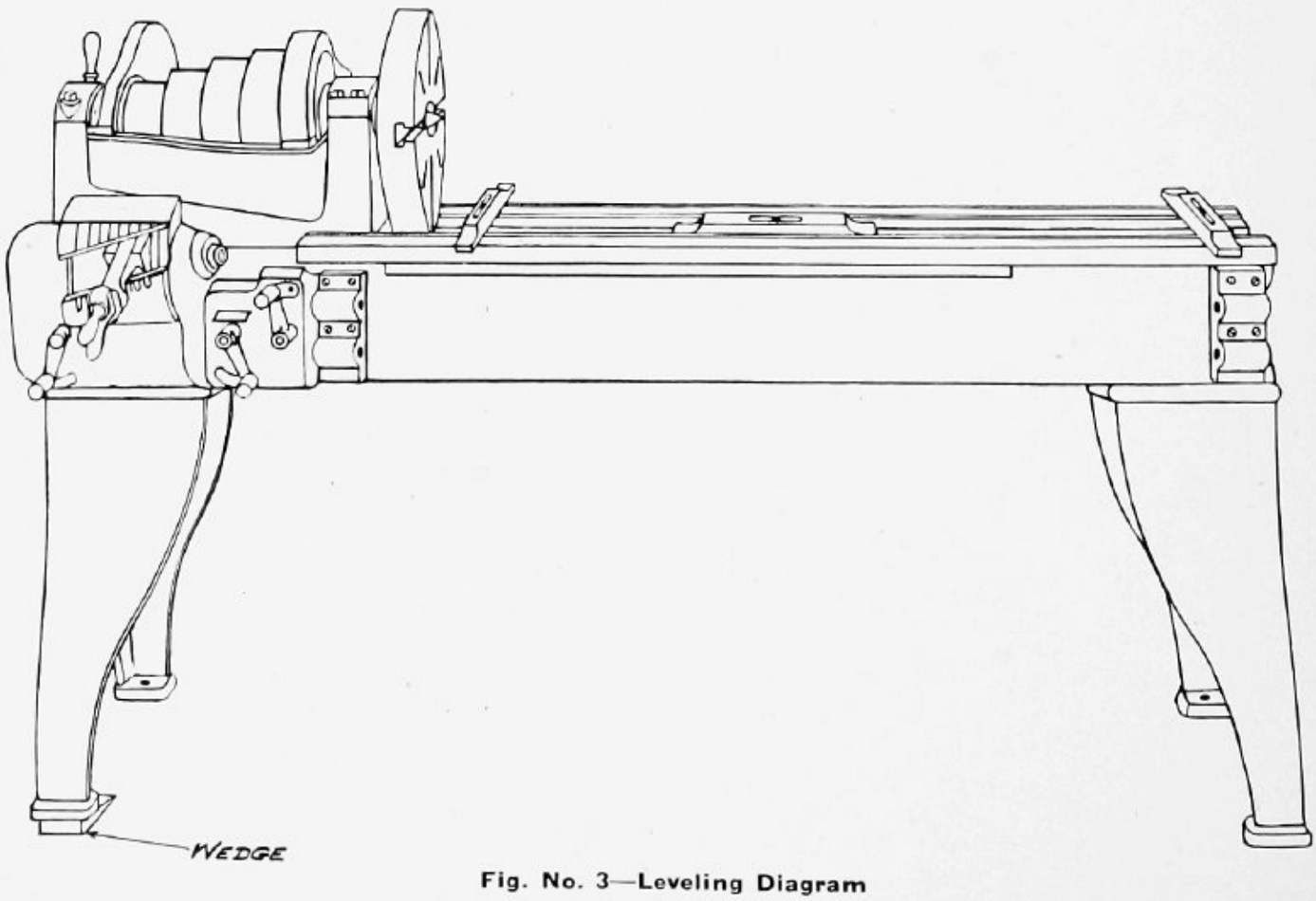

Fig. No. 3—Leveling Diagram

After the lathe has been carefully leveled the wedges should be replaced by metal blocks of the correct height.

Do not screw the lathe down to the floor. Lag screws should be used only to keep the machine in place on a leveling block, and should not be drawn down tightly, as this tightening tends to throw the bed out of level. Where lathes can be set on foundations it is neither necessary nor advisable to bolt them down.

When machines exceed about 30 ft. in length it is necessary to construct them in two or more sections, which are joined together by draw bolts, the joints being faced and scraped to fit properly before leaving the factory, so that the vees will present a continuous bearing for the carriage and tailstock, forming the equivalent of a one piece bed. When shipped they are disconnected.

When the parts are to be re-assembled they should be very carefully cleaned on the faces, and the draw bolt holes should be flushed out with gasolene. Then the two faces should be examined to see that no burrs were raised when shipping. Next the opposing faces should be brought together metal to metal and located very carefully, both in line and level, so as to bring the bolt holes in line. Then insert the two aligning pins sent with the machine, and carefully re-align the beds until the pins can be inserted and removed freely at each hole, then the bolts should be inserted carefully and the nuts drawn up uniformly on all of them, and after a final inspection the nuts should be drawn down tight.

After the two sections are properly aligned, the middle leg at the joint should be carefully wedged up to take the strains off the joint bolts.

Caution. Under no circumstances must any shims or packing be used between the bed sections, as they are fitted so as to come together "metal to metal" when properly aligned. Also do not force the bolts through the joint as this will bend them and cause a distortion of the bed and throw it out of line.

It is absolutely necessary, if accurate work is to be produced, for the spindle bearings to be properly set, for the chuck to be correctly fitted, and for the cutting tool to be rightly ground.

The spindle bearings on "American" lathes are thoroughly inspected and correctly adjusted before the machines leave our plant, consequently it is unnecessary for the customer to disturb these bearings when the lathe is received. We know of cases where the customer, either to assure himself of the bearings being clean, or for the purpose of inspecting the bearing

surfaces, has removed the spindle bearing caps, and then, because chatter, excessive wear and imperfect work resulted from his incorrectly replacing these caps, condemned the lathe, and put the manufacturer to considerable expense and annoyance to remedy the condition for which the customer himself was entirely responsible.

Do not remove the spindle bearing caps. They are already adjusted, and should not be touched until natural wear or the work demands it, and even then a slight tightening or loosening, as the conditions require, will be sufficient.

When a spindle becomes too loose in its bearings, some readjustment of the cap must be made, and this should be done in the following manner:— The caps are clamped down "metal to metal" on the head housings with laminated brass shims between them. The laminated shims are lightly soldered together in five layers, each of about 2/1000″ in thickness, and, in order to separate them, a knife should be used to loosen a layer by starting at a corner and then peeling it off, removing an equal amount on each side of the bearing. When the amount to be removed is more than 2/1000″ and less than 4/1000″ the difference should be made up by scraping the top of head housing where the shims are fitted. This also applies to instances where less than one shim thickness is to be removed.

When clamping a spindle cap the bolts on one side should not be pulled down tight before the opposite ones are adjusted. The best method is to alternately adjust the two screws diagonally opposite; this centralizes the cap and removes any cramping tendency. Then set the remaining screws.

The amount of running clearance in a bearing should be regulated to suit the nature of the work, as high speed work requires more freedom to allow for any heat generated which would expand the spindle, squeeze out the oil, and cause it to cut in the bearing.

The fitting of a chuck or spindle nose fixtures by a customer is often the source of inaccurate work. We much prefer to have all chucks and fixtures fitted by our experts before the lathe is shipped, for we not only thoroughly understand this work, but have hardened and ground masters to work to. When a customer fits a chuck or fixture, and does not secure a perfect fit between fixture and spindle nose, inaccurate work is sure to be the result.

Please understand that we do not make chucks, consequently cannot assume responsibility for inaccuracies that may exist in the chuck. We guarantee the alignments of our lathes, consequently in testing a lathe for

alignment the chuck should be removed, for there is always a possibility of the chuck being inaccurate, due to the possibility of the jaws distorting in the process of hardening, and to an improper fitting of a chuck by the customer. When chuck plates are fitted to the lathe spindles by us for customers to fit their chucks to, it is necessary to take a cut off the diameter to match chuck recess, and it is well to take a light skim cut across the face to insure correct alignment when in position on the spindle. When mounting a chuck on a triple geared lathe, it should be bolted to the main face plate, using a thin chuck plate between the main face plate and the chuck. The face plate should be bored out true at the spindle opening and the chuck plate hub fitted to this recess; then, after fitting diameter to chuck, pass the holding screws through the chuck and its plate into the main face plate.

When mounting chucks on smaller lathes, it is preferable to buy a chuck with a large hole through its body, as this will permit the hub of the chuck plate to enter the opening, and allow the chuck to come closer to the shoulder on the spindle, as the plate is screwed on the spindle nose with the hub out.

Probably the most common cause of chatter and inaccuracy in work is the use of an incorrectly ground cutting tool. The rake and clearance angles of a cutting tool should be governed by the nature of the material to be cut and the kind of a cut to be taken; whether cast iron, steel or bronze, and whether a heavy roughing cut, a medium cut, or a light cut.

The subject of tool grinding is far too extensive to even touch upon here, but, unless someone in your plant is fairly familiar with this subject, we suggest an immediate study of the authoritative works on tool grinding, for quite frequently the most serious ailments of a machine shop can be easily remedied by correct tool grinding.

If your lathe chatters and produces inaccurate work, do not immediately condemn the machine and blame the manufacturer, but first be sure that your operator is a thoroughly competent and reliable man, then make a thorough investigation to determine whether or not one or more of the conditions herein mentioned is not causing the difficulty.

Frequently customers complain about chatter, especially on cutting off and facing work which is held in a chuck, and in practically every instance, it is caused by faulty manipulation of the machine.

The following are among the principal causes of chatter:—

Front spindle bearing cap too loose, or improperly adjusted.

Chuck overhung too far beyond spindle nose.

Top slide of tool rest overhung too far.

Tool set too low, or not enough top clearance to roll the chips properly.

Tool overhung too far, or not set square with the work axis.

Gibs too loose in compound rest slides.

If these points are taken care of they will usually overcome any tendency to chatter.

An occasional inspection of the lead screw should be made, especially the thrust collars and adjusting nuts.

Stop the spindle, close the half nuts upon the lead screw, and then with the handwheel on the apron attempt to move the lead screw endwise, if any noticeable amount of end play is found, this should be taken up by a re-adjustment of the two round nuts on the screw just outside of feed box. This end play is often responsible for the inaccuracies in threads which are cut.

It is certainly to your advantage to discover the trouble, and remedy it yourself, if possible, for correspondence with the manufacturer takes time, and is not always satisfactory, owing to the difficulty of making letters sufficiently clear to give the manufacturer a thorough understanding of the situation.

Countershaft should be placed in position according to foundation plan, with arms toward line shaft. Fill the boxes and pulley bearings with good engine oil, for which liberal reservoirs are supplied. Oil these parts once a day for the first week, after which time once a week will usually suffice.

A good grade of double belting should be used, both for the machine and overhead shafting. Belt should be kept somewhat loose for the first few days. A few applications of a good belt dressing to the **back** of the belt will aid in making it more pliable, after which it can be tightened and preferably made endless.

Operation of Quick Change Gear Mechanism

Gear Box The changes of feed for threading or turning are made by manipulating the sliding tumbler in combination with the two levers on the box. The positions are clearly noted upon the index plate directly over the tumbler. This index plate is **direct reading,** and all that is necessary is to locate the sliding tumbler under the column showing the desired thread and then set the two levers to the letters as shown in right hand column of the plate directly opposite the thread to be cut.

Two gears are supplied for use on the end of gear box and stud on the headstock, which are used to modify the range of threads or feeds obtained through the sliding tumbler and the levers and produce both coarse and fine feeds of the wide range shown. The left hand column shows the position of gears for the threads desired. A reverse plate located between the stud on headstock and the spindle gear, is used to reverse the direction of lead screw for cutting left hand threads, etc.

It will be noted that some of the most frequently used threads and feeds are duplicated upon the index plate. This is provided so that these threads may be obtained at once without making any change of the gear setting.

Many errors in thread cutting are caused by the improper methods used in measuring threads, and frequently from the incorrect designation of the threads to be cut. All threads should be measured and designated as follows:—For example:—

The pitch of a V thread is the distance from the top of one thread to the top of the next one, measured parallel to the axis of the screw. The lead of the thread is the advance per turn of the screw regardless of the pitch, and on double, triple, and multiple threads, these terms are most frequently confused. On a "4 pitch" double thread screw the pitch is $\frac{1}{4}''$ and the lead is $\frac{1}{2}''$, on a triple thread screw, the pitch would remain $\frac{1}{4}''$, while the lead is $\frac{3}{4}.''$

Another source of error is the use of pitch as a substitute for "threads per inch" on single and multiple thread screws, and in designating the threads to be cut, the correct expression to use is "4 threads per inch single," or $\frac{1}{4}''$ pitch single, or $\frac{1}{4}''$ pitch, $\frac{1}{2}''$ lead double, etc., as the case may be.

On acme or square threads, the same method of measuring them is used except that the measuring point is from one side of one thread to the same side of the next one, and the terms "pitch" and "lead" are used in the same sense as for V threads. (See illustration No. 4.)

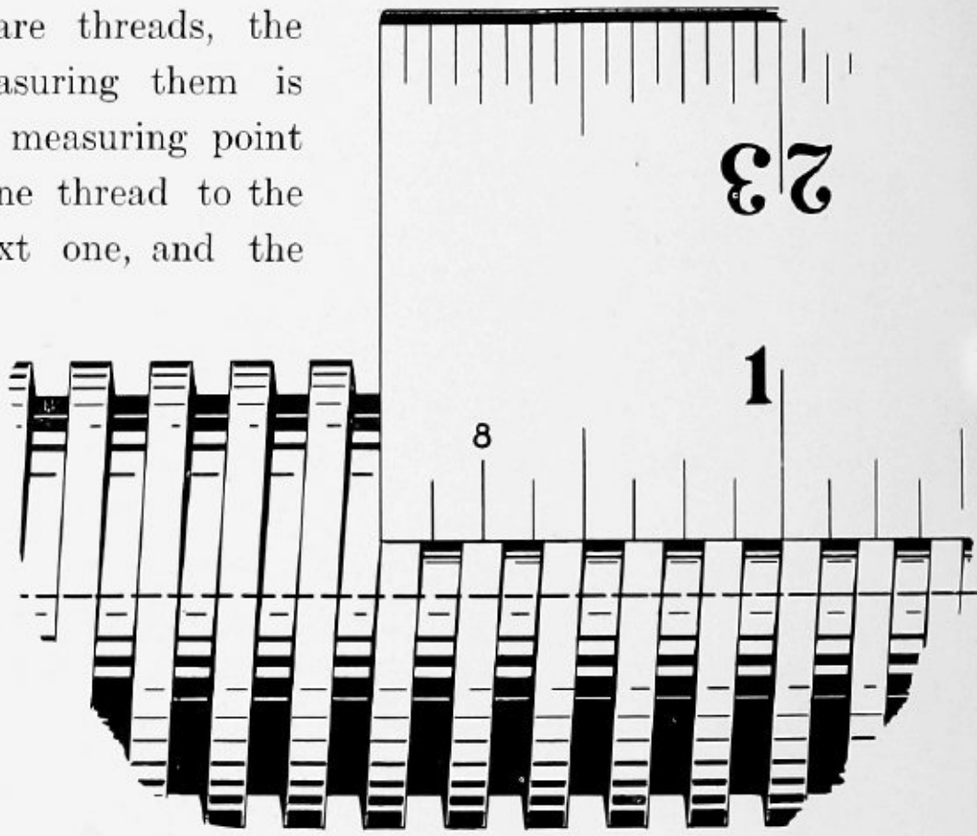

Fig. No. 4.—

Special Threads It may be found necessary occasionally to cut odd or special threads not included in the regular thread range. This can be accomplished on the "American" High Duty Lathe by adding whatever gear or gears are necessary to produce the desired thread to the quadrant at the headstock end of bed. (Fig. No. 5.) Formula for determining the proper gear or gears for producing a given thread is given herewith, in which the selected thread represents any thread included in the regular range, selected as a basis from which to work:

$$\frac{\text{Selected Thread}}{\text{Required Thread}} \times \frac{\text{30 Tooth Gear on Stud}}{\text{60 Tooth Gear on Box}} = \frac{A}{B}$$

or the ratio of the new gears which must replace the 30 and 60 tooth gears regularly provided. If by using this formula, the required gears are found to be either too large or too

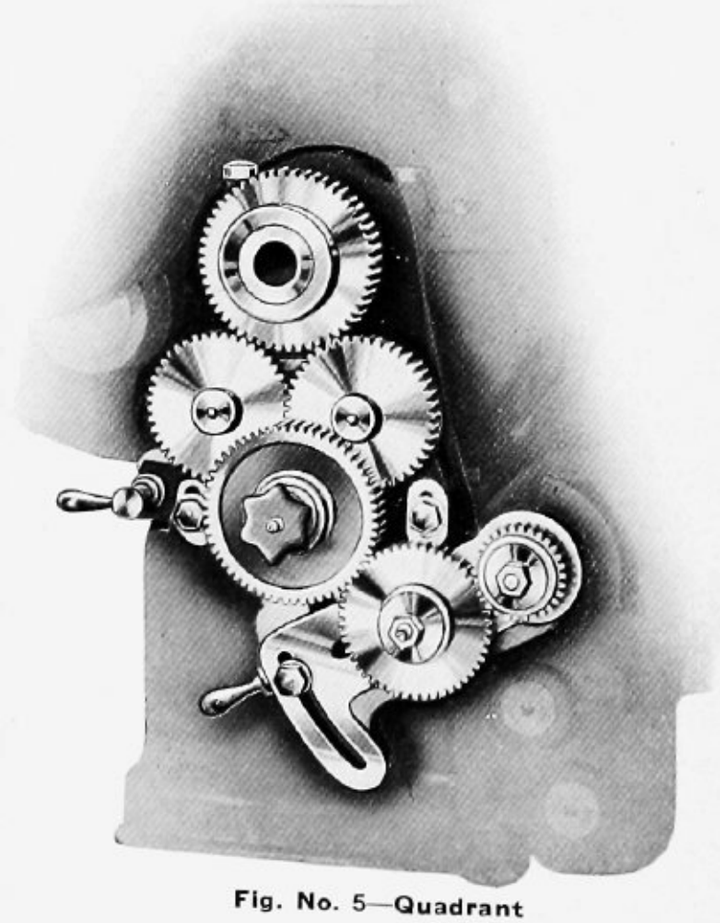
Fig. No. 5—Quadrant

small to be practical, select another thread as a basis and the results may be more satisfactory.

