ACCURACY BULLETIN

3

AMERICAN

LATHES
PLANERS
SHAPERS
RADIALS

THE AMERICAN TOOL WORKS CO.

CINCINNATI, U.S.A.

"THE FIRST COST SHOULD NEVER DETERMINE THE PURCHASE OF A LABOR SAVING MACHINE. The ultimate cost which is the sum of first cost plus the cost of maintenance, is the thing to be considered. There comes a time sooner or later when the ultimate cost is twice or thrice or many times the first cost. Just when that time will come depends upon the wearing power of the tool. If there is anywhere that quality counts, it is in a machine tool; for "Quality" is that element in a machine which keeps the ultimate cost down by keeping down the cost of maintenance. It pays to buy "quality" machines."

THE PURPOSE

The purpose of this bulletin is to acquaint its readers, by means of illustrations and short descriptions, with the very accurate workmanship which enters into the construction of "American" Tools.

We believe that machine tool purchasing is being done on a more intelligent basis than ever before and that buyers are entitled to know the kind of workmanship that enters into the construction of the machines in which they are interested, because the workmanship of a machine is the chief factor upon which its economic value depends. We in no way wish to minimize the importance of design, for a good design is absolutely essential to an efficient machine, but no matter how excellent the design of a machine may be, if good workmanship is lacking its value is practically lost.

It is not difficult for a competent machine designer to develop a good design. That is only a matter of a few days work and when it is finished, the design goes on record, whereas workmanship must be constantly developed day after day and year after year without ever reaching a predetermined point where further development is unnecessary.

High grade workmanship is essential to a machine tool. There is absolutely no room for argument on this point. It is only reasonable to assume that a machine of poor workmanship cannot possibly stand up to continuous service and produce accurate work the same as a well built tool.

The argument is some times advanced by purchasers when buying machine tools, that a certain machine, altho it be not of the very highest quality, still, is good enough for their work. That is a mistake. No machine work, produced for profit, can be economically done on an inferior machine. Even if such a machine were capable of producing accurate work when new, how long would it last? How long would that machine run after its installation without having to be shut down for repairs? How often would such breakages occur and what assurance would the purchaser have that the repair parts he would have to order and for which he would very likely have to wait a considerable length of time, would be absolutely interchangeable with the broken parts?

These questions can best be answered by the hundred of manufacturers who once held these same views; but who are now installing only the very best of tools. They

have discovered the fallacy of allowing the first cost of a tool to influence its purchase and are now buying machines whose maintenance cost, they believe, will be the lowest.

Select the most progressive concerns, those whose businesses are flourishing, and s if they are not the ones which are using the highest grade of machines in their shops an are employing the most modern and improved methods. The reason for this is clea enough. Practically every wide awake manufacturer realizes that there comes a time in the life of every machine tool when its maintenance cost will surely exceed its first cost. Just how soon that time will be reached naturally depends upon the quality of workmanship in the machine, assuming, of course, that the machine will be free from abuse. The only true economy, therefore, in buying machine tools is in buying the very best that can be obtained.

Now, the question arises, what machines do and what machines do not possess a high degree of workmanship. This is probably the most difficult question for a prospective purchaser to determine, for unless he can actually see the machine in the process of construction, and the methods used in its manufacture, there is no way for him to positively determine this point.

Unfortunately, the quality of a machine is not apparent on the surface. One cannot possibly determine from simply looking at a photograph or a halftone of a machine tool or even from observing the machine itself, whether or not quality is one of its assets. Quality exists in the bearings, in the gears, in the alignment, in the material, in the machining and fitting of every piece, both large and small that goes to make up the complete machine.

We realize that the only way to determine these points is to get right out into the shop where the machine is being built and observe every step in its construction, and we therefore, take this opportunity to issue to every reader of this bulletin a cordial invitation to visit our works at his convenience, in order that we may have the pleasure of making his acquaintance and of proving to him the quality of "American" Tools.

This is an invitation to you, Mr. Reader, which we hope you will accept the next time you come to Cincinnati. Our works are only a ten (10) minute walk from the hotel district, (the heart of the city) which fact, we trust, will make our invitation all the more acceptable.

We understand, of course, how impossible it is for every person interested in machine tools to visit our plant, and we, therefore, issue this bulletin as the next best method of showing the careful manner in which "American" Lathes, Planers, Shapers and Radial Drills are built.

IN GENERAL

"American" Lathes, Planers, Shapers and Radial Drills are built in lots, the number in each lot depending upon the size and type of the tool being built. Each type of machine is erected in its own individual department which is under the direct supervision of an experienced foreman.

A very complete jig and tool system has been developed for use in the manufacture of our product which insures the accuracy, exact duplication and interchangeability of parts. A jig designing department is maintained in addition to our regular engineering corps, the purpose of which is to develop new jigs to improve and complete our jig system. To insure the very highest possible degree of accuracy in the jigs, a set of Johannson gauges is used for testing the center distances, heights, etc.

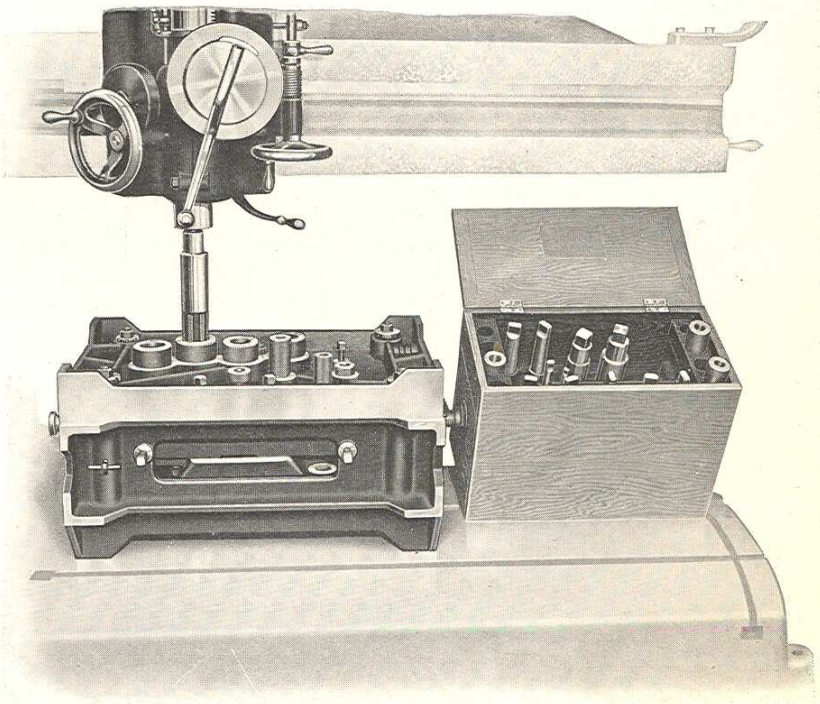

Fig. No. 8. Showing the method of boring and tapping "American" High Duty Lathe Aprons thru a jig.

In order to produce machines of the highest efficiency, the greatest care is exercised in machining the individual parts, in selecting the different materials, and in securing the alignments. For example, each mating pair of gears used in the construction of "American" Lathes, Planers, Shapers, and Radial Drills is cut with a special cutter made

especially to cut the exact pitch and number of teeth required for that particular pair, and, after being cut, the gears are carefully tested on a special gear testing machine having micrometer adjustment. This insures the use of gears that are absolutely correct; consequently, a minimum amount of power will be lost thru the gears in transmission and a smooth and quiet drive will result.

Loc. Number 6R23 — RADIAL DRILL INSPECTION RECORD. — Construction Number 34247

Size 5' Radial — Type Plain — Size of Drive 1 Spd. GB

ALIGNMENT RECORD.
ALL TESTS MADE IN THOUSANDTHS

BASE WITH ARM All Sizes	BASE WITH SPINDLE All Sizes	TABLE WITH SPINDLE 2'-2½"-3'-3½"	TABLE WITH SPINDLE 4'-5'-6'-7'
0 / 0 / .001 / .001	0 / 0 / .002 / .001		0 / 0 / .002 / .002

Spindle Runs .001 — Out in 12 — Inches — True

Spindle Bored #5 — Morse Taper — Special

THE FOLLOWING QUESTIONS MUST BE ANSWERED

BASE

- Has base been tested with straight edge and level? ✓
- Is it straight? ✓
- Will it level? ✓
- Has base been chipped to match column? ✓
- Has base been chipped to match gear box? ✓
- Are T-slots chipped and filed? ✓
- Is base polished? ✓
- Is leveling bolt in base? (4'-5'-6'-7' sizes). ✓
- Is drill fitted with plain base?
- Is drill fitted with base arranged for motor drive?
- If motor drive base is used, is extension for motor cast with base?
- If motor drive base is used, is extension for motor bolted to plain base?

