THE BULLARD MACHINE TOOL COMPANY

ESTABLISHED 1880 INCORPORATED 1894

Cable Address
"BULLARD" Bridgeport
Iron Age Code on page 8

Broad Street and Railroad Avenue
BRIDGEPORT, CONN., U. S. A.

Vertical Turret Lathes, Boring and Turning Mills, Mult-au-Matics, Etc.

Products

- Vertical Turret Lathes
- Bullard Maxi-Mills
- Bullard Mult-au-Matics

BULLARD
TRADE MARK

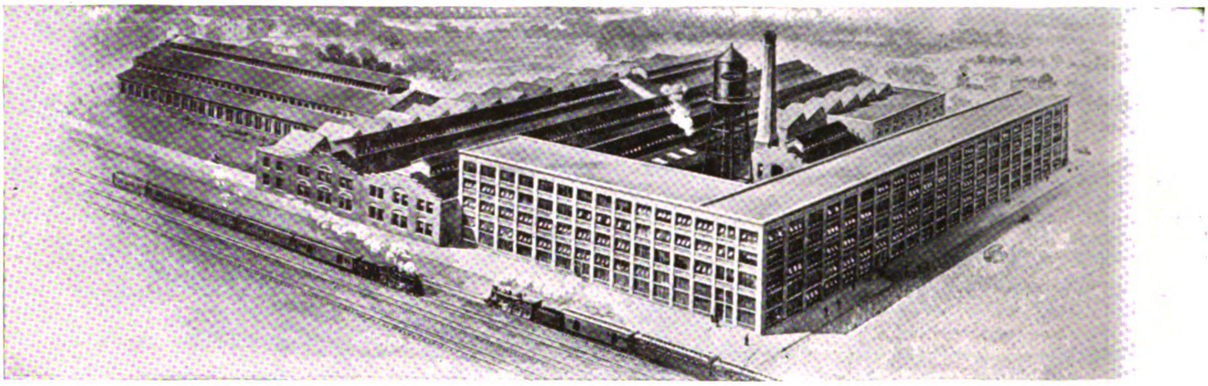

FIG. 1. THE BULLARD MAIN PLANT

Manufacturing Facilities

Modern equipment throughout the plant contributes materially to meet the ever-increasing demand for the products of this Company. Foundry, forge and machine shops, models of their kind, are under one ownership, control and supervision; this arrangement, together with chemical and physical laboratories, insures the use of high-grade materials only and their proper handling in the construction of Bullard machines.

The Bullard Products are designed by masters of machine construction and built by expert mechanics having many years' experience with this organization. Working under ideal conditions, these skilled employees produce, therefore, with dispatch and efficiency the Bullard Products which possess a recognized superiority of design and workmanship.

As the works are located at Bridgeport, Conn., on a main trunk railway, access is convenient to most excellent shipping facilities.

Standardized Parts

All parts of Bullard Vertical Turret Lathes, Maxi-Mills and Mult-au-Matics are standardized—having been tried and tested during 40 years of machine-tool building. After long-studied experience, each unit of construction was selected by reason of its superior merit in actual and continued service before being merged into the completed machines which we now offer.

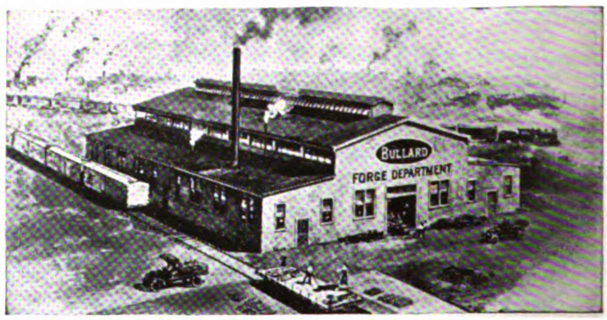

FIG. 2. THE BULLARD FORGE SHOP

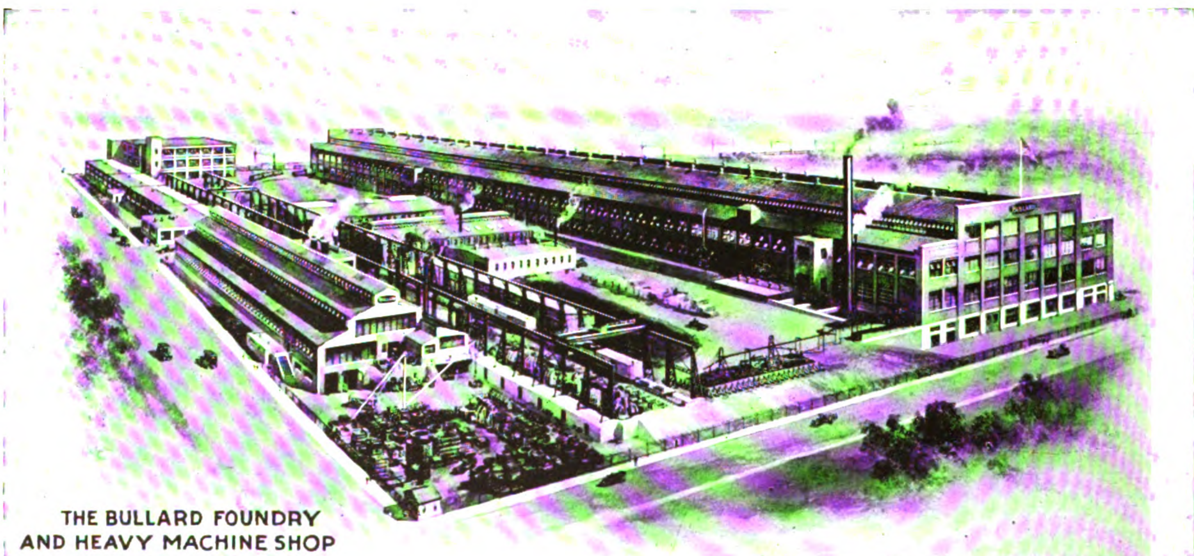

FIG. 3. THE BULLARD FOUNDRY AND HEAVY MACHINE SHOP

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LE TEXTE FRANÇAIS FAIT SUITE
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The Bullard Vertical Turret Lathe