Concrete Example Suppose you wanted to cut 27 threads per inch which is not listed on the index plate. First you select some standard thread in the regular range, say 36 threads per inch, then by following the formula, you get $\frac{36 \text{ Threads}}{27 \text{ Threads}} \times \frac{30 \text{ T Gear}}{60 \text{ T Gear}} = \frac{2}{3}$; $\frac{2}{3}$ then is the ratio of the new gears required. Now the 30T and 60T gears are regularly furnished; therefore, if you can use either of them in the new train, it is advisable to do so. In this case you can do so by multiplying both factors by 20: $\frac{2}{3} \times 20 = \frac{40}{60}$. The gears then necessary to produce 27 threads are 40T on the stud and 60T on the box. The 60 tooth gear, however, is already furnished, consequently it is only necessary to obtain a 40T gear, add it to the stud in place of the regular 30T gear, place the tumbler lever in the proper position to produce 36 threads when the two regular gears were being used and proceed. In other words, by the substitution of the 40 tooth gear for the 30 tooth gear, the 36 threads per inch position is converted into a 27 threads per inch position.

The extreme simplicity of the quick change mechanism and the few elements to be manipulated makes the settings for threads or feeds extremely easy for the most inexperienced operator.

To cut any desired thread, for example, 4 threads per inch. Reference to index plate will show that this thread is found in two locations, or at two positions of the levers, and gears. First examine the quadrant and note the combination of gears on the machine, then set tumbler under the column showing 4 threads, then set the levers to A-D, or A-C, as shown on the plate (Fig. No. 6) opposite the gear setting in left hand column, and proceed to cut.

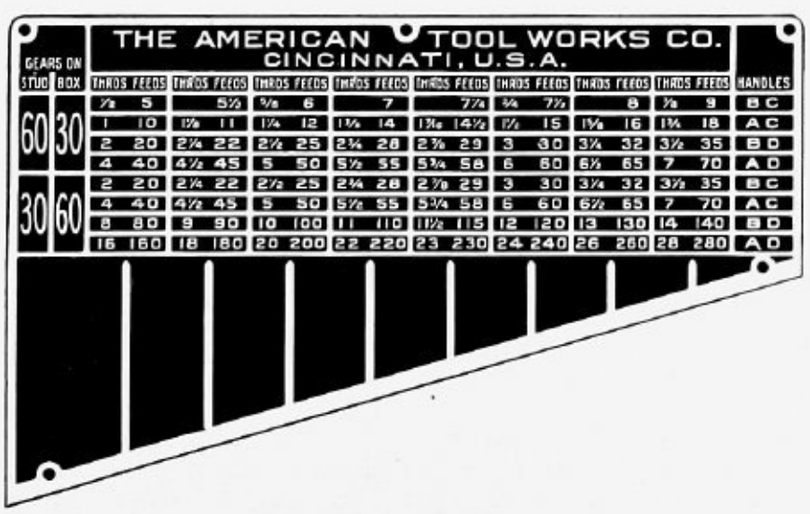

Fig. No. 6—Index Plate

A chasing dial located at the right hand end of the carriage is used when chasing odd or fractional threads, and its use will eliminate the necessity of reversing the lead screw in order to retain the half nut engagement with it.

When the lead screw is not in use, the chasing dial should be disconnected by pulling out the knob in the bracket and pushing down on the top of dial. To re-engage, pull up on dial sleeve and it will snap into place.

A plate on front of apron gives **specific directions** for using the dial.

The changes for feeding or thread cutting should only be made when spindle is running at a moderate speed, as this permits the gears and clutches to engage more readily and without shock.

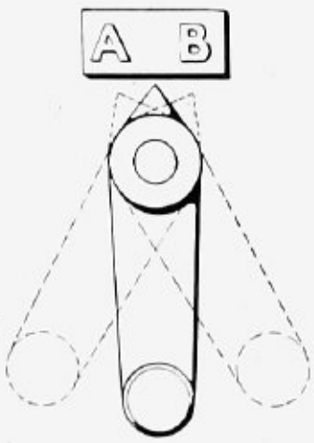

Fig. No. 7

It is necessary to set the sliding tumbler in the proper location, or at least have it locked in some hole in the box, before the clutches can be engaged, and on very fine feeds or threads, a few seconds may be required to engage the clutches.

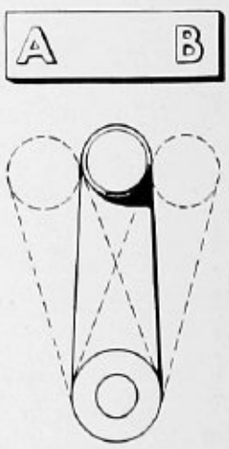

Fig. No. 7

When using no power feed or when filling the work, the sliding tumbler may be raised so the locking pin rests upon the top of locking plate, this will reduce the load on the belt or motor and greatly prolong the life of the machine, by stopping the movement of feed box and apron gearing and shafts.

On Lathes 27″ and smaller sizes, a lead screw and feed rod are supplied each being used for its particular line of work. The lever at end of feed change box shows clearly the position for feeds or threads as required.

When cutting threads or setting feed rates, care should be exercised in setting the two levers on the feed box to the A, B, C, or D positions.

On lathes below the 24" size, the pointer on the lever should be set to the letter desired, while on the larger machines, the handles of the levers should be set to the letters required. (See illustration No. 7.)

Metric Conversion

METRIC PITCHES

GEAR ON STUD	FEED BOX LEVERS			
	A-D	B-D	A-C	B-C
	M/M	M/M	M/M	M/M
40	.5	1.0	2.0	4.0
45	.5625	1.125	2.25	4.5
50	.625	1.25	2.5	5.0
55	.6875	1.375	2.75	5.5
60	.75	1.5	3.0	6.0
65	.8125	1.625	3.25	6.5
70	.875	1.75	3.5	7.0
75	.9375	1.875	3.75	7.5
80	1.0	2.0	4.0	8.0
85	1.0625	2.125	4.25	8.5
90	1.125	2.25	4.5	9.0
95	1.1875	2.375	4.75	9.5
100	1.25	2.5	5.0	10.0

PLACE 127 TOOTH GEAR ON GEAR BOX LOCK TUMBLER IN LOWEST HOLE

THE AMERICAN TOOL WORKS CO.
2411 CINCINNATI U.S.A.

Fig. No. 8—Metric Pitches

When specified by the purchaser, "American" High Duty Lathes can be readily arranged to cut metric pitches in addition to the regular range of English or Whitworth threads.

The method of conversion from the English to the metric range on these new lathes is unusually simple and efficient. There is absolutely no change made in the regular design of the lathe nor is there any complicated mechanism to apply in order to secure the desired result. The only work incident to making the conversion is the replacing of the original gear on the stud, the intermediate gear and the driving gear on the quick change box with the proper transposing gears that are furnished to produce the required range of pitches. Furthermore, the operation of this mechanism is so extremely simple that it is practically impossible to make a mistake in securing the desired pitch.

After the three transposing gears have been applied to produce one metric pitch all the other pitches, shown on the index plate, (Fig. No. 8) can be secured by simply interchanging the gear on the stud with the particular gear shown by the index plate to be necessary for the desired pitch, and then setting the two compounding levers, located at the left and right of the tumbler lever, to the positions as indicated on the index plate.

After once applying the 127 tooth transposing gear to the box it is not removed until it again becomes necessary to cut English or Whitworth threads, when the original gear is replaced.

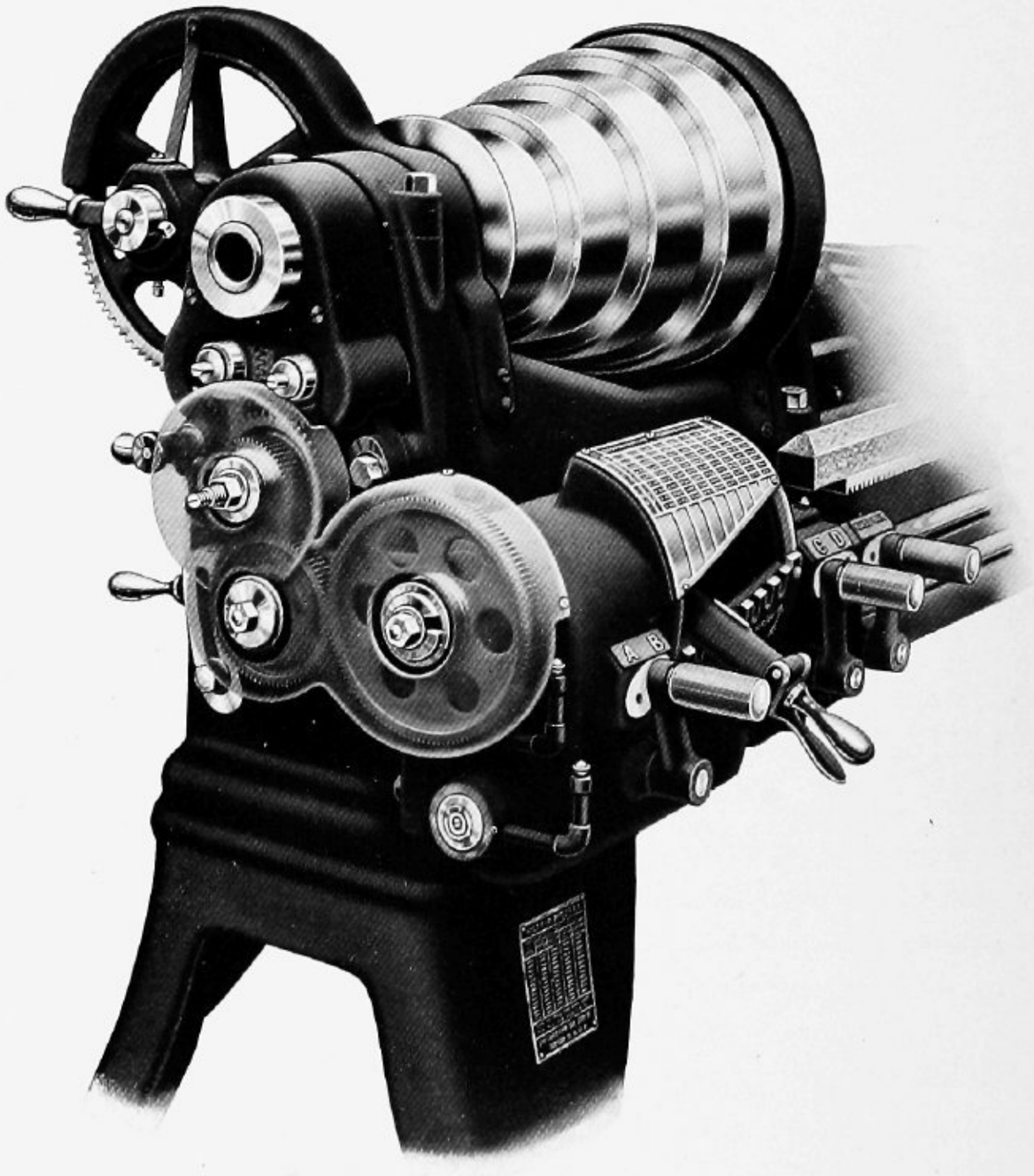

Fig. No. 9—Transposing Gears for Metric Pitches

All gear combinations incident to obtaining the entire range of metric pitches are calculated with the tumbler lever in the first position as it is shown by illustration, Fig. No. 9. Therefore, when cutting metric threads the position of this lever must not be changed.

In order that the screw cutting mechanism may be properly set for cutting both metric and English threads, two index plates, one showing

the combinations for metric and one for English pitches, are furnished with each lathe arranged for metric conversion.

Special threads and pitches not listed can be obtained by the use of additional compounding gears. However, those shown are considered sufficient for ordinary use.

To engage half nuts with lead screw for thread cutting, it is simply necessary to press downward on the lever at the right hand end of apron. Reverse lever, at the left of half nut lever, must be in central position, i. e., with its pin engaged in the center hole, otherwise, the non-interfering device will prevent movement of half nut lever. (Fig. No. 10.)

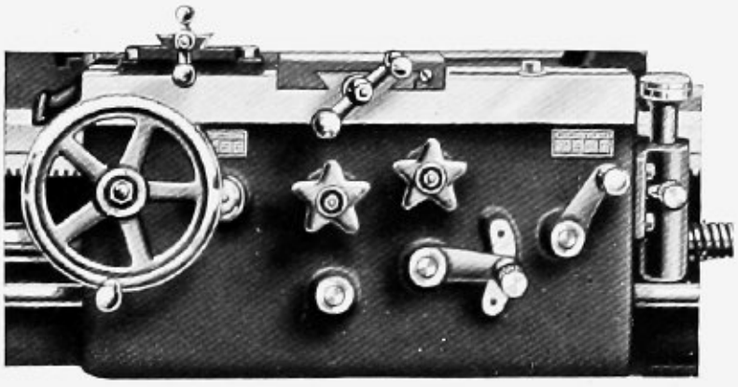

Fig. No. 10—Apron

To set the carriage for feeding, release the half nuts from engagement with lead screw, by throwing the lever at right hand end of apron up to horizontal position. The reverse lever, at left of half nut lever, must then be engaged with upper hole or lower hole, according to the direction in which the carriage is to be moved.

Apron Non-interfering device in apron makes it impossible to engage lead screw and feed rod at same time.

The first star knob directly under cross-feed screw controls the power cross-feed and is a friction (except on 36 in. H. P. and larger). Lower star knob controls the longitudinal feeds of the carriage and is a friction. These two knobs, or course, must not be engaged when screw cutting, although they may be engaged at the same time without doing any injury to the machine, such an operation, however, being unnecessary.

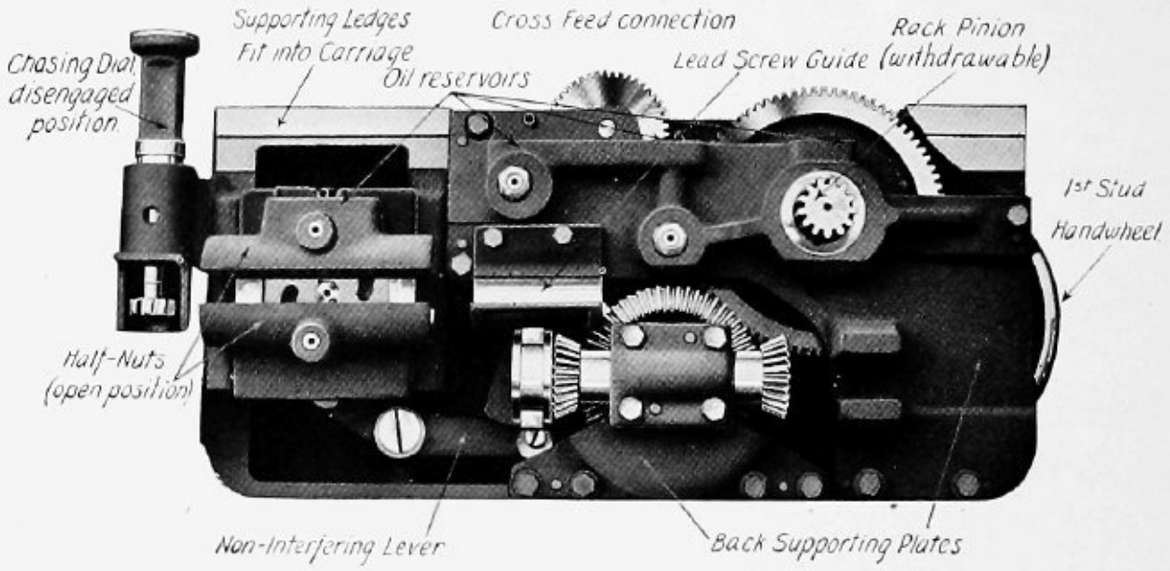

Fig. No. 11—Interior of Apron

The rack pinion should be withdrawn from the rack on the larger lathes, when cutting threads, as this removes the drag of the apron gears, and prevents the handwheel on apron from revolving at a high rate of speed which may possibly injure the operator.

