Operators Manual

Of 1A Models

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THE CARLTON MACHINE TOOL CO.,

CINCINNATI 25, OHIO

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Handling and Checking

Your Carlton Radial Drilling Machine has been thoroughly tested before leaving the factory. The accuracy that has been built into this machine can only be maintained by careful handling while it is being set up in your plant. The machine was carefully skidded and crated so it will reach its destination in perfect condition.

The machine can be removed from the truck or flat car by the use of a sling as shown in Figure 1. If the machine is shipped in a closed conveyance, rollers can be placed under the skids and then by the use of pry bars and block and tackle the machine can be rolled to the desired location. The depressions in the base will receive a standard jack foot, so that the skids can be removed easily and then levelled properly.

The next step to take is to remove the wrappings and check carefully for the possibility of loose parts, or parts being broken through rough handling in transit. If there appears to be any damage to the machine or to any parts shipped in conjunction with the machine, notify your dealer immediately.

Do not move the head on the arm until the arm has been thoroughly cleaned of slush and then lubricated. After the machine is in the permanent position, it is ready to be cleaned. To insure protection from the weather while the machine is in transit, it is necessary to cover all of the exposed finished parts with grease and wrappings. After the wrapping has been removed the grease can be washed off the machine with any standard solvent such as gasoline or kerosene. We then recommend that the arm and column be lubricated with a clean oil similar to what is called out on the lubrication chart, for use in the head.

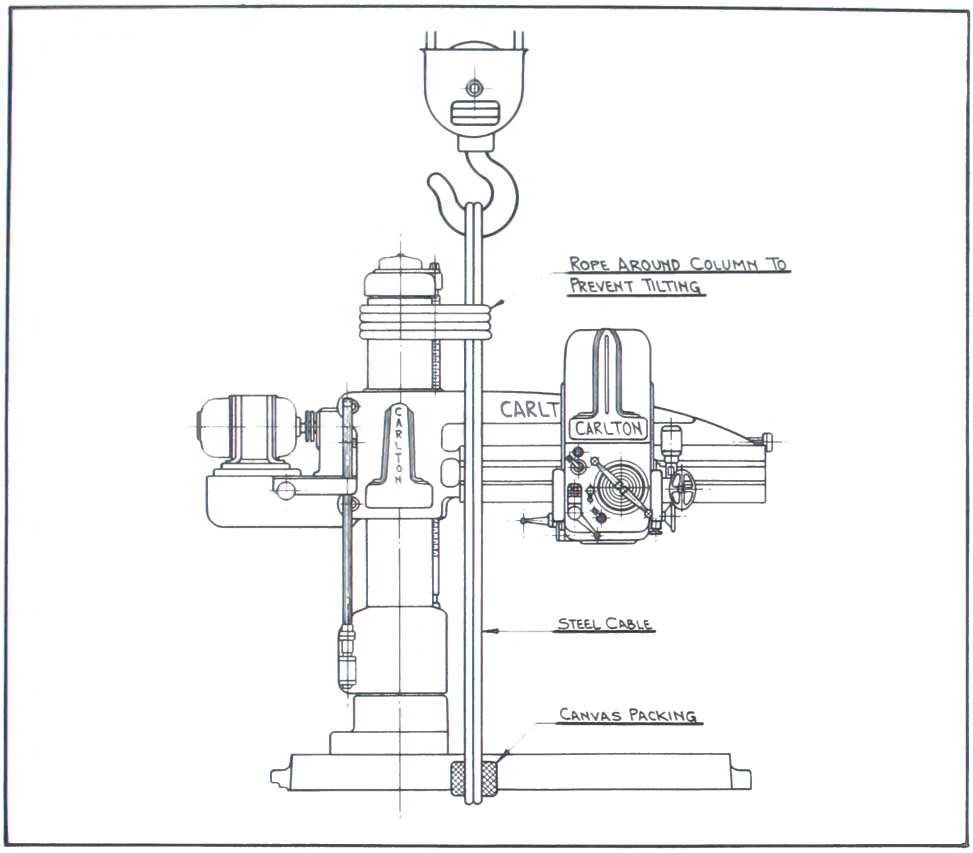
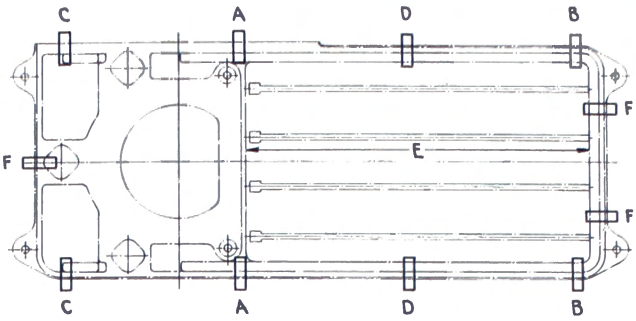


Figure 1

Levelling.

When the machine has been cleaned and placed in position, it should be levelled in accordance with Figure 2. It is of the utmost importance that the base is level at all times. When the machine was assembled at the factory the base was levelled to within .001″ per foot. When levelling the base in your Factory that same tolerance should be maintained. Use a high grade precision spirit level and follow the procedure included in Figure 2. If wedges are used, the base should be on a concrete floor. If shims are used and the machine is placed on a wooden floor we recommend placing the shims on steel plates no less than ½″ thick and 4″ x 6″



MACHINE LEVELING INSTRUCTIONS WITH ARM DOWN AND HEAD IN CENTER

1 INSERT WEDGES AT "A" UNDER BASE AS INDICATED AND LEVEL ACROSS BASE IN LINE WITH WEDGES "A".

2 INSERT WEDGES AT "B" AND LEVEL ACROSS BASE IN LINE WITH WEDGES "B", ALSO LEVEL BASE LENGTHWISE ALONG LINE "E".

3 INSERT WEDGES AT "C" AND CHECK LEVEL ACROSS BASE IN LINE WITH WEDGES "C", ALSO CHECK LEVEL BETWEEN WEDGES "A" & "C" ON BOTH SIDES OF COLUMN.

4 INSERT WEDGES AT "D" TO SUPPORT CENTER OF BASE.

5 INSERT WEDGES AT "F". BE CAREFUL NOT TO CHANGE LEVEL OBTAINED WITH WEDGES "A"-"B"-"C" & "D".

6 TIGHTEN ALL ANCHOR BOLTS.

Figure 2

long. For the best machining results it is important that the wedges are placed in all the positions shown.

If the machine is not level within the tolerances mentioned above, you will encounter many problems when operating the machine. First there is a probability that the arm will tend to drift when the column is in unclamped position. It will drift toward the side of the base that is low. Secondly the spindle will not be square with the base causing the holes that are drilled to be out of square with the machined surfaces of the workpiece.

If the machine is not supported as the drawing indicates, the chances for vibration will be increased. Vibration will cause the tool to get dull much faster than it would if the machine were supported properly and solidly. The finished surface in the holes that are machined will not be smooth and the work in general will be inferior. It is therefore very important that the instructions for levelling the machine are followed to the letter.

We do not recommend grouting the machine in concrete. If the machine is placed on a good solid floor or foundation, levelled and supported as recommended, and then bolted down, the machining results will be satisfactory.

Lubrication.

Figure 3 shows the lubrication chart of the Carlton Radial Drill. Every point of lubrication is noted on this chart along with the type of lubricant to use in each unit. With the exception of the head and cross drive unit the machine is shipped with the proper lubrication in place. It will be necessary to fill these two units before operating the machine.

We want to call special attention to the head. The oil should be put in the head until it comes up to the level line shown on the sight gauge. After the main drive motor is started the oil level will go down until it is practically empty. However, do not refill the head with oil because of this condition, because the oil is being circulated through the head and to refill it would only cause the head to leak oil when the machine sets idle over night.

Since there is no visual means of knowing when there is enough grease in the column bearings we recommend that no more than two or three pumps with a grease gun be applied at each fitting. To get too much grease in these bearings can prove to be troublesome, because the grease will work between the inner and outer column clamping surfaces and cause the column to "jump" excessively when clamping. These bearings should not be greased any more than every six months.

Starting the Machine.

After the machine has been cleaned, levelled, lubricated and power attached, the next step is starting the machine for production. The first thing to do when starting the machine is to check the direction of the

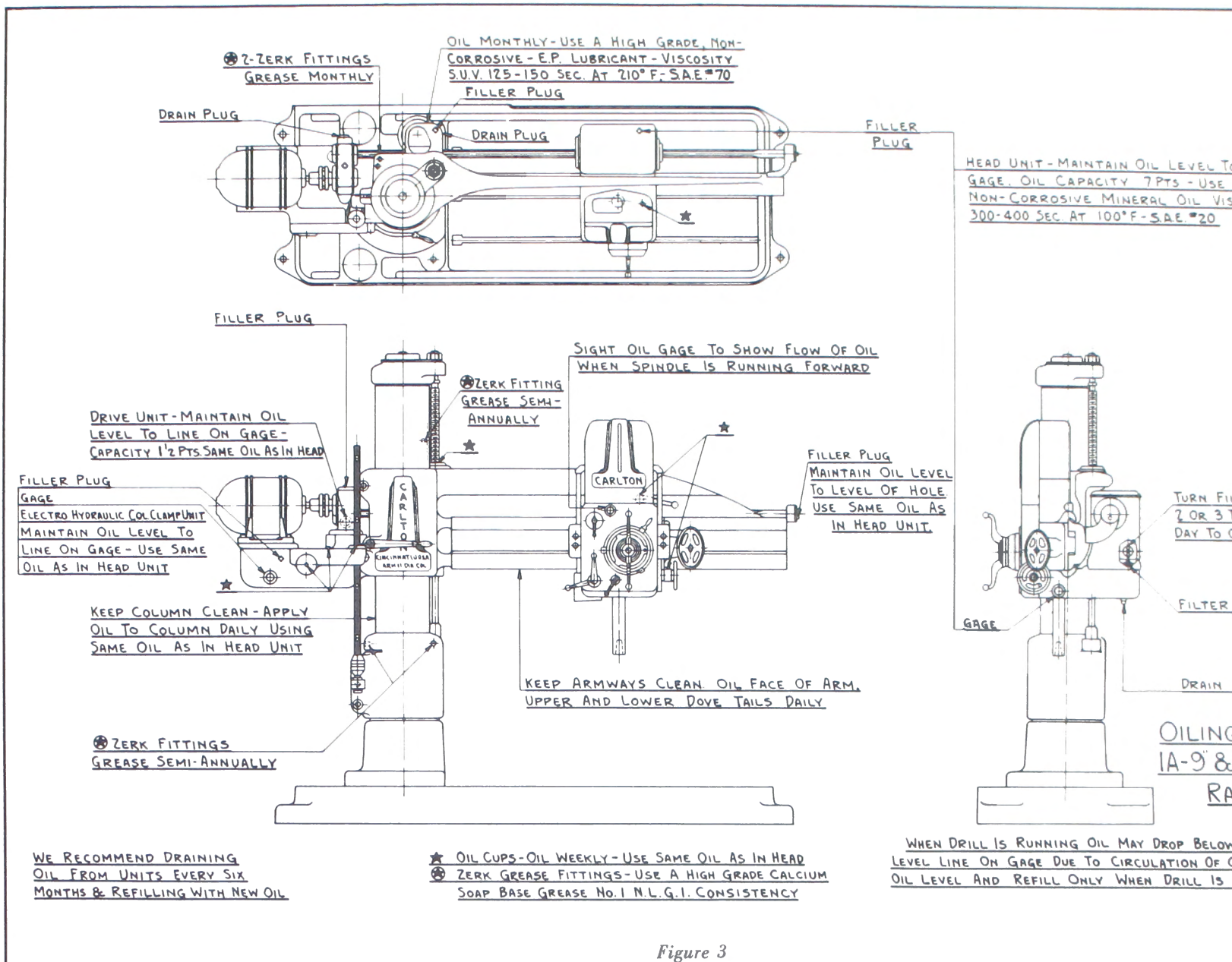

2-ZERK FITTINGS GREASE MONTHLY
OIL MONTHLY - USE A HIGH GRADE, NON-CORROSIVE - E.P. LUBRICANT - VISCOSITY S.U.V. 125-150 SEC. AT 210° F - S.A.E. #70
FILLER PLUG
DRAIN PLUG
DRAIN PLUG
FILLER PLUG
HEAD UNIT - MAINTAIN OIL LEVEL TO GAGE. OIL CAPACITY 7 PTS - USE NON-CORROSIVE MINERAL OIL VIS 300-400 SEC. AT 100° F - S.A.E. #20
FILLER PLUG
SIGHT OIL GAGE TO SHOW FLOW OF OIL WHEN SPINDLE IS RUNNING FORWARD
ZERK FITTING GREASE SEMI-ANNUALLY
DRIVE UNIT - MAINTAIN OIL LEVEL TO LINE ON GAGE - CAPACITY 1½ PTS. SAME OIL AS IN HEAD
FILLER PLUG
GAGE
ELECTRO HYDRAULIC COL CLAMP UNIT
MAINTAIN OIL LEVEL TO LINE ON GAGE - USE SAME OIL AS IN HEAD UNIT
CARLTON
FILLER PLUG
MAINTAIN OIL LEVEL TO LEVEL OF HOLE USE SAME OIL AS IN HEAD UNIT.
KEEP COLUMN CLEAN - APPLY OIL TO COLUMN DAILY USING SAME OIL AS IN HEAD UNIT
KEEP ARMWAYS CLEAN. OIL FACE OF ARM, UPPER AND LOWER DOVE TAILS DAILY
ZERK FITTINGS GREASE SEMI-ANNUALLY
GAGE
DRAIN
OILING
1A-9 &
RA
WE RECOMMEND DRAINING OIL FROM UNITS EVERY SIX MONTHS & REFILLING WITH NEW OIL
OIL CUPS - OIL WEEKLY - USE SAME OIL AS IN HEAD
ZERK GREASE FITTINGS - USE A HIGH GRADE CALCIUM SOAP BASE GREASE No. 1 N.L.G.I. CONSISTENCY
WHEN DRILL IS RUNNING OIL MAY DROP BELOW LEVEL LINE ON GAGE DUE TO CIRCULATION OF OIL LEVEL AND REFILL ONLY WHEN DRILL IS

