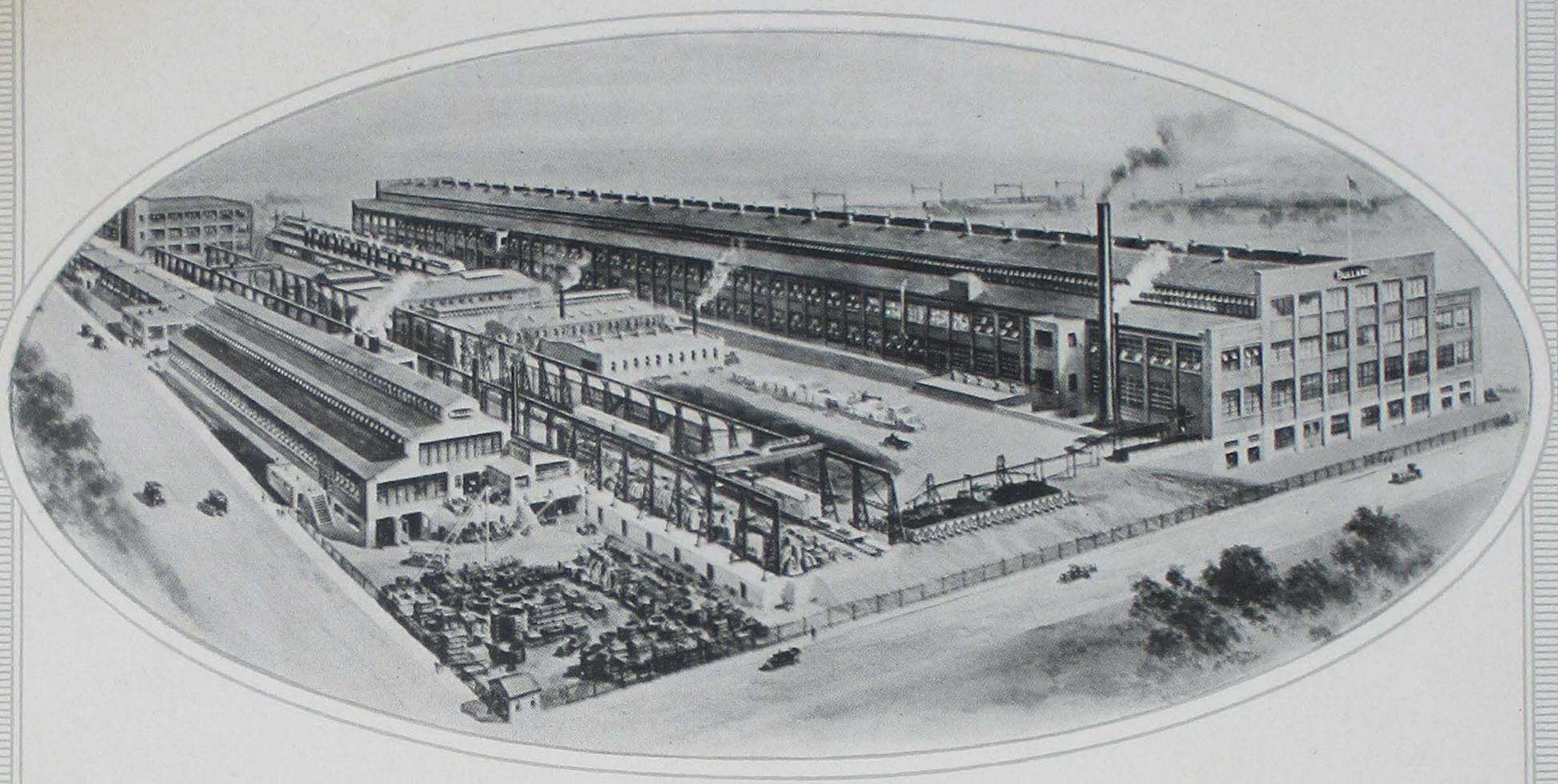
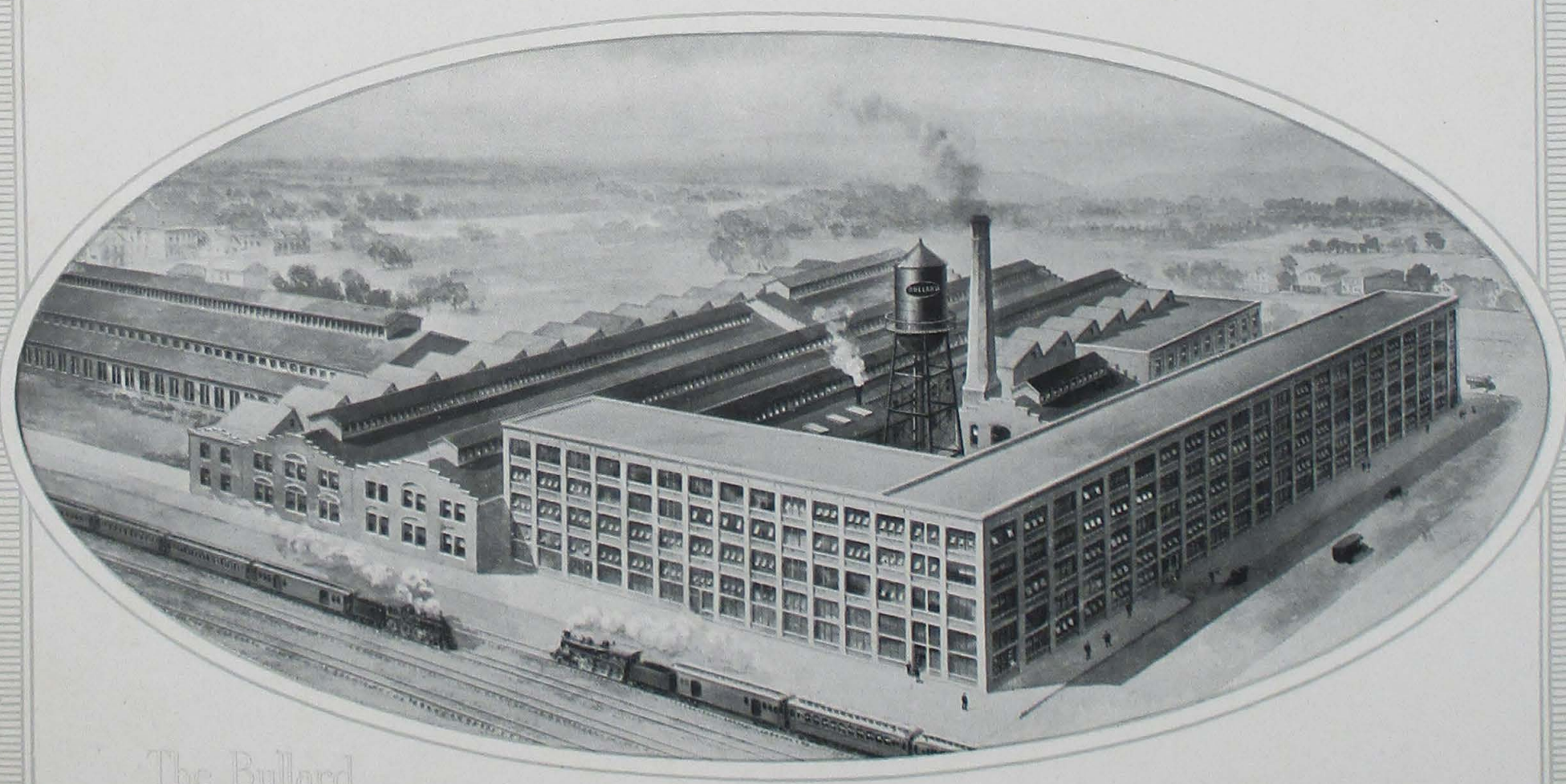
CUTTING TIME BETWEEN CUTS

BULLARD



The Bullard Foundry
and Heavy Duty Machine Shop



The Bullard
Machine Shop

CUTTING TIME BETWEEN CUTS

with the

BULLARD

VERTICAL TURRET LATHE

A Multi-purpose Machine Tool
of universal adaptability,
having in its design many
structural and operative
features of great advantage
in the machining of face
—— plate work ——

THE BULLARD MACHINE TOOL COMPANY
BRIDGEPORT, CONN., U. S. A.

V-27

PROGRESS

Progress in Machine Shop Practice has been general and rapid. The demand for an increased output, of an improved quality, has met with prompt response on the part of designers and builders of shop equipment.

The scope of certain types of equipment has been broadened to a remarkable degree, and methods formerly considered "good practice" have been superseded by others, resulting in a great increase in production.

The application of modern grinding methods has improved the quality of finish and accuracy of dimensions of all manner of cylindrical and plane-surface work, at the same time giving an increased output.

In the making of gears many changes have been effected, and the development of drilling, boring and planing machines has been notable.

In no field, however, has there been a more decided advance than in that pertaining to the boring, turning and facing of work held in a chuck—"Face Plate Work."

The Engine Lathe, equipped with a chuck, a compound rest (frequently having a turret mounted on a supplementary carriage) has, for this class of work, been developed along highly specialized lines—the modern horizontal turret lathe presenting great productive possibilities on certain classes of work.

The Vertical Boring and Turning Mill, for work of greater size and weight, was early acknowledged superior to the face-plate lathe in both volume and quality of output. This result reflects directly the greater rigidity and convenience of the type as well as the fact that "it is easier to lay a piece down than to hang it up." In recent years this type of equipment has been developed remarkably and its use extended in many ways.

Adopting a policy of specialization, many manufacturers of shop equipment have concentrated their efforts on the development of a certain type. They have studied closely the requirements of the work to be performed and, by analysis of conditions surrounding the use of their machines, brought their design to a point of broad usefulness truly abreast of the times.

Adaptability, Dependability and Productability are the elements of successful machine design.

To be adaptable a machine must be universal to a high degree, yet easily controlled and operated; its requirements in the way of tools must be simple in order that the supplementary expense may be kept low, and also that the time required for changing from one class of work to another may be minimized—"Cutting time only is productive."

The dependable machine must be a durable machine. Its design, and the materials entering into its construction, must be capable of withstanding, without injury, the strains entailed in heavy cutting at high speeds, and even the shock and jar of careless and unintelligent usage. All operative functions must be guarded by interlocks, safety devices must be incorporated to protect the driving and feeding mechanisms, bearing surfaces must be amply proportioned to maintain accuracy, and provision made for taking up natural wear. It is imperative that lubrication be ample and certain, and not dependent on the care and thoughtfulness of the operator.

In short, the dependable machine is one which is always ready; one which will carry through to a successful conclusion any task to which it may be set; one in which both manager and operator have absolute confidence based on demonstrated durability.

Several factors enter into the item of productability, each of which is, in a way, related to the others. If, for any reason, a machine is not in service, it is not producing, and is, therefore, inefficient. Continuous operation is an essential factor dependent not only on durability but on adaptability as well. If minor details of construction require constant attention and repair it is not a durable machine. If long delays are frequently occasioned by the necessity of changing, or providing, complicated and expensive tool equipments the machine is not adaptable.

Ample power in both driving and feeding mechanisms is required, and, by power operation of heavy moving parts, the operator should be relieved of the necessity of undue physical exertion.

Control of all parts should be convenient, certain and positive, without complication, thus "cutting time between cuts" and obtaining intensive production.

The Vertical Turret Lathe

The Bullard Vertical Turret Lathe meets these requirements to an exceptional degree. Distinctive and original in type it represents, in combination, an advanced development of the engine lathe, the horizontal turret lathe and the vertical boring and turning mill, in the designing, manufacture and use of which we have enjoyed a broad experience extending over a period of forty years.

Retaining the inherently good features of the types in which it had its origin, it has, since its conception in 1900, been the subject of continuous constructive analysis, which has resulted in a most rapid development along lines essentially original and having a particular bearing on productive capacity.

"The elimination of wasted time"—the fundamental principle of efficiency—formed the basis of the design of this machine, and the intensive effort expended in its development has been directed toward the accomplishment of this objective.

Adaptable

Two tool-carrying turret heads, one main and one side, are universal in their movement and adjustment throughout the entire range of the machine, thus simplifying the tool equipment required for a wide range and variety of work:—the same tools, excepting reamers, etc., are equally adaptable to the smallest and largest piece of the same class.

By means of accurately graduated scales and micrometer dials, and adjustable "Observation Stops" mounted thereon, tools are readily set and sizes obtained and maintained.

Dependable

Rigidly constructed, with bearings amply proportioned and specially selected material of maximum shock- and wear-resisting qualities used throughout the gears in both driving and feed trains; lubricated continuously and automatically with filtered oil; safety devices incorporated in feed mechanism and all operative levers interlocked—this machine marks a "New Era" in machine design, and is one in which implicit confidence may be placed by both manager and operator.

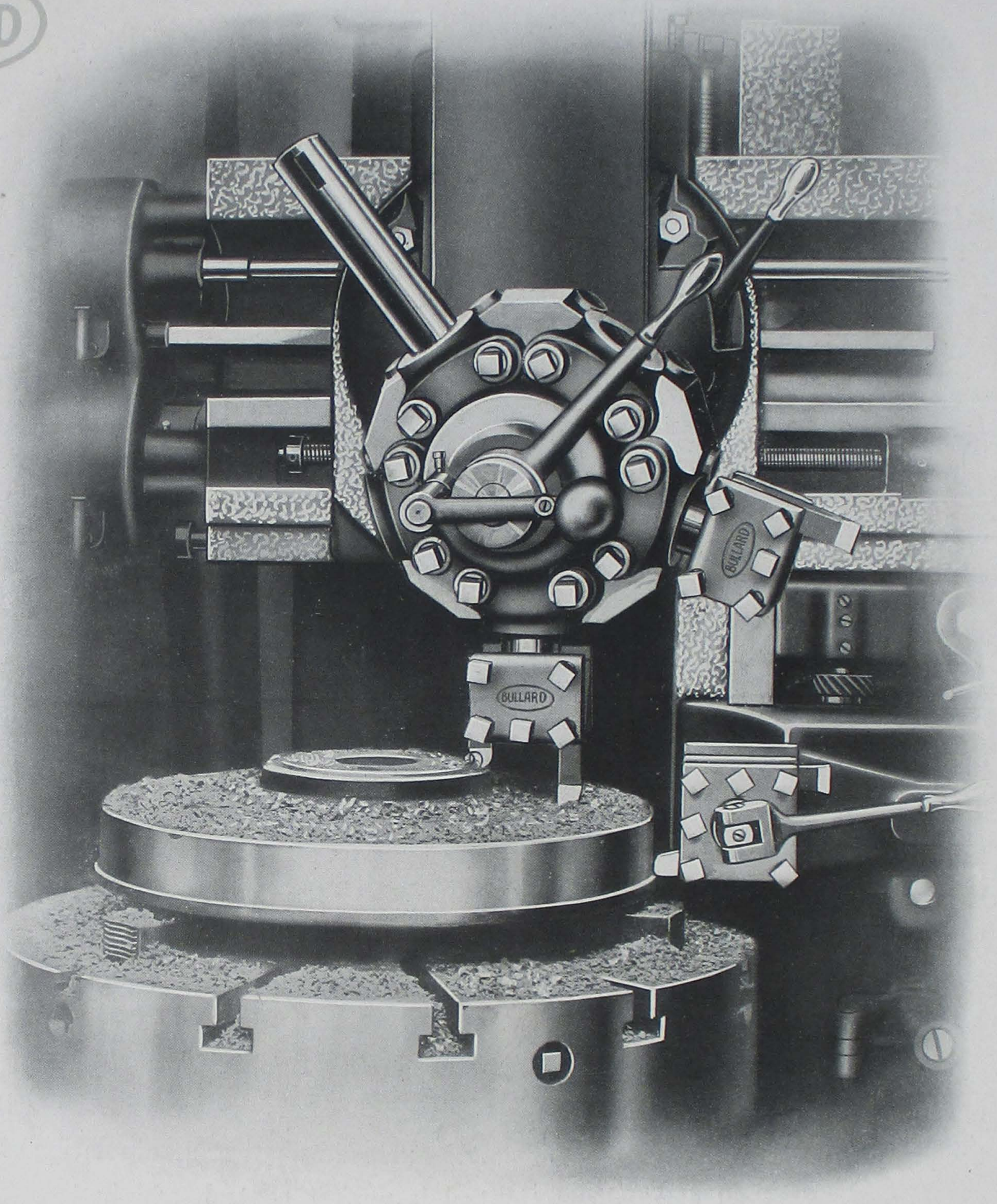
Productable

Widely adaptable and extremely durable the Bullard Vertical Turret Lathe may be kept in continuous operation. Excess power is provided in the drive, and the physical effort required of the operator reduced by power manipulation of heavy moving parts. Real Centralized Control is perfect control, and in this machine all levers and operating handles are, without complication, so arranged as to be within convenient reach from one position.

Each unit in its construction has been developed for the maximum service required thereof and with a due and intelligent regard for the completed whole.

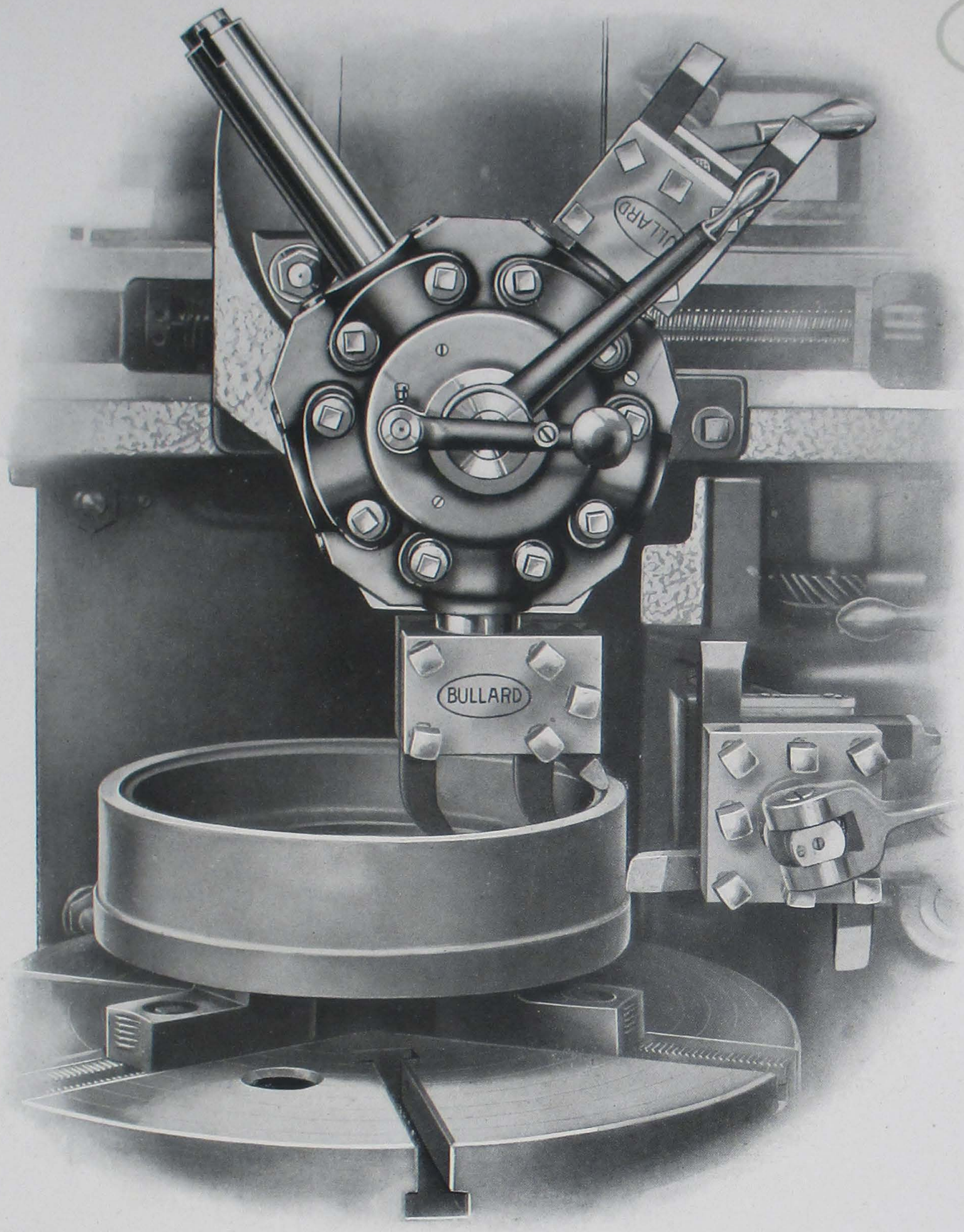
Thousands in use have demonstrated conclusively the Adaptability, the Dependability, and the Productability of the Bullard Vertical Turret Lathe, and from our experience with some, and observation of others, we submit the following methods of "Cutting Time Between Cuts."

BULLARD



THE VERTICAL TURRET LATHE

Chucked from the inside of rim this heavy plate-gear is finish-turned, faced and bored in one setting. The simultaneous turning and facing result in a considerable saving, and the simplicity of tools required is notable.

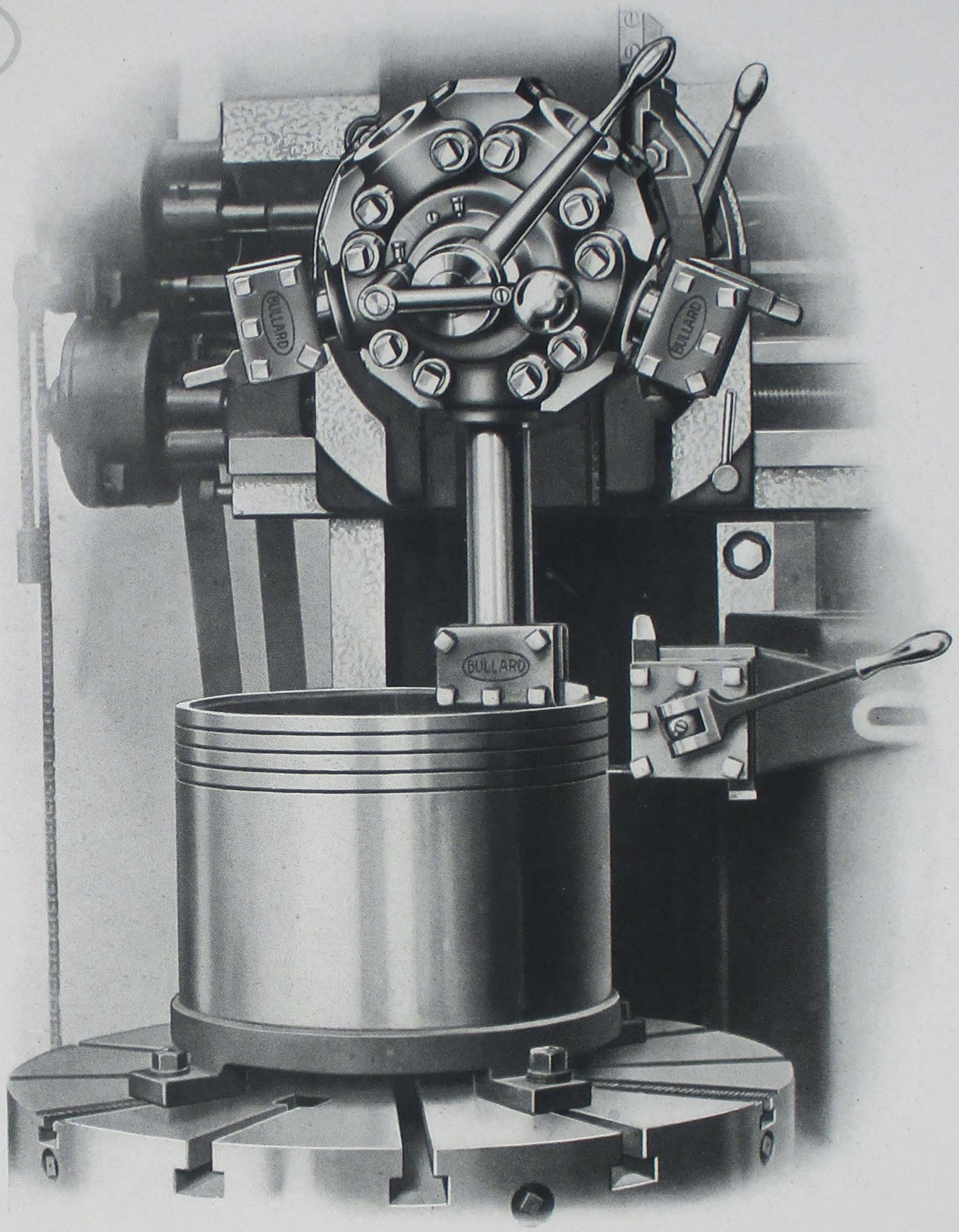


THE VERTICAL TURRET LATHE

Combined turning and facing is obviously advantageous. Four surfaces are machined at once on this fly-wheel in the time taken for the longest cut, and as all cuts are taken by single-point tools no excessive strains are set up in the piece.

Form tools or broad sweep-cutters are not required for this class of work because of the cross-movement of the Main Head.

BULLARD

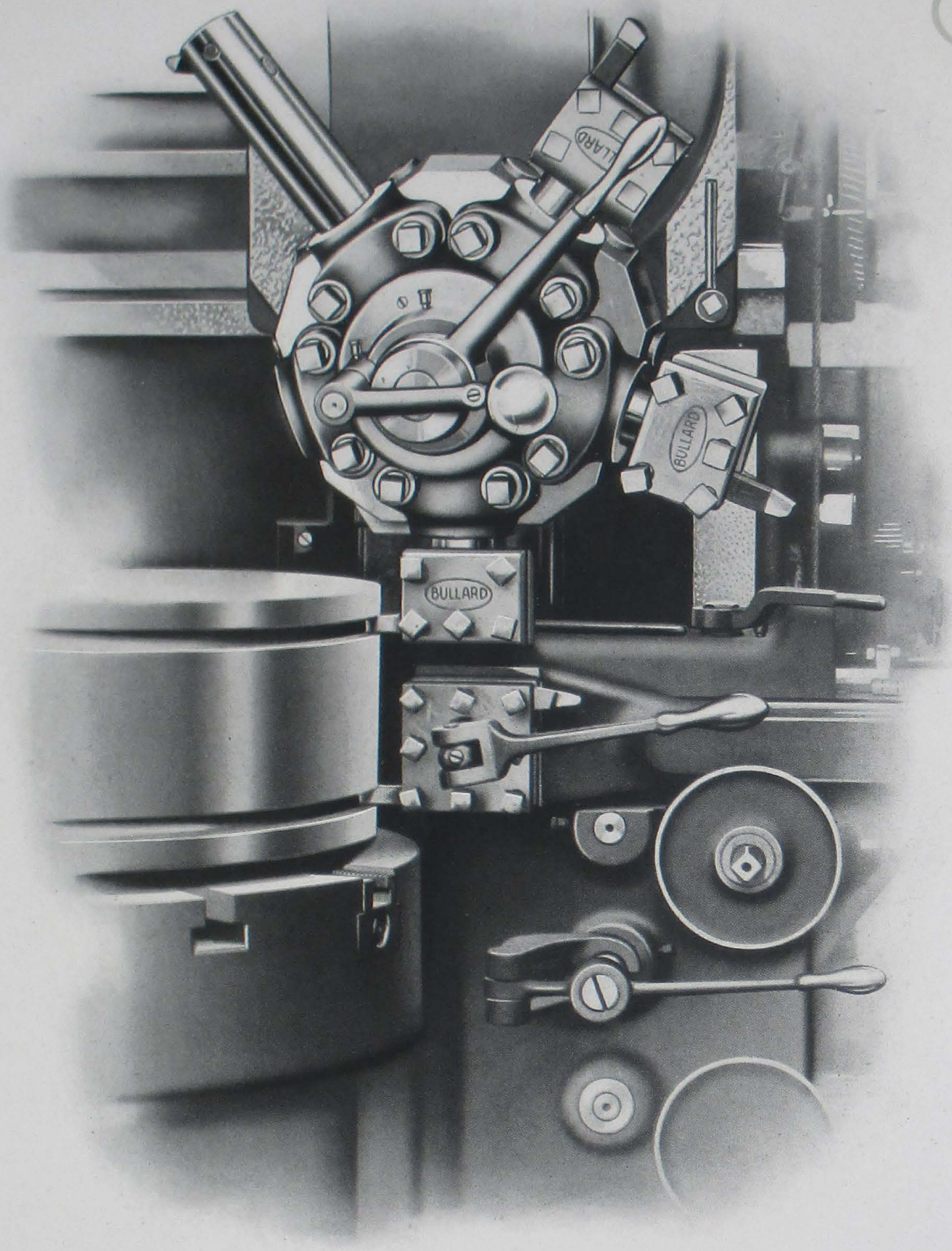


THE VERTICAL TURRET LATHE

In the machining of packing rings, both Main and Side Heads are continuously employed. In the parting operation the cutting-off tool is fed in to a given depth, at which point the ring is separated from the "pot" by a boring tool held in the Main Head. No fin is left if this method is employed.

The heads in no way interfere with each other, as would be the case if both were mounted on the cross-rail.

CUTTING TIME BETWEEN CUTS

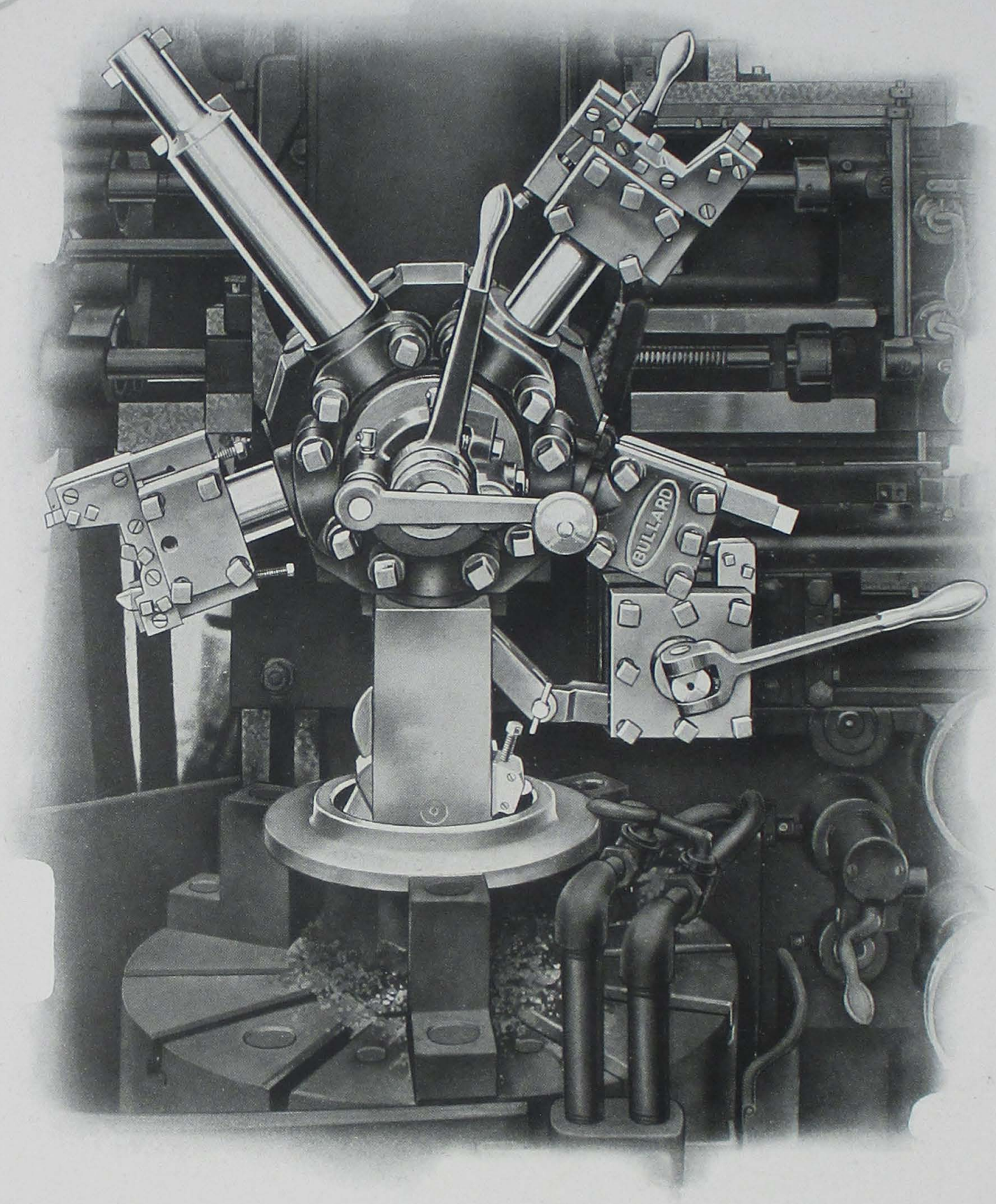


THE VERTICAL TURRET LATHE

Vertical construction is particularly advantageous in chucking heavy work, and the joint use of both heads in the operations shown saves considerable time in the machining as well.

Simple forged tools are usually quickly obtainable, are highly economical, and may also be used for other work than that for which they may have been especially made.

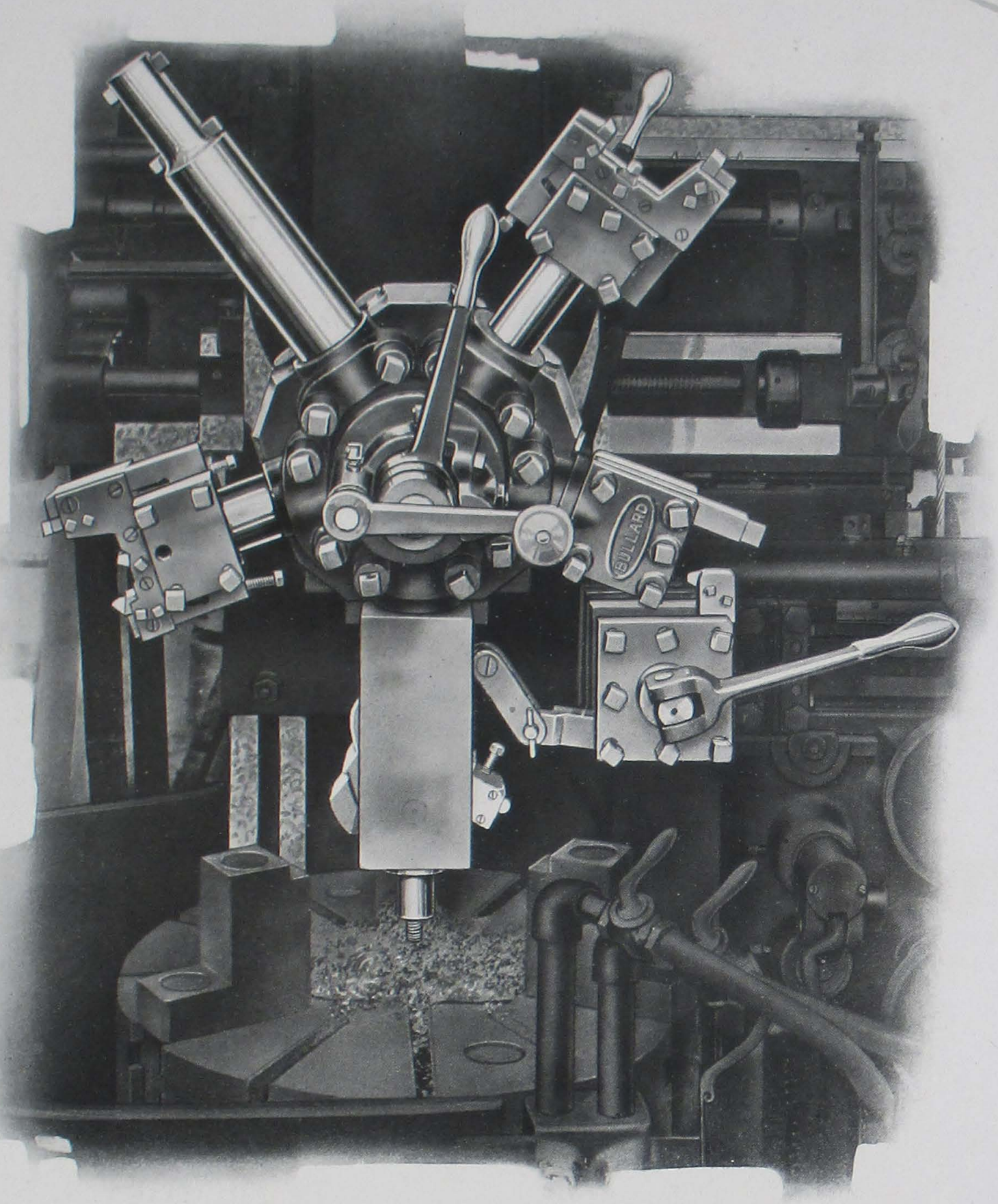
BULLARD



THE VERTICAL TURRET LATHE

The internal spherical surface of this radius-rod end bracket required accuracy in dimensions and a smooth finish. Formed sweep-cutters did not meet the requirements, and, in addition, were expensive to maintain—the material being a hard steel casting.

After planing, drilling and assembling the pieces are mounted in a fixture, the spherical boring bar placed in position and the cutter feed obtained by engaging the Side Head with the sliding member. Tools are changed between roughing and finishing cuts.



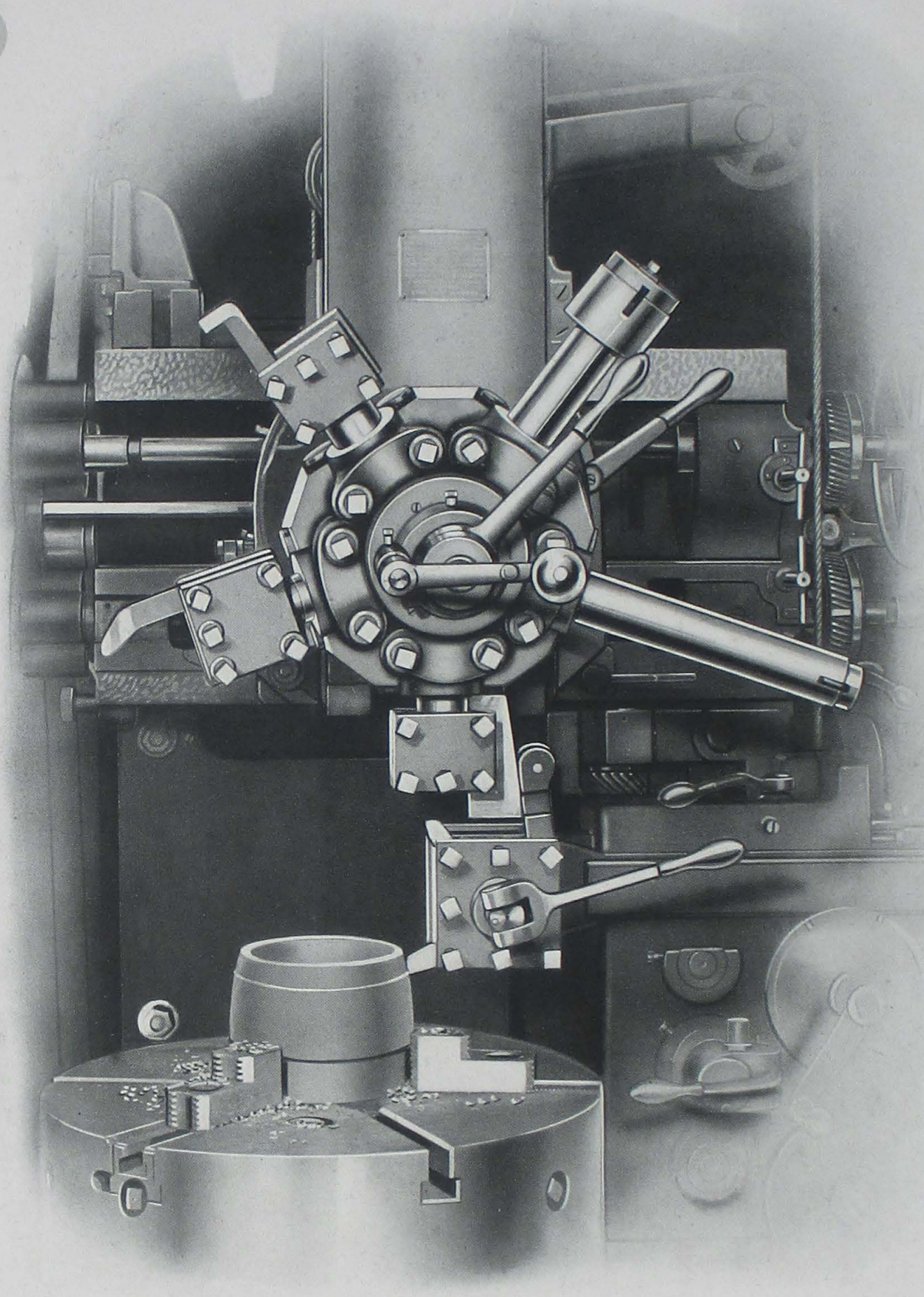
THE VERTICAL TURRET LATHE

Details of fixture and tools used in machining the radius-rod end bracket, shown on page 12, are clearly indicated in this illustration.

The bar is piloted in a hardened bushing-in fixture, which also serves to locate the center of cutter-arm with reference to the planed surface from which this operation registers.

Roughing and finishing tools are of different lengths and are changed between operations. An adjusting screw in cutter-arm locates the cutters as they are inserted.

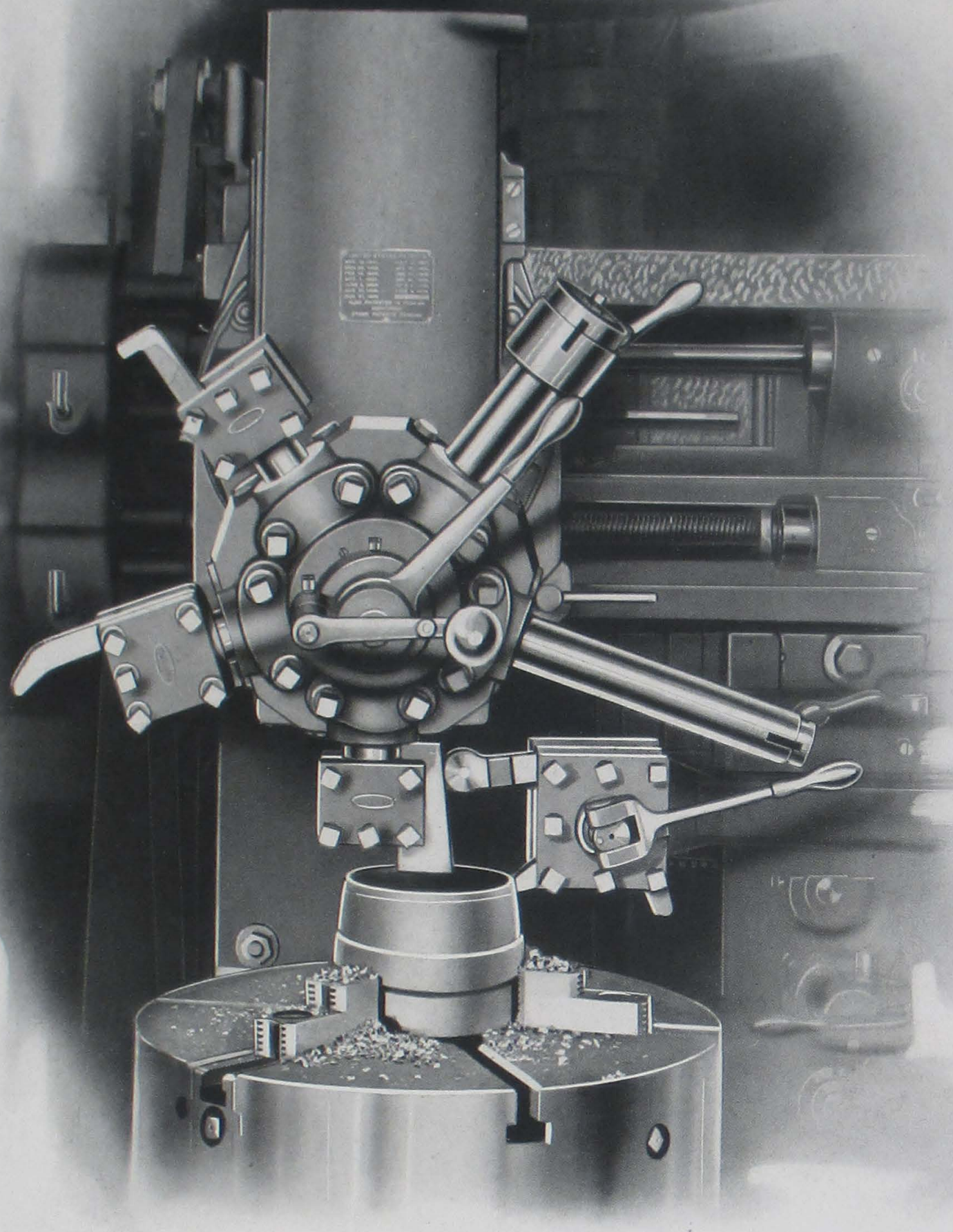
BULLARD



THE VERTICAL TURRET LATHE

A simple and inexpensive method of taper turning is shown above, the tool in Side Head Turret reproducing the angle of taper block held in the Main Head.

The vertical feed of the Side Head is engaged and the slide forced outward by the action of the roll-tool shown. Proper tension is applied by the Slide Binder.

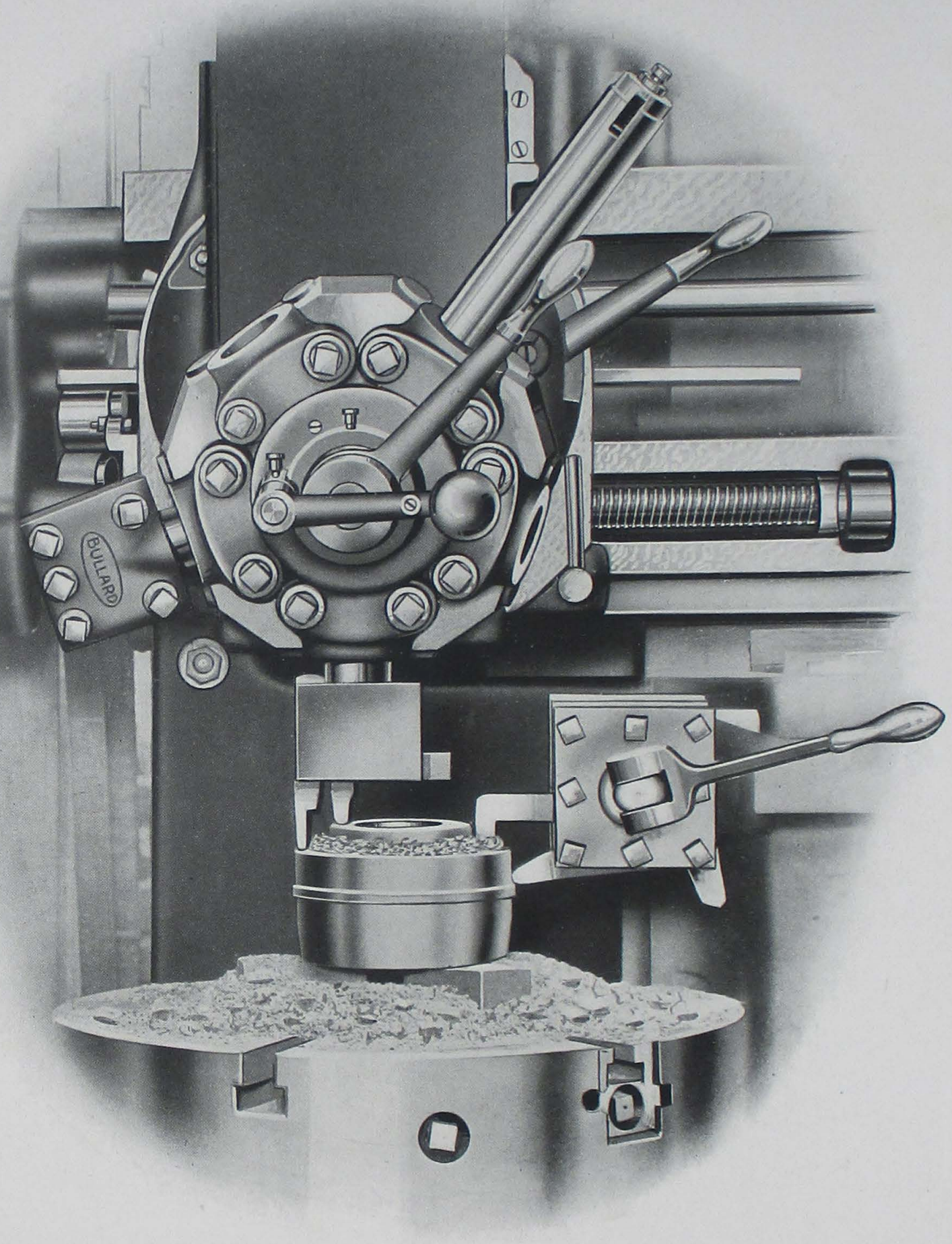


THE VERTICAL TURRET LATHE

The finish-turning tool in Side Head Turret brings the guide-roll into another position—the taper block being properly located for accuracy of finished dimension by the "Observation Stops" mounted on the micrometer dials on the feed rod and screw.

Single-point tools eliminate distortion of the piece.

BULLARD

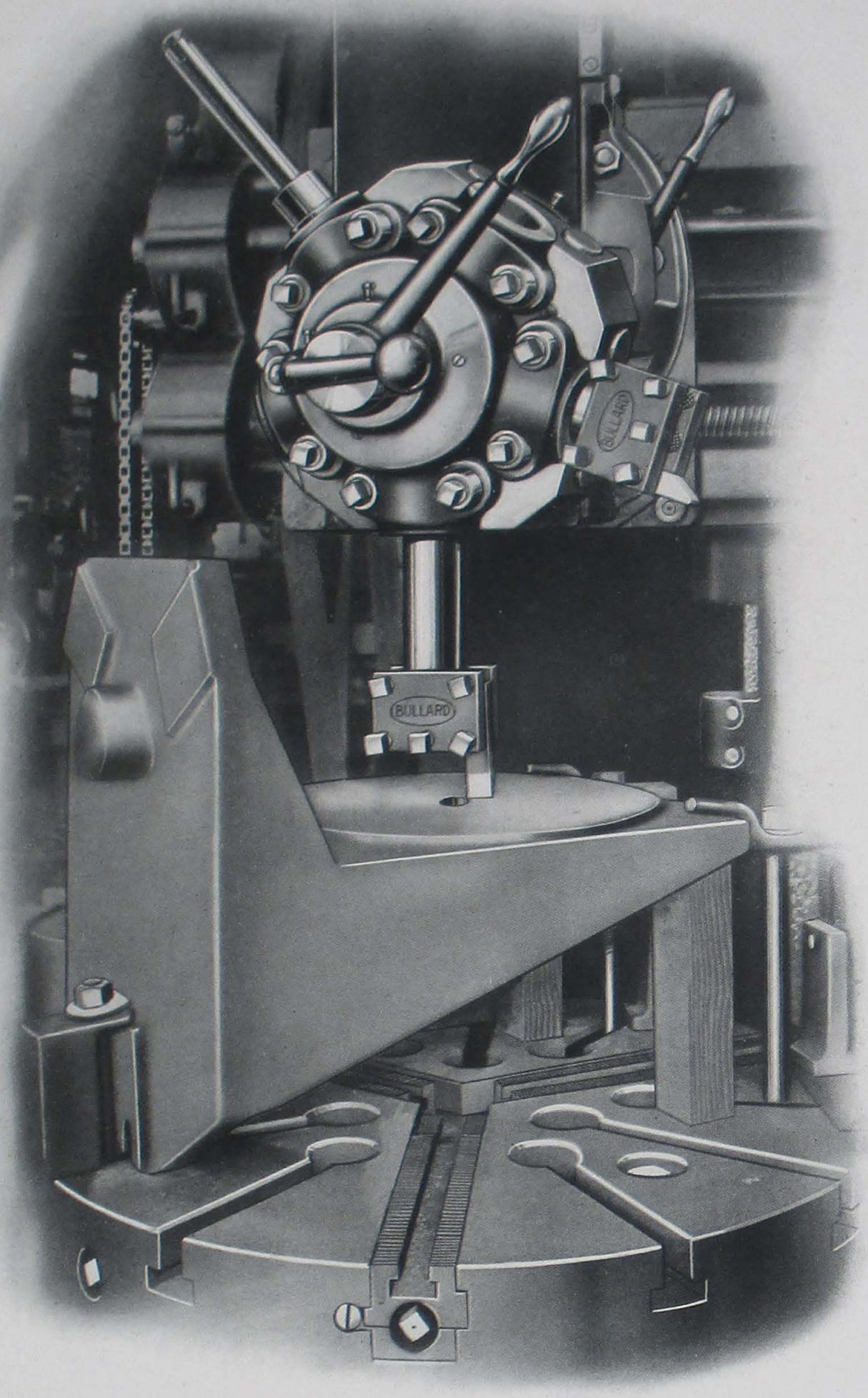


THE VERTICAL TURRET LATHE

Combinations of facing or turning tools secured in the same holder, and set to dimension by size blocks, are frequently possible. Such set-ups take but little time and add greatly to production.

The cross-movement of the Main Head, for a short distance beyond the center, presents an advantage which should not be overlooked. Operations may be combined and much time saved.

