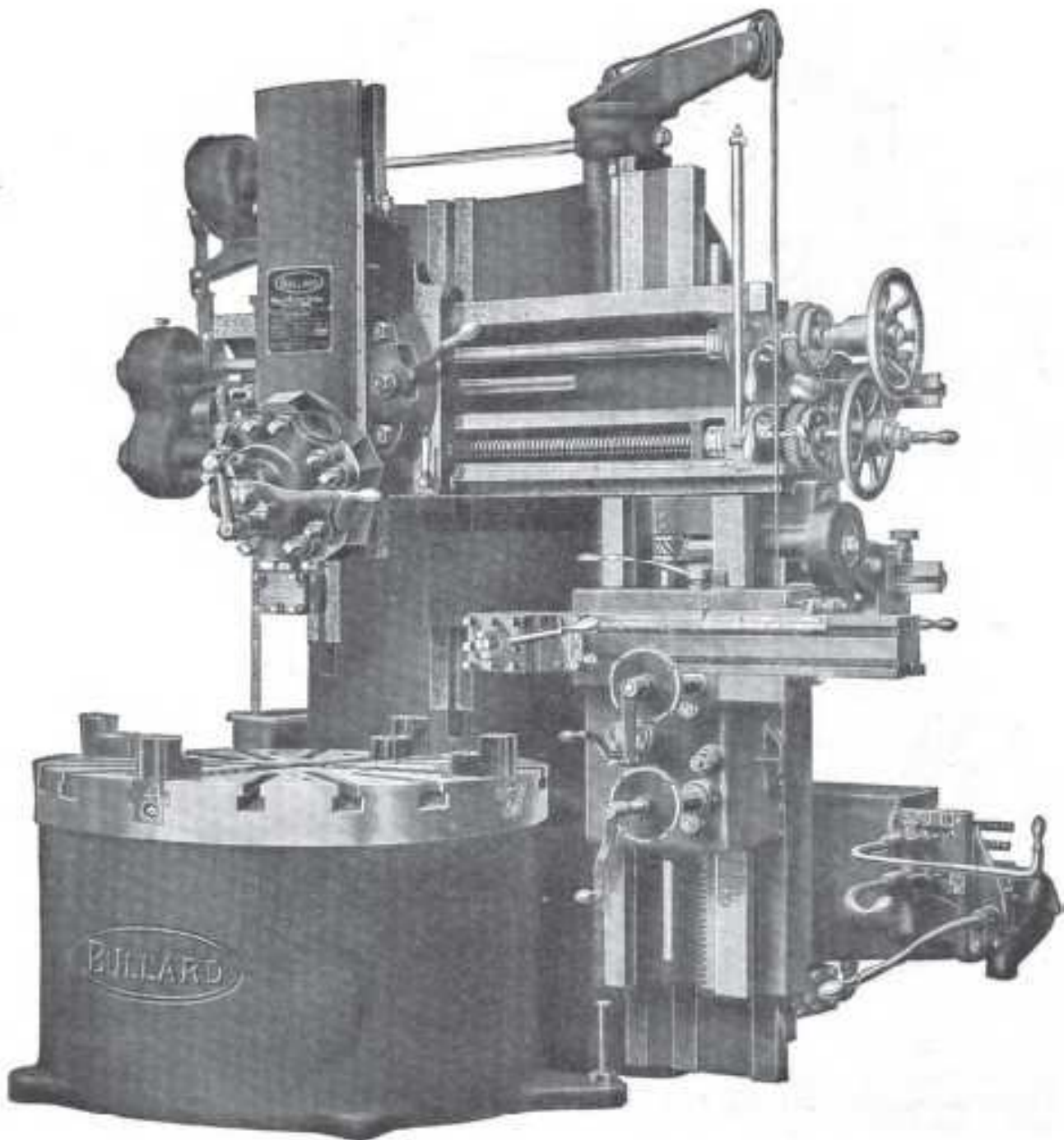


Vertical Turret Lathes and Maxi-Mills



Vertical Turret Lathes—Sizes 24, 36, 42 and 54 Inches

Sizes

The Bullard Vertical Turret Lathe is made in four sizes—24-inch, 36-inch, 42-inch and 54-inch. The general specifications of these machines are given below.

Adaptability

Widely adaptable and extremely durable, the Bullard Vertical Turret Lathe may be kept in continuous operation—in continuous production.