ARM

- Does arm fit sleeve? (Test with feelers). ✓
- Are adjusting bolts set right? (So oil does not smear when arm is raised or lowered). ✓
- Is adjusting bolt locked with set screw? ✓
- Are arm binders set? ✓
- Are binder studs locked with set screw? ✓
- Is arm miter bracket set and dowelled? ✓
- Is bronze liner on arm bracket anchored? ✓
- Is cover fitted to arm miter bracket? ✓
- Will cover clear miter gears and vertical shaft? ✓
- Is arm shaft support set? ✓
- Is pad chipped to match arm shaft support? ✓
- Does arm show good scraped bearing? ✓
- Does rack fit arm? (Test with feelers). ✓
- Is rack polished? ✓
- Are taper pins in rack? ✓
- Is elevating nut tight in arm? ✓

BACK BRACKET

- Is back bracket set correctly and dowelled? ✓
- Is head chipped to match back bracket? ✓
- Are tapping attachment frictions set correctly? ✓
- Are tapping attachment keys hard? (Test with file). ✓
- Will slip gears remain in any position at high speed? ✓
- Are covers fitted correctly? ✓
- Do covers clear all the gears? ✓
- Do all journals run freely and without heat? ✓
- Do all journals take oil freely? ✓
- Do miter gears run smoothly? ✓
- Do spur gears run smoothly? ✓
- Are all oil pipes in? ✓
- Are all oil pipe caps on? ✓
- Are vent holes in all oil pipe caps? ✓
- Are all spring oilers on? ✓
- Are all oil holes clear of paint or waste plugs? ✓
- Is there any paint on any scraped or polished parts? ✓
- Is the correct index plate on this drill? (See drawing). ✓
- Does this drill get an agent's name plate? Yes
- Are index and name plates put on straight?
- Does tang slot in spindle correctly fit hardened standard?
- Does shoulder in hardened standard clear bottom of hole? (Note length of grip).

COLUMN AND DETAILS

- Does column fit base? (Test with feelers). ✓
- Are taper pins in column? ✓
- Does table fit column?
- Is adjusting bolt set?
- Is leg fitted to table? (Test with feelers).
- Does sleeve fit column? ✓
- Will clamping ring lock sleeve? ✓
- Is Sleeve polished? ✓
- Does cap fit sleeve? ✓
- Do taper pins in cap fit? (See bearing). ✓
- Are bronze liners in column anchored? ✓
- Does cover fit cap? ✓
- Does cover clear all gears? ✓
- Are all oil pipes in? ✓
- Are caps on oil pipes? ✓
- Are vent holes in oil pipe caps? ✓
- Does oil pipe oil teeth of gears in stump? ✓

HEAD

- Does spindle sleeve fit head? ✓
- Does spindle gear fit head? ✓
- Does rack fit sleeve? ✓
- Does rack pinion fit rack without back lash? ✓
- Are graduations on sleeve correct? ✓
- Is feed box set correctly and dowelled? ✓
- Is worm bracket set and dowelled so feed gears mesh correctly? ✓
- Is clutch on worm hard? (Test with file). ✓
- Is sliding clutch hard? (Test with file). ✓
- Does sliding clutch run true? ✓
- Does feed box drive gear run true? ✓
- Can spindle be stopped automatically? ✓
- Does automatic stop binder fit? ✓
- Will quick return friction release when lever is out? ✓
- Does head moving pinion fit arm rack? ✓
- Is head adjusted to arm so arm shows good bearing? ✓
- Is head locking device correct so it will lock head before handle strikes? ✓

GEAR BOX

- Is gear box shaft in alignment with shaft in column? ✓
- Are springs in coupling? ✓
- Are taper pins fitted? ✓
- Is friction set to drive drill when tumbler is up? ✓
- Are stop screws in locking plate hard? (Test). ✓
- Do lock nuts clear tumbler? ✓
- Is locking pin hard? ✓
- Are screws set so tumbler does not mesh too tightly? (Test). ✓
- Is guide plate set correctly? ✓
- Is index plate set correctly? ✓
- Do the gears run smoothly? ✓
- Does tumbler, when up, clear all gears? ✓

TABLE

- Are T-slots in round table chipped and filed?
- Are T-slots in plain box table chipped and filed? ✓
- Are T- slots in plain swinging table chipped and filed?
- Are T-slots in worm swiveling table chipped and filed?
- Is table polished? ✓

INSPECTED Dec 28 1911 — BY Wm Hammerath

Fig. No 2. Inspection Record of a Radial Drill.

The materials entering into the construction of "American" Tools are the very best that can be obtained for their respective purposes. That is a subject to which we have given very careful study and we positively guarantee all the material used in our machines.

To insure uniformity in our materials, we have secured the services of a prominent metallurgist who frequently tests, both chemically and physically, the different metals used in our tools. Thus irregularity in the quality of the metal is avoided.

The aligning methods and inspection system incident to the building of "American" Tools are unusually thorough. For this particular work, a corps of men are employed who are all experts in their work. The methods used in aligning each type of machine are fully described by the following pages.

Every machine before leaving our works is put through a series of running

Fig. No. 1. Bar for testing the accuracy of threads cut by "American" High Duty Lathes.

tests, during which it is made to do a job of work and every thread, feed, speed, etc., is tried out and tested for accuracy. After this test is completed, providing the results are satisfactory, an inspection record is made out, similar to the Radial Drill Inspection Record shown by Figure 2, which contains an accurate record of the machine's alignments. This record is then turned over the the chief inspector who verifies and approves it after which the record is filed for reference.

The machine is now passed on to the shipping department where the necessary preparation is made for its shipment.

Preparation for shipment is a subject which has been given careful and scientific study. For domestic shipment, machines are skidded and securely crated in order to minimize the danger of damage in transit, and all finished parts are covered with a grease or slush to prevent rust. When a machine is damaged in transit it is not merely a question of replacing the broken parts to put the tool in condition again. It very often happens that when such accidents occur, the severe shock to which the machine is subjected strains or bends certain parts, destroys alignments and causes an inestimable amount of trouble and expense in the end. Therefore, the value of careful preparation for shipment cannot be over estimated.

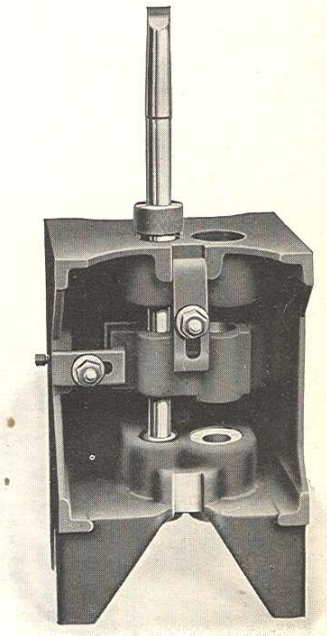

Fig. No. 4. Jig for boring Lead Screw and Feed Rod Bearing.

All loose parts that could possibly be detached and lost are packed in a box which is fastened to the crating. In order to insure machines being shipped complete, we have issued a sheet containing a list of parts which should accompany each machine and when the machine reaches the shipping floor each part is checked off by two checkers before it is prepared for shipment. With this double checking system it is practically impossible for a machine to be shipped with any of its parts missing.

Unusual care is exercised in preparing machines for foreign shipment. We have exported machine tools for approximately 25 years, consequently, thoroughly understand the requirements for over seas shipments. After a machine has been completely knocked down the parts are securely boxed, each piece being strongly braced to prevent any movement inside of the case. All finished surfaces are covered with a high grade slush which positively protects them against dampness. The net and gross weights, cubic feet, shipping marks, etc., are stenciled on the outside of the case or box in large legible figures.

LATHES

The Engine Lathe is the oldest, in point of design, as well as the most universally used of all metal working machines. It is therefore entitled to first place in the order in which we shall describe the methods used to obtain the high degree of excellence characteristic of "American" Tools.