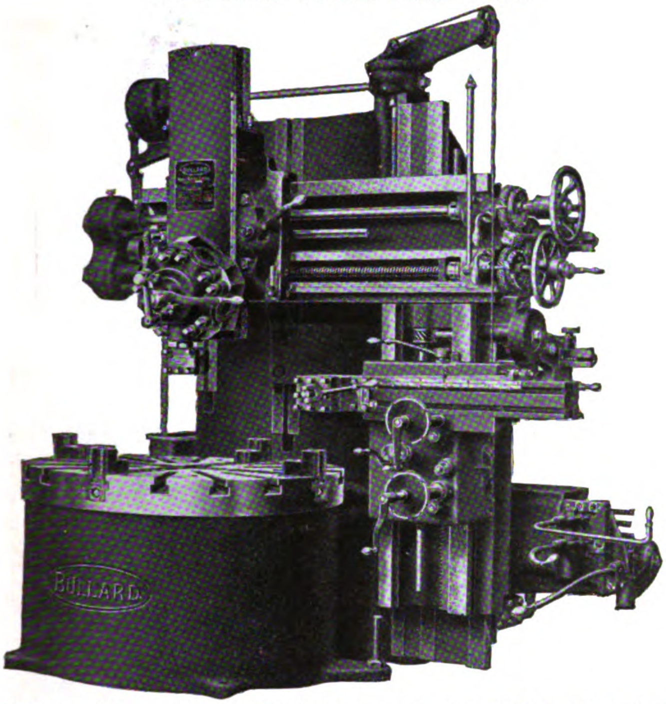

FIG. 4. BULLARD 54-INCH (1372 mm.) VERTICAL TURRET LATHE (PATENTED)

Made also in 42-in. (1067 mm.), 36-in. (914 mm.), and 24-in. (610 mm.) types. See table.

The 54-in. (1372 mm.) "New Era" Type has one swivel turret head and one non-swiveling side turret head.

Specifications Bullard Vertical Turret Lathes

The Bullard Vertical Turret Lathe is made in four sizes as above mentioned. General specifications of these machines are given below:

TABLE I. SPECIFICATIONS BULLARD VERTICAL TURRET LATHES

(1) Lathe sizes..........in. (mm.)	24 (610)	36 (914)	42 (1067)	54 (1372)
(2) Capacity-diameter...in. (mm.)	26 (660)	38 (965)	44 (1118)	56 (1422)
(3) Under cross-rail ...in. (mm.)	20 (508)	24 (610)	33 (838)	38 (965)
(4) Under turret face ..in. (mm.)	28½ (724)	35 (889)	43½ (1105)	49 (1245)
(5) Table diameter. ....in. (mm.)	24¼ (616)	34 (864)	42⅜ (1076)	50 (1270)
(6) No. of table speed changes....	8	12	12	12
(7) Range.............r.p.m.	7 to 120	4 to 70	3.3 to 56	3 to 54
(8) No. of feed changes..........	8	8	8	8
(9) Vertical head:				
(10) Vertical movement.in. (mm.)	18 (457)	26 (660)	27 (686)	27 (686))
(11) Will face.........in. (mm.)	26 (660)	38 (965)	44 (1118)	56 (1432)
(12) Side head:				
(13) Vertical movement.in. (mm.)	18 (457)	19 (483)	28 (711)	31 (787)
(14) Horizontal movement in.(mm.)	14½ (368)	20 (508)	21 (533)	21 (533)
(15) Turret-diameter .....in.(mm.)	14 (356)	15¼ (387)	16¾ (425)	16¾ (425)
(16) No. of faces	5	5	5	5
(17) Dia. of holes in face.in. (mm.)	2¼ (57)	2½ (63)	2¾ (70)	2¾ (70)
(18) Weight, net.........lb. (kg.)	9000 (4100)	14000 (6400)	18500 (8400)	23000 (1040)
(19) Floor space, width...in. mm.)	75 (1,9)	91 (2,3)	100 (2,5)	110 (2,8)
(20) Depth............in. (mm.)	61 (1,5)	75 (1,9)	85 (2,2)	120 (3,0)
(21) Height ....in. (mm.)	98 (2,5)	109 (2,8)	122 (3,1)	129 (3,3)
(22) Motor required..........h.p.	7½	10	15	15

TABLE II. CODE WORDS

(1) Lathe sizes in. (mm.)	24 (610)	36 (914)	42 (1067)	54 (1372)
(2) Lathe with;				
(3) 3-jaw comb. chuck..	VESPER	VISIT	VIPER	
(4) 4-jaw ind. chuck....	VESTAL	VISTA	VIXEN	VERLANT
(5) Plain table.........	....	....	....	VERDURE
(6) Plain table, 4 jaws..	....	....	....	VERANDA

TABLE III. CODE WORDS, CHUCKS FOR BULLARD VERTICAL TURRET LATHES

(1) Lathe sizes in. (mm.)	24 (610)	36 (914)	42 (1067)	54 (1372)
(2) 3-jaw combination chuck	ADAGE	ADDLE	ADORN	....
(3) 4-jaw independent chuck	BISON	BLEAK	BLUSH	BORAX

FOR VERTICAL TURRET LATHES ONLY

Universal forming attachment.. SCAMP
Plate type forming attachment.. SCARF
Standard tool equipment.. STATEQ**
XAP-2 face plate jaws, for use on 54-in. (1372 mm.) Vertical Turret Lathe... JARGON

**Standard tool equipment may be designated by the word "STATEQ" at the time when lathe itself is ordered, such as "VISIT STATEQ;" but, if equipment is ordered subsequently for a lathe already installed, for either a 3-jaw combination or a 4-jaw independent chuck, it may be designated by the code words in Table III.

The Bullard Maxi-Mill

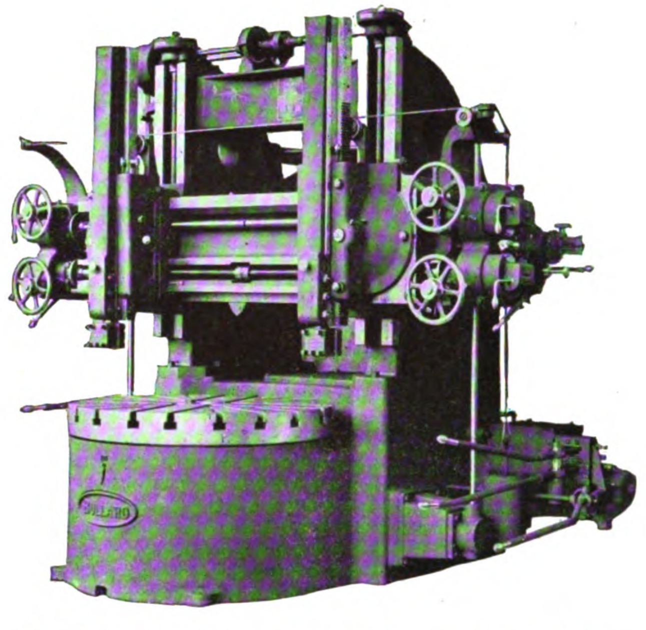

FIG. 5. THE BULLARD 61-INCH (1549 mm.) MAXI-MILL FRONT VIEW

Made also in 44-in. (1118 mm.) and 54-in. (1372 mm.) sizes. See table.

All gears are encased, though readily accessible. Crank handles and square-end shafts are eliminated. Operator is safe at all times. The tool carrying heads are well illustrated immediately above the table.