Figure 3

motors that control the various operations. All of the motors on the machine were checked for direction before leaving the factory, and if the main driving motor runs in the right direction all of the other motors will run in the correct direction. If the machine is equipped with AC motors and control, and the main drive motor runs backward simply reverse two of the lines that are connected to the machine at the base of the column.

The various functions of the machine are controlled electrically by means of motors and pushbuttons. The pushbuttons are located on each side of the head and the function of each pushbutton is marked on the nameplate. We suggest that each of the pushbuttons are tried to make sure that all of the units that they control are performing correctly. After this has been done the machine is ready to operate.

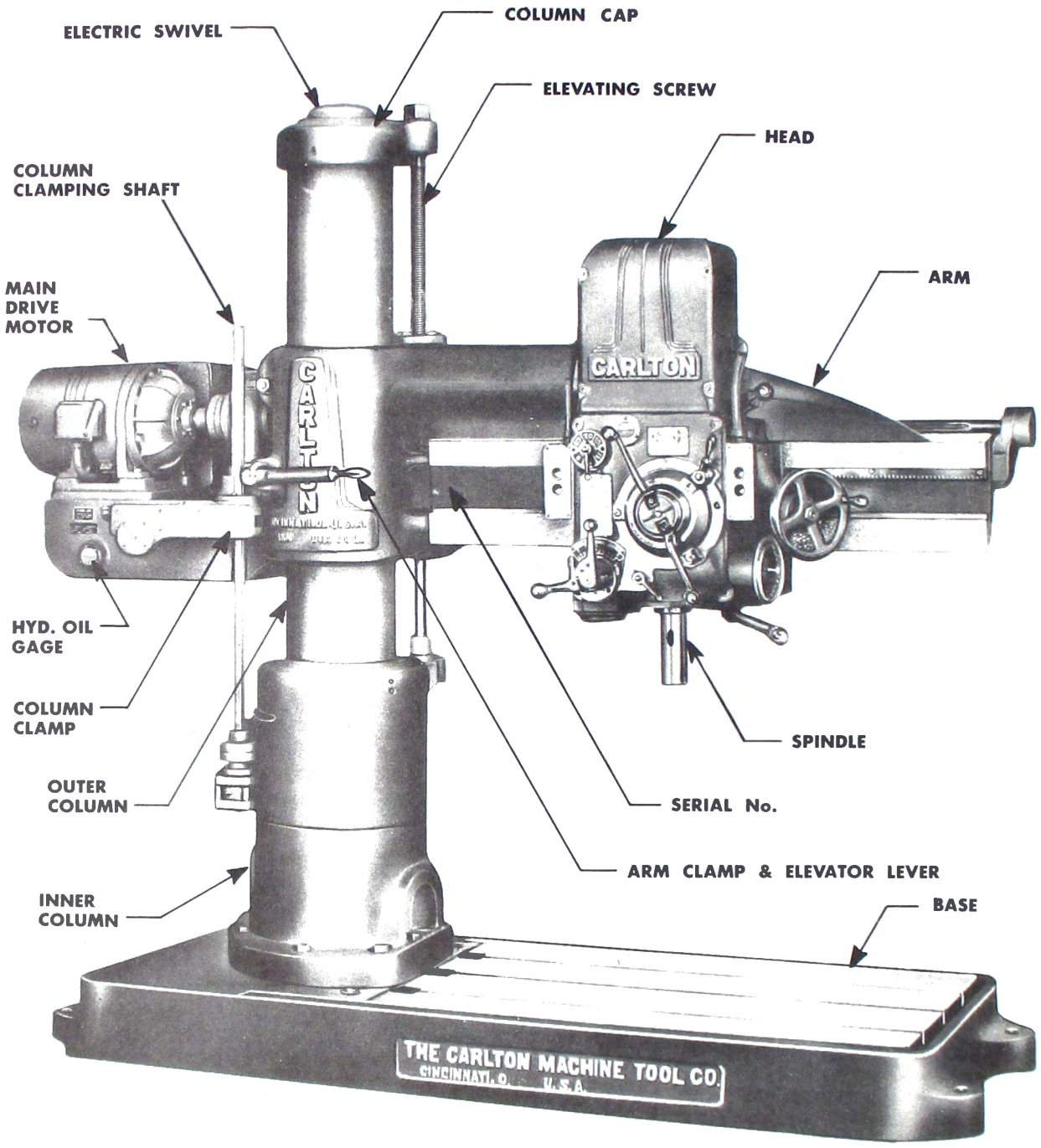


Photo 4

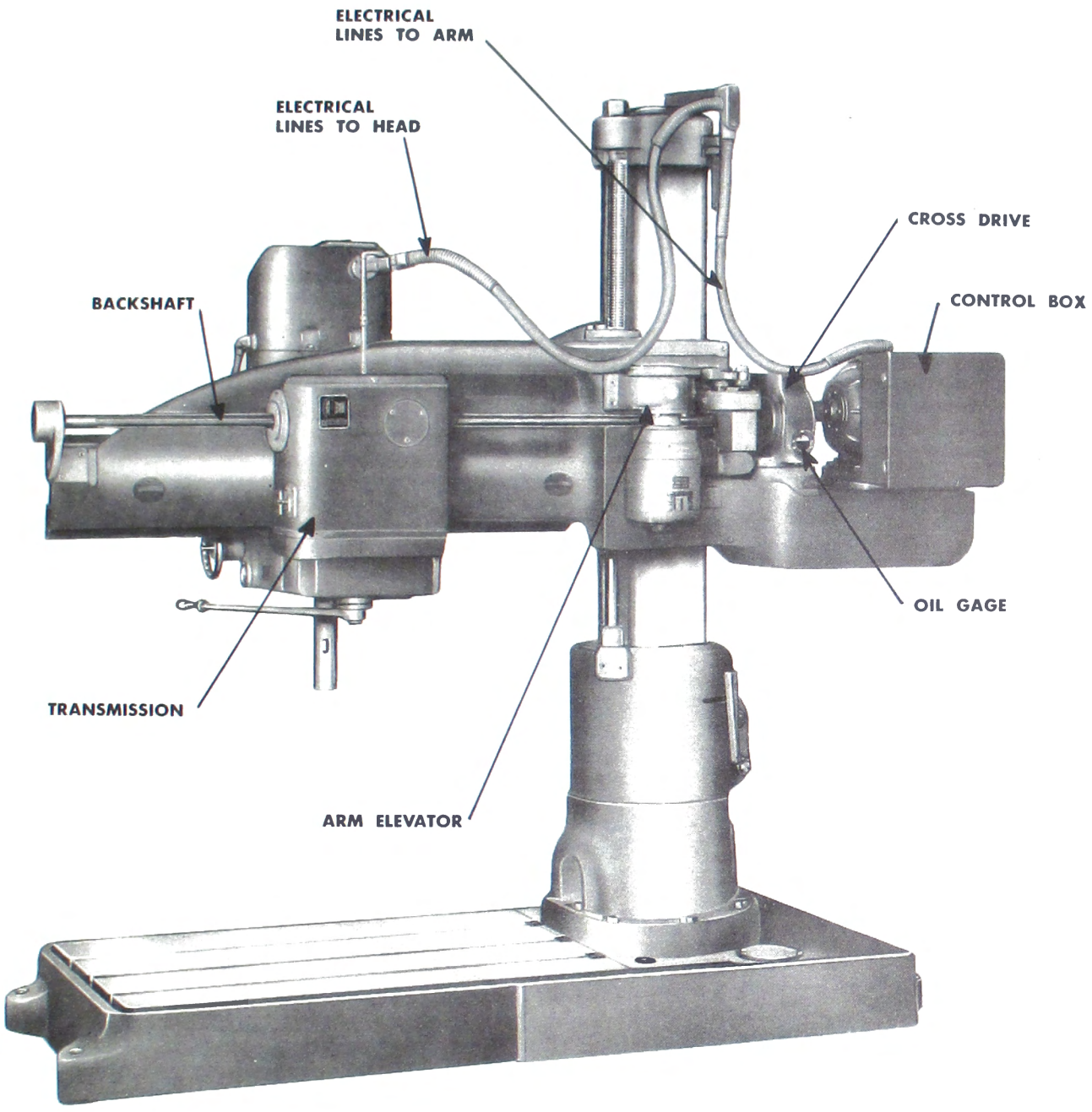

ELECTRICAL
LINES TO ARM
ELECTRICAL
LINES TO HEAD
CROSS DRIVE
CONTROL BOX
BACKSHAFT
OIL GAGE
TRANSMISSION
ARM ELEVATOR

Photo 5

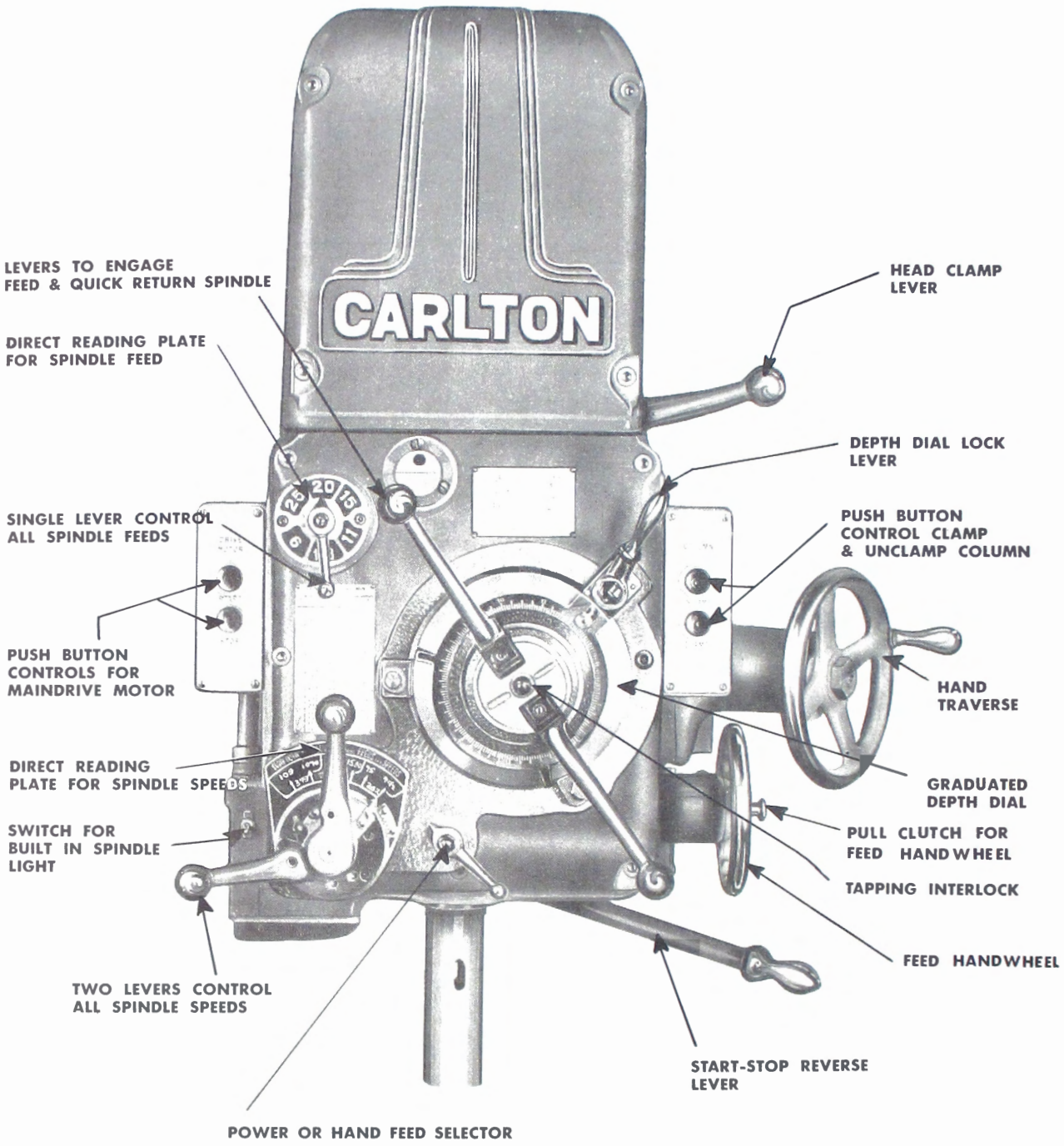

LEVERS TO ENGAGE FEED & QUICK RETURN SPINDLE
DIRECT READING PLATE FOR SPINDLE FEED
SINGLE LEVER CONTROL ALL SPINDLE FEEDS
PUSH BUTTON CONTROLS FOR MAINDRIVE MOTOR
DIRECT READING PLATE FOR SPINDLE SPEEDS
SWITCH FOR BUILT IN SPINDLE LIGHT
TWO LEVERS CONTROL ALL SPINDLE SPEEDS
POWER OR HAND FEED SELECTOR
HEAD CLAMP LEVER
DEPTH DIAL LOCK LEVER
PUSH BUTTON CONTROL CLAMP & UNCLAMP COLUMN
HAND TRAVERSE
GRADUATED DEPTH DIAL
PULL CLUTCH FOR FEED HANDWHEEL
TAPPING INTERLOCK
FEED HANDWHEEL
START-STOP REVERSE LEVER
CARLTON

Photo 6

Operation of the Machine 1A

Photo 6 shows a view of the head. All of the operating levers and pushbuttons are marked to show their location and function. The operation of the machine is controlled at the head with the exception of the arm elevating lever. On the 9" column 1A type machine the pushbutton for the column clamp is not included as standard which means that the column clamp lever is mounted on the column at the rear of the machine. The operation of these two levers will be explained further on in this article.

Starting at the upper left hand side of the Photo 6 the levers to engage the Feed and Quick Return the Spindle are designated. These levers are commonly known as the "Cow Horn Handles". These two handles control the vertical travel of the spindle, when operated manually. They also are used to engage the power feed clutch when drilling under power. To engage the power feed clutch, pull the levers forward until they stop. The spindle will then feed under power when the spindle starts to revolve.

The next lever pointed out is the Feed Change Lever, mounted directly in front of the Feed Dial. By turning this lever, six geared and selective power feeds are obtained. On a standard machine the rates of feed per one revolution of the spindle are .006", .008", .011", .015", .020" and .026". The feed that is indicated on the dial by the lever multiplied by the RPM of the spindle will determine the rate of penetration of the drill.

Below the feed dial is a speed chart. This chart is provided to assist you to determine the correct speed to run given sizes of drills in a given material. Of course, all of the speeds on this chart are not contained in the machine, so it will be necessary to select the speed closest to the one referred to on the chart. These speeds are recommended by the drill manufacturers after much research, taking into consideration the efficiency of the tool, number of holes per grind and the life of the tool under those conditions.

Adjacent to the feed dial and drill speed chart is the pushbutton for the Main Driving Motor. The pushbutton starts and stops the motor that drives the spindle.

The spindle speed change levers are located below the drill speed chart. These two levers control the twelve spindle speeds in the head. The outer lever changes three speeds and the inner lever changes four speeds. The speed plate is a direct reading plate changing position each time the inner lever is shifted. Every speed on the plate is read from the indicator on the outer lever which points directly to the speed that the spindle will revolve when spindle is set in motion. Each lever is positioned to a definite location by means of a spring loaded ball dropping into one of the indents provided in the index bushing.

To the left of the speed change levers is located the light switch that turns the light at the spindle on and off.

The Power or Hand Feed Selector is located to the right of the speed change levers. This lever indicates to an "IN" and "OUT" position. When placed in the "IN" position and the cow horn handles are engaged the spindle will feed under power. When placed in "OUT" position and the cow horn handles engaged the spindle can be fed vertically by turning the small feed handwheel on the lower right hand side of the head.