The principles of manufacture which must be observed in producing an accurate and efficient engine lathe are divided into two general classes which may be termed primary and secondary. The former class covers in a general way the efficient combination of skilled workmen with such necessary equipment as accurate machine tools, jigs, precision instruments, etc., by means of which true alignments and accuracy are produced. The latter class embraces the usual "routine" of ordinary machine operations in the production of detail parts such as shafts, studs, brackets, etc.

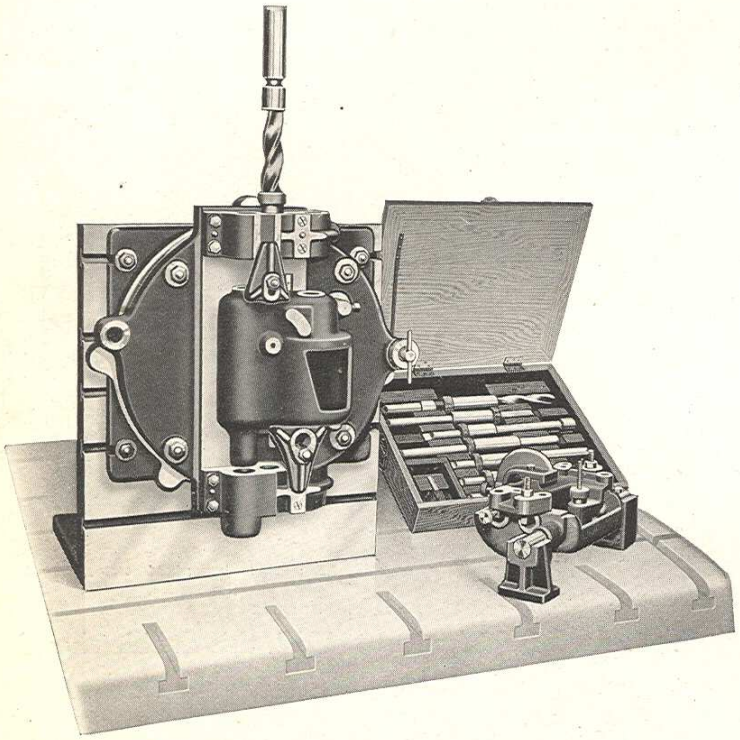

Fig. No. 9. High Duty Lathe, Quick Change Gear Boxes being bored through a Jig on an "American" Radial Drill.

In the following description no attempt will be made to treat of the latter class of shop work, as the conditions involved are common to the average machine shop and are well known to most mechanics. Attention will, therefore, be directed exclusively to such

operations and methods as will be recognized as being essential to the production of accurate machine tools.

The first requisite of an accurate lathe is a perfectly straight bed, and in order to produce this result extremely accurate planers must be used. To assure this condition every planer in our shop is frequently tested and releveled when necessary. In this way undue scraping is avoided, and at the same time a true planed surface is produced which is in every way superior to a scraped surface.

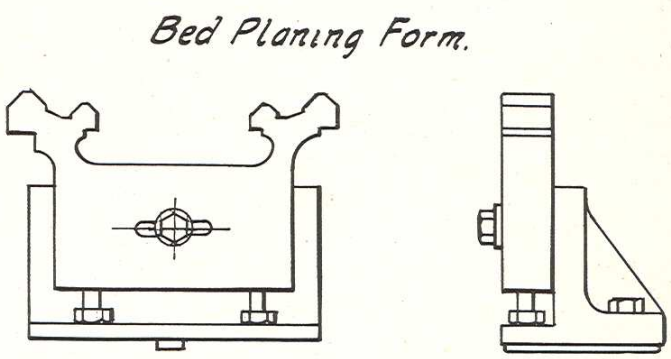

Fig. No. 3. Template for Planing Lathe Beds.

The "vees" of the bed are first planed to a template after which the center distances, heights, etc., are tested by means of suitable gauges. The pads on the front of the bed and the locating grooves for the quick change gear box and the lead screw bearings are then planed by means of templates mounted on the front carriage vee. Thus the lead screw, feed rod and other parts are given an exact, perma-

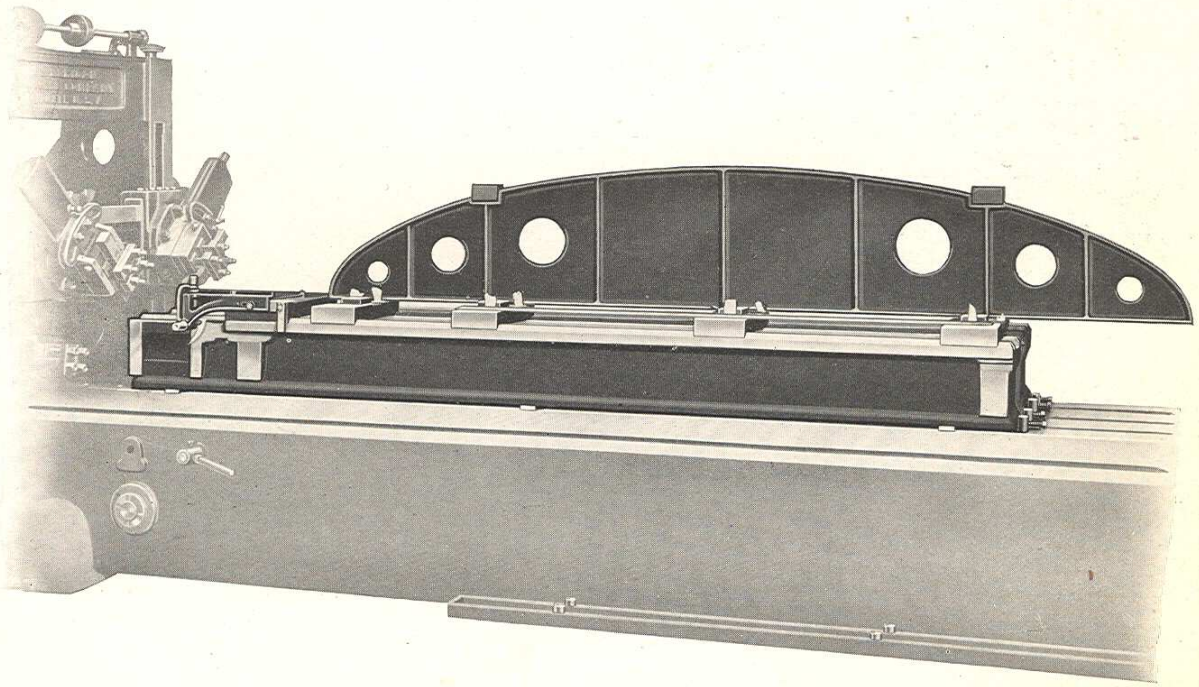

Fig. No. 7. Lathe Beds being tested on the Planer Table after finishing.

nent location on the bed. The headstock, tailstock, carriage, apron, quick change gear box and feed rod bearing brackets are also planed by means of templates and are tested with suitable gauges. The dovetails of the cross and compound rest slides are also planed and tested in the same manner.

After the bed has been completely rough planed the holding clamps are loosened, thus relieving the casting of all stresses after which the finishing cut is taken. The bed is then tested for accuracy (Figure No. 7) by means of four (4) blocks, located at regular intervals on the carriage "vees", which are used in connection with a Brown & Sharpe straight edge placed on the test blocks. Tissue pull papers are placed between the straight edge and the test blocks and if these do not prove the bed to be straight it must be replaned.

The parallel or side alignment of the vees is tested by means of a long straight edge which bears against a shoulder on each of the testing blocks. (See Figure No. 7.) Tissue test papers are then placed between the contact points of the straight edge and shoulders, and must all be held with the same tension. If these tests prove entirely satisfactory the beds are removed from the planer and passed on to the erecting floor where the entire machine is assembled.

Before it can be set up on the erecting floor, the bed must be drilled and tapped and the rack and the legs fixed in place, after which the loose metal on the "vees" is removed by cross scraping and the surfaces spotted. The bed is now ready or the erectors and aligners who first level it up carefully. This is accomplished by placing "Queen" levels at both ends and at the center and then, by driving wedges under the legs, the bed is adjusted until it is shown to be perfectly level.