Centers are ground and hardened, so that customers may start the lathe to work without delay.

Instructions for Operating Lathe Heads

To Operate the Double Back Geared Head Friction Type

The "open belt" or direct speeds to spindle are obtained by engaging the lock bolt in the large face gear on spindle with the cone pulley and disengaging the back gears at the eccentric lever. The slower or "back gear" speeds are obtained by first releasing the lock bolt in the spindle gear and then engaging the back gears with those on the spindle. Then move the friction lever to right or left to engage the required speed range. Always set the friction lever in a central position before engaging the back gears to stop the spindle from revolving, which protects the gear teeth from breakage when they are engaged.

Slip Gear Type

The slip gears should not be moved sidewise until the back gears are disengaged. The face gear locknut mechanism is operated as described above. Stop spindle before moving back gears.

Oil the back gear and cone pulley journals liberally.

To Operate the 8 Speed Patented Geared Head

The speed variations are obtained through a pair of friction clutches on the initial drive shaft in combination with sliding gears on spindle sleeve and back gear shaft, and a jaw clutch on the spindle. The lever at A-B, operates the slip gear unit on the spindle. Lever at C-D, operates the positive clutch on the spindle for direct drive, and also the slip pinion for the back gear drive. Lever at E-F, controls the two initial speeds and the stopping and starting of the head as well as facilitating the movement of the slip gears and clutch by disengaging the friction to permit the parts to slow down enough to make the changes. It is important that no lever be moved until the E-F lever is set neutral. The speed index plate on the head indicates the various lever positions and the corresponding spindle speeds.

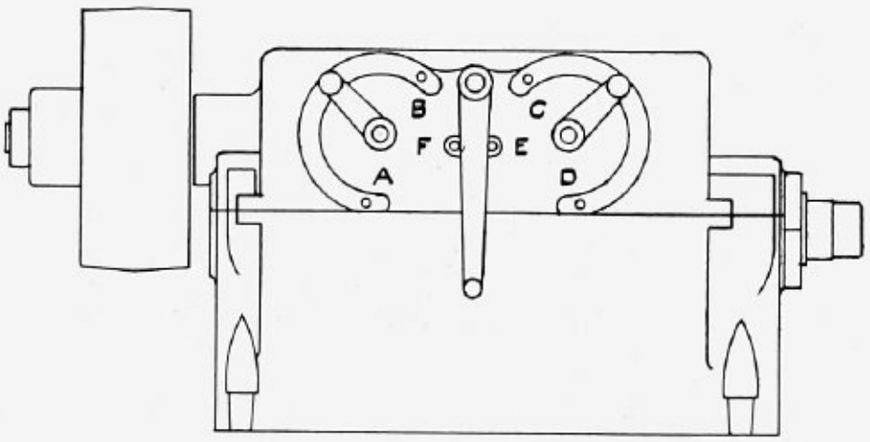

Fig. No. 12—Eight Speed Head

To adjust the tension of the two friction clutches, remove the hand hole covers at the rear of head cover; then turn the 1st shaft until the expanding finger comes into view. Then loosen the lock nut on the screw in finger and with screw driver screw in the set screw about a full turn, then try the tension by moving the E-F lever, after the tension is set satisfactorily the lock nut should be tightened.

To Operate the 12 speed Patented Geared Head

The speed variations are obtained through three slip gear units in combination with a pair of positive jaw clutches. The whole being under the control of a friction located in the initial driving pulley or gear. The lever at A-B, operates the first pair of slip gears on the driving shaft. The lever at C-D-E, operates the sliding gear unit on the spindle sleeve and a jaw clutch. The lever F-G, operates the positive jaw clutch on the spindle for direct drive and also the sliding back gear pinion. The friction lever is located at the left end of the head. No levers should be moved until the friction lever has been released in order to slow down the parts to facilitate the engagement of the various units without shock. The speed index plate on the head clearly indicates the positions of the levers to produce the various spindle speeds.

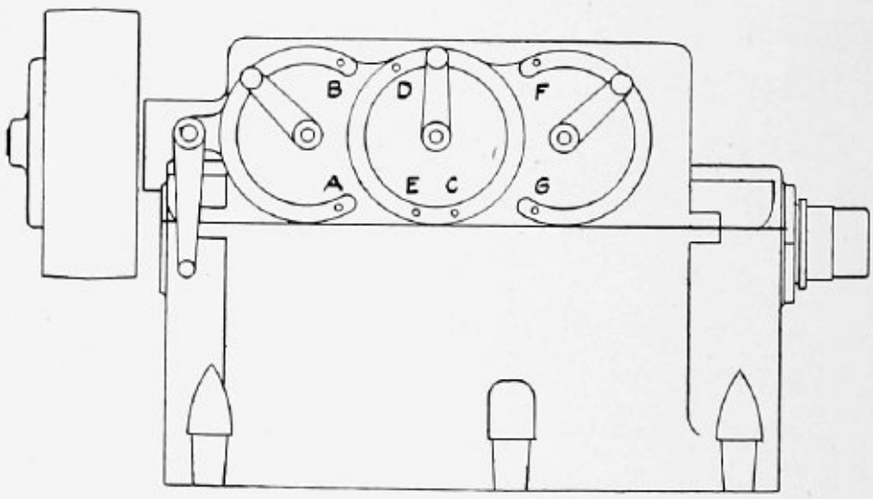

Fig. No. 13—Twelve Speed Head

To adjust the tension of the friction clutch on the initial drive shaft, stop the countershaft, or motor, then turn the shaft until the tension finger comes into a convenient position, loosen the lock nut on set screw, turn set screw about a full turn, and try the tension by moving the starting lever; when sufficient tension is obtained, tighten the lock nut.

To Operate the 16 Speed Patented Geared Head

The speeds are obtained through the combinations of four slip gear units, a jaw clutch, and the internal face plate pinion. Two drives are provided whereby eight fast speeds are obtained through the direct gear connections with the spindle, the other eight slower speeds being obtained through the internal face plate gear and pinion.

A-B operates sliding gears on initial drive shaft.

C-D operates sliding gears on 3rd shaft.

E-F operates a sliding gear and jaw clutch, also on 3rd shaft, for engaging back gearing. The handwheel at front operates the face plate pinion and direct spindle drive pinion.

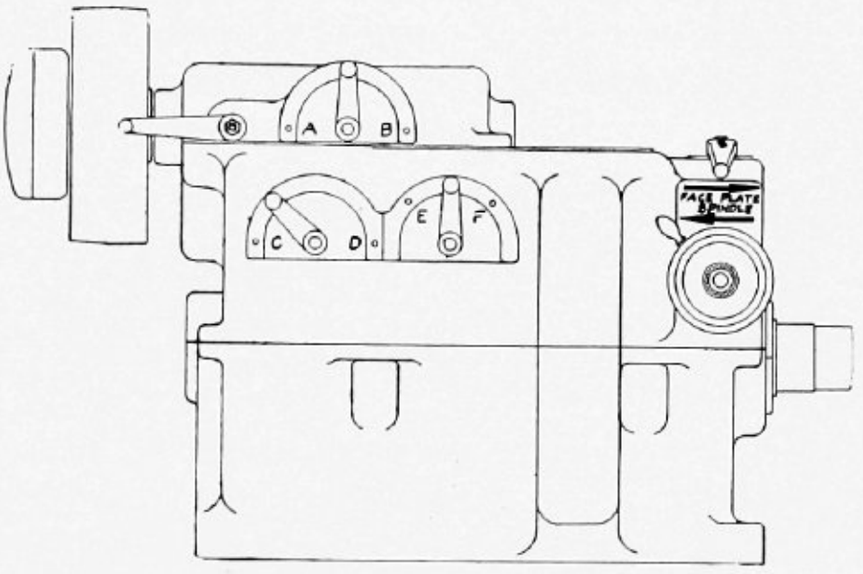

Fig. No. 14—Sixteen Speed Head

The operating levers at upper right and left hand ends of the head control the initial driving friction, which is located at the left end of initial drive shaft. The levers also operate a brake to stop spindle when friction is released. These levers are connected, and either will operate the friction. They control the movement of all the levers and the handwheel, and no change of lever position should be made until the friction lever is set neutral, in order to slow down the parts and prevent shock or breakage, due to the momentum developed by the parts when running at high speeds. The handwheel movement is governed by a plate just above it on the head cover with arrows showing the direction in which it should be moved to engage the two gear runs. The speed index plate on the head cover, clearly indicates the positions of the levers to produce the entire range of spindle speeds.

In order to adjust the tension of the friction on the initial drive shaft, the lower half of the friction cover should be removed; after removing the oil in its reservoir. Then turn the shaft until the tension stud (found on the face next to the head cover) comes into view; then loosen the outer lock nut, adjust inner nut on draw bolt, and after trying the tension by moving the operating lever, tighten the lock nut. Replace cover and fill oil reservoir.

Heads Should Run in Oil Bath. All "American" Geared Heads are oil tight in construction and we recommend that the internal mechanism be run in an oil bath excepting the 36 and 42 inch sizes, altho this is not absolutely necessary.

For this purpose should be used a heavy cylinder oil similar in constituency to "Capitol Cylinder Oil" produced by the Standard Oil Co. The use of a thin oil for this purpose will be found unsatisfactory as it has a tendency to vaporize. In order to use the proper amount in each head it will be well to note our recommendations.

SIZE.	AMOUNT.
14 in.	½ gallon.
16 in., 18 in., 20 in. and 24 in. M. P.	1 gallon.
24 in. and 27 in.	1½ gallons.
30 in. and 36 in. M. P.	1½ gallons.

If, for any reason the face plates on 36″ and 42″ lathes are to be removed, it is necessary to proceed as follows: First, center punch the end of spindle and face plate so as to indicate their relative positions, and withdraw the internal face plate pinion from the face plate; then turn the spindle until the lock screw in the hub of face plate comes into a convenient position; then unscrew this lock screw about ½ inch and then the face plate can be unscrewed by placing a bar in the tee slots in the periphery. Drop in the back gears to prevent spindle from turning.

Caution. Do not place a bar in the slot and bump it against the vees, as this will throw the vee out of line and also bruise it.

When replacing plate, bring the center punch marks in line, and then screw the lock screw home. This screw prevents the plate from unscrewing when spindle is reversed.

Taper Attachment

Every lathe carriage is drilled and tapped to permit the ready application of a taper attachment, and the attachment itself is so constructed that it can easily be attached by the customer after the machine is installed. It may be necessary for the customer to do some slight scraping on back of carriage, inasmuch as a perfect metal to metal contact is required.

Directions for Applying Taper Attachment to "American" Lathe

The back of carriage and the swivel base bracket of taper attachment, that fastens to the carriage, should be scraped to a perfect fit, and tested by red lead impressions. The screws and dowels should be put in place, the slide H properly adjusted to slide K and shoe L moved up to same. Some fitting will be necessary where shoe L fastens to slide H. These two surfaces should be scraped to a perfect fit to prevent binding of the parts.

Slide E should be set as nearly parallel as possible, and then a "proving bar" should be put between centers, with an indicator in the tool post, the carriage moved back and forth and readings taken at each end of the bar until it shows zero. After this the zero mark should be placed on the polished spot on graduated end of slide E, and also on the bracket M of the vernier attachment, used for finer adjustment.

The dog I should be rigidly clamped to bed and nut taken from bar N, so that the bar may pass through opening in dog I.

This bar is not intended to fit in this dog, as clearance has been provided for, but should come up squarely to the collar on the bar. Some slight fitting may be necessary at this point.

All of the working parts of this taper attachment are carefully jigged and the only work necessary in attaching is as above outlined. Perfect working of the attachment is thus insured.

Note:—The hole in slide K, formerly used to bind cross-feed nut to slide, should be plugged up after attachment has been applied, so as to protect the cross-feed screw from chips and dirt.

To Set Taper Attachment for Taper Work

1st. See that the binding screws A, B and C, are free.

2nd. Set slide E to desired taper.

3rd. After setting E to the desired taper, tighten screws B and C.

4th. Arrange the approximate location of bottom slide K with top slide F, set either parallel with the face plate or at a slight angle with the tool post and tool in place. Then loosen screw G, which releases the cross-feed nut from slide H. This will permit the use of the screw of top slide F, to feed the tool up to the work, also for repeated cuts.

5th. Tighten screw A, move the tool to the starting point (see note) and then bind dog I with nut J.

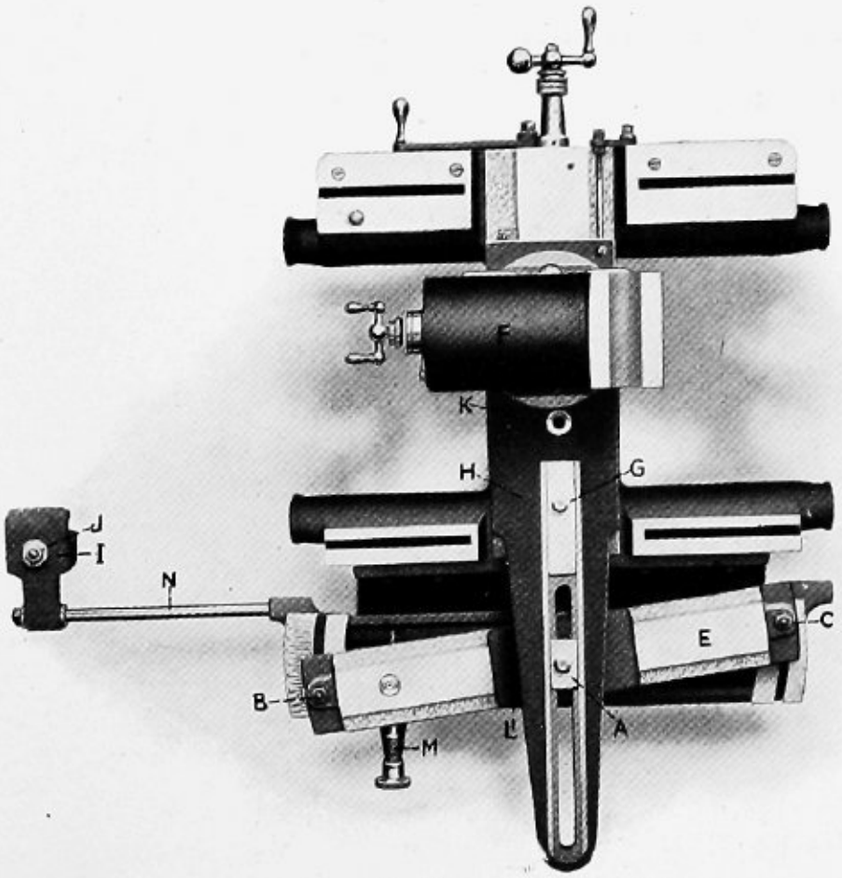

Fig. No. 15—Taper Attachment

Note:—The cross-nut "G" should be located about central in the slot in the yoke "H" in order to prevent it from striking the ends of the slot before the shoe "L" has travelled its full limit. This is most necessary when there is great angularity to the bar "E."

The taper attachment is then ready for use.

Note:—After setting the tool to the cut, a more perfect job is possible if tool is set slightly in advance of cut, which prevents its turning straight at starting point, due to the working fits. This is characteristic of all taper attachments, but will be more evident as the parts wear from continued use, after which all gibs should be re-adjusted.

When wishing to change from taper to straight turning all that is necessary to do is to release nut J and screw A, then tighten screw G.

When working near tailstock end of bed, the dog I may extend over end of bed. In this case change bar N and dog I to the opposite side of attachment.

The 36″ and 42″ attachments have their brackets mounted on guide ways on the rear wall of the bed, and the bracket should be clamped to the bed before using the attachment, to insure accuracy of the cuts. The yoke and cross feed screw connections are similar to those of the smaller lathes as described above.