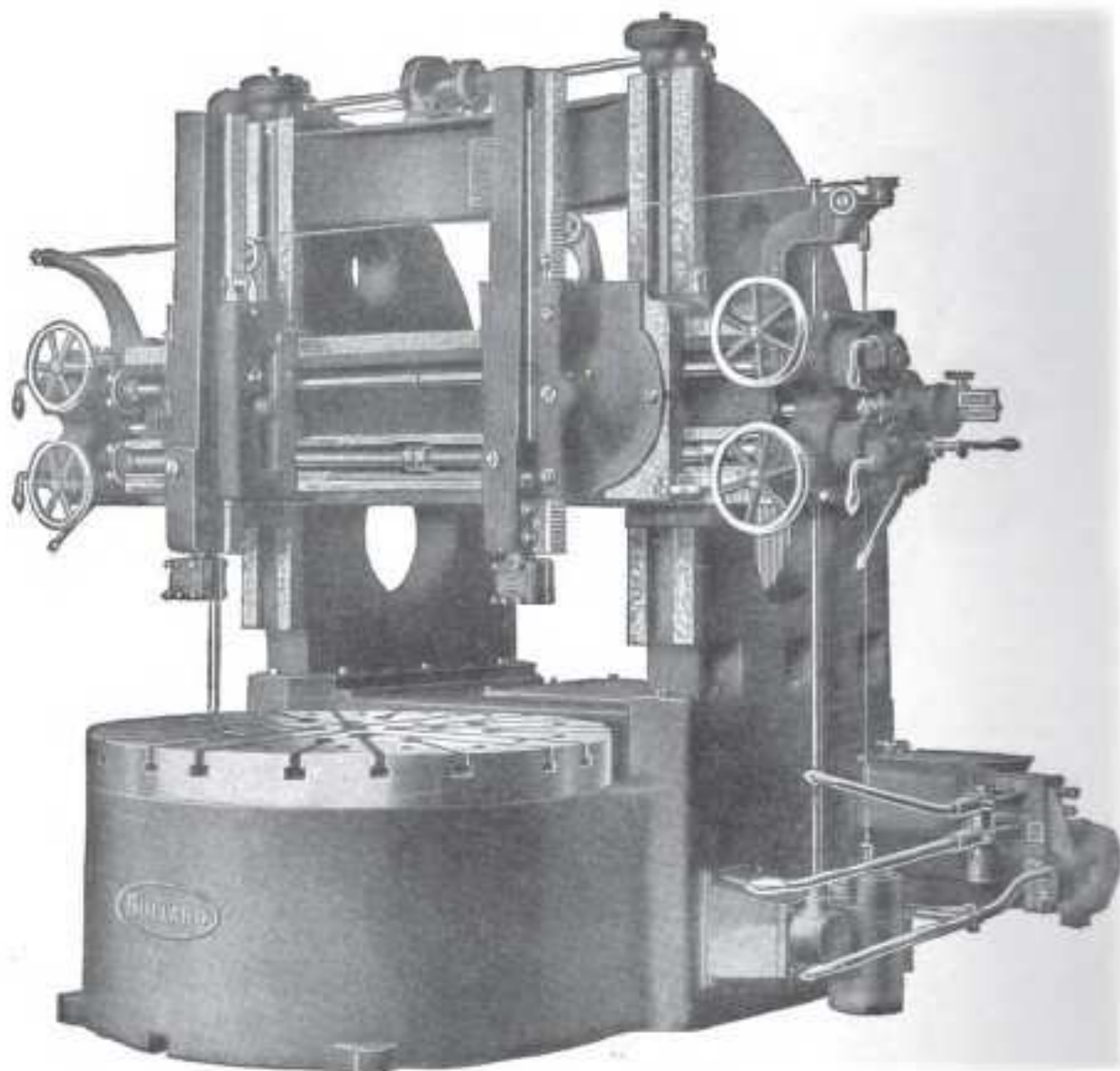
Two tool heads, one main and one side, are universal in their movement and adjustment throughout the entire range of the machine, thus simplifying the tool equipment required for a wide range and variety of work:—the same tools, excepting reamers, etc., are equally adaptable to the smallest and largest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

By means of accurately graduated scales and micrometer dials, and adjustable "Observation Stops"

| | | | | |
|-------------------------------|----------|---------|---------|---------|
| Machine..... | 24-Inch | 36-Inch | 42-Inch | 54-Inch |
| Capacity—Diameter..... | 24" | 36" | 44" | 56" |
| Under Tool Face..... | 26" | 38" | 46" | 58" |
| Table Diameter..... | 28 1/2" | 38" | 45 1/2" | 59" |
| Table Speeds..... | 24 1/2 | 34" | 42 1/2 | 50" |
| Feed Change—Both Heads..... | 8 | 12 | 12 | 12 |
| Main Head—Vert. Movement..... | 18" | 25" | 27" | 27" |
| Mill Face..... | 26" | 34" | 44" | 56" |
| Main Turret—Horizontal..... | 14" | 15 1/2" | 16 1/2" | 16 1/2" |
| Side Head—Vert. Movement..... | 11 1/2" | 20" | 24" | 31" |
| Both Heads..... | 14" | 19" | 21" | 21" |
| Weight—Net..... | 8500 | 14000 | 18500 | 25000 |
| Motor..... | 7 1/2 HP | 14 HP | 18 HP | 15 HP |

THE BULLARD MACHINE TOOL CO., BRIDGEPORT, CONN.

Vertical Turret Lathes and Maxi-Mills



Bullard Maxi-Mill—Sizes, 44, 54 and 61 inches

mounted thereon, tools are readily set and sizes obtained and maintained.

Convenient, certain and positive control, without complication, with each unit developed for the maximum service required thereof, and with a due and intelligent regard for the completed whole, results in quality intensive production.

The Bullard Maxi-Mill is made in three sizes—44-inch, 54-inch and 61-inch. The general specifications of these machines are given below.

| | | | |
|-------------------------------|---------|---------|---------|
| Machine | 44-Inch | 54-Inch | 61-Inch |
| Capacity—Diameter | 44" | 54" | 61" |
| Under Overall | 34" | 43" | 52" |
| Under Toolholders | 33" | 42" | 51" |
| Table Diameter | 42 1/2" | 50" | 61" |
| Table Speeds | 12 | 12 | 12 |
| Feed Changes—Both Ways | 8 | 8 | 8 |
| Tool Slides—Vertical Movement | 30" | 36 | 36 |
| Weight—Net | 20000 | 23000 | 28000 |
| Motor Drive | 15 HP | 15 HP | 15 HP |

Adaptability

This machine represents the maximum possibilities of the Vertical Boring and Turning Mill based upon a knowledge of the requirements gained by extensive observation and specialized experience as makers and users thereof. In design and materials of construction this machine is purposely designed to withstand the most severe usage continuously with a minimum of maintenance cost.