CUTTING TIME
BETWEEN CUTS

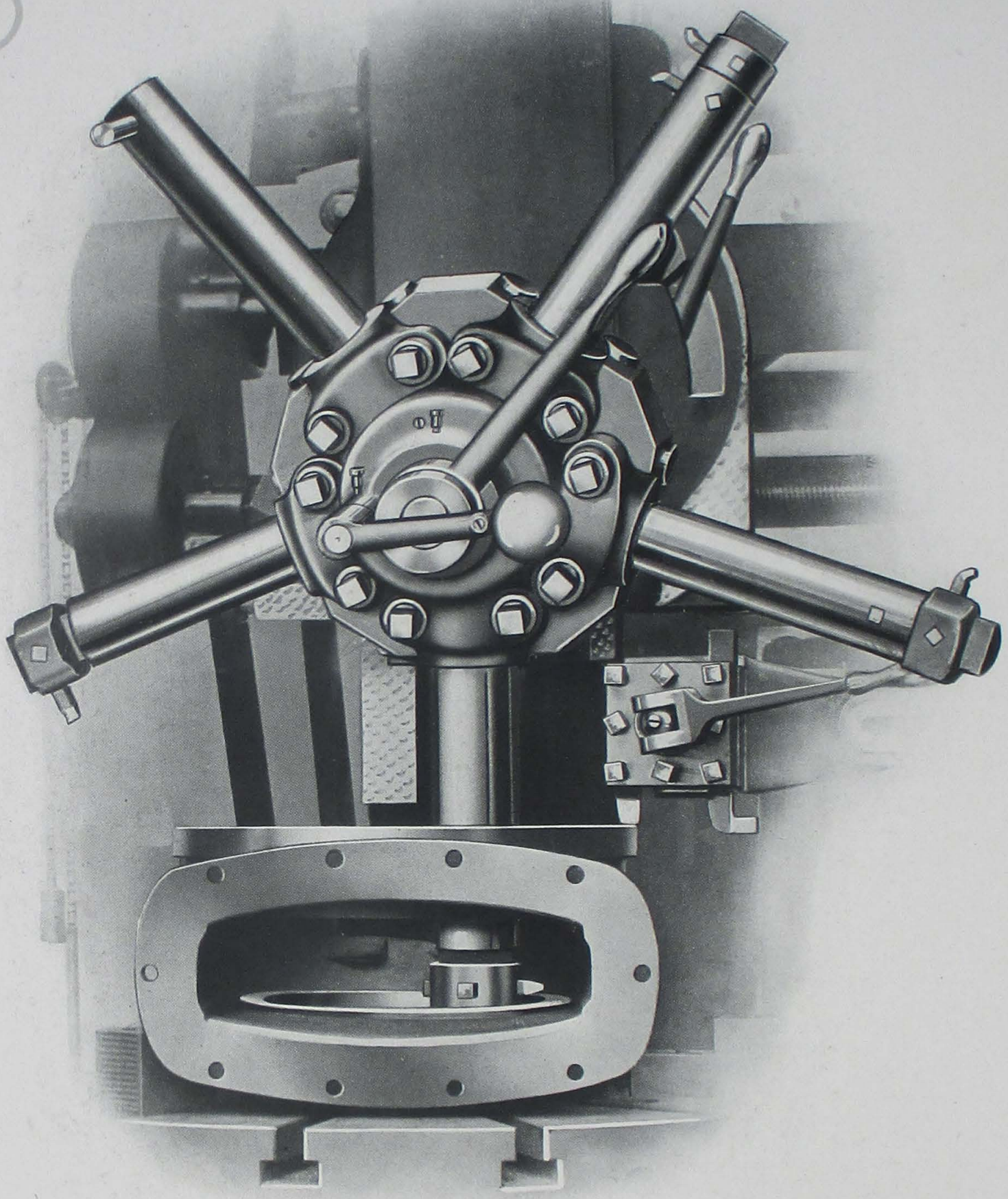


THE VERTICAL TURRET LATHE

One of the advantages of Vertical Construction is well illustrated above. To locate this swivel-fixture base on the face-plate of a horizontal machine would take considerable time and require the attention of one or more assistants.

The "odd job" may frequently be done to advantage on the Vertical Turret Lathe —its manufacturing features saving time on the single piece as well as on the many.

BULLARD

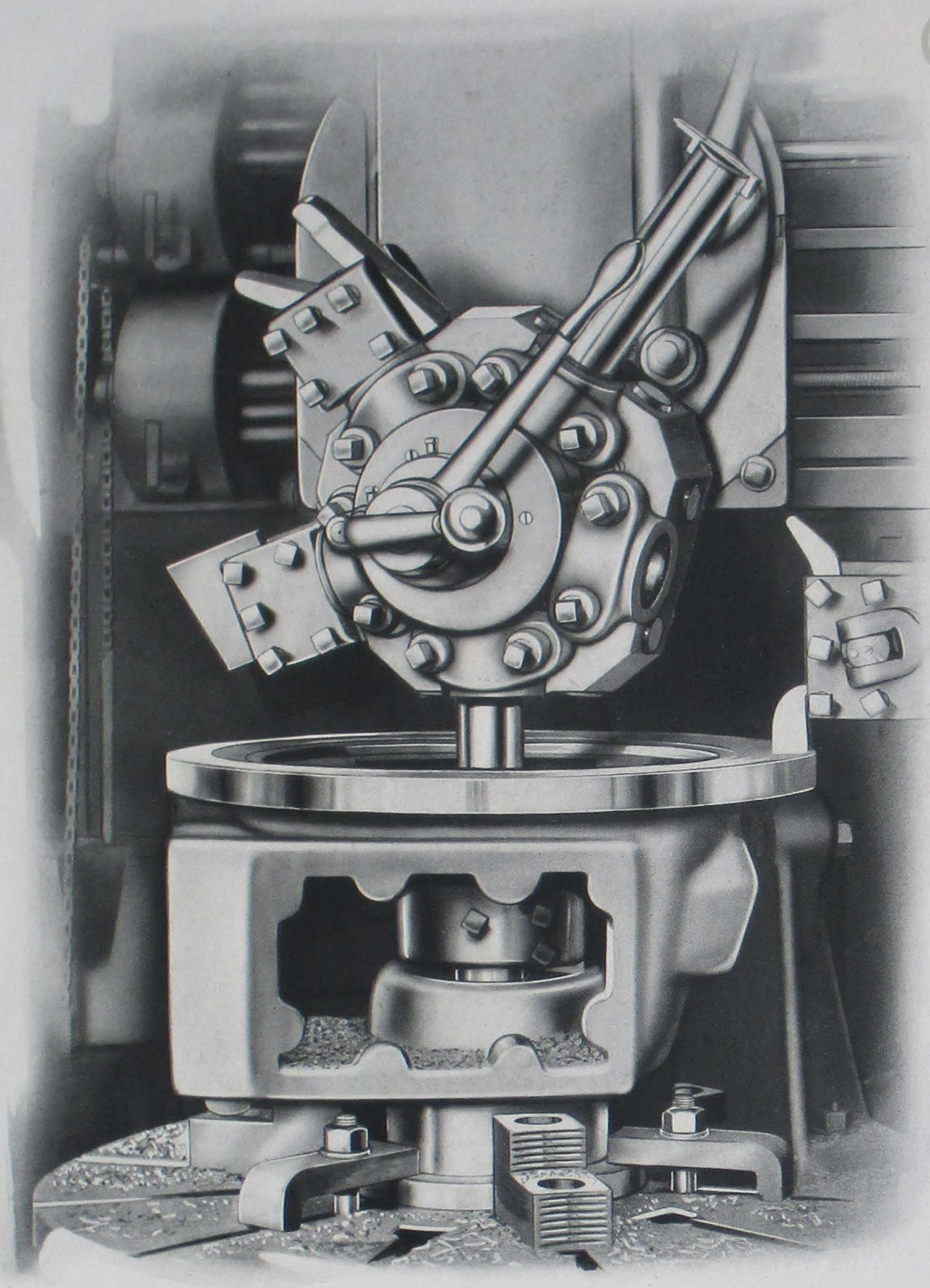


THE VERTICAL TURRET LATHE

The tool equipment required to machine a range of sizes of gate-valves of the parallel-seat type is extremely simple.

Bodies are bored, threaded and faced for seats, which are "forced home" by the driver-tool shown and finish-faced in position.

Positive control of the table-driving mechanism of the Vertical Turret Lathe relieves the seating operation of the danger of machine-breakage or shifting of the work.

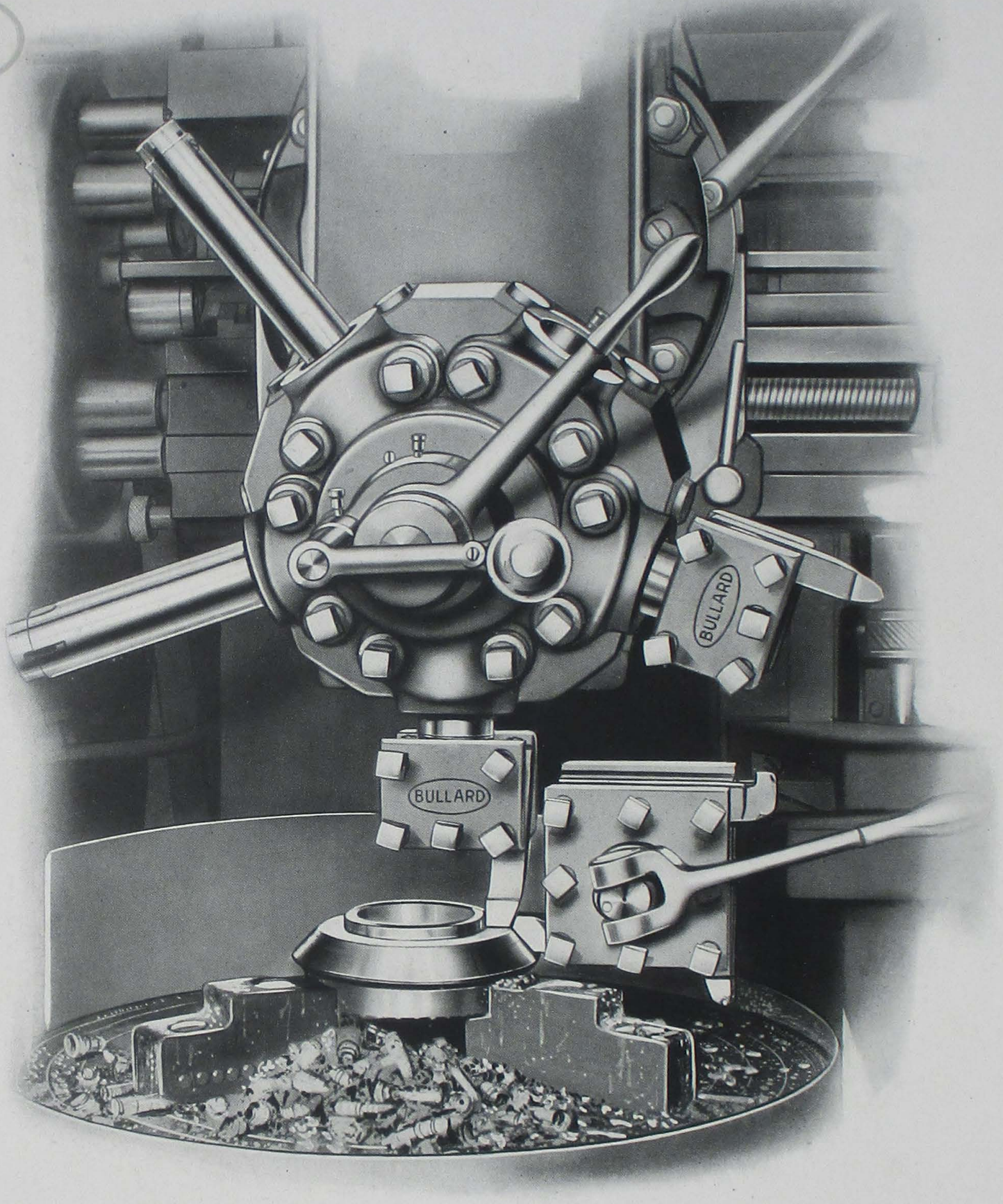


THE VERTICAL TURRET LATHE

A piece of irregular form having a base of small diameter is quickly secured to the chuck of the Vertical Turret Lathe and the time required to "true it up" reduced to a minimum. No balancing weight is necessary. The advantage of the vertical type, as compared with the horizontal, is obvious.

The horizontal angle of the valve seat is machined by a single-point tool in the Side Head guided by a taper block held in Main Head—the "chatter marks" of a sweep-tool being eliminated.

BULLARD

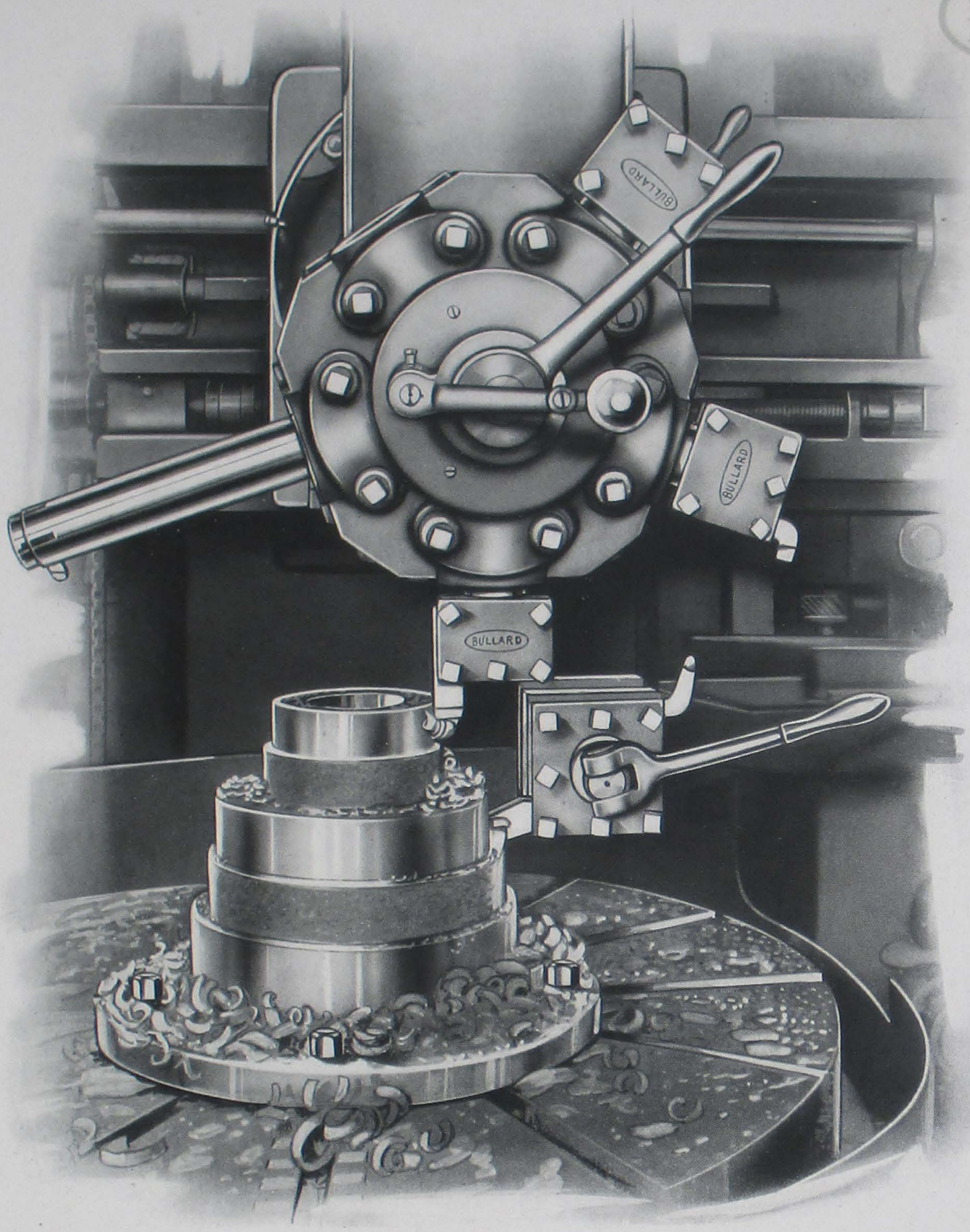


THE VERTICAL TURRET LATHE

Drop forgings are not always warranted. In such cases work of the nature shown may be economically produced from steel pieces cut from the bar or forged to diameter and length only.

Rough turned to approximate size by simple round-nose tools in both Main and Side Heads, the face angle is machined by a bevel-ground tool made from bar-stock.

On account of the face width, it may sometimes be necessary to take two or more cuts, each overlapping the last taken, thus producing a continuous plane surface.



THE VERTICAL TURRET LATHE

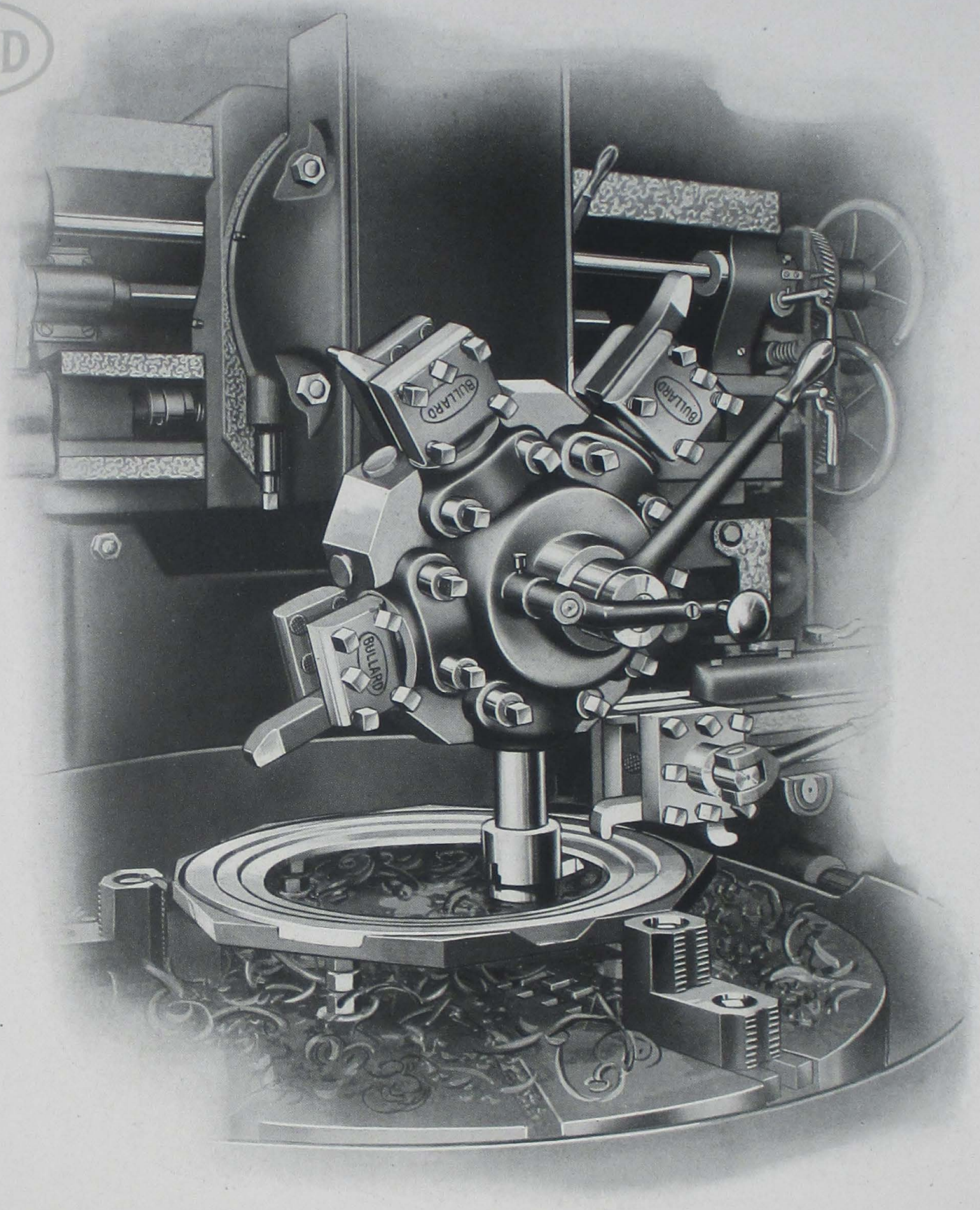
Large savings have been effected by the Vertical Turret Lathe in machining commutator shells.

When made from steel castings, the sand quickly destroys the expensive form-tools required in the horizontal type, whereas the simple forged tools of the Vertical Turret Lathe are reground or replaced at small cost.

Power and rigidity are essential in the rapid removal of excessive material, and the universal movement of the heads is advantageous in obtaining the various sizes.

For this work a special forming attachment has been developed for the Side Head, in order that the segment-retaining recess may be accurately and quickly finished.

BULLARD

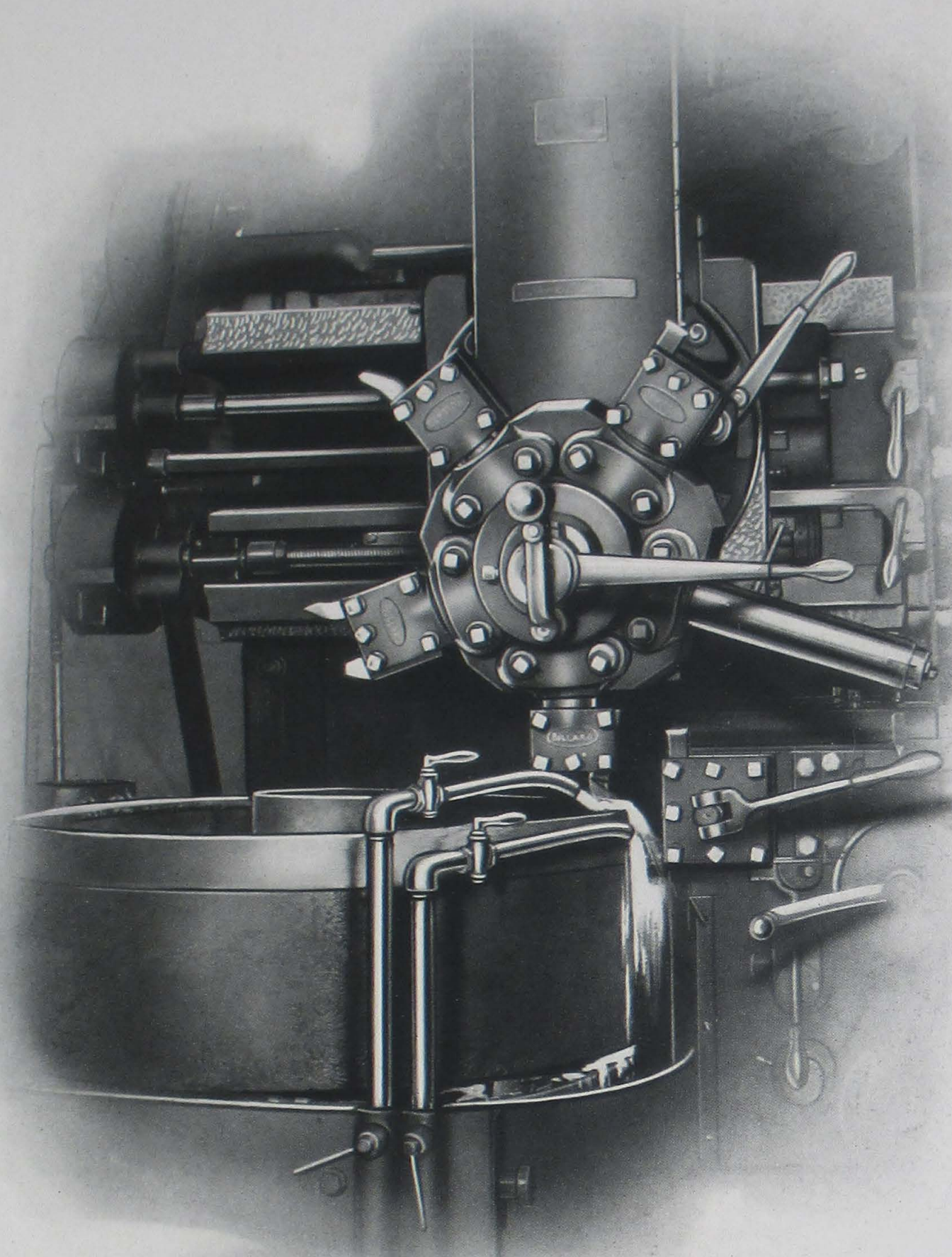


THE VERTICAL TURRET LATHE

The universal movement of the two heads—Main and Side—in combination with quickly obtainable changes of feed, and the Observation Stops, brought the manufacture of motor-truck sprockets from boiler-plate blanks to a profitable basis.

Both heads are kept continuously in operation, without interference, and the single-point forged tools do not spring the piece as would form tools working on such light sections.

The Cutting Lubricant System adds much to the daily production by keeping both work and tools properly cooled.



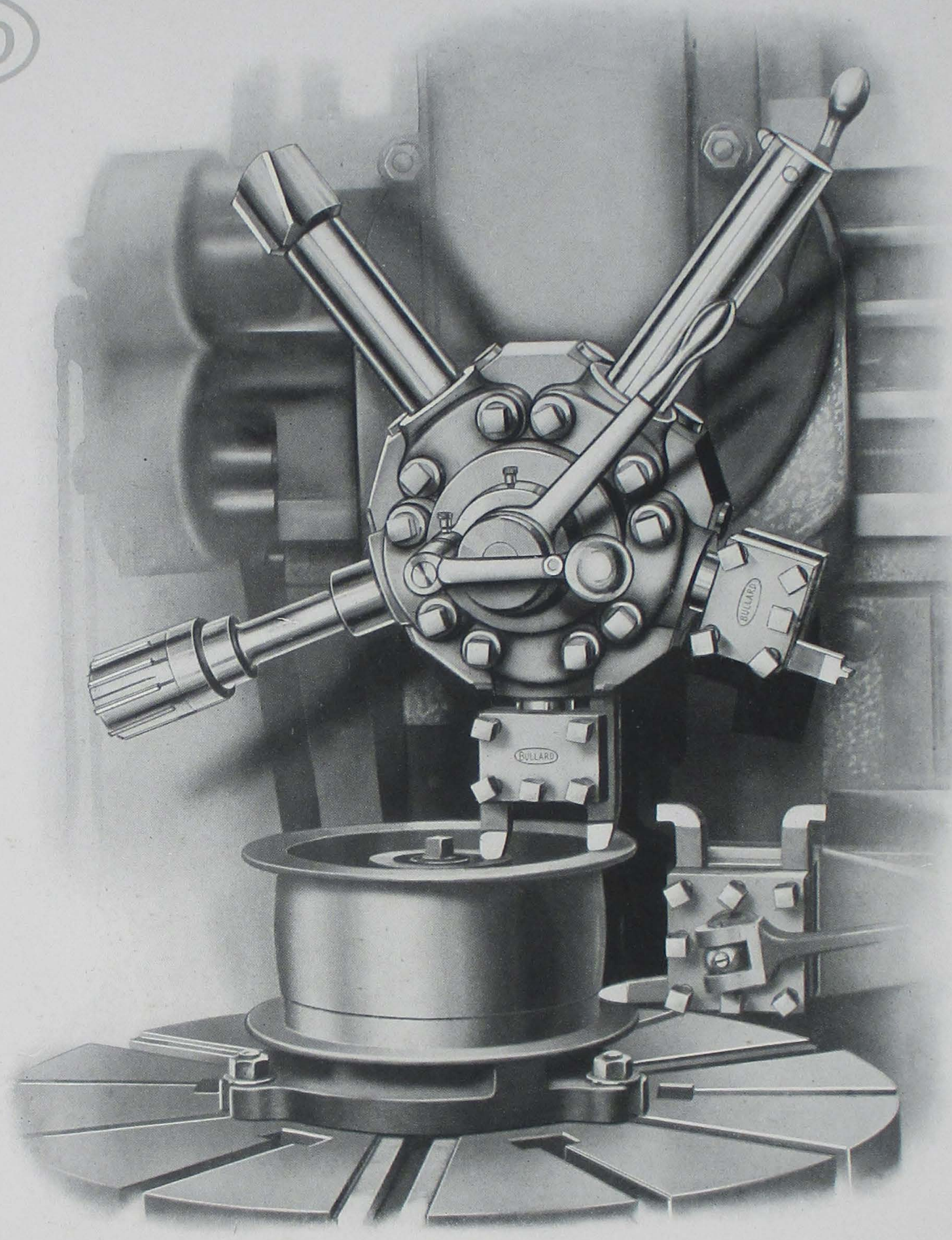
THE VERTICAL TURRET LATHE

The castings for steel motor-truck wheels are heavy, cumbersome and uneven in surface and have many parts to be turned, bored or faced to dimension.

Vertical construction, excess power and rigidity, and the universal movements of the two Heads render the Vertical Turret Lathe remarkably efficient on this class of work—in fact its productive capacity is unequalled by any other machine.

The Cutting Lubricant System increases the possible cutting speed and lengthens the life of tools. A greater accuracy of dimensions is maintained by eliminating distortion of work by the heat generated in removing metal.

BULLARD

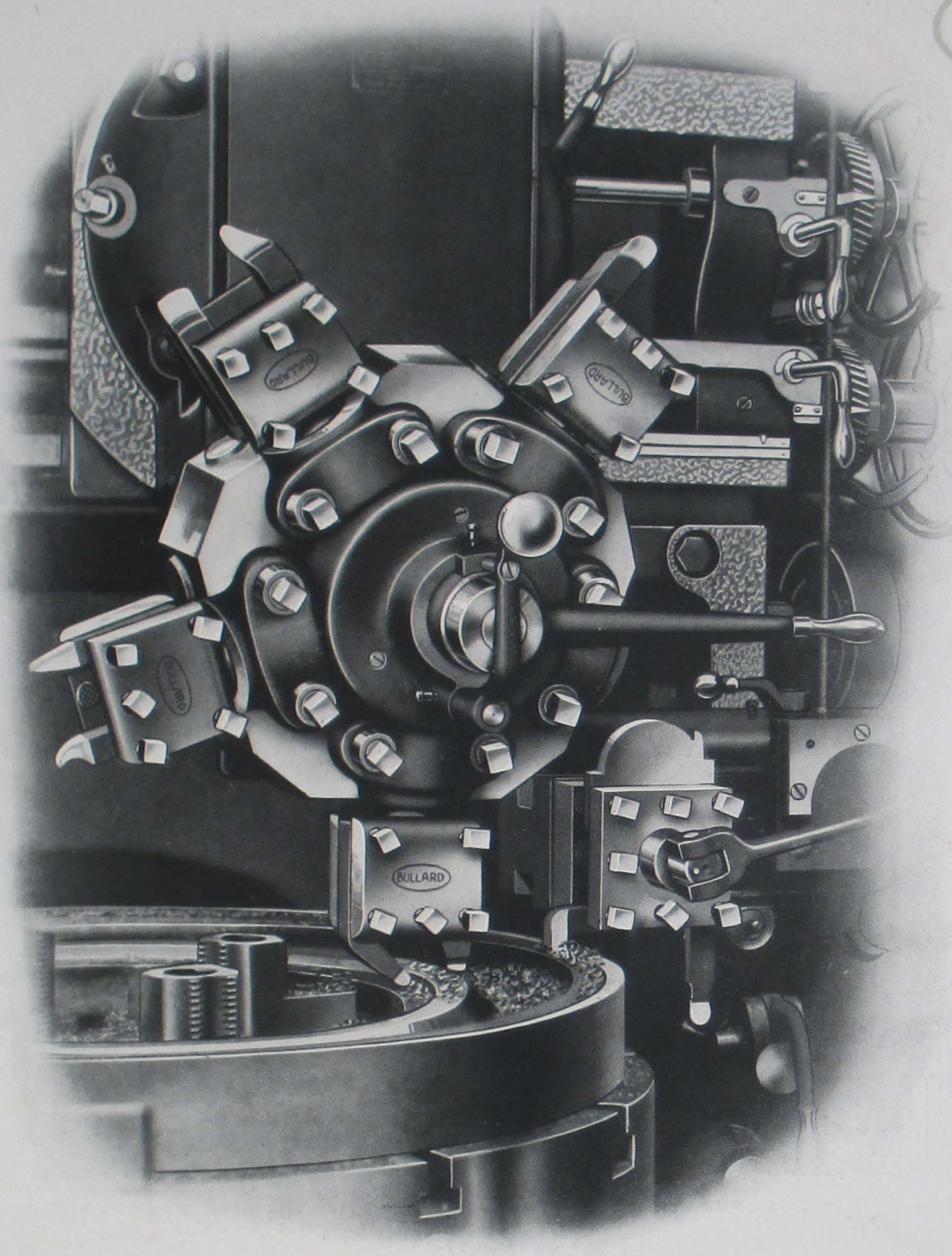


THE VERTICAL TURRET LATHE

High-speed pulleys on wood-working machinery are light in section and must run true. After finishing the hole and one side they may be mounted on an expanding arbor and the other side finished, as shown, by single-point tools which do not distort the piece or set up internal strains.

The crown is obtained by means of a forming attachment for the Side Head, consisting of a plate, slotted to the required form, and a roll or block secured to the tool slide. This mechanism in no way limits the regular use of the machine.

CUTTING TIME BETWEEN CUTS



THE VERTICAL TURRET LATHE

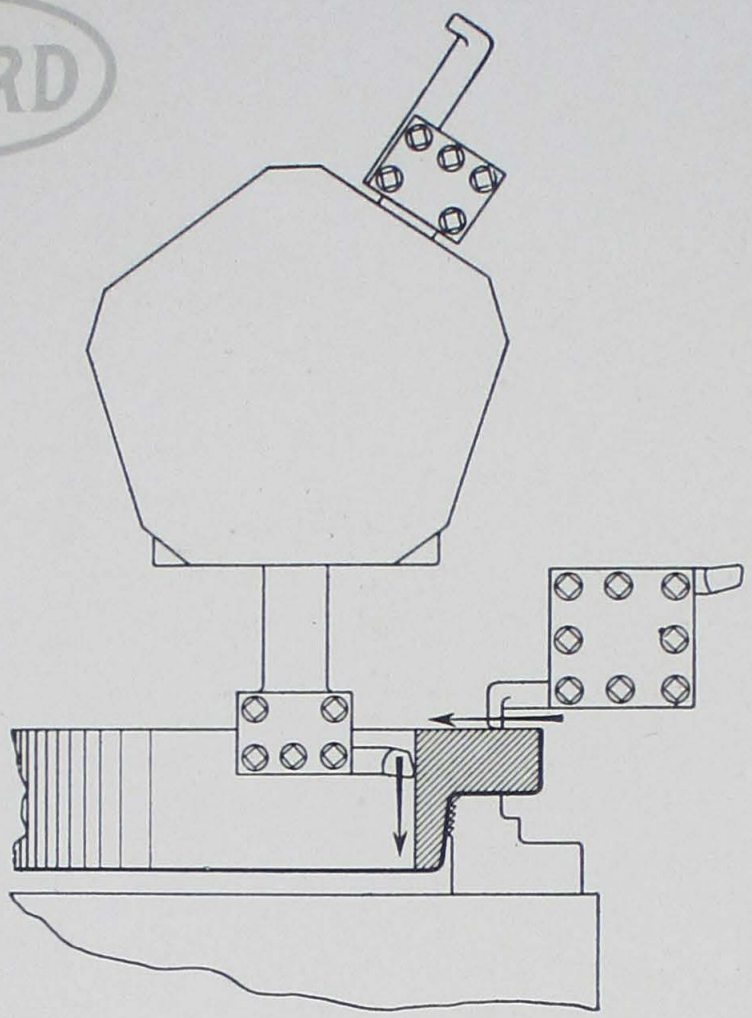
In the manufacture of automobile tire molds great economies have been effected by a slightly special application of the Vertical Turret Lathe.

All plane surfaces are machined by the Main Head—the Turret holding all tools required in the sequence of operations—while the mold cavity is simultaneously roughed-out to form and approximate size by the Side Head. The cavity is finished by a sweep-cutter.

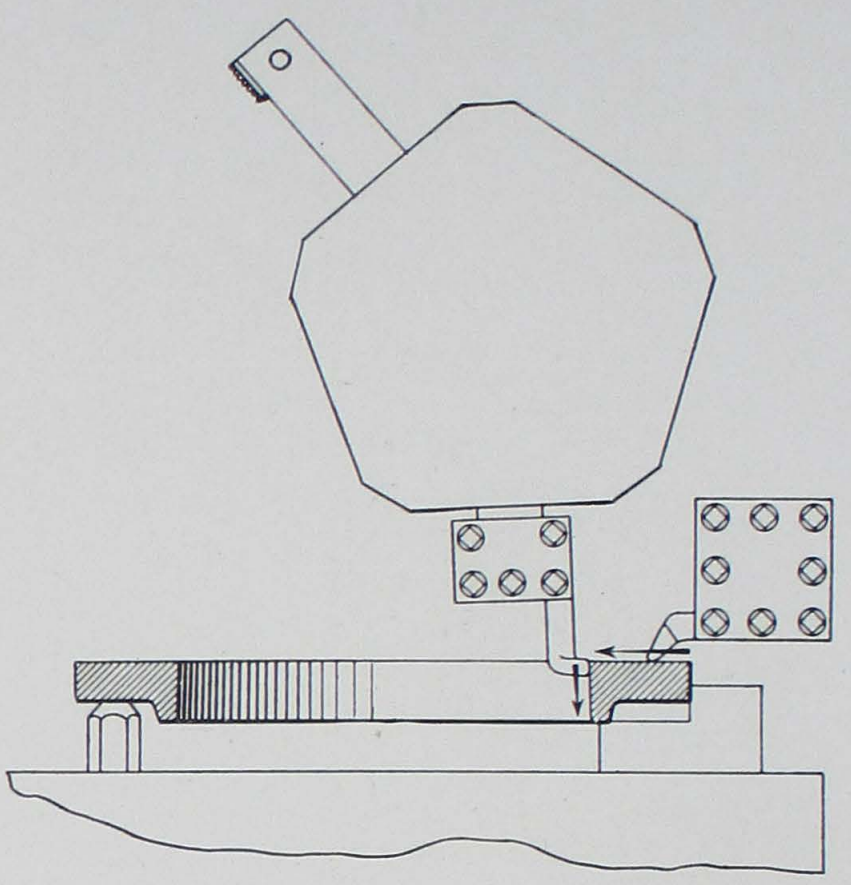
A cam plate, mounted on the Slide, and a guide roll, held stationary by a special bracket, render quite simple the formerly difficult operations of roughing out the cavity.

This machine has greater rigidity than the engine lathe, and is far more convenient than the boring mill, and produces the work in half the time of either.

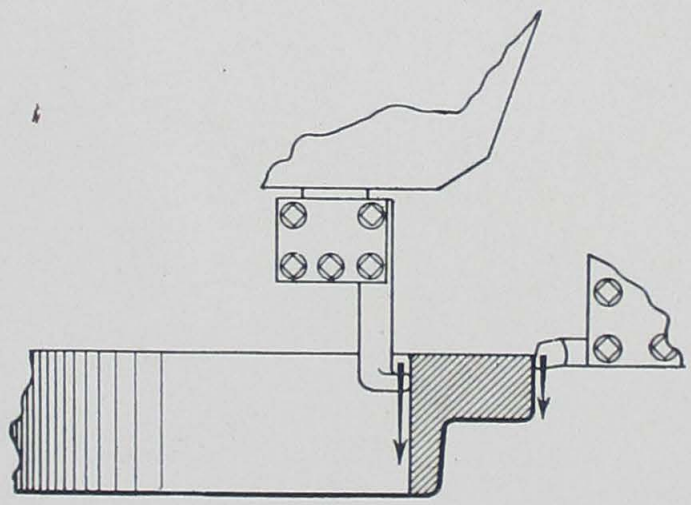
BULLARD



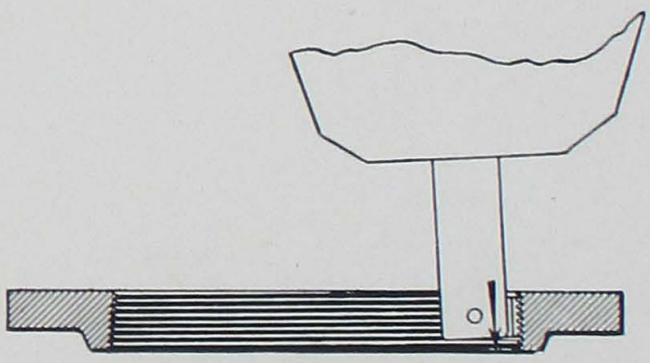
1ST SETTING. 1ST OPERATION.



1ST SETTING. 1ST OPERATION.



1ST SETTING. 2ND OPERATION.

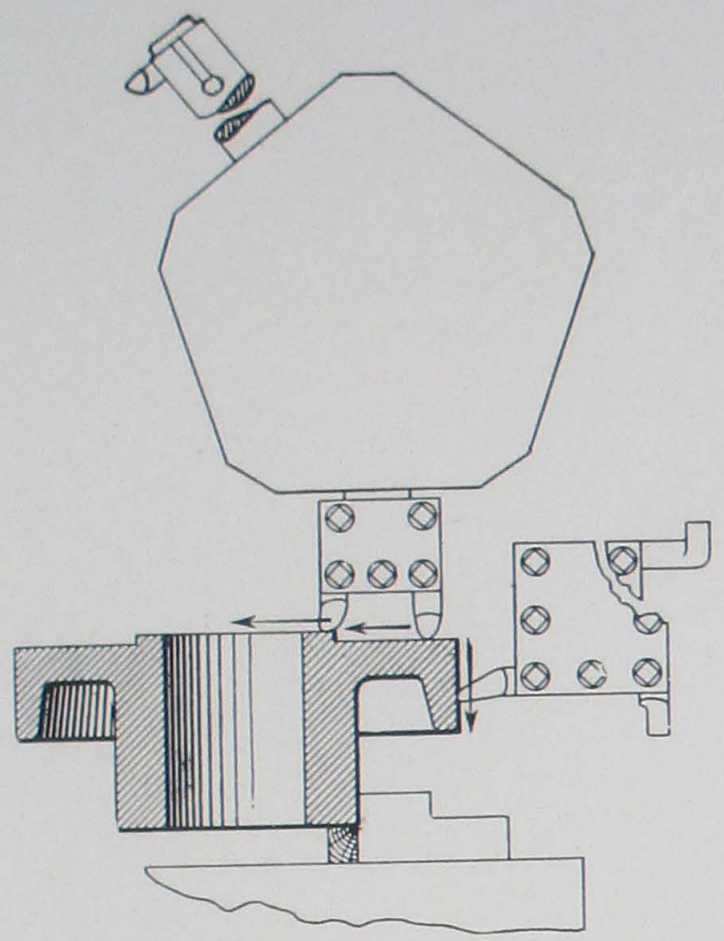


1ST SETTING. 2ND OPERATION.

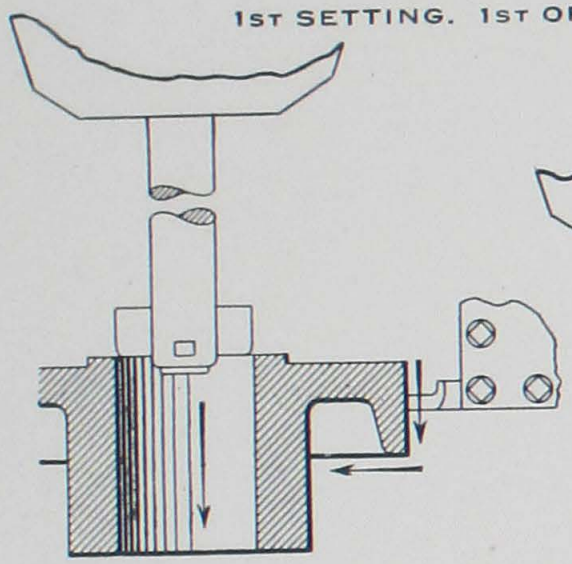
THE VERTICAL TURRET LATHE

Pipe flanges of all types are economically produced on the Vertical Turret Lathe. Boring and facing operations are carried on simultaneously—the same simple equipment serving for all sizes of the same type.

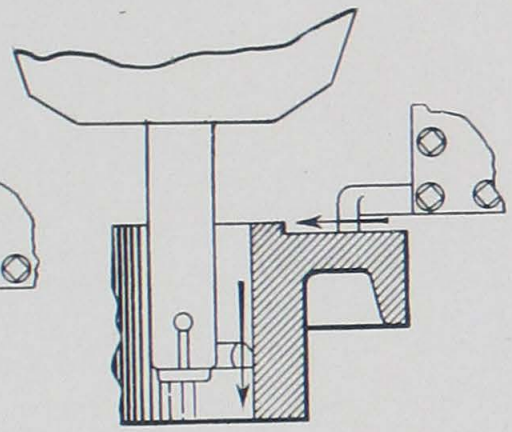
Threaded flanges may be machined in one setting, threads being chased in one or two passes.



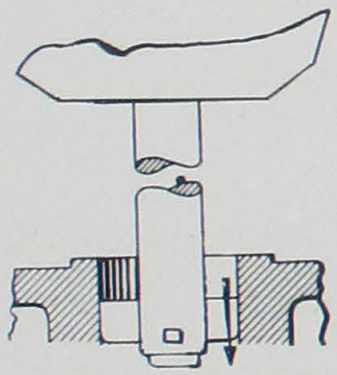
1ST SETTING. 1ST OPERATION.



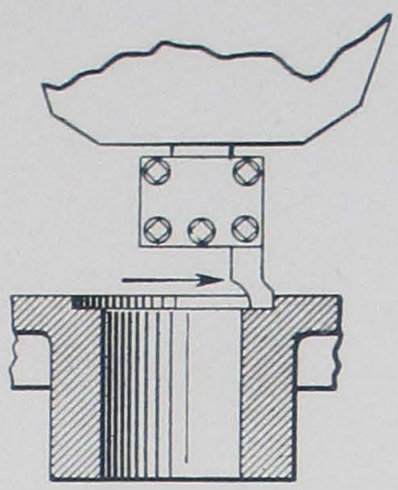
1ST STG. 3RD OPN.



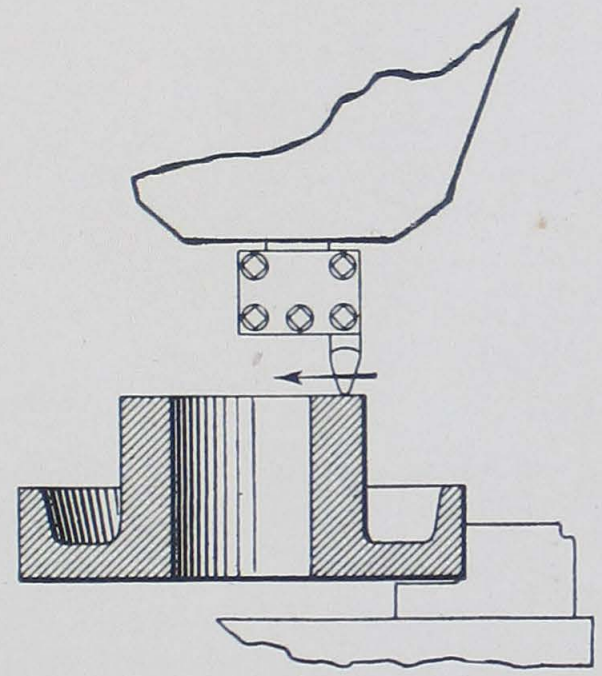
1ST STG. 2ND OPN.



1ST STG. 4TH OPN.



1ST SETTING. 5TH OPERATION.
(ON FEMALE)



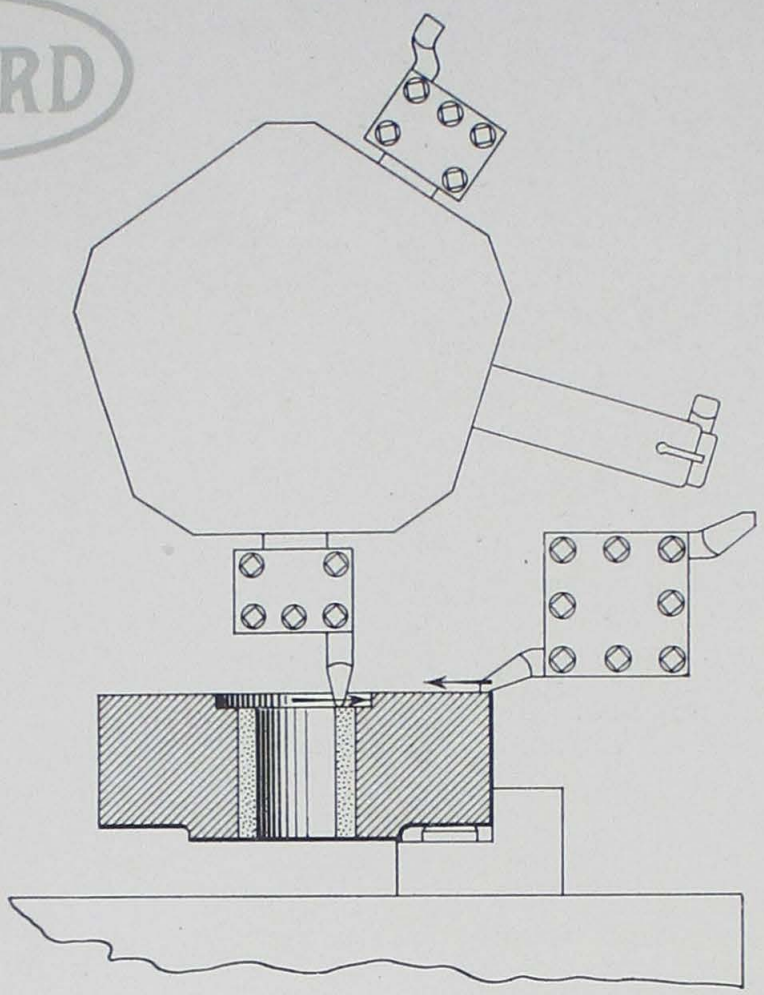
2ND STG. FINISH

THE VERTICAL TURRET LATHE

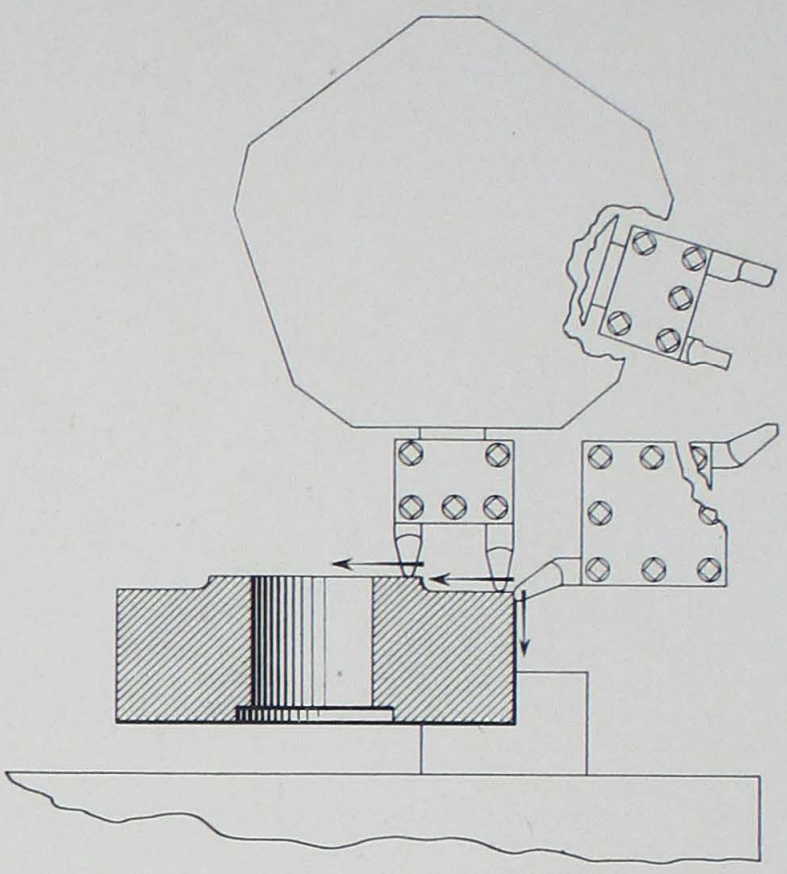
Flange couplings made as shown run true and square—single-point tools producing more accurate work than sweep tools.

Where but a few of each size are required the cross-movement of the Main Head is a decided advantage.

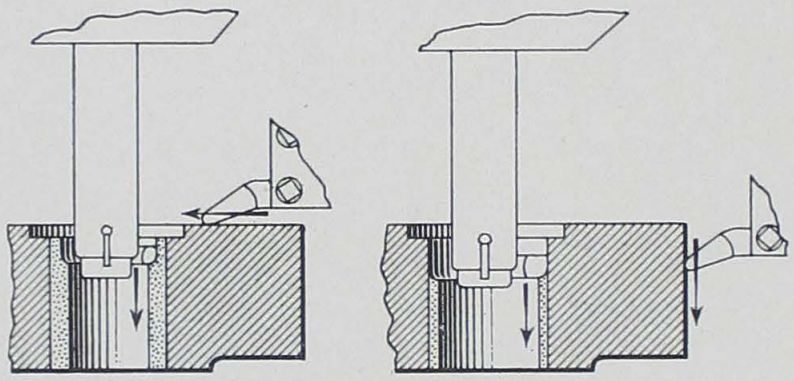
BULLARD



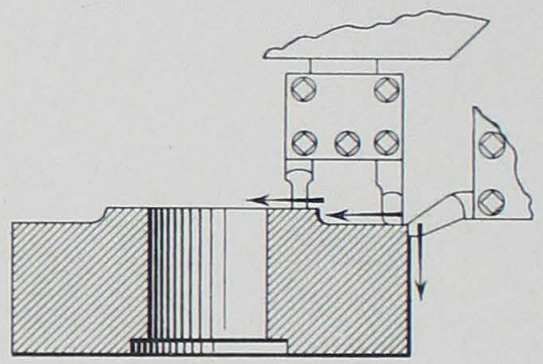
1ST SETTING. 1ST OPERATION.



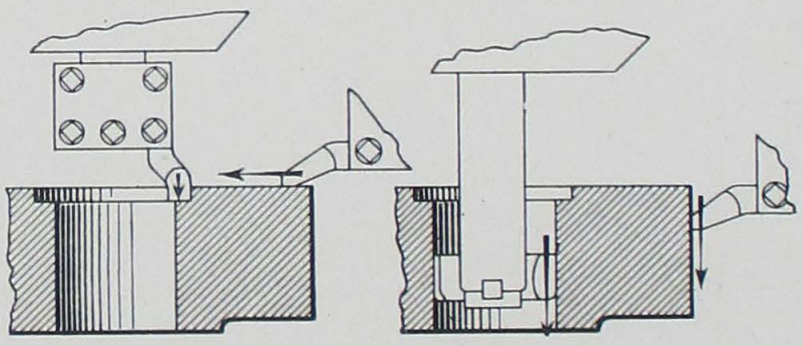
2ND SETTING. 1ST OPERATION.



1ST SETTING.
2ND OPERATION. 3RD OPERATION.



2ND SETTING. 1ST OPERATION.