After the bed is properly leveled, the headstock is placed in position and the spindle aligned absolutely parallel with it, in the following manner. A providing bar two feet long is placed in the spindle taper and readings are taken

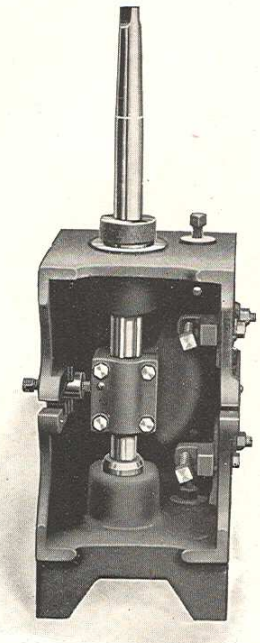

Fig. No. 5. Jig for boring Double Bevel Pinion Brackets.

at different points along the bar both on the top and side with a very accurate and sensitive Indicator which is held in the compound rest. (See Fig. No. 10.) If the variation in these readings indicate that the spindle is out of alignment the headstock is removed from the bed and scraped, after which it is replaced and again tested. This operation is repeated until the variation in the readings taken along the bar is shown to be less than .001 part of an inch which proves that the live spindle is practically parallel with the bed.

The tailstock is now placed on the bed and its spindle aligned with the headstock spindle by the following method. The proving bar previously mentioned is left in position in the headstock spindle and the indicator placed so that its point will rest on the bar, both on the top and front side near the unsupported end. The tailstock, with the spindle set flush with the barrel is now moved along the bed until its center comes in contact with the dead center in the end of the proving bar. The result is obvious. If the tailstock spindle center is not absolutely in line with the headstock spindle the indicator will show as many thousandths error as the tailstock is out of alignment with the headstock. Whatever error exists in this alignment is then remedied by scraping the tailstock ways and adjusting the set over screws.

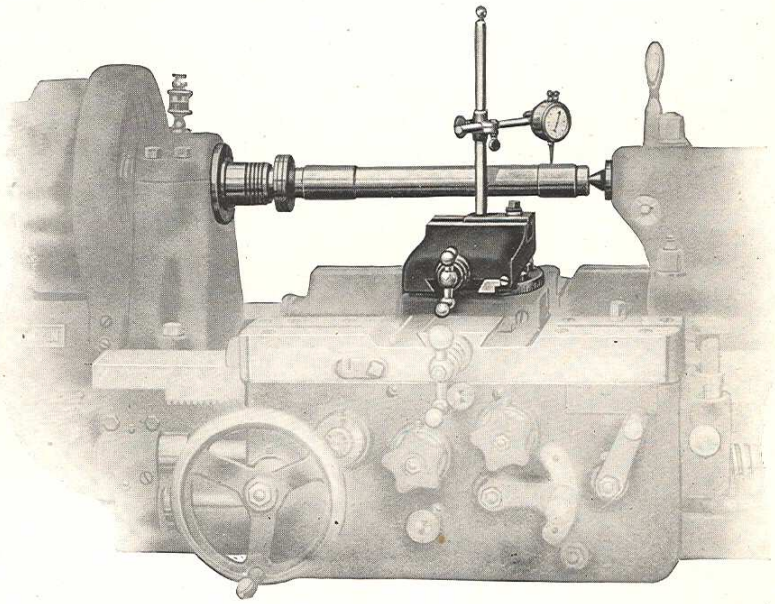

Fig. No. 10. Showing Method of Aligning Headstock and Tailstock Spindles.

The alignment of the tailstock spindle is then tested. With the spindle flush with the barrel, as before, the tailstock is moved along the bed until its center rests in the center of the proving bar. An indicator reading is then taken after which the tailstock is moved back and the spindle extended to the limit of its travel. With the spindle in this position the tailstock is again moved up until its center comes in contact with the

dead center of the proving bar and another reading is taken. Any variation in these readings is evidence that the tailstock spindle is out of alignment and further adjustment therefore is necessary.

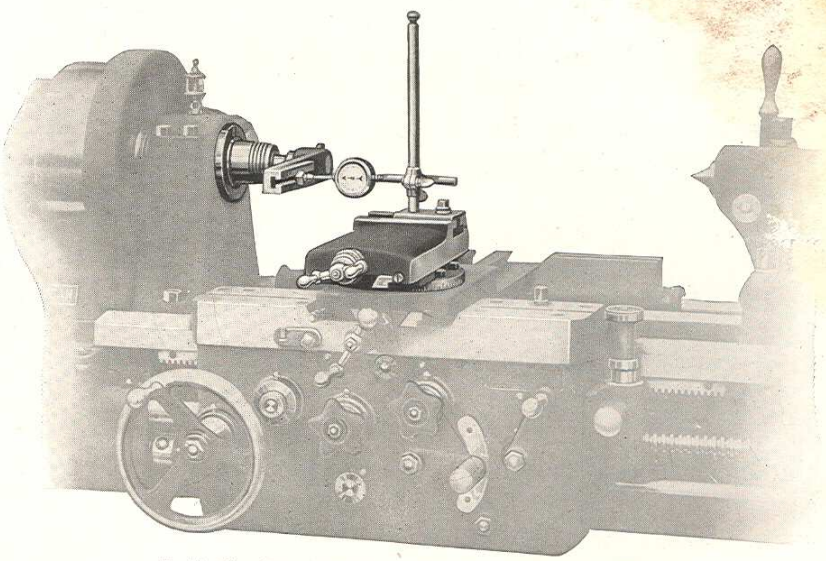

Fig. No. 11. Showing Method of Testing the Alignment of Cross Slide.

After the headstock and tailstock have been aligned, the carriage ways are red leaded and fitted to to the bed, while at the same time the cross slide is "squared up" at perfect right angles to the spindle. In place of the proving bar a tram or squaring arbor is inserted in the headstock spindle taper (See Figure No. 11) with the aligning arm at an exact right angle to the spindle axis. An indicator reading is then taken at the outer end of the tram, the indicator being held in a sliding block mounted on the carriage cross slide, or held in the compound rest.

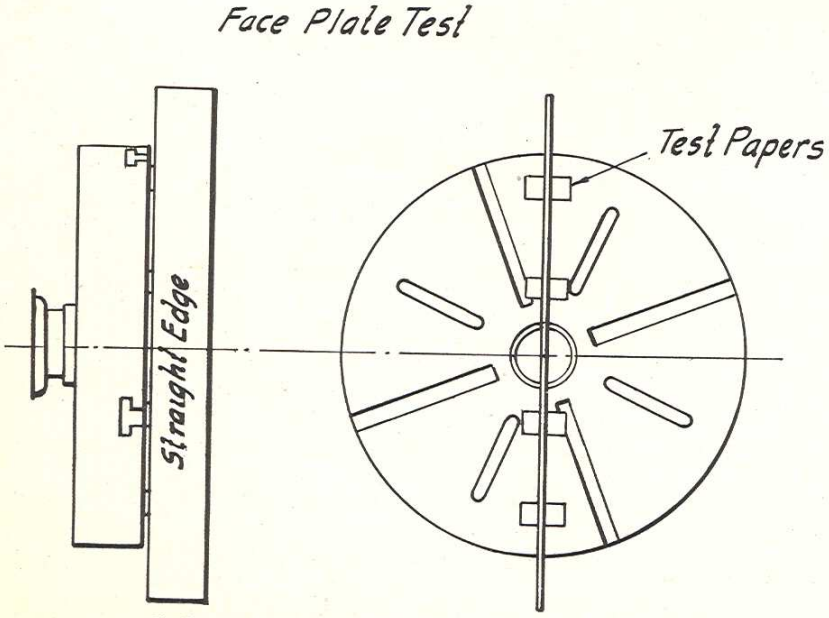

Fig. No. 12. Showing Method of Testing Accuracy of Large Face Plates.

The tram is then swung around 180 degrees to the rear of the spindle and the indicator block moved to the farthest position on that side and another reading taken. If the carriage bridge is not perfectly square with the spindle axis the indicator readings will vary. Should

this prove to be the case, the error is remedied by scraping the carriage ways until the indicator readings show it to be perfectly square.

As a final step in testing the alignments, the large face plate is attached and a finishing cut taken on its face after which the plate is tested with a straight edge and pull papers (See illustration No. 12) to determine whether or not the lathe has faced accurately.

We also wish to call attention to the methods used in chasing the lead screws of "American" Lathes which are such as to assure a uniformly high degree of accuracy; the greatest error allowed being only .001 inch per lineal foot, and as an average this error has proven to be even less. These screws are made from a .45 carbon, ground lead screw stock, and are chased on special lathes of our own design which are used for this purpose only. These lathes are equipped with two lead screws, one of which is used for the roughing operation while the master screw is used only for the finishing cut.