Specifications Bullard Maxi-Mills

The Bullard Maxi-Mill is made in three sizes as above mentioned. General specifications of these machines are given below:

TABLE IV. SPECIFICATIONS BULLARD MAXI-MILL

(1) Boring Mill sizes...in. (mm.)	44 (1118)	54 (1372)	61 (1549)
(2) Capacity-diameter.....in. (mm.)	48 (1219)	56 (1422)	63 (1600)
(3) Height under cross-rail...... in. (mm.)	34 (864)	43 (1092)	52 (1321)
(4) Height tool holders.in. (mm.)	34 (864)	43 (1092)	52 (1321)
(5) Table diameter......in. (mm.)	42⅝ ** (1083)**	50† (1270)†	61 (1549)
(6) Tool slides, vertical movement. in. (mm.)	36 (914)	36 (914)	36 (914)
(7) No. of table speeds..........	12	12	12
(8) Range...............r.p.m.	3.3 to 56	3.2 to 54	2.5 to 42.18
(9) No. of feed changes, both heads	8	8	8
(10) Weight, net............lb. (kg.)	20000 (9100)	23000 (10400)	28000 (12700)
(11) Motor required...........h.p.	15	15	15

TABLE V. CODE WORDS

(1) Maxi-mill with:			
(2) 3-jaw comb. chuck..........	MENTOR	....	....
(3) 4-jaw ind. chuck...........	MERGE	....	....
(4) Plain table.................	....	MARTINET	....
(5) Plain table, 4 jaws.........	....	MARVEL	....
(6) Plain table.................	....	....	MARMOT
(7) Plain table, 4 jaws.........	....	....	MARPLOT
(8) XAP-2 face plate jaws.......	....	....	JARGON

GENERAL CODE WORDS
VERTICAL TURRET LATHES AND MAXI-MILLS

Motor bracket only.. DUCK
Cutting lubricant system.. LUBRO
Thread-cutting attachment.. ED*

*"ED" added to code word of machine indicates that Vertical Turret Lathe or Maxi-Mill is to be equipped with thread-cutting attachment.

**3-jaw combination or 4-jaw independent chuck.

†"T" slots for 4-face plate jaws.

Standardization (Vertical Turret Lathes and Maxi-Mills)

In these two types of machines the form of table spindle, primary and speed change cases, multiple disc clutch and brake, constant flow system of lubrication, hammer handwheels, power rapid traverse device, maxi-power feed mechanism, cutting lubricant system, motor drive application and centralized control are standardized in design. The following pages are a general description of these parts.

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Bullard Vertical Turret Lathes

This machine represents, in combination, an advanced development of the engine lathe, the horizontal turret lathe and the vertical boring and turning mill. It retains the inherently good features of each of these individual types and has, since its inception in 1900, been most rapidly improved along lines essentially original and including a particular bearing on productive capacity. See Fig. 4.

Construction Data

TABLE—Is driven through accurately planed bevel gearing having a special tooth form which has a rotative effect only, obtaining thereby a smoothness of cut and absence of chatter and tooth marks—superior to spur drive.

HEADS—One vertical and one side head. Each head is independent in its movement, both as to direction and amount of feed. Both heads may be operated jointly on work of small diameter without interference.

TABLE SPEED INDICATOR—The number of table revolutions per minute may be instantly ascertained from direct reading indicator incorporated in the interlocking device.

THE MAIN TURRET—See Fig. 6. Has five faces; being set at an angle with the slide, large tools may be used without interference with slide in indexing. Turret holes are bushed, bushings being renewable. Turret slide has a very broad bearing on the swivel base; is provided with a narrow type of guide bearing, while perfect alignment with table center is maintained. Side head turret is a 4-face turret tool holder. See Fig. 4.

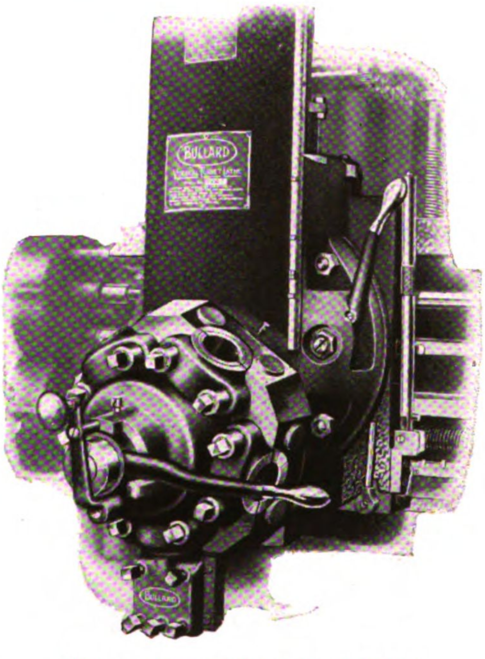

FIG. 6. THE BULLARD TURRET
The main head is distinctive both in construction and operation. Mounted in a swiveling saddle, it may be adjusted for taper boring or turning to any angle up to 45°, either side of vertical center. The saddle is graduated accurately and a convenient mechanical adjustment is provided for setting the head.

FEED WORKS—Are entirely independent for each head, conveniently operated. Feeds for both heads are positive as well as independent; have 8 changes in all directions; feed changes are obtained instantly by turning a knurled wheel, and amount of feed per revolution is indicated on a direct reading plate on each box. For the main head, the feed is engaged and disengaged, or change made from vertical to cross feed, or vice versa, by engaging the centrally located drop worm with worm gears on the end of feed rod and feed screw. Slip gears are eliminated. For side head, a similar feed is obtained by movement of a plunger lever located in side head saddle.

TABLE SPINDLE (Patented)—Has angular thrust bearing of large diameter, side strains being absorbed by vertical cylindrical bearings of ample proportions. All bearings are accurately and concentrically ground on a special machine. See sectional view, Fig. 7.

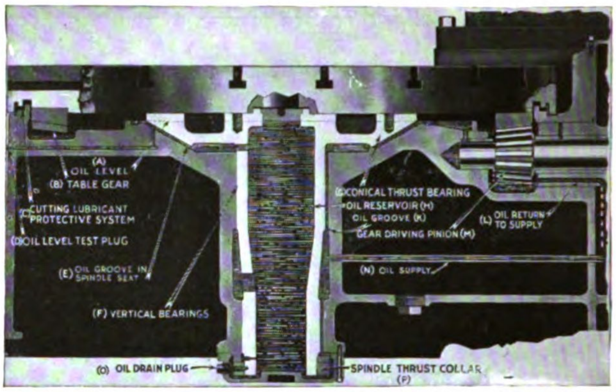

FIG. 7. SECTIONAL VIEW SHOWING TABLE SPINDLE AND OTHER IMPORTANT INTERNAL ARRANGEMENTS

SPEED CHANGES AND CONTROL—Are obtained through two systems of selective sliding gears and positive clutches. Only gears transmitting power are in mesh, no power being consumed by idle running gears. Clutch and brake are operated by one lever, engagement of one disengaging the other. Any one of 4 primary speeds may be selectively engaged by means of second lever. Secondary speed changes are obtained in like manner.