Like the Bullard Vertical Turret Lathe, it is equipped with certain, positive and convenient control, hammer hand wheels, continuous flow lubrication, graduated scales, micrometer dials, observation stops for the duplication of sizes, and the table may be started and stopped from either side of the machine.

THE BULLARD MACHINE TOOL CO., BRIDGEPORT, CONN.

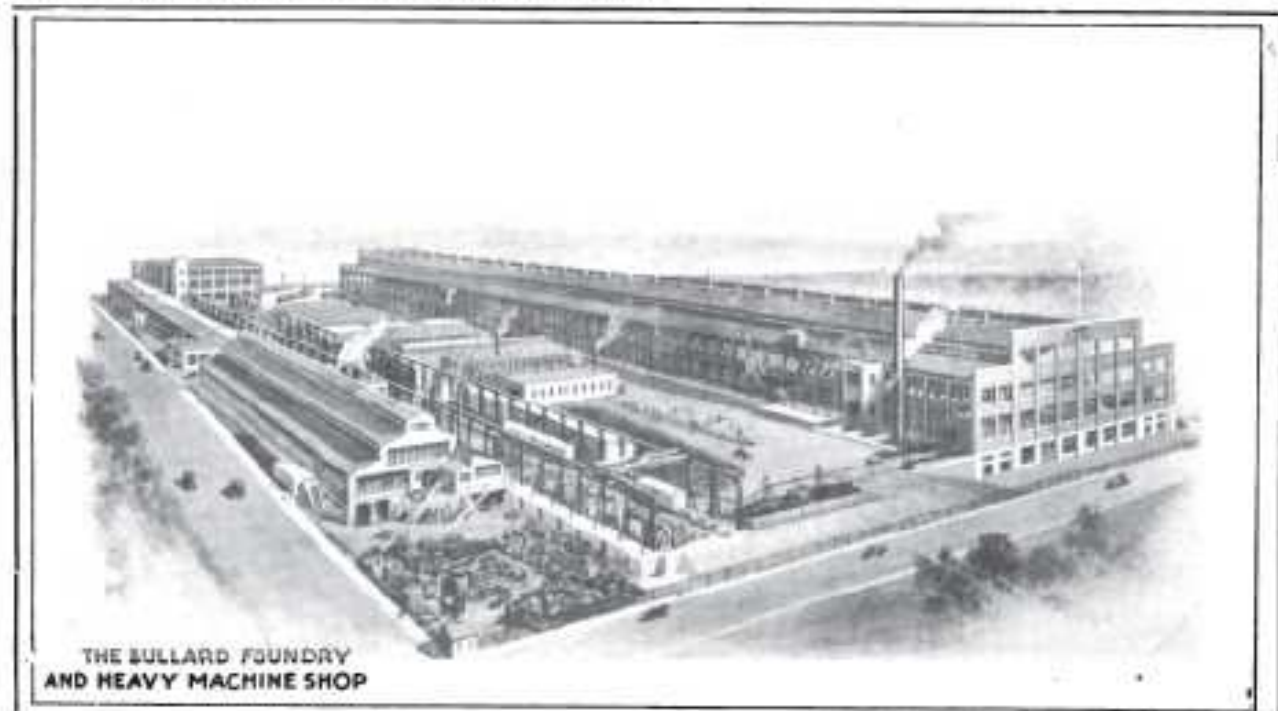
Vertical Turret Lathes and Maxi-Mills



Manufacturing Facilities

Established in 1880 as the Bridgeport Machine Tool Works, and incorporated in 1894 as The Bullard Machine Tool Co., this organization has enjoyed an ever increasing demand for its product. Thoroughly modern facilities have been provided to meet this demand. Foundry, Forge and Machine Shops, models of their kind, under one ownership, control and supervision, together with chemical and physical laboratories, insure the use of quality materials only and their proper handling in the construction of Bullard Machines.

Designed by masters of machine construction and built by expert mechanics of long standing with the

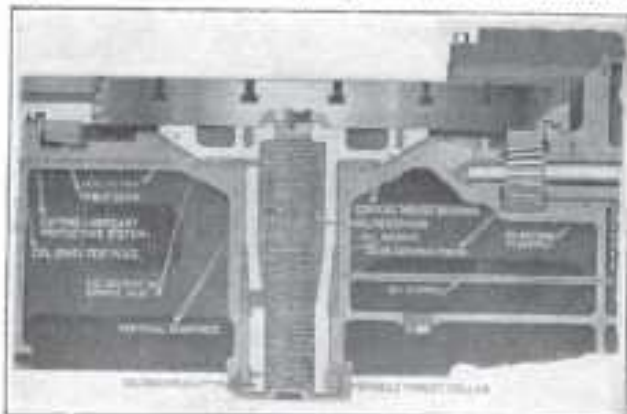


THE BULLARD MACHINE TOOL CO., BRIDGEPORT, CONN.

Vertical Turret Lathes and Maxi-Mills

Organization, working under ideal conditions, Bullard Machines have a superiority of design and workmanship which is recognized wherever machine tools are used.

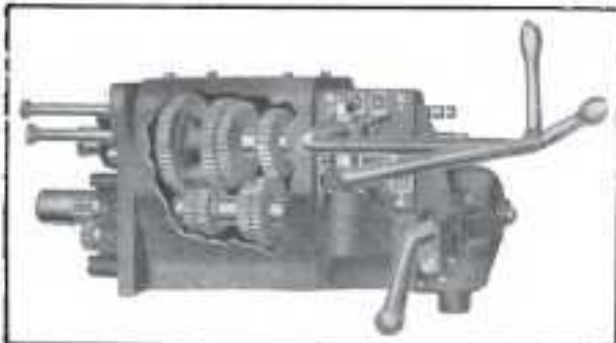
Situated in Bridgeport, Conn., on a main trunk railway, most excellent shipping facilities are enjoyed.