Turret on Shears

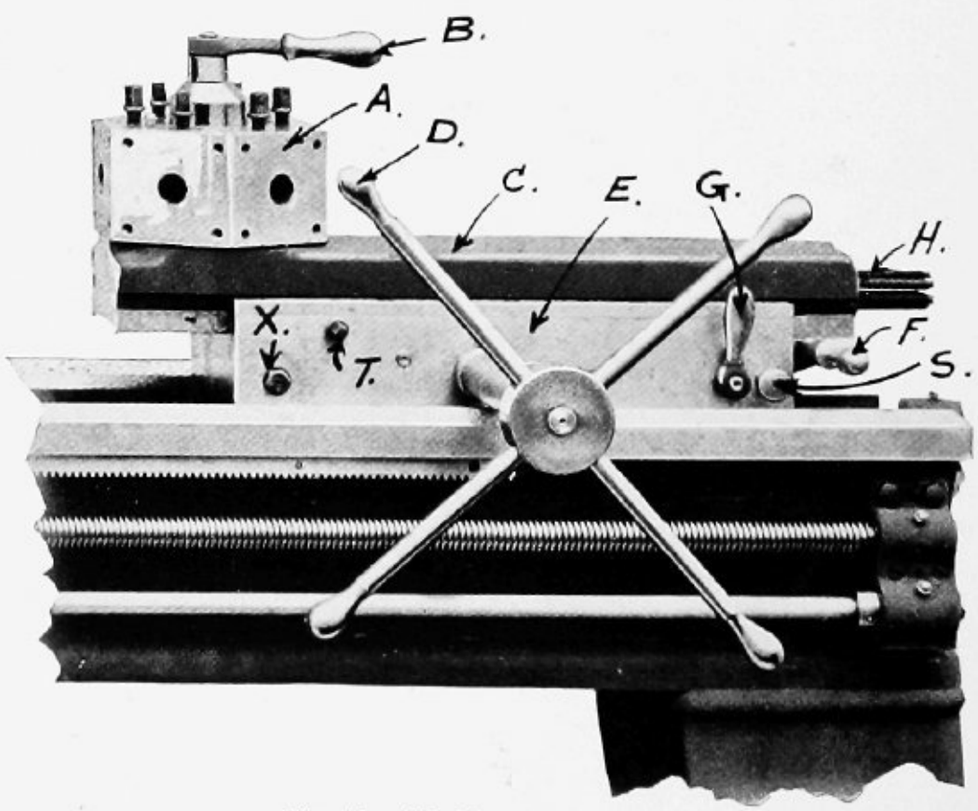

Fig. No. 16—Turret on Shears

To revolve turret "A" first loosen clamp lever "B," then turn the pilot wheel "D" in clockwise direction, which will move top slide "C" to the right, and cause the lock bolt to withdraw from turret "A," and also cause the pawl finger to engage the index pins in bottom of turret. These actions cause the turret to revolve automatically one station, or ⅙ turn per stroke of top slide. To move more than one station run top slide back until the lock bolt is released, when turret can be turned by hand to any desired position. Always turn it clockwise, and then move top slide to re-engage shot bolt. Always tighten binder lever "B" before starting cuts, and make sure turret is locked by lock bolt.

The travel of turret and top slide is regulated by a series of 6 adjustable stop screws "H," one for each face of the turret. These screws are mounted in a head which revolves automatically in unison with the turret "A." The inner end of the screws engage a stop finger, which trips the power feed. The screws are adjustable in and out.

The power feed is obtained from the live spindle, and is transmitted by belt to a splined feed shaft along rear of bed. The bottom slide "E" carries a feed box at the rear, which contains a series of compound gears in combination with a worm and worm wheel. A drive key engages the proper gear combination to produce the selected feed. The drive key is operated by a vertical shaft and pinion, at the top of which is a star knob and dial showing the 6 feed rates. To obtain the desired feed turn the star knob until the fixed pointer indicates the proper position of the dial.

The lever "F" is used to engage the power feed; it engages the worm with worm wheel for feeding, and its release by the automatic feed stop drops the worm out of engagement. The feed can be tripped by hand at any point, by moving lever "G." The round knob "S" is turned to throw the automatic trip finger out of the path of the stop screws when long stroke to top slide is required. The automatic stop screws do not trip feed at full length of top slide travel.

The bottom slide "E" may be moved along the bed, and is clamped by eccentric binder "X."

The clamp screw "T" binds top slide when this is required. On large lathes the pilot wheel "D" is mounted on a drop apron, which brings the handles below the path of tools in turret, and is also arranged to engage a hand moving pinion with bed rack, to move bottom slide along the shears. The pilot wheel is pushed to engage the bed rack, and pulled to engage the turret revolving and top slide moving mechanism.

When a turret is ordered after the lathe has been installed, the turret will be shipped with the holes semi-finished, because the finish cut must be taken with the turret in place on the lathe bed.

Construction Number When ordering extra attachments, accessories, or repairs for any of our machines, the construction number of the machine should invariably be given, since by so doing there can be no doubt as to the exact size and style of machine for which parts are desired. Every lathe built in our shops has its construction number, consisting of 5 figures, plainly stamped on the side or top of the bed at the **tailstock end.**

To Operate Universal Relieving Attachment

Note:—All work should be fluted before being relieved.

1st. For work with flutes parallel to the axis, or very nearly so, such as reamers, taps, etc., where the taper is very slight and straight relief is satisfactory.

Count the number of flutes on the work and then examine the index plate P for the correct combination of change gears and cam lobes to produce the number of flute reliefs required. Loosen the quadrant Q and insert the proper change gear at B, then select the cam number and put it on the cam shaft. (The 4 lobed cam is usually on the machine for average tool room work.) Then remove the block from yoke H and permit the yoke to ride on the cam face.

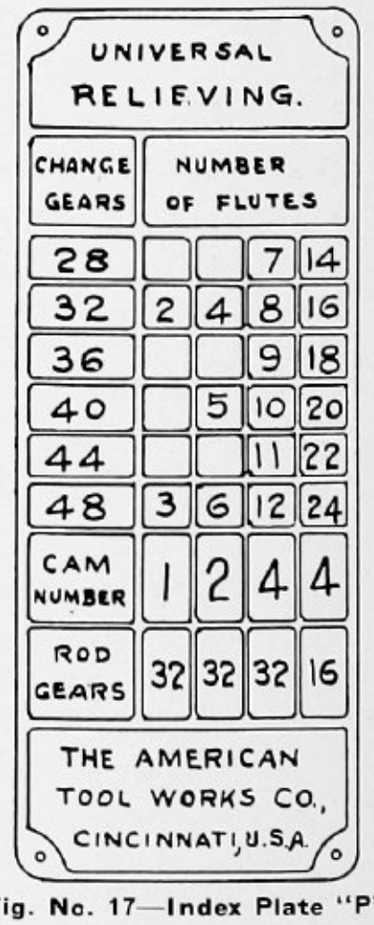

Fig. No. 17—Index Plate "P"

To remove, reverse, or change a cam, proceed as follows:—Turn the cam shaft until the yoke H is at the high point of cam, per Fig. 18. Then insert a wedge or block between the yoke and end of tool slide to hold the spring tension off the cam, then turn cam shaft slightly to loosen the cam. Then knock out taper pin in the collar at right hand end of cam shaft, and pull out the shaft. Then change cam and replace the shaft, collar, and taper pin. The jaw clutch sleeve which

engages the cam can be pushed in if it interferes with the removal or replacement of the cam. The shaft has a key in it which must properly engage the clutch sleeve.

Adjust the tool slide M to the proper angle for the work. To turn the slide and swivel to an angular position it is necessary to loosen the nuts N on the two swivel bolts, about two turns. Then with both hands raise the swivel and top slide vertically and turn it to the approximate angle required. When the swivel is raised it disengages a clutch in the swivel shaft, and each tooth position represents an angle of 30 degrees in the position of top slide from its original position. Should the clutch teeth not engage at once turn the swivel slightly when the teeth will come opposite the mating notches and the swivel may be clamped. Should the angle be too great or too small, the swivel may be turned slightly from the 30 degree position after the clutch is engaged, but as this will modify the movement of top slide somewhat it is not recommended for all purposes requiring the greatest accuracy in depth of relief, however, it is located close enough at the 30 degree position to accomodate all the average conditions usually met with and for all practical purposes, and at this position the spring tension is removed from the crank members and all parts operate with the greatest freedom.

To regulate the depth of relief, loosen the nuts J and with wrench on K set the index bar I over beyond zero to the amount of depth desired, as indicated on the index on the bar, then clamp nuts J and tighten binder L for feed screw.

Grind the tool to the proper shape and insert it in the tool post with the cutting edge exactly on center.

Insert the work between the centers, but do not secure the dog or driver to it until the tool is set in the proper relation to the flutes of the work.

Set the cam so the highest point of the lobe is just ready to drop off the shoulder on the yoke H, then move the tool into the work, and turn the work until the cutting edge of the tool is in the flute space and $\frac{1}{16}$" beyond the end of the relieved portion, then clamp the dog securely. (Fig. No. 18.)

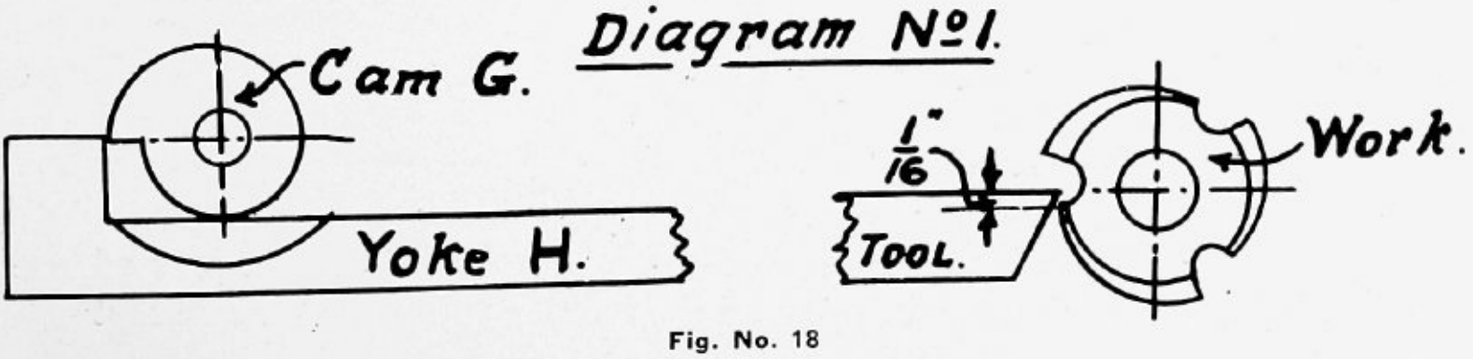

Fig. No. 18

Then withdraw the tool from the work and see that all parts are properly set and free from interference before starting to relieve.

Caution.—See that the top slide is set somewhat central on the swivel, so that the movement of the crank member will not be retarded by the end of the slide striking against the crank and damaging the mechanism. The top slide is usually used to set tool for depth of cut, while the tool rest is positioned by the cross-feed screw in carriage.

When relieving threaded work, such as taps and hobs, it is necessary to locate the tumbler at the proper point to correspond with the cut and engage the half nuts at lever O.

The speed at which the relief work is done is considerably slower than that used to turn or thread the work. This is necessary in order to permit the operator to examine the progress of the work, and on account of the intermittent nature of the cuts.

It is well to blue the parts relieved, or coat them with copper solution in order that the cuts may be more clearly defined.

2nd. To relieve work requiring end relief, such as end mills, counterbores, etc.

Proceed as on 1st operation, but set the top slide M parallel with the shears, and use the cross-feed if desired.

3rd. To relieve tapered work such as taps, etc. This may be accomplished without any deviation from the method as described in No. 1. with the exception that the taper attachment is put into commission.

4th. To relieve internal work, such as hollow mills, threading dies, etc.

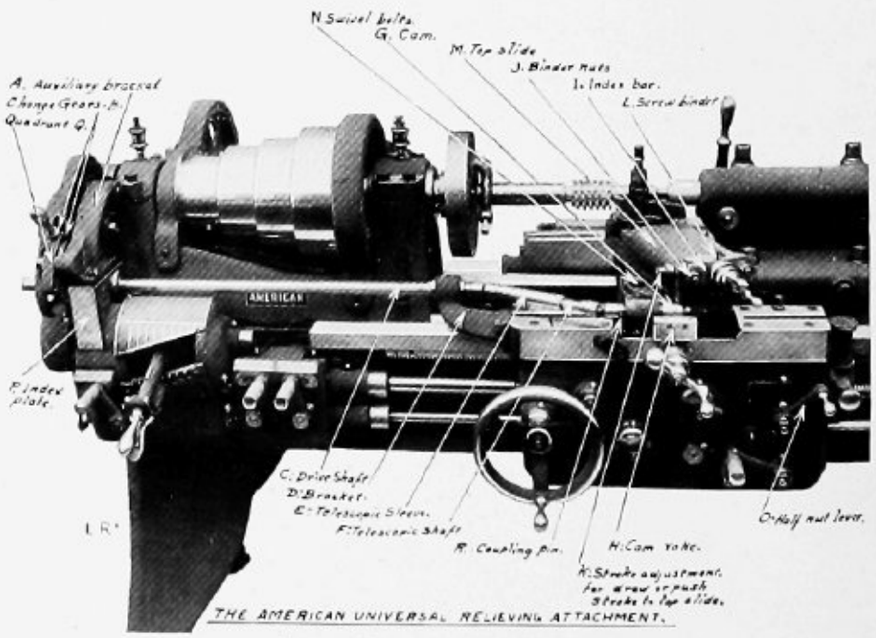

Fig. No. 19

Set the top slide M parallel with the carriage bridge, and turn the tool about parallel to the axis of the work. Set the index bar I over so as to produce the draw stroke to top slide, then proceed to cut, after placing the tool in the proper relation to the flute, as on first operation work.

The hand of the threads to be relieved will determine the direction of rotation of the work and the position of the cam G on the drive shaft.

5th. To relieve a square thread tap.

Locate the top slide M parallel to the shears. Grind the right and left side tools so as to clear the thread angle. Place the right side tool in position, and with the draw cut to the top slide, relieve the side of thread toward the face plate, then with the left side tool, relieve the other side using the push motion to the top slide.

The direction of rotation of the work and cam position being governed by the hand of the thread to be relieved, as on taps and hobs previously described.

6th To relieve left hand threaded work such as taps, hobs, etc.

It is necessary to change the direction of carriage travel in order to cut towards the tailstock. A stem about 2″ long should be left at the start of the taps in order to provide a means for driving the work. The spindle should revolve in the regular forward direction, with the tools set as for right hand threads. The lead screw should be reversed by throwing the reverse plate at end of headstock.

7th. To relieve angular faced and side cutters.

The description given for relieving end mills, and square thread taps will apply in this instance, the only material difference being in the shape of the tools.

When spiral fluted work is to be relieved, it is necessary to mill the flutes to a special pre-determined angle so as to conform to the change gear ratios, and the gearing must be modified for each change of flute angle. Special instructions and formula for obtaining the gears and flute angles will be supplied upon request.

To Operate Plain Relieving Attachment

NOTE—All work should be fluted before being relieved.

1st. For work with flutes parallel to the axis, or very nearly so, such as reamers, taps, etc., where the taper is very slight, and straight relief is satisfactory.

Count the number of flutes on the work, and then examine the index plate for the correct combination of change gears and cam lobes to produce the number of flute reliefs required. Loosen the quadrant, and insert the

proper change gear, then select the cam number, and put it on the cam shaft. (The 4 lobed cam is usually on the machine for average tool room work.) Should a change be necessary, the cam yoke should set on low point of cam lobe; this relieves the cam of the spring tension. Withdraw the headless screw from cam sleeve, and remove cam shaft and cam, place new cam in position (with clutch engaging the proper direction), and replace the headless screw in cam sleeve.

To regulate the depth of relief loosen the nuts on 2 tension rods on top slide, and with wrench adjust them so cam block contacts with cam lobe only enough to provide the depth desired, then clamp nuts, and tighten binder for feed screw on tool slide.

Grind the tool to the proper shape, and insert it in the tool post, with the cutting edge exactly on center.

Insert the work between the centers, but do not secure the dog or driver to it until the tool is set in the proper relation to the flutes of the work.

Set the cam so the highest point of the lobe is just ready to drop off the shoulder on the yoke, then move the tool into the work, and turn the work until the cutting edge of the tool is in the flute space and $\frac{1}{16}''$ beyond the end of the relieved portion, then clamp the dog securely. (See Fig. No. 20.)