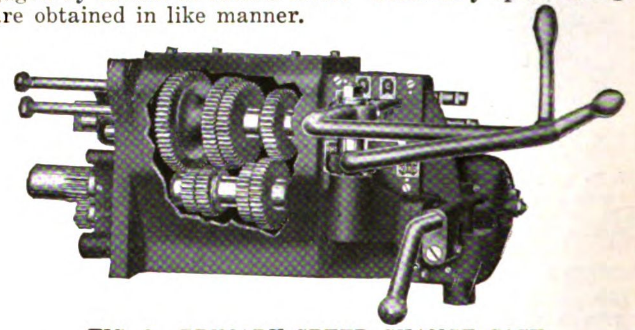

FIG. 8. PRIMARY SPEED CHANGE CASE
Showing in Detail the Control Levers and Interlocking System.

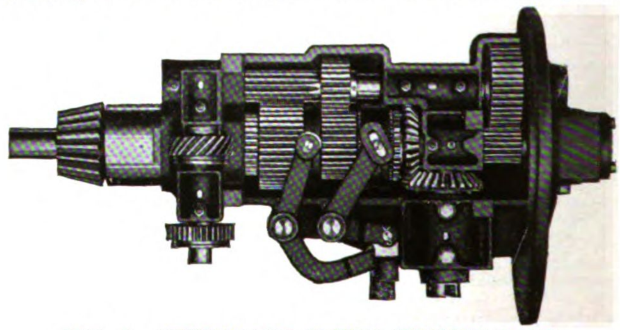

FIG. 9. SECONDARY SPEED CHANGE CASE

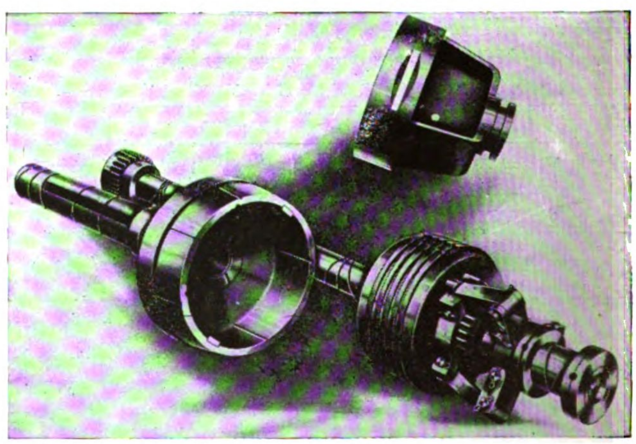

FIG. 10. MULTIPLE DISC CLUTCH AND BRAKE DRUM

BRAKE—Brake parts are integral with the driven member of disc clutch and, running at constant speed, have a constant braking value regardless of table speed.

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Lubrication—An automatic system of lubrication is incorporated in the construction of Bullard Vertical Turret Lathes, Maxi-Mills and Mult-Au-Matics; a constant and positive, sight-feed flow of oil lubricates the table spindle, table driving gear, primary and secondary speed change mechanism, clutch and brake, main driving shaft journals, etc.

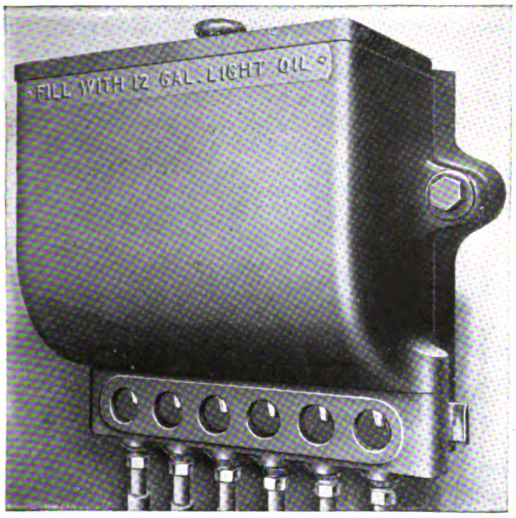

FIG. 11. OIL DISTRIBUTING RESERVOIR AND SIGHT FEEDS (PATENTED)

Hardened Steel Gearing—Special analysis alloy steels, selected for the particular service to be rendered and scientifically heat-treated, are used throughout the entire driving and feed train, including table driving gear. All gearing is constantly immersed in oil.

Center Stop (Patented)—An absolutely accurate center stop is provided for the main head, which is so designed as to permit the head to be carried beyond the center. This stop mechanism is unique in design and does not present the inherent weakness and consequent inaccuracy of the ordinary center stop.

Guide Bearing—The guide bearing for rails on column and bed has great length in proportion to its width, assuring permanency of alignment in the vertical movement of these parts. The same type of guide bearing is provided on the cross rail and side rail for the saddles.

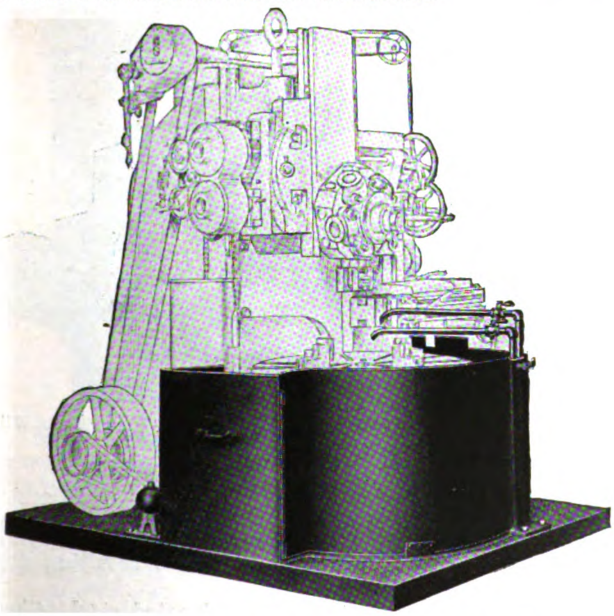

FIG. 12. A CUTTING LUBRICANT SYSTEM FOR THE VERTICAL TURRET LATHE AND MAXI-MILL

This consists of a steel pan, floor plates, steel guards, a centrifugal pump and adjustable lubricant conductors. This unit having a capacity for a large supply of cutting lubricant permits the use of maximum feeds and speeds. It keeps the cutting solution out of the machine and off the floor in addition to providing ample capacity for chip storage.