The lead screw is first roughed out to within approximately .015 inch of the finished size and is then removed from the lathe and set up on end to season. After being seasoned it is returned to the lead screw lathe and finished by means of the master screw, after which it is tested for accuracy with a device especially adapted to this purpose.

The master lead screw used for finishing is also tested at short intervals and if found to vary more than the limit of error allowed, it is replaced by a new screw. These master screws are chased from a Brown & Sharpe Master Lead Screw, 26′ long and $3\frac{1}{2}''$ in diameter which is used for no other purpose than the chasing of the finishing screws for the special lead screw lathes.

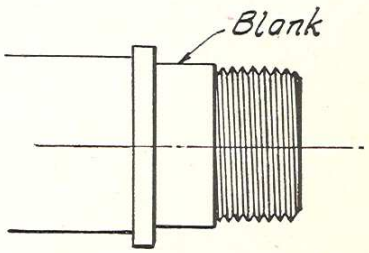

Fig. No. 6. Showing Construction of Spindle Nose.

Another characteristic example of the excellent quality of workmanship in "American" Lathes is illustrated by the method of fitting the face plate to the spindle nose. The face plate is tapped and the spindle threaded to exact sizes by means of master plugs and gauges which are hardened and lapped, thereby insuring interchangeability of all face plates on the same size machine. Figure No. 6 shows the manner in which the spindle nose is threaded, from which it will be noted that only about one-half of the nose is threaded while the other half is blank. The face

plate is chased and turned to correspond, the blank on the plate being made a "twisting" fit to that on the spindle nose. This additional bearing between the face plate and the spindle insures a much greater degree of rigidity to the face plate than is possible with the construction commonly used in which the entire spindle nose is threaded.

After concluding the alignment inspection described in the foregoing, the finished lathe is given a thorough running test of from six (6) to ten (10) hours duration. Under this final test the various speed changes are all "tried out" and the thread changes are tested on a long bar on which every thread shown on the index plate must be chased. The machine is then run at its highest speed for several hours in order to determine if the gears are all running quietly and if the lubricating system is in proper working order. The headstock is then taken apart and the spindle bearings examined as these must show an absolutely perfect contact with the spindle.

An inspection record is then made out and the machine is passed on to the finishing department where it is sanded and the first coat of finishing paint put on. A coat of shell-lac is then applied and finally another coat of finishing paint is applied which produces a beautiful and lasting finish. The machine is then thoroughly cleaned and all oil ducts are flushed out with kerosene applied with small force pumps, after which the oilers are refilled. The machine is then slushed up and made ready for shipment.

PLANERS

In machine construction planed surfaces almost invariably form the foundation from which all other surfaces are fitted and aligned. It is equally true that a planer more nearly reproduces the class of workmanship inherent in itself than does any other machine tool. Therefore, it is of the most vital importance that this type of machine be built with the greatest care, both in respect to its general workmanship and its various alignments, so as to insure the production of work of the very highest degree of accuracy.

The workmanship and alignments of "American" Planers in every detail are consistent with the above principles, as will be evident from the following.

The beds are first planed to templets and are then bored and double reamed by means of a jig located by the planed ways. The cross rails are then planed to standards and are tested for accuracy by means of standard bearing blocks. The top and faces of the rail are afterwards tested with a straight edge surface plate in order to insure perfectly straight surfaces. The saddles are then fitted and scraped to the rail, and all dovetails are tested by means of standard angle blocks. The down slides, clapper boxes, etc., are scraped to Brown & Sharpe surface plates and accurately fitted together.

It is unnecessary, we believe, to enter into a detailed description of these operations. We mention them simply to illustrate the unusual care which is exercised in the building of "American" Planers.

We shall, however, devote the next few paragraphs to a detailed description of our methods of aligning the machine after the various parts reach the erecting floor.

The first step is to level up the bed and to free it from distortion. This is accomplished by means of four levelling bars and a "Queen" level. Starting just in front of the housing seat, the heaviest part of the bed, and therefore the most difficult

to adjust, three of the bars are placed on top of the bed at short intervals and at right angles to the ways, while the fourth bar, which is the longest of the four, is placed so that it rests on top of the three cross bars about midway between the ways of the planer. The "Queen" level is now placed lengthwise on this top bar, which shows whether the bed that point needs raising or lowering. This same operation is repeated until the entire bed has been tested and leveled.

In addition to the above, the bed is further tested to determine whether the sides are of equal height. This is accomplished by simply removing the top levelling bar, and placing the level lengthwise on each of the three bars that are at right angles to the bed.

After the bed has been properly leveled a squaring plate is placed on the bed which serves as a base for the testing square. This plate, which is located by the ways of the bed, is very accurate and is used only for the purpose of aligning planer housings.

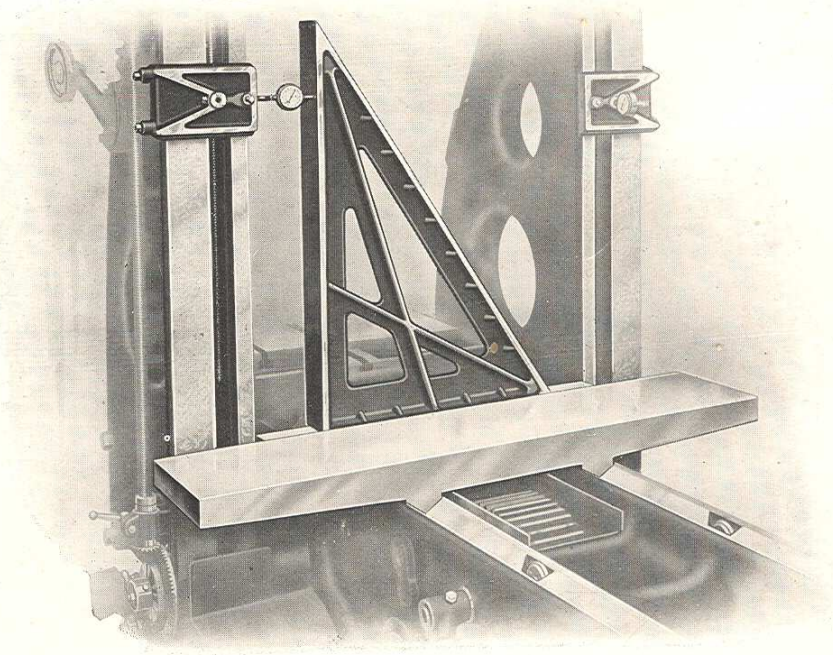

Fig. No. 13. Testing Slide Alignment of Housing.

We now come to the most interesting and exacting work which enters into the construction of "American" Planers. This refers to the alignment of the housings, both with relation to each other and with the bed. Both housings are temporarily fixed into place and one of them is then squared up with the bed in the following manner.

An accurate square, 30″ in height, is placed on the squaring plate, and a jig which carries the indicator is mounted on one of the housings, the indicator first

being set so as to extend inward at right angles to the inside face of the housings. (Figure No. 13.) The square is next placed on the squaring plate so that the indicator point touches the top of the square. A reading is now taken, after which the indicator holder or jig is moved down so that the indicator touches about the center of the square at which point another reading is taken. A third reading is then taken at the bottom in the same manner. Any variation in these readings will, of course, indicate that the housing is out of the perpendicular, and, if this be the case, it is brought into line by scraping until finally all of the indicator readings correspond.

After this alignment has been secured, the location of the indicator is changed so that its contact point will extend from the front face of the housing as shown by illustration Figure No. 14. The position of the square is also changed to correspond and the same process described above is repeated. This test is for determining whether or not the housing is leaning forward or backward from a perpendicular plane parrallel to the bed. Any perceptible error in this alignment is also rectified by scraping.