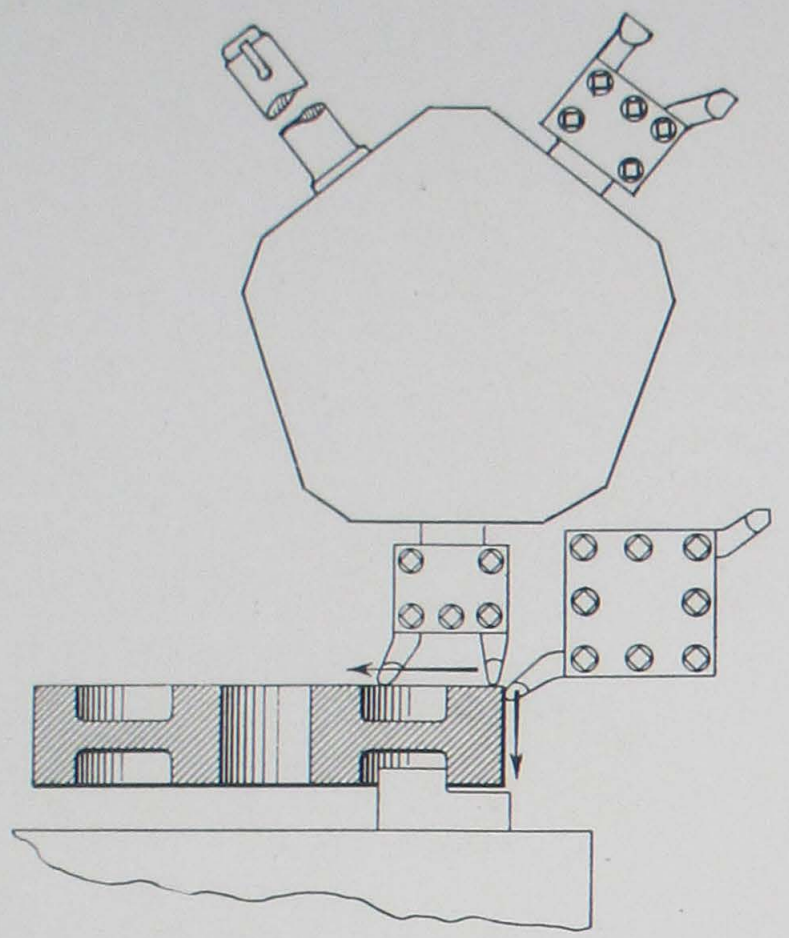


1ST SETTING.
5TH OPERATION. 4TH OPERATION.

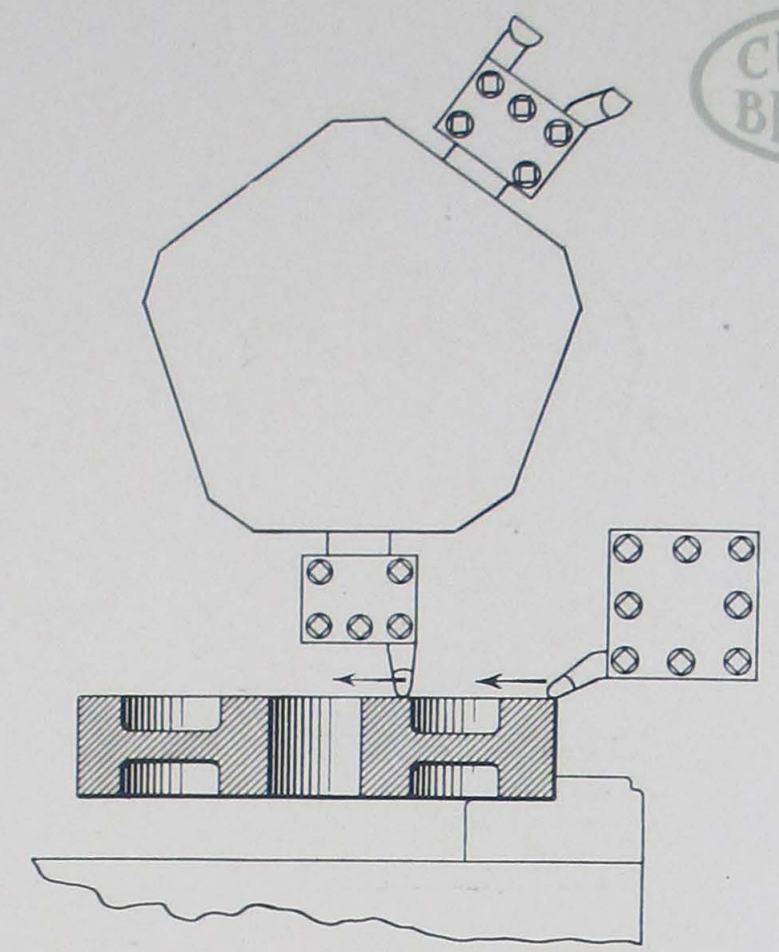
THE VERTICAL TURRET LATHE

Simple gear-blanks may be produced singly or in large lots to good advantage. Combining the operations, as shown, economizes in time and tools, and produces work of high character.

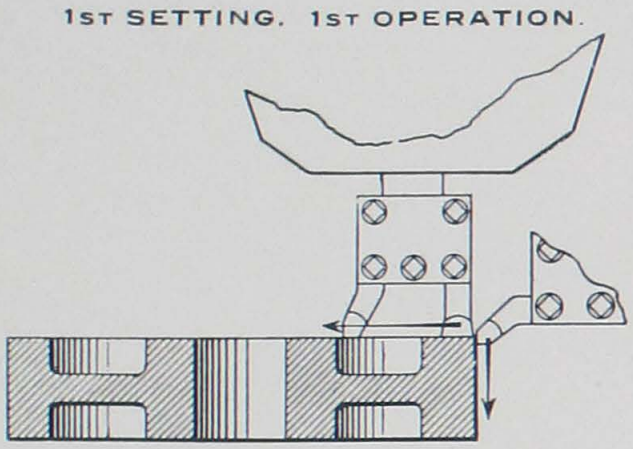
In the second setting, soft jaws, machined in position, under chucking tension, hold the partly turned piece true to center while the balance of O. D. is finished and cuts lapped.



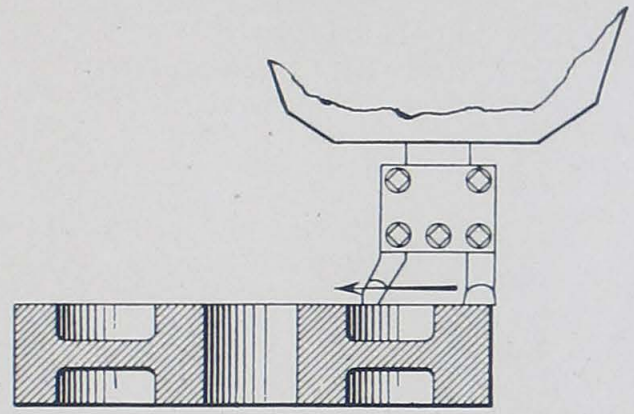
1ST SETTING. 1ST OPERATION.



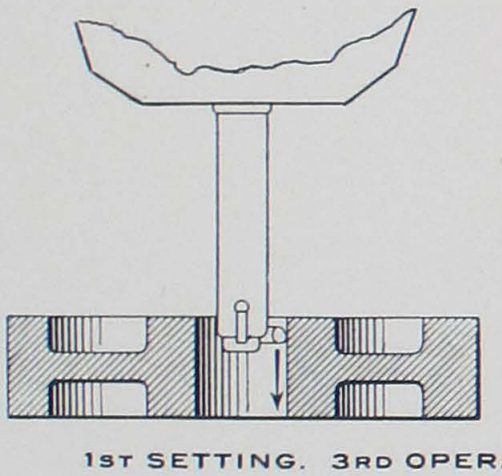
2ND SETTING. 1ST OPERATION.



1ST SETTING. 2ND OPERATION



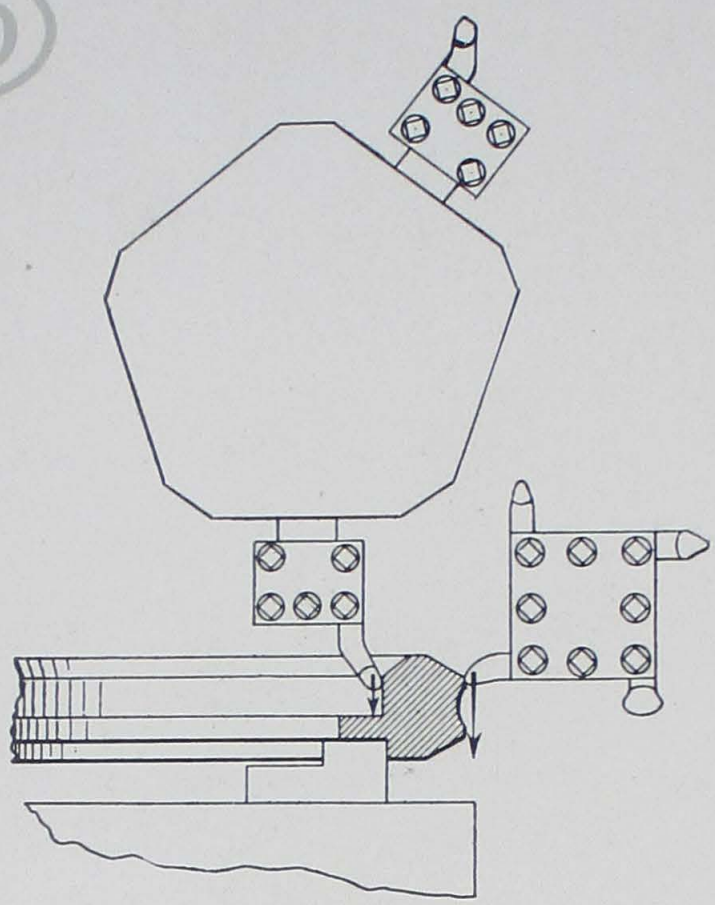
2ND SETTING. 2ND OPERATION



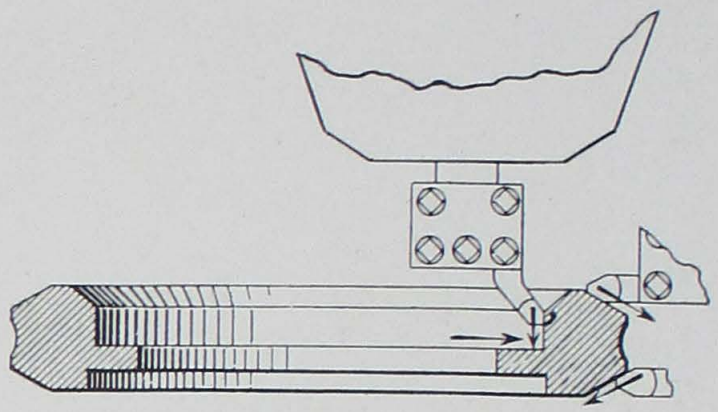
1ST SETTING. 3RD OPERATION.

THE VERTICAL TURRET LATHE

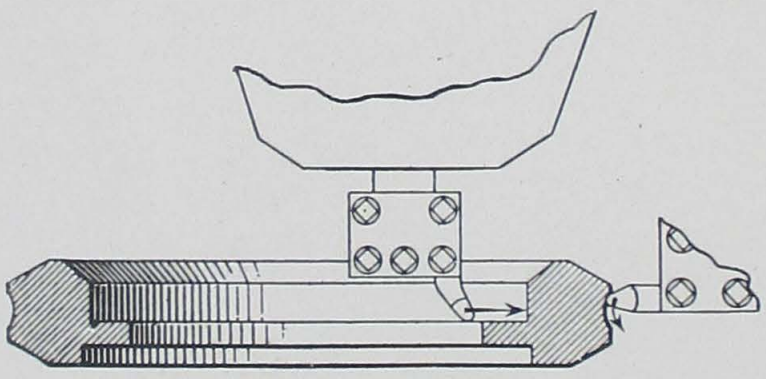
Chucking from the inside of rim, in the manner shown, permits the finish of all surfaces, except under face, at one setting. Parallel faces are obtained by the use of soft jaws, turned in position, for the second setting.



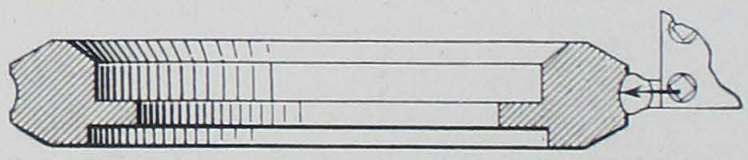
1ST OPERATION.



3RD OPERATION



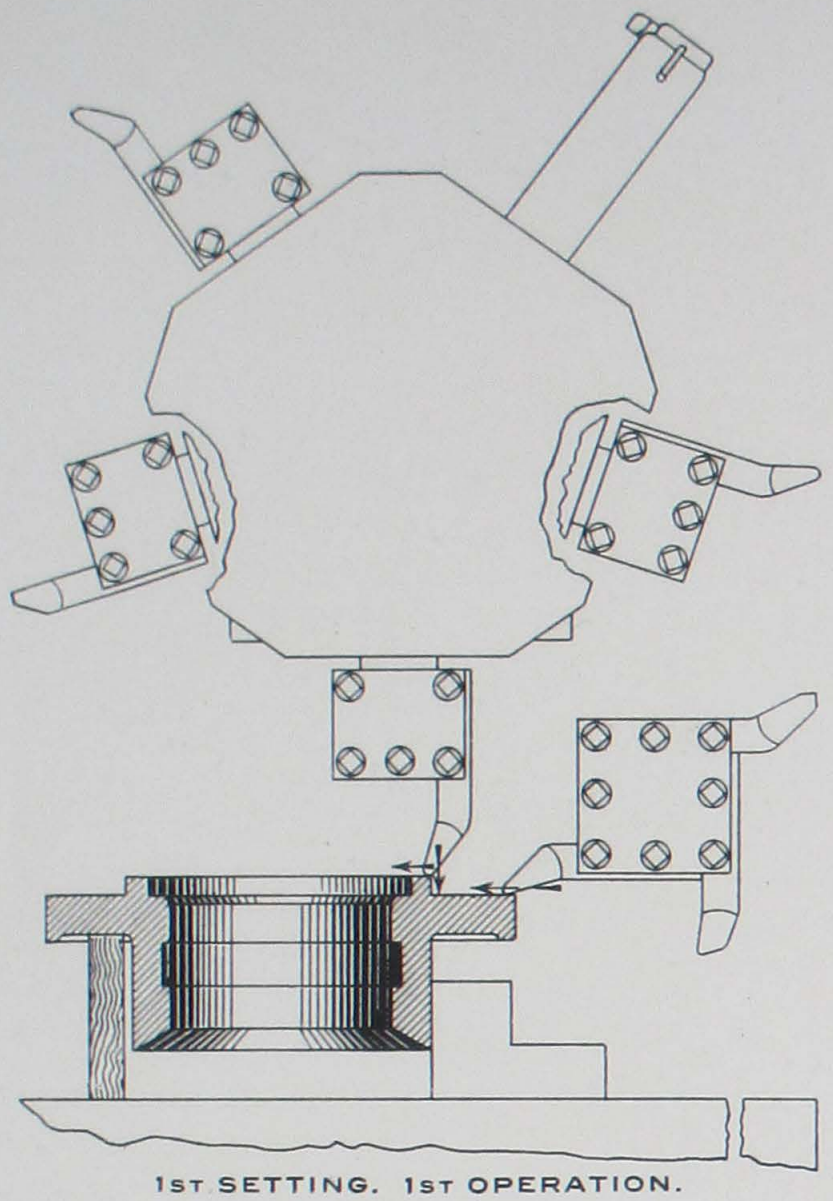
2ND OPERATION.



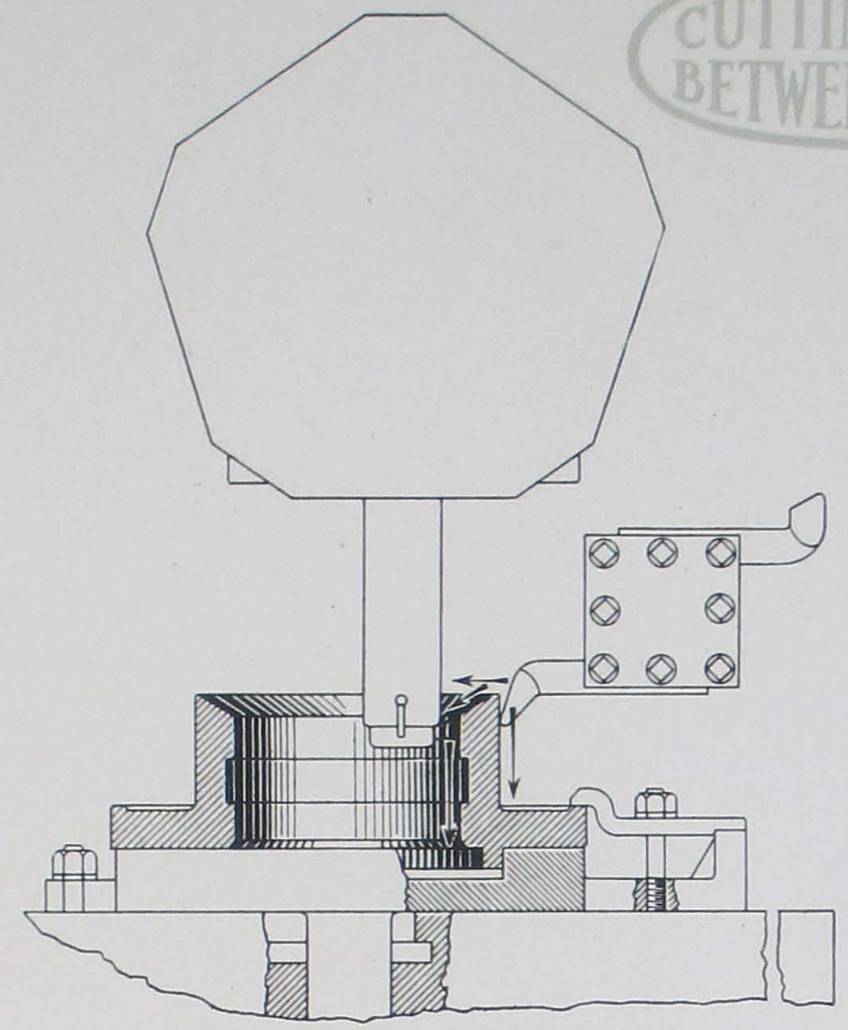
4TH OPERATION

THE VERTICAL TURRET LATHE

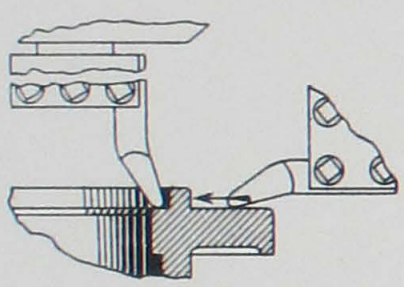
A simple job requiring but few tools for the operations shown. Observation Stops are a great aid in reproducing sizes without measurements.



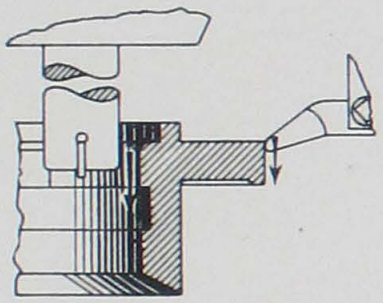
1ST SETTING. 1ST OPERATION.



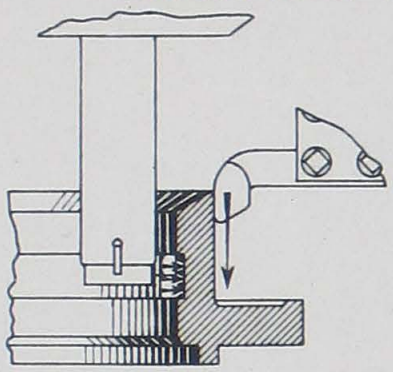
2ND SETTING. 1ST OPERATION.

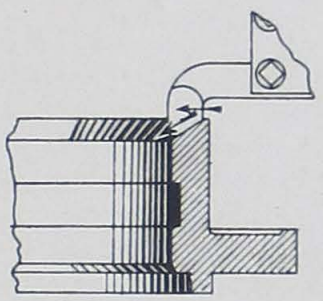


1ST STG. 2ND OPN.

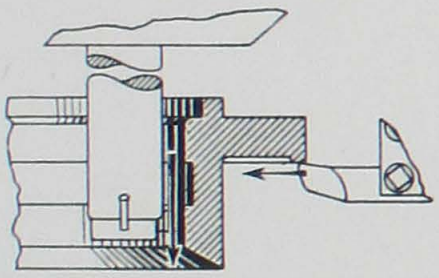


1ST STG. 3RD OPN.

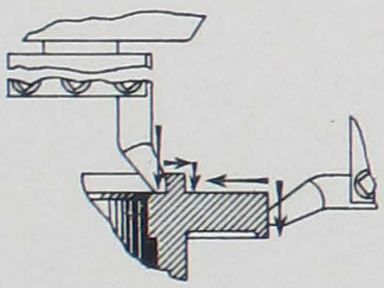




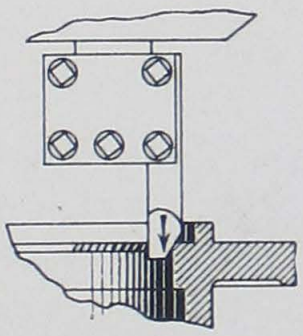
2ND SETTING.
2ND OPERATION. 3RD OPERATION.



1ST STG. 4TH OPN.



1ST STG. 5TH OPN.

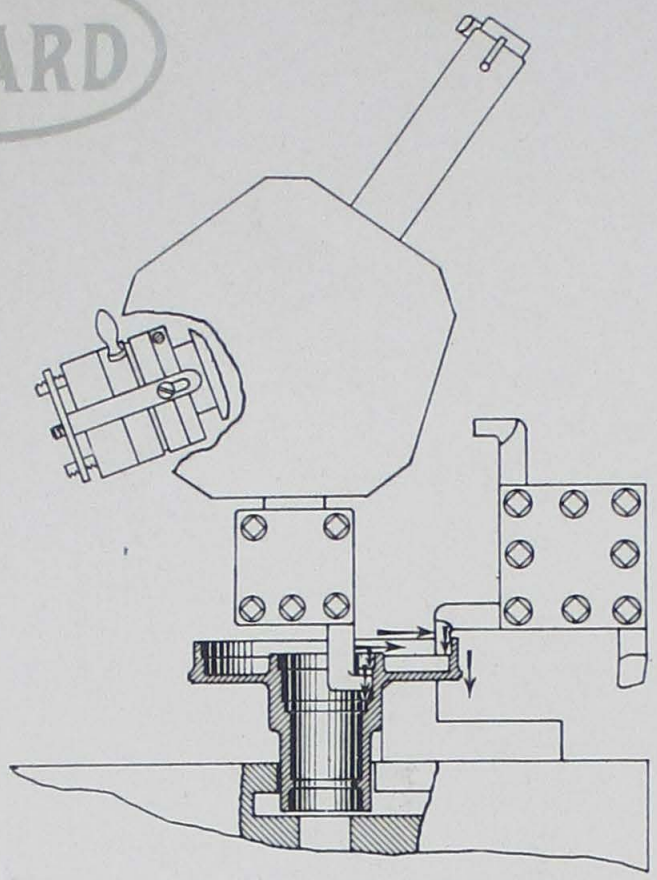


1ST SETTING. 6TH OPERATION.

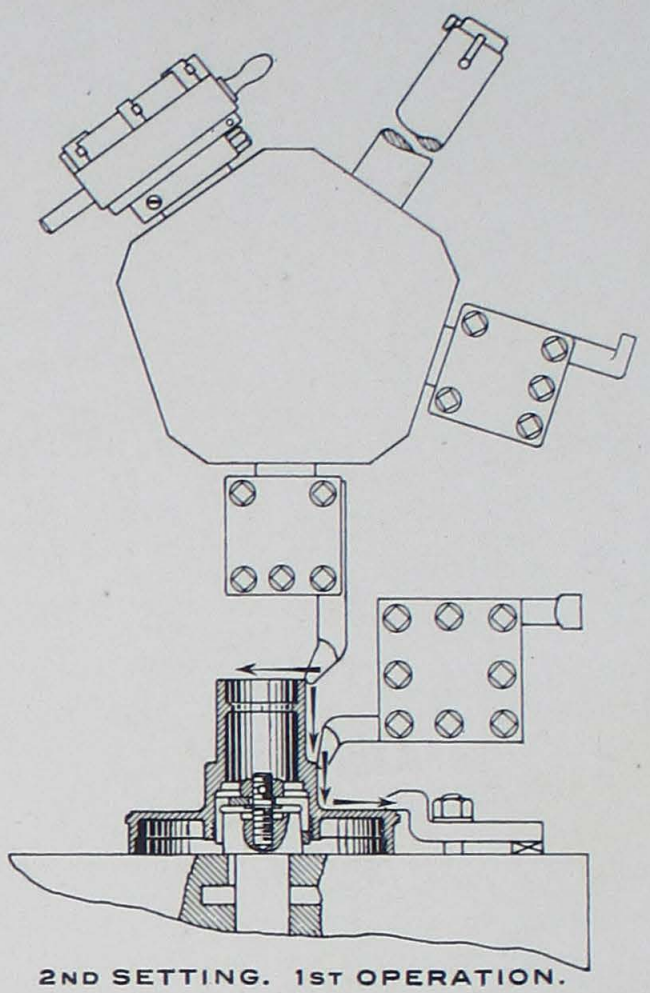
THE VERTICAL TURRET LATHE

The packing gland shown requires a combination of boring, turning and facing operations which are quite simple. Both Heads are in continuous operation without interference.

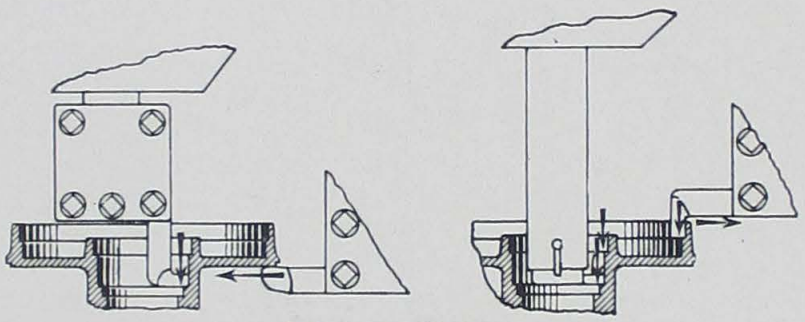
The piece is finish-bored in the second setting in the fixture shown, and, in recessing, the cross-movement of the Main Head is used.



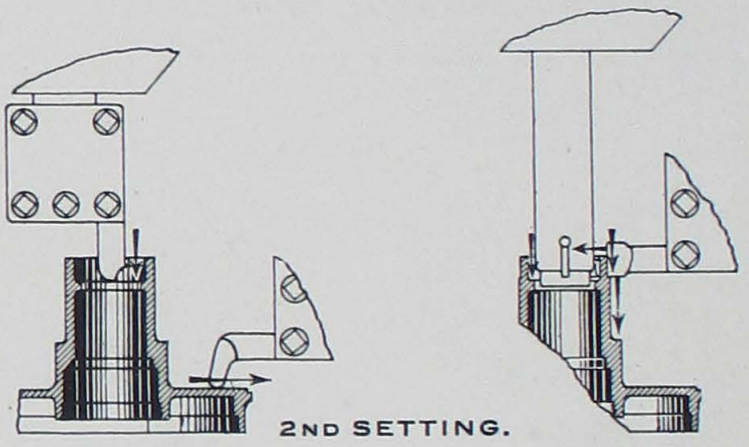
1ST SETTING. 1ST OPERATION.



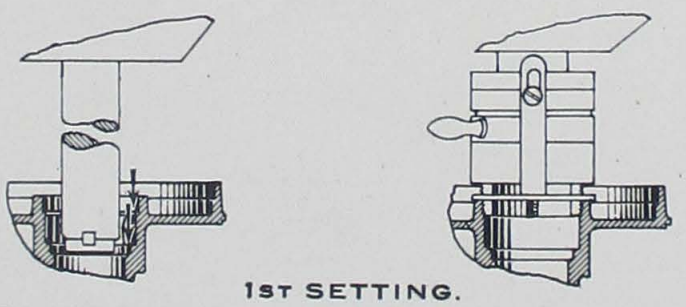
2ND SETTING. 1ST OPERATION.



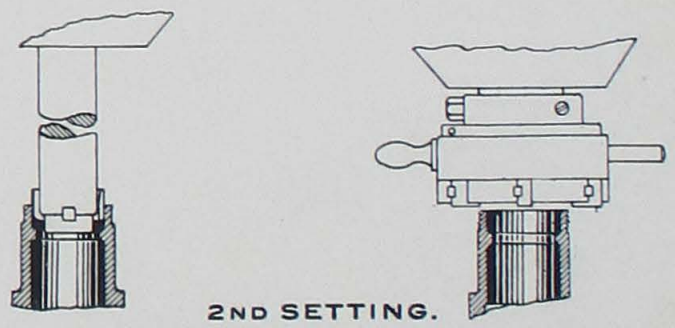
1ST SETTING.
2ND OPERATION. 4TH OPERATION.



2ND SETTING.
2ND OPERATION. 3RD OPERATION.



1ST SETTING.
3RD OPERATION. 5TH OPERATION.

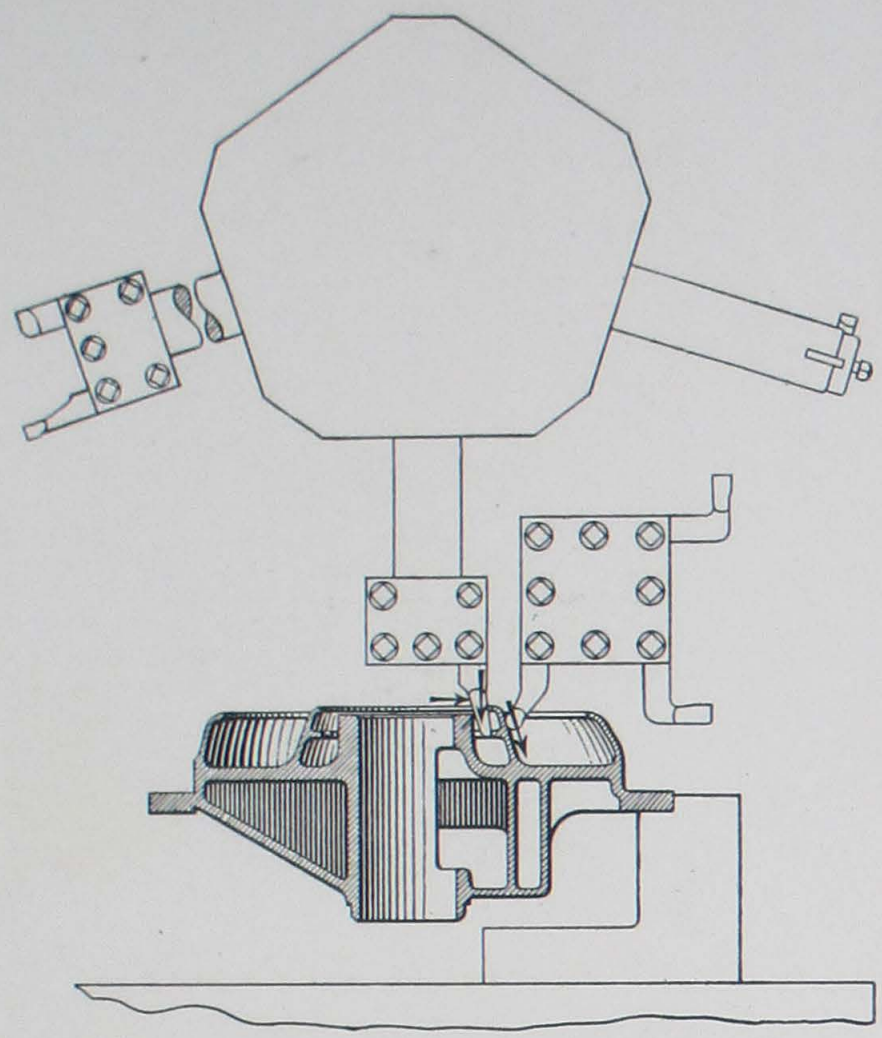


2ND SETTING.
4TH OPERATION. 5TH OPERATION.

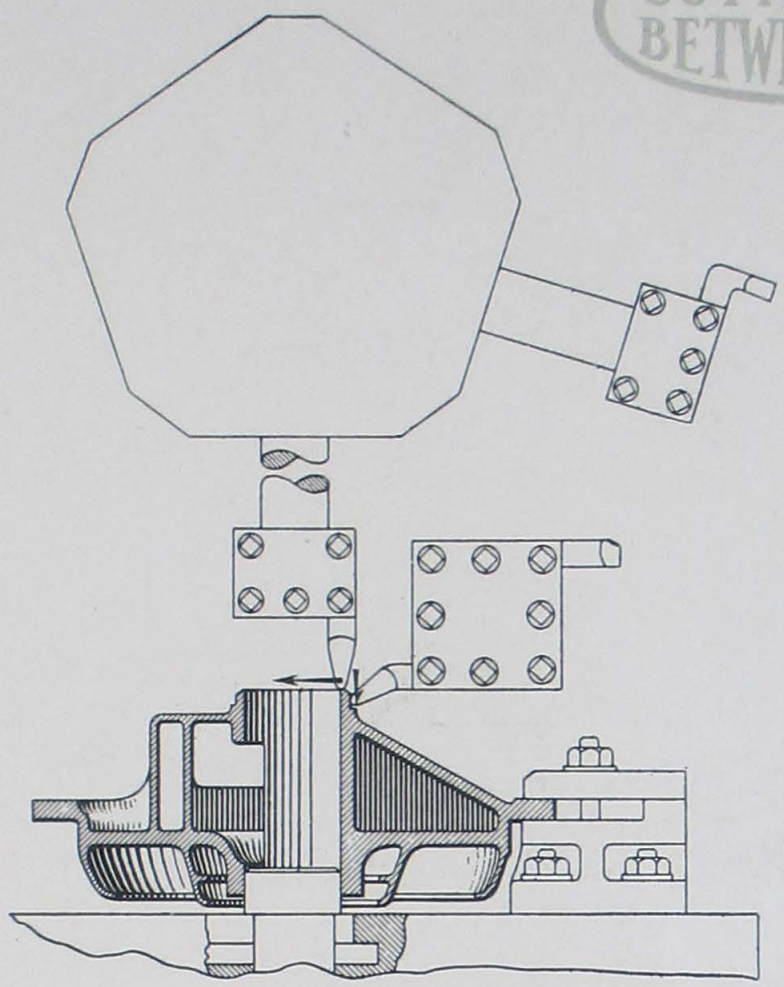
THE VERTICAL TURRET LATHE

Collapsible taps and self-opening dies present an advantage when parts are manufactured in quantities. In such work the Thread Cutting Attachment is indicated in order to properly start and follow the thread cut.

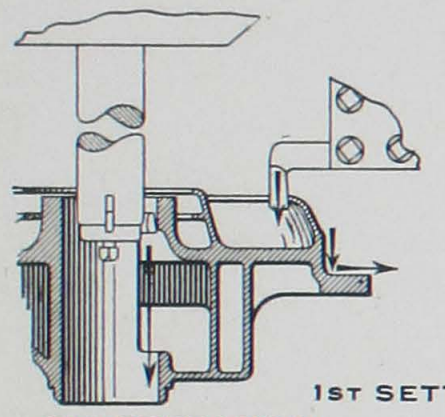
An expanding plug arbor locates the work for the second setting.

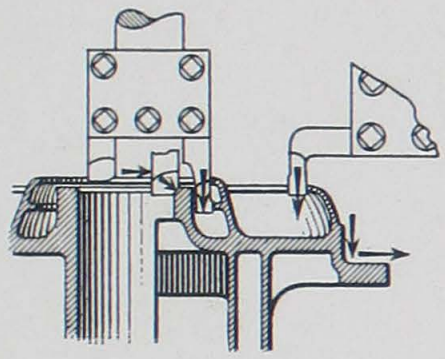


1ST SETTING. 1ST OPERATION.

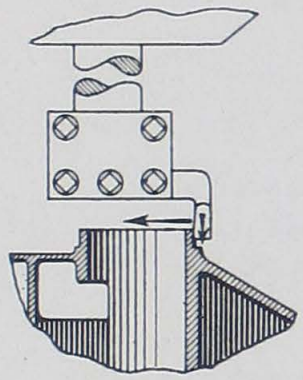


2ND SETTING. 1ST OPERATION.

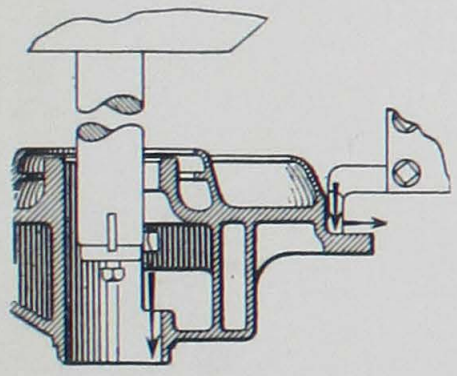




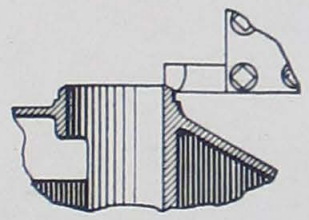
1ST SETTING.
2ND OPERATION. 4TH OPERATION.



2ND SETTING.
2ND OPERATION.



1ST SETTING.
3RD OPERATION.

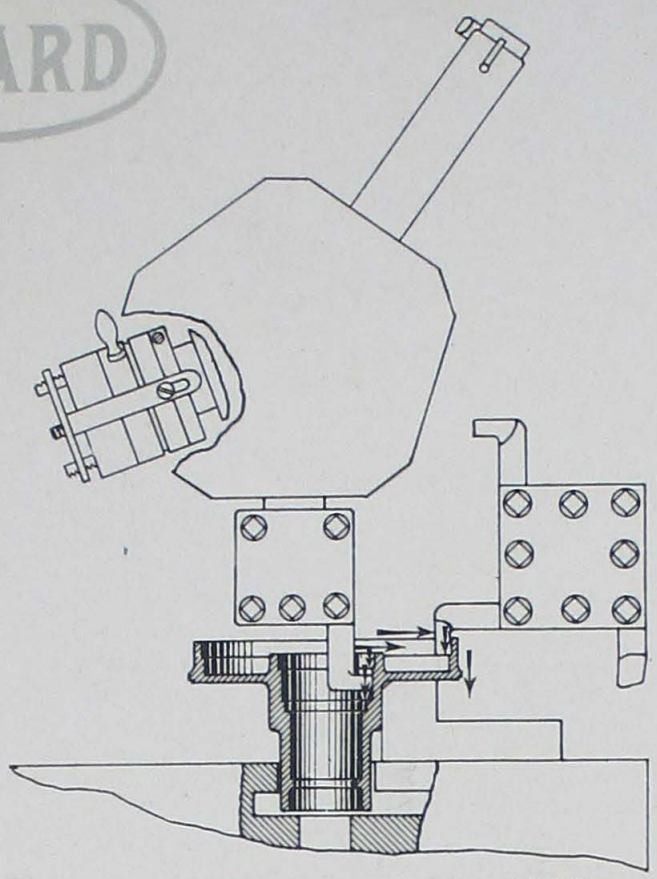


2ND SETTING.
3RD OPERATION.

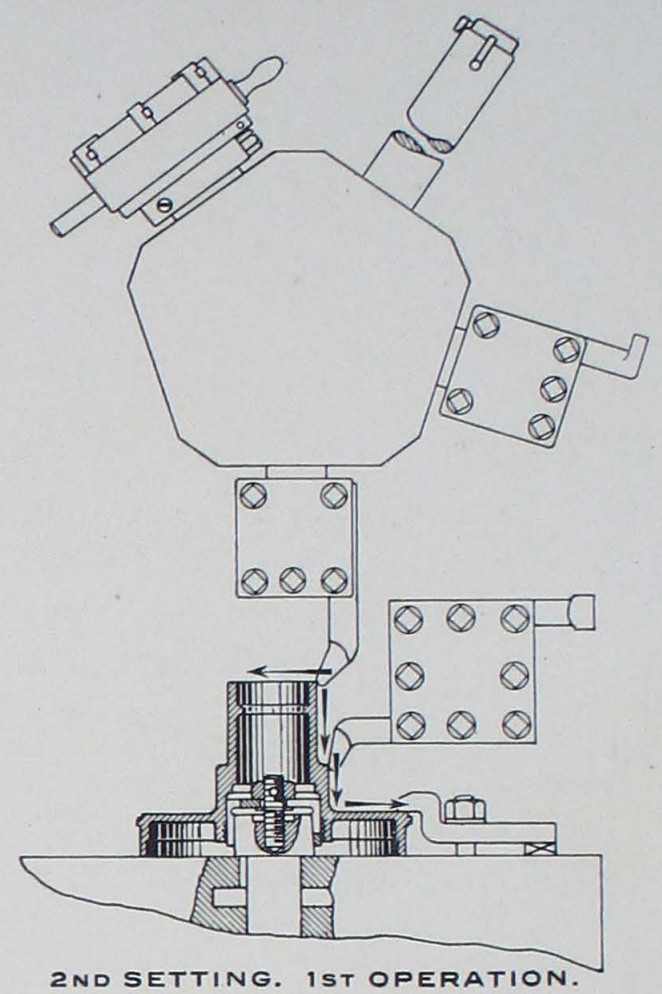
THE VERTICAL TURRET LATHE

Pieces of the nature shown are easily distorted by sweep tools. The single-point tools used in the Vertical Turret Lathe reduce this tendency, and the Observation Stops, set while machining the first piece, insure the duplication of sizes in those following.

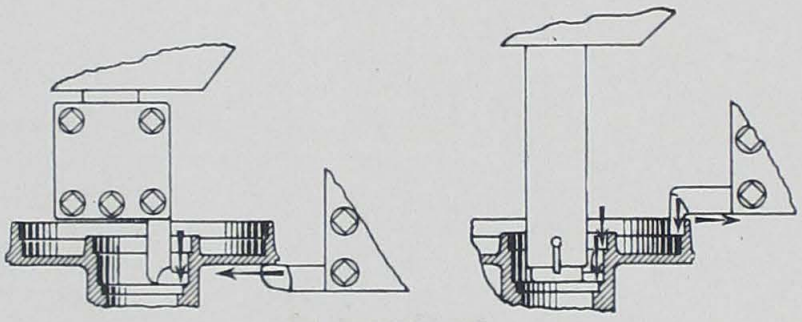
A locating stud and clamp-jaws are used in the second setting.



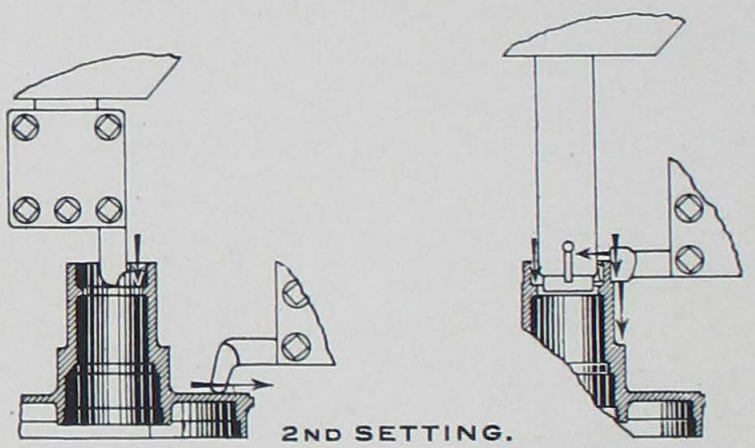
1ST SETTING. 1ST OPERATION.



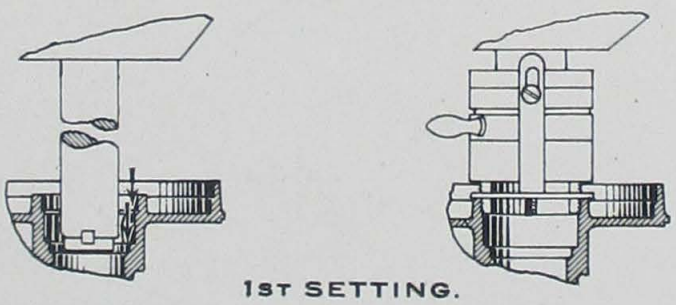
2ND SETTING. 1ST OPERATION.



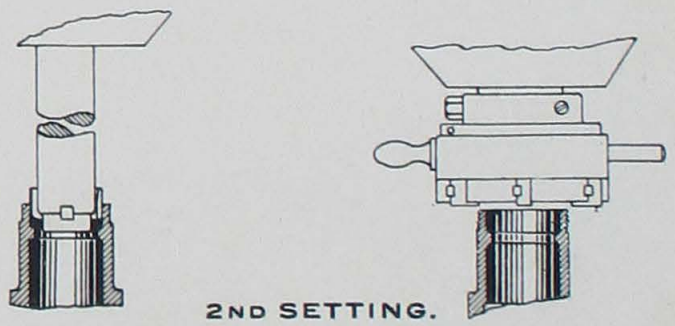
1ST SETTING.
2ND OPERATION. 4TH OPERATION.



2ND SETTING.
2ND OPERATION. 3RD OPERATION.



1ST SETTING.
3RD OPERATION. 5TH OPERATION.

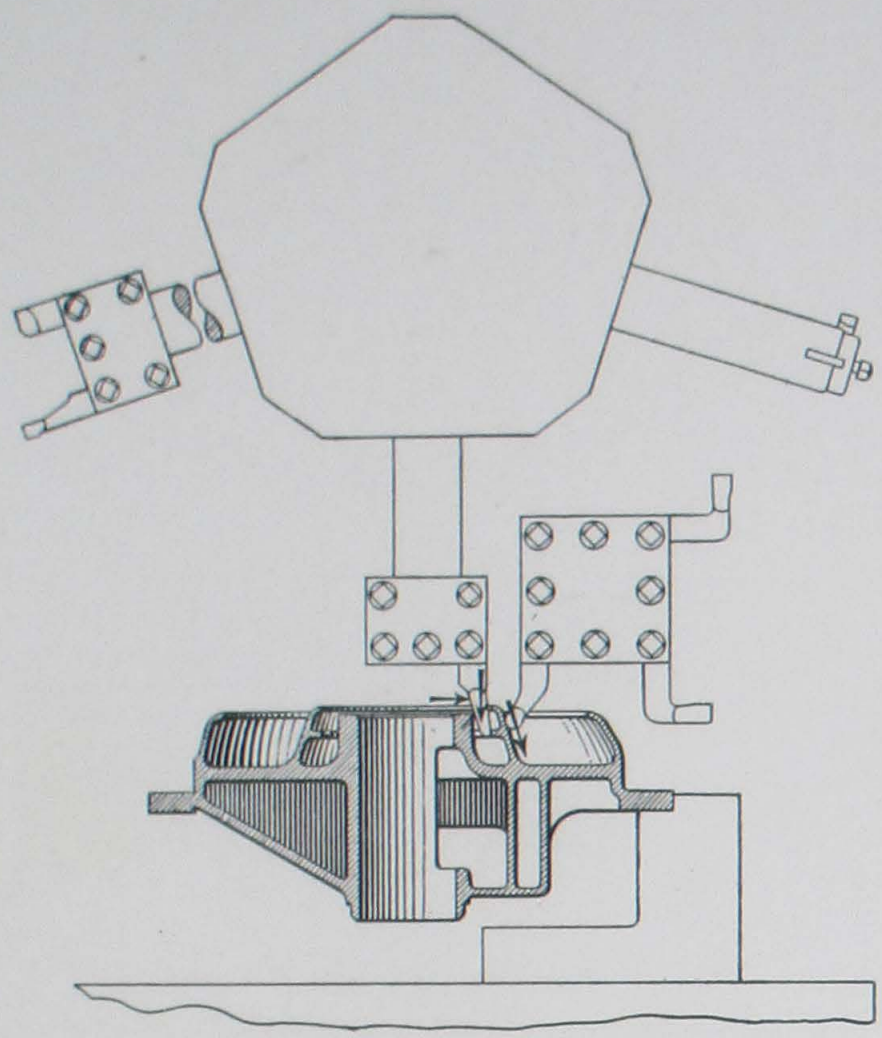


2ND SETTING.
4TH OPERATION. 5TH OPERATION.

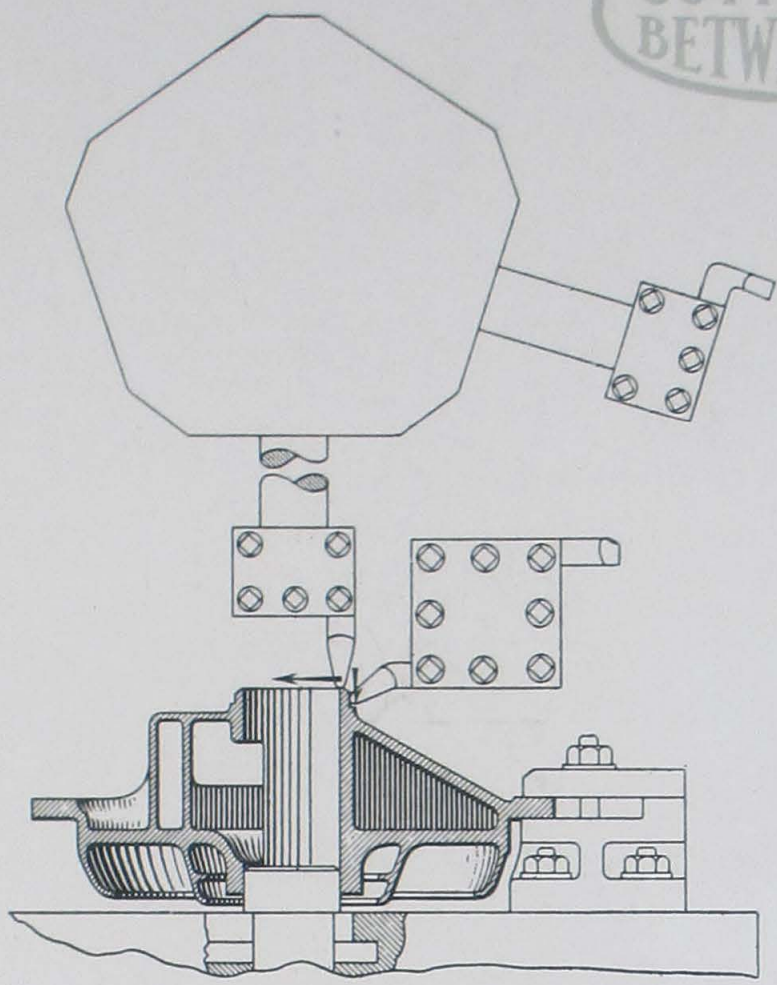
THE VERTICAL TURRET LATHE

Collapsible taps and self-opening dies present an advantage when parts are manufactured in quantities. In such work the Thread Cutting Attachment is indicated in order to properly start and follow the thread cut.

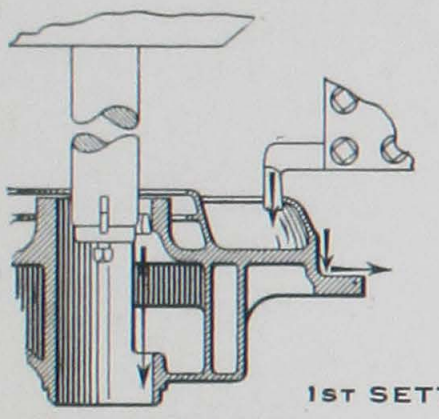
An expanding plug arbor locates the work for the second setting.

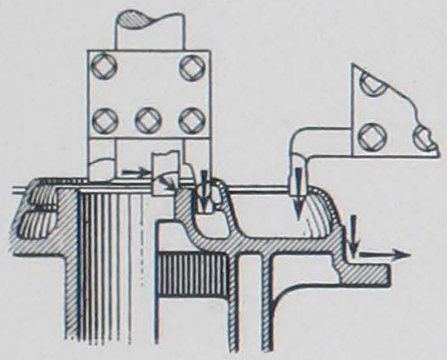


1ST SETTING. 1ST OPERATION.

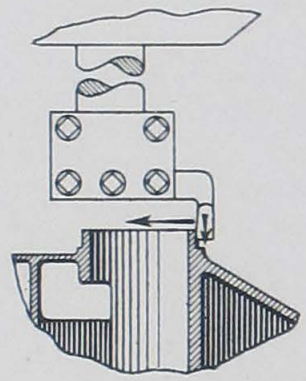


2ND SETTING. 1ST OPERATION.

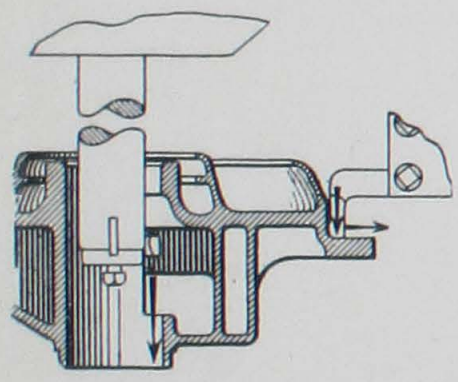




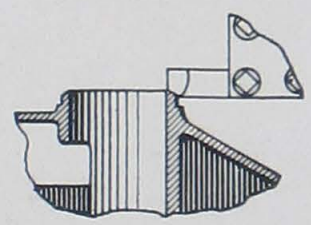
1ST SETTING.
2ND OPERATION. 4TH OPERATION.



2ND SETTING.
2ND OPERATION.



1ST SETTING.
3RD OPERATION.

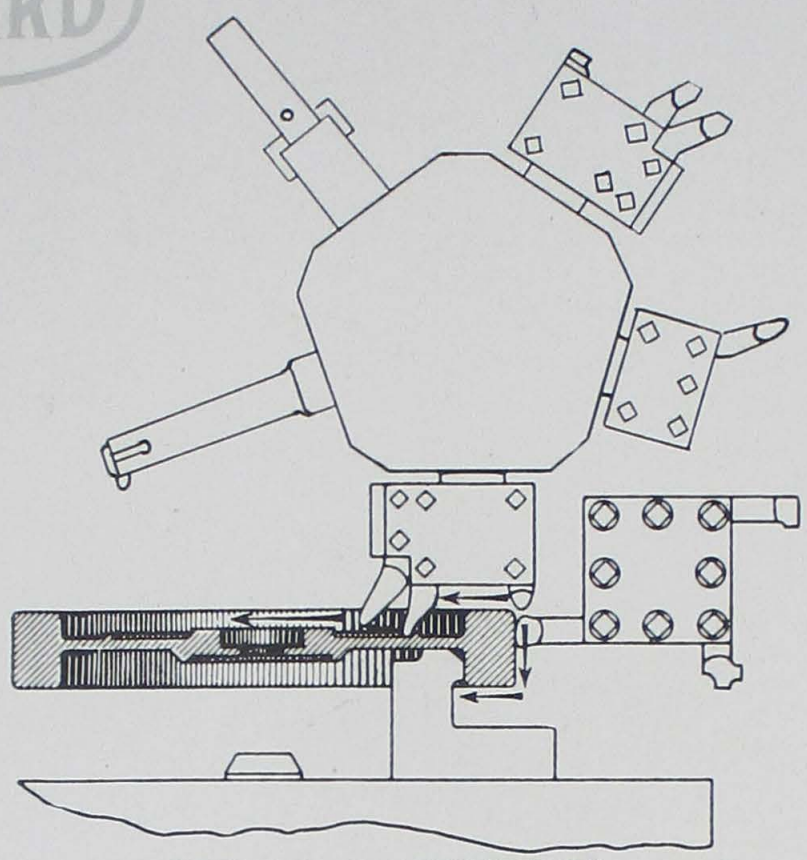


2ND SETTING.
3RD OPERATION.