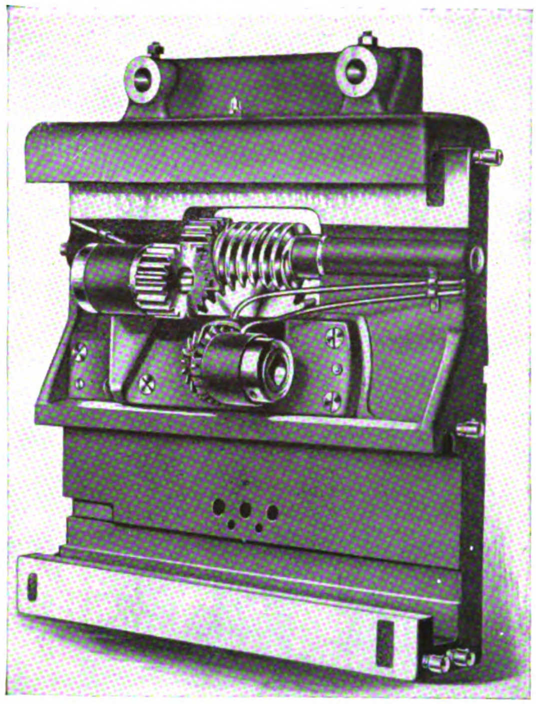

FIG. 13. CROSS-RAIL SADDLE CONSTRUCTION SHOWING MAXI-POWER FEED MECHANISM

The hardened worm and worm gear are of extra large diameter, giving maximum power, efficiency and long wearing qualities.

Safety Devices—One of them is incorporated in each feed works, preventing breakage of gears or mechanism by careless handling of the heads. Also, all gears are encased; counterweights are enclosed; crank handles on rapidly moving power-operated parts are eliminated; operator is safe at all times.

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.

Motor Drive—A constant speed motor, having a speed not to exceed 1200 r.p.m., may be mounted on bracket at rear of machine and connected with driving pulley by belt.

Accessories—The productive capacity of a machine is governed largely by the character of its tool equipment, and, having had long experience in the use of Boring and Turning Mills and Vertical Turret Lathes, we have developed standard tool equipments, which are strongly recommended.

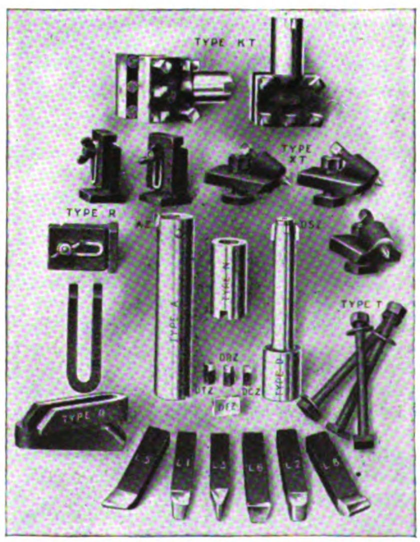

FIG. 14. TYPICAL STANDARD TOOL EQUIPMENT FOR VERTICAL TURRET LATHES

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The Bullard Maxi-Mill

This machine tool represents the maximum possibilities of the Vertical Boring and Turning Mill. It is constructed to withstand the most severe usage continuously with a minimum of maintenance cost. Like the Bullard Vertical Turret Lathe, the Maxi-Mill is equipped with certain, positive and convenient control, hammer hand-wheels for setting the tools, continuous flow lubrication, graduated scales, micrometer dials, observation stops for the duplication of sizes, etc., and the table may be started and stopped from either side of the machine. See Figs. 5 and 15.

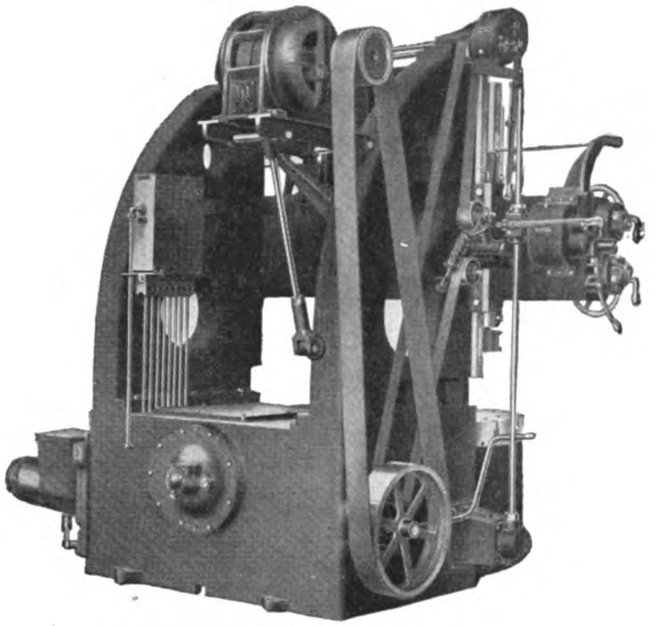

FIG. 15. BULLARD 61-INCH (1549 mm.) MAXI-MILL, REAR VIEW
In this view the scientific distribution of weight and the proportion of various load-carrying members are evident; also, the location of filter for lubricating oil, as well as the simple and efficient method of mounting the driving motor. The convenience of the left-hand power control lever will be readily appreciated. Also showing standardized motor drive. For front view, see Fig. 5

Design—Is based upon the demand for almost continuous cutting operations which have, in this machine, been achieved by reducing the time necessary to chuck the work and remove it, to make adjustments, changes of speed and other movements; the main features contributing to these results are the Bullard Centralized Control, Continuous-Flow Lubrication and Cutting Lubricant System.

Material—The driving units, of sliding-gear and positive clutch type, serve also as speed-change mechanism. Gearing and shafts throughout are of high-grade alloy steel, hardened and heat-treated for severe service, all encased in rigid units supporting shafts, thus obviating deflection, torsion and consequent misapplication of power. The table driving gear is a forging of alloy steel, heat-treated before machining, of such composition as to give maximum strength.

Strength—The elements of strength and rigidity are readily apparent in the illustrations, Figs. 5 and 15, which also show the convenient location of control levers for power and speed change, feed change, power-traverse for tool heads, and the safety "Hammer Hand Wheels" for tool setting, which eliminate the dangerous crank handle. Rail construction, which includes a narrow guide bearing for heads, with feed pressure directly centralized, is clearly shown.

Feed Works—Are entirely independent for each head, conveniently operated. Feeds for both heads are positive as well as independent; have 8 changes, in all directions; feed changes are obtained instantly by turning a knurled wheel, and amount of feed per revolution is indicated on a direct reading plate on each box. For the main head, the feed is engaged and disengaged, or change made from vertical to cross feed, or vice versa, by engaging the centrally located drop worm with worm gears on the end of feed rod and feed screw. Slip gears are eliminated. For side head, a similar feed is obtained by movement of a plunger lever located in side head saddle.