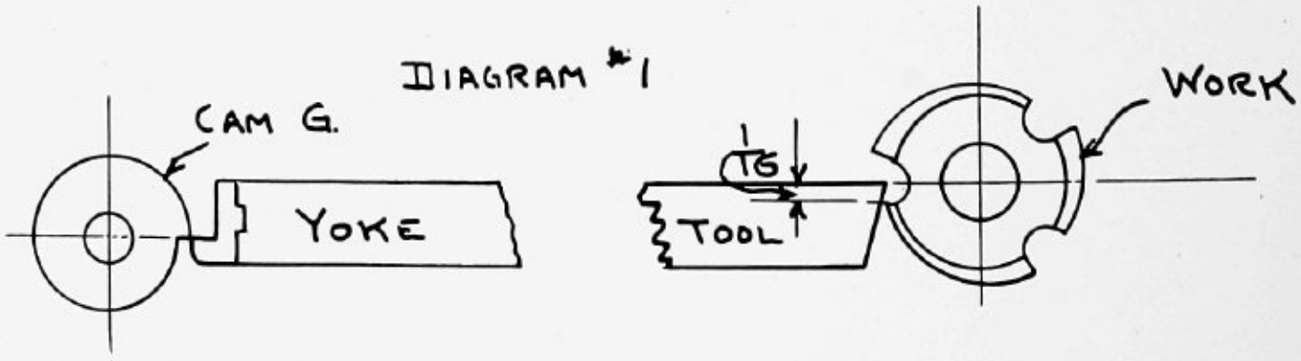

Fig. No. 20

Then withdraw the tool from the work, and see that all parts are properly set and free from interference before starting to relieve.

Caution—See that the top slide is set somewhat central on the swivel, so that the movement will not be retarded by the end of the slide striking against the nut and damaging the mechanism. The top slide is usually used to set tool for depth of cut, while the tool rest is positioned by the cross feed screw in carriage.

When relieving threaded work, such as taps and hobs, it is necessary to locate the tumbler at the proper point to correspond with the cut, and engage the half-nuts at lever on apron.

The speed at which the relief work is done is considerably slower than that used to turn or thread the work. This is necessary in order to permit the operator to examine the progress of the work, and on account of the intermittent nature of the cuts.

It is well to blue the parts to be relieved, or coat them with copper solution, in order that the cuts may be more clearly defined.

2nd. To relieve tapered work, such as taps, etc.

This may be accomplished without any deviation from the method as described in No. 1, with the exception that the taper attachment is put in commission. All that is necessary is to release the screw which holds cross feed nut, and tighten the bolt at the sliding shoe on taper bar. Set the carriage for the start of the cut, and clamp the bolt in draw bar dog on rear Vee.

3rd. To relieve internal work, such as hollow mills, threading dies, etc.

Turn the tool about parallel to the axis of the work, with cam arranged so as to produce the draw stroke to top slide, then proceed to cut, after placing the tool in the proper relation to the flute, as on first operation work.

The hand of the threads to be relieved will determine the direction of rotation of the work and the position of the cam on the drive shaft.

4th. To relieve left hand threaded work, such as taps, hobs, etc.

It is necessary to change the direction of carriage travel in order to cut towards the tailstock. A stem about 2″ long should be left at the start of the taps in order to provide a means for driving the work. The spindle should revolve in the regular forward direction, with the tools set as for right hand threads. The lead-screw should be reversed by throwing the reverse plate at end of headstock.

5th. To relieve angular faced and side cutters use especially formed tools.

The oscillating movement of the tool slide is obtained from the left end of the lathe spindle, through the medium of a train of gears and a series of 3 cams, a telescopic shaft and pair of universal joints.

The number of lobes on the cam and its number of revolutions, as compared to those of the lathe spindle, determine the number of flutes that can be produced upon the work. By referring to the index plate supplied with the attachment the proper gear and cam combination can be obtained to produce work within the range of the attachment.

The independent drive from spindle can be disconnected at head end of lathe by moving the small quadrant, when attachment is not in use.

The 3 cams are interchangeable on the cam shaft in tool rest, and are also reversible, which provides the proper tool motion for external or internal work, the tool being pushed toward the lathe center for external work, and pushed away from center for internal work, by the action of the cam.

The direction of the lathe spindle may be reversed without causing a reverse of the cam; this prevents the oscillation of the tool when the carriage is being run back for a new or successive cut. This condition is automatically provided for through the medium of a single tool clutch on the cam end and a similar mating clutch on a clutch sleeve on the cam shaft.

The cams may be removed from the tool slide for reversal or changes of lobes, as follows:

Remove the oil cup and cam guard, then turn the cam shaft until the small headless screw appears at left of cam; back out this screw far enough to permit the right hand end of cam shaft to be withdrawn when pulling on knurled knob, which should not be done, however, until the yoke or contact foot on tool slide is at the lowest point on cam lobe, in order to remove the tension of spring from the cam. The cam is then pressed against the clutch sleeve to release the clutch member and spring tension, and withdrawn, and then reversed, or another inserted, as required.

When the cam is reversed for internal work the small hardened contact foot which contacts with the cam must be removed, and another substituted which has a reversed contact face, these two plates being supplied with the attachment, and the outside work foot being in position when attachment is shipped.

Some internal work will necessitate the lathe spindle and work being revolved backwards, or in some instances, being run forward with an inverted tool operating beyond the lathe center.

The tension of the tool slide yoke against the cam is produced by a heavy spring within the tool slide, the tension being regulated by a pair of adjusting nuts on two buffer rods projecting out from the inner end of the top slide. These nuts should be adjusted carefully, in order that the tension be equally divided between the two rods, so as to throw the strain of the recoil upon the two sets of multiple disk rawhide buffer pads within the slide.

It is possible to modify the stroke of the tool slide to reduce the depth of relief, by adjusting the tension nuts on the buffer rods sufficiently to prevent the contact foot from touching the bottom of cam hole.

Special depths of relief can be provided under some conditions, which are greater than regularly furnished, however, each case must be investigated and treated individually.

To change from Relieving Attachment to regular compound rest, remove the taper gib from the bottom slide, and the screw in cross-feed nut, also remove the screws in the universal shaft bracket on left wing of carriage, then unhook the tool rest from carriage dovetail (and yoke of taper attachment if one is used), and set aside, as a unit.

Tool Setting

When using a 4-stud tool holder it is important that the tool be clamped in the proper position. If the tool be incorrectly clamped, the top slide will likely be distorted and its movement impaired. Then following diagram will show both the correct and incorrect method of clamping:

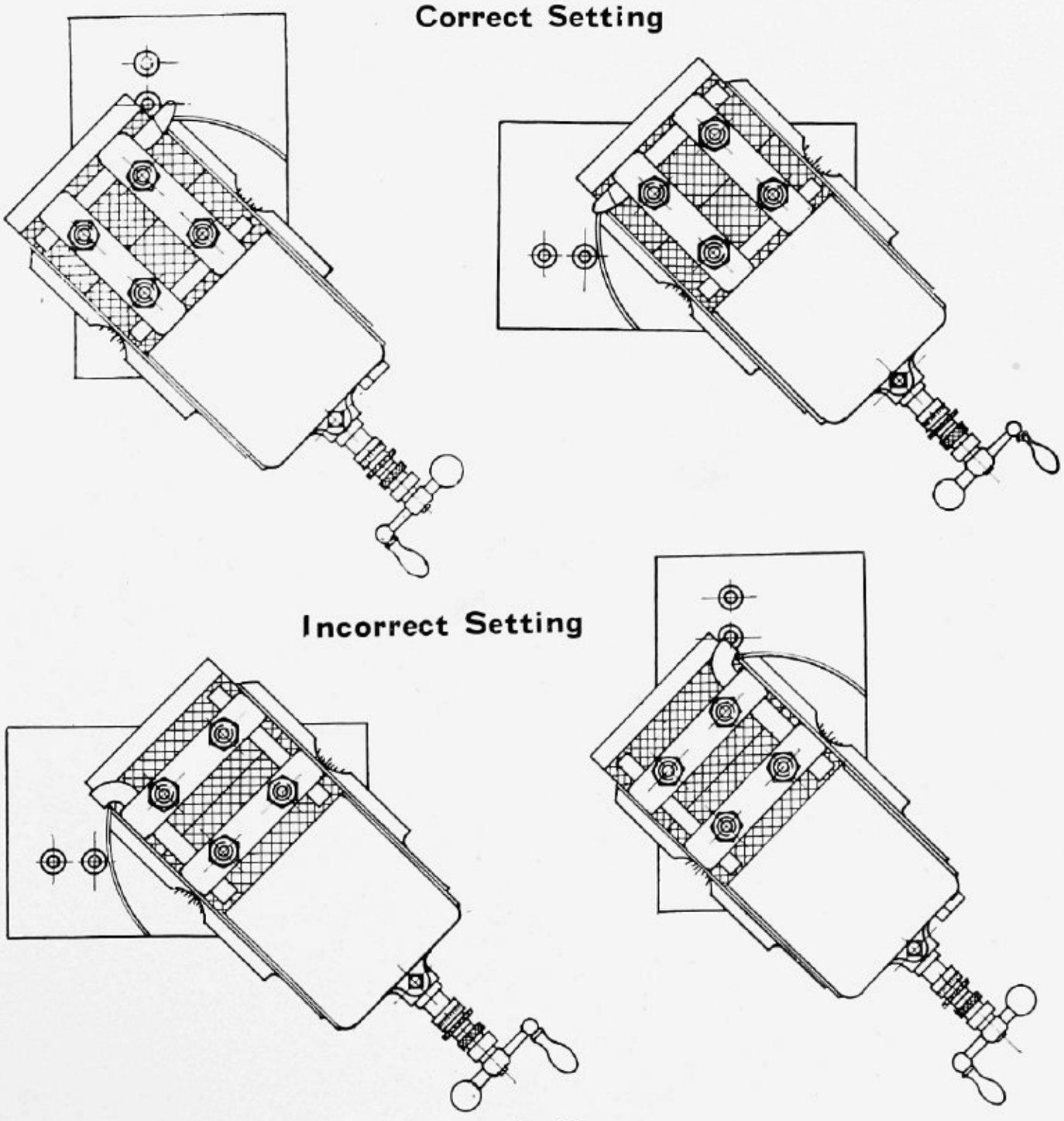

Fig. No. 21

Guarantee

We absolutely guarantee our lathe to be accurate within the prescribed limits of .001 of an inch in 12 inches.

Every machine we build is thoroughly tested for alignments before shipping, consequently it is practically impossible for a machine to get out of our plant that is not well within these limits.

We positively do not, and will not guarantee the **work** produced by one of our machines in a customer's plant. We cannot be responsible for the inexperience, ignorance or carelessness of an operator, nor can we be responsible for the customer's fitting of chucks and fixtures, nor his grinding of tools, all of which have a certain and definite bearing upon the work produced.

We guarantee the **machines** and will stand back of them, but we cannot guarantee the work produced by a customer, because we have no way of regulating his methods of or means for manufacturing.

Directions for Installing and Operating "American" Planers

Foundation A Planer, on account of its weight, extreme accuracy and length of its alignments, requires a very substantial foundation. It is one of the most difficult machines to keep in alignment and therefore the most careful attention should be given to its foundation.

Leveling The beds should be leveled **lengthwise** and **crosswise** on the top of the "V's," using a sensitive metal, machinist's level with graduated glass. A level such as made by Queen & Co., Philadelphia, Pa., is suitable for this work. We wish to emphasize the fact that an ordinary wooden carpenter's level will **not** be found satisfactory for such work, as it is neither sufficiently sensitive nor accurate for such precise duty. This leveling process should be repeated at least once within the next month after installation. The table should be removed from the bed before attempting to level the bed.

We recommend that a series of screw jacks or wedge blocks be used under the planer beds, and securely seated in the foundation. These can be adjusted at frequent intervals to keep the planer in correct alignment. After bed is carefully leveled, the spaces between the bed and foundation should be filled with melted sulphur which will not shrink when cooled.

Countershaft Great care should be used in placing the countershaft exactly as per location shown on the foundation plan, since, if it is set too far forward or too far to the rear, the belts will not properly pass through the belt loops of the shifting mechanism, and they, consequently, cannot shift properly.

Belting The best of extra heavy double belting must be used and belts should be made endless.

The cross driving belt, which runs from the small pulley on countershaft to the large pulley on the machine should be crossed in such a manner that the end running up to the countershaft pulley is on the **inside** next to the housing. This method of belt application insures a more rapid shifting of the driving belt from the tight to the loose pulley and does away with the tendency to shriek.

Length of Belting Belts that are too long are just as unsatisfactory as those which are too short. Long belts will not respond to the shifting device readily and are liable to twist. They are also difficult to keep tight enough to pick up the load at the instant of reverse. Countershaft placed 10 ft. to 12 ft. above the center of the pulley shaft, gives the best results. It should not exceed 12 ft., especially on small Planers where the belts are narrow. 10 ft. is best suited to Planers from 24 in. to 30 in. inclusive.

Important—Carefully watch the reversal of planer table for a week or so after installation, or at least until all the stretch is taken out of vertical belts. These belts, if unduly stretched, cause sluggish reversal and possible damage to machine.

Speeds The speeds shown on the foundation plan are based on the performance of a general class of work. Speeds ranging from 20 ft. to 75 ft. per minute may be successfully used on our planers, varying, of course, with the nature of the work. Where the cut is slight or intermittent, a higher speed may be maintained, but, where the reduction is heavy and the piece of sufficient stiffness, it will be found that a moderate speed and coarse feed will produce a greater output, dependent largely upon the efficiency of the cutting tool.

Our Multi-Speed Planers are of the belted type and speeds can be changed while machine is in operation.

Oiling A high grade of machine oil should be used on all parts except the ways, where we recommend the use of lard oil. The machine should be oiled three or four times a day during the first week of its installation, after which one oiling each day is sufficient, if carefully done.

The teeth of driving gears inside of bed are oiled through pipes, which are brought to a central point on the outside of bed. This does not require the table to be run off, a feature original with us.

Testing During the thorough test which our planers receive we set the cross rail parallel with the ways of the bed and then the table top and T slots are finished in place. For fear, however, that the machine may have been disturbed during shipment, we recommend that the rail should be tested for alignment with the table. This can readily be accomplished by lowering the rail to within a few inches of table and trying one end and then the other with a surface gauge. If the end of the working side of the planer shows **low,** then that end of the rail should be

raised by loosening the bolts in the flange coupling on top shaft and adjusting one half of coupling and its half of the elevating shaft until rail is parallel to table. If it shows **high,** lower it below the other end, then raise it in the same manner to test true with that end.

Feed Friction The smaller size planers up to the 30 inch Standard Pattern size, are fitted with our special type of face friction, which being properly adjusted under a working test before leaving our shop, requires little attention other than frequent oiling.

The three screws in the face of the friction plate serve to adjust the springs on the inside, by means of which a constant tension is maintained. Should the friction at any time fail to move the head at the instant of reverse, it will then be necessary to loosen the lock nuts in the rear of the plate and by adjusting the screws, the springs will be compressed and a greater tension will thus be created. However, it should be carefully noted that these springs in the feed friction should not be kept at a greater tension than is necessary to properly perform their work, as it will act as a brake and retard the action of the planer.

On the large size planers, commencing with 30 inch Heavy Pattern size, the feed friction is a combined band and face friction, which receives its proper adjustment at our shop before shipment. The face friction is kept at an even tension at all times by the three screws, to be seen on outside of plate, and is used to keep the band expanded after the finger strikes the stop. This occurs at the instant of reverse, thus preventing undue wear between the band and revolving hub. It needs no further adjustment until the leather has become sufficiently worn to cause the friction to rebound after striking the stops. This would indicate that it was failing to hold the band expanded, which in time would cause the hub and band to wear. In such cases, the friction should be tightened by means of the screws, after which, tightly lock the nuts on end of screws.

However, if the heads are properly adjusted, and the friction still fails to do its work, and if the feed is not occuring at the end of the stroke, (which would cause the feed to act after the tool had entered the metal), then, it would be necessary to tighten the nut on end of stud that passes through at under side of band. A tension will thus be put on the spring through which the stud passes, thus giving the band a tighter grip.

On planers of 30 inch standard pattern and larger sizes, an improved friction controlled rail elevating and lowering device is used. The frictions used are of the wedge expanding type and need no adjustment, the pulling capacity of the friction being controlled by the tension of the operating lever.

Double Head Feed Mechanism to Rail Heads The improved feed mechanism on cross rail allows one head to be fed across the rail simultaneously with the other head being fed either up or down. This valuable feature permits the use of either head on cross rail as a side head and is of special value where the regular side head on the housing will not reach the work.

When planers below 30 inch standard pattern are supplied with single rail heads, no provisions are made for attaching an additional rail head, and it is necessary to order an entire new rail in addition to extra head when an additional head is required.

On larger planers, the rails are regularly constructed for double heads, and when one head is ordered one cross feed screw and its feed mechanism are omitted, and are supplied with the extra head.

Side Heads The side heads are not affected by the feeds of the cross rail heads. The handle for raising and lowering the side head is within easy reach of the operator, being attached directly to the head. To engage the power feed to side head, after first moving the head, by means of the crank, to its desired location, bind the feed nut (in its split bearing, at back of head) with its binder screw and regulate the amount of feed by means of the slot at bottom of bed. To feed the side head by hand first loosen screw that binds nut in its split bearing, then tighten screw that is attached to one of the brackets which form a bearing for the side head feed screw. It is necessary that this latter screw be released before the power feed is engaged.