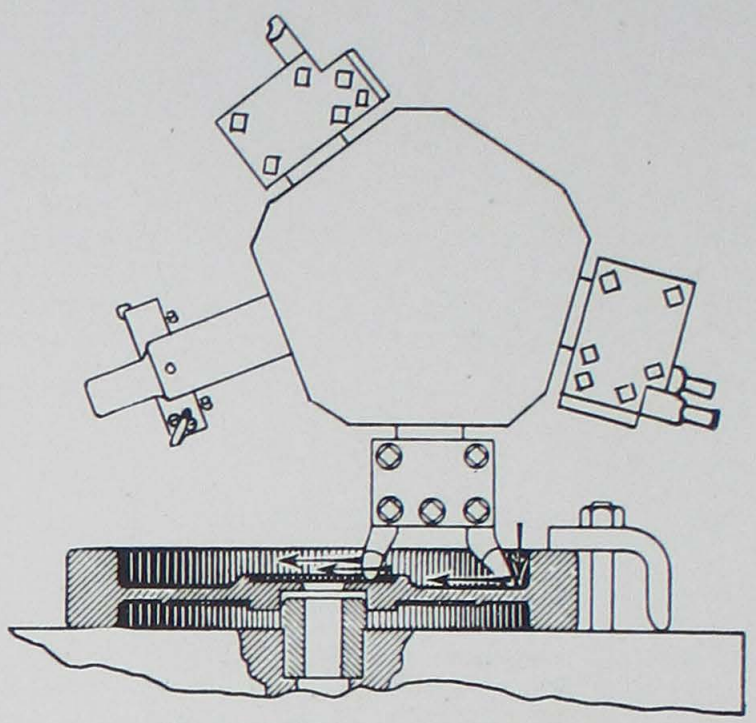
THE VERTICAL TURRET LATHE

Pieces of the nature shown are easily distorted by sweep tools. The single-point tools used in the Vertical Turret Lathe reduce this tendency, and the Observation Stops, set while machining the first piece, insure the duplication of sizes in those following.

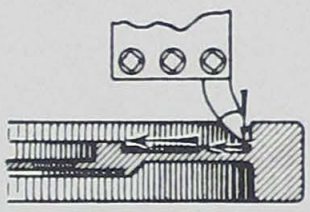
A locating stud and clamp-jaws are used in the second setting.



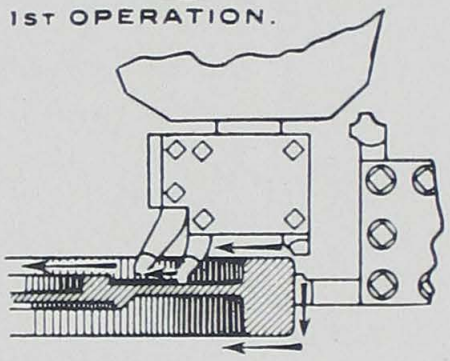
1ST SETTING. 1ST OPERATION.



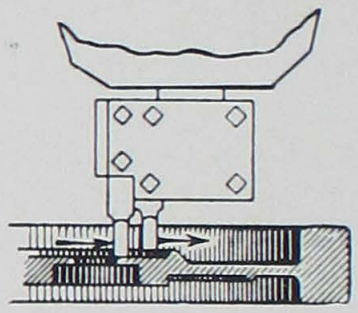
2ND SETTING. 1ST OPERATION.



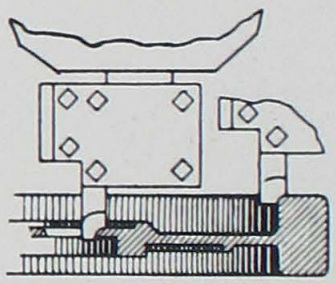
1ST STG 2ND OPN



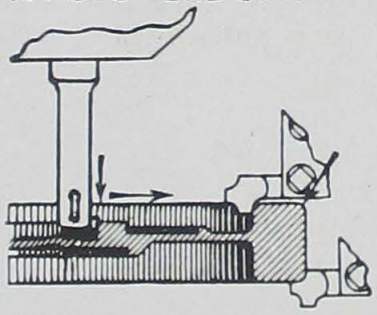
1ST STG 4TH OPN



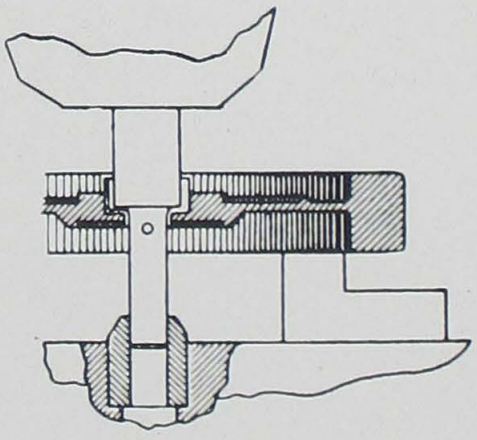
2ND STG. 2ND OPN.



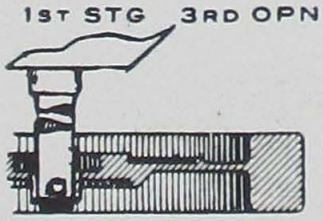
2ND STG 3RD OPN.



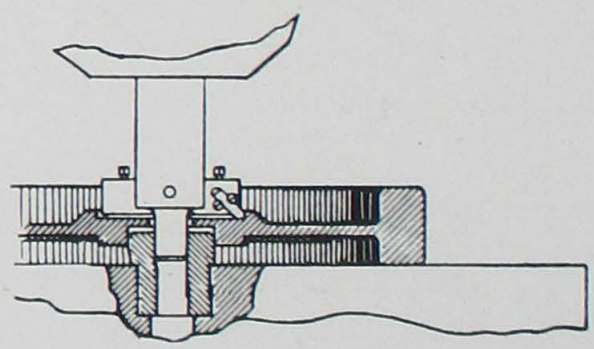
1ST STG 3RD OPN



1ST STG 6TH OPN.



1ST STG. 5TH OPN

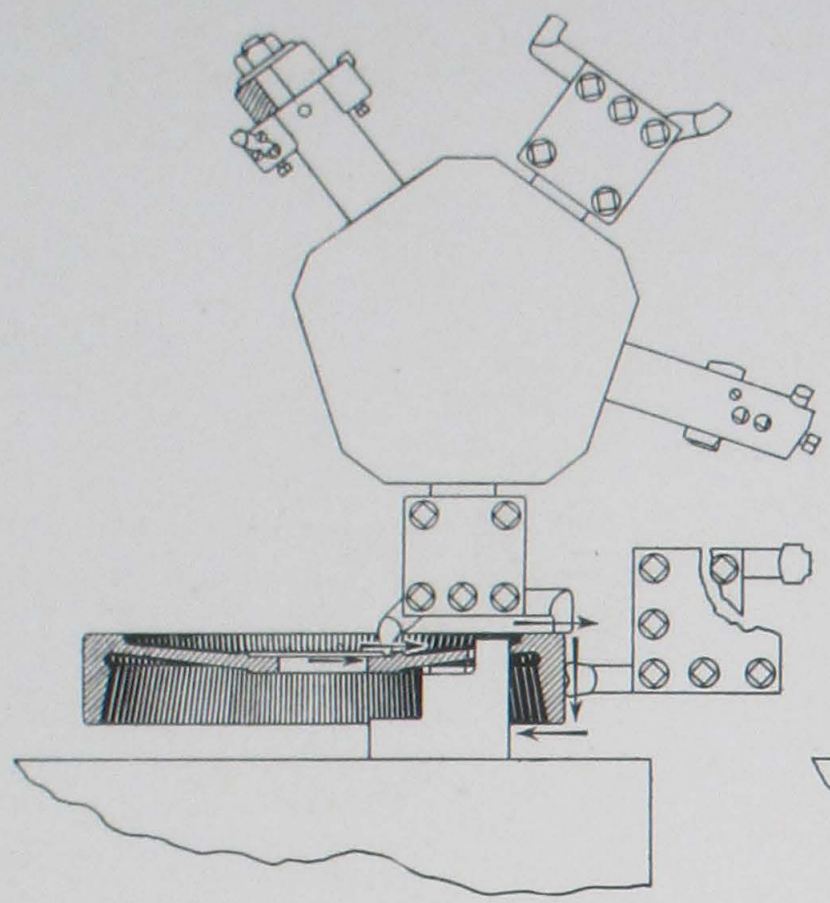


2ND STG. 4TH OPN

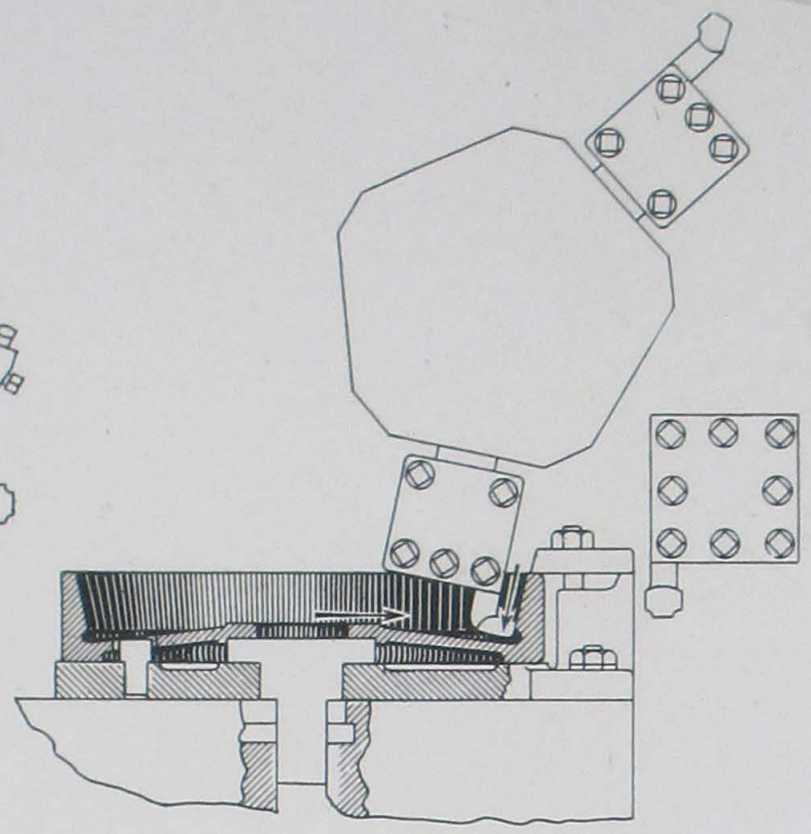
THE VERTICAL TURRET LATHE

A multiplicity of single-point tools may be used on work of this nature without fear of springing the piece as the pressure is not directly against the web.

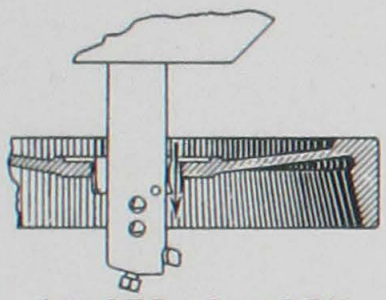
In the second setting the piece is centered by a locating plug which also serves as a pilot-bush for the shaft-flange fit. Clamps on the rim securely hold the work and give sufficient drive for cuts required.



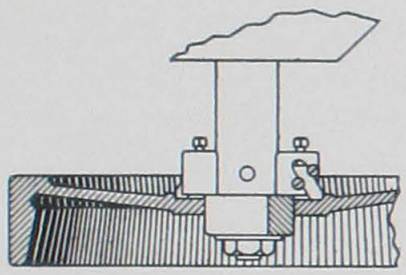
1ST SETTING. 1ST OPERATION.



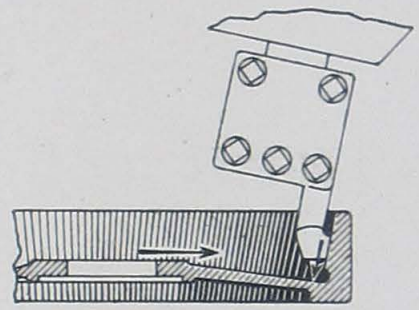
2ND SETTING. 1ST OPERATION.



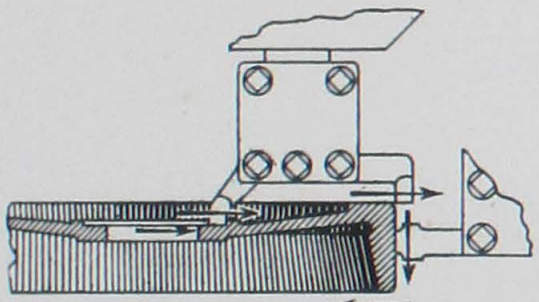
1ST STG. 2ND OPN.



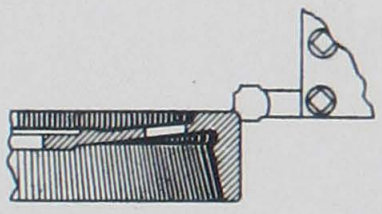
1ST STG. 4TH OPN.



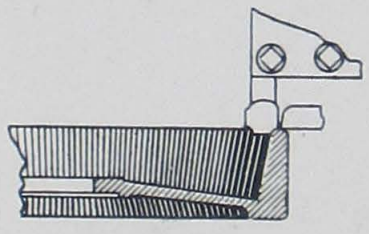
2ND STG. 2ND OPN.



1ST STG. 3RD OPN.



1ST STG. 5TH OPN.

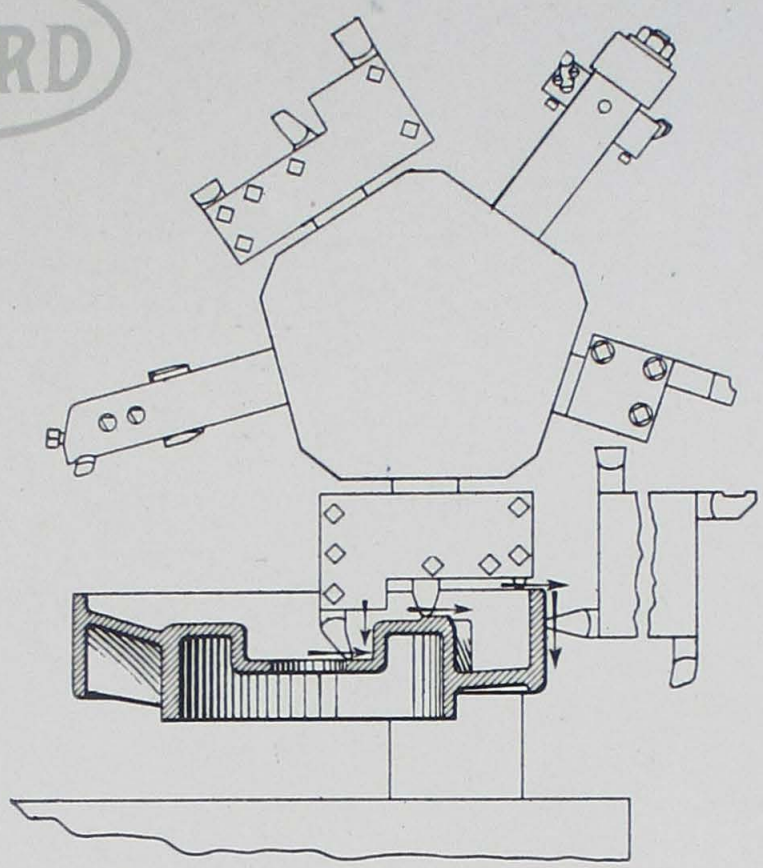


2ND STG. 3RD OPN.

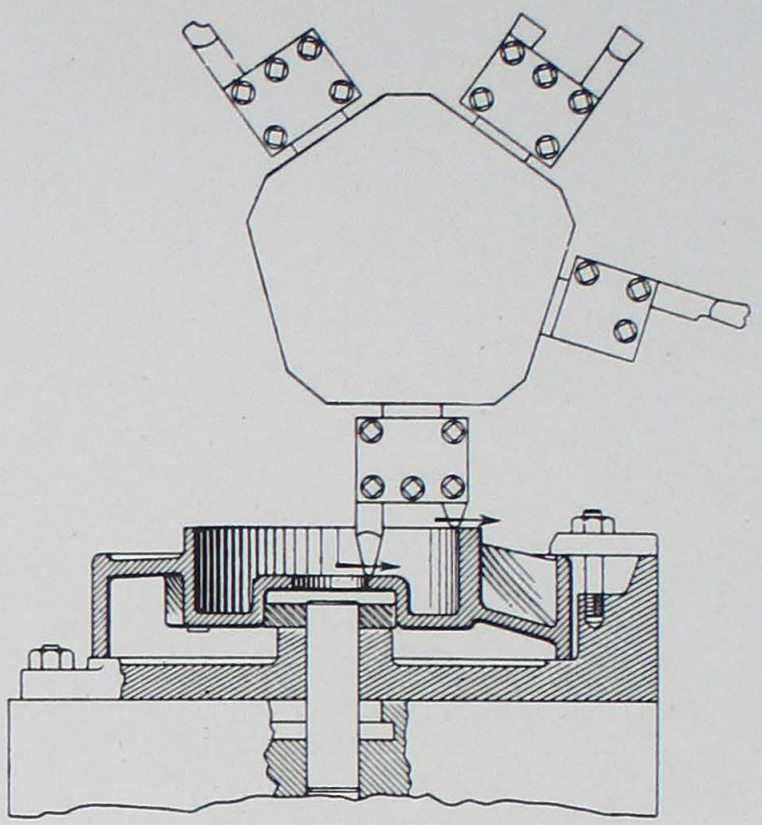
The special combination boring-bar used in the first setting of this wheel finishes the hole in one pass—the cutters being so spaced in the bar that no two are cutting at the same time. The reamer floats.

The hole, so finished, acts as a pilot for the flange-seat sizing tool, thus ensuring concentricity of all surfaces subsequently machined.

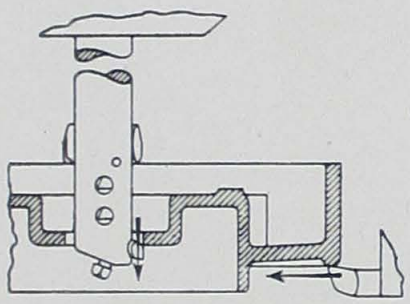
For the clutch-surface angle the Main Head is swivelled and remains set.



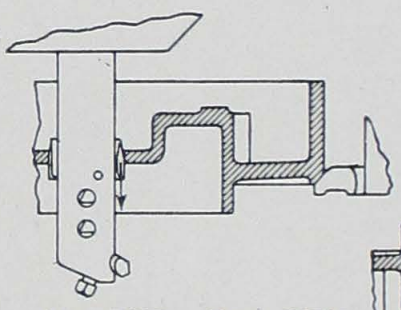
1ST SETTING. 1ST OPERATION.



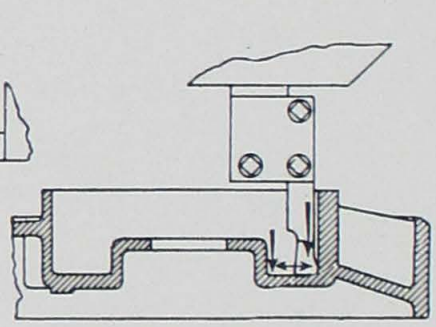
2ND SETTING. 1ST OPERATION.



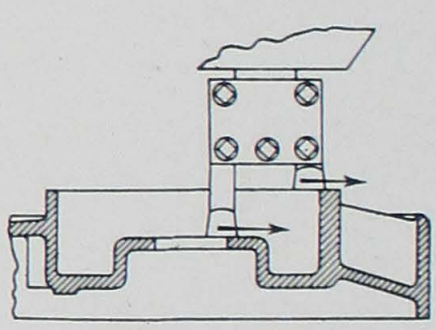
1ST STG. 2ND OPN.



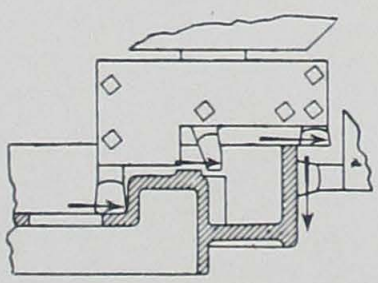
1ST STG. 3RD OPN.



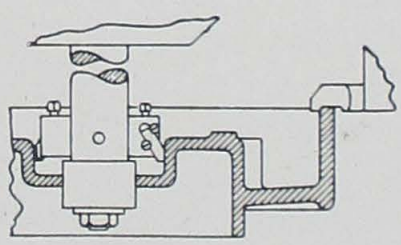
2ND STG. 2ND OPN.



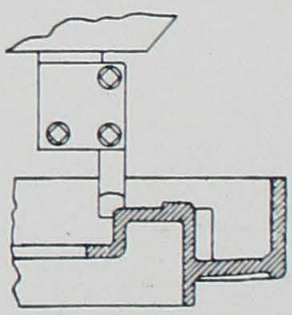
2ND STG. 3RD OPN.



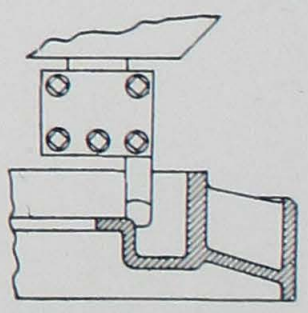
1ST STG. 4TH OPN.



1ST STG. 6TH OPN.



1ST STG. 5TH OPN.

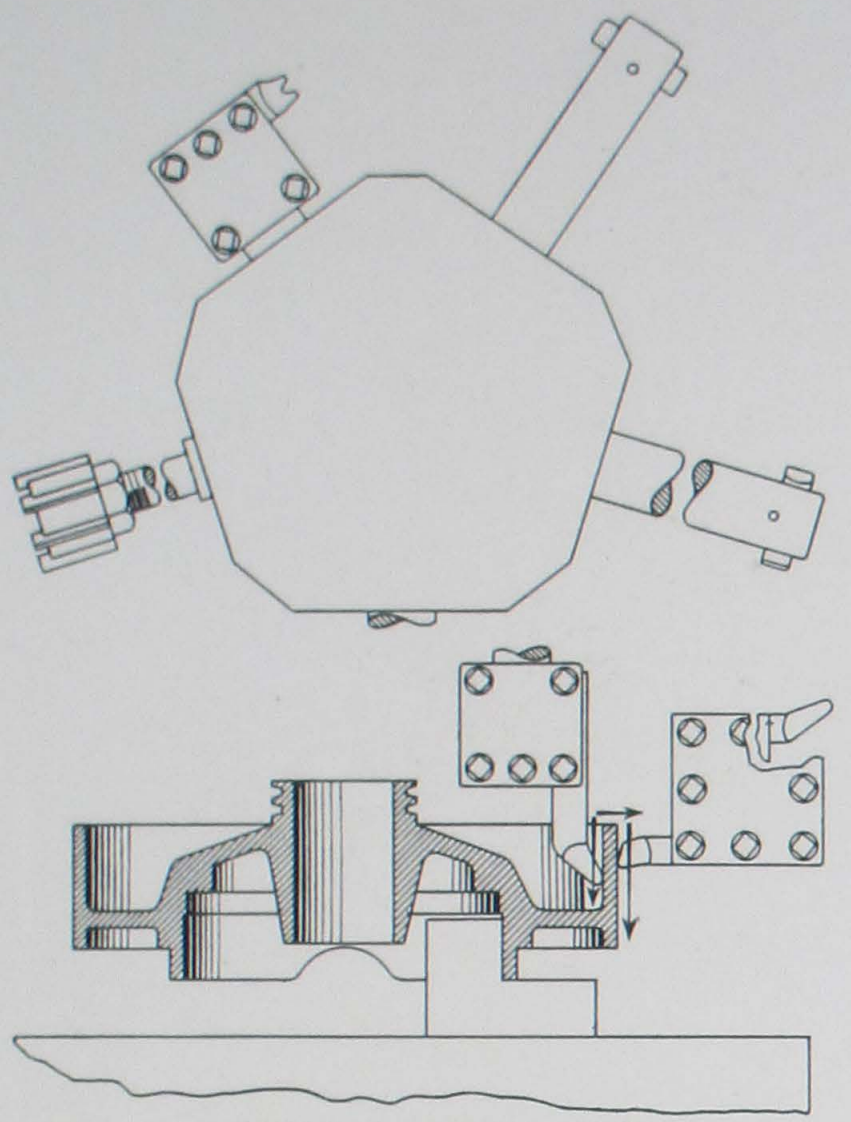


1ST STG. 8TH OPN.

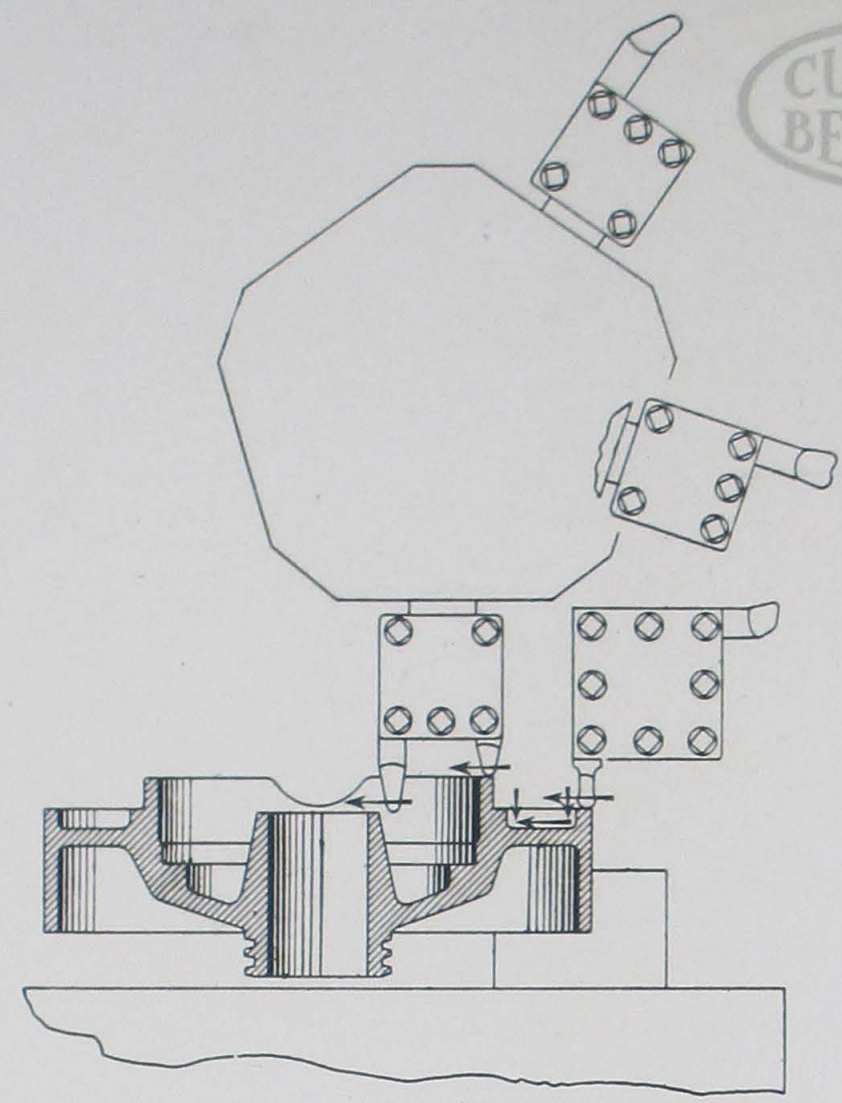
THE VERTICAL TURRET LATHE

The operations shown clearly indicate the value of tooling-combination where warranted by quantity production.

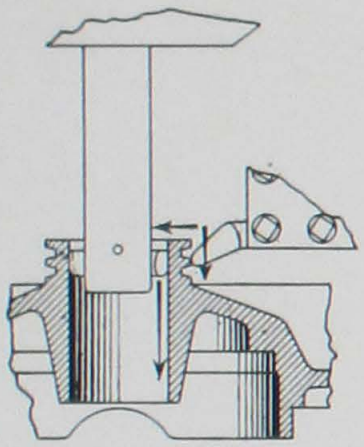
Single-point tools of this nature are easily replaced and reduce to a minimum the possibility of springing the work.



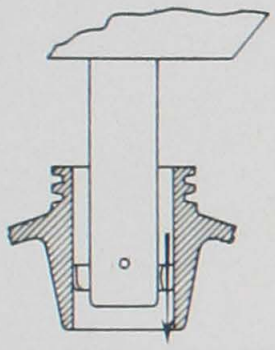
1ST SETTING. 1ST OPERATION.



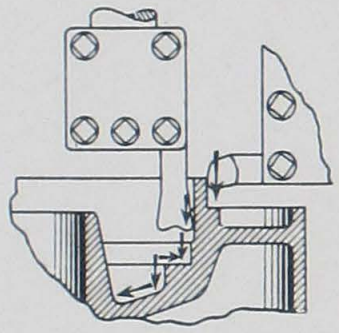
2ND SETTING. 1ST OPERATION.



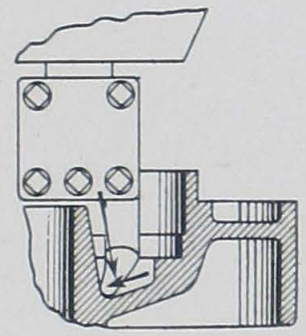
1ST STG. 2ND OPN.



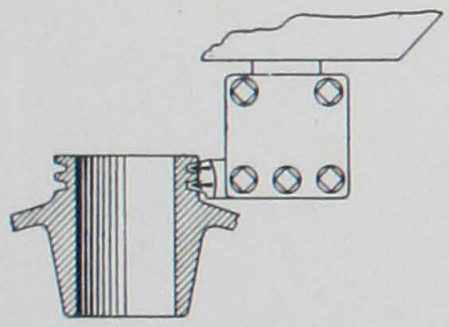
1ST STG. 4TH OPN.



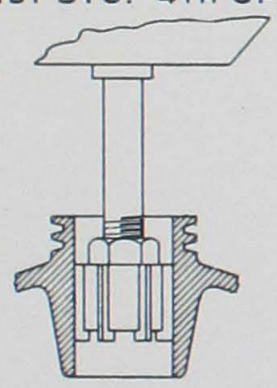
2ND STG. 2ND OPN.



2ND STG. 3RD OPN.



1ST STG. 3RD OPN.

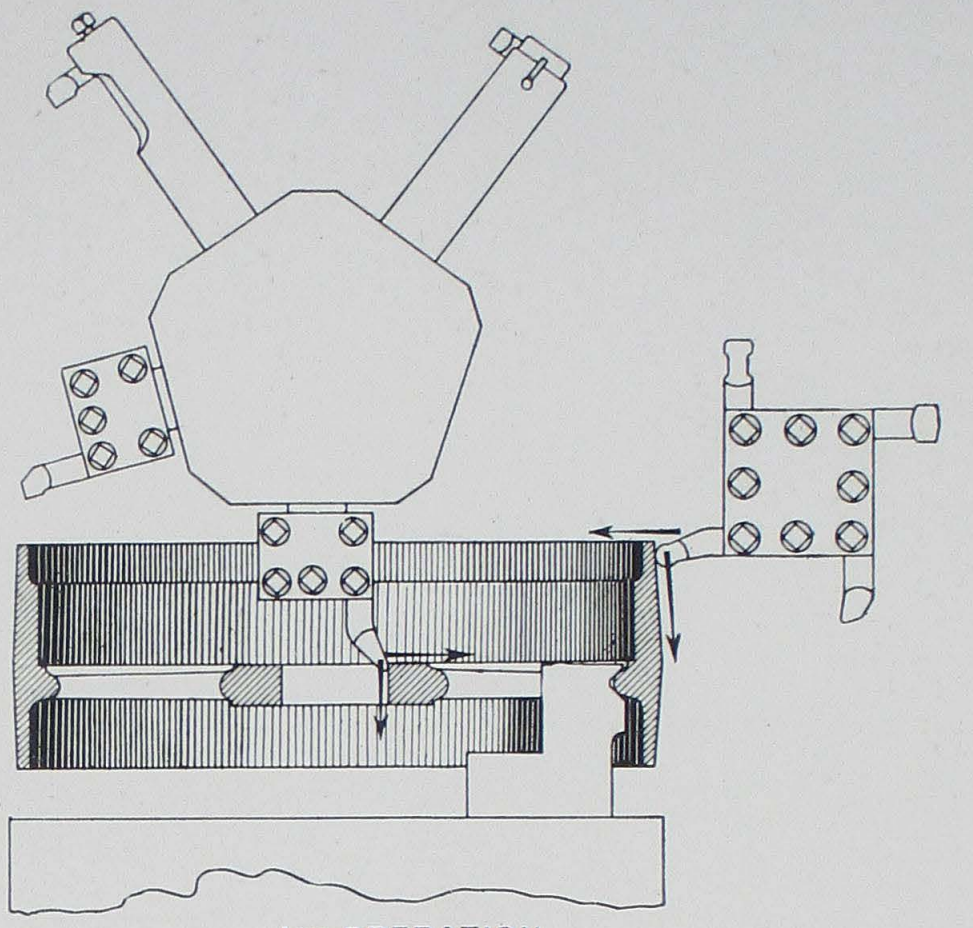


1ST STG. 5TH OPN.

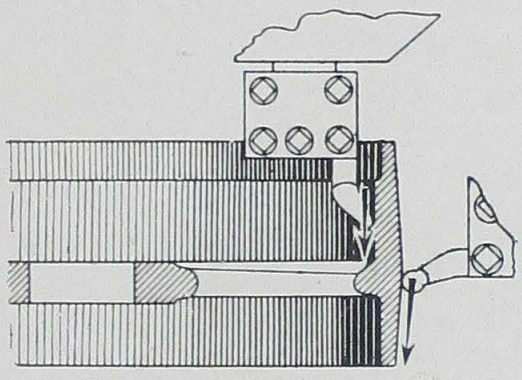
THE VERTICAL TURRET LATHE

Accuracy of a high order is required in this clutch-pulley which runs at high speed without vibration.

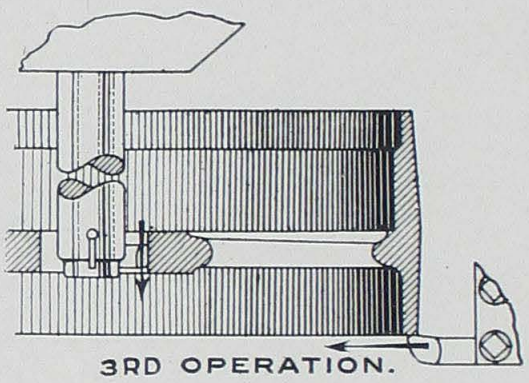
The method shown gave this result and effected a large saving in the cost of manufacture.



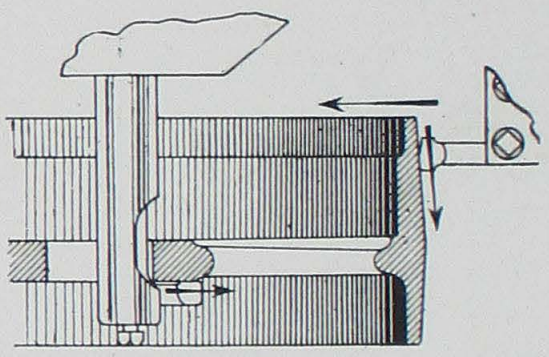
1ST OPERATION.



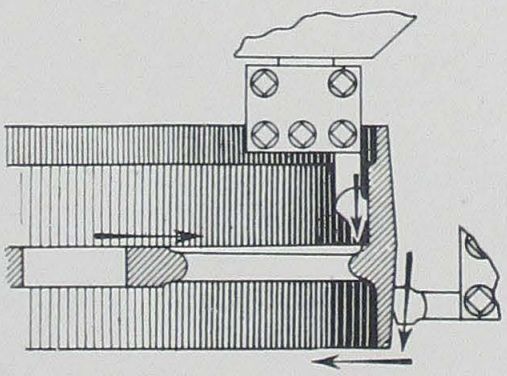
2ND OPERATION.



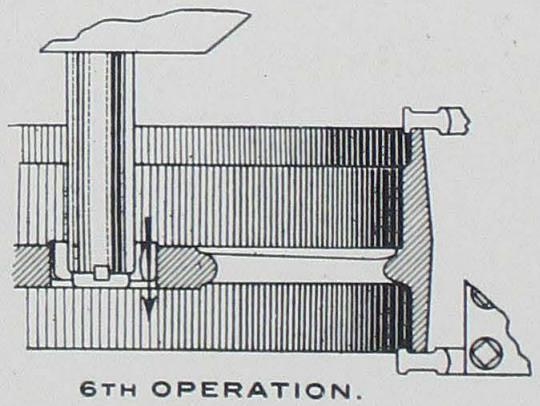
3RD OPERATION.



4TH OPERATION.



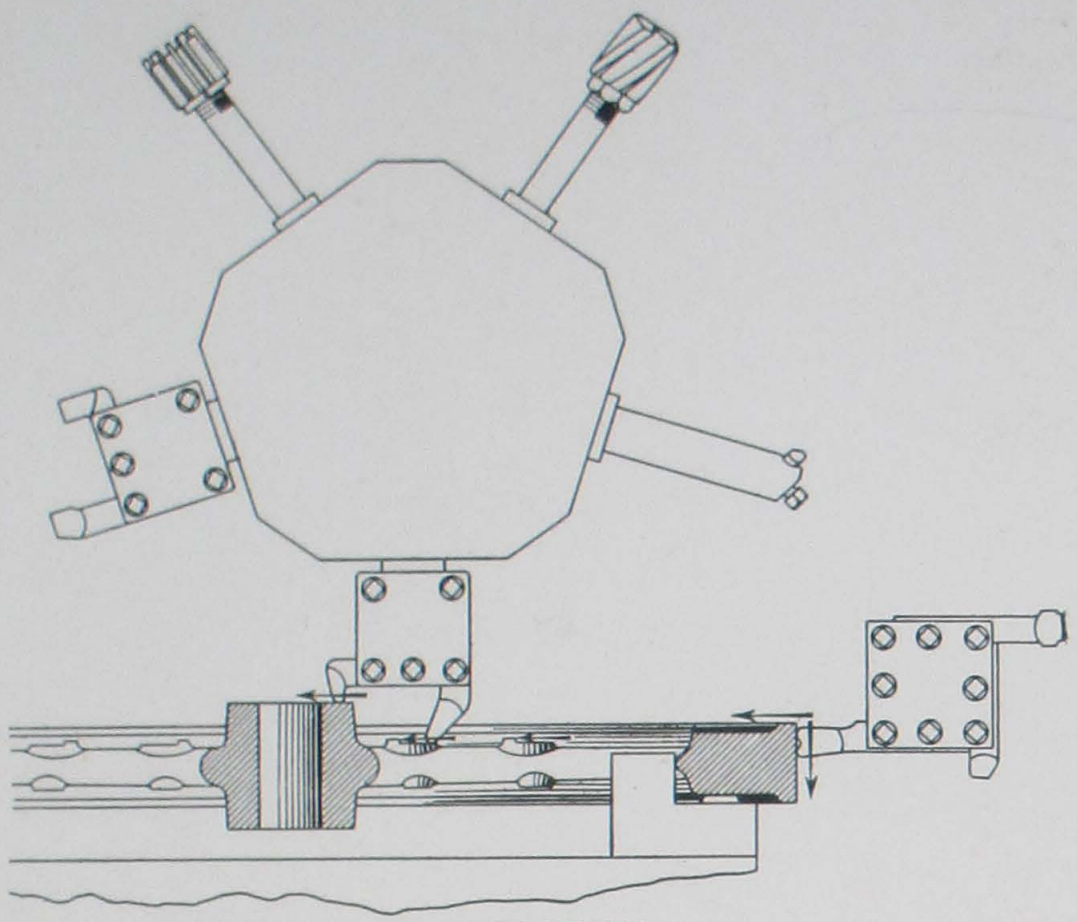
5TH OPERATION.



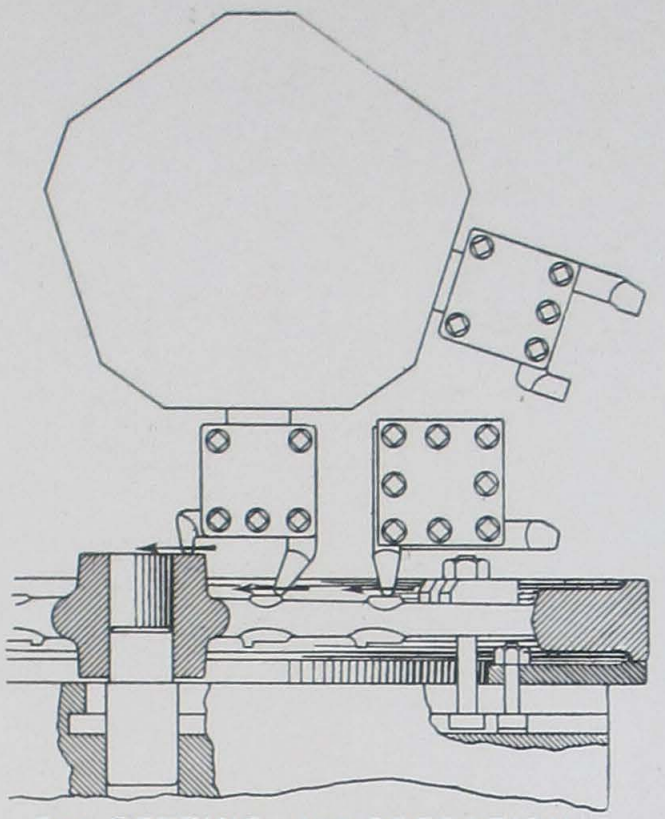
6TH OPERATION.

The use of special jaws and an under-cutting bar save a second setting in this case.

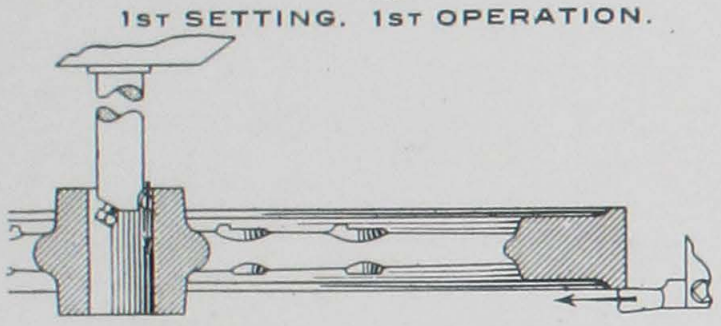
In crowning the outside diameter a standard plate-type forming attachment is used in conjunction with the Side Head, and, as the crown is double-taper, wide finishing feeds are used.



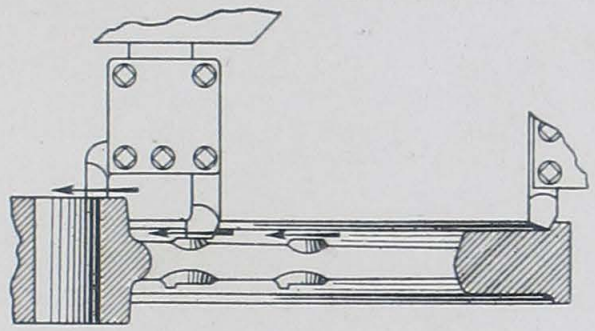
1ST SETTING. 1ST OPERATION.



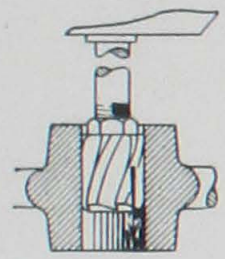
2ND SETTING. 1ST OPERATION.



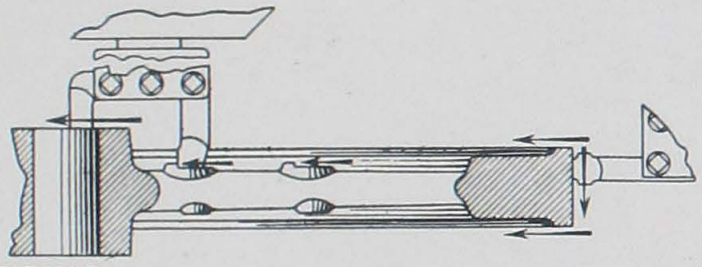
1ST SETTING. 2ND OPERATION.



2ND SETTING. 2ND OPERATION.

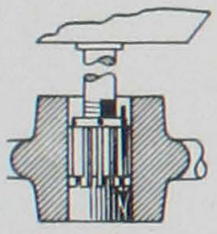


3RD OPERATION.

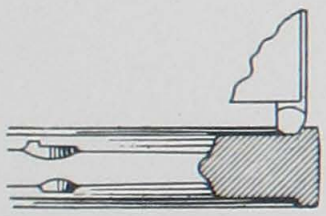


1ST SETTING.

5TH OPERATION.



1ST SETTING
4TH OPERATION.



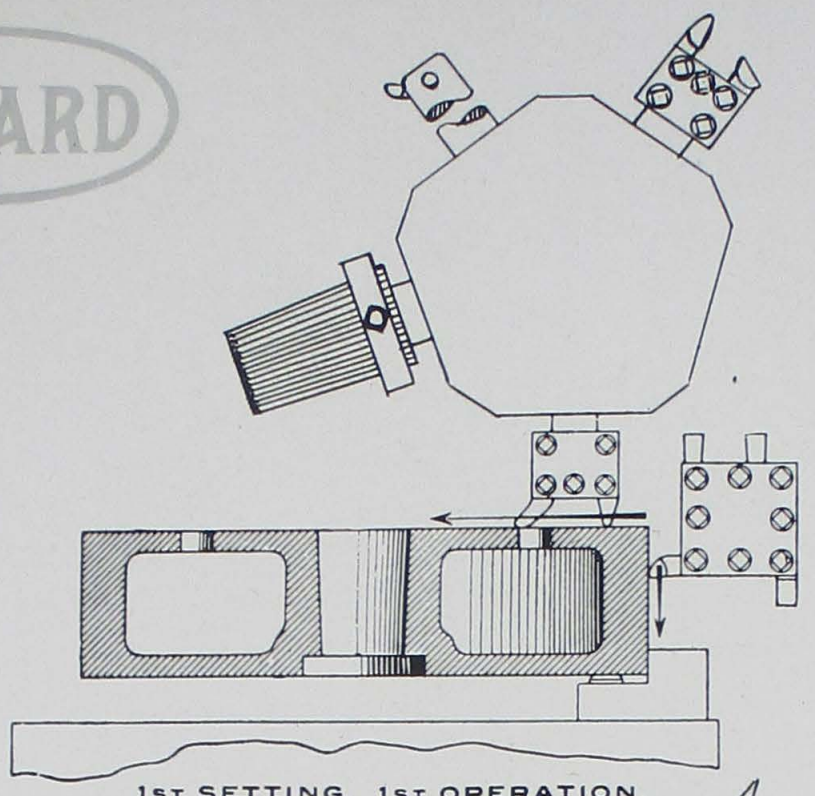
6TH OPERATION.

THE VERTICAL TURRET LATHE

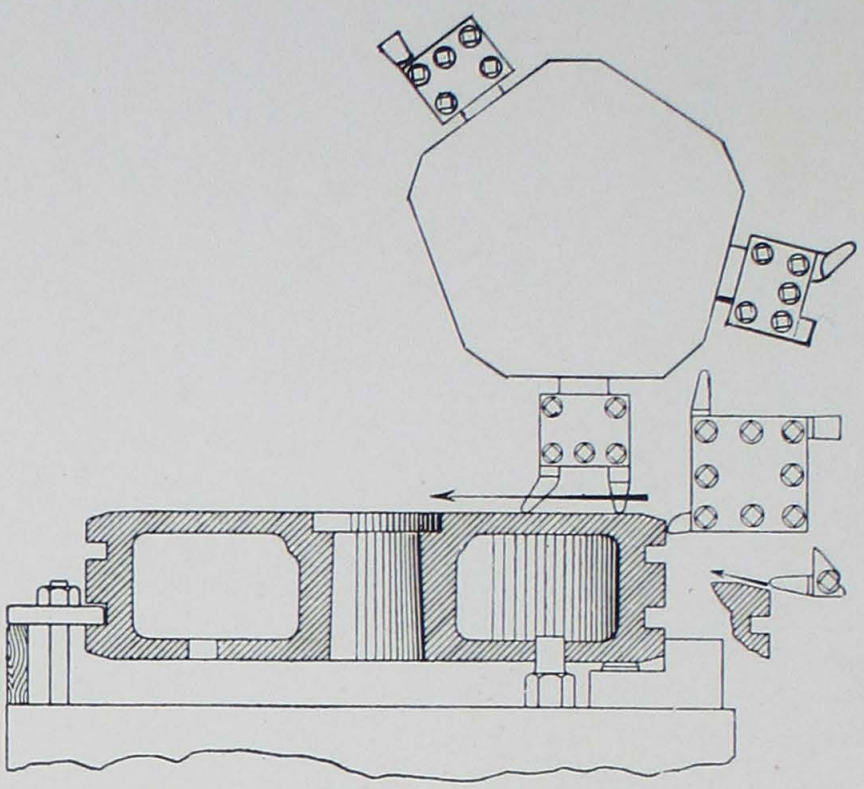
The tool combination shown, in conjunction with the rapidity and convenience of operation of the Vertical Turret Lathe, reduced this farm-engine fly-wheel job to one of great economy.

Wheels made in this way run true and eliminate vibration in the engine.

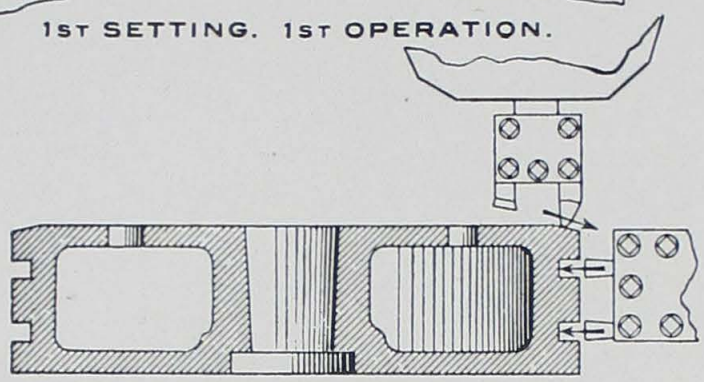
BULLARD



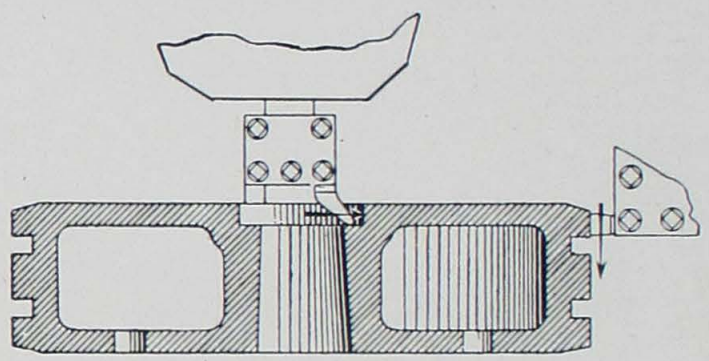
1ST SETTING. 1ST OPERATION.



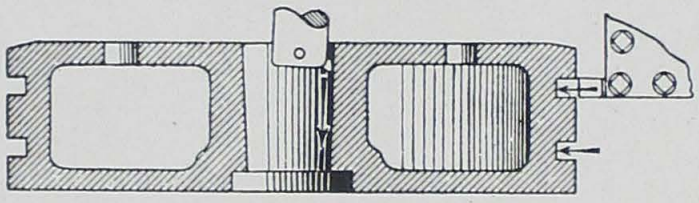
2ND SETTING. 1ST OPERATION.



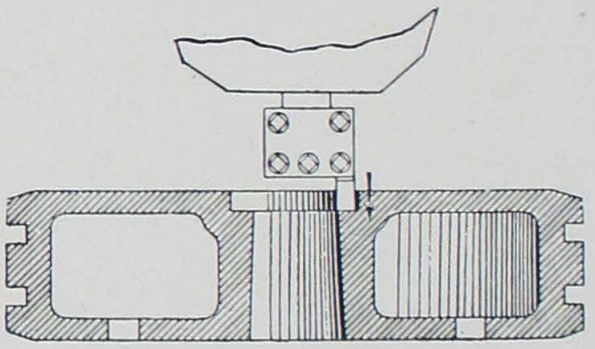
1ST SETTING. 2ND OPERATION.



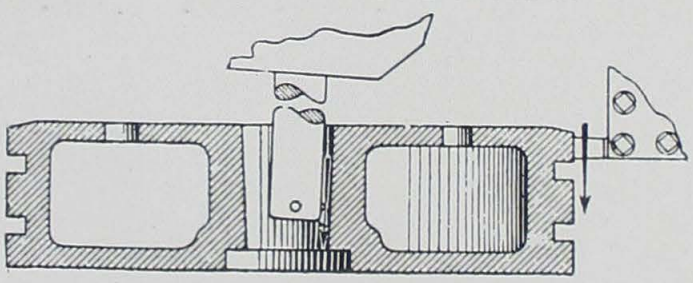
2ND SETTING. 2ND OPERATION.



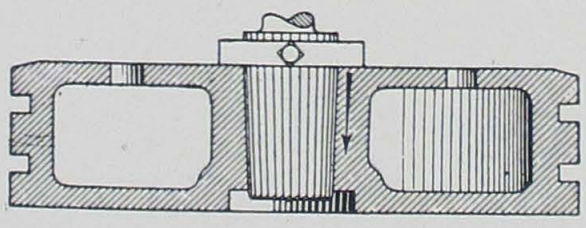
1ST SETTING. 3RD OPERATION.



2ND SETTING. 3RD OPERATION.