Bullard Table Spindle Construction

Standardized Parts

An important feature in Bullard design and construction is the standardization of parts. In their design the Bullard Vertical Turret Lathes and Maxi-Mills represent the culmination of forty years in machine-tool building. The principles they embody have been tried and tested in more than ten thousand machines. Materials of construction have been selected and adopted after a demonstration of superior merit in actual and continued service.



Primary Speed Change Case

Mechanical Speed Changes

Table speed changes are mechanically obtained through two systems of selective sliding gears and positive clutches. Speeds may be selectively changed without disengaging either cuts or

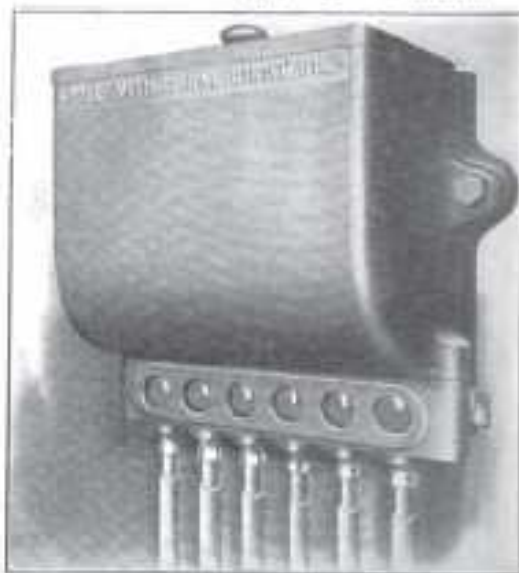


Secondary Speed Change Case

feeds, or stopping the main driving pulley. Change from highest to lowest, and vice versa, or to any intermediate speed, may be instantly made. No power is consumed by idle running gears—only those actually transmitting power are in mesh. These members are protected by a system of positive interlocking which makes it impossible to release brake or engage clutch until gears for any speed are fully mesh.

Constant Flow Lubrication

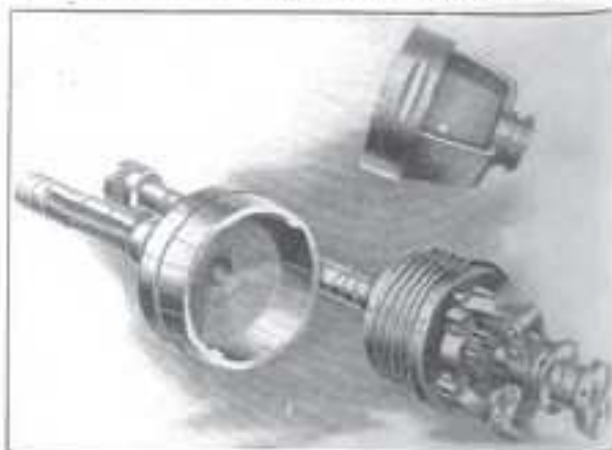
A large percentage of machine breakdowns, are the direct result of insufficient and improper lubrication of gears and bearings. To guard against burnt bearings and worn gears, to secure a maximum power efficiency, Bullard Vertical Turret Lathes and Maxi-Mills have an automatic system of lubrication. Table spindle, table drive gear, primary and secondary speed change mechanism, clutch and brake, and main driving shaft journals are lubricated by a flow of oil that is constant and positive so long as the main driving pulley is in motion.



Oil Distributing Reservoir

Multiple Disc Clutch

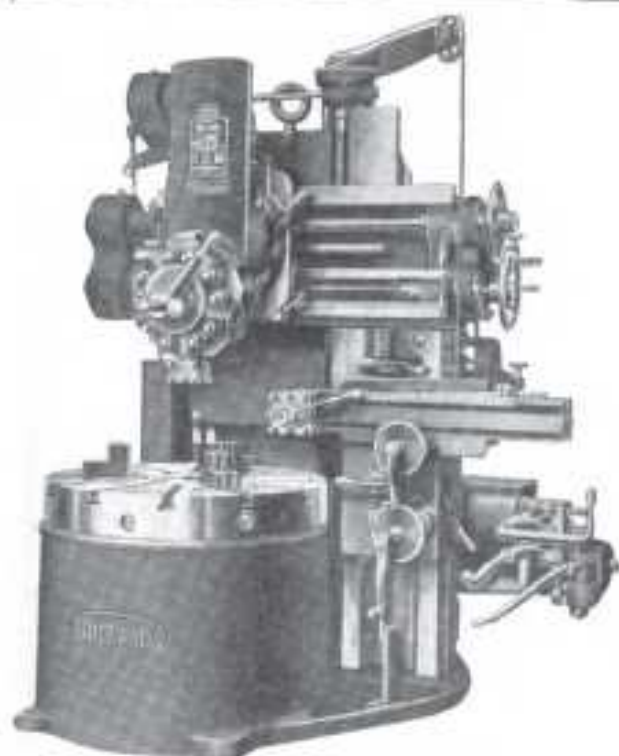
The friction clutch and brake is mounted on the main driving shaft and is used only as a means of starting and stopping the machine. Running



Multiple Disc Clutch and Brake Drum

THE BULLARD MACHINE TOOL CO., BRIDGEPORT, CONN.