Speed Changes and Control—Are obtained through two systems of selective sliding gears and positive clutches. Only gears transmitting power are in mesh, no power being consumed by idle running gears. Clutch and brake are operated by one lever, engagement of one disengaging the other. Any one of 4 primary speeds may be selectively engaged by means of second lever. Secondary speed changes are obtained in like manner. See Figs. 8—9.

Friction Clutch—A multiple disc clutch, readily adjustable, is interposed between the main driving shaft and primary speed change device. The members run at a constant speed and its efficiency does not vary. See Fig. 10.

Interlocking—Controlling levers are positively interlocking. Clutch must be released and brake engaged before speed change can be made. A complete engagement of gears for any speed is necessary before brake can be released and clutch re-engaged—an absolute safeguard against breakage, while not hindering manipulation.

Centralized Control—The location of all operating levers and handles is in a position convenient to the operator, permitting him to concentrate on productive effort.

Lubrication—While main driving pulley is in motion, all units having a fixed relation to the bed of machine are supplied with clean, filtered oil at all times; other units, such as feed works, power traverse brackets, etc., mounted on cross rail, form individual reservoirs in which gears and shafts are constantly immersed in oil. See Fig. 11.

Power—A constant speed pulley of large dimensions provides for connection to either motor or main line shaft. A well-proportioned clutch, of multiple-disc type, is located between motor or shaft and the speed-change units, which permits of instant application or stoppage of power, as desired; in connection with the clutch is incorporated a quick-acting brake for stopping the table.

Maximum Production—Bullard Maxi-Mills possess certain fundamental features in design and construction that insure the production of the maximum of work within their range: (1) Design embodies conveniences of operation, accurate alignment of all component factors and less work by operator. (2) High quality materials only are used, and machine parts are proportioned by a combined process of selection and elimination to withstand the most severe service with minimum charges for up-keep. (3) Ample and constant source of power. (4) A continuous flow system of lubrication to all gears and bearing surfaces, oil being circulated by pump directly connected to main drive shaft. (5) Accuracy of machine-tool construction. See Figs. 5—15.

Bullard Independent Face-Plate Jaws

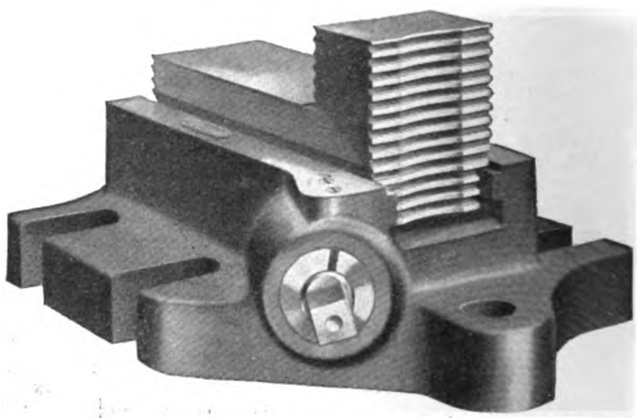

FIG. 16. BULLARD INDEPENDENT FACE-PLATE JAWS
Type XAP-2. Patented June 2, 1903
Drop Forged Heat-Treated Steel Bodies

Face-Plate Jaws—For securing work beyond a certain size to the table, when it is impracticable to incorporate the chucking members in the table itself. The jaws are, therefore, a necessity; are a development resulting from years of study and experience.

Chuck bodies are drop-forged, heat-treated steel. Chuck jaws are made of special steel, not subject to fracture under severe service. Actuating screws, at an angle with jaw, give a powerful differential action which resists backward strain and any tendency to loosen jaw. Jaws securely held to table by four bolts in parallel "T" slots.

This accessory can be used on any make of machine requiring face-plate jaws. See Fig. 16.

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The Bullard Mult-Au-Matic

TYPE—The Mult-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 co-ordinating the control and operation thereof.

In development it is radically and essentially different from 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.

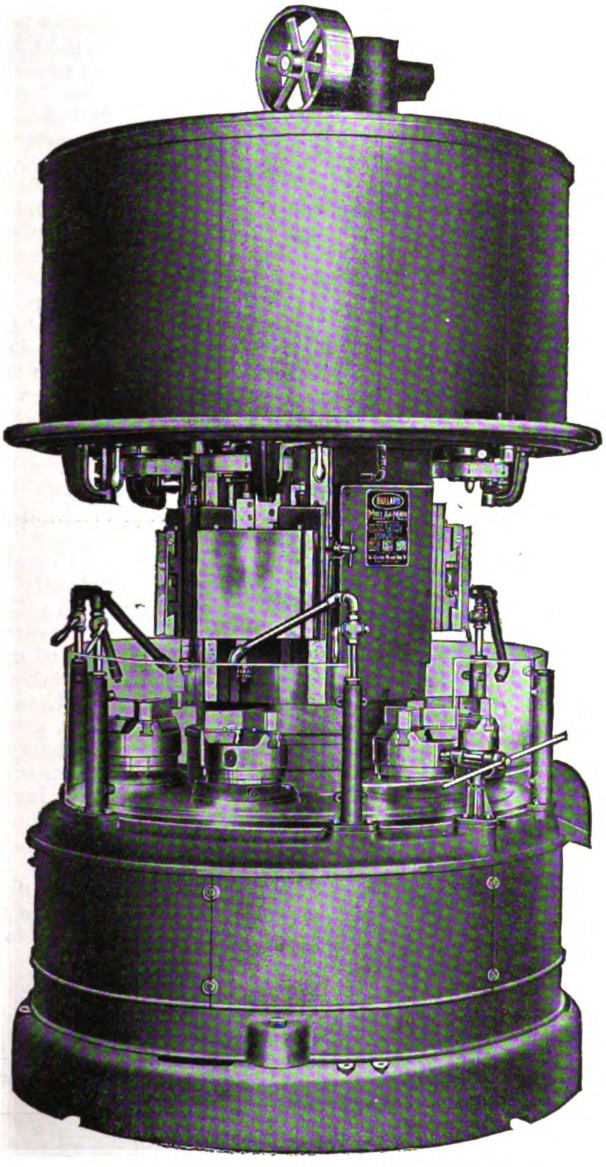

FIG. 17. THE BULLARD MULT-AU-MATIC

GENERAL PRINCIPLES—Briefly, the Mult-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 possibilities 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, in 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 co-ordinated and positively interlocked by a unique mechanism which provides protection for the machine, the work and the attendant.