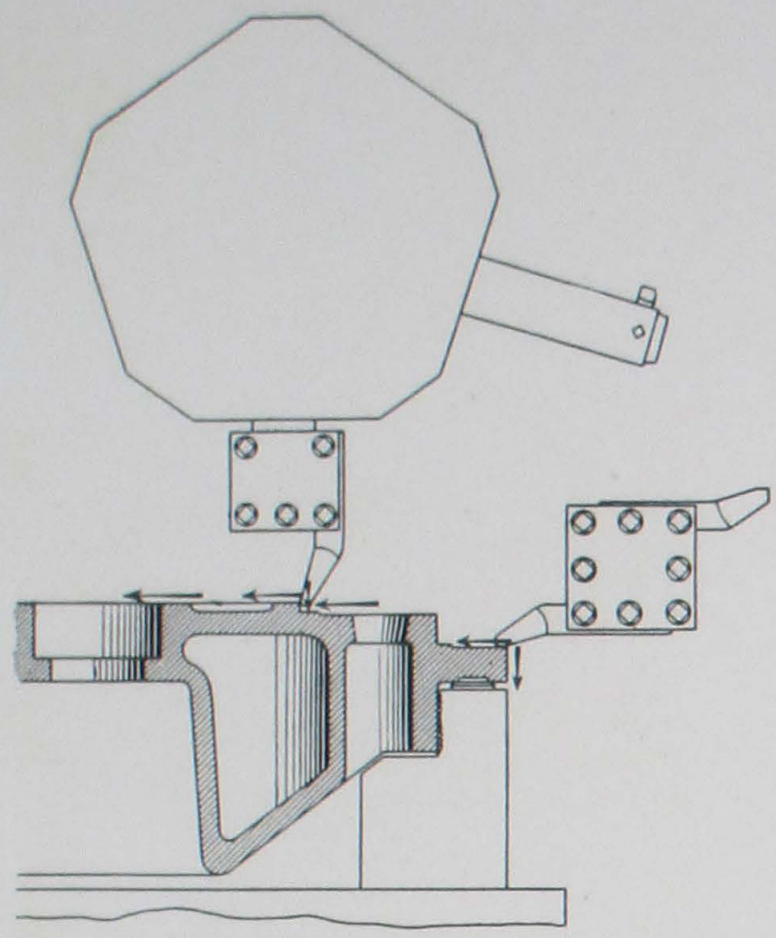
1ST SETTING. 4TH OPERATION.



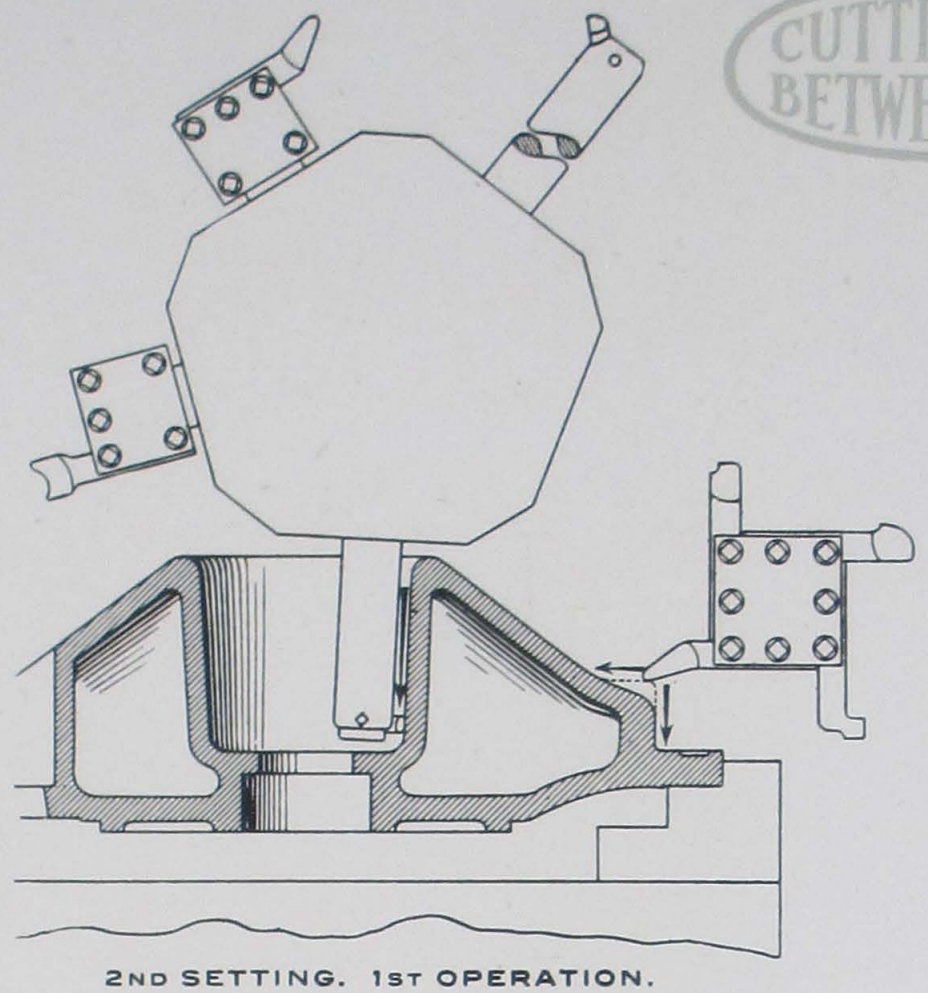
1ST SETTING.
5TH OPERATION.

THE VERTICAL TURRET LATHE

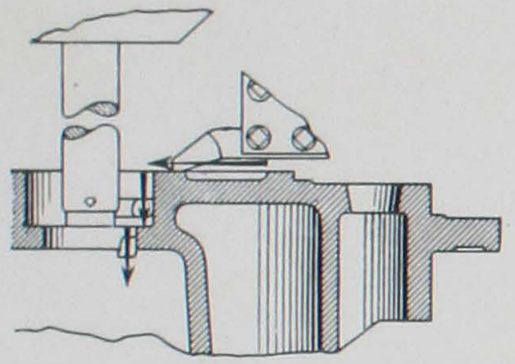
To both the manufacture and repair of locomotive parts the Vertical Turret Lathe is particularly adapted. The universal nature of the machine covers a wide field of engine work, and in the machining of pistons its record is unequalled.



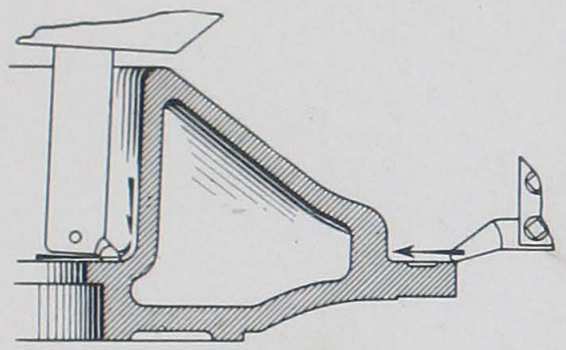
1ST SETTING. 1ST OPERATION.



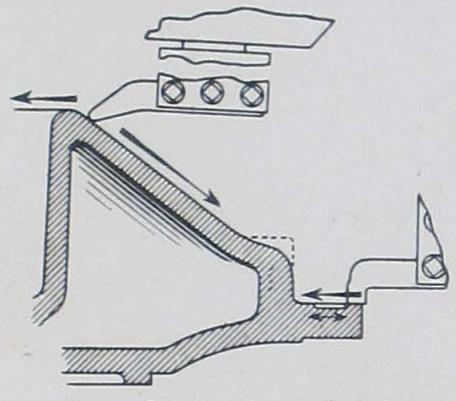
2ND SETTING. 1ST OPERATION.



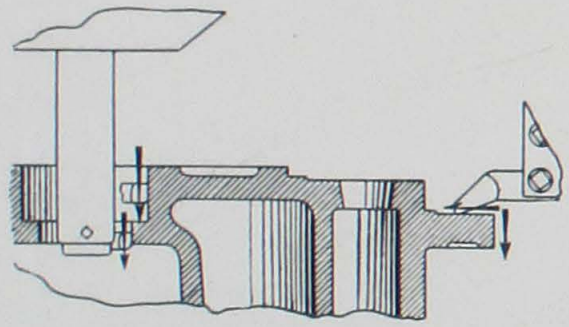
1ST STG. 2ND OPN.



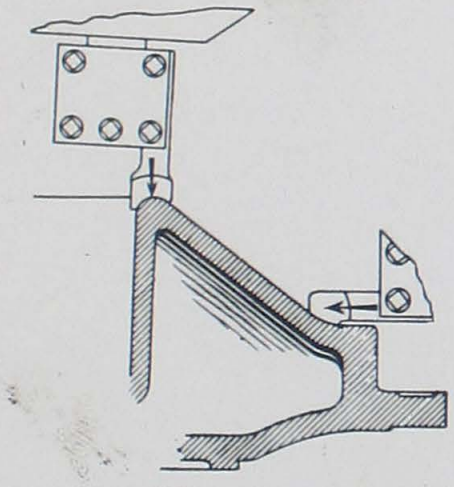
2ND STG. 2ND OPN.



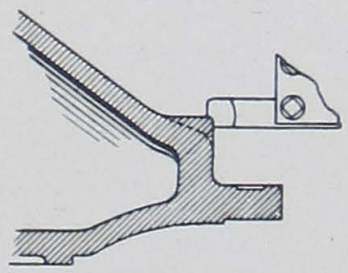
2ND STG. 3RD OPN.



1ST STG. 3RD OPN.



2ND STG. 4TH OPN.

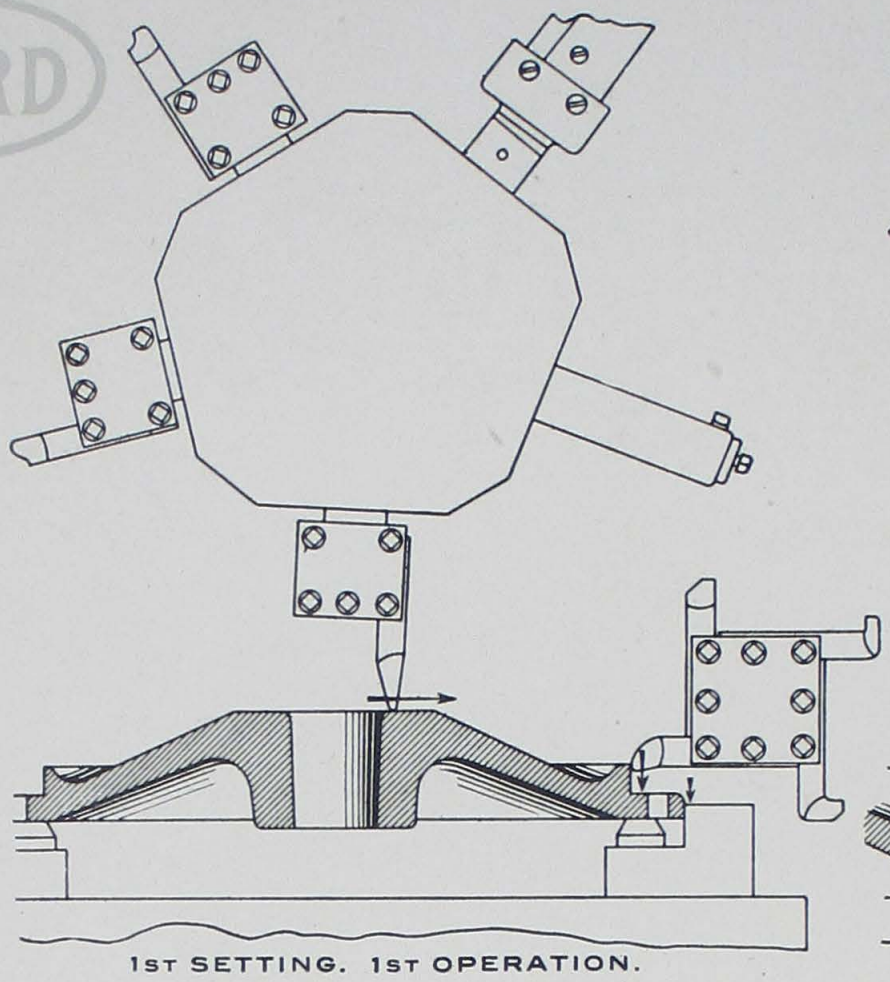


2ND STG. 5TH OPN.

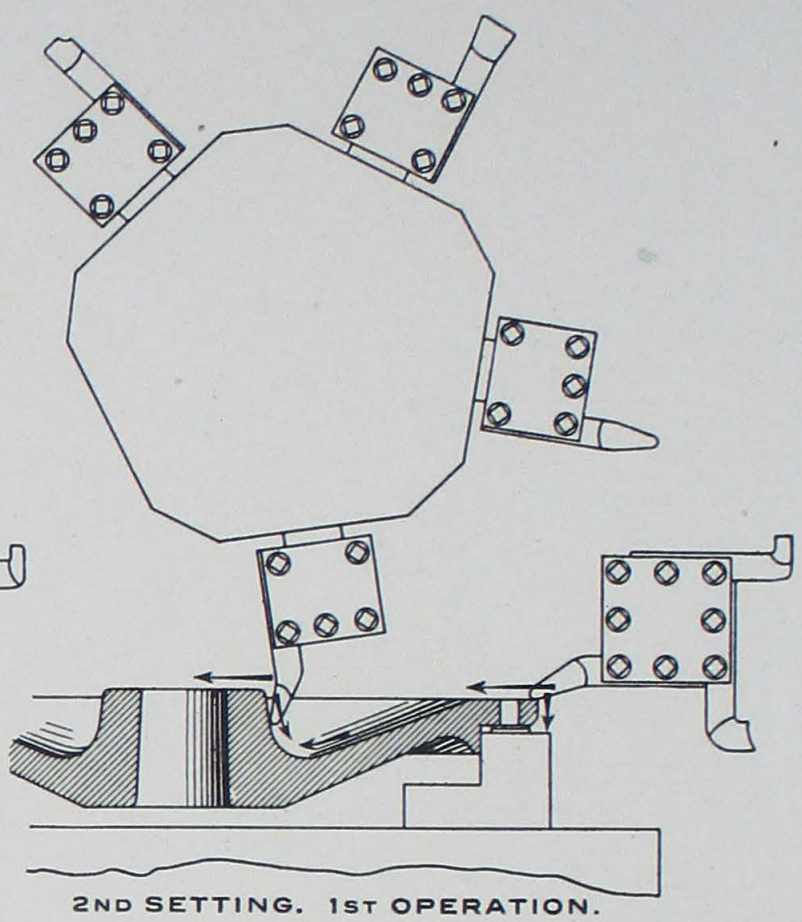
THE VERTICAL TURRET LATHE

A back head requires machining practically all over—some surfaces being merely "cleaned up" for clearance.

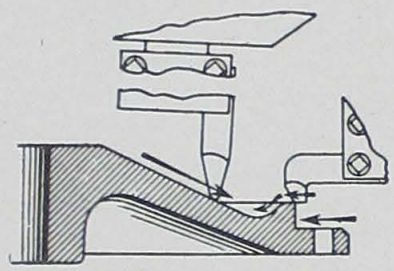
The angular inside surface is machined by engaging the Main Head cross-feed, a compounding gear connection to the vertical-feed giving the required angle.



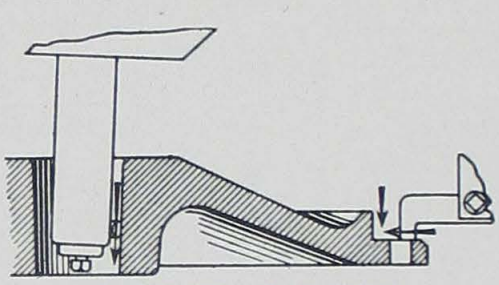
1ST SETTING. 1ST OPERATION.



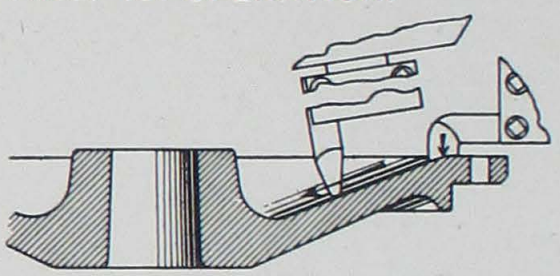
2ND SETTING. 1ST OPERATION.



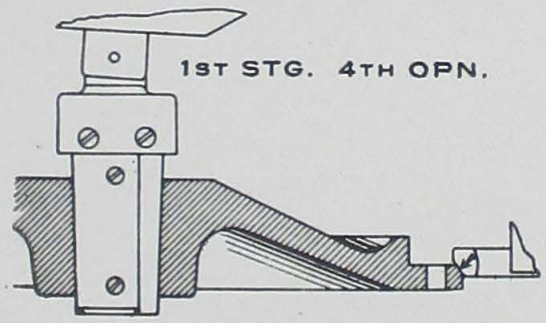
1ST STG. 2ND OPN.



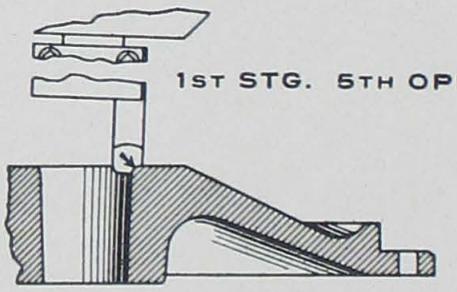
1ST STG. 3RD OPN.



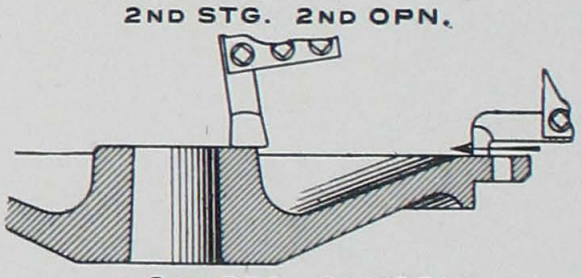
2ND STG. 2ND OPN.



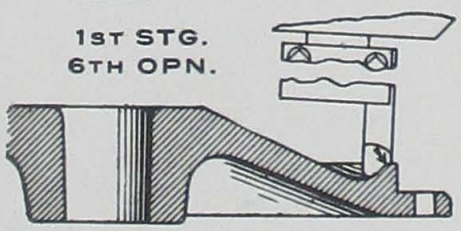
1ST STG. 4TH OPN.



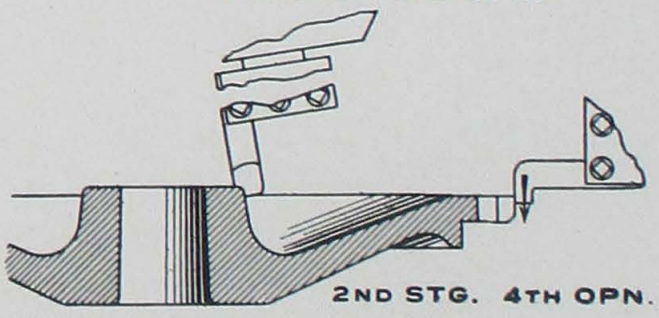
1ST STG. 5TH OPN.



2ND STG. 3RD OPN.



1ST STG.
6TH OPN.

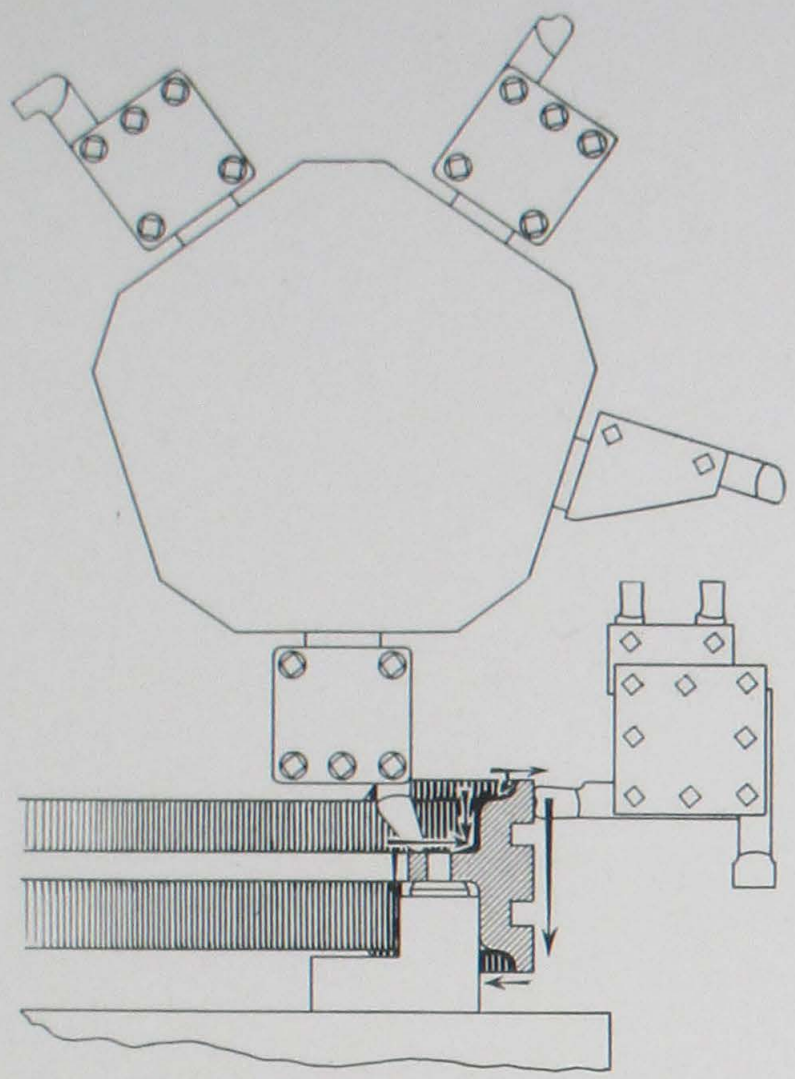


2ND STG. 4TH OPN.

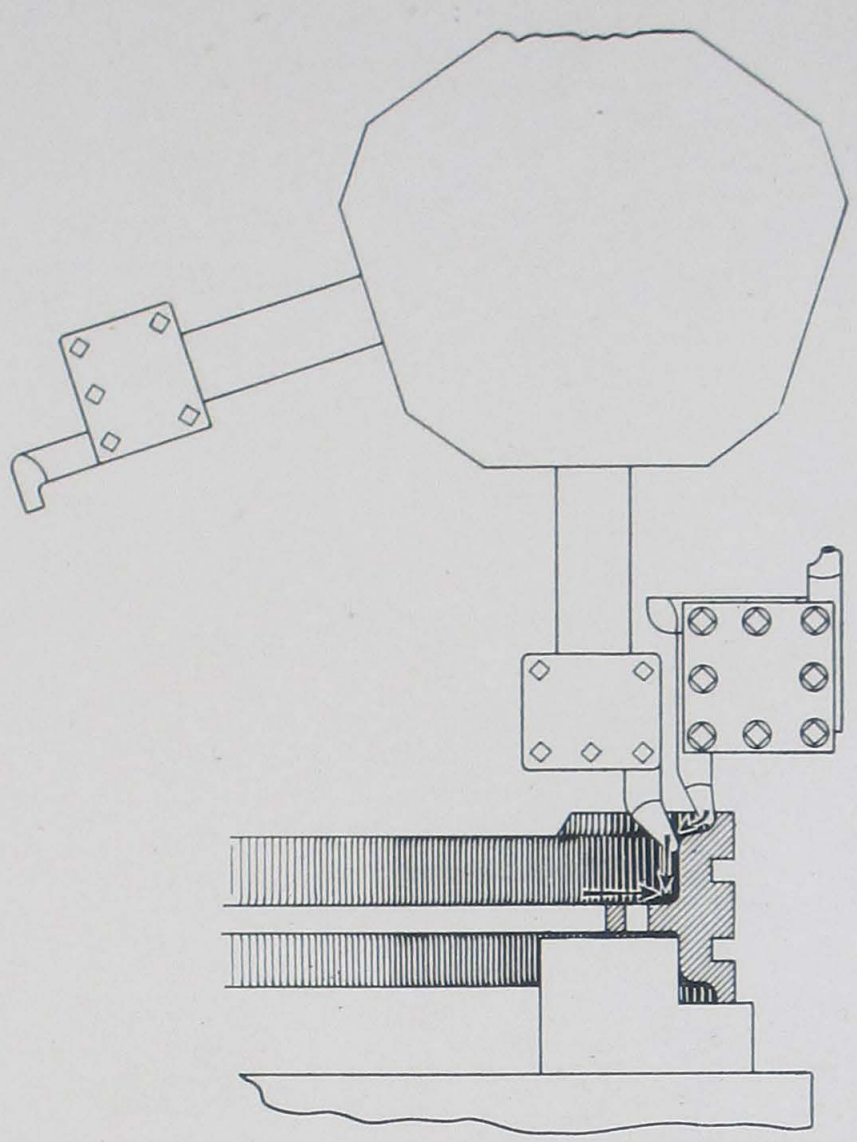
Much time is saved in machining centers for Mallet piston heads—the swivelling feature of the Main Head and Compound Feeding Device covering every angle.

Sweep tools would be highly impractical in this work, as the steel castings are rough and require the removal of a large amount of material.

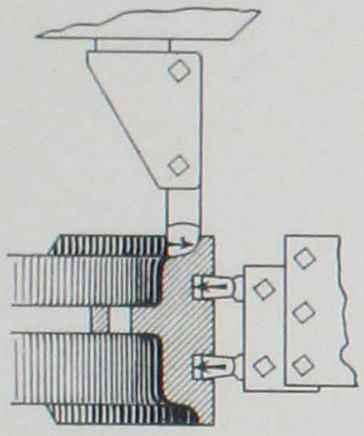
Cutting Lubricant increases the cutting speed and lengthens the tool life.



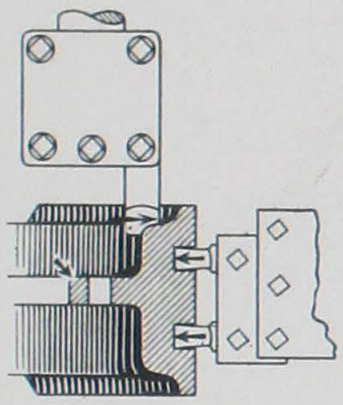
1ST SETTING. 1ST OPERATION.



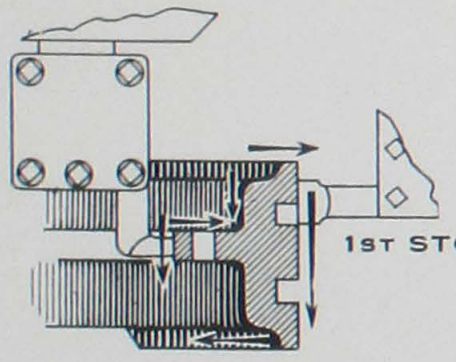
2ND SETTING. 1ST OPERATION.



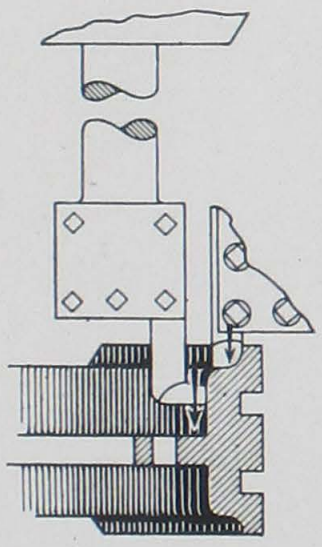
1ST STG. 2ND OPN.



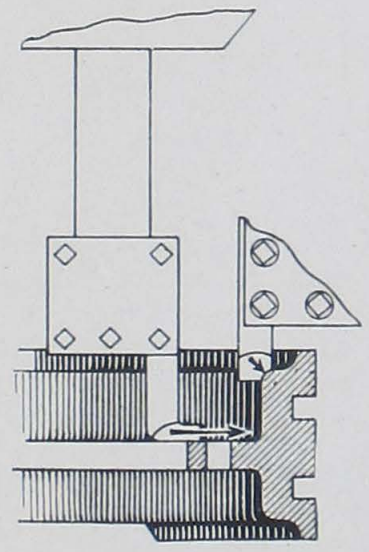
1ST STG. 3RD OPN.



1ST STG. 4TH OPN.



2ND STG. 2ND OPN.

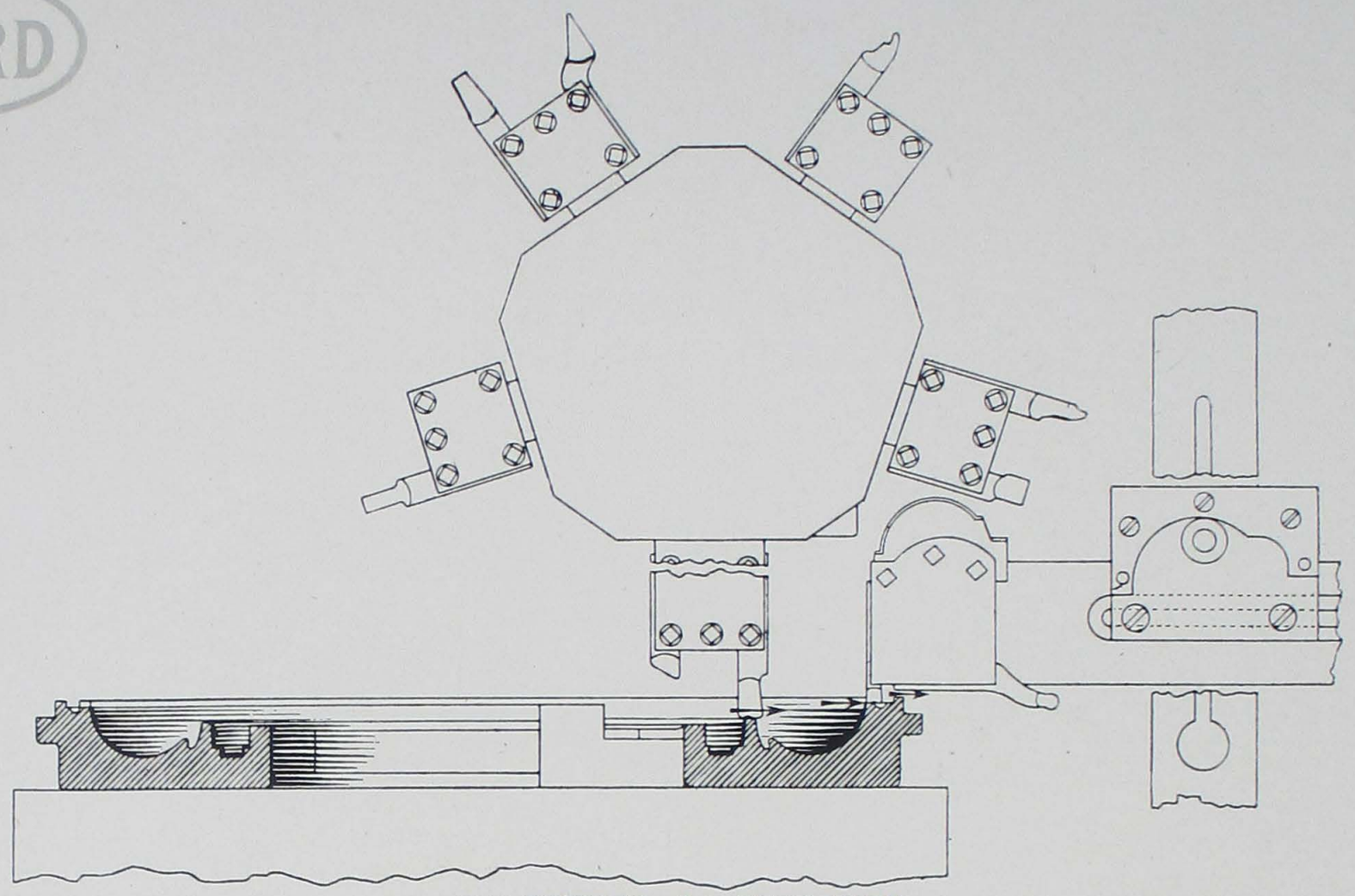


2ND STG. 3RD OPN.

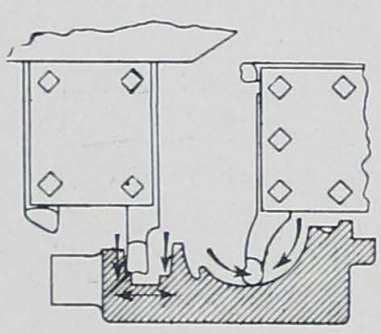
The built-up head is now largely used, and such repairs or replacements as are required are economically made on the Vertical Turret Lathe.

Packing Rings are good work for this machine, also Bushings and Cross-Heads—a large number being so employed.

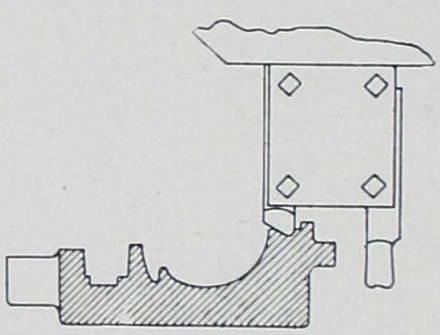
BULLARD



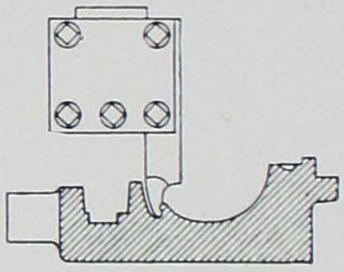
2ND SETTING. 1ST OPERATION.



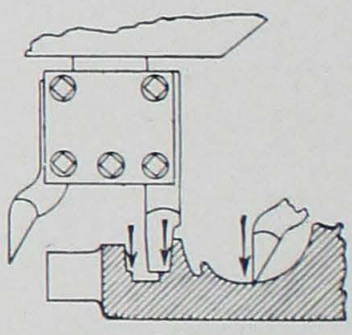
2ND OPN.



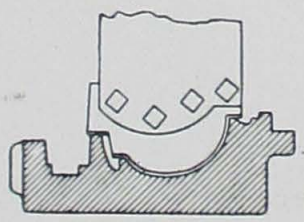
3RD OPN.



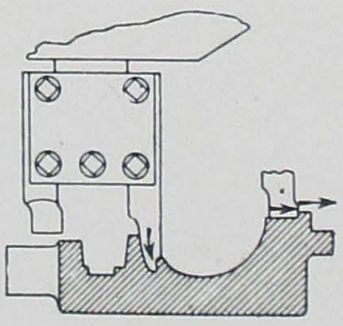
6TH OPN



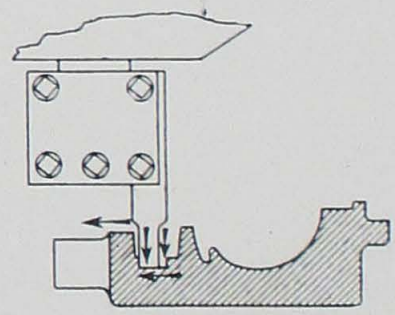
8TH & 9TH OPN.



4TH OPN.



5TH OPN.



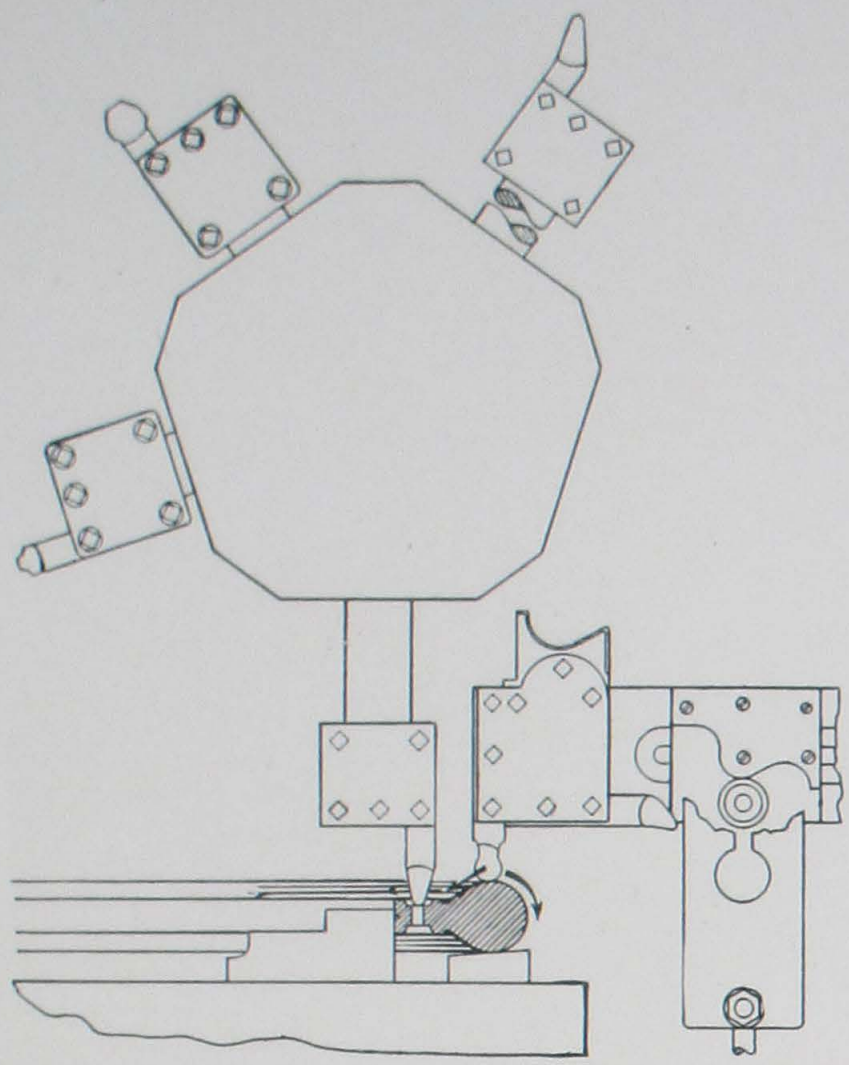
7TH OPN.

THE VERTICAL TURRET LATHE

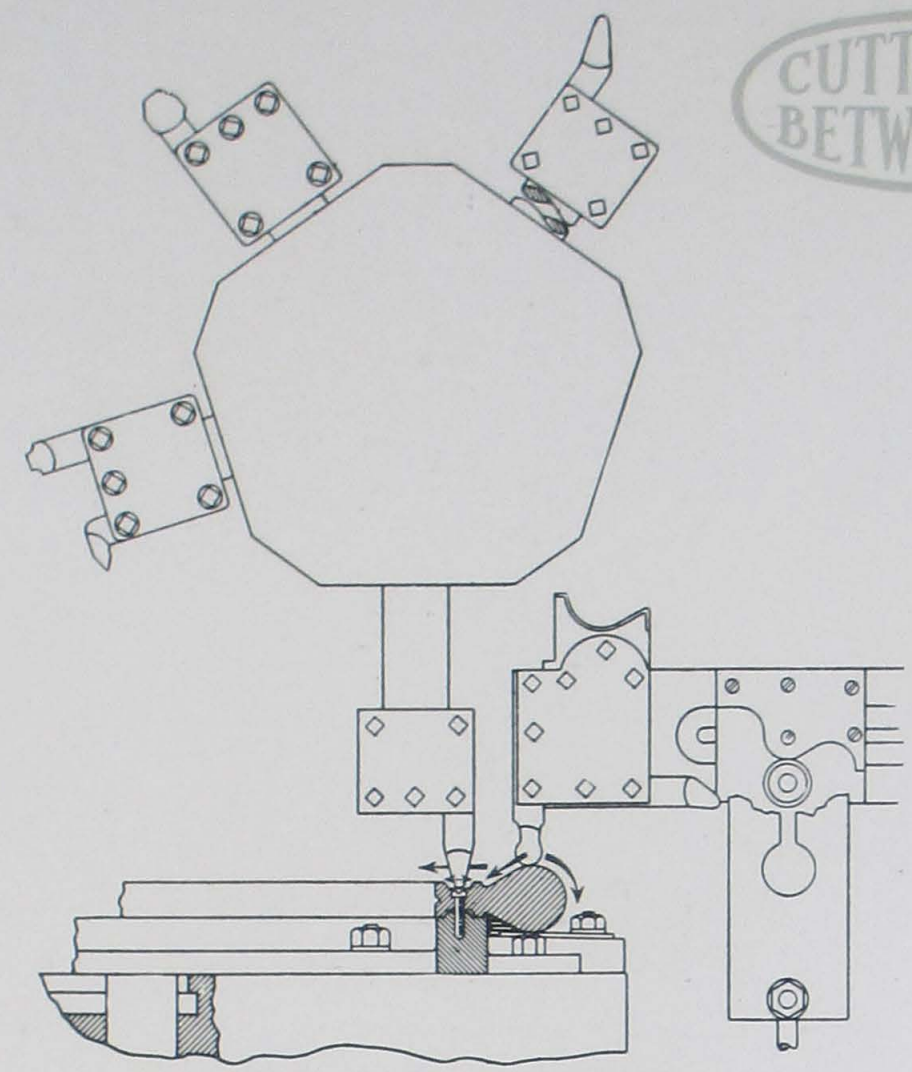
Formerly considered work for boring and turning mills or special face-plate lathes, tire-molds are now being more economically produced on the Vertical Turret Lathe.

The two turrets keep the tools set for the entire sequence of operations, and eliminate time-wastes in tool setting. Power and rigidity are required to remove the chilled iron at proper speeds.

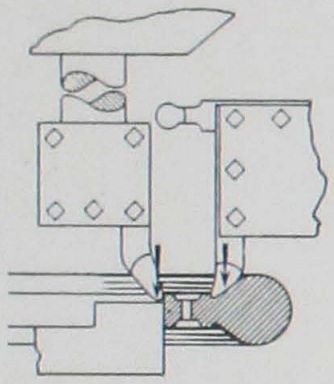
The special forming attachment for mold-cavity materially simplifies this operation and saves much finishing time by roughing close to size and form.



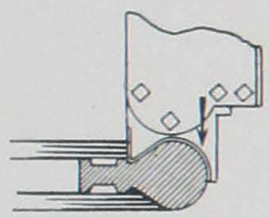
1ST SETTING. 1ST OPERATION.



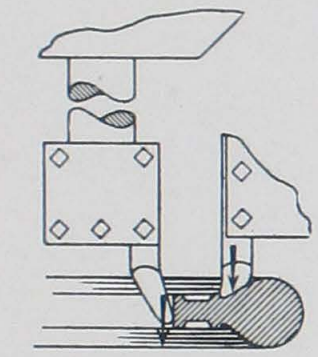
2ND SETTING. 1ST OPERATION.



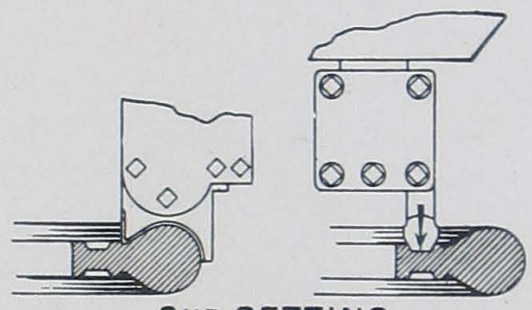
1ST STG. 2ND OPN.



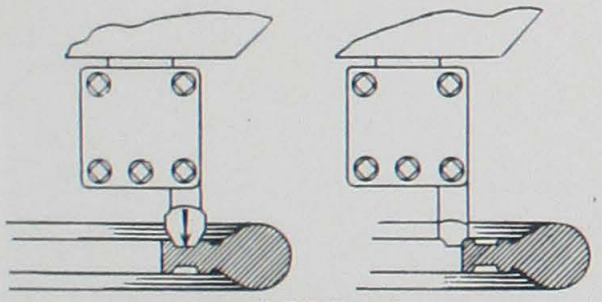
1ST STG. 3RD OPN.



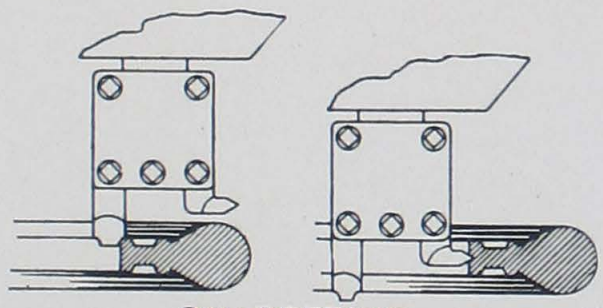
2ND STG. 2ND OPN.



2ND SETTING. 3RD OPN. 4TH OPN.



1ST SETTING. 4TH OPN. 5TH OPN.

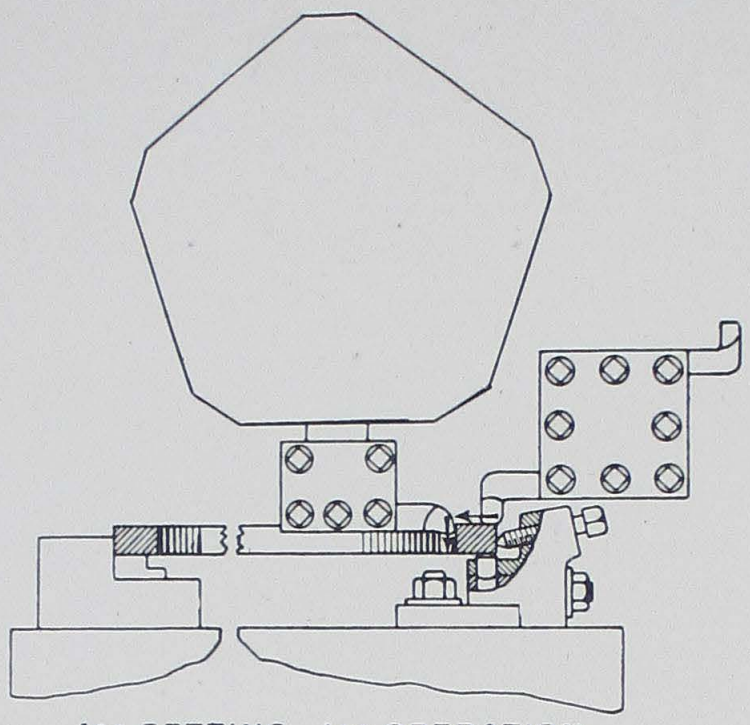


2ND SETTING. 5TH OPN. 6TH OPN.

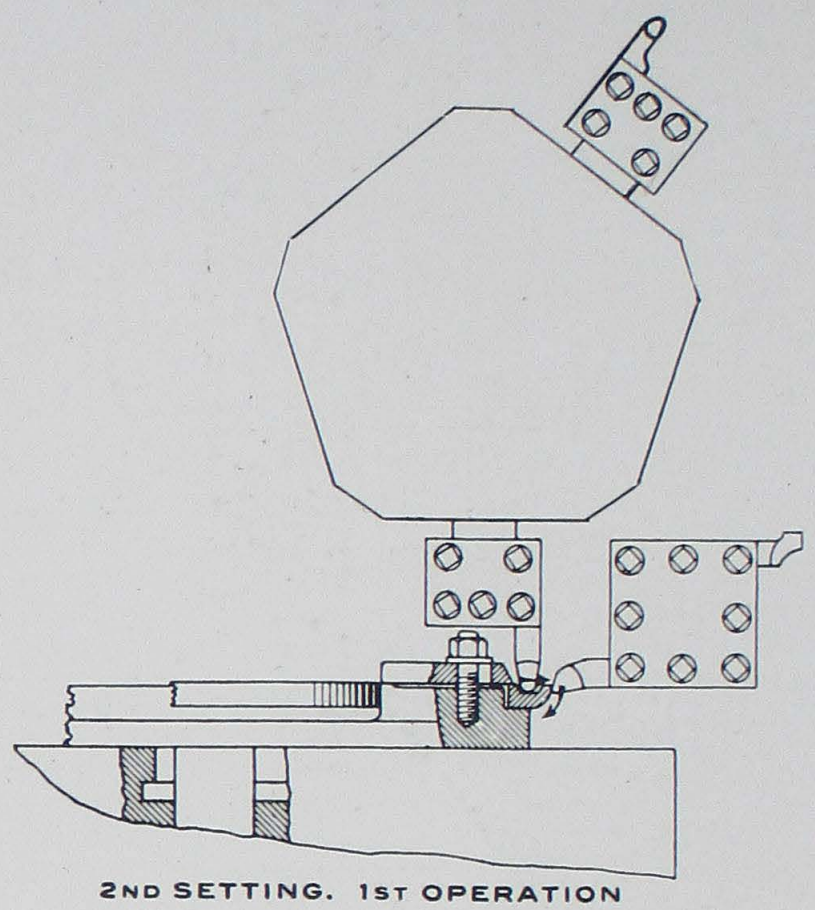
THE VERTICAL TURRET LATHE

The advantage of two turrets and the special forming attachment is equally apparent in machining tire-mold cores.

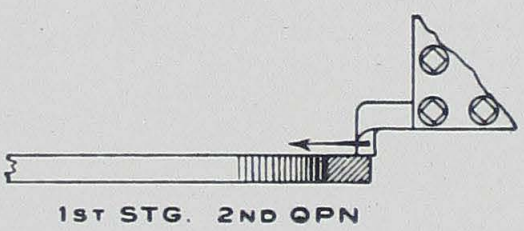
Observation Stops aid materially in reproducing sizes, and the rigidity of the machine produces a surface free from chatter—one which requires no polish.



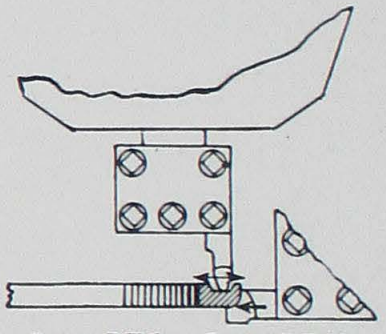
1ST SETTING. 1ST OPERATION.



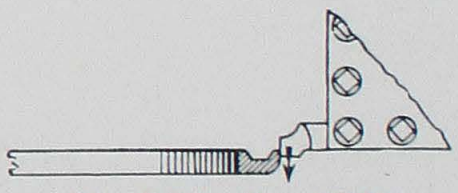
2ND SETTING. 1ST OPERATION



1ST STG. 2ND OPN



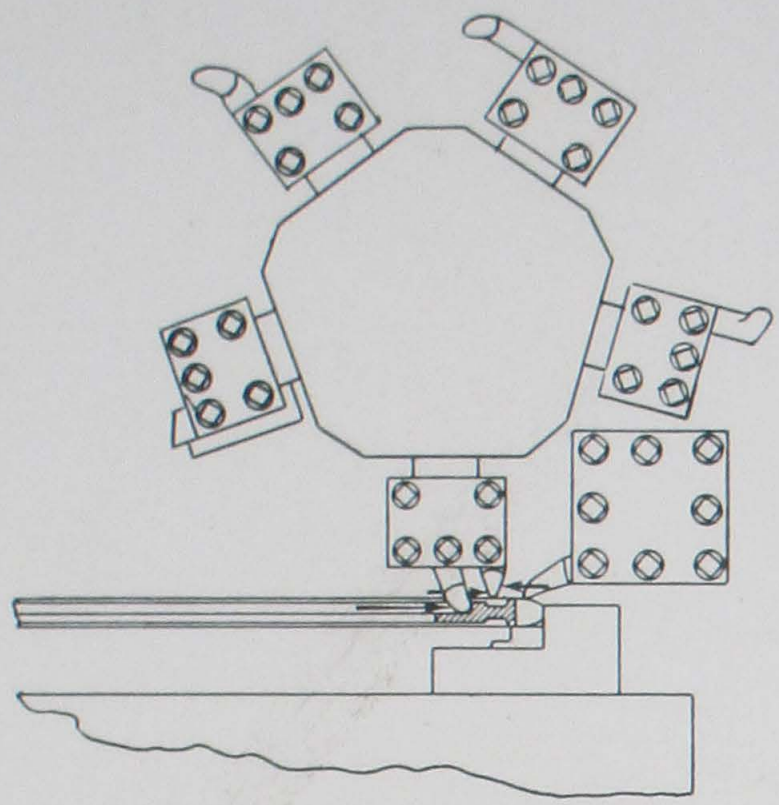
2ND STG. 2ND OPN.



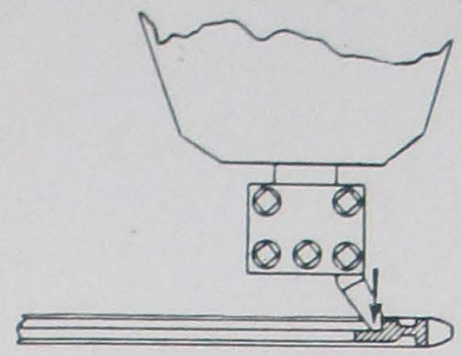
2ND STG 3RD OPN.

The retaining ring for sectional cores is easily sprung out of shape. Single-point tools reduce this possibility, and, as sizes must be accurately maintained, the Observation Stops save much time.

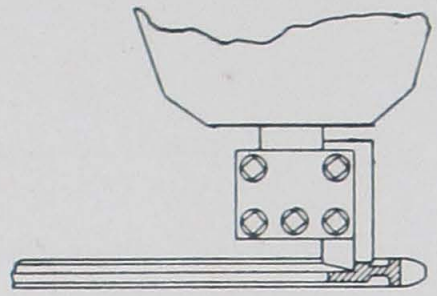
The Cutting Lubricant System absorbs the heat generated in cutting and reduces the distortion from this cause.



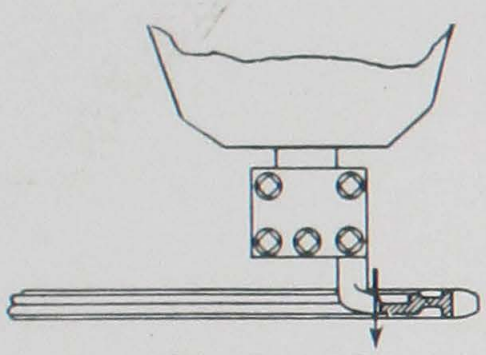
1ST SETTING. 1ST OPERATION.