Vertical Turret Lathes and Maxi-Mills



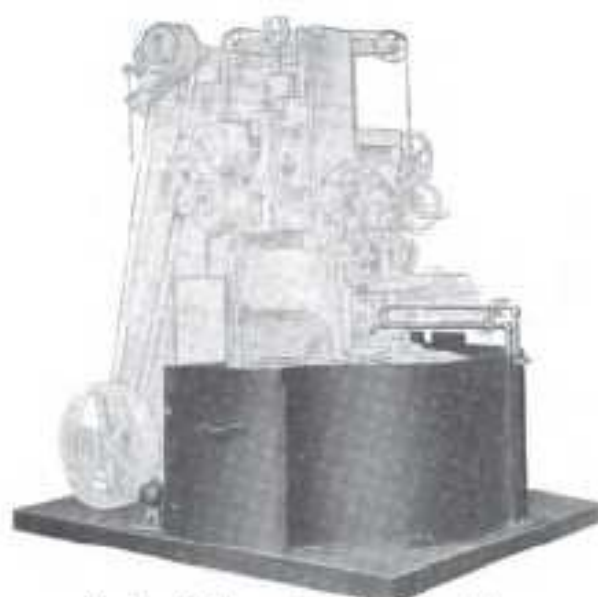
42" Vertical Turret Lathe, Front

at constant speed in a bath of oil, wear is reduced to a minimum and a maximum unvarying efficiency secured.

The engaging pressure is applied evenly throughout the entire surface of the discs by a three-point toggle motion acting directly on a spherical seat in the pressure plate. Both brake and clutch are operated by one lever—the engagement of one disengaging the other, and vice versa.

General Construction

The Bullard Vertical Turret Lathe is original and distinctive in type. It represents, in combination, an advanced development of the engine lathe, horizontal turret lathe, and the vertical boring and



Cutting Lubricant System, Left Hand View

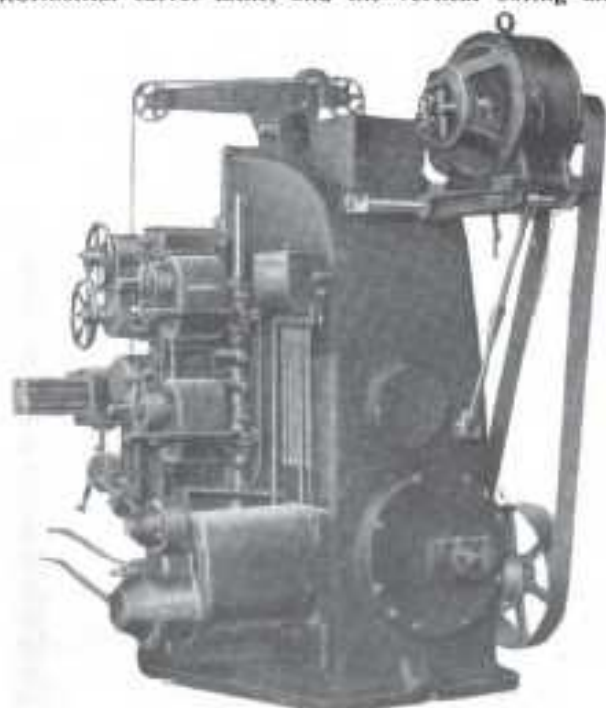
turning mill, in the design, manufacture and use of which we have enjoyed a broad experience extending over a period of thirty years.

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 rapid development along lines essentially original and having a direct bearing on productive capacity.

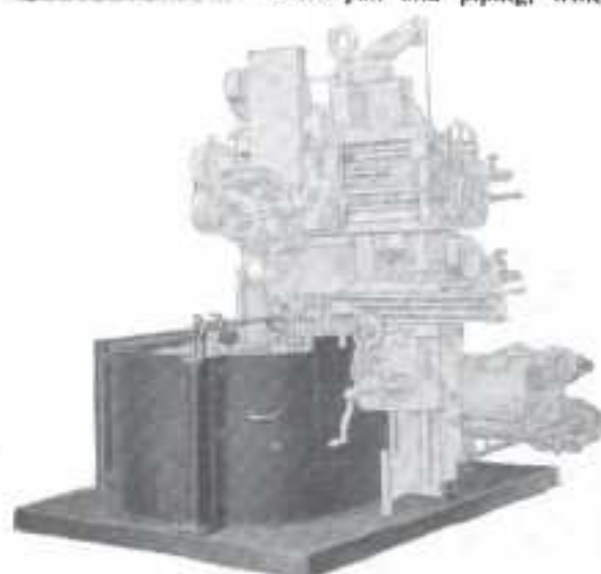
Rigidly constructed, with bearings amply proportioned and specially selected material of maximum shock- and wear-resisting qualities used throughout the gears in both driving and feed trains; lubricated continuously and automatically with filtered oil; safety devices incorporated in feed mechanism and 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.