The next lever shown is the Start-Stop and Reverse Lever. This lever controls the rotation of the spindle, by engaging the frictions in the forward and reverse mechanism. When the lever is positioned in Neutral, there is a brake provided that will slow down the spindle and bring it to a stop. For the occasional large boring or trepanning job the frictions can be slipped in order to produce the slower speeds that are required. This is also an ideal arrangement for tapping into steel. The tap can be eased into the hole and then reversed slowly enough so that a sudden reversal will not break the tap.

The Feed Handwheel is located at the lower right hand corner of the head. This handwheel is used mostly for fine hand feeding and is coupled up to the feed mechanism through a wormshaft and worm. There is a pull out clutch provided in the center of this handwheel that can be disengaged when feeding under power. When drilling at high speeds and feeds this handwheel will revolve at a rapid rate of speed, so it is recommended that the clutch be disengaged at all times except when feeding by hand.

The pushbutton for clamping and unclamping the column is mounted on the right side of the head. This pushbutton station is marked "UNCLAMP" and "CLAMP". These pushbuttons are standard equipment on the 1A machines that are furnished with an 11" diameter column. If the 1A machine is furnished with a 9" diameter column a Hand Clamp Lever is mounted on the column at the rear of the machine.

The Hand Traverse Wheel is located on the right side of the head. By turning the wheel clockwise the head

will traverse in toward the column. The handle is provided for fast travel and the final or close location is obtained by grasping the rim of the wheel and by inching the wheel forward or reverse, the spindle and drill can be located on the exact spot.

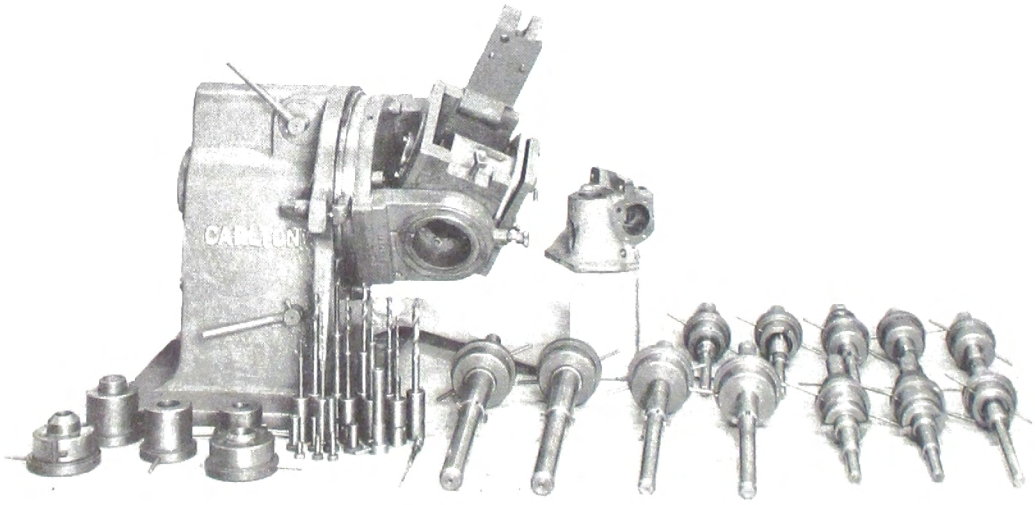
Above the traverse handwheel is the Head Clamp Lever. This lever clamps the head to the arm after the drill has been located. To clamp the head, push the lever up as far as it will go. To unclamp the head, give the lever a slight tap with the heel of the hand and the lever will fall into an unclamped position.

The Graduated Depth Dial and Clamp for this dial is adjacent to the cow horn handles. To drill to a given depth, move the drill down until the point touches the workpiece. Turn the dial until the desired depth to be drilled is directly opposite the "ZERO" on the rotating head in which the cow horn handles are mounted. Lock the depth dial in position with the locking handle. Engage the feed clutch, start the spindle in forward direction and the drill will penetrate the workpiece until the predetermined depth is reached and automatically release the feed clutch.

The Tapping Interlock is placed in the center of the rotating head and is turned 90° when tapping operations are in work in the machine. When this is done the feed clutch can not be engaged and feed the spindle at a different rate of feed than the tap lead. The tap will produce its own lead into the work and then back out of the work when the spindle is reversed.

The Arm Elevator is controlled by the lever that is located on the side of the arm near the column. This lever also controls the clamping and unclamping of the arm to the column. As long as the lever is in neutral position the arm is clamped to the column. To raise the arm, push the lever up as far as it will go. This automatically unclamps the arm and throws the electrical switch that controls the elevating motor and starts the arm moving up the column. When the desired heighth is reached, place the lever in neutral position and the arm will stop and be clamped to the column. To lower the arm, push the lever down as far as it will go and the arm will move in the down direction.

In order to position the drill in different locations on the workpiece it is necessary to swing the arm to whatever location that is in need of drilling. This means that the column upon which the arm is mounted has to be unclamped then easily moved in the desired direction. When the pushbutton clamping arrangement is not furnished on the 1A type machines, a lever is provided on the column for the purpose of clamping and unclamping the column. To unclamp the column, pull the lever up until it indexes into the slot that is milled in the clamping bush. When clamping the column push the lever down as far as it will go. Push straight down on the lever so there will be no tendency to move the drill off of the spot because of the side pull on the lever. When locating a drill or other tools to very close limits do not unclamp the column all the way. Release the lever far enough to allow the column to turn with a slight drag. The drill can be located very close and the column can then be clamped without much chance of moving the drill off of the spot.



Drilling, Tapping, Reaming, Boring and Counterboring Six Faces in One Setup with a Double Trunion Fixture.