No side heads are furnished on planers below 42 inch size. All large machines are machined ready to receive them at any time after machine is shipped.

Safety Locking Device When the machine is at rest, do not fail to engage the safety locking device, conveniently located on the shifter handle on working side of planer. This device prevents the machine from starting until the operator is ready, the obvious advantage of which will readily be appreciated.

Adjustment of Belt Arms The bracket in which the belt arm studs fit is slotted, thus providing a means of adjustment should the arms not throw the belts in proper relation to the pulleys. This adjustment can readily be performed by loosening the nut on end of stud, moving it in the desired direction and then binding same fast.

Remarks The planer will give much better results after the belts have become pliable, which condition will be hastened by the daily application of a coat of good belt dressing to the **back** of the belt.

When working on short stroke the tight pulleys are bound to get warm owing to the slippage of the belts when taking up the load at either end.

Before taking a cut, be sure to securely bind the rail to the housing. by means of the hexagon screws in clamps. Do not disturb the round head screws in the clamps, as they are set to permit the rail to slide freely on the housings when clamp screws are loose, and are not used to bind it to the housing.

We advise that all work be squared from the side of the table rather than from the face of the housings as there is a greater working surface offered by the side of the table.

Construction Number When ordering extra attachments, accessories, or repairs for any of our machines it is necessary to refer to the construction number of the machine, since by so doing there can be no doubt as to the exact size and style of machine for which the parts are desired. Every planer built in our shops has its construction number, consisting of 5 figures plainly stamped on the **end of the rail.**

Directions for Installing and Operating "American" Shapers

UPON its arrival the shaper should be thoroughly cleaned, every oil hole should be washed out with gasolene or kerosene and then all oil holes and running bearings should be thoroughly filled with a first class grade of engine oil. Cheap oil is not economical and will not produce the best results. Not only at the installation, but at intervals later on, it is necessary to clean the oil holes and give them an entirely fresh supply, as the old oil sometimes becomes clogged or gummed and its passage impeded. Do not overlook any oil holes; each one must be given the proper attention. Lard oil should not be used in internal parts, but is satisfactory for use on exposed surfaces.

Leveling Every machine should be leveled with the greatest degree of accuracy. It is rather astonishing, but a fact, nevertheless, that many mechanics overlook this, the most important feature of successful machine tool installation. A short machinist's or carpenter's level is **not** sufficiently sensitive for machine tools. A first class metal level about eighteen inches in length, with graduated glass, (such as made by Queen & Co., Philadelphia, Pa.) should be used.

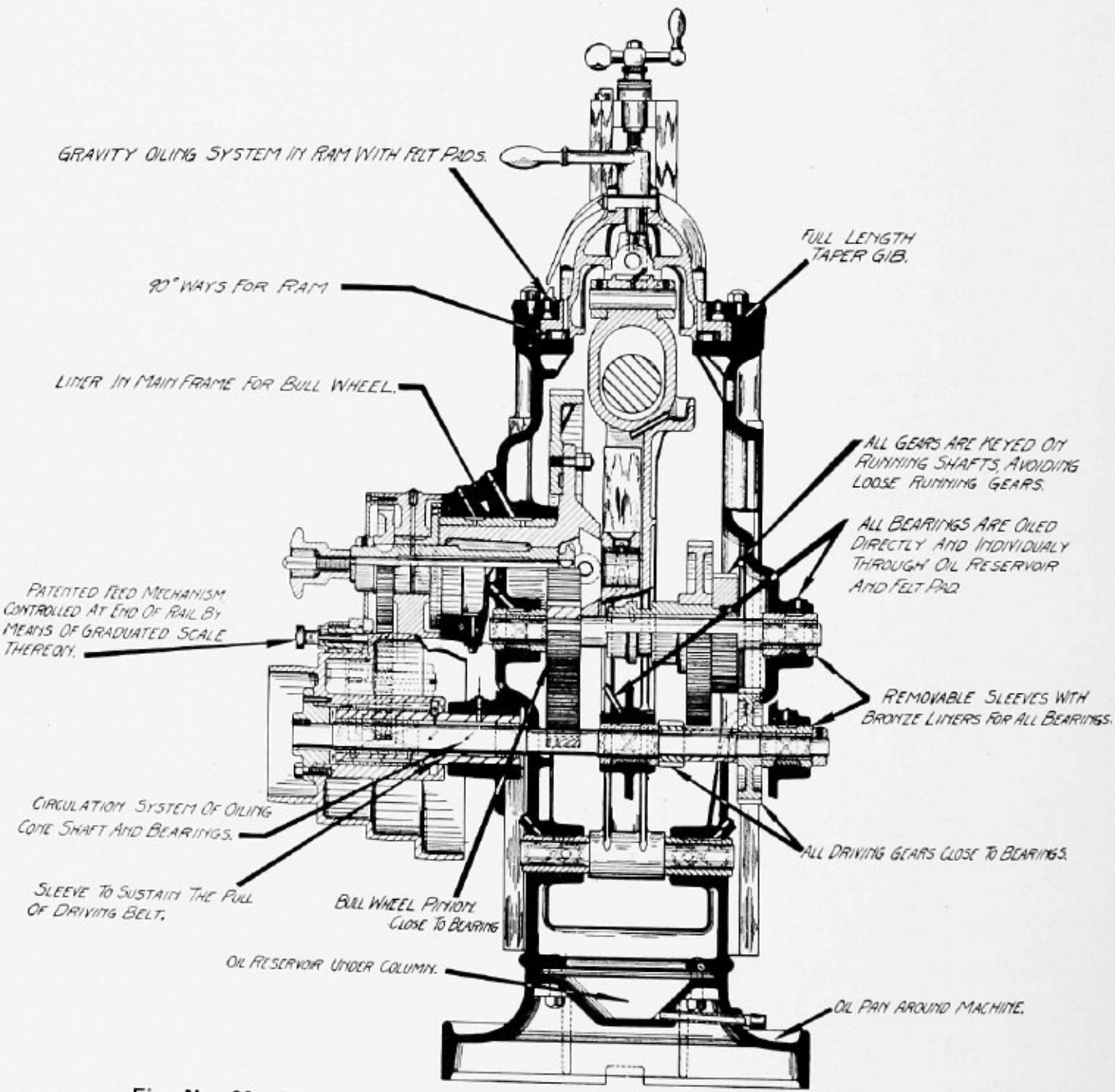

Fig. No. 22—Diagram of "American" Heavy Service Back Geared Shaper

Do not drive wedges under the extension on base for table support when leveling, but drive them in at points opposite the ends of the Column; then when level, fit metal blocks under base in place of wedges, including the base extension. And if a foundation is used, fill with cement grout wedges.

The shaper must be carefully leveled both **lengthwise** and **crosswise,** either from the top of the table or from the cross rail, as it will run much smoother when properly leveled. It is also advisable to occasionally re-level the shaper after it has been put in use.

Countershaft Countershaft should be placed in position according to foundation plan. Fill the boxes and pulleys with good engine oil, for which liberal reservoirs are supplied. Oil these parts once a day for the first week, after which time once a week will usually suffice.

The driving cone and single pulley are mounted upon a long self-oiling sleeve in which about ½ pint of oil circulates, the oil filling tube is located on the boss on the housing, and, when oiling at this point the quantity should be sufficient to fill the reservoir before machine is started. When too full, the oil will run out of pulley hub next to column.

The sliding block in vibrating arm, and the wrist pin on crank gear, are lubricated through the small hand hole in back wall, when vibrating arm is vertical. A reservoir and felt strainer in the arm feeds the oil to a reservoir in the sliding block, which in turn oils the slide ways and wrist pin journal. A good quantity of oil should be fed slowly to this reservoir.

All the running journals are provided with reservoirs, located in the column bushes, and plenty of oil should be fed to them.

Feed all oil slowly so felt pads will absorb it and also permit reservoirs to fill up.

Gear box drive and speed change gears should be run in heavy grease.

Belting A good grade of double belting should be used, both for the machine and overhead shafting. Belts should be kept somewhat loose for the first few days. A few applications of good belt dressing to the **back** of the belt will aid in making it more pliable, after which it can be tightened and preferably made endless. Belt must be run in direction indicated by arrow on foundation plan.

Stroke Adjustment Stroke is adjusted while running, from the operator's side of column, at the squared rod which passes through the bonnet. Loosen the star knob, place the crank on squared rod and turn until stroke length suits the work, then tighten the knob.

Ram Adjustment Position the ram to suit location of work, at squared rod on top of ram near head end. This may be done while machine is running. The binder on top of ram must be released before adjustment is made and kept tight thereafter The clamps on column should be adjusted to permit the ram to work freely in its bearings, a slight adjustment being provided for wear. A full length taper gib, with end screw adjustment, provides means for taking up the wear.

Back Gearing The back gears are of the sliding gear type and are operated by the lever at the right of the column. To move the back gears, the countershaft should be stopped on cone drive, and the friction disengaged on the gear box drive, to relieve the pressure on the teeth and also prevent breakage when shifting under a load.

Cross Rail Adjustment Rail is raised or lowered at square rod at rear end of rail, after which it must be securely bound to the column by means of the hexagon head bolts. The round head screws are adjusted at our works to permit the rail to slide freely on column and should not be disturbed. Do not expect to do a good job of planing with cross rail clamps loose, they should be securely clamped to column.

Feeding Mechanism Power cross feed to table is stopped, started and reversed by the plunger knob "A" on the top of the oscilating feed gear cover. (Fig. No. 23.)

The rate of feed is regulated by the knurled feed adjusting knob on outer hub of feed gear which operates a movable graduated index dial "B" By bringing the desired feed rate opposite the zero line, the feed is automatically obtained when the feed plunger "A" is engaged with notch gear.

The index dial "B" has two sets of graduations marked Right and Left respectively, and when either of the scales are brought to the zero line, the feed of table will be in the same direction.

Should the feed take place on the cutting stroke, the knob "C" on the swinging gear should be pulled out to disengage the plunger from feed drive gear and then released to engage at the opposite side of the gear which will produce the feed on the back stroke.

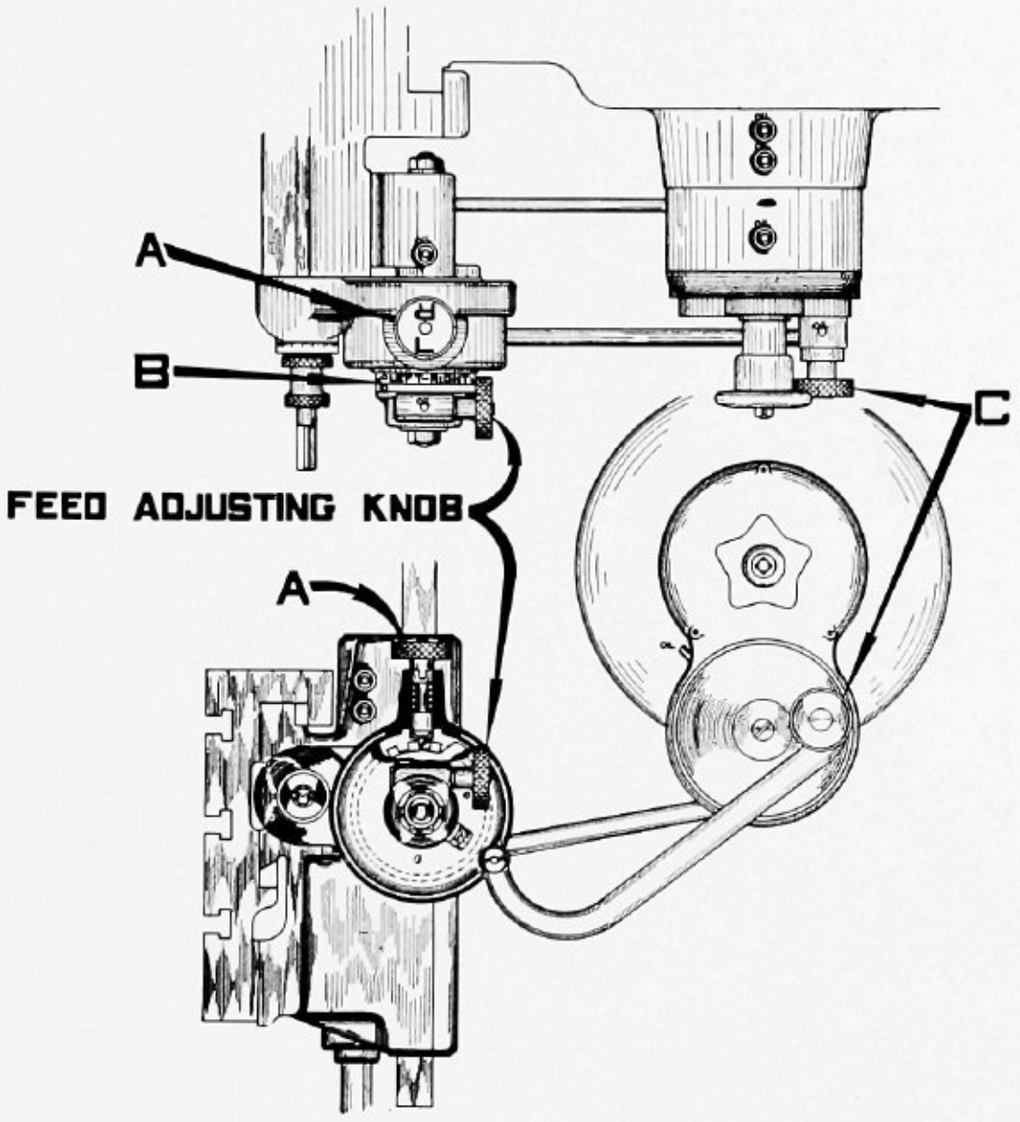

Fig. No. 23—Details of Feeding Mechanism

The feed knob "A" is stamped R and L, which indicates the proper setting when feeding right or left hand. When the graduated dial is used on the Right side, then the knob "A" should be turned so that R is facing the operator, and vice versa for left hand feeds.

The feed device automatically adjusts itself to the position of the rail.

The cross feed screw dial is used for hand feeding.

An automatic feed stop is provided at the pinion on the cross feed screw, which slips under undue strains or when table strikes the ends of the rail, and thus protects the feed gearing from breakage. It consists of a bronze-lined pinion connected to the cross feed screw by the friction of two fibre washers, one on each side, and the tension is regulated by an adjusting nut. This tension is regulated before the machine leaves the Works, and requires no other attention unless it has slipped quite frequently, so as to wear the parts enough to make the pinion slip when feeding.

To adjust the "take-up nut," turn the cross feed screw until the headless set screw in the nut comes to the bottom of the screw, where it can be loosened thru the opening in the gear guard. Then insert a small iron pin in the spanner hole in the nut and tighten it slightly. Then try the tension of the friction by running the table against the end of the rail **by hand,** which will regulate the slipping point. Too much tension is not desirable, as this will overcome the value of the device, so great care should be used in setting this nut.

Table Support

To adjust table support, proceed as follows:—

Loosen the binder nut in the table boss which will permit the notched bar to be turned and elevated or lowered to suit new table location. Turn the notched bar about one quarter of a revolution, which will automatically disengage the plunger key from the notches. Then move it down until the star head at bottom is close to the finished pad on the base. Then turn the bar and re-engage the plunger key. Lock the bar binder in table boss. Then adjust the star head at bottom to the finished pad on the base. Care should be used in adjusting the star head, so that too much tension is not put on the support, as this will raise the table at the outer end and prevent the shaping of parallel work. An easy sliding fit is all that is required. If the work is very heavy, the support should be adjusted before it is placed upon the table or in vise. After adjusting star head, lock the binder screw to prevent it from turning.

Power Down Feed

The manipulation of the feed of the Power Down Feed is similar to that of the rail feed previously described, the difference being that this feed is only downward, and the feed pawl has only one position and a corresponding single set of graduations on the feed dial.

The trip dog on the bar should be located so the finger on the feed box will operate at the beginning of the reverse stroke of the ram. This will permit of short strokes being taken if necessary.

A safety pin is provided on the reverse stroke of the feed finger. This pin is operated by a headless screw at the left of pawl plunger so that should the pin shear off, it can be pushed out for a new setting by adjusting the headless screw. Should the pin become too short, a new piece should be put in, made from soft iron rod.

The knurled thumbscrew on the down slide should be tightened when using the power down feed. This will prevent the screw from turning, and the square head screw in ram head should be loosened. When hand feed is used the knurled screw is loosened and the square head screw in ram head is tightened.

Remarks The table may be removed from the saddle in order to provide means for bolting bulky work to the face of same. In order to remove the table, the nuts on the two dowel pins in the top should be screwed down, which will withdraw the pins. Then remove the nuts from the tee-slot bolts inside the table and remove it. When replacing the table, great care should be taken to see that no dirt gets into the joints to cause bad alignment. Loosen the dowel nuts before replacing the pins.