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

CHIEF CHARACTERISTICS—The chief characteristics and novel features of the Mult-Au-Matic are:

Six work holding spindles.
Five universal tool-carrying heads.
Widely variable and independent spindle speeds at each station.
Independent and widely variable feeds for each tool head.
Extreme simplicity of tool equipment.
Elimination of sweep cutters.
Independence in tool setting.
Accurate, positive stops.
Accurate indexing of spindle carrier.
Independent adjustment of spindles in carrier with relation to each other and to registry mechanism.
Automatic operation.
Positive co-ordination and interlocking of all machine movements.
Mechanically controlled rate of production.
Gearing and shafts of material (alloy steel, bronze 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 lubricating oil as circulated.
Vertical construction.
Minimum floor space.

THE MASTER ELEMENT—In comparison with any other previous type of machine tool, either hand operated or automatic, developed for the machining of work coming within the range of the Mult-Au-Matic, the productive capacity of the Mult-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 various 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 coördination, 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 speaking of the Bullard Mult-Au-Matic. Even then 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.

The Bullard Mult-Au-Matic (Continued)

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 overhauling.

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 4,185,690 lb., (1,898,600 kg.), removing 950,606 lb. (431,200 kg.) of chips from 5,136,296 lb. (2,329,800 kg.) 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 second series operations.

The same machines in a later monthly period averaged in the 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 36⅔ pieces per hour on first series operations, and for No. 3 an average hourly output of 73⅜ pieces on second series operations.

Economy of the Mult-Au-Matic—The various savings effected are: (1) 4/5 to 9/10 in labor cost, men being released for other work. (2) 4/5 to 9/10 in man power, by multiplying one man's production capacity. (3) 4/5 to 9/10 in floor space, machine being vertical—6 machines in one. (4) 2/3 to ¾ in power loss, fewer parts being in motion, lubrication perfect, no countershaft and but little line shaft required. (5) 2/3 to ¾ in power equipment, the line shafting, hangers, belting, etc., being reduced. (6) 2/3 to ¾ in tool equipment, one simple set for the 6 machines combined in one being required. (7) Will save in original investment, because floor space, other machines, tools and related equipment for equal output cost more. (8) Will save in maintenance cost, machine being simply constructed and perfectly lubricated. (9) Will save in tool grinding time and in tool renewal expense, because tools of longest operation only need be driven to their utmost—other tools are only required to complete their work within the time of the longest operation. (10) Will save overhead expense, by reason of less investment, less floor space, fewer men, less power, smaller tool renewal and lower maintenance charges. (11) Will save supervision expense, the number of men to be "hired, trained and—" being reduced. (12) Will save "setting up time," because each tool head has independent feeds and stops and may be "set up" regardless of the others. (13) Will save machining time, because the right feed and speed may be set for the operation, or group of operations, to be performed (at highest efficiency) at each station. (14) Will save "time between cuts," machine being mechanically controlled and automatically operated. (15) Will save "Idle Machine" Time, no time being taken for oiling up or shutting down to remove chips; the latter are constantly discharged into a container. (16) Will save Operating Time, because all *automatic functions* are performed at a constant speed, independent of cutting speeds, feeds or will of operator. (17) Will save Time of Work in Process, because the times of setting up, machining, operating, and "time between cuts," as well as tool grinding and resetting, are reduced to a minimum. (18) Will save time on Subsequent Operations, because *uniform work* is produced by means of the accuracy of index and feed stops. (19) Will save Inspection Costs, uniform work requiring less inspection; also, the completion of several operations in *one* machine eliminates any necessity for inspection *between* operations. (20) Will save Equivalently, on Relatively Small Lots, because all of its time-cutting, cost-reducing factors are applicable to any work within its range—setting up time reduced to a minimum.

TABLE VI. BULLARD MULT-AU-MATIC SPECIFICATIONS

(1) Size of machine ... in. (mm.)	8 (203)	12 (305)
(2) Mult-Au-Matic capacities: Diameter ... in. (mm.)	8 (203)	12 (305)
(3) Height ... in. (mm.)	6 (152)	6 (152)
(4) Standard chucks, 3-jaw universal: Diameter ... in. (mm.)	10 (254)	14 (356)
(5) Will grip, diameter ... in. (mm.)	8 (203)	12 (305)
(6) Spindle head, diameter ... in. (mm.)	9¾ (248)	14 (356)
(7) Spindle speeds, at each station, with standard gears* ... r.p.m.	33, 37 42, 48, 56, 66, 73, 81, 90, 100, 122, 135, 150, 175, 207, 233, 263, 300	20.3, 23.3, 26.1, 30, 34.7, 40.6, 45, 49.9, 55.1, 61, 67.4, 74.5, 82.5, 91.4, 102, 113, 127, 142, 161, 183
(8) Tool-carrying heads, number of tools** ...	5	5
(9) Movement of toolheads: Vertical ... in. (mm.)	6 (152)	6 (152)
(10) Horizontal or angular directions ... in. (mm.)	3 (76)	3 (76)
(11) Rates of feed per revolution of spindle, with standard gears ... in.	0.0067—0.0086—0.0096—0.0133—0.0163—0.020—0.0244—0.030—0.0415—0.0467—0.060	0.0086—0.0111—0.0125—0.0173—0.0212—0.0259—0.0317—0.0389—0.0538—0.0605—0.0778
mm.	(0.17—0.22—0,24—0,34—0,41—0.51—0.62—0,76—1,05—1,19—1,52)	(0,22—0,28—0,32—0,44—0,54—0,66—0,81—0,99—1,37—1,54—1,98)
(12) Main drive pulley: ... r.p.m.	760	600
(13) Diameter ... in. (mm.)	14 (356)	14 (356)
(14) Face ... in. (mm.)	4½ (114)	6½ (165)
(15) Floor space required: Machine only, diameter ... in. (m.)	67 (1,7)	77 (2,0)
(16) Chip container ... in. (m.)	29x15 (0,7x0,4)	29x15 (0,7x0,4)
(17) Height from floor to top, not including motor† ... in. (m.)	128 (3,3)	128 (3,3)
(18) Weight, net ... lb. (kg.)	18000 (8200)	22500 (10200)
(19) Code word: Machine without chucks ...	AMANDA	AMAZON
(20) Machine with chucks ...	ADELAIDE	ADELPHI

*Other spindle speeds may be obtained through use of special gears.

**Tool carrying heads are independent in movement and will face, bore and turn at any angle.

†Motor when used, is mounted on top of machine, connected to drive shaft by silent chain and sprockets. 10 h.p., 1200 r.p.m. motor required. We recommend a standard horizontal constant speed direct current motor, equipped with field rheostat providing 15 per cent. speed increase—a sufficient variation to compensate for difference in hardness of stock being machined. Alternating current motors may be used if desired.