DECIMAL EQUIVALENTS OF REGULAR SIZES

Drill	Diam. Inches	Drill	Diam. Inches	Drill	Diam. Inches	Drill	Diam. Inches	Drill	Diam. Inches
80	.0135	47	.0785	21	.1590	6.25 m/m	.2461	T	.3580
79	.0145	2. m/m	.0787	20	.1610	6.3 m/m	.2480	9.1 m/m	.3583
1/64	.0156	46	.0810	4.1 m/m	.1614	E	.2500	23/64	.3594
78	.0160	45	.0820	4.2 m/m	.1654	1/4	.2500	9.2 m/m	.3622
77	.0180	2.1 m/m	.0827	19	.1660	6.4 m/m	.2520	9.25 m/m	.3642
.5 m/m	.0197	44	.0860	4.25 m/m	.1673	6.5 m/m	.2559	9.3 m/m	.3661
76	.0200	2.2 m/m	.0866	4.3 m/m	.1693	F	.2570	U	.3680
75	.0210	2.25 m/m	.0886	18	.1695	6.6 m/m	.2598	9.4 m/m	.3701
74	.0225	43	.0890	11/64	.1719	G	.2610	9.5 m/m	.3740
.6 m/m	.0236	2.3 m/m	.0906	17	.1730	6.7 m/m	.2638	3/8	.3750
73	.0240	42	.0935	4.4 m/m	.1732	17/64	.2656	V	.3770
72	.0250	3/32	.0937	16	.1770	6.75 m/m	.2657	9.6 m/m	.3780
71	.0260	2.4 m/m	.0945	4.5 m/m	.1772	H	.2660	9.7 m/m	.3819
.7 m/m	.0276	41	.0960	15	.1800	6.8 m/m	.2677	9.75 m/m	.3839
70	.0280	40	.0980	4.6 m/m	.1811	6.9 m/m	.2717	9.8 m/m	.3858
69	.0292	2.5 m/m	.0984	14	.1820	I	2720	W	.3860
.75 m/m	.0295	39	.0995	13	.1850	7. m/m	.2756	9.9 m/m	.3898
68	.0310	38	.1015	4.7 m/m	.1850	J	.2770	25/64	.3906
1/32	.0312	2.6 m/m	.1024	4.75 m/m	.1870	7.1 m/m	.2795	10. m/m	.3937
.8 m/m	.0315	37	.1040	3/16	.1875	K	.2810	X	.3970
67	.0320	2.7 m/m	.1063	4.8 m/m	.1890	9/32	.2812	Y	.4040
66	.0330	36	.1065	12	.1890	7.2 m/m	.2835	13/32	.4062
65	.0350	2.75 m/m	.1083	11	.1910	7.25 m/m	.2854	Z	.4130
.9 m/m	.0354	7/64	.1094	4.9 m/m	.1929	7.3 m/m	.2874	10.5 m/m	.4134
64	.0360	35	.1100	10	.1935	L	.2900	27/64	.4219
63	.0370	2.8 m/m	.1102	9	.1960	7.4 m/m	.2913	11. m/m	.4331
62	.0380	34	.1110	5. m/m	.1968	M	.2950	7/16	.4375
61	.0390	33	.1130	8	.1990	7.5 m/m	.2953	11.5 m/m	.4528
1. m/m	.0394	2.9 m/m	.1142	5.1 m/m	.2008	19/64	.2969	29/64	.4531
60	.0400	32	.1160	7	.2010	7.6 m/m	.2992	15/32	.4687
59	.0410	3. m/m	.1181	13/64	.2031	N	.3020	12. m/m	.4724
58	.0420	31	.1200	6	.2040	7.7 m/m	.3031	31/64	.4844
57	.0430	3.1 m/m	.1220	5.2 m/m	.2047	7.75 m/m	.3051	12.5 m/m	.4921
1.1 m/m	.0433	1/8	.1250	5	.2055	7.8 m/m	.3071	1/2	.5000
56	.0465	3.2 m/m	.1260	5.25 m/m	.2067	7.9 m/m	.3110	13. m/m	.5118
3/64	.0469	3.25 m/m	.1280	5.3 m/m	.2087	5/16	.3125	33/64	.5156
1.2 m/m	.0472	30	.1285	4	.2090	8. m/m	.3150	17/32	.5312
1.25 m/m	.0492	3.3 m/m	.1299	5.4 m/m	.2126	O	.3160	13.5 m/m	.5315
1.3 m/m	.0512	3.4 m/m	.1339	3	.2130	8.1 m/m	.3189	35/64	.5469
55	.0520	29	.1360	5.5 m/m	.2165	8.2 m/m	.3228	14. m/m	.5512
54	.0550	3.5 m/m	.1378	7/32	.2187	P	.3230	9/16	.5625
1.4 m/m	.0551	28	.1405	5.6 m/m	.2205	8.25 m/m	.3248	14.5 m/m	.5709
1.5 m/m	.0591	9/64	.1406	2	.2210	8.3 m/m	.3268	37/64	.5781
53	.0595	3.6 m/m	.1417	5.7 m/m	.2244	21/64	.3281	15. m/m	.5906
1/16	.0625	27	.1440	5.75 m/m	.2264	8.4 m/m	.3307	19/32	.5937
1.6 m/m	.0630	3.7 m/m	.1457	1	.2280	Q	.3320	39/64	.6094
52	.0635	26	.1470	5.8 m/m	.2283	8.5 m/m	.3346	15.5 m/m	.6102
1.7 m/m	.0669	3.75 m/m	.1476	5.9 m/m	.2323	8.6 m/m	.3386	5/8	.6250
51	.0670	25	.1495	A	.2340	R	.3390	16. m/m	.6299
1.75 m/m	.0689	3.8 m/m	.1496	15/64	.2344	8.7 m/m	.3425	41/64	.6406
50	.0700	24	.1520	6. m/m	.2362	11/32	.3437	16.5 m/m	.6496
1.8 m/m	.0709	3.9 m/m	.1535	B	.2380	8.75 m/m	.3445	21/32	.6562
49	.0730	23	.1540	6.1 m/m	.2402	8.8 m/m	.3465	17. m/m	.6693
1.9 m/m	.0748	5/32	.1562	C	.2420	S	.3480	43/64	.6719
48	.0760	22	.1570	6.2 m/m	.2441	8.9 m/m	.3504	11/16	.6875
5/64	.0781	4. m/m	.1575	D	.2460	9. m/m	.3543	17.5 m/m	.6890

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DECIMAL EQUIVALENTS OF REGULAR SIZES—Continued

Drill	Diam. Inches	Drill	Diam. Inches	Drill	Diam. Inches	Drill	Diam. Inches	Drill	Diam. Inches
45/64	.7031	13/16	1.1875	42.5 m/m	1.6732	55. m/m	2.1654	2 21/32	2.6562
18. m/m	.7087	30.5 m/m	1.2008	1 11/16	1.6875	2 11/64	2.1719	67.5 m/m	2.6575
23/32	.7187	1 13/64	1.2031	43. m/m	1.6929	55.5 m/m	2.1850	2 43/64	2.6719
18.5 m/m	.7283	17/32	1.2187	1 45/64	1.7031	2 3/16	2.1875	68. m/m	2.6772
47/64	.7344	31. m/m	1.2205	43.5 m/m	1.7126	2 13/64	2.2031	2 11/16	2.6875
19. m/m	.7480	1 15/64	1.2344	1 23/32	1.7187	56. m/m	2.2047	68.5 m/m	2.6968
3/4	.7500	31.5 m/m	1.2402	44. m/m	1.7323	2 7/32	2.2187	2 45/64	2.7031
49/64	.7656	1 1/4	1.2500	1 47/64	1.7344	56.5 m/m	2.2244	69. m/m	2.7165
19.5 m/m	.7677	32. m/m	1.2598	1 3/4	1.7500	2 15/64	2.2344	2 23/32	2.7187
25/32	.7812	1 17/64	1.2656	44.5 m/m	1.7520	57. m/m	2.2441	2 47/64	2.7344
20. m/m	.7874	32.5 m/m	1.2795	1 49/64	1.7656	2 1/4	2.2500	69.5 m/m	2.7362
51/64	.7969	1 9/32	1.2812	45. m/m	1.7717	57.5 m/m	2.2638	2 3/4	2.7500
20.5 m/m	.8071	1 19/64	1.2969	1 25/32	1.7812	2 17/64	2.2656	70. m/m	2.7559
13/16	.8125	33. m/m	1.2992	45.5 m/m	1.7913	2 9/32	2.2812	2 49/64	2.7656
21. m/m	.8268	1 5/16	1.3125	1 51/64	1.7969	58. m/m	2.2835	70.5 m/m	2.7756
53/64	.8281	33.5 m/m	1.3189	46. m/m	1.8110	2 19/64	2.2969	2 25/32	2.7812
27/32	.8437	1 21/64	1.3281	1 13/16	1.8125	58.5 m/m	2.3031	71. m/m	2.7953
21.5 m/m	.8465	34. m/m	1.3386	1 53/64	1.8281	2 5/16	2.3125	2 51/64	2.7969
55/64	.8594	1 11/32	1.3437	46.5 m/m	1.8307	59. m/m	2.3228	2 13/16	2.8125
22. m/m	.8661	34.5 m/m	1.3583	1 27/32	1.8437	2 21/64	2.3281	71.5 m/m	2.8150
7/8	.8750	1 23/64	1.3594	47. m/m	1.8504	59.5 m/m	2.3425	2 53/64	2.8281
22.5 m/m	.8858	1 3/8	1.3750	1 55/64	1.8594	2 11/32	2.3437	72. m/m	2.8346
57/64	.8906	35. m/m	1.3780	47.5 m/m	1.8701	2 23/64	2.3594	2 27/32	2.8437
23. m/m	.9055	1 25/64	1.3906	1 7/8	1.8750	60. m/m	2.3622	72.5 m/m	2.8543
29/32	.9062	35.5 m/m	1.3976	48. m/m	1.8898	2 3/8	2.3750	2 55/64	2.8594
59/64	.9219	1 13/32	1.4062	1 57/64	1.8906	60.5 m/m	2.3819	73. m/m	2.8740
23.5 m/m	.9252	36. m/m	1.4173	1 29/32	1.9062	2 25/64	2.3906	2 7/8	2.8750
15/16	.9375	1 27/64	1.4219	48.5 m/m	1.9094	61. m/m	2.4016	2 57/64	2.8906
24. m/m	.9449	36.5 m/m	1.4370	1 59/64	1.9219	2 13/32	2.4062	73.5 m/m	2.8937
61/64	.9531	1 7/16	1.4375	49. m/m	1.9291	61.5 m/m	2.4213	2 29/32	2.9062
24.5 m/m	.9646	1 29/64	1.4531	1 15/16	1.9375	2 27/64	2.4219	74. m/m	2.9134
31/32	.9687	37. m/m	1.4567	49.5 m/m	1.9488	2 7/16	2.4375	2 59/64	2.9219
25. m/m	.9843	1 15/32	1.4687	1 61/64	1.9531	62. m/m	2.4409	74.5 m/m	2.9331
63/64	.9844	37.5 m/m	1.4764	50. m/m	1.9685	2 29/64	2.4531	2 15/16	2.9375
1	1.0000	1 31/64	1.4844	1 31/32	1.9687	62.5 m/m	2.4606	75. m/m	2.9528
25.5 m/m	1.0039	38. m/m	1.4961	1 63/64	1.9844	2 15/32	2.4687	2 61/64	2.9531
1 1/64	1.0156	1 1/2	1.5000	50.5 m/m	1.9882	63. m/m	2.4803	2 31/32	2.9687
26. m/m	1.0236	1 33/64	1.5156	2	2.0000	2 31/64	2.4844	75.5 m/m	2.9724
1 1/32	1.0312	38.5 m/m	1.5157	51. m/m	2.0079	63.5 m/m	2.5000	2 63/64	2.9844
26.5 m/m	1.0433	1 17/32	1.5312	2 1/64	2.0156	2 1/2	2.5000	76. m/m	2.9921
1 3/64	1.0469	39. m/m	1.5354	51.5 m/m	2.0276	2 33/64	2.5156	3	3.0000
1 1/16	1.0625	1 35/64	1.5469	2 1/32	2.0312	64. m/m	2.5197	3 1/32	3.0312
27. m/m	1.0630	39.5 m/m	1.5551	2 3/64	2.0469	2 17/32	2.5312	3 1/16	3.0625
1 5/64	1.0781	1 9/16	1.5625	52. m/m	2.0472	64.5 m/m	2.5394	3 3/32	3.0937
27.5 m/m	1.0827	40. m/m	1.5748	2 1/16	2.0625	2 35/64	2.5469	3 1/8	3.1250
1 3/32	1.0937	1 37/64	1.5781	52.5 m/m	2.0669	65. m/m	2.5591	3 5/32	3.1562
28. m/m	1.1024	1 19/32	1.5937	2 5/64	2.0781	2 9/16	2.5625	3 3/16	3.1875
1 7/64	1.1094	40.5 m/m	1.5945	53. m/m	2.0866	2 37/64	2.5781	3 7/32	3.2187
28.5 m/m	1.1220	1 39/64	1.6094	2 3/32	2.0937	65.5 m/m	2.5787	3 1/4	3.2500
1 1/8	1.1250	41. m/m	1.6142	53.5 m/m	2.1063	2 19/32	2.5937	3 9/32	3.2812
1 9/64	1.1406	1 5/8	1.6250	2 7/64	2.1094	66. m/m	2.5984	3 5/16	3.3125
29. m/m	1.1417	41.5 m/m	1.6339	2 1/8	2.1250	2 39/64	2.6094	3 11/32	3.3437
1 5/32	1.1562	1 41/64	1.6406	54. m/m	2.1260	66.5 m/m	2.6181	3 3/8	3.3750
29.5 m/m	1.1614	42. m/m	1.6535	2 9/64	2.1406	2 5/8	2.6250	3 7/16	3.4375
1 11/64	1.1719	1 21/32	1.6562	54.5 m/m	2.1457	67. m/m	2.6378	3 1/2	3.5000
30. m/m	1.1811	1 43/64	1.6719	2 5/32	2.1562	2 41/64	2.6406		