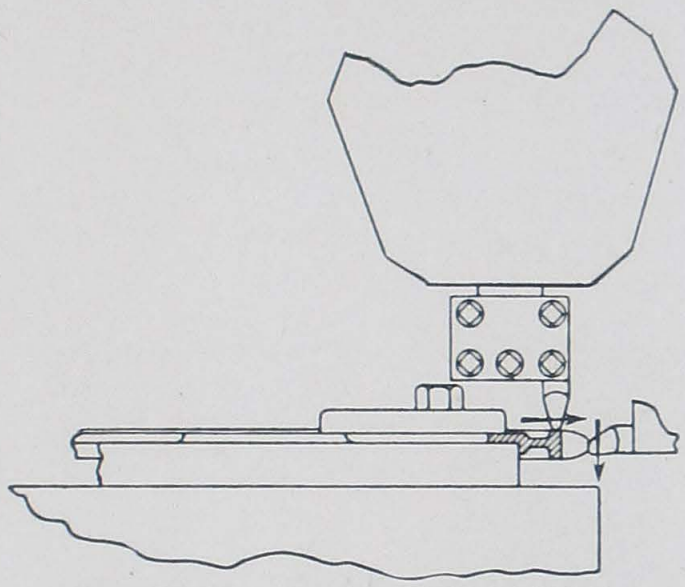
1ST STG. 4TH OPN



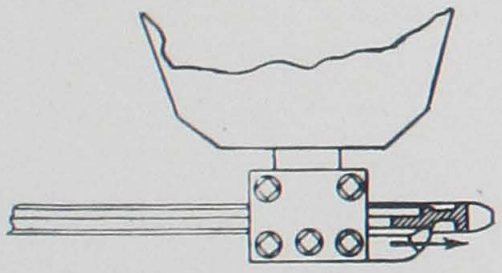
1ST STG 5TH OPN.



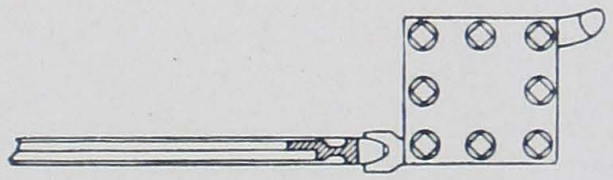
1ST STG. 2ND OPN.



2ND SETTING. 1ST OPERATION.



1ST STG. 3RD OPN.



2ND STG. 2ND OPN.

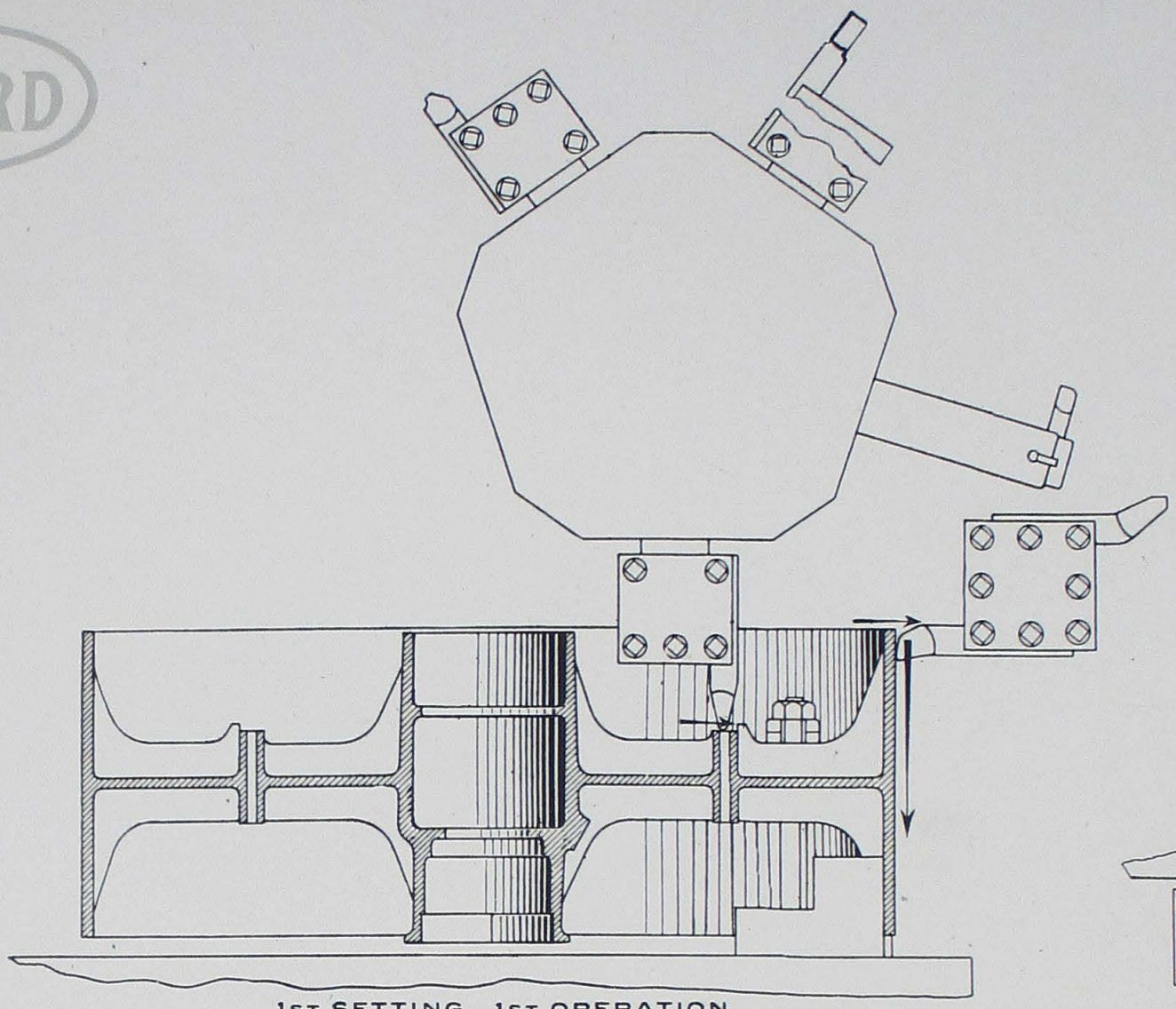
THE VERTICAL TURRET LATHE

Great economies have been effected by the Vertical Turret Lathe in the manufacture of sprockets and similar work from either forgings, castings or sheared boiler-plate blanks.

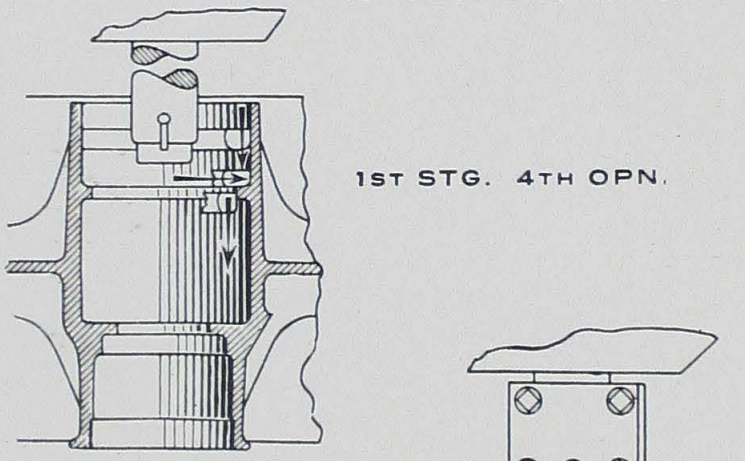
The range of sizes which may be handled by the same set-up of tools brings about a manufacturing condition even if size changes are frequent throughout the day.

Copious streams of cutting lubricant bring speeds and feeds to the maximum and keep the work cool.

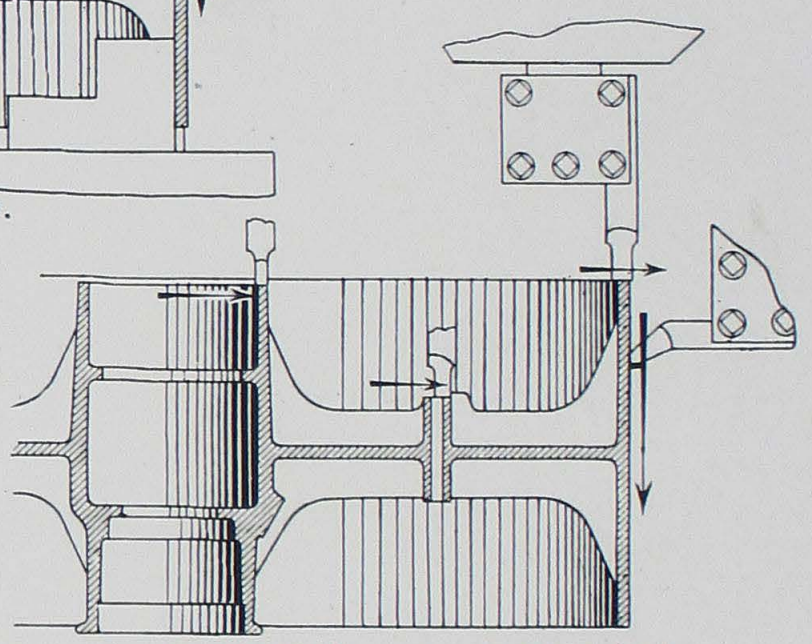
BULLARD



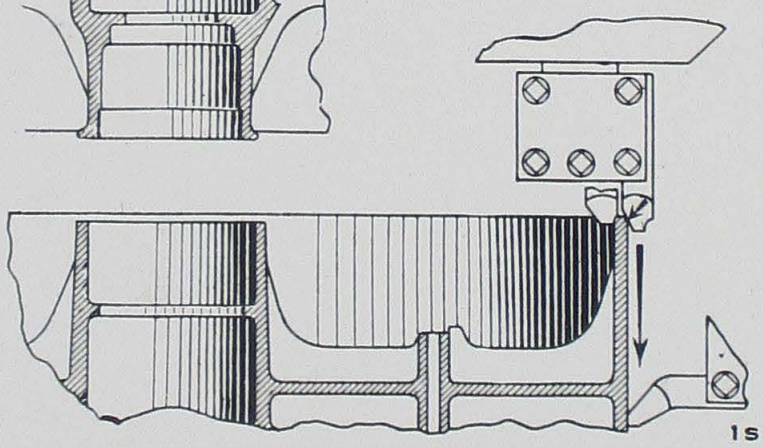
1ST SETTING. 1ST OPERATION.



1ST STG. 4TH OPN.

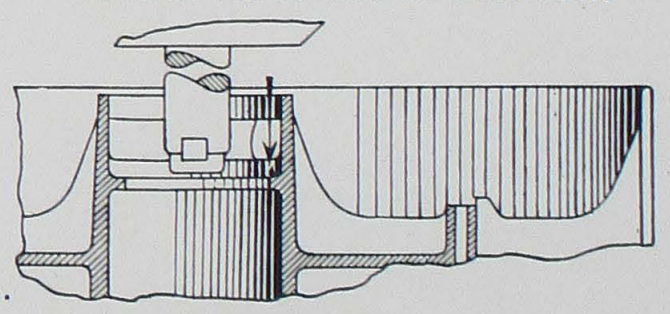


1ST SETTING. 2ND OPERATION.



3RD OPERATION.

1ST SETTING.



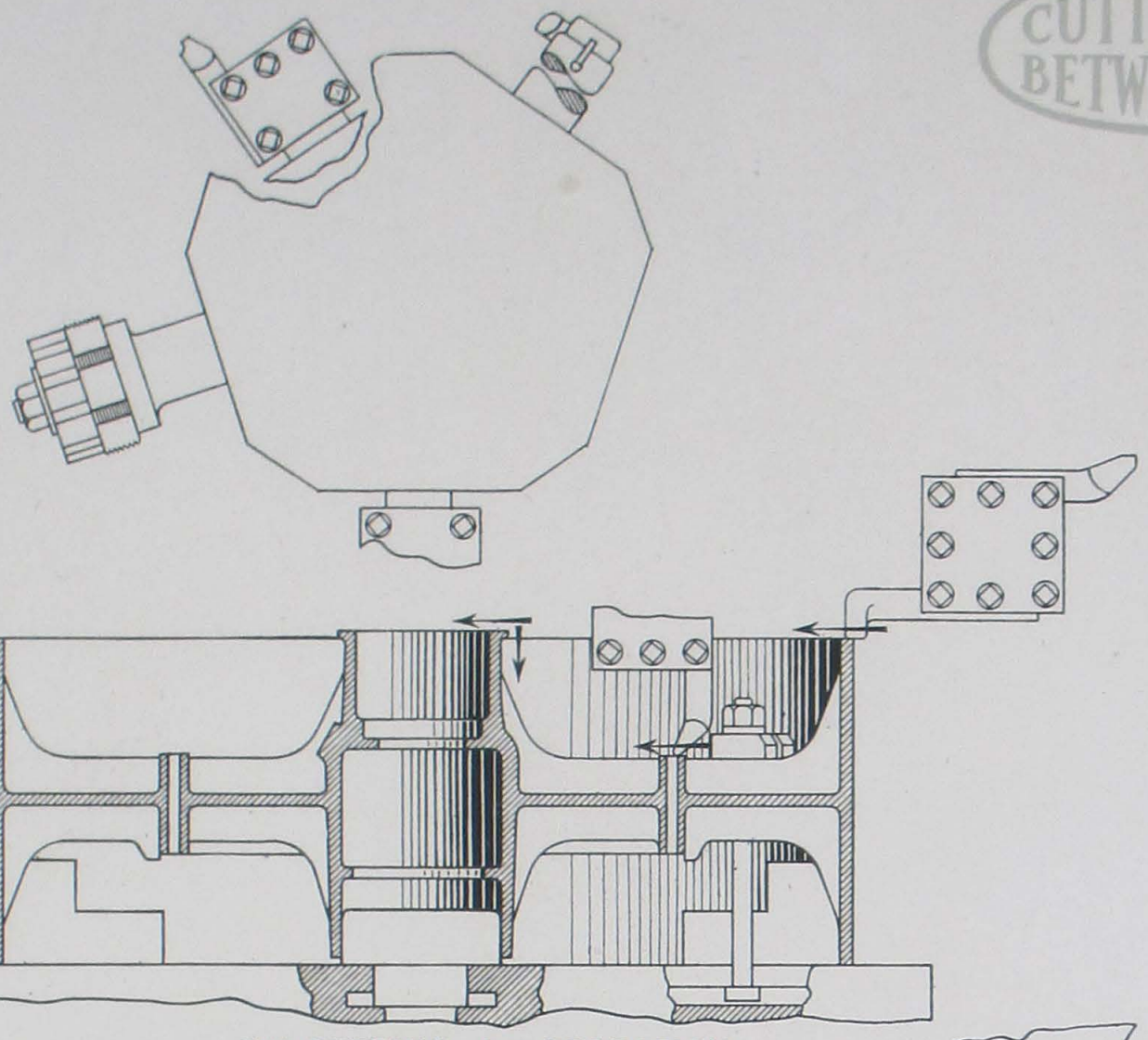
4TH OPERATION.

THE VERTICAL TURRET LATHE

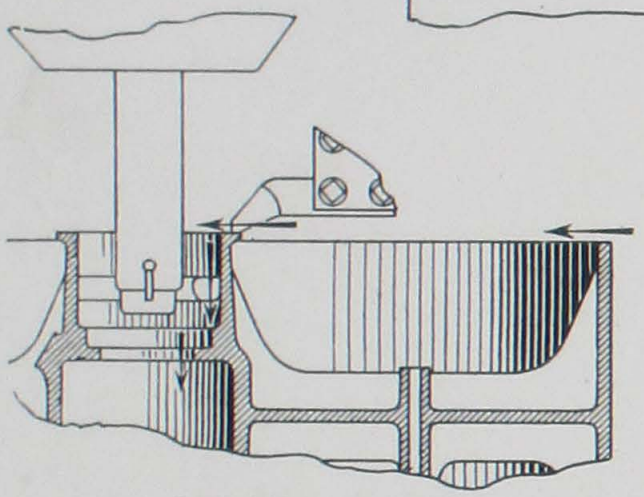
Steel motor-truck wheels require power in the extreme, as castings are rough and uneven and much material is removed.

The two turrets of the Vertical Turret Lathe are in almost continuous simultaneous use, and in no way interfere, as would the heads of a vertical boring mill.

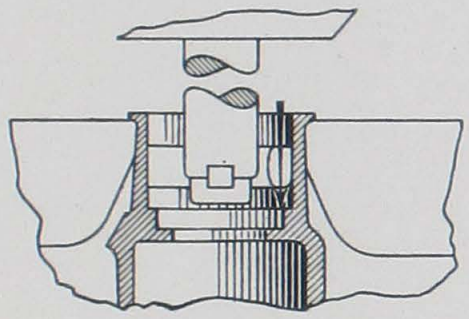
Observation Stops eliminate constant measuring for size and save much time.



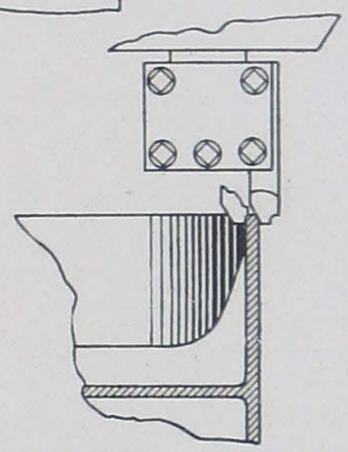
2ND SETTING. 1ST OPERATION.



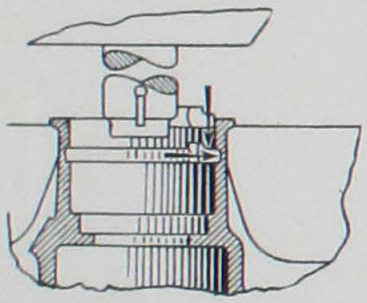
2ND STG. 3RD OPN.



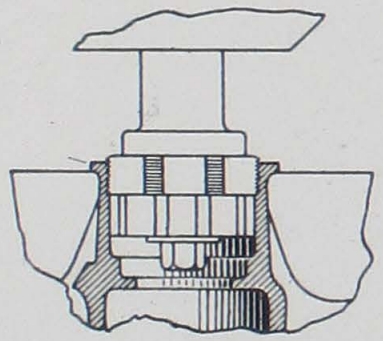
2ND STG. 4TH OPN.



2ND STG. 2ND OPN.



2ND STG. 5TH OPN.

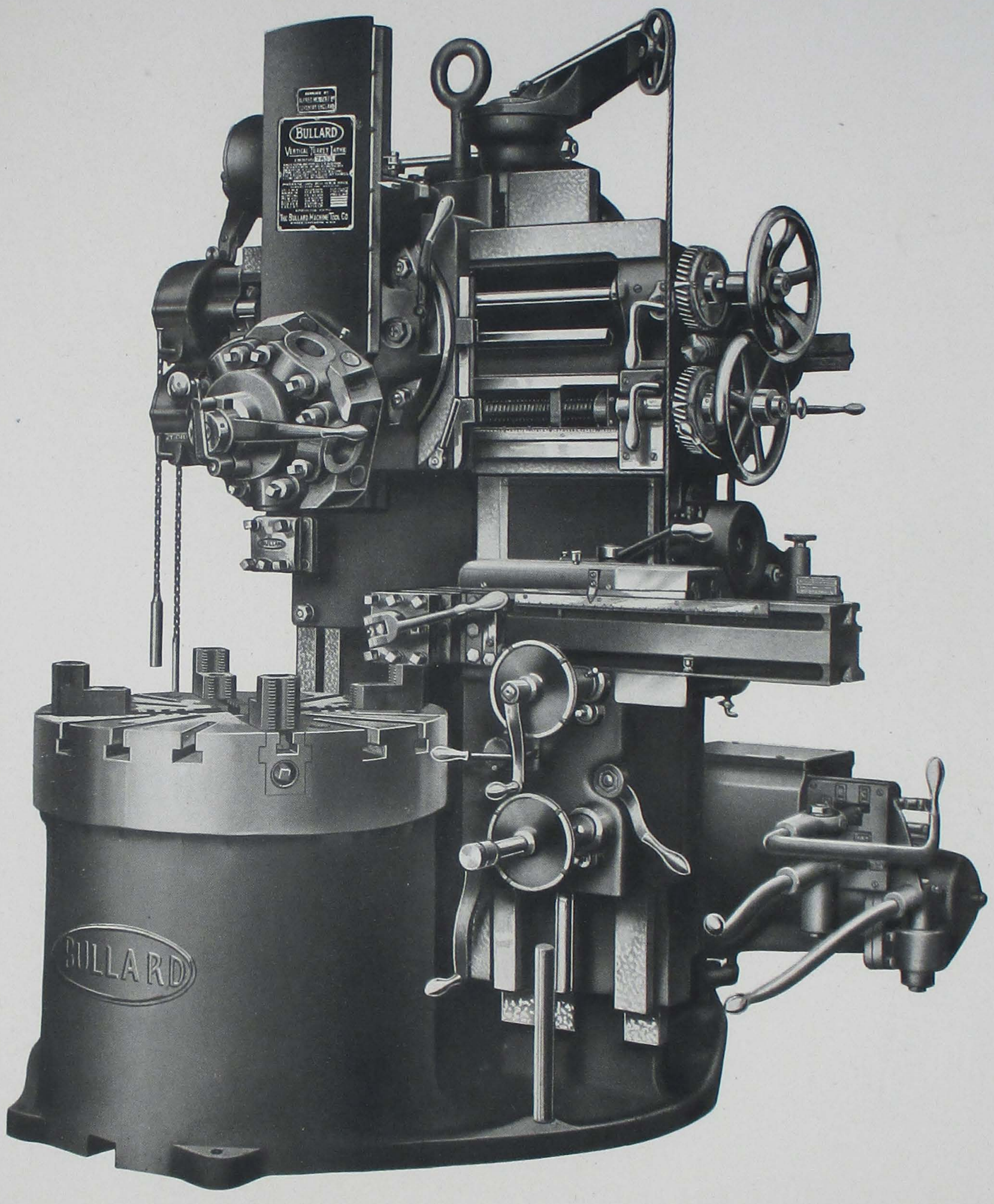


2ND STG. 6TH OPN.

THE VERTICAL TURRET LATHE

Alignment of the bearing-case fits is assured by using a Centering Plug in the second setting, and it is also considered advisable to pilot the large tap for adjusting collar thread.

The Cutting Lubricant System is particularly advantageous on this class of work owing to the long cuts and the great amount of heat generated. Sizes are easier to obtain, and tool grinding is reduced if lubricant is used.



THE VERTICAL TURRET LATHE

The development of this distinctive type of machine tool has resulted from an intensive study of the requirements of chucked, or face-plate work. Each feature in its design fills a need—each unit in its construction has been developed for the particular service required of it, and with a due and intelligent regard for the completed whole.

In its entirety it represents a new era of lower costs—of maintenance as well as of production.

THE VERTICAL TURRET LATHE

THE VERTICAL TURRET LATHE

The fundamental principle of efficiency is the elimination of waste—waste in effort, waste in motion, waste of time. Every step in the development of the Vertical Turret Lathe has been subjected to a searching analysis with reference to these cardinal factors in obtaining increased production.

Minimizing the Effort Required

Whether the work is light or heavy, it is "easier to lay a piece down than to hang it up"—gravity serving as an aid, rather than a hindrance, in the chucking operation.

Work which is irregular in form or relatively heavy may be properly chucked and secured to the horizontal table of the Vertical machine, and cuts finished, in less time than is often required in chucking alone on the horizontal type.

Unnecessary exertion is wasteful. A heavy tool-head constantly operated by hand is much slower in the latter part of the day than in the morning. The fatigue thus evidenced is very effective in reducing output, as every other hand-operated part of the machine is likewise affected.

The Power Traverse Device eliminates this waste and enables the operator to maintain the morning's pace throughout the day.

Reducing Lost Motion

The centralized control of the Vertical Turret Lathe is perfect control. All operating levers and actuating handles are so arranged that every machine movement may be accomplished from one position.

The attendant may readily change either feed or speed, or quickly set the cutting tools in the required position, from his operating position, with both work and tools in full view.

THE VERTICAL TURRET LATHE

Elimination of Wasted Time

Quick and easy chucking, power operation of heavy parts and convenient and rapid control "cut time between cuts."

The rigid construction of the Vertical Turret Lathe, its alloy steel gearing and its excess driving power, reduce the "cutting time" to a minimum, making the *tool* the limiting factor in production.

Lubrication, automatic and continuous, eliminates the waste of delay occasioned by over-heated bearings and, by relieving the operator of the necessity of constant attention to this detail, adds to his *producing time* that time usually required to "oil up."

Adding to Productiveness

The simultaneous use of two or more cutting tools is of obvious value. This practice has long been followed in the use of the Vertical Boring and Turning Mill —large diameter work presenting this possibility.

The Side Head of the Vertical Turret Lathe—one of the characteristic and original features of this machine—is a large factor in the economical production of work coming within its range.

Entirely independent of the Main Head, and mounted at a right angle thereto, it is used in the simultaneous machining of surfaces adjacent to those being machined by the tools in the Main Head, without in any way interfering therewith.

Multi-cutting increases production.

THE VERTICAL TURRET LATHE

Vertical Construction

The advantage in chucking operations is obvious. The horizontal table of the vertical type presents a surface on which work may be set up, levelled and trued without preliminary strapping; gravity serving as an aid rather than a hindrance.

The table (or face-plate) spindle is of large diameter, and having a self-centering conical thrust bearing, provides a rigid support for the work.

Bearing surfaces are immeasurably greater than in the horizontal type, ensuring a more nearly permanent alignment, and, in addition, the overhanging feature of both chuck and work is eliminated.

The conical thrust bearing of the Bullard spindle is amply proportioned—in fact, if a solid body of metal, of a size equal to the rated swing and height under rail, were placed upon the table of a machine, the bearing pressure would not exceed fifty pounds per square inch. Under ordinary working conditions the pressure would not average over fifteen pounds.

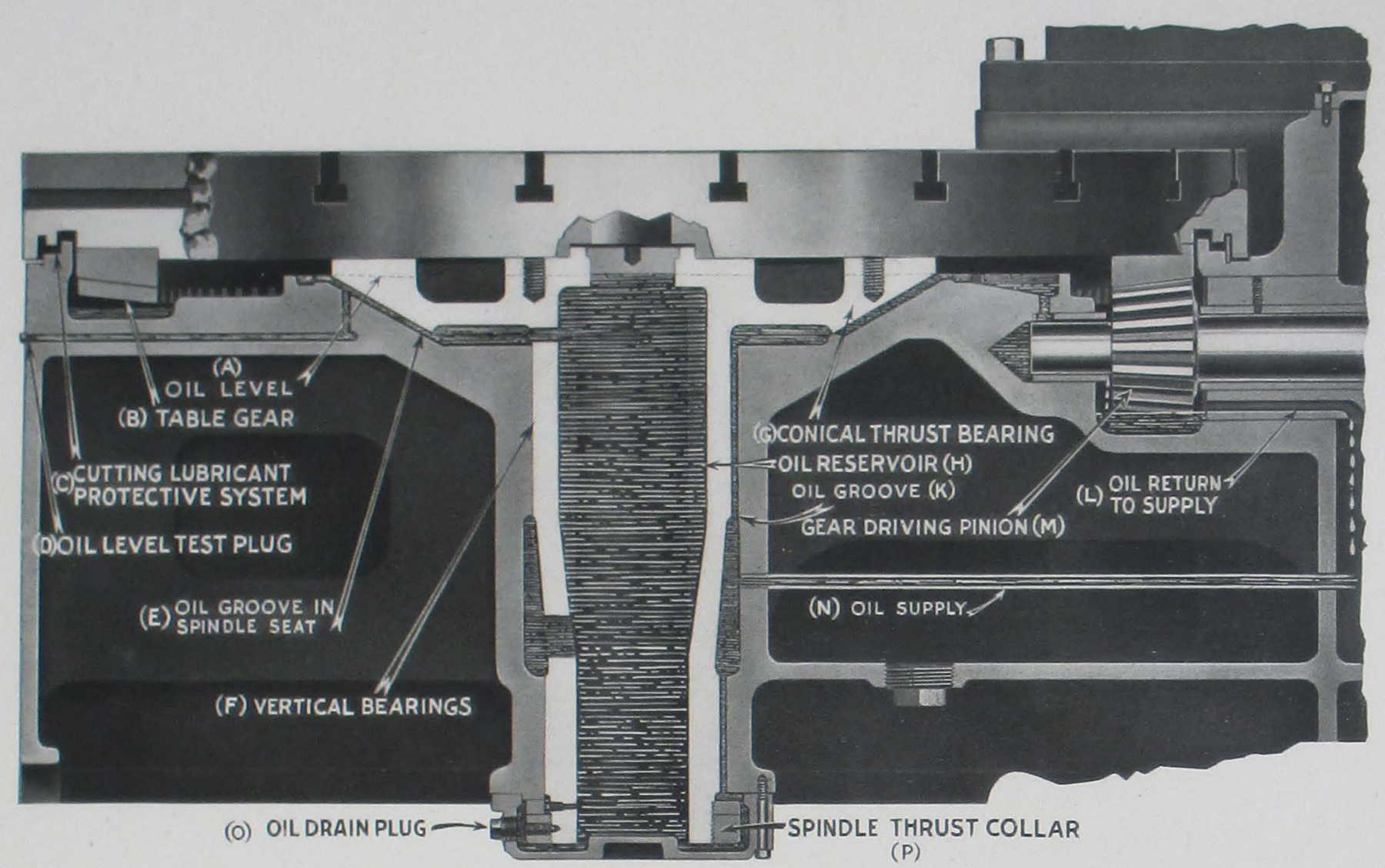
A constant film of oil is maintained between all bearing surfaces, a continuous stream flowing to the dust-proof reservoir formed by the spindle-bearings in bed.

In the matter of floor-space there is decided advantage, the vertical machine occupying but half of the room required for a horizontal machine of equal capacity.

Table Drive

The table is driven by bevel gearing having a special tooth form which has a rotative effect only. The gear is cut from a rolled forging of heat-treated alloy steel and meshes with a hardened pinion which is at all times immersed in oil.

The driving pinion shaft has ample bearings each side of the pinion which is in this manner rigidly supported. Having no overhang, as is necessary with a spur gear drive, the alignment is maintained and a perfect tooth-contact assured at all times.



THE VERTICAL TURRET LATHE

THE BULLARD TABLE SPINDLE

(PATENTED)

The spindle is cast from special analysis iron and all journals are ground in a machine particularly designed and built for this purpose. The bearings in bed are accurately scraped to fit and, as properly lubricated cast-iron bearings have an infinite life, no adjustment is either required or provided.

Oil is maintained at a constant level, a continuous stream flowing into the reservoir and, by the overflow, lubricating the table gear and pinion as well as the bearings therefor.

Specially designed guards prevent dust or cutting-lubricant from entering the spindle or gear chambers and thus coming in contact with the oil which is returned by gravity to the main reservoir in the base of machine.

This construction provides a rigid support for the work and eliminates chatter and vibration.

THE VERTICAL TURRET LATHE

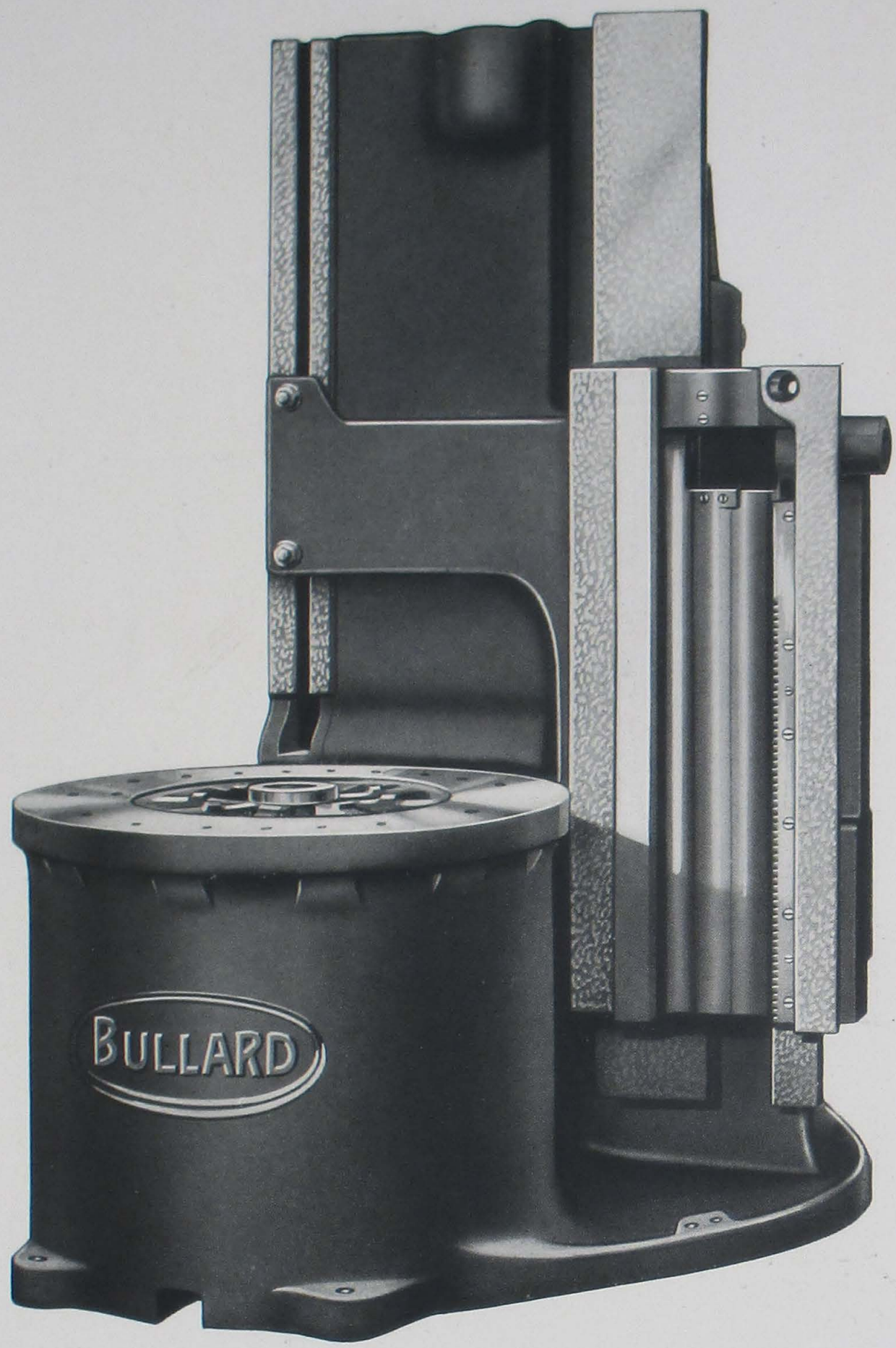
THE BULLARD BED

The Base and Column form a unit having a broad base. Being of box construction, well ribbed and braced throughout, it is well designed to resist cutting strains and obviate chatter and vibration.

The table spindle is fitted thereto and the driving mechanism mounted therein in a manner which eliminates torsional strains.

Rail supporting surfaces are amply proportioned and accurately machined and scraped—particular attention having been given to the support of the Side Rail to eliminate chatter and vibration. Note the extended bearing rising from the ribbed-base; this is further supported by a web-brace extending rearward to the column.

The guide-way for Rails is of the type having great length in proportion to its width, thus assuring accuracy of alignment in any position of the Rails which are adjustably mounted on the Column.



THE VERTICAL TURRET LATHE

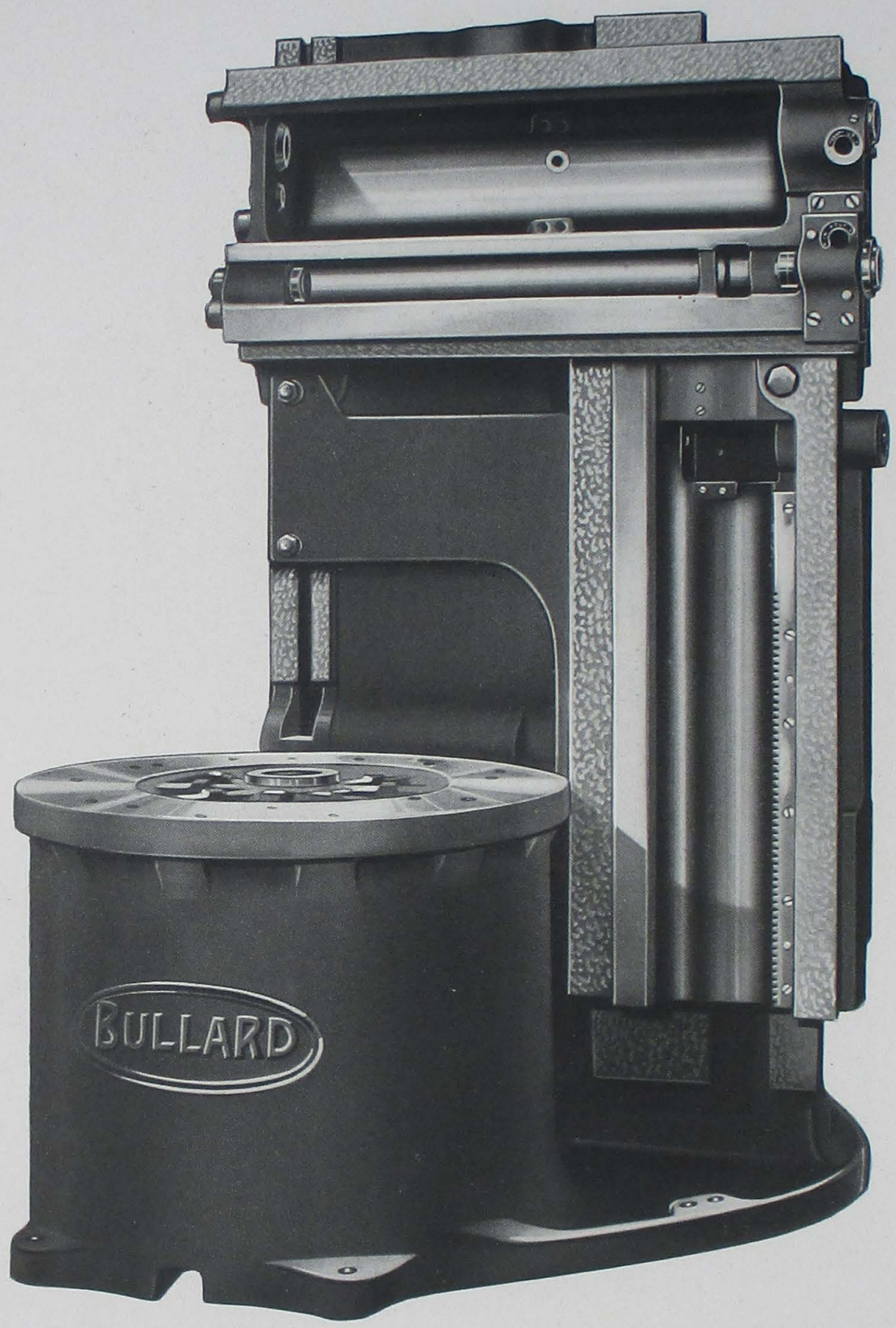
THE BULLARD SIDE RAIL

(PATENTED)

This unit, which supports the Side Head, has the form of the letter L. It is firmly secured to the bed and column in such manner as to become a part thereof, being bolted and gibbed at such points as will ensure absolute rigidity. It is adjustable vertically, by power, in conjunction with the Cross Rail.

This construction provides greater bearing surface for the Side Head, and brings its ultimate support much closer to the point of cutting tool than would be otherwise possible, thus eliminating chatter and obviating any tendency of the Side Head to tilt and bind under cutting strain as would be the case if same were mounted on the column itself.

Provision is also made thereby for maintaining alignment without the necessity of replaning the bed and column.



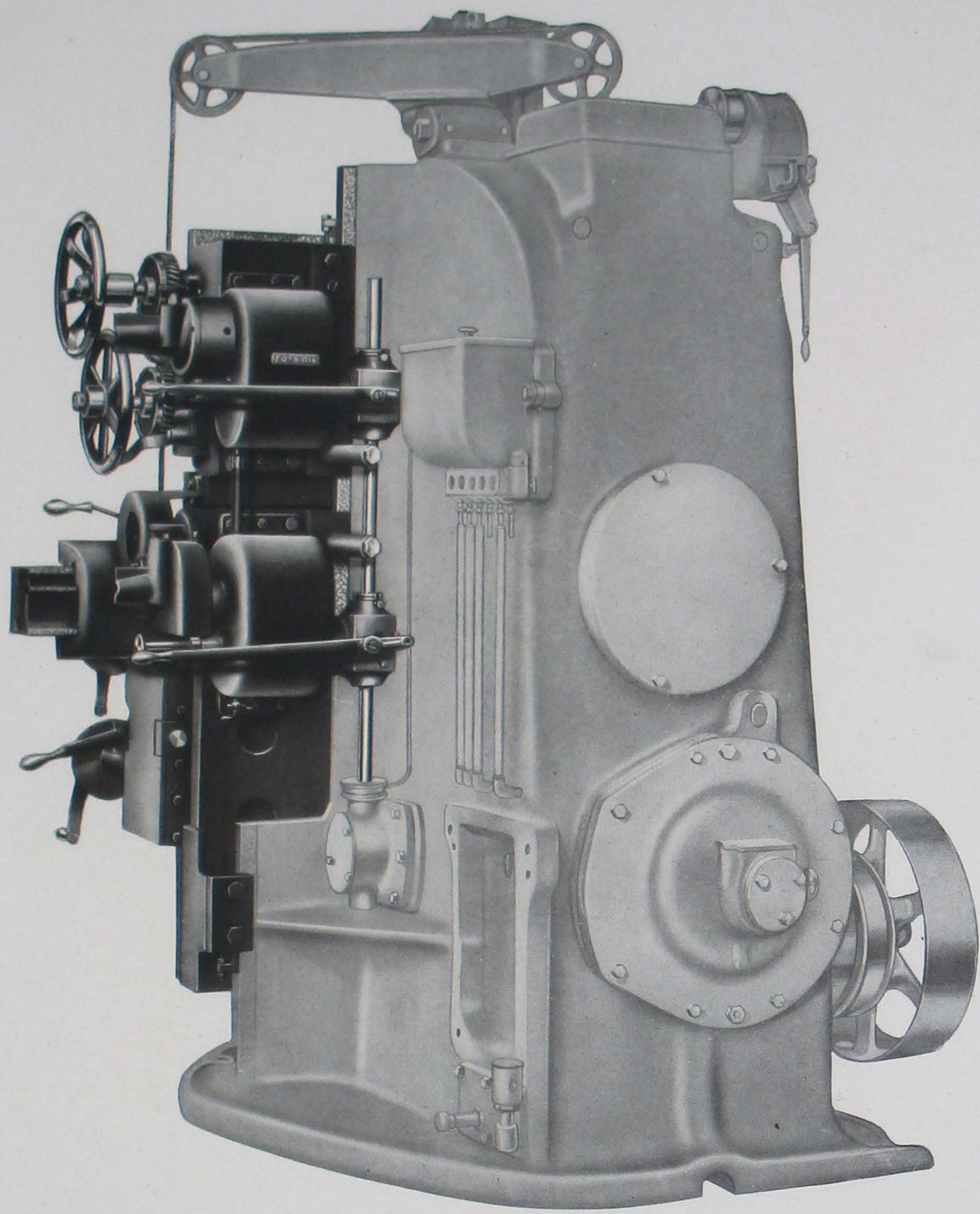
THE VERTICAL TURRET LATHE

THE BULLARD CROSS RAIL

This member forms a rigid ultimate support for the main Turret Head. Well-ribbed box construction is employed and its extension forms a firm support for the upper end of Side Rail.

Narrow guide bearings are provided for both Main and Side Head Saddles, obviating any tilting or binding tendency of the Heads when under cutting strain, thus relieving the feed-mechanism of undue strain. This feature also tends to greater accuracy and maintains better alignment of all moving parts.

Both Main and Side Rails are adjustable vertically on Column, being movable as a unit when binding bolts are released.



THE VERTICAL TURRET LATHE

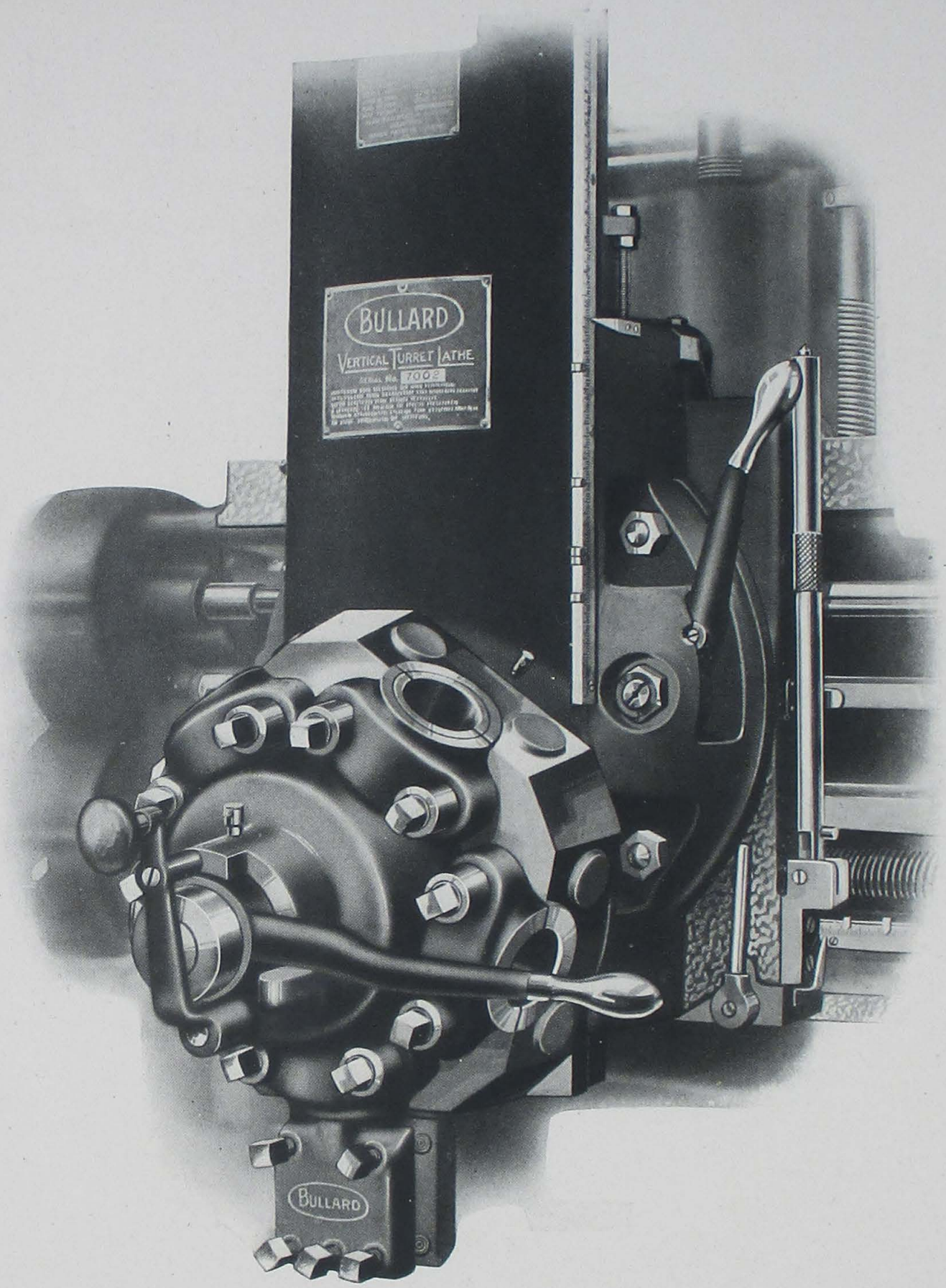
THE BULLARD BED AND RAILS

(REAR VIEW)

The rigid construction of the Column is particularly notable in this illustration, which also serves to show the method of securing thereto the Cross and Side Rails.

The solid support of the bottom of Side Rail is clearly shown, and the rigidity obtained by further supporting this member by the extension of Cross Rail is also made evident.

This original and patented construction is absolutely essential to eliminate chatter, vibration and torsional twist from a Side Head. It is the result of a careful observation and analysis of several thousand machines of this type which we have manufactured and tested.



THE VERTICAL TURRET LATHE

Two Independent Heads

An original and characteristic feature of the Vertical Turret Lathe is the arrangement—at a right angle with each other—of two independent turret heads.

This construction permits the simultaneous use of two or more cutting tools on work of even the smallest diameter, without interference, and materially increases the production obtainable.

Each head has a full movement, either by hand or power, throughout the entire range of the machine. The Main Head, mounted in a Swivelling Saddle, may be adjusted for taper boring or turning to any angle up to 45° either side of the vertical center. The Saddle is graduated accurately and a convenient mechanical adjustment is provided for setting the Head.

The Main Head

The construction employed is exceptionally rigid, the design of each part being well calculated to absorb, without distortion, the strains and stresses incident to heavy cutting at high speeds.

The Turret Slide is of open-box construction, well ribbed and braced; has extremely broad bearing surfaces in Swivel Plate to resist twisting strain under cutting action, and is provided with adjustment to take up natural wear and maintain alignment of holes in turret with center of table spindle.

Swivel Plate is of large diameter, and binding bolts are spaced at maximum radius permissible, rigidly and firmly securing the Swivel to Saddle.

The counter-weight balancing-effort is applied to the feed-rack in Slide through a separate pinion, concentric with the feed pinion which engages therewith. This patented system maintains a constant upward pressure *against* the teeth of feed pinion and positively overcomes the tendency of Slide to drop and dig the tool into the work. Maintaining a reverse-tension on the feed pinion *does not* accomplish this purpose, serving only to take up back-lash in the worm and worm-gear.

Independent Feed Mechanisms

At the rear of the Rails are mounted the feeding mechanisms—one for each Head—driven by a vertical shaft revolving in a constant ratio with the table.

This construction brings the final reduction in speed close to the point of power application and, by eliminating torsion in shafts, provides a steady feed free from any jumping tendency.

The feed gears are continually in mesh, changes being accomplished by the engagement of diving keys so arranged that it is impossible for a key to be engaged with more than one gear at a time.

Feed controlling levers and handles are conveniently located and changes may be made without stopping the machine or withdrawing the tools from the cuts.

A wide range of both roughing and finishing feeds is provided, any one of which is instantly obtainable for either Main or Side Heads.

Narrow Guide Bearings

Throughout the entire machine all sliding units are adjustably gibbed to guide bearings having great length in proportion to their width, which assure permanency of alignment and, in the Heads and Slides, eliminate all tilting and binding under heavy cutting strain. Accuracy is maintained thereby, and the efficiency of feed-works is largely increased.

Solid Square Locks

The reduction of the number of joints in such a part as a Rail-Saddle increases its strength and rigidity. Angular locks and bolted-on flat gibs are superseded in the Vertical Turret Lathe by a continuation of the Saddle castings for both Main and Side Heads. The Slides are secured in the Saddles in the same manner and all adjustments for wear provided for by taper gibs.

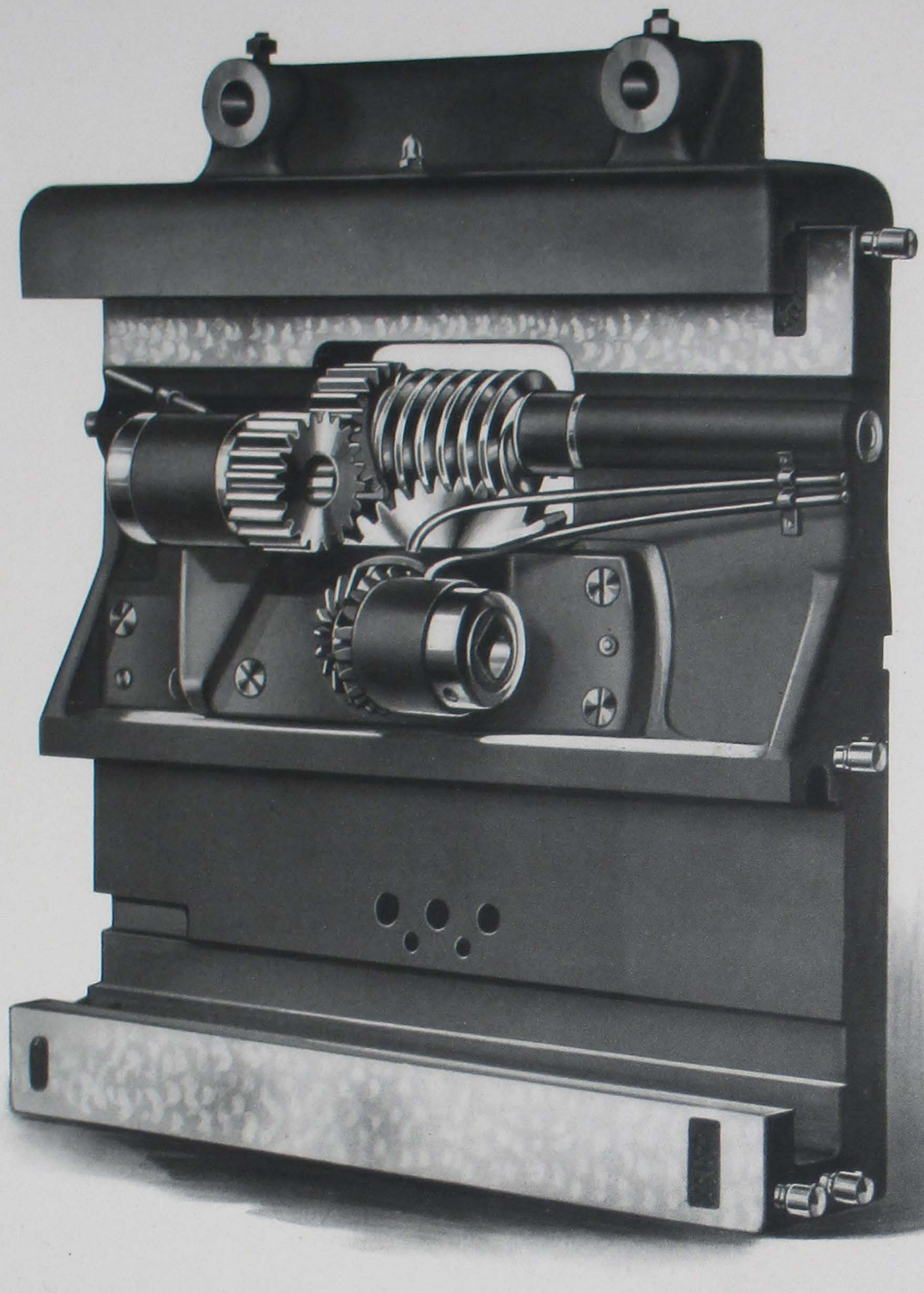
"Maxi-Power" Feed Mechanism

The great amount of power transmitted at slow speed by the worm and worm-gear in the Saddle sets up excessive strain and wear in these parts if the usual construction is employed.