SIGUE EL TEXTO ESPAÑOL

LE TEXTE FRANÇAIS FAIT SUITE

PLATE I. SAMPLES OF WORK PERFORMED BY BULLARD VERTICAL TURRET LATHES

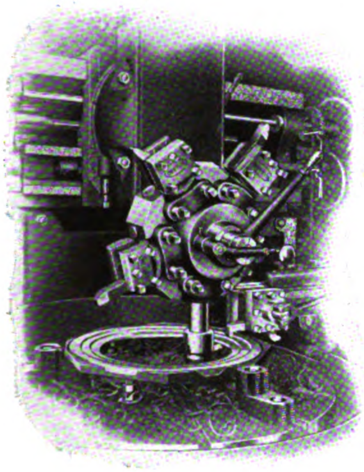

FIG. 18
Simultaneous multi-cutting, with all tools set for the cuts in sequence, is a big factor in cutting costs.

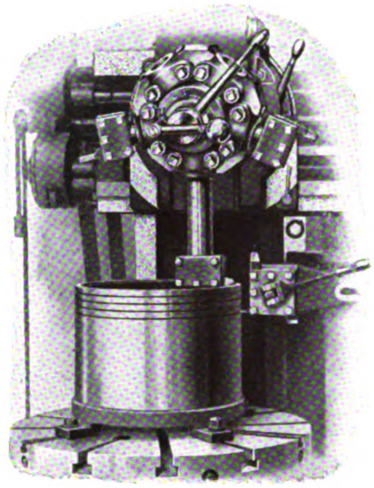

FIG. 19.
Piston packing rings of all types are accurately and economically machined with simple tools on the Vertical Turret Lathe.

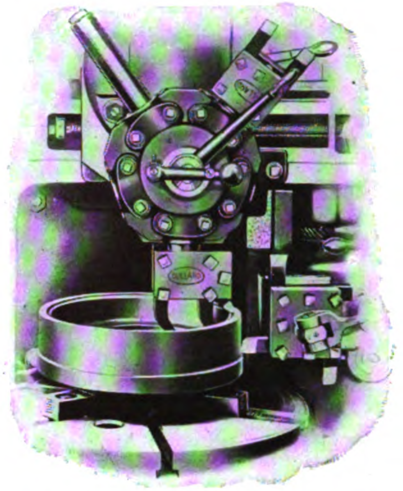

FIG. 20
The Vertical Turret Lathe machining a steel motor flywheel. The work is accomplished in two chuckings with an average saving of 60 per cent. over former methods.

PLATE II. ACTUALITIES ON THE BULLARD MULT-AU-MATIC

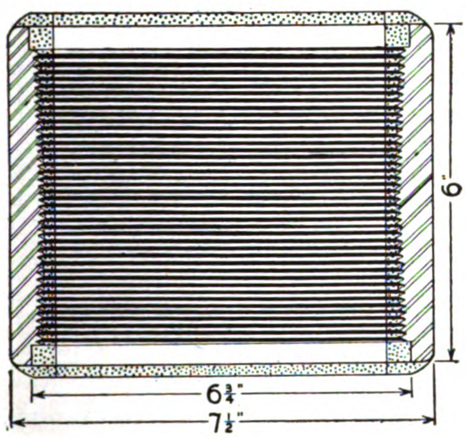

FIG. 21
Pipe coupling with continuous thread, steel forging. Time, one chucking, 3 minutes. Cut about 1/3 size.

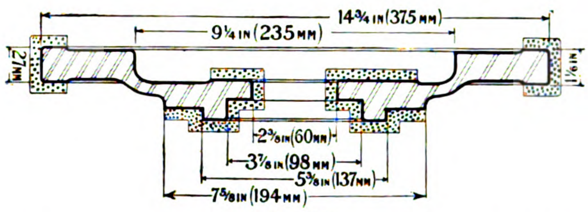

FIG. 22
Motor flywheel, cast iron. Total time, two chuckings, 2 min. 15 sec. First chucking, 1 min. 22 sec. Second chucking, 0 min. 53 sec.

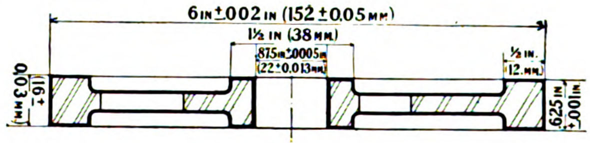

FIG. 23
Automobile timing gear, cast iron, 15 per cent. steel mixture. Time, one chucking, 38 sec.

PLATE III. APPLICATIONS OF THE BULLARD MAXI-MILL

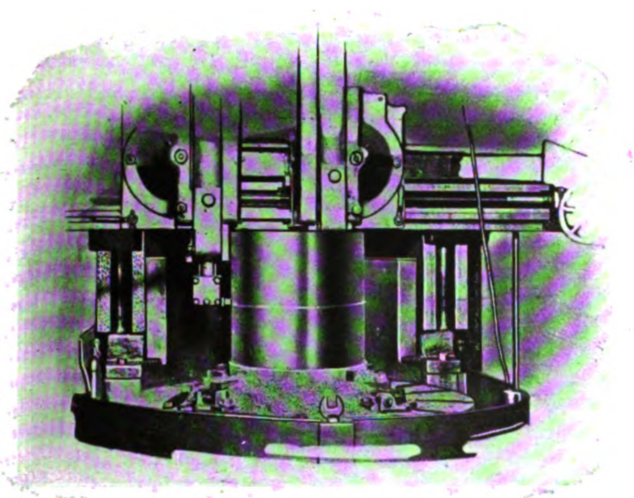

FIG. 24
A typical boring mill job, a cylinder being machined on a Maxi-Mill in two hours. This boring mill is the result of an experience covering thirty-five years during which period 10,000 machine tools have been built by the Bullard Company.

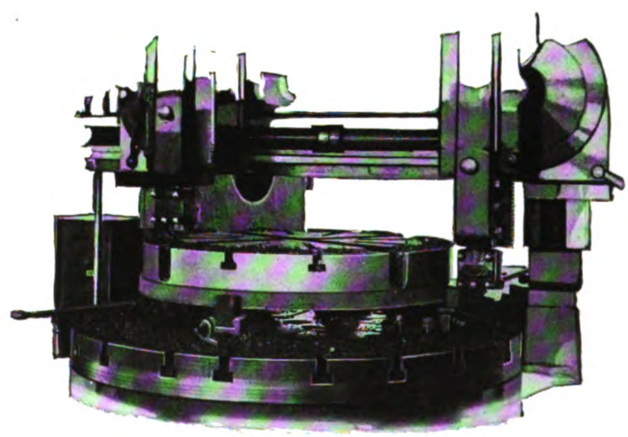

FIG. 25
The Maxi-Mill machining a part of its prototype. In making these counterparts, the Bullard Company became users of machine tools as well as makers. Therefore, daily in their own shops, tests are made of their own machine tools while engaged in actual manufacturing work, a remarkable guarantee to the prospective buyer that these machines will live up to all claims made for them.

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