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TABLE OF CUTTING SPEEDS

FRACTION SIZE DRILLS

Feet per Minute	30′	40′	50′	60′	70′	80′	90′	100′	110′	120′	130′	140′	150′
Diameter Inches	Revolutions per Minute												
1/16	1833	2445	3056	3667	4278	4889	5500	6111	6722	7334	7945	8556	9167
1/8	917	1222	1528	1833	2139	2445	2750	3056	3361	3667	3973	4278	4584
3/16	611	815	1019	1222	1426	1630	1833	2037	2241	2445	2648	2852	3056
1/4	458	611	764	917	1070	1222	1375	1528	1681	1833	1986	2139	2292
5/16	367	489	611	733	856	978	1100	1222	1345	1467	1589	1711	1833
3/8	306	407	509	611	713	815	917	1019	1120	1222	1324	1426	1528
7/16	262	349	437	524	611	698	786	873	960	1048	1135	1222	1310
1/2	229	306	382	458	535	611	688	764	840	917	993	1070	1146
5/8	183	244	306	367	428	489	550	611	672	733	794	856	917
3/4	153	203	255	306	357	407	458	509	560	611	662	713	764
7/8	131	175	218	262	306	349	393	436	480	524	568	611	655
1	115	153	191	229	267	306	344	382	420	458	497	535	573
1 1/8	102	136	170	204	238	272	306	340	373	407	441	475	509
1 1/4	92	122	153	183	214	244	275	306	336	367	397	428	458
1 3/8	83	111	139	167	194	222	250	278	306	333	361	389	417
1 1/2	76	102	127	153	178	204	229	255	280	306	331	357	382
1 5/8	70	94	117	141	165	188	212	235	259	282	306	329	353
1 3/4	65	87	109	131	153	175	196	218	240	262	284	306	327
1 7/8	61	81	102	122	143	163	183	204	224	244	265	285	306
2	57	76	95	115	134	153	172	191	210	229	248	267	287
2 1/4	51	68	85	102	119	136	153	170	187	204	221	238	255
2 1/2	46	61	76	92	107	122	137	153	168	183	199	214	229
2 3/4	42	56	69	83	97	111	125	139	153	167	181	194	208
3	38	51	64	76	89	102	115	127	140	153	166	178	191
3 1/2	33	43	55	65	76	87	98	109	120	131	142	153	164
4	29	38	47	57	67	76	86	95	105	114	124	134	143
4 1/2	25	34	43	51	60	68	76	85	93	102	110	118	127
5	23	31	38	46	54	61	69	76	84	92	99	107	115
5 1/2	21	28	35	42	49	56	62	69	76	83	90	97	104
6	19	25	32	38	45	51	57	64	70	76	83	88	95
6 1/2	18	23	29	35	41	47	53	59	65	71	76	82	88
7	16	22	27	33	38	44	49	55	60	66	71	76	82
8	14	19	24	28	33	38	43	48	53	57	62	67	72
9	13	17	21	25	29	34	38	42	47	51	55	59	64
10	11	15	19	23	27	30	34	38	42	46	49	53	57

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TABLE OF CUTTING SPEEDS
NUMBER SIZE DRILLS

Feet Per Min.	30′	40′	50′	60′	70′	80′	90′	100′	110′	120′	130′	140′	150′
No. Size	Revolutions per Minute												
1	503	670	838	1005	1173	1340	1508	1675	1843	2010	2179	2346	2513
2	518	691	864	1037	1210	1382	1555	1728	1901	2074	2247	2420	2593
3	538	717	897	1076	1255	1434	1614	1793	1974	2152	2331	2511	2690
4	548	731	914	1097	1280	1462	1645	1828	2010	2193	2376	2560	2741
5	558	744	930	1115	1301	1487	1673	1859	2045	2230	2416	2602	2788
6	562	749	936	1123	1310	1498	1685	1872	2060	2247	2434	2621	2809
7	570	760	950	1140	1330	1520	1710	1900	2090	2281	2470	2660	2850
8	576	768	960	1151	1343	1535	1727	1919	2111	2303	2495	2687	2879
9	585	780	975	1169	1364	1559	1754	1949	2144	2339	2534	2728	2923
10	592	790	987	1184	1382	1579	1777	1974	2171	2369	2566	2764	2961
11	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3001
12	606	808	1010	1213	1415	1617	1819	2021	2223	2425	2627	2829	3032
13	620	826	1032	1239	1450	1652	1859	2065	2271	2479	2684	2891	3097
14	630	840	1050	1259	1469	1679	1889	2099	2309	2518	2728	2938	3148
15	638	851	1064	1276	1489	1702	1914	2127	2334	2546	2759	2971	3183
16	647	863	1079	1295	1511	1726	1942	2158	2374	2590	2806	3021	3237
17	662	883	1104	1325	1546	1766	1987	2208	2429	2650	2870	3091	3313
18	678	904	1130	1356	1582	1808	2034	2260	2479	2704	2930	3155	3380
19	690	920	1151	1381	1611	1841	2071	2301	2531	2761	2991	3222	3453
20	712	949	1186	1423	1660	1898	2135	2372	2610	2847	3084	3322	3559
21	721	961	1201	1441	1681	1922	2162	2402	2644	2883	3123	3363	3604
22	730	973	1217	1460	1703	1946	2190	2433	2676	2920	3164	3406	3649
23	744	992	1240	1488	1736	1984	2232	2480	2728	2976	3224	3472	3720
24	754	1005	1257	1508	1759	2010	2262	2513	2764	3016	3267	3518	3769
25	767	1022	1276	1533	1789	2044	2300	2555	2810	3066	3322	3577	3832
26	779	1039	1299	1559	1819	2078	2338	2598	2858	3118	3378	3638	3898
27	796	1061	1327	1592	1857	2122	2388	2653	2919	3183	3448	3714	3979
28	816	1088	1360	1631	1903	2175	2447	2719	2990	3262	3534	3806	4078
29	843	1124	1405	1685	1966	2247	2528	2809	3090	3370	3651	3932	4213
30	892	1189	1487	1784	2081	2378	2676	2973	3270	3567	3864	4162	4459
31	955	1273	1592	1910	2228	2546	2865	3183	3501	3821	4138	4456	4775
32	988	1317	1647	1976	2305	2634	2964	3293	3622	3951	4281	4610	4939
33	1014	1352	1690	2028	2366	2704	3042	3380	3718	4056	4394	4732	5070
34	1032	1376	1721	2065	2409	2753	3097	3442	3785	4129	4474	4818	5162
35	1042	1389	1736	2083	2430	2778	3125	3472	3821	4167	4514	4861	5209
36	1076	1435	1794	2152	2511	2870	3228	3587	3945	4304	4663	5021	5380
37	1102	1469	1837	2204	2571	2938	3306	3673	4040	4407	4775	5142	5509
38	1129	1505	1882	2258	2634	3010	3387	3763	4140	4516	4892	5269	5645
39	1152	1536	1920	2303	2687	3071	3455	3839	4222	4607	4991	5374	5758
40	1169	1559	1949	2339	2729	3118	3508	3898	4287	4677	5067	5457	5846

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TABLE OF CUTTING SPEEDS

NUMBER SIZE DRILLS—Continued

Feet Per Min.	30′	40′	50′	60′	70′	80′	90′	100′	110′	120′	130′	140′	150′
No. Size	Revolutions per Minute												
41	1194	1592	1990	2387	2785	3183	3581	3979	4377	4775	5172	5570	5968
42	1226	1634	2043	2451	2860	3268	3677	4085	4494	4902	5311	5719	6128
43	1288	1717	2146	2575	3004	3434	3863	4292	4721	5150	5579	6008	6438
44	1333	1777	2221	2665	3109	3554	3999	4442	4886	5330	5774	6218	6662
45	1397	1863	2329	2795	3261	3726	4192	4658	5124	5590	6056	6522	6987
46	1415	1886	2358	2830	3301	3773	4244	4716	5187	5659	6130	6602	7074
47	1460	1946	2433	2920	3406	3893	4379	4866	5352	5839	6326	6812	7299
48	1508	2010	2513	3016	3518	4021	4523	5026	5528	6031	6534	7036	7539
49	1570	2093	2617	3140	3663	4186	4710	5233	5756	6279	6808	7326	7849
50	1637	2183	2729	3274	3820	4366	4911	5457	6002	6548	7094	7640	8185
51	1710	2280	2851	3421	3991	4561	5131	5701	6271	6841	7413	7982	8552
52	1805	2406	3008	3609	4211	4812	5414	6015	6619	7218	7820	8421	9023
53	1924	2566	3207	3848	4490	5131	5773	6414	7062	7704	8346	8988	9630
54	2084	2778	3473	4167	4862	5556	6251	6945	7639	8334	9028	9723	10417
55	2204	2938	3673	4408	5142	5877	6611	7346	8080	8815	9549	10284	11028
56	2465	3286	4108	4929	5751	6572	7394	8215	9036	9857	10678	11500	12322
57	2671	3561	4452	5342	6232	7122	8013	8903	9771	10660	11548	12436	13325
58	2729	3637	4547	5456	6367	7275	8186	9095	10004	10913	11823	12732	13642
59	2795	3726	4658	5590	6521	7453	8388	9316	10248	11180	12111	13043	13975
60	2865	3820	4775	5729	6684	7639	8594	9549	10504	11459	12414	13369	14324
61	2938	3918	4897	5876	6856	7835	8815	9794	10774	11753	12732	13712	14691
62	3015	4020	5025	6030	7035	8040	9045	10050	11057	12060	13068	14073	15078
63	3096	4128	5160	6192	7224	8256	9288	10320	11366	12398	13421	14453	15485
64	3183	4244	5305	6366	7427	8488	9549	10610	11671	12732	13793	14854	15915
65	3273	4364	5455	6546	7637	8728	9819	10910	12005	13096	14187	15279	16370
66	3474	4632	5790	6948	8106	9264	10422	11580	12732	13890	15047	16205	17362
67	3582	4776	5970	7164	8358	9552	10746	11940	13130	14324	15517	16712	17905
68	3696	4928	6160	7392	8624	9856	11088	12320	13554	14786	16018	17250	18482
69	3918	5224	6530	7836	9142	10488	11754	13060	14389	15697	17006	18314	19622
70	4091	5456	6820	8184	9548	10912	12276	13640	15006	16370	17734	19099	20463
71	4419	5892	7365	8838	10311	11784	13257	14730	16160	17629	19099	20568	22037
72	4584	6112	7640	9168	10696	12224	13752	15280	16807	18335	19863	21390	22918
73	4776	6368	7960	9552	11144	12736	14328	15920	17507	19099	20690	22282	23873
74	5106	6808	8510	10212	11914	13616	15318	17020	18674	20372	22069	23767	25465
75	5457	7276	9095	10914	12733	14552	16371	18190	20008	21827	23646	25465	27284
76	5730	7640	9550	11460	13370	15280	17190	19100	21008	22918	24828	26738	28648
77	6366	8488	10610	12732	14854	16976	19098	21220	23343	25465	27587	29709	31831
78	7161	9548	11935	14322	16709	19096	21483	23870	26260	28648	31035	33422	35810
79	7902	10536	13170	15804	18438	21072	23706	26340	28988	31611	34246	36880	39514
80	8490	11320	14150	16980	19810	22640	25470	28300	31123	33953	36782	39612	42441

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DRILLING SPEEDS AND FEEDS

SPEEDS

THE subject of the speed at which a drill should run and the feed per revolution is one upon which no rule can be given. The following recommended speeds and feeds should be considered as guides only, due to the variations in materials, methods and other operating conditions. The correct speeds and feeds should be determined by good, sound judgment for each particular case.

SUGGESTED SPEEDS FOR HIGH SPEED DRILLS

	Speed in F.P.M.		Speed in F.P.M.
Alloy Steel, 300 to 400 Brinell	20- 30	Malleable Iron	80- 90
Stainless Steel	30- 40	Monel Metal	40- 50
Automotive Steel Forgings	40- 50	High Tensile Strength Bronze	70-150
Tool Steel, 1.2C	50- 60	Ordinary Brass and Bronze	200-300
Steel .4 to .5C	70- 80	Aluminum and its alloys	200-300
Mild Machinery Steel .2 to .3C	80-110	Magnesium and its alloys	250-400
Hard Chilled Cast Iron	30- 40	Slate, Marble and Stone	15- 25
Medium Hard Cast Iron	70-100	Bakelite and similar material	100-150
Soft Cast Iron	100-150	Wood	300-400

Carbon drills should be run at speeds of from 40 to 50% of those given above.

FEEDS

Feeds are governed by the size of the drill and the material drilled. The general rule is—use a feed of .001 to .002 inch per revolution for drills smaller than 1/8 inch, .002 to .004 inch for drills 1/8 to 1/4 inch, .004 to .007 inch for drills 1/4 to 1/2 inch, .007 to .015 inch for drills 1/2 inch to 1 inch, and .015 to .025 inch for drills larger than 1 inch. Alloy and hard steels should be drilled at a lighter feed than given above while cast iron, brass and aluminum may usually be drilled with a heavier feed than given above.