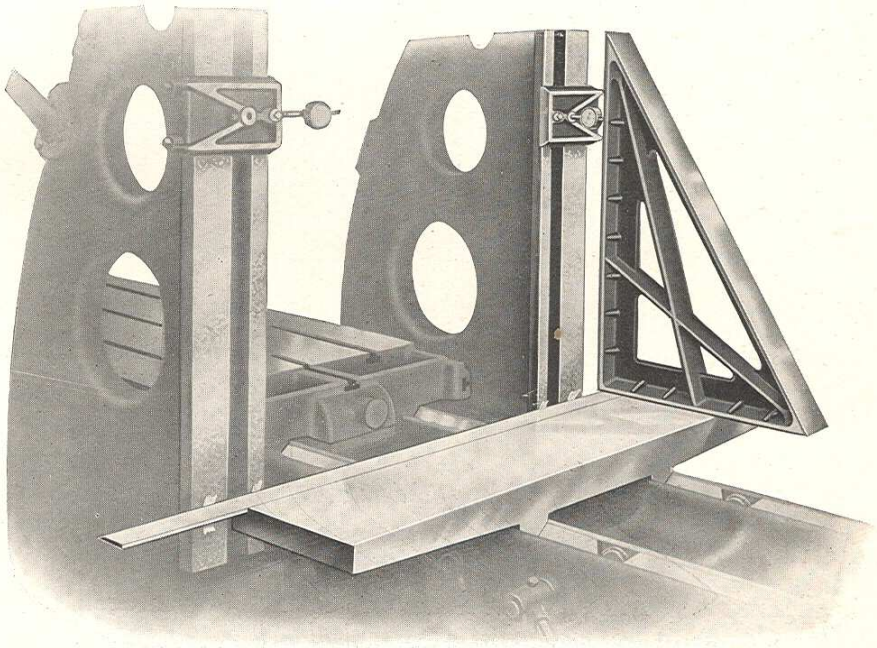

Fig. No. 14. Testing Front Alignment and Faces of Housings.

One housing having been perfectly aligned with the bed, the attention of the aligners is directed to the other housing which is also brought into alignment by the same careful and thorough method.

The bed has been previously proven absolutely straight and level, the hous-

ings perpendicular to it and parallel with each other. It must now be determined if the faces of the housings are in exact alignment with each other. To test this, the square is removed and a Brown & Sharpe straight edge is placed on the front edge of the squaring plate on a suitable ledge planed at right angles to the fixture. The plate with the straight edge is now moved up to the housings until the straight edge bears against their front faces and strips of tissue paper are placed between the straight edge and the faces of the housings at the inner and outer edges. Obviously these strips will all be held fast if the housings are in alignment. If, on the contrary, some of the papers do not hold, it proves that the housings are not in alignment and further adjustment is required.

With reference to the square mentioned above, it might be interesting to know that every time one of them is to be used it must first be tested for accuracy on a special testing apparatus which we have developed expressly for this purpose, and which will indicate the slightest variation from truth.

The next step in the aligning of the planer is simply a check on the accuracy of the squares and squaring up plate. Readings are taken at the top, center and bottom of the housings, with inside micrometers, which again prove that the housings are parallel. If this last test proves satifactory the housings are finally secured into their respective positions by dowel pins, in addition, of course, to the regular fastening bolts.

The arch is now placed in position and the housings again tested in the same manner as described above, to determine whether the application of the arch has in any way affected their alignment. Allowance is made on the ends of the arch for any necessary scraping.

The completely assembled cross rail is now placed in position on the housings. Then a leveling bar is set crosswise to the bed, the ends being supported by standard rollers placed in the bed vees. This leveling bar is used as a base for two templet blocks upon which the cross rail is supported temporarily while the elevating mechanism is being assembled and adjusted. The rail is now raised sufficiently to permit the removal of the rollers, bars and templets and is then tested for accuracy of alignment with the housings. A square is placed on the top surface of the rail and readings are taken along its perpendicular face with an indicator which is held in a fixture adjustably mounted on one of the

housings. This fixture is then moved up and down and if any perceptible variation occu in the readings, that end of the rail which supports the square is adjusted by means o a flange coupling which divides the elevating shaft in the center. After the rail is shown to be perfectly square with the housings this coupling is bound together by two clamping bolts.

This alignment is tested with the rail at its lowest extremity; therefore in order to test the accuracy of the elevating screws the rail is raised and the same test as described above is repeated. It is evident that if the rail still retains its alignment with the housings the elevating screws must be accurate. These screws are guaranteed to be cut within a limit of accuracy of .001 inches per foot.

We are now ready to fit the table to the bed. The table vees are first scraped to remove the loose iron, after which they are red leaded, placed in position on the bed and drawn back and forth several times in order to show any high spots in the bearings. The table is then removed and any necessary scraping is done. This scraping is usually limited to that required to remove the loose metal as these parts are very accurately planed by means of suitable jigs, consequently very little fitting need be done with the scraper. As evidence of this fact we will guarantee that all tables are interchangeable with any bed for the same size planer and that they can also be reversed end for end, thus conclusively proving the accuracy with which they are planed.

After the table is fitted in place the T slots are planed from the solid and the top of the table is finished planed in its permanent position on the bed. Thus every planer is required to finish up its own table.

The table is now tested by the same method with which the housings were tested excepting that the table itself instead of the squaring plate forms a base for the square. If the indicator readings still correspond it is conclusive proof that the table and housing are perfectly square with each other and that the tools are cutting absolutely straight.

A final test to determine the accuracy of the table is made by means of a straight edge and four tissue pull papers placed at various points along the table, both at right angles to and diagonally across it.

The planer is now turned over to the testing department where a detailed examination is made of all its alignments. After this final examination has shown that the p. fulfills all requirements, the inspector in charge makes out and signs an inspection rec which is filed away for future reference. The machine is then sent to the finishing d partment from which it is passed on to the shipping floor where it is carefully prepar for its coming journey.

It will be obvious from a careful review of the proceeding that there is no exaggeration in the claims made for the high degree of accuracy characteristic of "American" planers. As a matter of fact, we believe it would be impossible for skilled mechanics to produce a more accurate or better constructed machine. As a further assurance of their quality we guarantee that every "American" Planer, if properly set up and leveled, will be smooth running and will plane perfectly square and parallel up to its maximum capacity to within .001 part of an inch.

This latter does not mean that every "American" planer is out .001 of an inch in its alignment. This is by no means the case. It does mean, however, that no "American" planer is out more than this. One thousandth part of an inch is the limit of error allowed in aligning these machines, which, under no circumstances, is permitted to be exceeded.

SHAPERS

The Shaper, like the Planer, is very often required to produce extremely accurate work. For example; the shaper is used extensively in the tool room where accuracy is essential, and also in forming molds, dies, etc., which can only be satisfactorily done on a very accurate machine.

A short description of a few of the methods employed in building "American" Shapers together with a few illustrations will, we believe, bear ample evidence of the care and accuracy with which these tools are built.

The first operation on the main housing or column is the planing of the ram slides which are finished to their exact size by means of a planing template. The finished slides are then utilized for mounting the column on a planing jig which locates it at a perfect right angle to the planer table. This permits of accurately planing the rail slides on the front of the column at a perfect right angle to the ram slides.

Immediately after the column leaves the planer it is taken to the Boring Machine Department where all shaft bearings are accurately bored and reamed through jigs which are located by means of the planed surfaces before mentioned.

The ram slides on the column, the full length taper gibs and the ram bearings are then tested with accurate surface plates and scraped until they show a perfect full length bearing. The rail is then tested and is also scraped to a surface plate, after which it is fitted to the face of the column which has previously been surfaced. Before fitting the rail to the column, the saddle, which has also been surfaced, is scraped to a perfect bearing on the rail.

The table which has been accurately fitted to the saddle is now placed in position and the shaper is ready to begin its series of running tests; the driving mechanism, head, etc., having been previously assembled.

One of the most interesting operations connected with the building of this machine is found in our method of finishing the table, a description of which will convey some idea of the care which is exercised in constructing "American "Shapers.

These tables are first put on a planer, the T slots formed and all surfaces rough planed, except the back surface which is to bear against the saddle. This is given its finishing cut on the planer.

The back surface is next scraped to a perfect bearing with the saddle after which with the table bolted securely in place on the shaper, a finishing cut is taken over the top surface and for about one inch down each side. The T slots in the top of the table are also finished and are tested for accuracy with standard gauges. Thus, each shaper finishes the top of its own table and T slots.

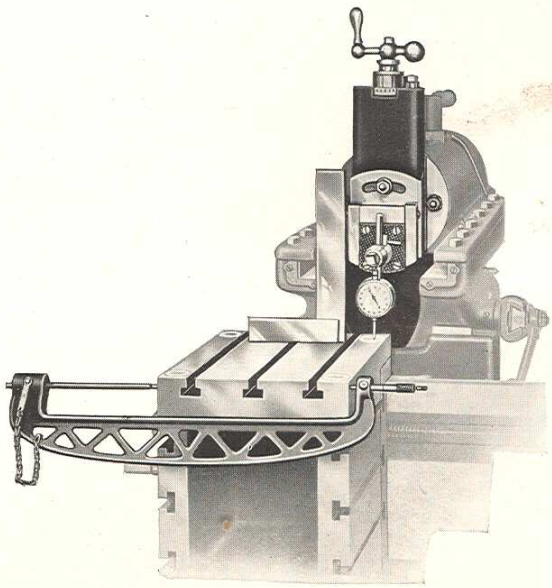

Fig. No. 15. Testing Shaper Table and Down Slide.