Taper Gibs Full Length Taper Gibs with End Screw Adjustment, of the most improved form, are provided for ram, down slide and cross slide. As occasion demands, these gibs should be carefully adjusted and a close running fit obtained, in order to maintain the precision of the machine.

While the machine is in operation the rail must be kept tight on the column, otherwise dirt and chips may work in between the rail and column, thus tending to impair the accuracy of the table as well as cause a consequent inaccuracy in the work produced. A dirt guard is supplied to shield this joint.

On shapers with speed box drive, changes in speeds are made by slowing down the machine through our friction control, by disengaging the friction or initial drive shaft before the slip gears are moved.

Construction Number When ordering extra attachments, accessories or repairs for any of our machines, it is necessary to refer to the construction number of the machines, since by doing so, there can be no doubt as to the exact size and style of machine for which the parts are desired. Every shaper built in our shops has its construction number, consisting of 5 figures, plainly stamped on the down slide.

Directions for Installing and Operating "American" Radial Drills

UPON its arrival the radial should be **thoroughly cleaned,** every oil hole should be washed with gasolene or kerosene and then all oil holes and running bearings should be thoroughly filled with a first class grade of engine oil. Cheap oil is not economical and will not produce the best results. Not only at the installation, but at intervals later on, it is necessary to clean out the oil holes and give them an entirely fresh supply, as the old oil sometimes becomes clogged and gummed, and its passage is impeded. Do not overlook any oil holes; each one must be given proper attention. Lard oil should not be used on internal parts, but is satisfactory for use on exposed surfaces.

When lifting the Radial Drill for any reason, **do not lift it by attaching sling to the arm,** but carry slings down under the base with another rope from chain hook around the column near the top. (See Fig. No. 24). Any pull on the arm alone will lift the arm and column sleeve off the column, and cause breakage, and spoil the arm alignment.

Leveling After being set on the foundation, the base must be carefully leveled in all directions, **lengthwise, crosswise** and **diagonally,** with wedges placed as per foundation plan, after which cement grout should be used to give it a firm setting. A short machinist's or carpenter's level is not sufficiently sensitive for machine tools. A first class level about eighteen inches in length with graduated glass, (such as made by Queen & Co., Philadelphia, Pa.), should be used.

After machine is leveled, the jack screw if front of larger machine columns should be screwed down to the metal plate in the foundation.

Countershaft Great care should be used in placing the countershaft exactly as per location shown on the foundation plan. Fill the boxes and pulley bushings with good engine oil, for which liberal reservoirs are supplied. Oil these parts once a day for the first week, after which time once a week will usually suffice.

It must be carefully noted that the driving pulley should be run in the direction indicated by the arrow mark on same, for if the belt drives in the opposite direction, the elevating gears will not engage properly.

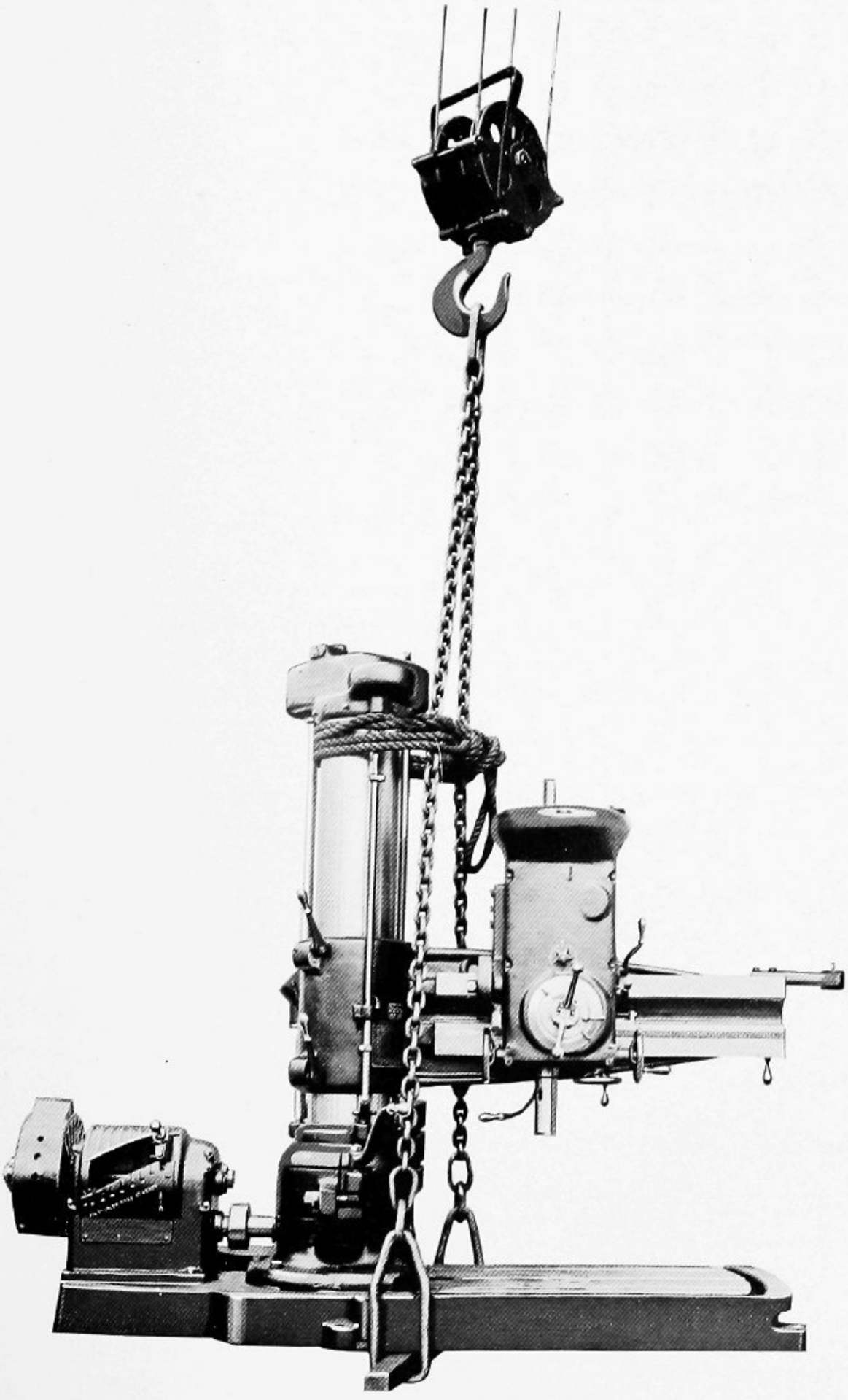

Fig No. 24

Belting A good grade of double belting should be used, both for the machine and overhead shafting. Belt should be kept somewhat loose for the first few days. A few applications of good belt dressing to the **back** of the belt will aid in making it more pliable, after which it can be tightened and preferably made endless.

Tapping Attachment Tapping attachment is regularly built in all "American" radials and is located on the head. It operates through powerful frictions, controlled by lever on head below the arm, and near spindle, convenient to operator. This lever has also an additional value, since it starts, stops and reverses the spindle without distrubing the source of power.

2-ft., 2½-ft., 3-ft. and 3½-ft. Radials

Speeds Sixteen (16) spindle speeds are obtained on the 2 ft., and 2½ ft., sizes when equipped with regular 4 step cone pulley, and 12 speeds when supplied with 6 change gear box drive. Back gears are located on head and controlled by vertically operated lever at left of spindle. On 3 ft., and 3½ ft., sizes 24 speeds are obtained with cone pulley drive, and 24 with 6 speed box drive.

Feeds A wide range of useful geared feeds, arranged in geometrical progression, is supplied, any one of which may be obtained while the machine is running, by turning star knob until the desired feed indicated on dial comes opposite the fixed pointer.

ARM ELEVATING SCREW

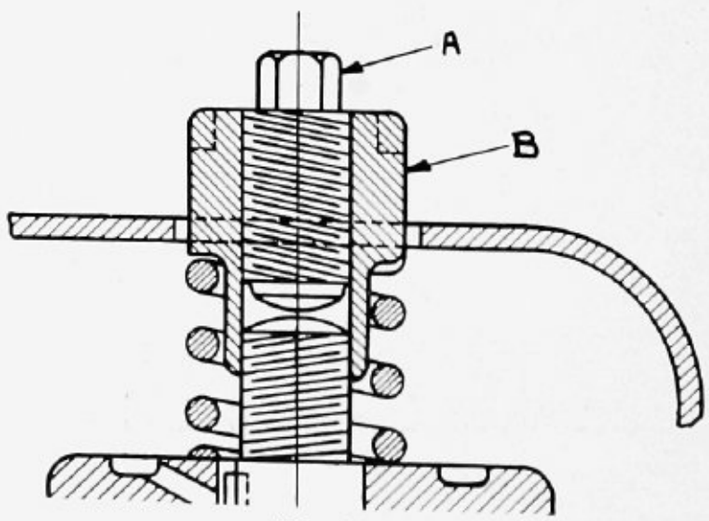

Fig. No. 25

Arm The arm is raised and lowered by a power elevating device, while the machine is running. The fixed binding levers, which bind the arm to the column, must be loosened before the elevating gears are engaged.

In order to prevent breakage of the gears should the elevating mechanism be engaged without first loosening the arm binders, a yieldable

gear is incorporated in the elevating train which will slip before the strain becomes great enough to break the gears. This device consists of a gear mounted loose on the elevating screw, but connected thereto by an improved friction. This friction is carefully adjusted at the works before shipping, and will practically require no other attention, unless it has slipped enough to cause it to wear and permit of slippage under the strain of elevating the arm, in which case great care should be exercised in the adjustment, as too much tension will overcome the advantage of the yielding feature.

If the elevating friction requires any adjustment, the round tension nut and hex. screw which project through the cap must be re-adjusted. (See Fig. No. 25.)

To adjust friction, loosen the lock screw "A," and tighten round nut. "B" a very little, then tighten screw "A." Repeat this if necessary.

"Arrows" on column cap indicate the proper direction to throw handle for raising or lowering.

Speed Box The Speed Box is of the cone and tumbler type providing 6 speed changes. Speeds can be changed instantly while the machine is running at full speed by merely shifting the tumbler lever from one position to another. An auxiliary drive is also provided for rotating the gears while speed changes are being made. This drive operates automatically thru an automatic overtake clutch when the tumbler is raised.

Altho the speed box mechanism is very simple in construction, in order to operate satisfactorily it **must be kept well lubricated** as must all other mechanisms in which the parts run at high speeds.

4-ft., 5-ft., 6-ft. and 7-ft. Plain Radials

Tapping Attachment Tapping attachment is a unit built into the head, and is operated by a pair of powerful friction clutches, which are adjustable for wear. A convenient bolt with lock nuts is supplied for adjusting the tension on the friction bands. They are accessible through the small hand hole covers on rear housing.

Speeds Thirty-two spindle speeds are obtainable when using 8-speed box or cone drives. The back gears are located within the upper rear head housing, and are accessible through hand hole at that

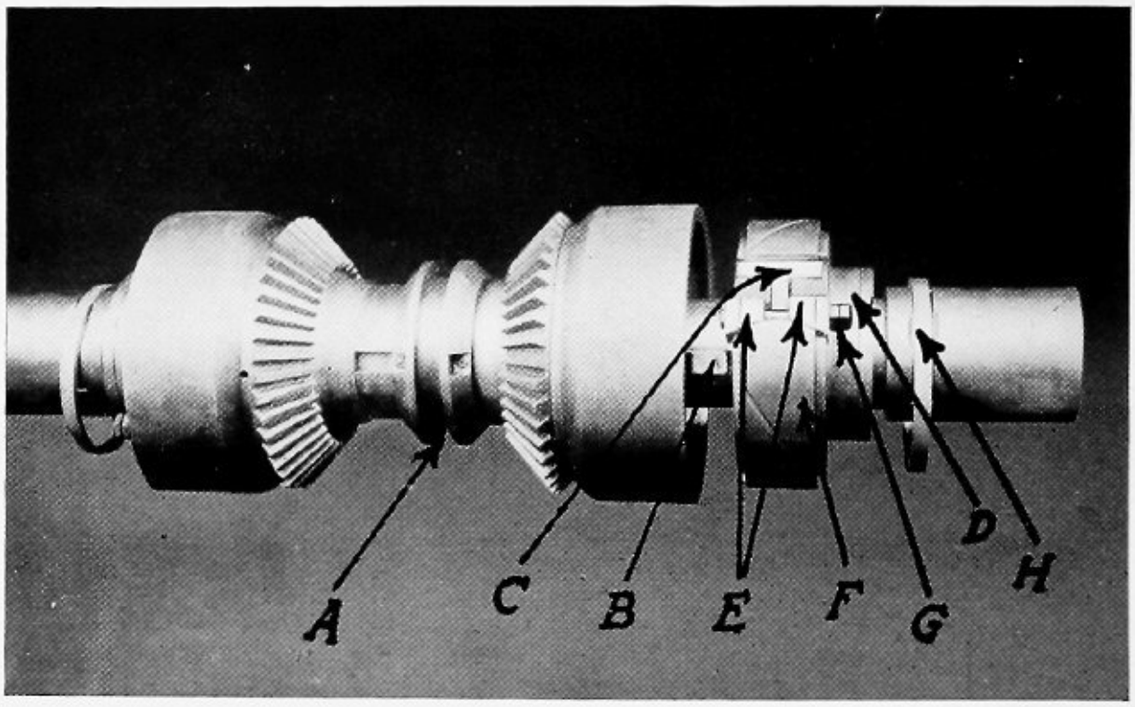

Fig. No. 26—Tapping Attachment

point. The two levers for shifting the gears are located at the left of head, and operate vertical rack bars, which in turn engage the gear shifting fork segments.

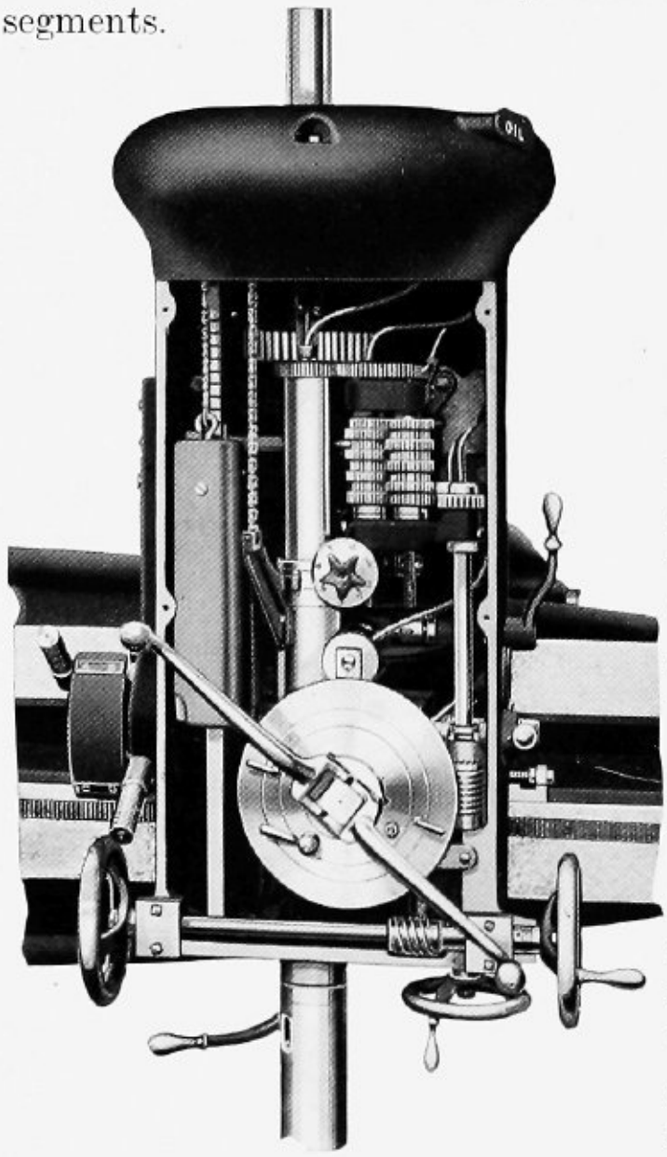

Fig. No. 27—Interior of Head

Feeds Any one of the 8 feeds shown on large feed dial can be instantly obtained by turning the feed star knob until the feed desired comes opposite a fixed pointer.

The feeds are controlled by an automatic tripping device, which trips the feed at any pre-determined point, the depth being read on a graduated dial. All depths read from zero. A trip lever at right side of head, just above the saddle gib is used to trip out and re-engage the feed clutch.