Cutting Lubricant System

Special attention has been given to the handling of cutting lubricant. A complete equipment of pump, water guard, water pan and piping, which,



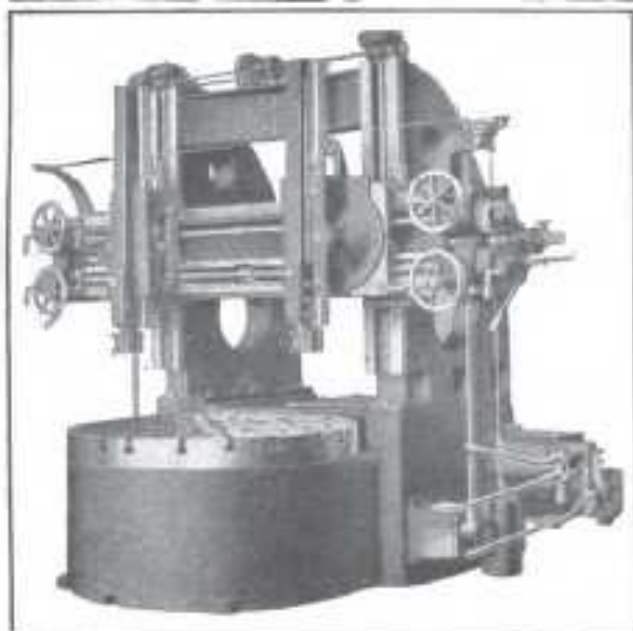
42" Vertical Turret Lathe Showing Motor Application



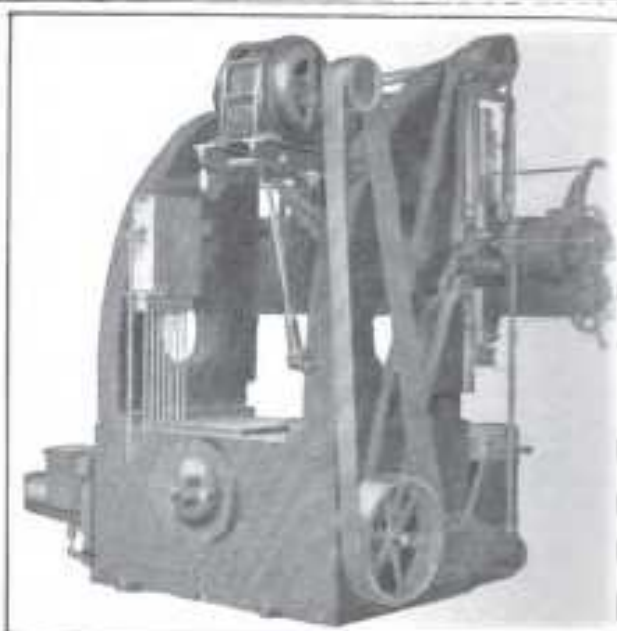
Cutting Lubricant System, Right Hand View

THE BULLARD MACHINE TOOL CO., BRIDGEPORT, CONN.

Vertical Turret Lathes and Maxi-Mills



61" Maxi-Mill, Front View



61" Maxi-Mill, Rear View, Showing Motor Application

competently and in a cleanly manner, will deliver a flow of coolant at the point of the cutting tools, has been designed for use with this machine in handling steel parts. This is not included in the regular equipment of the machine, but may be applied at any time after installation of the machine.

It is an established fact that, by the use of cutting lubricant, cutting speeds may be increased 40%. The life of tools is materially increased, the number of pieces produced between grinds multiplied, and a big reduction is made in the time-loss incident to grinding and tool setting. By maintaining an even temperature in the work itself, a greater accuracy is obtained, and experiments indicate a considerable saving in power consumption.

Maxi-Mill Design

In design the Bullard Maxi-Mill is a development of the maximum possibilities of the vertical boring and turning mill. The principles it embodies have, without exception, a

foundation on the axiom that a machine is productive only when actually cutting, so that every effort has been centered upon reducing the time necessary to chuck the work and remove it, to make adjustments, changes of speed, and other operations which are incidental to production but only increase it as the time necessary to accomplish them is reduced. Among the features that contribute to this are the Bullard Centralized Control, Continuous Flow Lubrication, Cutting Lubricant System, Rapid Power Traverse, Hammer Hand Wheels, and the Bullard Multiple Disc Clutch and Brake.

Production

To be capable of producing the maximum amount of work within its range and to meet the exacting demands of present-day requirements, there are certain fundamentals in machine-tool design and construction which must be complied with fully. These are:

1st. A design which has been developed through years of experience with, and close observation of, the classes of work for which the machine is in-

tended—a design which embodies convenience of operation and manipulation which reduce the physical effort required of the operator, and one which insures the possibility of maintaining the original accuracy of alignment of its various component factors.

Such design must be modern in the highest sense, taking into consideration the progress and change which has entered into the design and materials of the product which it will be called upon to produce.

2nd. The use of the materials and the proper fitting of machine parts by the combined process of selection and elimination based on a broad engineering knowledge and experience—all with a view of developing a construction which will withstand the most severe usage with a minimum maintenance charge.

3rd. The provision of an ample and convenient source of power and its application to the cutting driving units of a design and construction which are highly efficient and have, as well, a large factor of safety to sustain long and continued hard usage without shocks. Control of power is paramount in importance.

4th. A lubrication system, which, with minimum attention from the operator, will insure the continued and positive maintenance of a film of cleanliness between all bearing surfaces as well as gears. This means least loss of power, longest life of parts, least maintenance charges and—increased production per day, as the operator, knowing that his machine is continually lubricated, needs but to give his entire attention to the actual production of work.

5th. An original accuracy of construction of the highest order—for no machine tool can produce work that is more accurate than itself and, in addition, original accuracy tends to continued accuracy as well as insuring easier, quicker operation; longer life of parts and economy of power.