The two finished strips along the sides are now tested with micrometers and the top surface of the table with an indicator and a surface plate. (See Illustration No. 15.) In this manner any inaccuracy in the table is readily detected and remedied. The table is then taken off the shaper and sent back to the planer and finished, the two previously finished surfaces and the strips forming the basis from which the sides are squared up for the finishing cut. After finishing, the table is sent back to the assembling floor where its sides are tested with a micrometer and a square in connection with test papers to prove that the table has been planed perfectly square. If the result of these tests is satisfactory the table is bolted to its permanent position on the saddle and a series of final tests are made which prove conclusively the accuracy of all working alignments.

The head is first set to a perfect right angle with the table. This is accomplished by placing a square on the table (Figure No. 15) and then with the indicator at right angles to it, readings are taken along the perpendicular edge of the square from top to bottom to the full limit of the vertical travel of the head. Any inaccuracy in the head is thus detected by the variations in the readings. When the readings indicate that the head is at absolutely right angles to the table the zero line is marked on the ram to correspond

to the zero mark on the swivel. Thus when these two lines coincide it is conclusive proof that the head is in a true vertical position.

The vise is now placed on the table and tested for accuracy. The method of testing the vise is very simple. A standard squaring up devise is placed in the vise (See Figure No. 16) and the vise adjusted until the indicator readings taken along the side of the top block show it to be exactly parallel to the ram. This proves that the vise is holding the block perfectly parallel to the ram and that the jaw is at a perfect right angle to the side of the ram. With the vise in this position zero lines are marked on both sides of the swivel to correspond to those on the vise base, this having been previously graduated in a half circle from zero to 90 degrees on both sides. The proving block is now removed and the vise swung around 90 degrees which should bring the jaws parallel to the ram. This alignment is now tested by opening the vise jaws and taking indicator readings along the face of the stationary jaw. If these readings correspond, the graduations and likewise the vise jaws, are proven to be absolutely accurate.

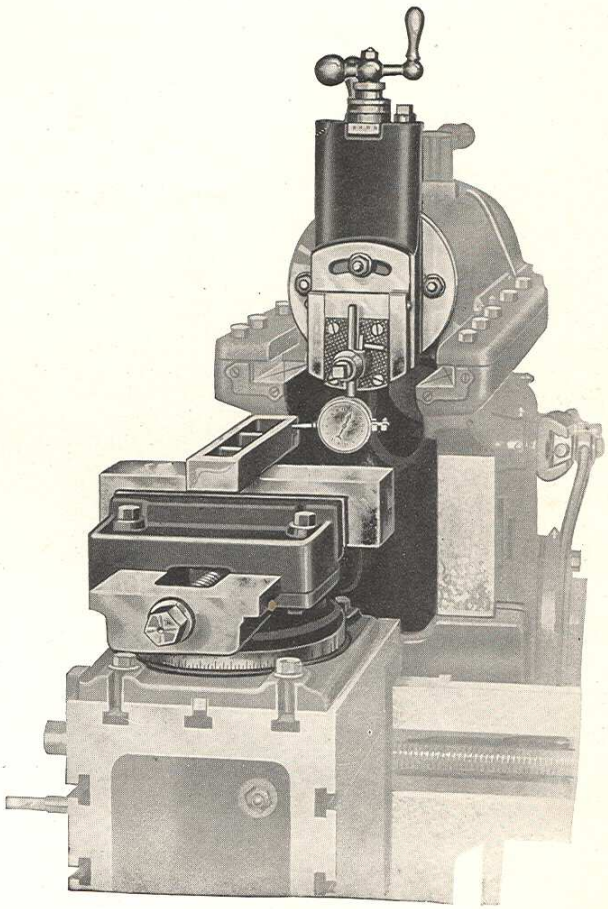

Fig. No. 16. Testing Shaper Vice.

After this final test is completed the machine is turned over to the inspector in charge who examines it in detail and makes out an inspection record similar to those mentioned before, containing a complete record of all the machine's alignments. If the shaper successfully passes this final inspection it is sent to the Shipping Department and there made ready for shipment.

RADIAL DRILLS

The average requirements of a Radial Drill do not demand the high degree of accuracy which is essential to many other classes of machine shop work. Nevertheless, there are occasions when a Radial Drill is called upon to produce very accurate results. In order to meet just such conditions "American" Radials are built with the same high standard of workmanship and with the same accuracy of alignments that characterize "American" Lathes, Planers, and Shapers.

The base is accurately planed and before removing it from the planer table is carefully tested both crosswise and diagonally by means of a suitable straight edge; strips of tissue paper being placed between the straight edge and the base which must all be held with the same tension. It is obvious that this test will indicate any imperfections in the planing.

The columns are first turned on a lathe by means of a suitable fixture, and are tested with micrometers, after which they are sent to the Boring Department where they are bored and reamed thru jigs.

The Radial Arms are first split and drilled and are then bored out to standard gauges on a horizontal boring machine. They are then taken to the Planing Department where they are planed by means of a jig which accurately locates the arm "ways" in their relation to the column center. Before removing the arms from the planer, the "ways" are tested with standard bearing blocks.

A jig is also used in planing the dovetails of the head casting which are afterwards estedt with angle blocks.

The back gear brackets are bored and reamed thru jigs as shown by illustration Figure No. 17, after which the bronze bushed bearings are inserted.

After being planed, the arm ways and arm bearings on the head are cross scraped to remove the loose metal and are then tested with surface plates for perfect bearing surfaces. If necessary, these surfaces are then scraped to remove any imperfections. Very little fitting need be done by scraping, however, for these surfaces are very accurately planed by means of suitable jigs which insure a high degree of accuracy in the surfaces produced.

In order that the finished machines will be smooth running and highly efficient in regard to transmission, every gear used in their construction is cut with a special cutter adapted to the exact number of teeth in each gear. They are then tested for accuracy on a special gear testing machine which indicates the slightest error.

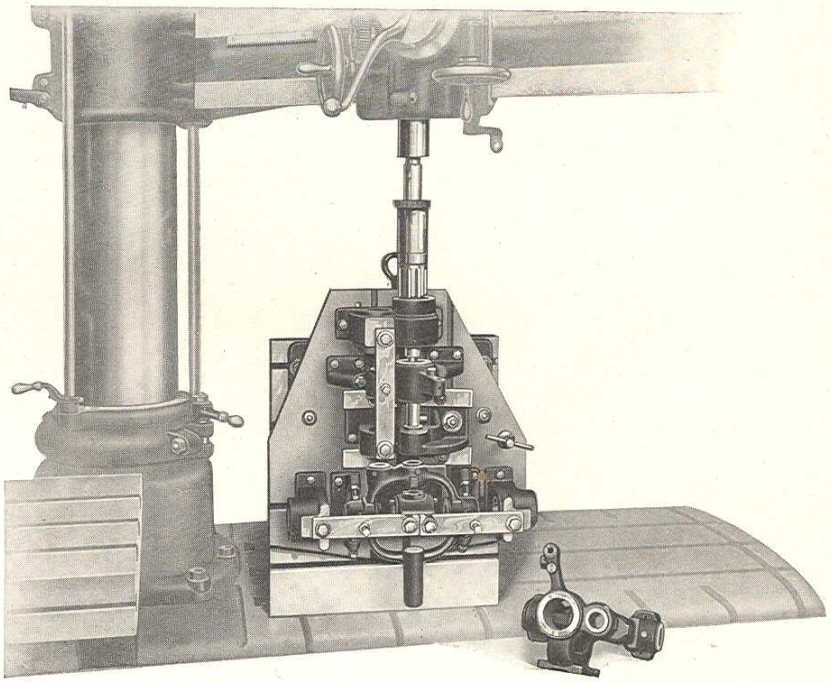

Fig. No. 17. Boring Back Brackets on a Radial Drill.

The friction bands used in the tapping attachment of these machines are ground on a special fixture which holds them in their normal expanded position and therefore insures a perfect contact with the ground surfaces of the gears when the band is expanded.