In the "Maxi-Power" Feed Mechanism (Patented) the worm, with its integral pinion, is mounted *in the Saddle* and revolves on a stud which is supported at both ends. Worm thrust is absorbed in the Saddle itself and not in the bracket bolted thereto. The worm-gear is also doubly supported by bearings on either side, and revolves in an oil reservoir providing perfect lubrication. Both are hardened, and as larger diameters are possible, the efficiency is greater than in the construction usually adopted.

Lubrication of Sliding Bearings

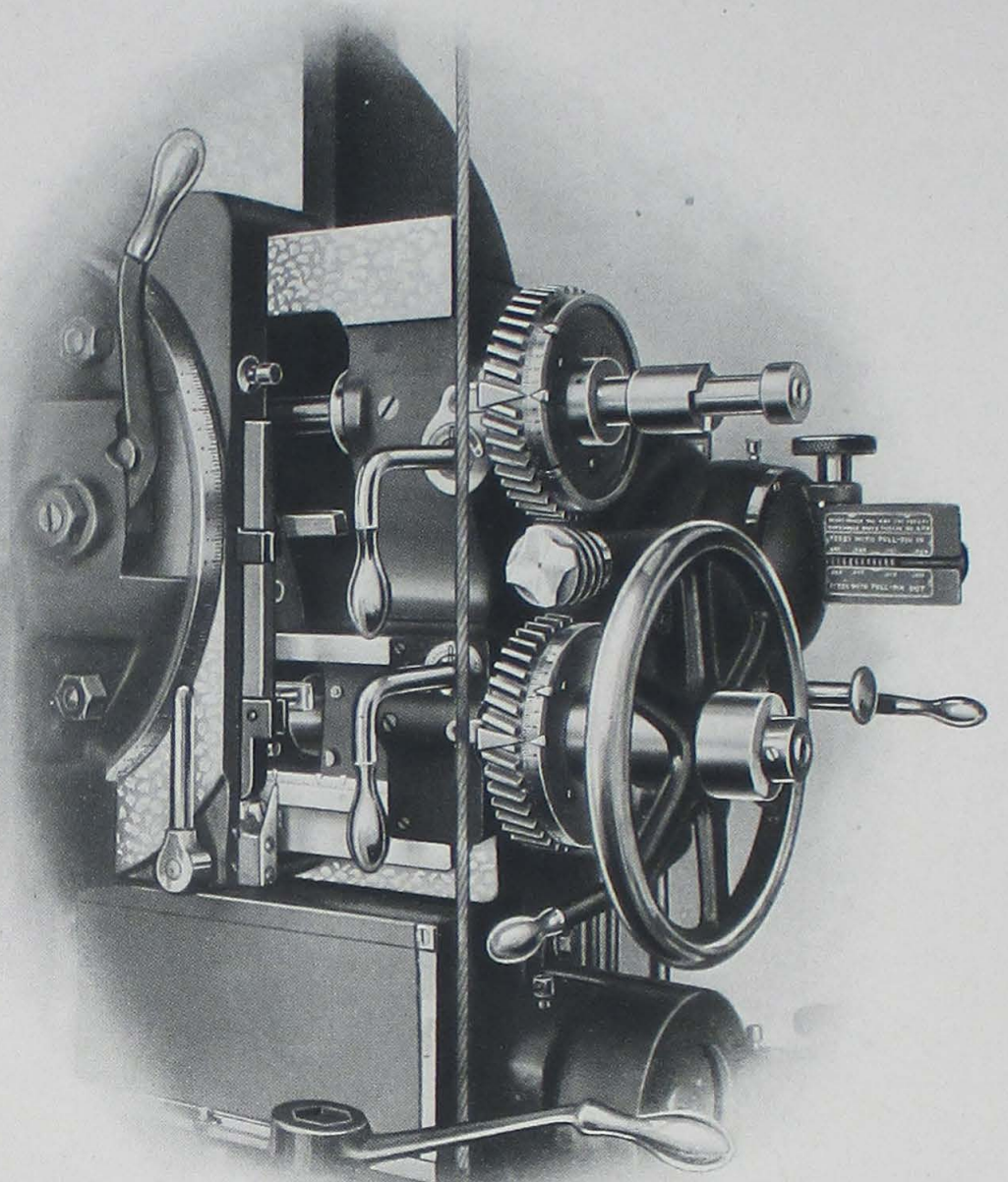
Bearing surfaces are lubricated by felt pads inserted in pockets at either end. The pads serve also as wipers, keeping the bearings free from foreign matter and abrasive particles.



THE BULLARD SADDLE

This rear view of Main Saddle shows the extra large worm and worm-gear in the "Maxi-Power" Feed Mechanism, also the Solid Square Locks and Narrow Guide Bearing.

The weight of head is borne directly by the saddle casting, which also receives the direct pressure of cutting strain. Taper gibs, adjustable to compensate for wear, are incorporated in the Saddle construction.



THE VERTICAL TURRET LATHE

Hammer Hand Wheels (Patented) eliminate the dangerous crank-handle and enable the operator to readily make the finest adjustment of the cutting tool.

Observation Stops, adjustably mounted on large Micrometer Dials, are dependable in repetition work, are easily set for each tool and do not present the complications or limitations of a positive stop mechanism.

The Feed Indicator is direct-reading and shows, at a glance, the amount of feed per revolution of table.

Feed Engagement

The feed is engaged or disengaged, and changed from vertical to cross-feed, or vice versa, by means of a centrally located drop-worm which may be meshed or disengaged with the worm-gears mounted on the ends of feed-rod and feed-screw. Slip gears and jaw clutchés are eliminated.

Safety Device

The webs of feed-worm-gears are held between compression collars keyed to the rod and screw. Hand tension on the adjusting screws is sufficient to drive the heaviest cuts, but will allow the gear to slip if the head is fed against a solid obstruction. The feed mechanism is thus protected from breakage due to careless handling.

Measurement Scales

An accurately graduated scale is attached to the Main Slide, a similar scale being mounted in the face of the cross-rail. A scale is also attached to the tool slide of the side head. These scales proving of material assistance in the setting of tools.

Micrometer Dials

Index Dials, accurately graduated in thousandths of an inch, are mounted on both feed rod and screw. Large in diameter, the graduations thereon are widely spaced and are exceptionally distinct and readable.

Center Stop

A center stop, having means of adjustment should same become necessary, has been provided for the Main Head. Its location obviates injury or destruction of accuracy by careless handling of the head, which at all times may be run a short distance beyond the center—an advantage in recessing or under-facing operations.

Observation Stops

Observation stops, bearing numbers to correspond with those on the faces of turrets, are adjustably mounted on graduated scales and micrometer dials and are invaluable in the duplication of various sizes. They do not represent the limitations and objectionable features, mechanical and otherwise, of the automatic feed trip, which can be set for one dimension only and is undependable for accurate reproduction.

Sizes are obtained by bringing into coincidence the marked graduation on feed dial and the knife-edge of the stationary indicator. Accuracy is not dependent on equalized pressure as is the case with a positive stop.

Tool Setting Device (PATENTED)

The rod and screw of main head revolve rapidly when power traverse mechanism is engaged. Crank handles would, therefore, be dangerous. These have been supplanted by hand wheels mounted on sleeves secured to the rod and screw. The wheels are free to make a partial revolution on the sleeves before becoming engaged therewith, the engagement imparting a hammer action similar to a hand tap on the end of a crank handle. The finest adjustment of tools may be made by this means. Hand wheels rigidly attached to rods will not accomplish this purpose.

Rapid Power Traverse

The vertical head may be rapidly moved in all directions by power independent of feed works or table drive. Vertical and cross motion in either direction may be engaged singly or simultaneously, the operating mechanism for each being independent of the other. Safety device prevents damage resulting from careless handling.

This device, which is in no way connected with the feed, adds largely to the day's production—the operator's energy being conserved and a rapid pace set for all hand movements of other machine parts.

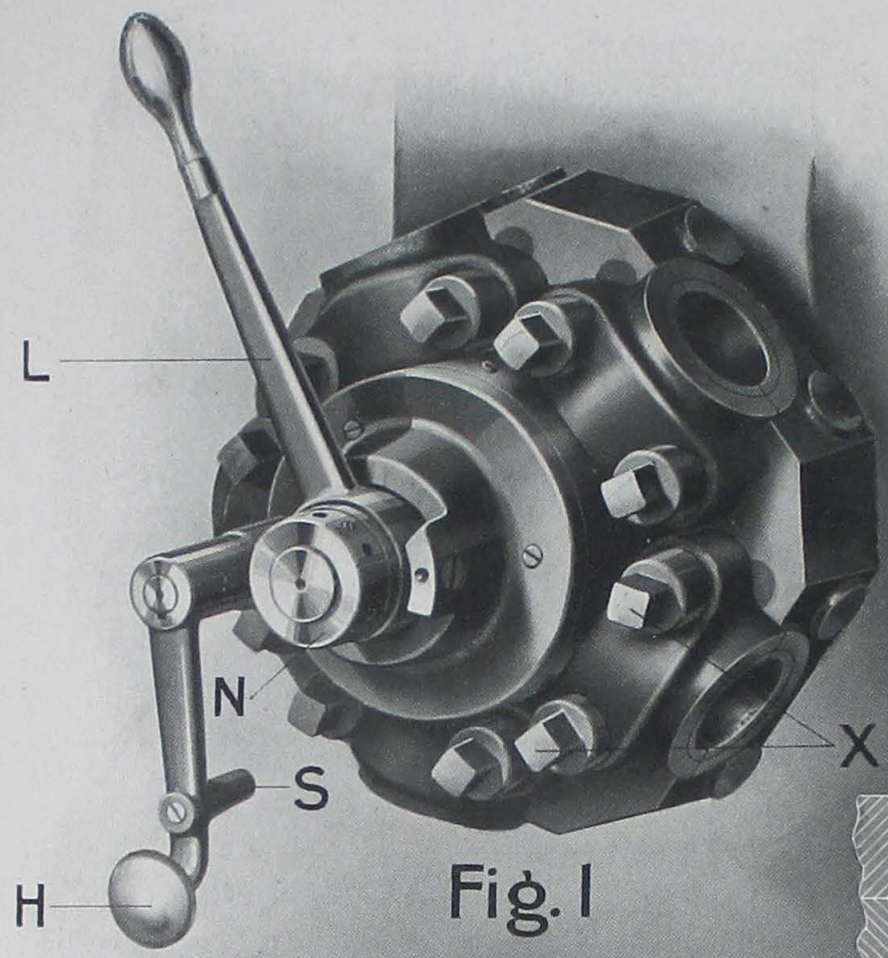


Fig. 1

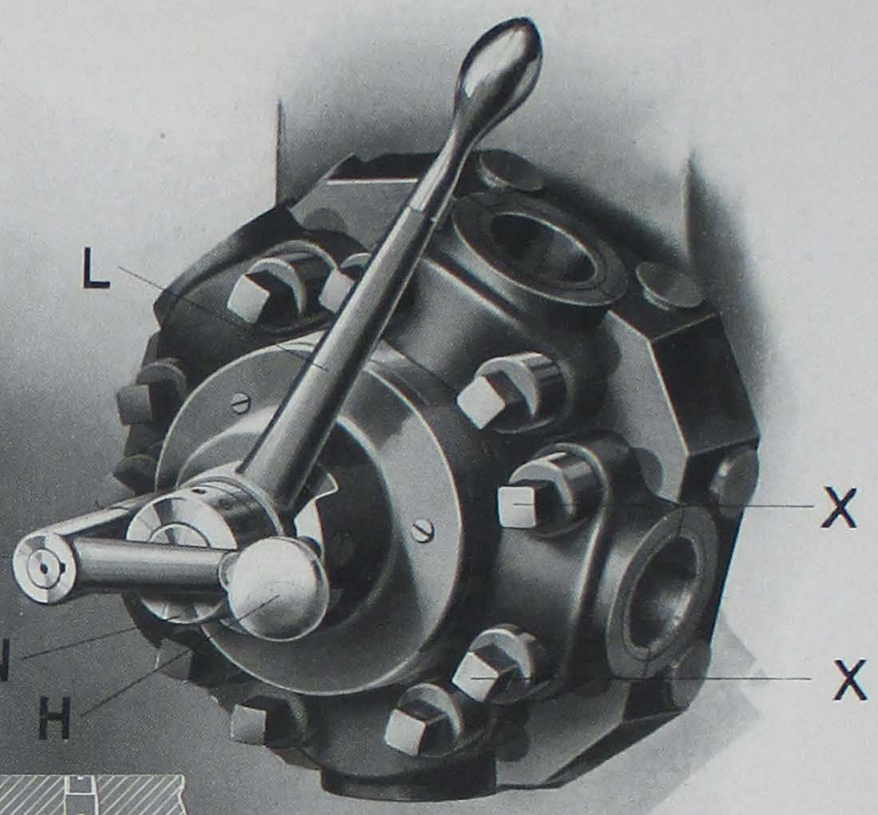


Fig. 2

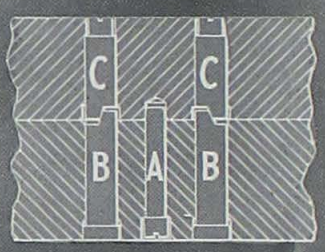


Fig. 3

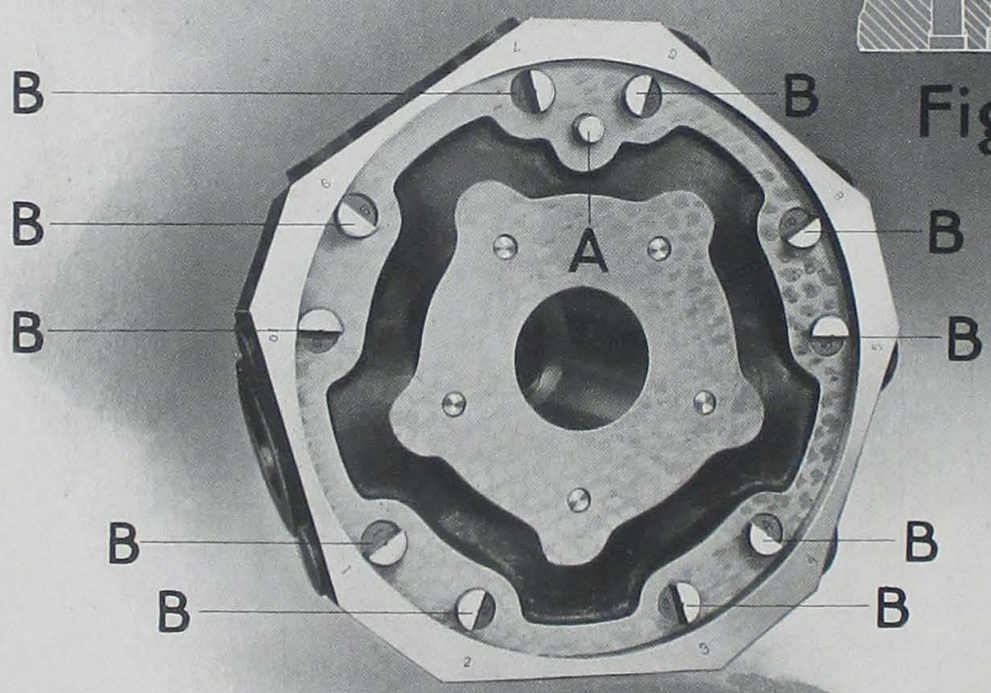


Fig. 4

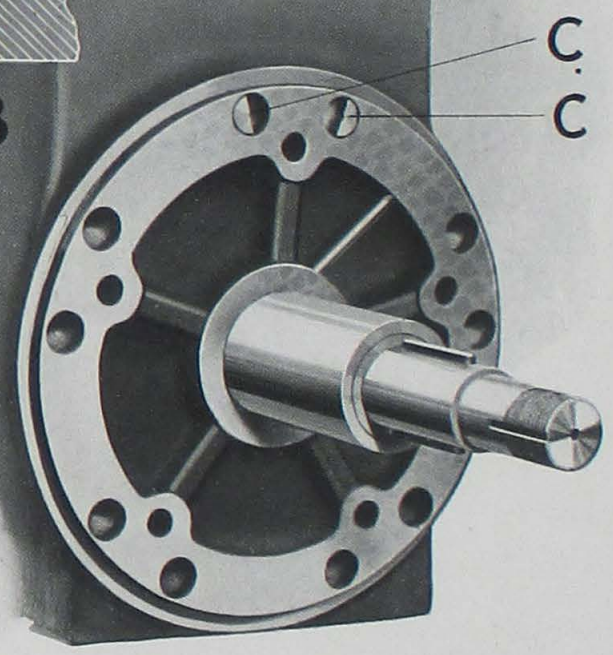


Fig. 5

DETAILED REFERENCES

A—Indexing Pin

B—Registry Pins in Turret

C—Registry Pins in Slide

H—Turret Indexing Handle

L—Turret Locking Lever

N—Locking Lever Adjustment

S—Feeler Pin

X—Tool Binder Cap Nuts

THE BULLARD TURRET

(PATENTED)

The Vertical Turret Lathes are equipped with a new type Turret which is designed on lines that are broadly different. Features are incorporated in its construction which minimize the possibility of error in indexing and registry, and also provide means of correction should inaccuracy occur in use.

Turret Functions

The function of a turret is to hold tools for successive operations so that they may be quickly and accurately brought into operating position. Exact registry at all times is of the utmost importance—the duplication of sizes in repetition work being dependent thereon, as the slightest error in the registering mechanism is increased in direct proportion to the extended distance of the tool from the turret face.

Standard Turret Construction

Turret design has moved in a groove for over half a century, such improvements as have been developed since the inception of the locking bolt tending only to reduce, rather than eliminate, the possibilities of error and inaccuracy inherent to that construction.

Better materials, handled in an improved manner and assembled with greater refinement of fit have, to a large degree, reduced the inaccuracy of indexing and registering by means of the bolt, and vastly improved means of securing the turret, *after* it has been indexed, have been devised, but the real seat of error, *the bolt itself*, has been perpetuated.

Turret Analysis

Facts regarding turret design and operation were made apparent by observation. The analysis which resulted in the Bullard Turret is tabulated on pages 70 and 71.

Enumerated in the order of their co-relation, and in parallel columns, are, 1st, the features of construction and operative means of the standard turret; 2d, the results obtained thereby and the effect of its use as observed in innumerable cases; 3d, the remedies suggested and found feasible, and, 4th, an outline of the essential features of the Bullard Turret.

The New Turret

Briefly,—the turret is registered by pins of opposing tapers rigidly fixed in the turret and base respectively; the center stud is slightly tapered and is a binding fit in its mating hole when the turret is seated. When drawn forward to disengage the registry pins and to permit indexing, the turret is clear of its seat and there is ample freedom between it and the center stud, so the turret may be easily revolved, yet when locked there is no freedom between turret and stud.

Wear in this taper fit, other than that caused by the action of pulling the turret off and on, has been obviated, and as the turret comes in contact with the base only when seated no wear can occur at that point.

Details of the turret are illustrated on page 66; Figs. 1 and 2 being assembled views showing it and the operating levers in an unlocked and a locked position respectively.

Turret Indexing

The index pin, in turret, projects beyond the face of registry pins and must enter a hole in slide before the latter can come in contact.

Turret Registry

Registry pins project in pairs from back of Turret, one pair serving for each turret position. Opposing master pins are fixed in slide and engage as desired with each pair in the Turret. These pins are milled to give inclined contact faces, and as the movement is longitudinal only there is no appreciable wear therein.

Adjustment

Pins in turret are backed by adjusting screws sunk below the surface. A smooth finished plug protects the original adjustment but may be removed should error in any face require correction.

Turret Operation

Turret is released by reverse action of Locking Lever, a cam therein disengaging the registry pins.

A single revolution of Indexing Handle, which has gear connection with Turret Body, revolves the Turret from one hole to the next. This handle controls the Turret perfectly regardless of weight or position of tools.

The Locking Lever, through toggle action, firmly seats the Turret and engages the registry pins. Toggle pins are hardened and fit into hardened seats in the lever hub and spherical equalizing washer.

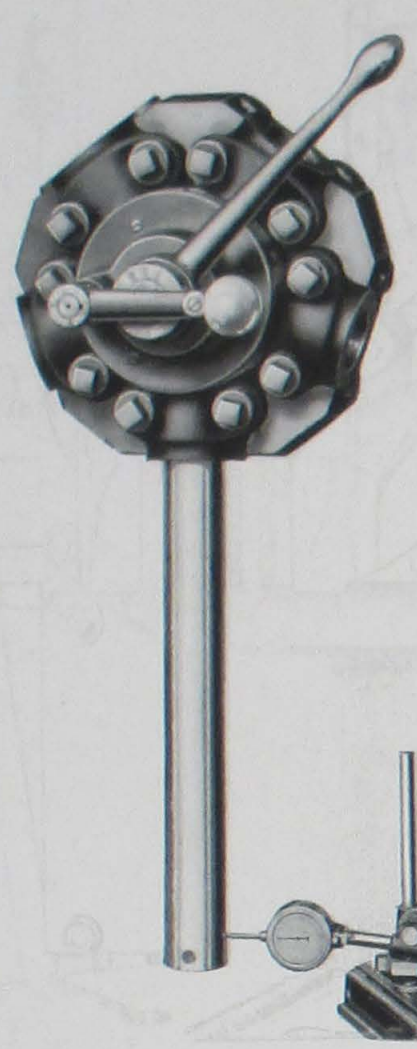
Turret Bushings

Holes in turret are bushed in order that sizes and alignment may be readily maintained. Bushings may be removed and replaced without destroying the original hole in turret.

Seat Protection

A ring at the outside diameter of the turret seat fits snugly over a projection from the base and thoroughly protects the seat from the entrance of dust and foreign matter.

A TEST FOR TURRET ACCURACY



The original and continued accuracy of indexing and registry of the Bullard Turret is indicated in the following tabulation of test records made at various times in a period of approximately four years' continuous and varied service.

During this time no repairs or adjustments have been made though full provision is made therefor in the construction of the Turret, nor has the Turret Seat been cleaned.

MAXIMUM VARIATION FROM ZERO ON INDICATOR IN THOUSANDTHS OF AN INCH

Test Number	1	2	3	4
Date of Test	Oct. 2, 1909	July 2, 1910	Jan. 11, 1912	Sept. 12, 1913
Face Number 1	0.00000	0.00050	0.00025	0.00150
Face Number 2	0.00025	0.00050	0.00000	0.00050
Face Number 3	0.00000	0.00000	0.00050	0.00050
Face Number 4	0.00025	0.00000	0.00025	0.00100
Face Number 5	0.00000	0.00025	0.00000	0.00100

Bar extending 20 inches from face of Turret.

Center of Turret to point of Contact with Indicator $27\frac{3}{8}$ inches.

American Watch Tool Co.'s Indicator used in all Tests.

Graduations for one-thousandth of an inch are spaced less than $\frac{1}{16}$ of an inch on dial. Readings to one-quarter-thousandth are a matter of judgment.

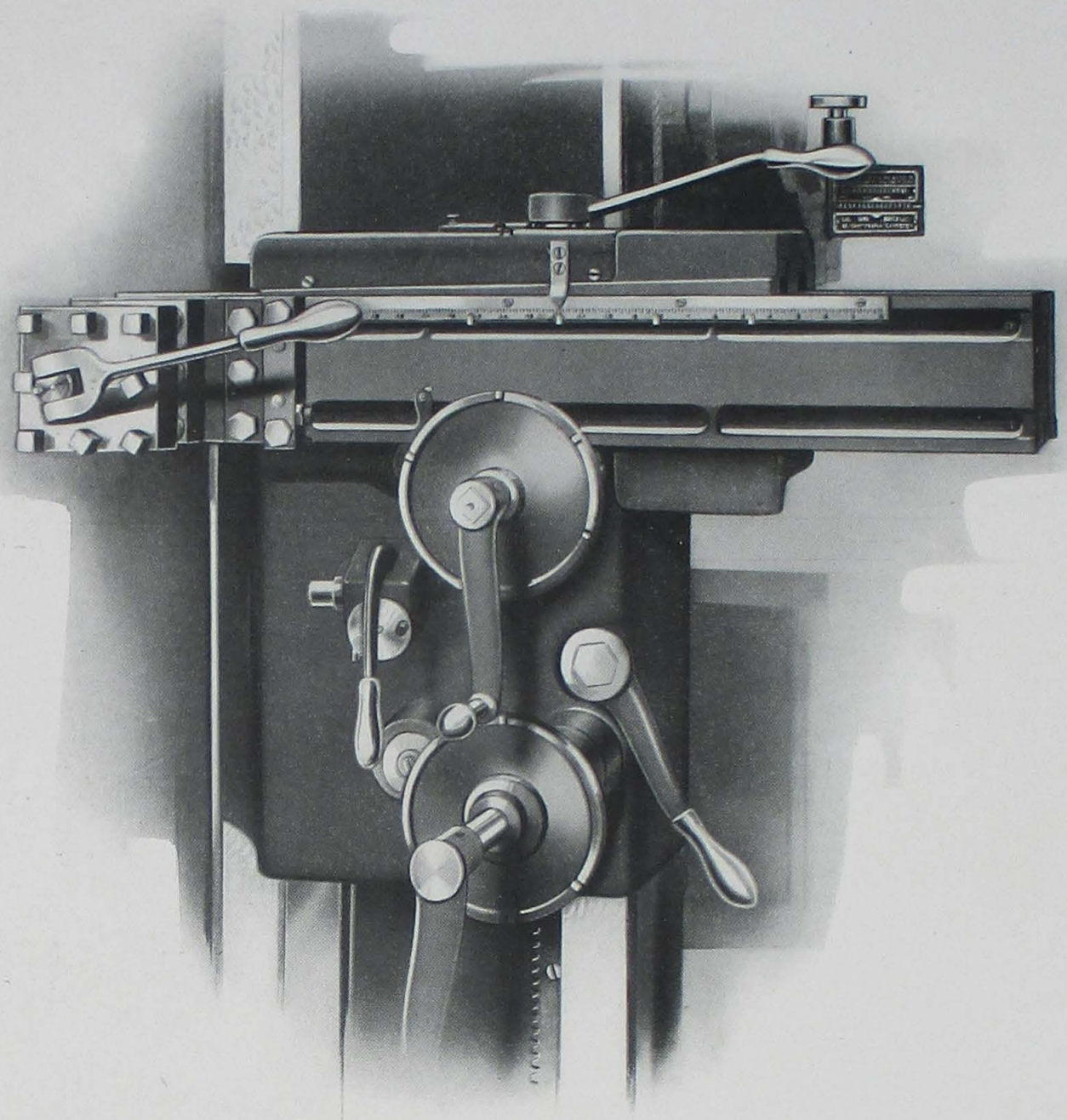
Each Face tested twenty times, maximum indication from Zero, at which indicator was set at first test, recorded in tabulation.

ANALYSIS OF STANDARD TURRET AND RESULTS FROM ITS USE

MECHANISM AND OPERATION OF STANDARD TURRET	RESULTS IN USE
Turret revolves on seat.	Turret wears back and alignment with center is destroyed.
Turret revolves on straight center stud. Customary clearance for running fit about 0.00125 inch.	Necessary original clearance caused error in registration of tool as pressure was applied on one side or the other under working conditions. Conditions grow worse as turret is used, due to wear of hole and stud, also peening action of cut.
Lock pin must be free in guide to permit of engagement and disengagement.	Freedom allowed for sliding fit presents the same difficulties as described above. Gib on side takes up wear in one direction only and will eventually throw faces out of alignment. Gib on both sides increases number of parts subject to wear and looseness.
Single lock pin for all faces of turret.	Any adjustment for one face of turret is reflected in all other faces of turret.
Lock pin is spring controlled.	Springs vary in strength according to material and temper; are subject to breakage. Effective engagement of lock pin in indexing ring varies with pressure of spring and adjustment of gibs. Pin rebounds from its seat in ring when shot into place by spring action. Full seating of pin in ring not invariably obtained.
Hardened index ring.	Ring must be drilled for securing screws and dowels before hardening with resultant warped holes, to which dowels cannot properly be fitted. Rings, therefore, become loose under action of cut and careless engagement of lock pin therewith; alignment of turret faces soon becomes destroyed. Both index ring and lock pin are subject to serious abuse, as the lock pin is engaged with great force when turret is indexed, no device being provided to ensure even approximate indexing before engagement. Correction of error in alignment due to wear in index slots is extremely difficult even if possible.
Turret revolved by taking hold of tools.	Unless tools in turret are placed in balance this operation presents possibility of danger to the operator.
Holes in turret bored into turret body itself.	Holes are subject to wear in the mounting of boring bars, tool holders, etc., and unless a perfect fit is maintained the hole is gradually peened out of shape by vibration and alignment is destroyed. An entire new turret is required to correct the error in even one hole.
Binder plugs on only one side of hole.	Even with floating differential binder plugs there is a tendency to crowd the shanks of bars to one side—thus destroying the hole.

REMEDIES TO BRING ABOUT IMPROVEMENT AND FEATURES OF THE BULLARD TURRET

REMEDY	CONSTRUCTION OF BULLARD TURRET
Raise turret from seat before revolving.	Reverse action of lock pin lever disengages registry pin and raises turret from seat.
Use taper stud on which turret fits absolutely when forced back to its seat. Stud should have sufficient taper to permit of free revolution of turret when it is away from its seat.	Turret stud is tapered and lapped to a perfect fit in turret when same is seated on slide.
Locking or registry pins must be rigidly and immovably secured in both slide and turret respectively.	Pins in both slide and turret are fitted tightly therein. No side- or end-play is permitted.
Registry pins for each face must be individually adjustable when required, but so constructed as to eliminate the possibility of wilful tampering with the original adjustment.	Registry pins in both slide and turret are backed by threaded plugs which permit of individual adjustment of each face. Adjusting screws are protected by unslotted screw plugs which are removable should occasion require.
Fixed registry pins eliminate the requirement of spring action.	There is no spring action in any part of the Bullard Turret. The action of registry pins is positively controlled by toggle-action of Binder lever.
Provide means of indexing turret before engagement of registry pins if possible, thus avoiding injury to them.	Registry pins are protected by an indexing pin, in turret, projecting beyond the registry pins, which enters a hole in slide before registry pins can come in contact.
Provide mechanical means of revolving turret to have sufficient power to absolutely control turret movement regardless of position or weight of tools.	The turret is revolved by means of a handle having a geared connection therewith (Patented). The operating handle makes one revolution to each face of turret, this ratio giving absolute control regardless of weight or disposition of tools held therein.
Bush turret holes with sleeves readily removable without injury of original hole, thus permitting easy repair of turret holes.	Turret holes are bored over-size in position by tools held in fixture secured to table. Bushings are ground inside and out and are removable without injury to hole in turret.
Binding pressure should be equal over entire surface of the shank of bar or tool holder. Spring bushings and box cap will compensate for slight wear in bushing or shank or a variation in sizes of shanks.	Tool binder has the form of a half-box and is secured to the face of turret by two binder bolts. The frictional pressure is, however, not sufficient to secure bars and tool holders against the twisting strain of cuts. A pin of large diameter, located across the inner end of turret hole, enters a slot in the end of bar or tool holder, acting as a driver therefor.



THE VERTICAL TURRET LATHE

THE BULLARD SIDE HEAD (PATENTED)

The Side Head of the Vertical Turret Lathe is an integral part of the machine, conceived and developed as a distinctive feature having an important bearing on the matter of increased production.

Firmly supported close to the point of cutting tool by the side rail, it is capable of absorbing, without vibration, chatter or any tilting tendency, the heaviest cuts permissible with modern tool steel.

Its location permits the simultaneous machining of surfaces adjacent to those being machined by tools in the main head, without in any way interfering therewith. Facing and turning operations may be accomplished while the main head is boring, or both heads may be used, in combination, in facing and turning operations—tools in each head being used in close proximity on work of either large or small diameter.

Its control is convenient. Its operation does not in any way tax the strength of the operator, as it is perfectly counterbalanced.

Usable throughout the entire *actual* range of the machine, the Bullard Side Head in no way limits the capacity thereof.

While massively proportioned, it does not require excessive counterweighting, as the rail, upon which it is mounted, is stationary and in reality forms an extension of the column, providing a broad bearing surface closer to the work than is possible without this construction.

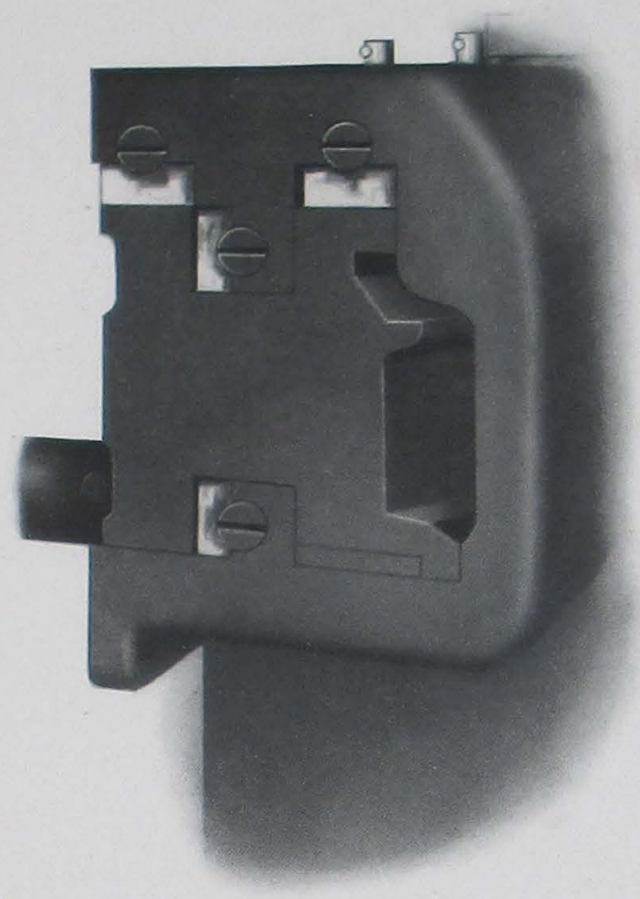
The Bullard Side Head does *not* overhang.

Side Head Saddle

Rigid, well-braced box construction is employed in this member, in which is mounted, as a self-contained unit, the feeding mechanism for both vertical and horizontal movements of the head.

Side Head Slide

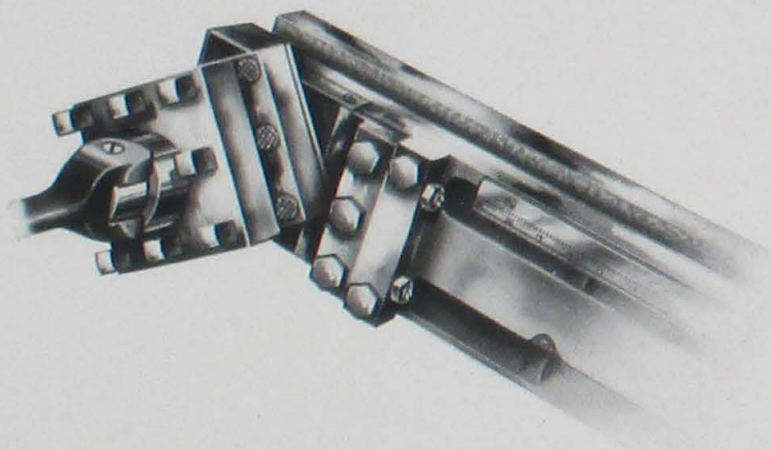
A box-girder in form, and having longitudinal trussed webs its entire length, the slide is capable of supporting the heaviest cuts in any position. Additional strength is secured by the use of a steel casting for this part.



Solid Square Locks

The saddle is designed to surround the slide on three sides. Bearing surfaces are extended to a point as near as possible to the cutting tool to eliminate torsion. Taper gibs provide adjustment for wear.

Side Head Turret



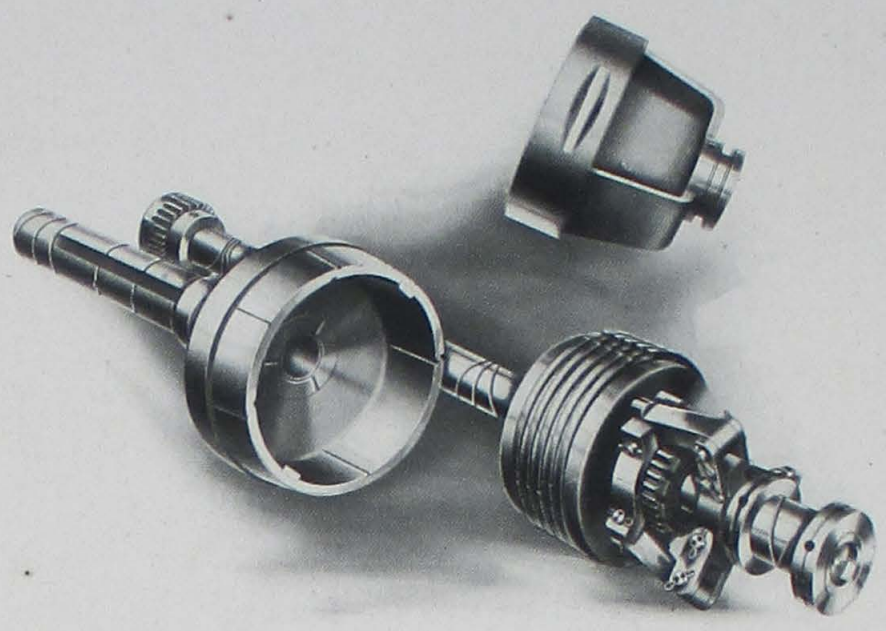
The Turret Tool Holder is made of alloy steel, heat-treated to obtain added strength. Hardened steel buttons inserted therein form seats for the cutting tools. In indexing, the turret is raised from its seat sufficiently to clear the hardened registry block, which is adjustably mounted on the slide. Bevelled locking faces on block and turret assure accurate registry for the various turret positions.

Feed Changes

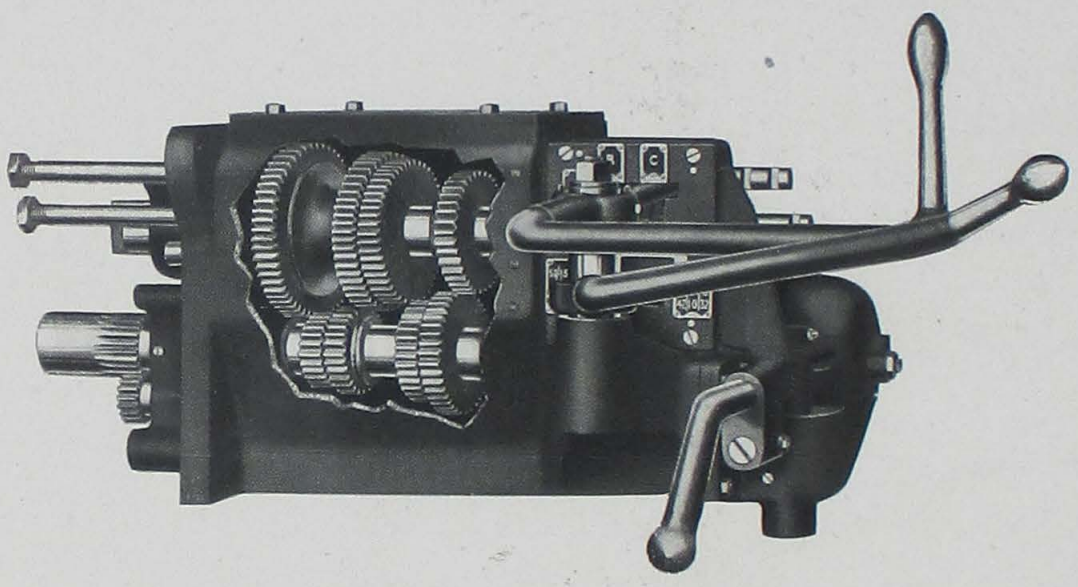
Changes in direction of feed from either vertical to horizontal, or vice versa, and the engagement and disengagement of feed, are controlled by a lever mounted on face of saddle. Changes in amount of feed per revolution of table are obtained through independent feed works mounted at rear of rail—the control thereof being extremely convenient and similar in all respects to that of the main head.

Micrometer Dials and Scale

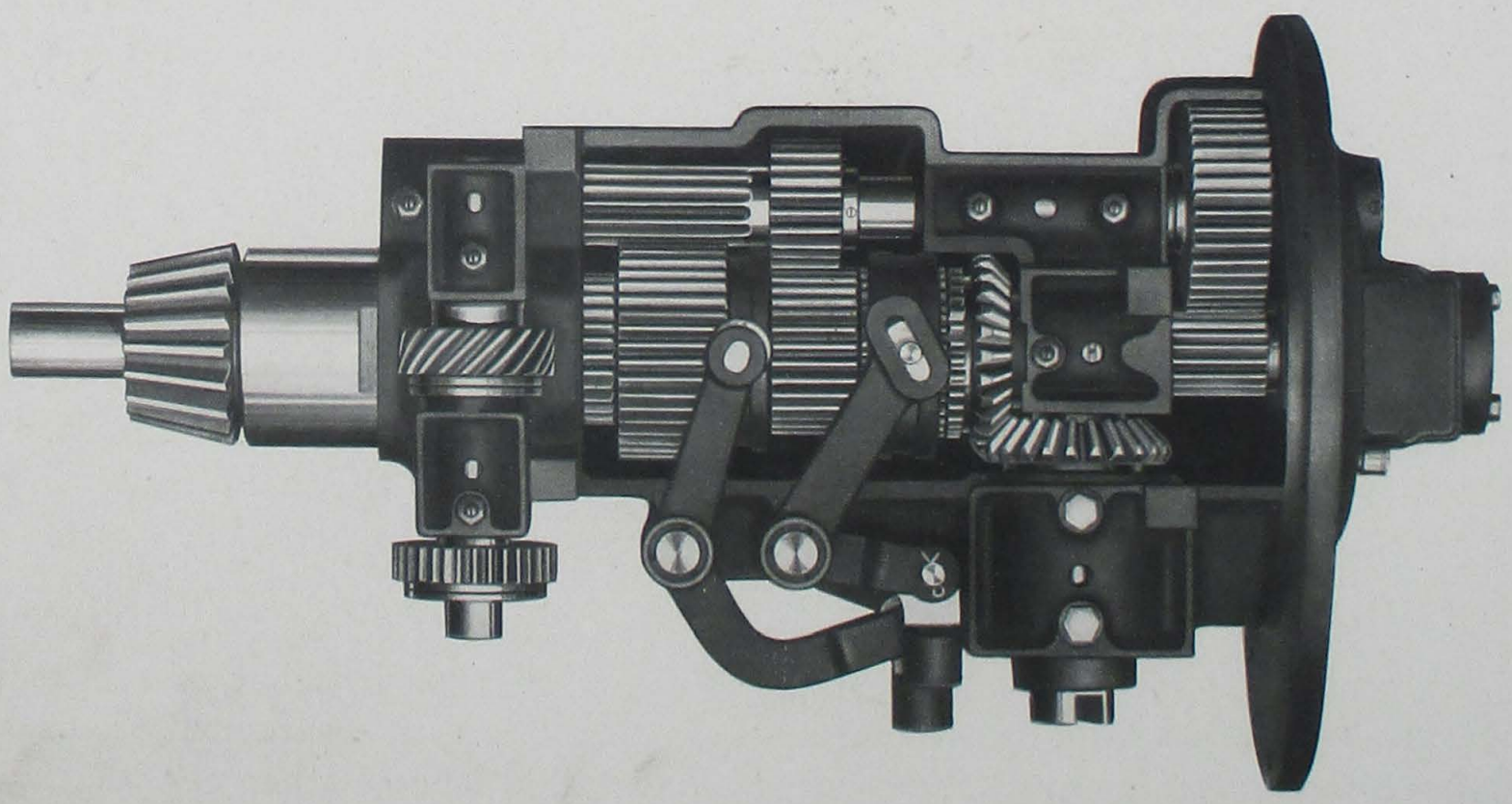
A scale on slide and micrometer dials on feed rods in front of saddle have observation stops adjustably mounted thereon. These measurement devices are easily readable as they are not obscured by the slide or any other part of the side head.



MULTIPLE DISC CLUTCH AND BRAKE DRUM.



PRIMARY SPEED CHANGE CASE SHOWING, IN DETAIL, THE CONTROL LEVERS AND INTERLOCKING SYSTEM.



SECONDARY SPEED CHANGE CASE. A POWER UNIT OF EXTREME STRENGTH AND MAXIMUM DURABILITY.

The use of this material renders possible a reduction in the diameters of gears, which in turn permits the use of higher speed shafts while maintaining a low peripheral speed of gearing. The Lewis formula establishes 1,200 feet peripheral speed as the maximum. No gear in the Vertical Turret Lathe, even when running at highest speed, exceeds 600 feet peripheral speed per minute. High table speeds for efficient boring of small holes is thus rendered possible by the use of this material.

Table Gear

The table gear is of such form and section as to render impractical heat treatment and hardening after the machining operations have been completed. For this part a rolled forging, high in carbon and manganese content, is employed. To avoid distortion and insure a smooth-running, quiet gear, of maximum strength and wearing quality, the forging is heat-treated, before machining, to a point closely approaching the limit of machine-ability. In combination with the hardened driving pinion, which is continuously immersed in oil, its wearing qualities in this service are unexcelled.

Feed Gears

Being constantly in mesh and not subjected to the shock of end engagement, as are the speed change gears, a case-hardened alloy steel is used in the feed gears. Maximum strength and wearing qualities are obtained by special heat treatment and hardening subsequent to the impregnating process.

The hardened steel feed gears are equal in size and pitch to the cast-iron gears used for this service in previous designs, a remarkably small number of which, considering the thousands in use, have failed by either wear or breakage. The high factor of safety is self-evident.

Lubrication

A surprisingly large percentage of machine failures, or breakdowns, are the direct result of insufficient and improper lubrication of bearings and gears. The insistent demand for increased production from each unit and the wage incentives offered distract the operator's attention from the care of his machine. Heavier cuts at higher speeds require the transmission of greater power, which imposes an increased pressure on all bearings as well as gear teeth.

Ordinary methods are wasteful of both lubricant and power, and result in a rapid depreciation of machine value from the standpoint of both production and asset. The life of a machine is largely dependent on its lubrication.

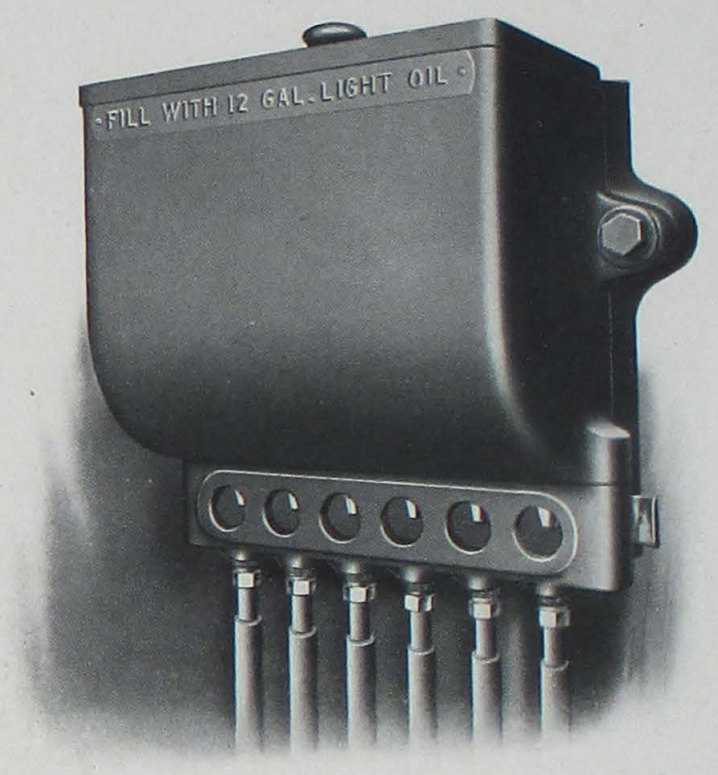
A Continuous Flow System

The Vertical Turret Lathe, New Era Type, has incorporated in its construction an automatic system of lubrication which insures a maximum power efficiency, and infinite life of bearings and gears, a freedom from delay due to burned bearings and worn gears, and, by relieving the operator from the necessity of constant attention to lubrication, adds to the productive time of the machine that time usually taken to "oil up."

Details of System

Table spindle, table driving gear, and pinion, primary and secondary speed change mechanism, clutch and brake, and main driving shaft journals are lubricated by a continuous flow of oil from a centrally located reservoir. A film of oil is maintained between all bearing surfaces and the teeth of gearing transmitting power, eliminating metal to metal contact.

After performing its function the oil is returned to a sump, located in the bottom of column, from which it is again pumped to the distributing reservoir through a filtration system. The flow of oil is constant so long as the main driving pulley is in motion.



Sight feeds indicate the flow of oil to each of the above-mentioned parts, and should the distributing ducts become clogged the stoppage would immediately be made apparent.

Feed-change, power traverse and rail raising mechanism, having a variable relation to the column, form self-contained reservoirs in which the constant-level system is employed. The splash from gears is used to lubricate bearings in these units, the oil being returned by ducts to the reservoirs therein.

Oil level indicators are provided at all points in order that a proper amount of lubricant may be maintained.

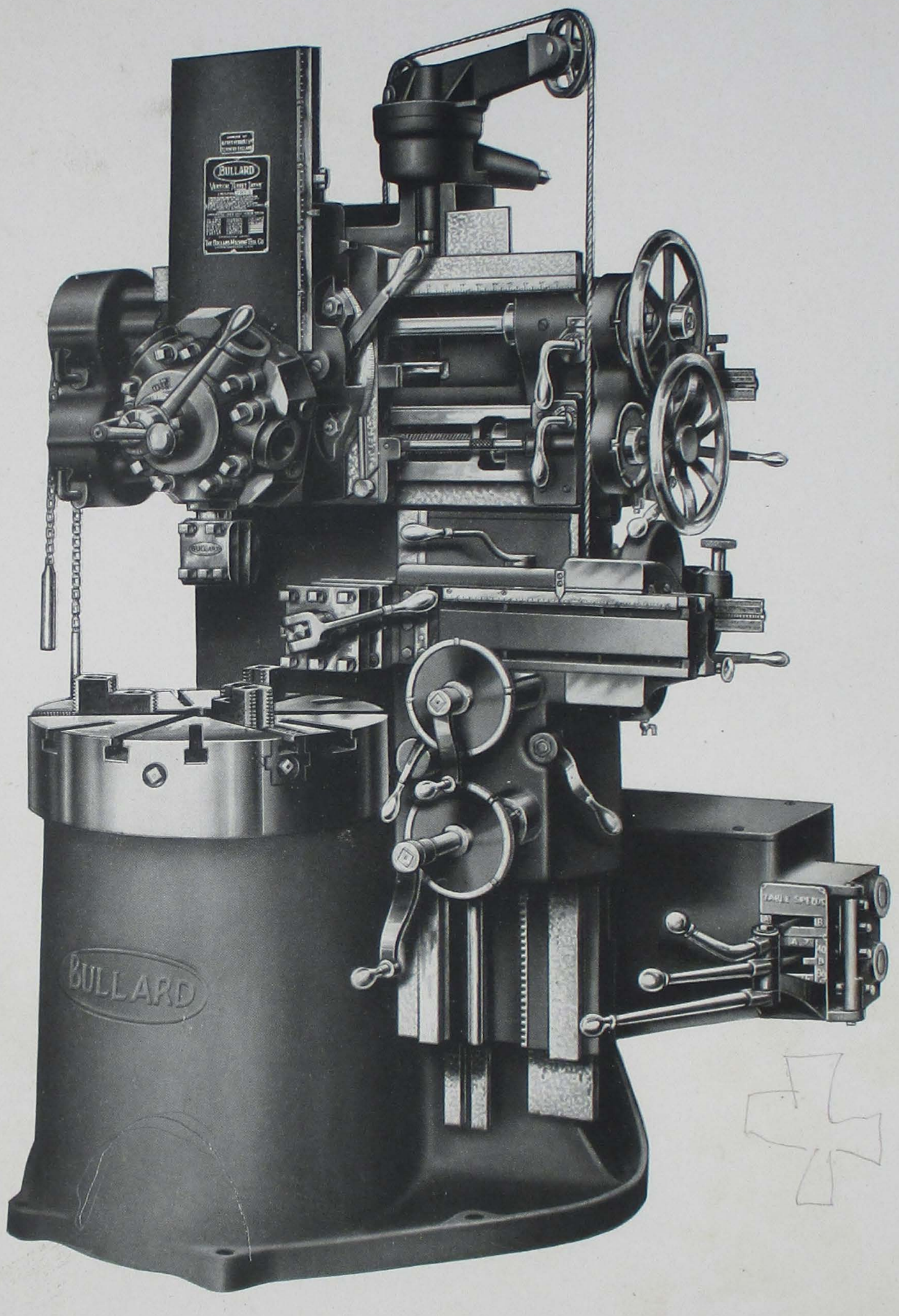
All other bearings are oiled through self-closing oilers, which also serve to indicate the few parts requiring this attention.

Operator's Safety

This important element in machine design has been given special attention. Gearing is entirely encased, and, although readily accessible, cannot injure the operator. Counterweights are encased or so located as to render it impossible for the operator to come in contact therewith while operating the machine. Crank handles on rapidly moving power-operated parts have been eliminated. Operating and controlling levers are so located as to render it unnecessary for the operator to stand or bend near the revolving table, thus obviating possible injury to eyes, face or hands, by chips dropped or thrown therefrom.

THE BULLARD VERTICAL TURRET LATHE, THROUGHOUT, IS AN ORIGINAL DEVELOPMENT. IN DESIGN AND CONSTRUCTION IT MARKS THE BEGINNING OF A NEW ERA. HUNDREDS OF MACHINES OF THE PRESENT TYPE HAVE, IN ACTUAL SERVICE, DEMONSTRATED ITS MERIT AND ADAPTABILITY.

MACHINE SPECIFICATIONS



THE VERTICAL TURRET LATHE

24-INCH "NEW ERA" TYPE

With Three-Jaw Combination Chuck—Code word: Vesper

With Four-Jaw Independent Chuck—Code word: Vestal

SPECIFICATIONS

24-INCH VERTICAL TURRET LATHE

"NEW ERA" TYPE

Capacity—

26 inches in diameter; 20 inches in height under crossrail; 28½ inches under turret face.

Table—

24¼ inches in diameter.

Chuck Equipment—

A three-jaw combination, or four-jaw independent, chuck is built into table as ordered.

Table Speeds—

Eight changes ranging from 7 to 120 revolutions per minute.

Feed Changes—

Eight positive and independent feeds for each head, ranging from .007 to .340 of an inch per revolution of table.

Main Head—

Vertical movement of 18 inches; will face 26 inches; has movement of 2½ inches beyond center.