INDICATION OF EXTREME SPEEDS AND FEEDS A drill split up the web is evidence of too much feed or insufficient lip clearance at the center due to improper grinding. The rapid wearing away of the extreme outer corners of the cutting edges indicates that the speed is too high. The best results will be obtained when the effect of the work on the tool is somewhere between the above conditions. A drill chipping or breaking out at the cutting edges indicates that either the feed is too heavy or the drill has been ground with too much lip clearance.

When drilling abrasive or work hardening materials, too light a feed will result in excessive wear of the cutting edges. In other materials too light a feed may sometimes give a very flexible chip which refuses to break up and packs in the flutes.

LUBRICANTS

Lubricants have many functions, several of which are as follows:

1. To cool both the cutting edges of the tool and the work being machined. This can best be done by directing as large a volume of the coolant as possible on the cutting edges. On thin walled work it often helps to allow a large volume to flow onto and around the piece.
2. To lubricate the chips. This aids in chip clearance.
3. To force the chips back from the cutting edges and out the flutes of oil feeding drills. High oil pressures will accomplish this more efficiently.
4. To improve the finish of the work. The selection and proper application of the lubricant will materially influence the machined finish.

It is suggested that lubrication problems be referred to a reputable manufacturer of cutting oils. The following list of lubricants should be used as suggestions only:

Aluminum and its alloys: Soluble oil, kerosene and lard oil compounds, light non-viscous neutral oil, kerosene and soluble oil mixtures.

Brass: Dry, soluble oil, kerosene and lard oil compounds, light non-viscous neutral oil.

Copper: Soluble oil, winter strained lard oil, Oleic acid compounds.

Cast Iron: Dry or with a jet of compressed air for a cooling medium.

Malleable Iron: Soluble oil, non-viscous neutral oil.

Monel Metal: Soluble oil, sulfurized mineral oil.

Steel, ordinary: Soluble oil, sulfurized oil, high E. P. Value mineral oil.

Steel, very hard and refractory: Soluble oil, sulfurized oil, turpentine.

Steel, Stainless: Soluble oil, sulfurized mineral oil.

Wrought Iron: Soluble oil, sulfurized oil, high animal oil content mineral oil compound.

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Suggestions for the Regrinding of Drills

TO get the maximum efficiency and full life of a drill, it is absolutely essential that it be properly ground at the point. The two cutting edges must be (1st) of exactly the same length (2nd) of the same inclination to the axis of the drill. 59° is recommended as the best angle for ordinary purposes (see Fig. 1).

Another important thing to be considered in grinding drill points is the angle of lip clearance, or the proper backing off of the cutting edges. Experience has shown that a clearance angle of between 8° and 12° at the periphery of the drill is best for regular shop work. This angle should be measured immediately back of the cutting edge as shown in Fig. 2. The clearance angle, however, should be gradually increased as the center of the drill is approached, until the line across the center of the web stands at an angle with the cutting edges of approximately 120°-135°, as shown in Fig. 3.

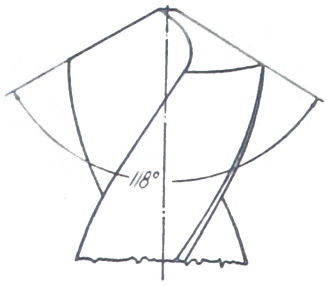

Figure 1

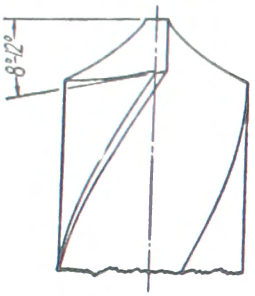

Figure 2

For a heavy feed in soft material the angle of lip clearance may be increased to 15° at the periphery, but care should be taken that the angle at the center is given a corresponding increase. The failure to give sufficient angle of lip clearance at the center of the drill is the *principal cause of splitting drills up the web.*

If you are having trouble with your drills examine the grinding of the points.

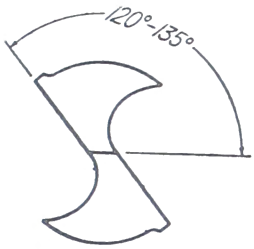

Figure 3

THE LITTLE DOCTOR

A FIRST AID FOR DRILL PRESS OPERATORS

SYMPTOMS	PROBABLE CAUSE	REMEDY
BREAKING of drill.	Spring or back lash in press or work. Too little lip clearance. Too low speed in proportion to the feed. Dull drill. Improper chip clearing by drill.	Test press and work for rigidity and alignment. Regrind properly. Increase speed or decrease feed. Sharpen drill. Correct application.
BREAKING down of outer corners of cutting edges.	Material being drilled has hard spots, scale or sand inclusions. Too much speed. Improper cutting compound. No lubricant at point of drill. Improper chip clearing by drill.	Reduce speed. Use proper cutting compound. Correct application.
BREAKING of drill when drilling brass or wood.	Chips clog up flutes.	Increase speed. Use drills designed for these materials.
BROKEN TANG.	Imperfect fit of taper shank in the socket—due to nicks, dirt, burrs, or worn out socket	Get a new socket or ream old one to prevent recurrence.
CHIPPING of margin.	Oversize jig bushing.	Use proper size bushing.
CHIPPING of lip or cutting edges.	Too much feed. Too much lip clearance.	Reduce feed—see table on page 7. Regrind properly.
CHIPPING or checking of a high speed drill.	Heated and cooled too quickly while grinding or while drilling. Too much feed.	Warm slowly before using. Do not throw cold water on hot drill while grinding or drilling. Reduce feed.
HOLE too large.	Unequal angle or length of the cutting edges—or both. Loose spindle.	Regrind properly. Test spindle for rigidity.
ONLY one lip cutting.	Unequal length or angle of cutting lips or both.	Regrind drill properly.
SPLITTING up center.	Too little lip clearance. Too much feed.	Regrind with proper lip clearance. Reduce feed.
ROUGH HOLE.	Dull or improperly ground drill. Lack of lubricant or wrong lubricant. Improper set-up. Too much feed.	Regrind properly. Lubricate or change lubricant. Reduce feed.

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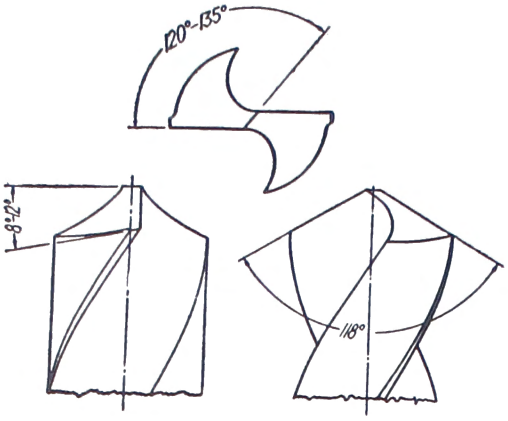
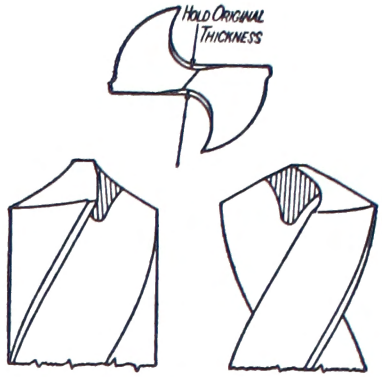
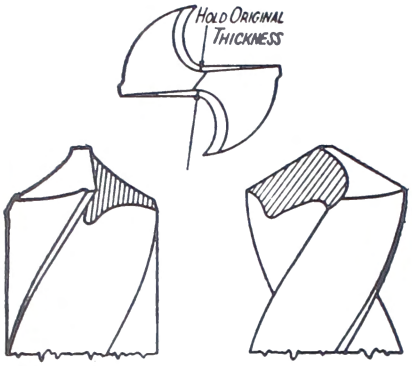
METHODS OF POINTING AND THINNING DRILLS



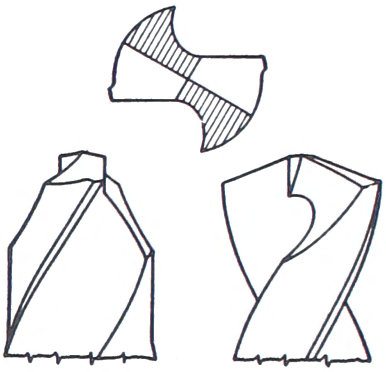
REGULAR DRILL POINT
Standard Point for a General Use.



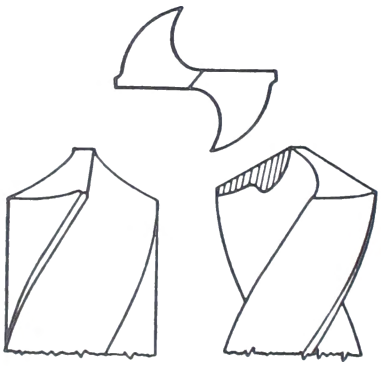
THINNED POINT
Usual method of thinning the point of a drill when the web has become too thick because of repeated re-pointing.



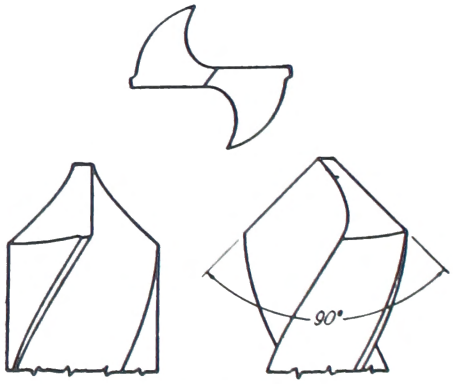
UNDERCUT THINNED POINT
Another common method of web thinning. If properly done this type of thinning will produce a fine curled chip.



OFFSET POINT
General method of thinning and pointing heavy web drills.



REDUCED RAKE POINT
The added strength of the cutting edge is of help in drilling very hard material. Also used for shallow holes in any material to prevent "grabbing" when breaking through the bottom of the hole.



LONG POINT
Often used in softer materials such as plastics, wood, cast-iron, etc.

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REAMING HINTS

REAMING SPEEDS Speeds for machine reaming may vary considerably depending in part on the material to be reamed, type of machine, and required finish and accuracy. In general most machine reaming is done at about ⅔ the speed used for drilling the same material. Speeds for drilling are shown on page 7.

REAMING FEEDS Feeds for reaming are usually much higher than those used for drilling, often running 200 to 300% of drill feeds. Too low a feed may result in excessive reamer wear. At all times it is necessary that the feed be high enough to permit the reamer to cut rather than to rub or burnish. Too high a feed may tend to reduce the accuracy of the hole and may also lower the quality of the finish. The basic idea is to use as high a feed as possible and still produce the required finish and accuracy.

STOCK TO BE REMOVED For the same reason, insufficient stock for reaming may result in a burnishing rather than a cutting action. It is very difficult to generalize on this phase as it is tied in closely with type of material, feed, finish required, depth of hole, and chip capacity of the reamer. For machine reaming, .010" on a ¼" hole, .015" on a ½" hole, up to .025" on a 1½" hole, seems a good starting point. For hand reaming, stock allowances are much smaller, partly because of the difficulty in forcing the reamer through greater stock. A common allowance is .001" to .003".

ALIGNMENT In the ideal reaming job, the spindle, reamer, bushing, and hole to be machined are all in perfect alignment. Any variation from this tends to increase reamer wear and detracts from the accuracy of the hole. Tapered, oversize, or bell-mouthed holes should call for a check of alignment. Sometimes the bad effects of misalignment can be reduced through the use of floating or adjustable holder. Quite often if the user will grind a slight back taper on the reamer it will be of help in overcoming the effects of misalignment.

CHATTER The presence of chatter while reaming has a very bad effect on reamer life and on the finish in the hole. Chatter may be the result of one of several causes, some of which are listed:

1. Excessive speed.
2. Too much clearance on reamer.
3. Lack of rigidity in jig or machine.
4. Insecure holding of work.
5. Excessive overhang of reamer or spindle.
6. Excessive looseness in floating holder.
7. Too light a feed.

Correcting the cause can materially increase both reamer life and the quality of the reamed holes.

COOLANT In reaming, the emphasis is usually on finish and a coolant is normally chosen for this purpose rather than for cooling. Quite often this means a change from that recommended for drilling as shown on page 7 but in general this list will be found satisfactory.