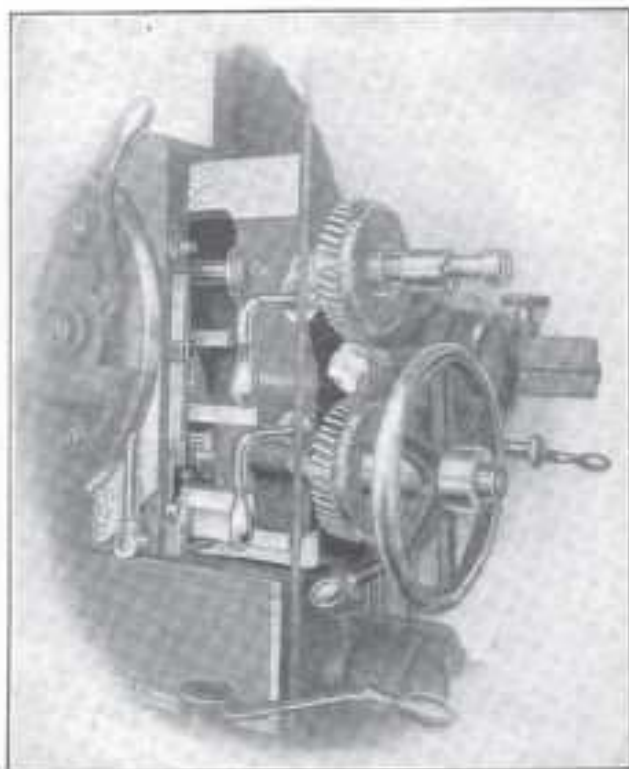
Materials

Properly speaking, the subject of materials is a subdivision of the factor of design. The materials to be used are always specified with the order. It is not ordinarily con-

sidered as separable from the question of design, chiefly for the reason that an amount of attention consist-

THE BULLARD MACHINE TOOL CO., BRIDGEPORT, CONN.

Vertical Turret Lathes and Maxi-Mills



Bullard "Hammer Hand Wheels"

with its importance has not been given to the subject hitherto. With the advent of alloy steels and their common use, particularly in automobile construction, machine-tool builders were called upon to build tools that would stand the greatly increased stresses of cutting such materials. Machine tools were accordingly made heavier without any departure from the materials commonly employed.

Increased proportion of parts, with added weight, is not wholly effective, however, particularly in such items as gears, shafts and similar parts required to transmit the greater power loads and withstand the conditions of usage now imposed. Further production demands called for construction embodying the highest convenience and ease of manipulation, and this, also, indicated a change in material which would permit a reduction in size and weight of parts without sacrifice, but rather an increase, of strength.

Realizing these facts fully, the Bullard Company was accordingly a pioneer in the adoption of alloy steels of the highest grade for all parts called upon to carry the major stresses of power and feed transmission. Superior facilities for the scientific heat treatment of these materials are an important part of our plant equipment.

It is highly consistent with Bullard policy that the final selection and adoption of any material is dependent on its demonstration of superior merit in actual and continued service.

Hammer Hand Wheels

The Bullard Hammer Hand Wheels, or Safety Tool Setting Device (Patented), provide a quick and accurate means of tool setting, and eliminate the danger of rapidly revolving crank handles. Mounted on sleeves secured to the down feed rod and cross feed screw, the wheels are free to make a partial movement before becoming engaged therewith, the engagement imparting a hammer action similar to a hand tap on the end of a crank

handle. By this means the finest adjustment of tools may be made.

In the illustration at the left, the hand wheel has been removed from the down feed rod, showing the notched sleeve which forms a bearing for, and is actuated by, the hand wheel.

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.

Maxi-Power Feed Mechanism (Patented)

The illustration below shows a rear view of the Main Saddle. Note the extra large worm and worm gear in the feed mechanism, also the solid square locks and narrow guide bearing. In the Maxi-Power feed mechanism 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.



Bullard Maxi-Power Feed Mechanism

THE BULLARD MACHINE TOOL CO., BRIDGEPORT, CONN.

The Bullard Multi-Au-Matic



Bullard Multi-Au-Matic—Sizes 8 and 12 Inches

Type

The Multi-Au-Matic is essentially a manufacturing machine. In principle it is of the automatic, multiple spindle or station type—the units of which are vertically disposed for the purpose of coordinating the control and operation thereof.

In development it is radically and essentially different than other machine tools. In its design and construction are embodied many original features and combinations which have a most direct and positive bearing on productive capacity as well as on quality of output.

General Principles

Briefly, the Multi-Au-Matic comprises six independent machines automatically operated, in combination, on a series of pieces of the same form and size—all required operations in sequence, including chucking, being performed simultaneously, thereby producing a completely finished piece in the time consumed by the longest operation, plus the few seconds required for the indexing of the carrier and its spindles from one station to the next.

Advantage is thus taken of the maximum possi-

bilities of simultaneous multi-cutting without in any way sacrificing the quality or accuracy of product.

The six independent work-holding spindles are mounted on a carrier, or turret, which revolves around a central column having six faces—the first of which being the loading station, is blank. On the remaining five faces are mounted tool-carrying slides which are adjustably independent, each from the others, as to amount, rate and direction of movement.

The action of all tool heads, as well as the indexing of the carrier from station to station, is essentially automatic the whole being coordinated and positively interlocked by a unique mechanism which provides protection for the machine, the work, and the attendant.

Scope

The field of the Multi-Au-Matic includes all class castings, forgings or bar sections, cut to length, and within its capacity and which require boring, facing, turning or threading operations, either singly or in combination.

Chief Characteristics

The chief characteristics or novel features of the Multi-Au-Matic are:

Six work holding spindles.
Five universal tool-carrying heads.

Widely variable and independent spindle speeds for each station.

Independent and widely variable feeds for each head.

Extreme simplicity of tool equipment.

Elimination of sweep cutters.

Independent in tool setting.

Accurate, positive stops.

Accurate indexing of spindle carrier.

Independent adjustment of spindles in carrier as to relation to each other and to registry mechanism.

Automatic operation.