The alignments of "American" Radials are secured in a very simple and effective manner. After the base reaches the erecting floor it is carefully leveled and again tested with a straight edge and test papers to prove its accuracy. The column seat on the base is tested with a surface plate and any necessary scraping is done to insure an accurate

bearing between the base and the column. The column is then bolted to the base, and the sleeve, arm, head and driving mechanism assembled.

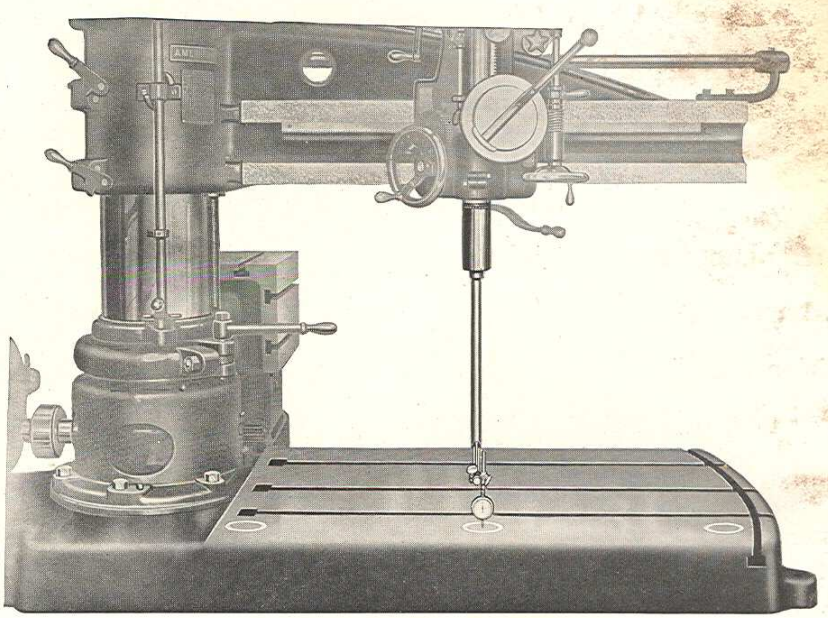

Fig. No. 18. Testing Radial Drill Arm.

The arm is then tested for alignment with the base. A tram holding an indicator is placed in the spindle and the head is run along the arm as far as possible towards the column. Here an indicator reading is taken on the base. The head is now moved to a central position on the arm and another reading is taken as indicated by illustration Figure No. 18, after which a further reading is taken with the head at its extreme position from the column. If these all correspond it is evident that the arm is perfectly parallel with the base.

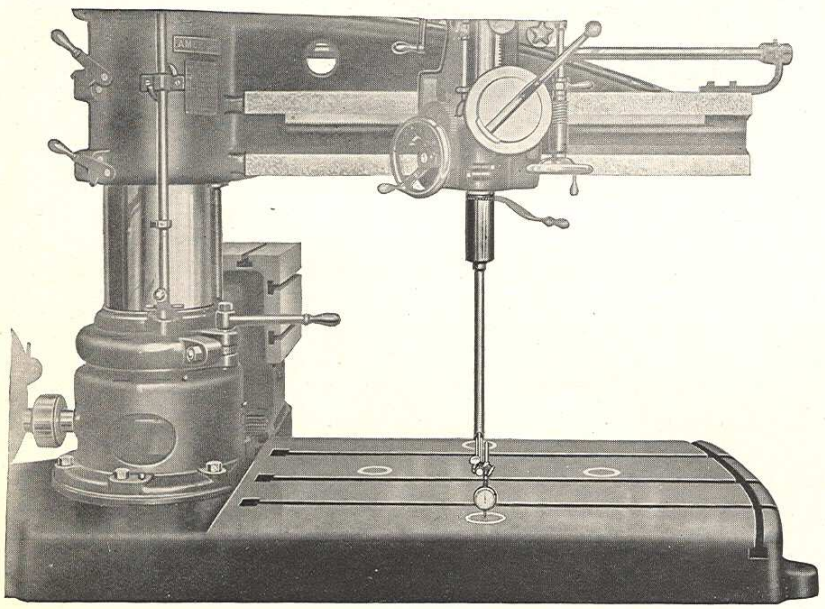

Fig. No. 19. Testing Radial Drill Spindle.

The next test is to prove the accuracy of the spindle in relation to the base. The head is locked in a central position on the arm and, with the tram still in the spindle, readings are taken at four equally distant points around the circumference of an imaginary

circle described by the indicator point when the spindle is revolved. This test is shown by illustration Figure No. 19. If the readings coincide, it proves that the spindle revolves in a plane exactly perpendicular to the base.

The table bearings on the base (on 4, 5, 6 and 7 ft. sizes) are next scraped to a surface plate and the table bolted in position. It is then tested with a square and test papers after which the arm is swung around and an indicator test made over the top surface of the table as shown by illustration Figure No. 20. In this manner the top surface of the table is proven to be level and at right angles to the spindle.

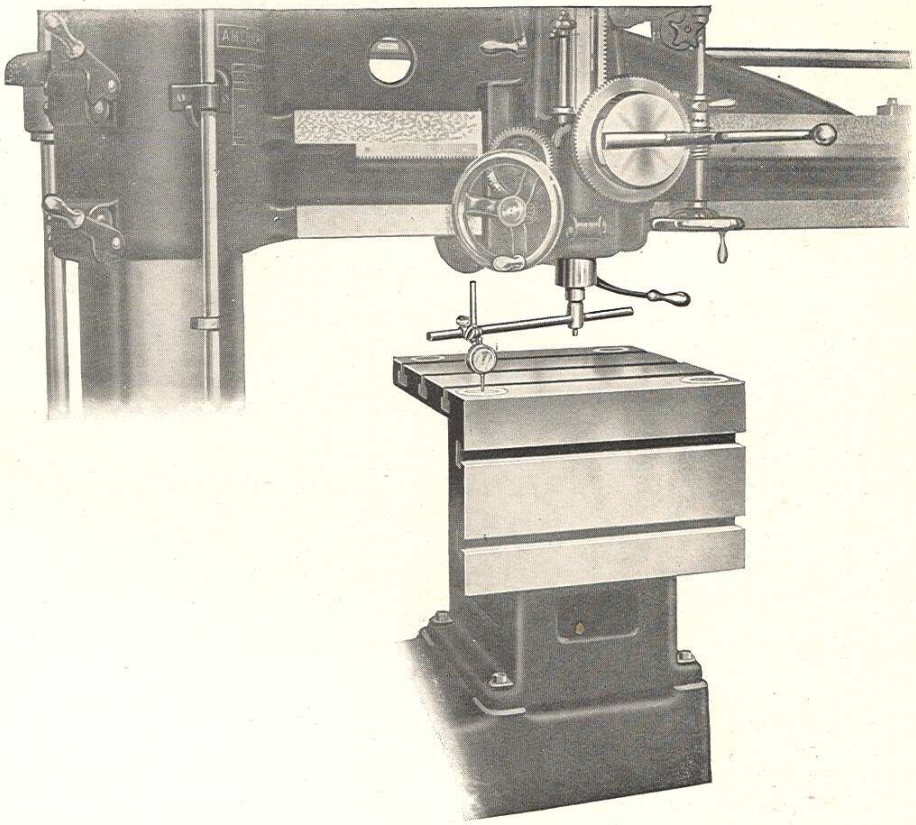

Fig. No. 20. Testing Radial Drill Table.

After these tests are completed an automatic head moving device is attached to the head of the drill, by means of which the head is run back and forth along the arm in order to eliminate any "stiffness" in the movement of the head.

The machine is then turned over to the inspector in charge who verifies and records its alignments. An inspection record is then filled out and signed by the chief inspector, after which it is filed away for future reference.

SUMMARY

It will be evident from a careful perusal of the preceeding paragraphs and examination of the illustrations that neither expense nor intelligent effort is spared to produce in "American" Tools the very highest degree of efficiency.

Knowing the class of workmanship and kind of material used in their manufacture, we do not hesitate to fully guarantee our machines in regard to the workmanship, accuracy of alignments and quality of material which enters into their construction.

If you are at all doubtful, we only ask your careful investigation of our product. We have our machines running in all parts of the world, and if you cannot come to Cincinnati to investigate we shall gladly advise you where you can see "American" Tools in operation in your immediate vicinity.