REAMER REGRINDING In obtaining maximum economy from reamers the same principles apply as in the case of most other cutting tools. One of these principles is not to allow a tool to become too dull. It is best practice to regrind the chamfer on a reamer long before it exhibits excessive wear or refuses to cut. This sharpening is usually restricted to the entering taper or chamfer. It can be done on almost any tool and cutter grinder. Care must be taken so that each flute is ground exactly even or the tool is apt to cut oversize.

Sharpening the chamfer on a reamer by hand is not recommended as it is practically impossible to keep the cutting edges even.

The following figures show three common types of grinds used on reamers:

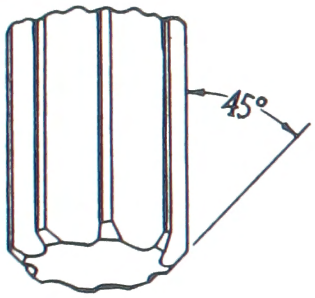

Figure A
Ordinary reamer point for most jobs.

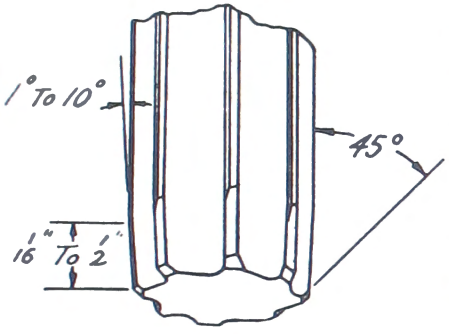

Figure B
Hand reamer grind also used on some machine reamer applications to obtain required finish or tolerance.

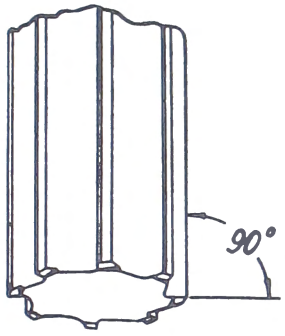

Figure C
Semi finish reamer grind to straighten out bent or misaligned holes. Corners must be kept sharp.

In grinding down a reamer to special size it is usually necessary to relieve or clear the lands. No hard or fast rule may be given as to the amount of this clearance but the following table may be of help:

Size of Reamer	Circular Land Width	Primary Clearance
¼"	.007	14°
½"	.009	11°
1"	.013	9°
1½"	.016	7°
2"	.023	7°

CARE OF REAMERS Reamers are precision tools and careful treatment of their cutting edges will pay big dividends in smooth accurate holes and long life. The use of racks, containers, or boxes will be of great help in preventing nicks along the cutting edges.

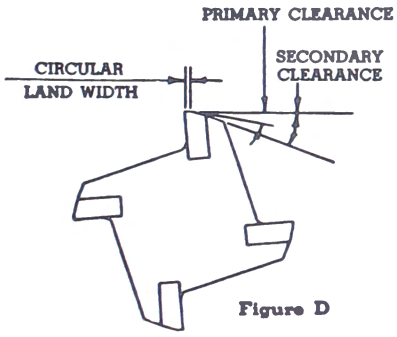

Figure D

A secondary clearance is often ground on reamers as shown in Fig. D. This clearance is only to insure the back of the land being well away from the wall of the reamed hole in order to prevent rubbing.

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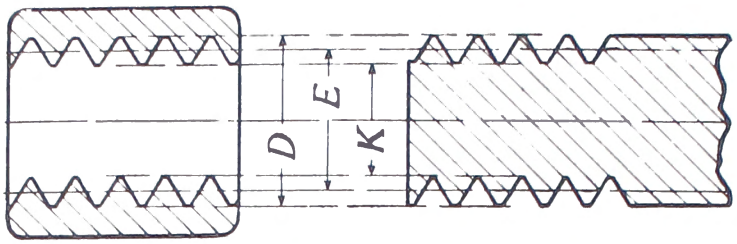
BASIC THREAD DIMENSIONS AND TAP DRILL SIZES

AMERICAN NATIONAL COARSE THREAD

Formerly A.S.M.E. Regular for Sizes 1-12; U.S. Standard for Sizes 1/4 in. and larger



D = Major Dia.
E = Pitch Dia.
K = Minor Dia.

Size of Thread and Threads per Inch	Major Diameter D Inches	Pitch Diameter E Inches	Minor Diameter K Inches	Commercial Tap Drill to Produce Approx. 75% Full Thread	Decimal Equivalent of Tap Drill Inches
1 x64	.0730	.0629	.0527	No. 53	.0595
2 x56	.0860	.0744	.0628	No. 50	.0700
3 x48	.0990	.0855	.0719	No. 47	0785
4 x40	.1120	.0958	.0795	No. 43	.0890
5 x40	.1250	.1088	0925	No. 38	.1015
6 x32	.1380	.1177	.0974	No. 36	.1065
8 x32	.1640	.1437	.1234	No. 29	.1360
10 x24	.1900	.1629	.1359	No. 25	.1495
12 x24	.2160	.1889	.1619	No. 16	.1770
1/4x20	.2500	.2175	.1850	No. 7	.2010
5/16x18	.3125	.2764	.2403	F	.2570
3/8x16	.3750	.3344	.2938	5/16	.3125
7/16x14	.4375	.3911	.3447	U	.3680
1/2x13	.5000	.4500	.4001	27/64	.4219
9/16x12	.5625	.5084	.4542	31/64	.4844
5/8x11	.6250	.5660	.5069	17/32	.5312
3/4x10	.7500	.6850	.6201	21/32	.6562
7/8x 9	.8750	.8028	.7307	49/64	.7656
1 x 8	1.0000	.9188	.8376	7/8	.8750
1 1/8x 7	1.1250	1.0322	.9394	63/64	.9844
1 1/4x 7	1.2500	1.1572	1.0644	1 7/64	1.1094
1 3/8x 6	1.3750	1.2667	1.1585	1 7/32	1.2187
1 1/2x 6	1.5000	1.3917	1.2835	1 11/32	1.3437
1 3/4x 5	1.7500	1.6201	1.4902	1 9/16	1.5625
2 x 4 1/2	2.0000	1.8557	1.7113	1 25/32	1.7812
2 1/4x 4 1/2	2.2500	2.1057	1.9613	2 1/32	2.0312
2 1/2x 4	2.5000	2.3376	2.1752	2 1/4	2.2500
2 3/4x 4	2.7500	2.5876	2.4252	2 1/2	2.5000
3 x 4	3.0000	2.8376	2.6752	2 3/4	2.7500
3 1/4x 4	3.2500	3.0876	2.9252	3	3.0000
3 1/2x 4	3.5000	3.3376	3.1752	3 1/4	3.2500
3 3/4x 4	3.7500	3.5876	3.4252	3 1/2	3.5000
4 x 4	4.0000	3.8376	3.6752	3 3/4	3.7500

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BASIC THREAD DIMENSIONS AND TAP DRILL SIZES

(Continued)

AMERICAN NATIONAL FINE THREADS

Formerly A.S.M.E. Special for Sizes 0-12; S.A.E. Standard for Sizes 1/4 in. and Larger

Size of Thread and Threads per Inch	Major Diameter D Inches	Pitch Diameter E Inches	Minor Diameter K Inches	Commercial Tap Drill to Produce Approx. 75% Full Thread	Decimal Equivalent of Tap Drill Inches
0 x80	.0600	.0519	.0438	3/64	.0469
1 x72	.0730	.0640	.0550	No. 53	.0595
2 x64	.0860	.0759	.0657	No. 50	.0700
3 x56	.0990	.0874	.0758	No. 45	.0820
4 x48	.1120	.0985	.0849	No. 42	.0935
5 x44	.1250	.1102	.0955	No. 37	.1040
6 x40	.1380	.1218	.1055	No. 33	.1130
8 x36	.1640	.1460	.1279	No. 29	.1360
10 x32	.1900	.1697	.1494	No. 21	.1590
12 x28	.2160	.1928	.1696	No. 14	.1820
1/4 x28	.2500	.2268	.2036	No. 3	.2130
5/16 x24	.3125	.2854	.2584	I	.2720
3/8 x24	.3750	.3479	.3209	Q	.3320
7/16 x20	.4375	.4050	.3725	25/64	.3906
1/2 x20	.5000	.4675	.4350	29/64	.4531
9/16 x18	.5625	.5264	.4903	33/64	.5156
5/8 x18	.6250	.5889	.5528	37/64	.5781
3/4 x16	.7500	.7094	.6688	11/16	.6875
7/8 x14	.8750	.8286	.7822	13/16	.8125
1 x14	1.0000	.9536	.9072	15/16	.9375
1 1/8 x12	1.1250	1.0709	1.0167	1 3/64	1.0469
1 1/4 x12	1.2500	1.1959	1.1417	1 11/64	1.1719
1 3/8 x12	1.3750	1.3209	1.2667	1 19/64	1.2969
1 1/2 x12	1.5000	1.4459	1.3917	1 27/64	1.4219

AMERICAN NATIONAL PIPE THREAD

Nominal Size Inches	Number of Threads Per Inch	Pipe O.D. Inches	Depth of Thread Inches	Tap Drills for Pipe Threads		Nominal Size Inches	Number of Threads Per Inch	Pipe O.D. Inches	Depth of Thread Inches	Tap Drills for Pipe Threads	
				Minor Diam. Small End of Pipe	Size Drill					Minor Diam. Small End of Pipe	Size Drill
1/8	27	.405	.02963	.33388	R	1 1/4	11 1/2	1.660	.06957	1.48757	1 1/2
1/4	18	.540	.04444	.43294	7/16	1 1/2	11 1/2	1.900	.06957	1.72652	1 47/64
3/8	18	.675	.04444	.56757	37/64	2	11 1/2	2.375	.06957	2.19946	2 7/32
1/2	14	.840	.05714	.70129	23/32	2 1/2	8	2.875	.10000	2.61953	2 5/8
3/4	14	1.050	.05714	.91054	59/64	3	8	3.500	.10000	3.24063	3 1/4
1	11 1/2	1.315	.06957	1.14407	1 5/32	3 1/2	8	4.000	.1000	3.73750	3 3/4

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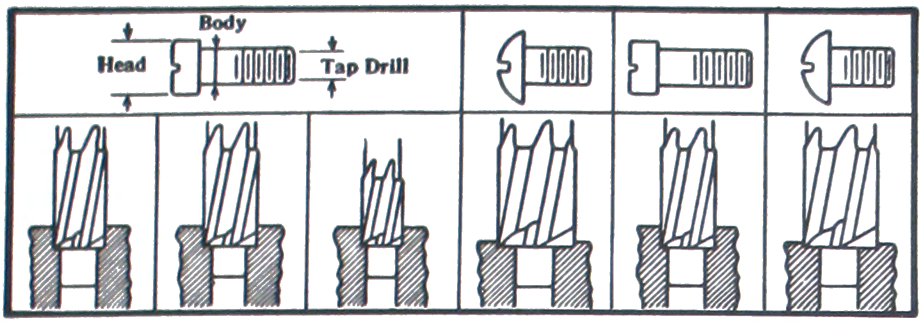
BASIC THREAD DIMENSIONS AND TAP DRILL SIZES