Positive coordination and interlocking of all machine movements.

Mechanically controlled rate of production.

Gearing and shafts of material (alloy steel, brass or iron) scientifically, and in the light of experience selected to best meet the individual service requirements thereof.

Continuous flow lubrication of all bearings and gears.
Positive and assured filtration of all lubrication as circulated.

Vertical construction.

Minimum floor space.

The Master Element

In comparison with any previous type of machine tool, either hand operated or automatic, developed for the machining of work coming within the range of the Multi-Au-Matic, the productive capacity of the Multi-Au-Matic is incomparably and marvelously greater.

An analysis of the operations required in machining any given piece will indicate that under like conditions the sum total of actual cutting time (not including time required for machine movement) on the vari-

THE BULLARD MACHINE TOOL CO., BRIDGEPORT, CONN.

The Bullard Mult-Au-Matic

surfaces will, if efficiently performed, be equal, whether the work be performed in an engine lathe with single tool, in a turret lathe with group tooling and operations in sequence, or in the Mult-Au-Matic, with its multiplicity of operations carried on simultaneously, with the time of the longest operation as the controlling factor of the situation.

The master element in the greater production results of the Mult-Au-Matic lies in the principle of mechanically controlled intervals—by means of

1st. The combination in one of six individual machine units.

2nd. The coordination, mechanically, of all machine units movements, and

3rd. The refinement, without complication, of the mechanism required for this purpose.

The mechanical control of intervals reduces to a minimum the lost time usually incident to machine operation. Production is no longer dependent on the speed of the operator—a decidedly variable factor. Even the time required for chucking—the one manual operation entering into Mult-Au-Matic production—is mechanically paced by the automatic control of machine unit movements.

Compelling Facts

"Eleven men were released for other work by this machine," said the Mechanical Engineer of one of America's largest and most highly developed specialty manufacturing plants, in speak-

ing of the Bullard Mult-Au-Matic. And, at that, they had not pushed the machine in any sense.

From an average total time of 15 minutes for a series of different machining operations on a certain piece,—each operation in a machine selected and tooled to obtain highest efficiency, to an average of 2 minutes and 15 seconds on thousand after thousand of the same piece, but of a higher and more uniform quality, is a matter of record in another plant of international renown since the installation of the Bullard Mult-Au-Matic.

Another Mult-Au-Matic saved thirty-two and one-half minutes on a thirty-six minute job originally performed in a thoroughly modern and well tooled turret machine.

Ninety-six thousand eight hundred bevel gear blanks of varying sizes, from drop forgings, is one year's production record for one Bullard Mult-Au-Matic in yet another American plant where intensive production of quality work at lowest cost is the sole aim of the management.

Men of the so-called "operator class" (supervised, of course, by skilled mechanics) made these records. And others like them, obtainable at all times, are capable of making and maintaining similar increases in production and like savings in labor-cost on an untold variety of work coming within the range and scope of the Bullard Mult-Au-Matic.

Your work can be reduced in cost, produced in shorter time and with less overhead expense on the Bullard Mult-Au-Matic because of its unique and novel design, its in-built quality and the power and durability incorporated in its construction.

As evidence of the dependableness of the Bullard Mult-Au-Matic and its capacity for maintained production at a high rate, we submit data from the shop records of a prominent user of these machines. On work in question three machines were engaged—two on identical first series operations, and the third, with two operators, on the second or finishing operations. For purposes of identification and comparison they are, in the following, indicated by number in the above order.

In a period of sixteen weeks, including two holidays, or ninety-four working days totaling a maximum possibility of 2256 hours on a basis of 24 hours per day—

Number 1 Mult-Au-Matic was run 1808 hours on first series operations, with 32 hours required for tool-setting and repairs.

Number 2 Mult-Au-Matic was run 2032 hours on first series operations, with 40 hours credited to tool-setting and over-hauling.

Number 3 Mult-Au-Matic was operated 1968 hours on second series operations and required 64 hours for tool-setting and repairs.

In this time the three machines finished in two chuckings 116,734 pieces of a total finished weight of 4,185,600 lbs., removing 950,606 lbs. of chips from 5,136,296 lbs. of rough castings.

An average hourly production of 30.4 pieces was maintained in the first series operation on machines Nos. 1 and 2. Machine No. 3 averaged 53.7 pieces per hour on the second series operations.

The same machines in a later monthly period averaged in first series operations 33.5 pieces per hour for machines Nos. 1 and 2, and 67 pieces per hour on second series operations for machine No. 3.

The following monthly period included continuous operation even on Sundays. The record shows an average for Nos. 1 and 2 increased to 36 $\frac{3}{4}$ pieces per hour on first series operations, and for No. 3 an average hourly output of 73 $\frac{3}{4}$ pieces on second series operations.

DIMENSIONS

| Details | DIMENSIONS | |
|-----------------------------|--|--|
| | 8-Inch Machine | 12-Inch Machine |
| Capacity | 8 inches diameter. 6 inches in height | 12 inches diameter. 6 inches in height |
| Movement of Tool Heads... | 6 inches vertically. 3 inches in horizontal or angular directions. | 6 inches vertically. 3 inches in horizontal or angular directions. |
| Projected Floor Space..... | Machine only. 67 inches in diameter | Machine only. 77 inches in diameter |
| Actual Height from Floor... | 128 inches | 128 inches |
| Weight { Net | 18,000 pounds | 22,500 pounds |
| { Domestic Shipping | 18,200 pounds | 22,750 pounds |
| Code Word | Amanda | Amazon |

THE BULLARD MACHINE TOOL CO., BRIDGEPORT, CONN.