The feed is connected to spindle through a powerful friction operated by a pair of quick return levers, either of which will operate it. The small clamp handle on graduated feed dial is used to lock it in position. The automatic feed trip will operate at any point up to the limit shown on the dial, and it may be reset again to get the benefit of the full

Travel of spindle. Hand feed to spindle is obtained through lower horizontal hand wheel. The hand feed to head is obtained through the two hand wheels on horizontal shaft, the right hand wheel for quick traverse, and the left hand wheel for locating over jigs, etc.

Arm Swinging Adjustment
Column Sleeve Adjustment
Adjustment for Clamping Mechanism

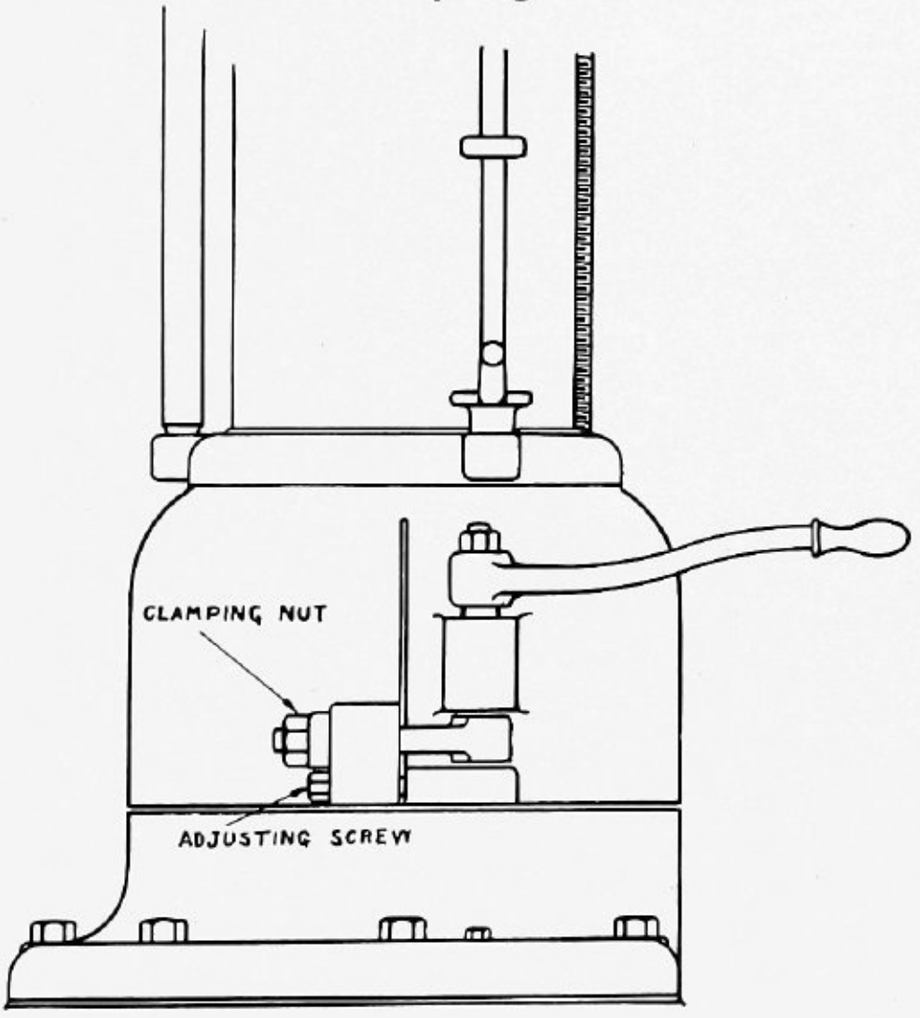

Fig. No. 28

It is impossible to make the swinging of the arm satisfactory to all users. Some want the arm to swing very easily, while others desire less ease of movement. We have decided that a required pressure of about 18 lbs. comes the nearest to meeting with universal satisfaction, consequently have set this as a standard. Recognizing the fact, however, that for some purposes an easier arm movement is better, and that for other work a greater moving pressure is more satisfactory, we have provided means for adjustment between the column and sleeve, by which the required moving pressure can be regulated.

To make the arm swing harder, tighten up on the adjusting screw shown in Fig. No. 25, which increases the friction between the column and sleeve.

To make the swinging of the arm easier relieve the friction between the column and sleeve by loosening the adjusting screw.

Means has also been provided for regulating the clamping effect of the arm binding or clamping mechanism. The clamping effect can be regulated by adjusting the clamping nut shown on Fig. No. 28.

Lubrication The oiling facilities are complete on head and column cap. All the oil tubes are brought to central locations, and are centered in a depression covered by a sliding plate marked OIL. Fill these depressions or reservoirs with a good grade of oil and perfect lubrication of the bearings is insured.

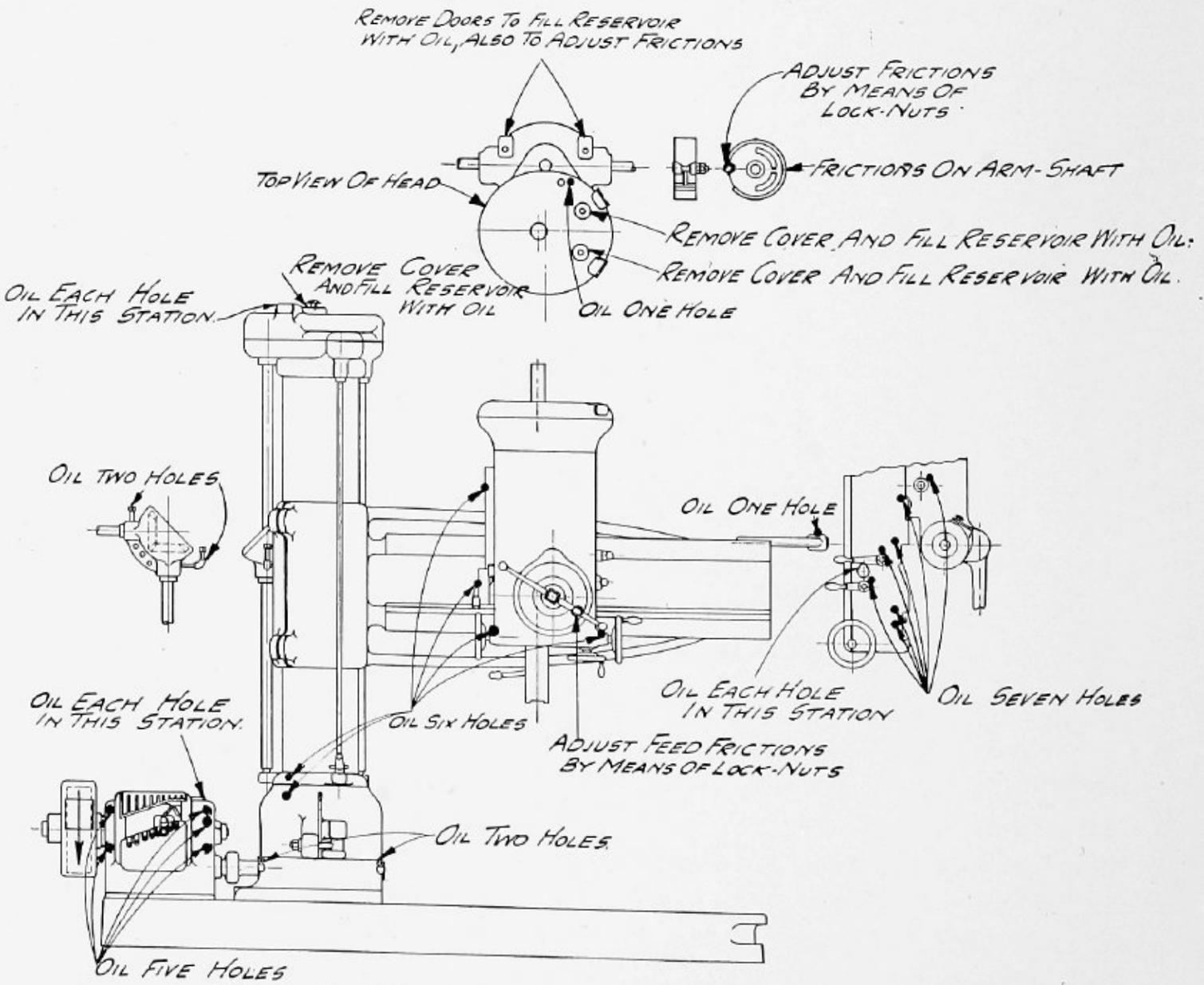

Fig. No. 29—Oiling Diagram for 3, 3½, 4, 5, 6 and 7 ft. Plain Radials

All oil tubes should be filled at other locations on column, base and speed box, as these communicate with oil chambers which hold quite a little oil, and which once filled need only a small amount each day to replenish the supply.

Special Tap Leading Device This device is a separate feed unit mounted in the head housing on special order. Its purpose is to advance the spindle at a series of 4 fixed rates per revolution, to suit the lead of the tap in use. This is used especially when pipe tapping. This feed is independent from the regular feeding device for drilling, and when it is engaged, the regular feed is automatically locked out, and vice versa. A star knob at upper right hand side of head engages either feed or tap leads. A separate feed dial designates the rate of feed, and is operated the same as for regular feeds. An additional star knob at upper central portion of head cover is used to disengage the entire tap lead gear train from spindle.

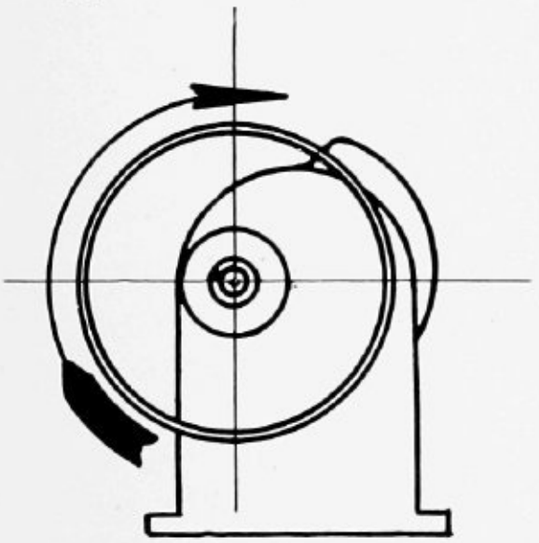

Fig. No. 30—Pulley Rotation

Speed Box Changes in speed box can be made while machine is running without danger to parts. An auxiliary drive thru an overtake clutch is provided to automatically pickup and keep the machine running when changing speeds. This clutch works automatically and needs no adjustment. All speed box parts should be kept well oiled.

Half and Full Universal Radial Drills

Tapping Attachment Tapping Attachment is regularly built in all "American" radials and operates through powerful frictions. In this machine it is located in the saddle and is operated by the long vertical lever at left of head. This lever has also an additional value since it starts, stops and reverses the spindle without disturbing the source of power. Tapping Attachment mechanism should be oiled by filling the oil tubes.

Speeds Twenty-four (24) spindle speeds are obtainable. Triple gears give 3 changes and are located in the saddle. They are operated by levers No. 1 and No. 2 at left of spindle.

Feeds A wide range of 8 useful geared feeds, arranged in geometrical progression, is supplied, any one of which may be obtained while the machine is running, by turning the star knobs on front of head, until the desired feed, indicated on dial, comes opposite the fixed pointer.

In connection with the feeds, an **automatic stop** is provided which acts as a depth gauge reading from zero to the depth desired. To operate:—locate the **graduated slide** so that the depth desired comes opposite the **scratch line** on the guide. Then, as the spindle feeds down, the guide block travels down until the proper depth is reached, when it trips the saw tooth feed clutch in the head. The **short vertical lever,** at left of spindle re-engages the feed clutch and also acts as a hand trip at any point of spindle travel.

Head Head may be swiveled in a complete circle, saddle being graduated in degrees. A removable taper pin locates the head in a true vertical position when desired. The three (3) clamping bolts on head should be pulled up tight when the machine is in operation.

Hand wheel, below arm, moves head along arm or swivels head on saddle to desired angle, by engaging double jaw clutch **below** or **above** respectively.

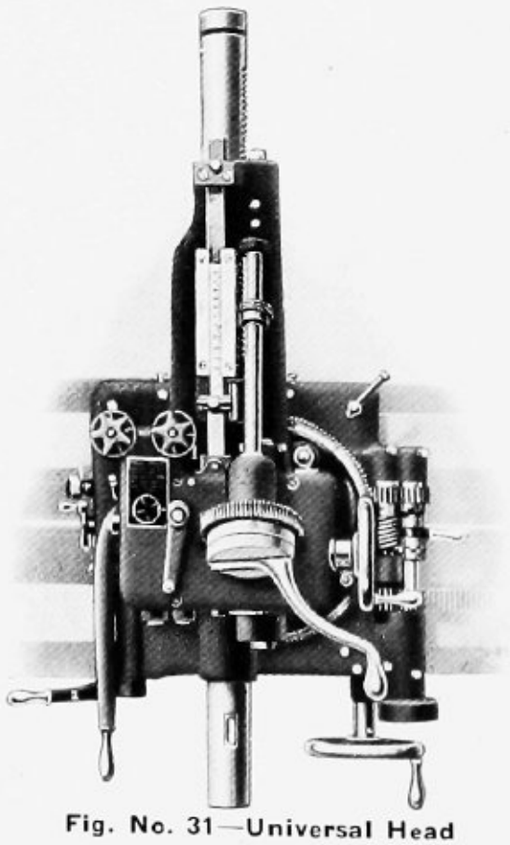

Fig. No. 31—Universal Head

Full Universal Arm Arm may be swiveled in a complete circle by means of a crank which actuates a pair of reduction gears and a worm and which in turn engages a worm wheel cut integral with the arm. The periphery is graduated in degrees. A removable taper pin locates the arm in a correct vertical position when desired. Arm should be firmly clamped to its swivel by the four (4) stationary binderbolts, when operating the machine. It is raised and lowered by power elevating device, while the machine is running. The fixed binding levers which bind the arm to the column must be loosened before the elevating gears are engaged. The arm is stopped automatically at its extreme upper or lower position.

Speed Changes To make the changes of speed in head gearing, the tapping attachment lever should be set neutral before moving levers Nos. 1 and 2, and only engaged slightly should the slip gear or clutch not engage readily. Do not change speed while running the spindle as the speed of the gears is great enough to damage them should the edges of the teeth be permitted to clash under the load.

General Remarks

Be careful to use sharp and properly cleared twist drills and taps.

The speed box lever for obtaining the changes of spindle speeds, may be thrown in at full speed, but longer life will be insured by slowing down to engage the 3 highest speeds.

An index plate on arm shows the proper position of levers for the desired speed for various sizes of drills and taps, within the range of the machine. It gives the proper speeds for both carbon and high speed drills.

Back gears will be relieved of unnecessary shock when changing speeds in the head by first allowing the machine to slow down, which can be easily accomplished with the tapping attachment lever.

Do not attempt to drill or tap large holes without using the back gears. In order to use a feed up to the limit of capacity, all holes over 1½ inches should be drilled with either 1st. or 2nd. B. G., in accordance with size of holes to be drilled.

Do not drill, face or tap without binding the column to the stump by means of the handle, which is always within easy reach of the operator.

Do not do facing or boring operations without binding the head to the arm by means of the binder handle located on head.

Our spindles are reamed to suit Morse Taper, but they will afford a liberal hold on the tang of either Morse or Cleveland sockets.

Do not use old battered sockets in the spindle and expect to get good results. You cannot expect to get good results without keeping drills ground with proper clearance, and points thinned down. The latter applies especially to the large drills where points are heavy when received from the drill makers.

The **quick return lever** should be used solely for the quick advance and return of the spindle, and to engage or disengage the feed friction; therefore, do not use same as a means to drive drills up into the spindle socket.

Do not attempt to drive large pipe taps without the use of a suitable chuck. Such a chuck should be made to slip over the nose of the spindle and slide freely on a pin through the tang hole, which will prevent the chuck from sliding off the spindle and act as a driver as well. Allow some end play in chuck to prevent stripping of threads at start or reversal. In large tapping operations, the friction created is so great that the tap is liable to strip the threads, particularly when working in cast iron, unless assisted by the operator by turning the quick return lever, and the power feed should be disconnected before attempting to back out a tap.

To obtain the best results from a radial drill the installation must be made with care, and in accordance with the instructions given on the foundation and erection plan sent with the machine.

On the larger sizes of radials a jack screw is supplied which is located close to the column at the center point of the base. This is necessary because the rim of the base is only part in contact with the foundation, and the weight of column, arm and head together with the weight of heavy work is concentrated at this point.

This screw should bear upon a piece of flat steel about ½ inch in thickness, which should be set into the foundation.

Extreme care should be used in driving the wedges at the points shown on the plan.

Construction Number When ordering extra attachments, accessories, or repairs for any of our machines, it is well to refer to the construction number of the machine, since by so doing, there can be no doubt as to the exact size and style of machine for which the parts are desired.

Every radial drill built in our shops has its construction number consisting of 5 figures, plainly stamped on the **end of the arm.**

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