Main Turret—

14 inches in diameter; five faces having 2¼ inch holes therein.

Side Head—

Vertical movement of 18 inches; horizontal movement of 14½ inches. Top of table to under side of side head slide 12 inches.

Tool Sizes—

Side Head Turret and Tool Holders in Main Head will carry 1¼ inch x 1 inch tool steel.

Driving Pulley—

Driving pulley 16 inches in diameter; 4½ inch face; runs 480 R.P.M.

Weight—

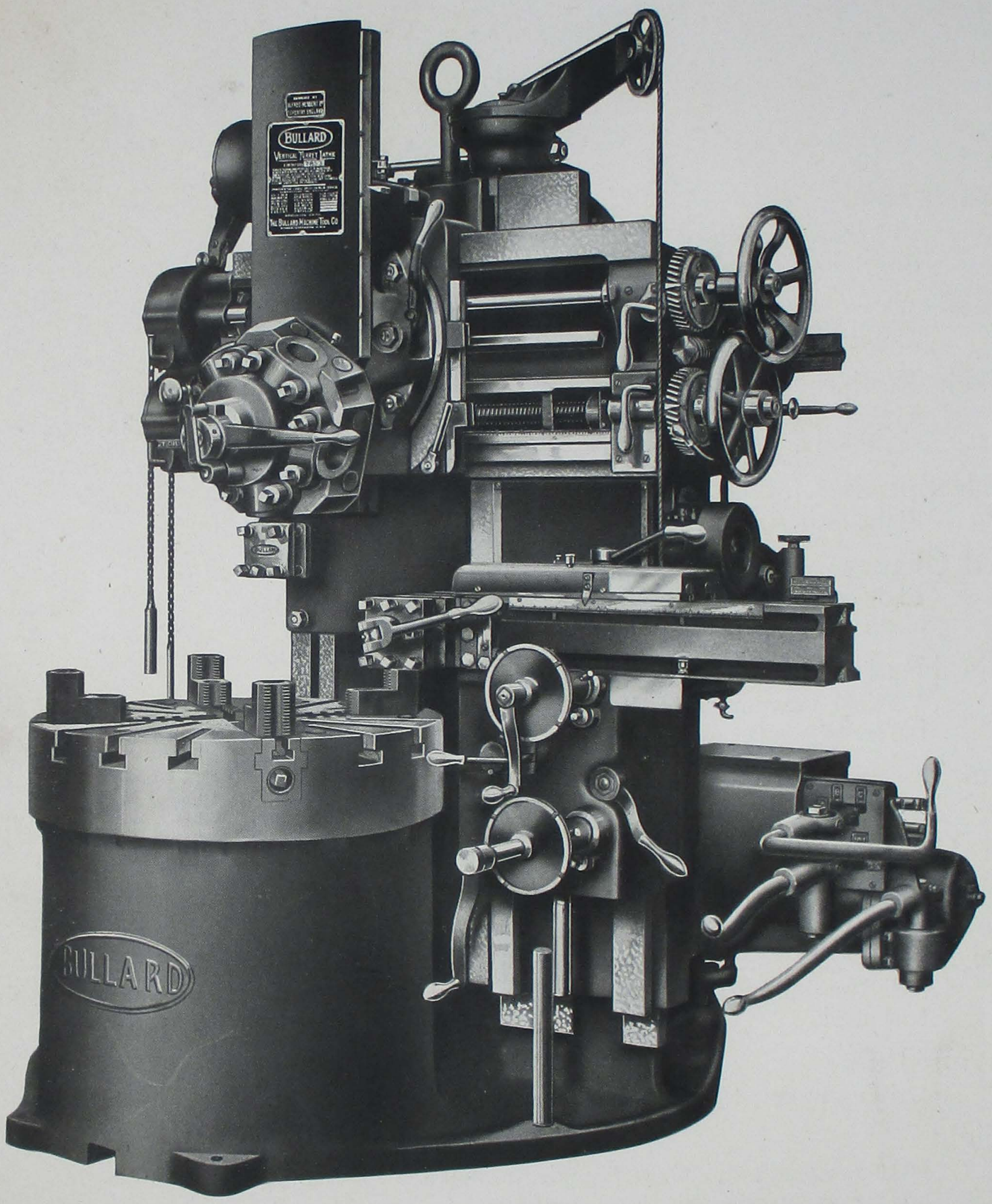
9000 pounds, net. 9500 pounds, domestic shipping. 10000 pounds, boxed for sea shipment.

Floor Space—

75 inches wide, 61 inches deep, 98 inches maximum height.

Attachments—

For Main Head: Thread Cutting.
For Side Head: Pulley Crowning and Bevel Turning Attachments.
Cutting Lubricant System.
Motor Drive. 7½ horse-power motor recommended for average work.



THE VERTICAL TURRET LATHE

36–INCH "NEW ERA" TYPE

With Three-Jaw Combination Chuck—Code word: Visit

With Four-Jaw Independent Chuck—Code word: Vista

SPECIFICATIONS

36-INCH VERTICAL TURRET LATHE

"NEW ERA" TYPE

Capacity—

38 inches in diameter; 24 inches in height under crossrail; 35 inches under Turret Face.

Table—

34 inches in diameter.

Chuck Equipment—

A three-jaw combination, or four-jaw independent, chuck is built into table as ordered.

Table Speeds—

Twelve changes ranging from 4 to 70 revolutions per minute.

Feed Changes—

Eight positive and independent feeds for each head, ranging from .0113 to .500 of an inch per revolution of table.

Main Head—

Vertical movement of 26 inches; will face 38 inches; has movement of 3 inches beyond center.

Main Turret—

15¼ inches in diameter; five faces having 2½ inch holes therein.

Side Head—

Vertical movement of 19¾ inches; horizontal movement of 20 inches. Top of table to under side of side head slide 16¼ inches.

Tool Sizes—

Side Head Turret and Tool Holders in Main Head will carry 1¼ inch x 1 inch tool steel.

Driving Pulley—

Driving pulley 21 inches in diameter; 5 inch face; runs 375 R.P.M.

Weight—

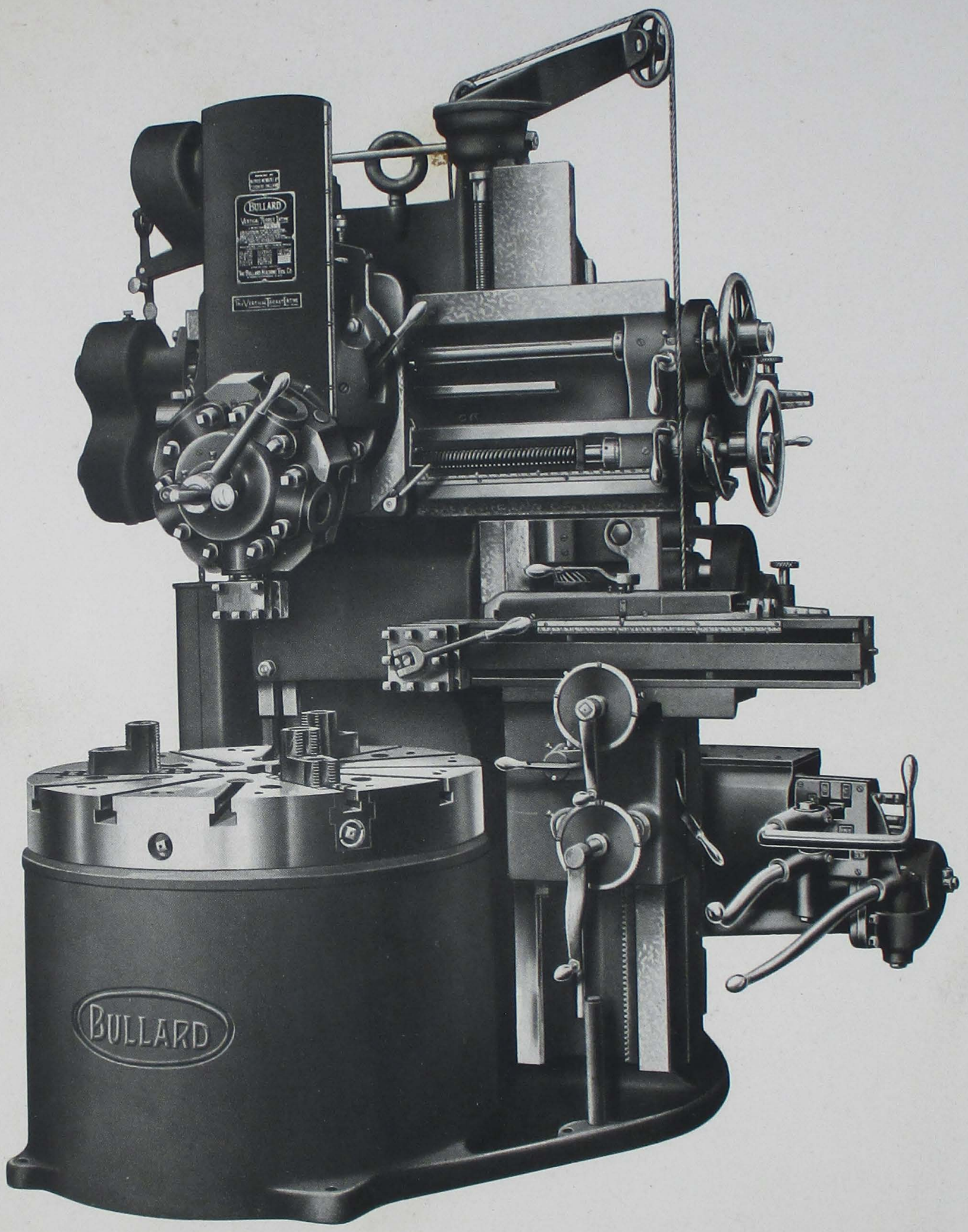
14000 pounds, net. 14500 pounds, domestic shipping. 15500 pounds, boxed for sea shipment.

Floor Space—

91 inches wide, 75 inches deep, 109 inches maximum height.

Attachments—

For Main Head: Thread Cutting.
For Side Head: Pulley Crowning and Bevel Turning Attachments.
Cutting Lubricant System.
Motor Drive. 10 horse-power motor recommended for average work.



THE VERTICAL TURRET LATHE

42–INCH "NEW ERA" TYPE

With Three-Jaw Combination Chuck—Code word: Viper

With Four-Jaw Independent Chuck—Code word: Vixen

SPECIFICATIONS

42-INCH VERTICAL TURRET LATHE

"NEW ERA" TYPE

Capacity—

44 inches in diameter; 33 inches in height under crossrail; 43½ inches under Turret Face.

Table—

42⅜ inches in diameter.

Chuck Equipment—

A three-jaw combination, or four-jaw independent, chuck is built into table as ordered.

Table Speeds—

Twelve changes ranging from 3.3 to 56 revolutions per minute.

Feed Changes—

Eight positive and independent feeds for each head, ranging from .0113 to .500 of an inch per revolution of table.

Main Head—

Vertical movement of 27 inches; will face 44 inches; has movement of 3 inches beyond center.

Main Turret—

16¾ inches in diameter; five faces having 2¾ inch holes therein.

Side Head—

Vertical movement of 28 inches; horizontal movement of 21 inches. Top of table to under side of side head slide 25 inches.

Tool Sizes—

Side Head Turret and Tool Holders in Main Head will carry 1½ inch x 1¼ inch tool steel.

Driving Pulley—

Driving pulley 24 inches in diameter; 5½ inch face; runs 360 R.P.M.

Weight—

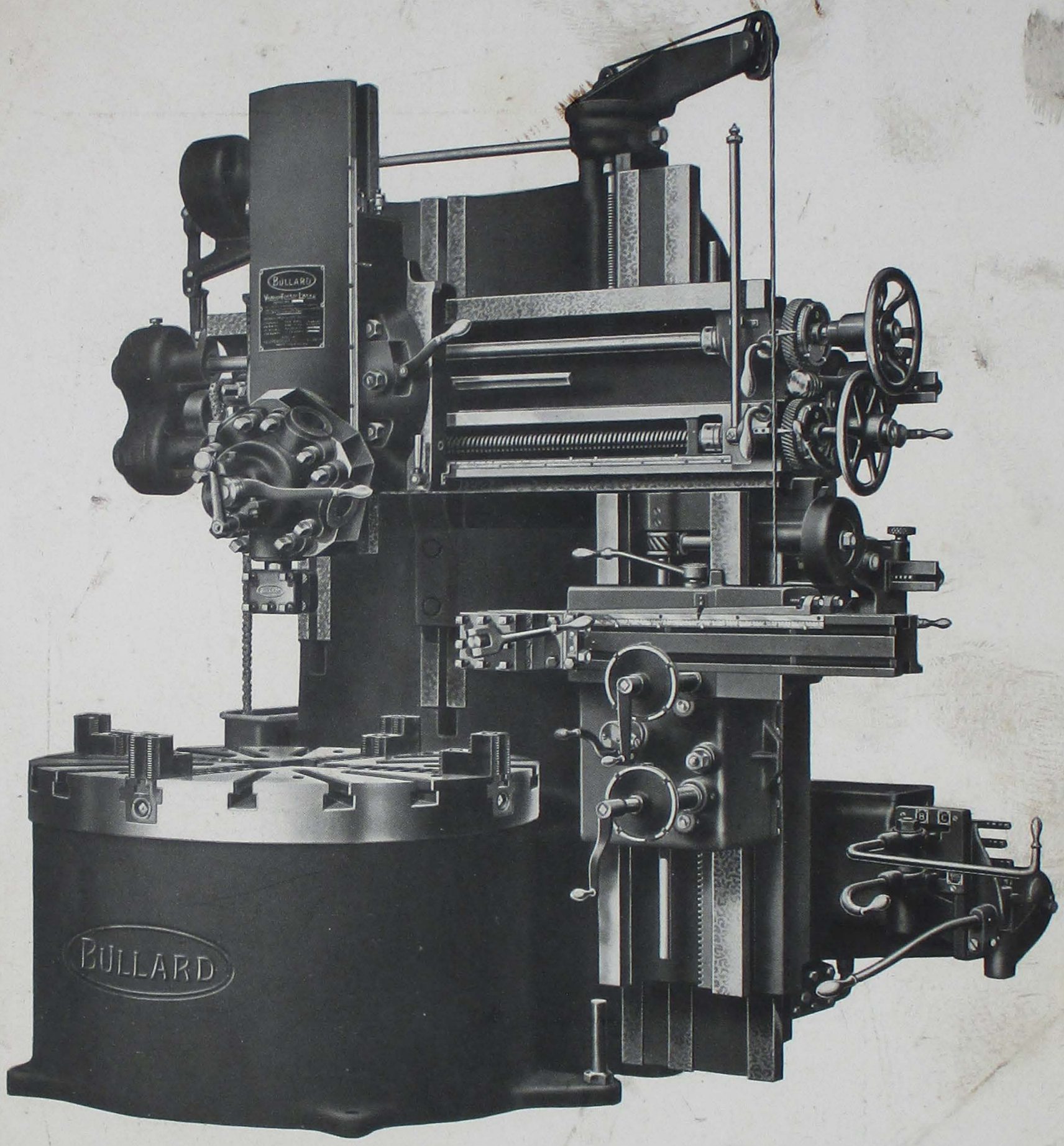
18500 pounds, net. 19000 pounds, domestic shipping. 20500 pounds, boxed for sea shipment.

Floor Space—

100 inches wide, 85 inches deep, 122 inches maximum height.

Attachments—

For Main Head: Thread Cutting.
For Side Head: Pulley Crowning, Bevel Turning, and Tire Mold Forming Attachments.
Cutting Lubricant System.
Motor Drive. 15 horse-power motor recommended for average work.



THE VERTICAL TURRET LATHE

54–INCH "NEW ERA" TYPE

With Four-Jaw Independent Chuck Built Into Table—Code word: Verlant

With Plain Table—Code word: Verdure

SPECIFICATIONS

54-INCH VERTICAL TURRET LATHE

"NEW ERA" TYPE

Capacity—

56 inches in diameter; 38 inches in height under crossrail; 49 inches under Turret Face.

Table—

50 inches in diameter.

Chuck Equipment—

A four-jaw independent chuck is built into table. May also be supplied with plain table having parallel "T" slots.

Table Speeds—

Twelve changes ranging from 3 to 54 revolutions per minute.

Feed Changes—

Eight positive and independent changes for each head, ranging from .010 to .500 of an inch per revolution of table.

Main Head—

Vertical movement of 27 inches; will face 56 inches; has movement of 3 inches beyond center.

Main Turret—

16¾ inches in diameter; five faces having 2¾ inch holes therein.

Side Head—

Vertical movement of 31 inches; horizontal movement of 21 inches. Top of table to under side of side head slide 30 inches.

Tool Sizes—

Side Head Turret and Tool Holders in Main Head will carry 1½ inch x 1¼ inch tool steel.

Driving Pulley—

Driving pulley is 24 inches in diameter; 5½ inch face; runs 405 R.P.M.

Weight—

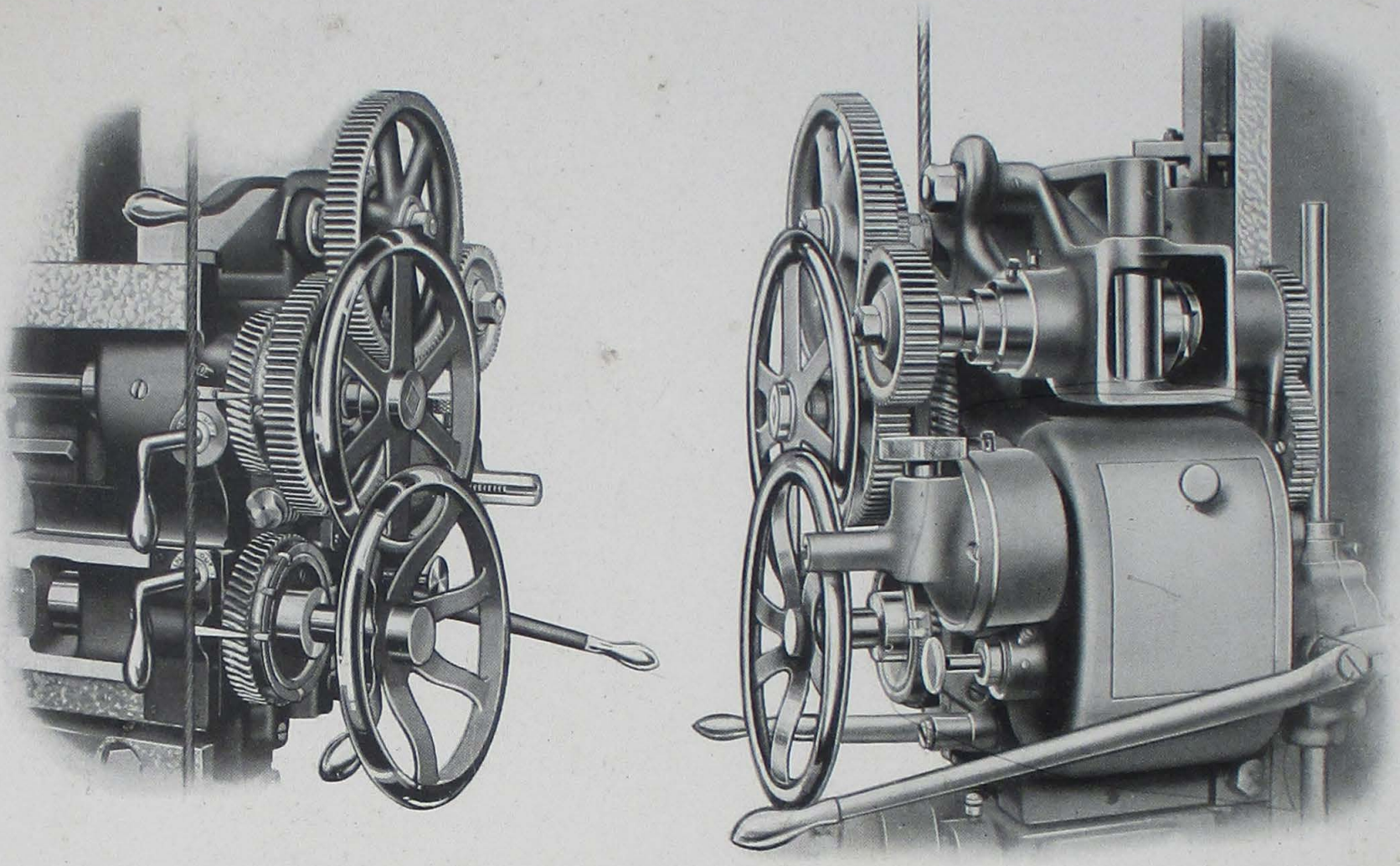
23000 pounds, net. 23500 pounds, domestic shipping. 24850 pounds, boxed for sea shipment.

Floor Space—

110 inches wide, 120 inches deep, 129 inches high.

Attachments—

For Main Head: Thread Cutting.
For Side Head: Pulley Crowning and Bevel Turning Attachments.
Cutting Lubricant System.
Motor Drive. 15 horse-power motor recommended for average work.



THREAD CUTTING ATTACHMENT

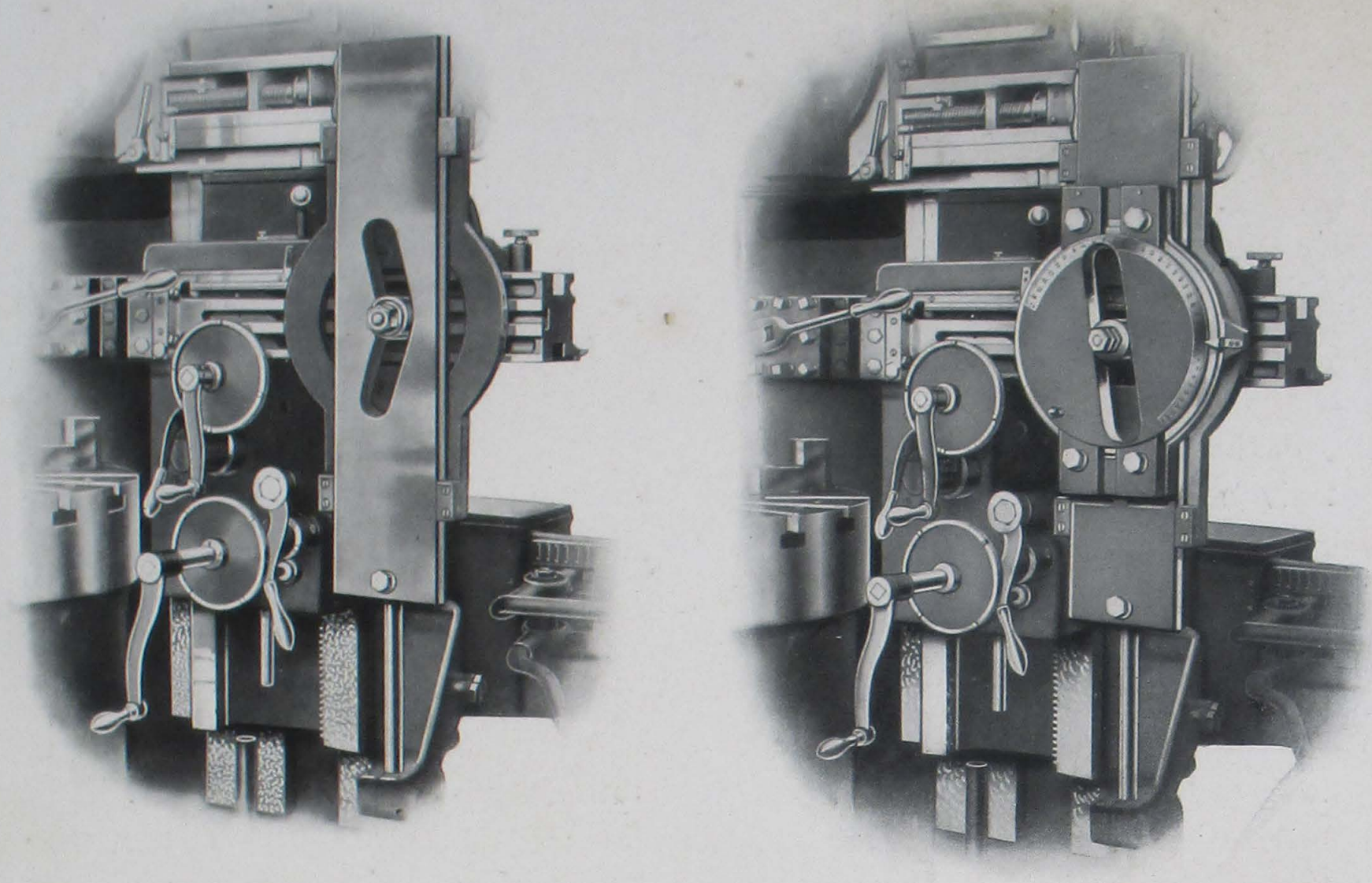
For cutting threads with tools held in the Main Head, a special bracket will, on order, be attached to the back of Crossrail; this device may, however, be applied without difficulty to machines not so equipped at time of shipment.

It is entirely independent from the standard feed-works and in no way interferes therewith.

A single tooth clutch renders it impossible to split the thread and enables the operator to return the Head by power traverse without regard to the starting point of tool or position of table.

Change gears are provided for all standard threads from 2 to 16, including 11½. All gears are encased.

Code: The letters ED added to code word of machine will indicate that Thread Cutting Attachment is required.



FORMING ATTACHMENTS FOR SIDE HEAD

Three types of Forming Attachments may be supplied for use in connection with the Side Head.

The Plate Type, illustrated above at left, has been developed for crowning pulleys. This device comprises a plate having a slot of required contour milled therein, and a roll-post which is adjustable in tee-slot in Slide for different diameters. For straight turning and facing the roll-post is disconnected from Slide by releasing the binding bolt.

The Universal Type, illustrated above at right, is designed to cover a wide range of angles as required in machining bevel gears, etc. The guide slot is adjustable to various angles, and for different diameters the roll is movable in tee-slot in Slide. For straight turning and facing the roll-post is disconnected as above.

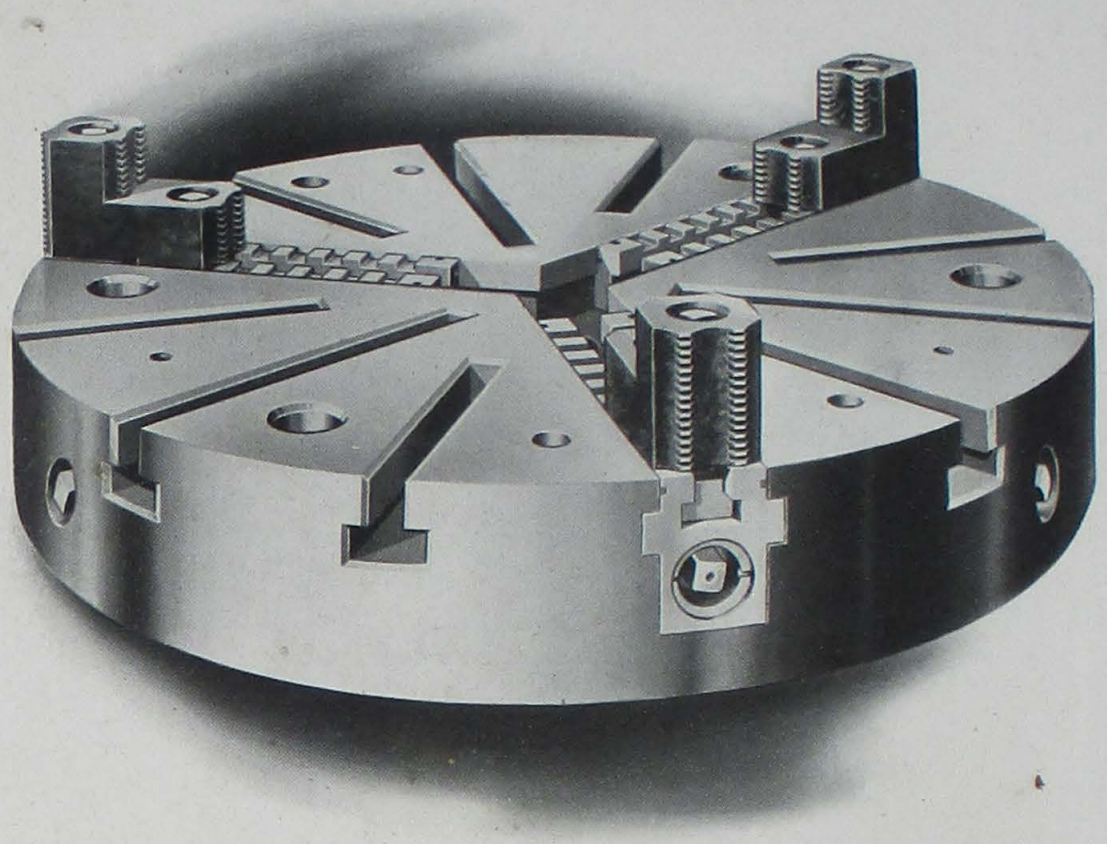
For tire molds and similar work, a special design is required which consists of a cam, milled to required contour, secured to Slide—the guide roll being held in position by a bracket secured to rail (see pages 44 and 45). This arrangement is also available for bevel facing.

Plate Type—Code Word: Scamp. Universal Type—Code Word: Scarf. Cam Type—Code Word: Scope.

Scarf

Scamp

BULLARD THREE-JAW COMBINATION CHUCK*



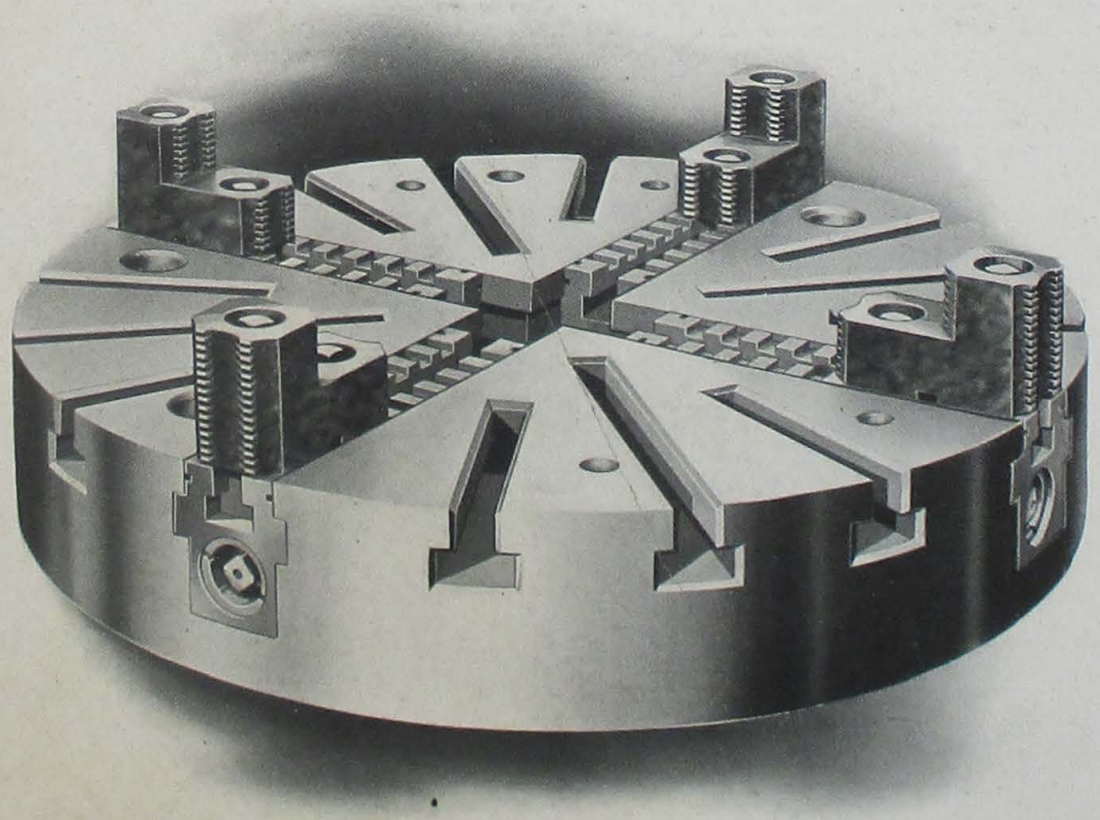
These powerful chucks have been developed to meet the exacting requirements of the Vertical Turret Lathe. The bodies are heavily proportioned to avoid distortion, and operating parts are made of selected materials best suited to the service required.

Universal movement is obtained by scroll-plate and nuts accurately fitted thereto. Operating pinions are heat-treated chrome nickel steel having ample bearings each side of pinion to obviate cramping. Holes therefor are bushed.

Independent movement is obtained by screws of large diameter having a *full bearing* in actuating nuts, on which are cut the scroll threads meshing with plate. Thrust is taken on washers which are adjustable for wear.

The sliding jaws are forged steel accurately fitted to chuck-body and special provision is made to prevent the entrance of foreign matter into the operating mechanism, which, in assembling, is packed with non-fluid oil and graphite.

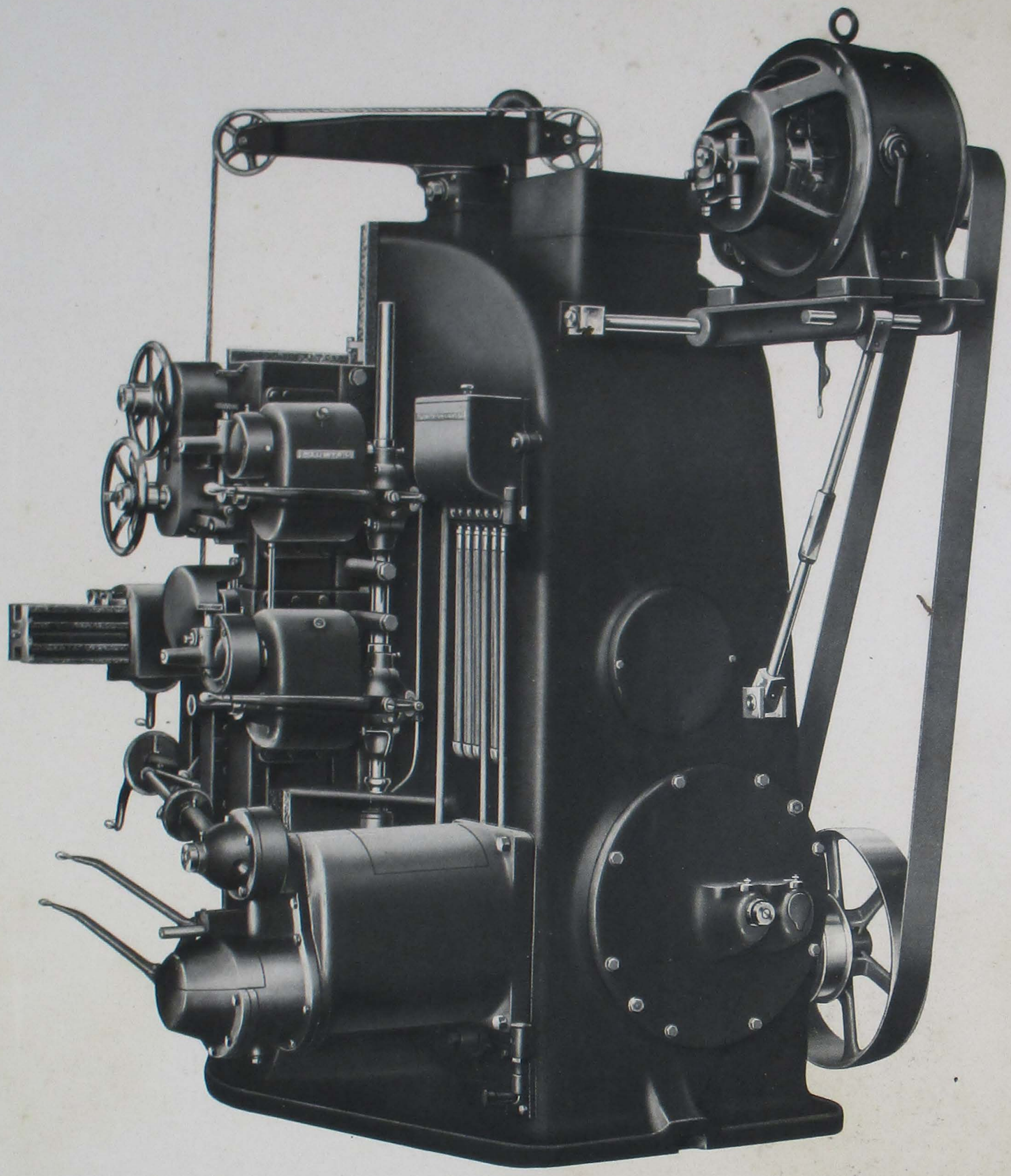
Top jaws are adjustably mounted on sliding members, and may be readily reversed or removed. A special steel is used for this part, and, after hardening, the jaws are ground to height.



BULLARD FOUR-JAW INDEPENDENT CHUCK*

The four-jaw chuck has independent movement only, no scroll-plate being incorporated in its construction. In all other details it is identical with the three-jaw chuck described above. This type is recommended where exceptionally heavy duty is required.

* Arrangement of "T" slots illustrated is typical only.



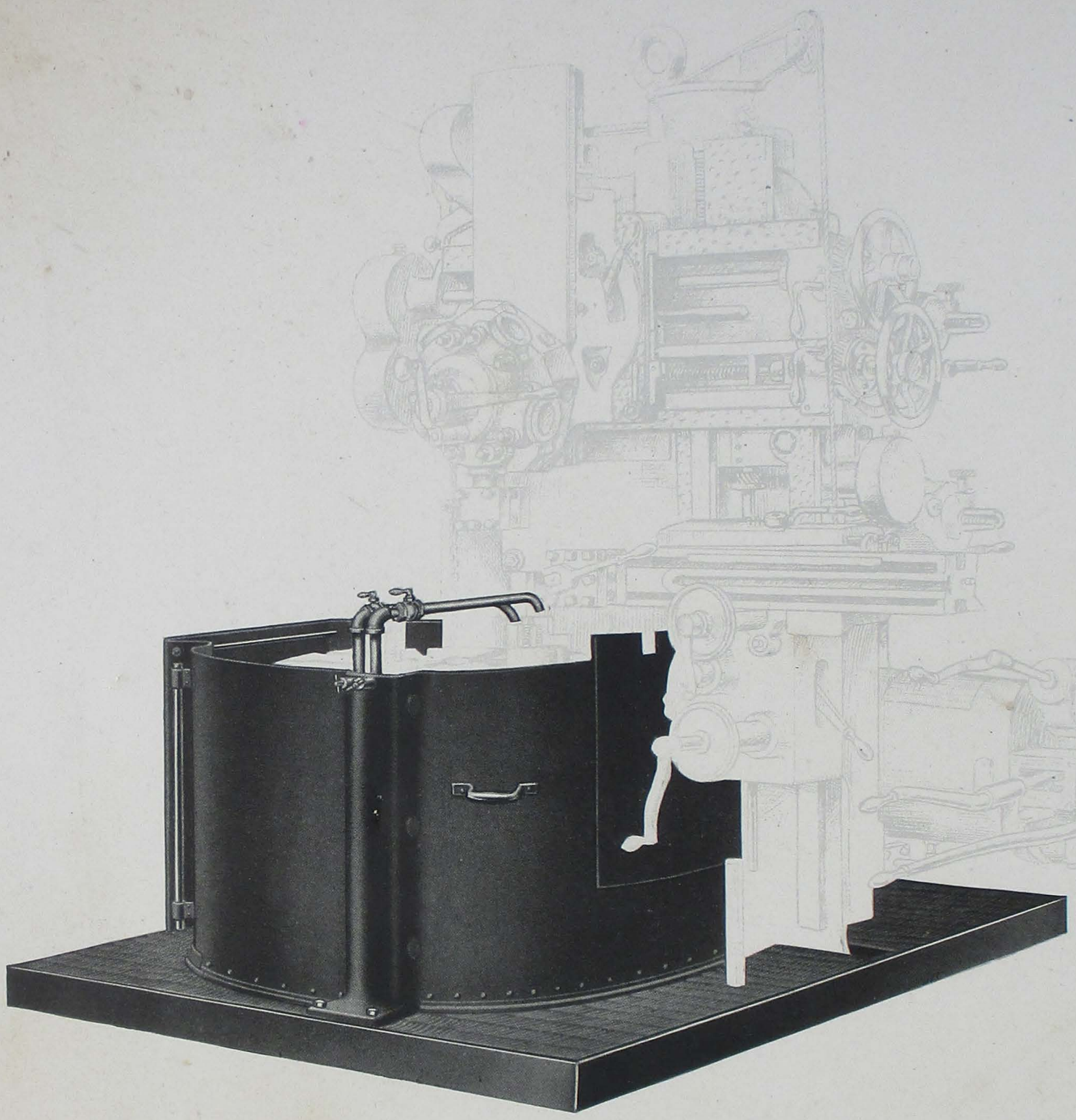
MOTOR DRIVE, TYPE "F"

Code Word: Duck

Brackets for motor may be applied at any time without difficulty—all machines being bored to receive same.

Motors mounted as shown occupy but little additional space and are in no way subject to injury from flying chips or accumulated sweepings.

Constant speed motors only are required, as all speed changes are mechanically obtained.



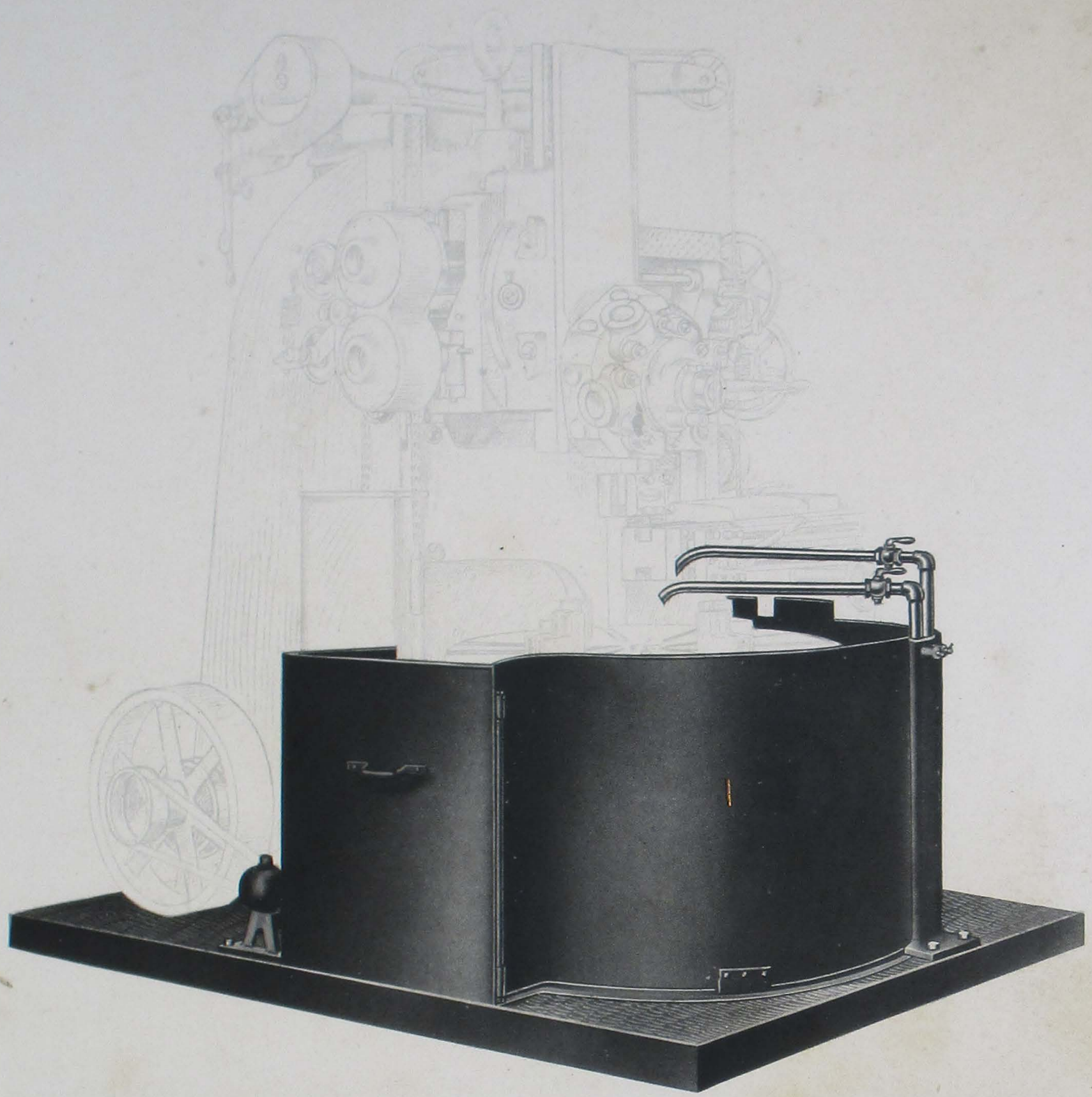
A CUTTING LUBRICANT SYSTEM

The transformation of power into work is attended by the generation of heat. In the removal of metal by cutting-tools, the heat is greatest at the point of separation, and as excessive heat is destructive to the cutting edge of tools, the rapidity of production is dependent on either the heat-resistive capacity of tool-steel, or means for absorbing and diffusing the heat generated.

Taylor, in "The Art of Cutting Metals," develops the fact that, by the use of cutting lubricant, cutting speeds may be increased by 40 per cent. Other observations indicate commensurate gains along other lines, equal in importance to cutting speed, and meriting special consideration in connection with work performed in a turret machine, in which are used a multiplicity of cutters, each set in a given relation to the others.

The life of tools is materially increased, the number of pieces produced between grinds is multiplied, and a big reduction is made in the time-loss incident to grinding and resetting tools. By maintaining an even temperature of the work itself a greater accuracy is obtained, and experiments indicate a considerable saving in power.

In the design of the "New Era" type of Vertical Turret Lathe, special provision (patented) has been made for the exclusion, from the table and its driving mechanism, of cutting lubricant and the abrasive particles of silt, etc., carried in suspension thereby.



The turret and its supporting slide are, by their designed location, entirely removed from contact with the lubricant and are in no way subjected to its destructive action, as are similar parts of a horizontal machine.

The Bullard System, consisting of a steel pan, steel floor plates, steel guards, a highly efficient centrifugal pump and adjustable lubricant conductors, forms a unit into which the machine may be easily set.

It affords full protection to the operator, as well as to the floor surrounding the machine—has ample chip capacity and easy means for their removal—is so designed as to in no way interfere with machine movements or manipulation—and having capacity for a large supply of cutting lubricant permits the use of maximum feeds and speeds continuously.

The Bullard System is the result of exhaustive experiment, and is offered as an invaluable aid in obtaining maximum efficiency from Vertical Turret Lathes employed in the machining of steel.

Code word—Lubro.

ACCESSORIES

The reasons which prompt the purchase and installation of a new machine in different shops are as divergent as the products of the several plants.

In one the large number of duplicate pieces to be machined is sufficient to keep one or more machines in continual operation, without change, for an indefinite period.

In another there is perhaps a greater diversity of work and not sufficient demand for any one piece to keep a machine constantly occupied in its manufacture.

Under either condition *lower cost of production* is, however, the prime consideration in the selection of new equipment.

Low *labor cost* is, of course, an important factor, but *total cost* must not be overlooked nor the elements of which it is comprised be forgotten.

That element of cost which is frequently given the least consideration is TOOLS AND ACCESSORIES, without which *any* machine is handicapped in productive capacity to an inconceivable degree.

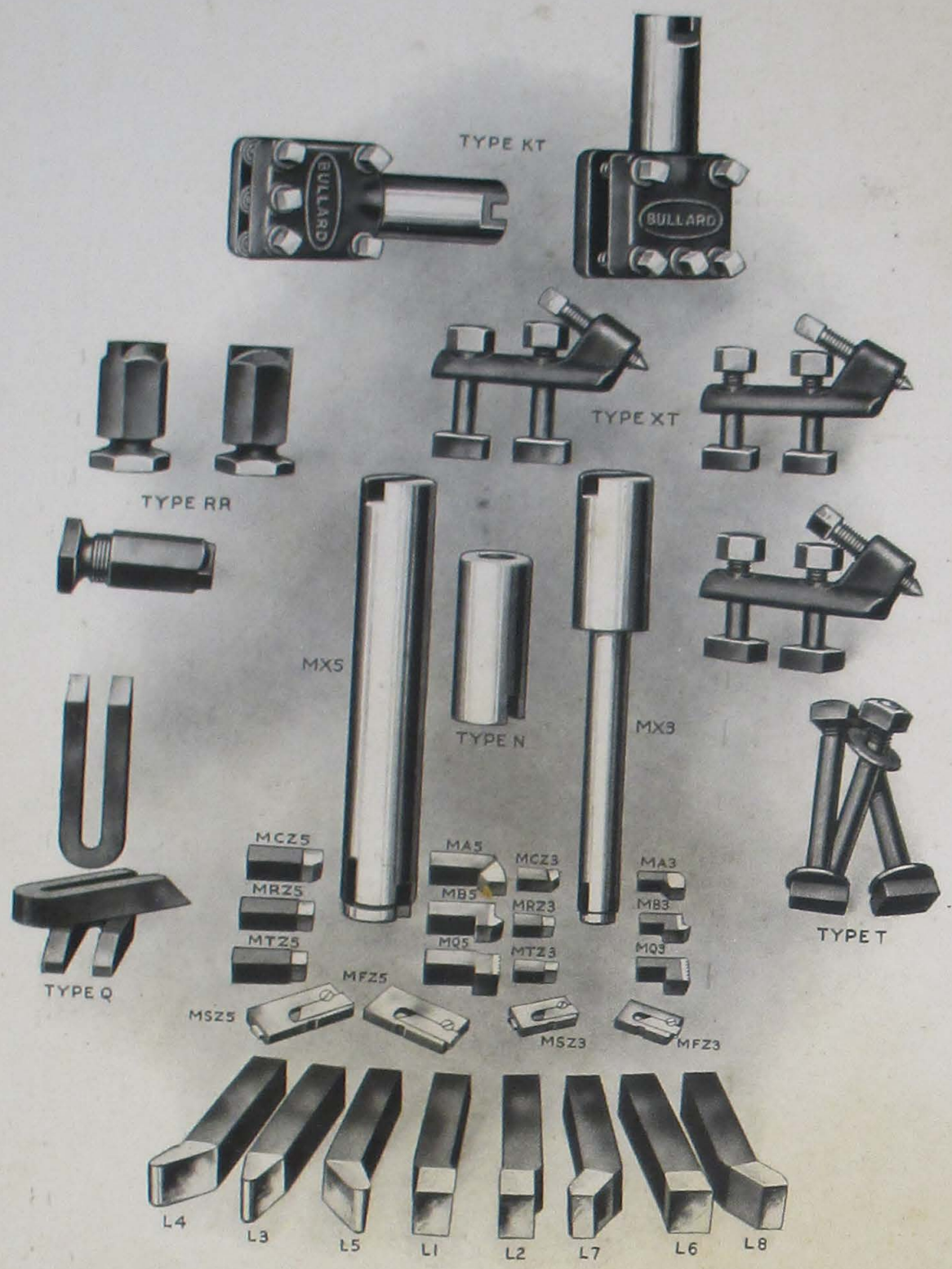
The Vertical Turret Lathe is a *multi-purpose tool* which fully meets the requirements of *either* shop as outlined above; *one* of its cardinal virtues being the simplicity of its requirements in the way of tools.

From our experience as builders of this machine, and from the knowledge gained through the study of the wide variety of work to which the machine is adapted, we have acquired a vast fund of information regarding the equipment required under different conditions, which, through the medium of our Engineering Department, we are pleased to place at the disposition of our friends and customers.

Blueprints of parts to be machined will be given our careful consideration, and suggestions of economical methods and a list of the tools required will be submitted with a view of assisting in obtaining a maximum output.

Such tools as are of a general character have been listed in our catalog of Accessories, and are in hand for prompt shipment on receipt of order. Special tools, if required, will be well and promptly made as our facilities for this work have been given particular attention.

On the opposite page are illustrated and listed a collection of Accessories which our experience has shown to be universally useful in obtaining output, and we strongly recommend that the equipment designated as suitable thereto be ordered with the machines unless a specially designed equipment is considered advisable under the conditions to be met.



STANDARD TOOL EQUIPMENT FOR VERTICAL TURRET LATHES

Number Supplied	Name of Part	No. 1 for 24″ Machine	No. 2 for 36″ Machine	No. 3 for 42″ Machine	No. 4 for 54″ Machine
Two	Tool Holders	KT-1	KT-3	KT-4	KT-4
One	Multi-Bar	MX-3	MX-13	MX-23	MX-23
One	Multi-Bar	MX-5	MX-15	MX-25	MX-25
	Cutters for each Bar as follows:				
One	Single Point Boring Tool	MAZ	MAZ	MAZ	MAZ
One	Single Point Threading Tool	MBZ	MBZ	MBZ	MBZ
† One	Thread Chaser (U. S. Std. Thread), or	MQZ	MQZ	MQZ	MQZ
† One	Thread Chaser (Briggs Std.)	MQQZ	MQQZ	MQQZ	MQQZ
* One	Set Boring and Reaming Cutters: Chamfering, Rough Boring, Truing, Sizing and Reaming	MXZ	MXZ	MXZ	MXZ
Eight	Turning Tools	LB	LB	LD	LD
‡ Three (or four)	Securing Straps	Q-1	Q-1	Q-2	Q-2
‡ Three (or four)	Securing Bolts	T-2	T-13	T-23	T-23
‡ Three (or four)	Adjustable Blocks	RR-2	RR-2	RR-2	RR-2
‡ Three (or four)	Screw Dogs	XT	XT	XT	XT
One	Taper Collet	N-3	N-13	N-23	N-23

† Only one thread chaser will be supplied. Chaser for U. S. Standard thread, 8P., will be furnished unless otherwise specified.

* Unless orders specify the finished diameter of holes for which cutters, Type MXZ, are required shipment will include Cutter Set MXZ-2″ for Multi-Bars MX-3, 13 and 23, also Cutter Set MXZ-3½″ for Multi-Bars MX-5, 15 and 25.

‡ When ordering give equipment number and letter. If for use with machine having 3-Jaw combination chuck, indicate by letter "A." If for 4-Jaw Table, use letter "B."

Example: 3-A is for 42″ Machine with 3-Jaw combination chuck. 3-B is for 42″ Machine with 4-Jaw independent chuck.

Prices upon application.

Code Word: Stateq, to which should be added the designating number and letter of equipment required. Example: "Stateq 2-B" indicates Standard Tool Equipment for 36″ Vertical Turret Lathe with 4-Jaw Independent Chuck.

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