AMERICAN NATIONAL FORM THREAD SPECIAL PITCHES

Size of Thread and Threads per Inch	Major Diameter D Inches	Pitch Diameter E Inches	Minor Diameter K Inches	Commercial Tap Drill to Produce Approx. 75% Full Thread	Decimal Equivalent of Tap Drill Inches
1/4x24	.2500	.2229	.1959	4	.2090
5/16x20	.3125	.2800	.2475	17/64	.2656
3/8x20	.3750	.3425	.3100	21/64	.3281
7/16x24	.4375	.4104	.3834	X	.3970
1/2x12	.5000	.4459	.3917	27/64	.4219
1/2x16	.5000	.4594	.4188	7/16	.4375
1/2x24	.5000	.4729	.4459	29/64	.4531
9/16x16	.5625	.5219	.4813	1/2	.5000
5/8x12	.6250	.5709	.5167	35/64	.5469
5/8x16	.6250	.5844	.5438	9/16	.5625
11/16x11	.6875	.6285	.5694	19/32	.5937
11/16x12	.6875	.6334	.5792	39/64	.6094
11/16x16	.6875	.6469	.6063	5/8	.6250
3/4x12	.7500	.6959	.6417	43/64	.6719
13/16x10	.8125	.7476	.6826	23/32	.7187
13/16x12	.8125	.7584	.7042	47/64	.7344
13/16x16	.8125	.7719	.7313	3/4	.7500
7/8x12	.8750	.8209	.7667	51/64	.7969
7/8x16	.8750	.8344	.7938	13/16	.8125
15/16x 9	.9375	.8653	.7932	53/64	.8281
15/16x12	.9375	.8834	.8292	55/64	.8594
15/16x16	.9375	.8969	.8563	7/8	.8750
1 x12	1.0000	.9459	.8917	59/64	.9219
1 x16	1.0000	.9594	.9188	15/16	.9375
1 1/8x16	1.1250	1.0844	1.0438	1 1/16	1.0625
1 1/4x16	1.2500	1.2094	1.1688	1 3/16	1.1875
1 3/8x16	1.3750	1.3344	1.2938	1 5/16	1.3125
1 1/2x16	1.5000	1.4594	1.4188	1 7/16	1.4375
1 5/8x 5 1/2	1.6250	1.5069	1.3888	1 29/64	1.4531
1 3/4x10	1.7500	1.6850	1.6201	1 21/32	1.6562
1 3/4x12	1.7500	1.6959	1.6417	1 43/64	1.6719
1 3/4x16	1.7500	1.7094	1.6688	1 11/16	1.6875
1 7/8x 5	1.8750	1.7451	1.6152	1 11/16	1.6875
2 x10	2.0000	1.9350	1.8701	1 29/32	1.9062
2 x12	2.0000	1.9459	1.8917	1 59/64	1.9219
2 x16	2.0000	1.9594	1.9188	1 15/16	1.9375
2 1/8x 4 1/2	2.1250	1.9807	1.8363	1 29/32	1.9062
2 1/4x 8	2.2500	2.1688	2.0876	2 1/8	2.1250
2 1/4x12	2.2500	2.1959	2.1417	2 11/64	2.1719
2 1/4x16	2.2500	2.2094	2.1688	2 3/16	2.1875
2 3/8x 4	2.3750	2.2126	2.0502	2 1/8	2.1250
2 1/2x 8	2.5000	2.4188	2.3376	2 3/8	2.3750
2 1/2x12	2.5000	2.4459	2.3917	2 27/64	2.4219
2 1/2x16	2.5000	2.4594	2.4188	2 7/16	2.4375
2 3/4x 8	2.7500	2.6688	2.5876	2 5/8	2.6250
2 3/4x12	2.7500	2.6959	2.6417	2 43/64	2.6719
2 3/4x16	2.7500	2.7094	2.6688	2 11/16	2.6875
3 x 3 1/2	3.0000	2.8144	2.6288	2 23/32	2.7187
3 x 8	3.0000	2.9188	2.8376	2 7/8	2.8750
3 x12	3.0000	2.9459	2.8917	2 59/64	2.9219
3 x16	3.0000	2.9594	2.9188	2 15/16	2.9375

Reproduced by permission of The Cleveland Twist Drill Co.

COUNTERBORE SIZES FOR CAP SCREWS AND MACHINE SCREWS



	Fillister Head Cap Screw		Fillister Head Cap Screw		Body and Tap Hole for any Screw		Round or Hexagon Head Cap Screw		Fillister Head Machine Screw		Round or Hex. Head Machine Screw		
	Head and Body		Head and Tap Hole				Head and Body		Head and Body		Head and Body		
Size Thread N.F. and N.C.	Cutter for Head	Pilot for Body	Cutter for Head	Pilot for Tap Hole	Cutter for Body	Pilot for Tap Hole	Cutter for Head	Pilot for Body	Cutter for Head	Pilot for Body	Cutter for Head	Pilot for Body	Tap Drills
1/4-28	.375	.250	.375	.213	.250	.213	.500	.250	.437	.250	.500	.250	3
1/4-20	.375	.250	.375	.201	.250	.201	.500	.250	.437	.250	.500	.250	7
5/16-24	.437	.312	.437	.272	.312	.272	.625	.312	.531	.312	.625	.312	I
5/16-18	.437	.312	.437	.257	.312	.257	.625	.312	.531	.312	.625	.312	F
3/8-24	.562	.375	.562	.332	.375	.332	.687	.375	.625	.375	.750	.375	Q
3/8-16	.562	.375	.562	.312	.375	.312	.687	.375	.625	.375	.750	.375	5/16
7/16-20	.625	.437	.625	.390	.437	.390	.813	.437	.718	.437	.875	.437	25/64
7/16-14	.625	.437	.625	.368	.437	.368	.813	.437	.718	.437	.875	.437	U
1/2-20	.750	.500	.750	.453	.500	.453	.875	.500	.843	.500	1.000	.500	29/64
1/2-13	.750	.500	.750	.421	.500	.421	.875	.500	.843	.500	1.000	.500	27/64
9/16-18	.812	.562	.812	.515	.562	.515	1.000	.562					33/64
9/16-12	.812	.562	.812	.484	.562	.484	1.000	.562					31/64
5/8-18	.875	.625	.875	.578	.625	.578	1.062	.625					37/64
5/8-11	.875	.625	.875	.531	.625	.531	1.062	.625					17/32
3/4-16	1.000	.750	1.000	.687	.750	.687	1.312	.750					11/16
3/4-10	1.000	.750	1.000	.666	.750	.656	1.312	.750					21/32
7/8-14	1.125	.875	1.125	.812	.875	.812	1.375	.875					13/16
7/8- 9	1.125	.875	1.125	.765	.875	.765	1.375	.875					49/64
1 -14	1.312	1.000	1.312	.937	1.000	.937	1.500	1.000					15/16
1 - 8	1.312	1.000	1.312	.875	1.000	.875	1.500	1.000					7/8

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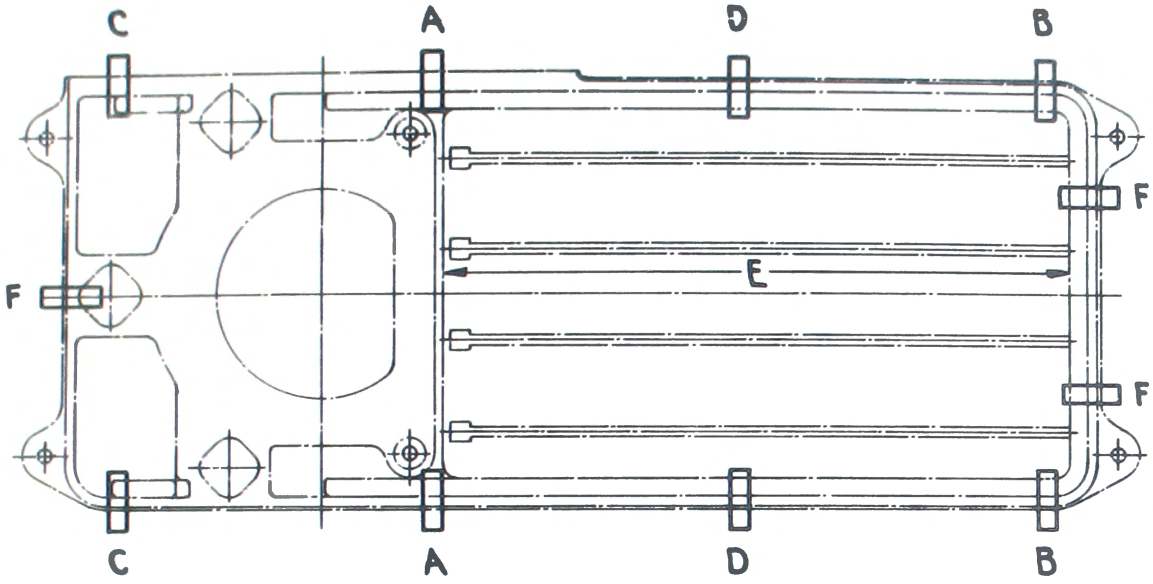


MACHINE LEVELING INSTRUCTIONS WITH ARM DOWN AND HEAD IN CENTER

1 INSERT WEDGES AT "A" UNDER BASE AS INDICATED AND LEVEL ACROSS BASE IN LINE WITH WEDGES "A".

2 INSERT WEDGES AT "B" AND LEVEL ACROSS BASE IN LINE WITH WEDGES "B", ALSO LEVEL BASE LENGTHWISE ALONG LINE "E".

3 INSERT WEDGES AT "C" AND CHECK LEVEL ACROSS BASE IN LINE WITH WEDGES "C", ALSO CHECK LEVEL BETWEEN WEDGES "A" & "C" ON BOTH SIDES OF COLUMN.

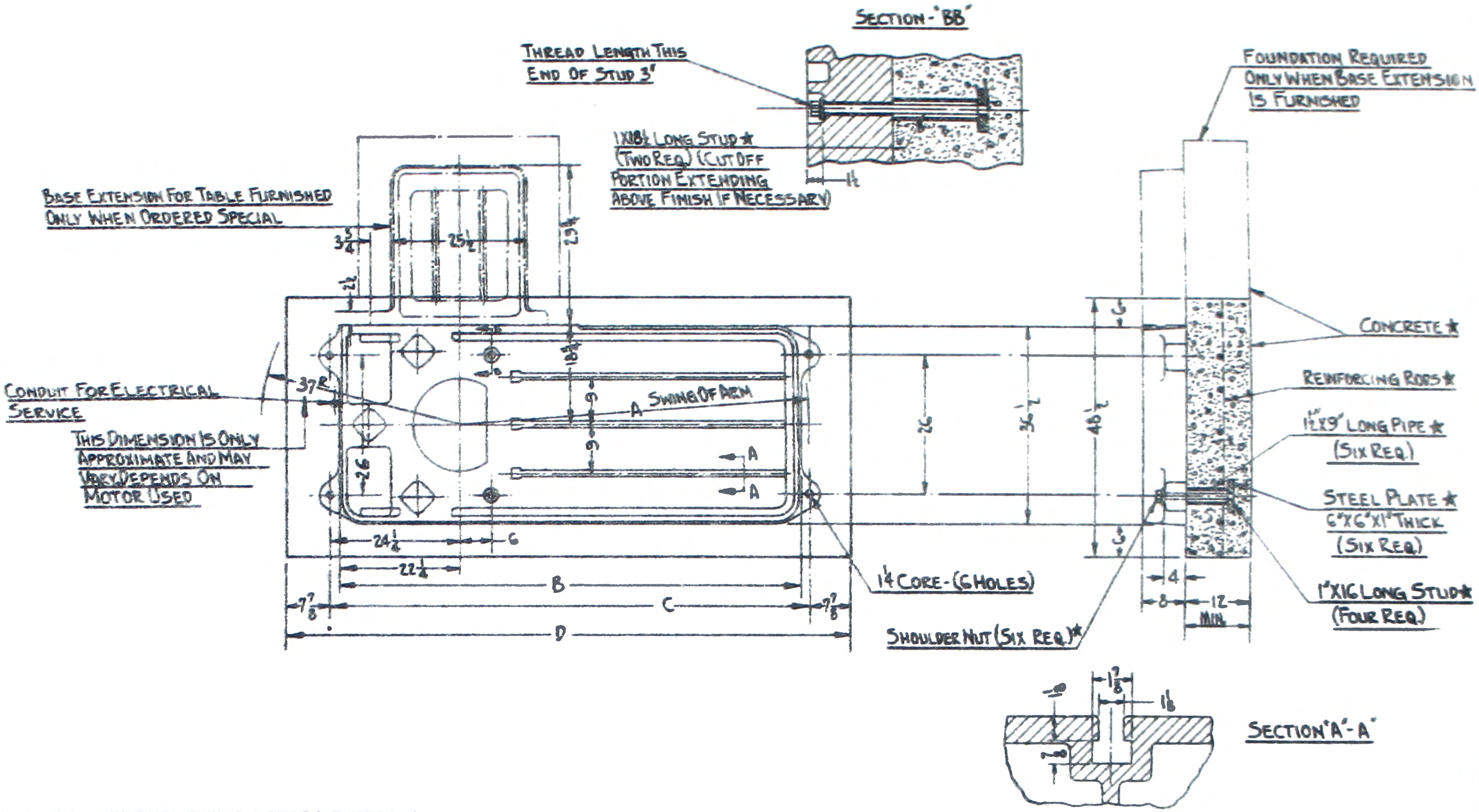
4 INSERT WEDGES AT "D" TO SUPPORT CENTER OF BASE.

5 INSERT WEDGES AT "F". BE CAREFUL NOT TO CHANGE LEVEL OBTAINED WITH WEDGES "A"-"B"-"C" & "D".

6 TIGHTEN ALL ANCHOR BOLTS.

DRAWING NO. 15035 MR. SIZE B
Dr. R.M.V. 8-22-36

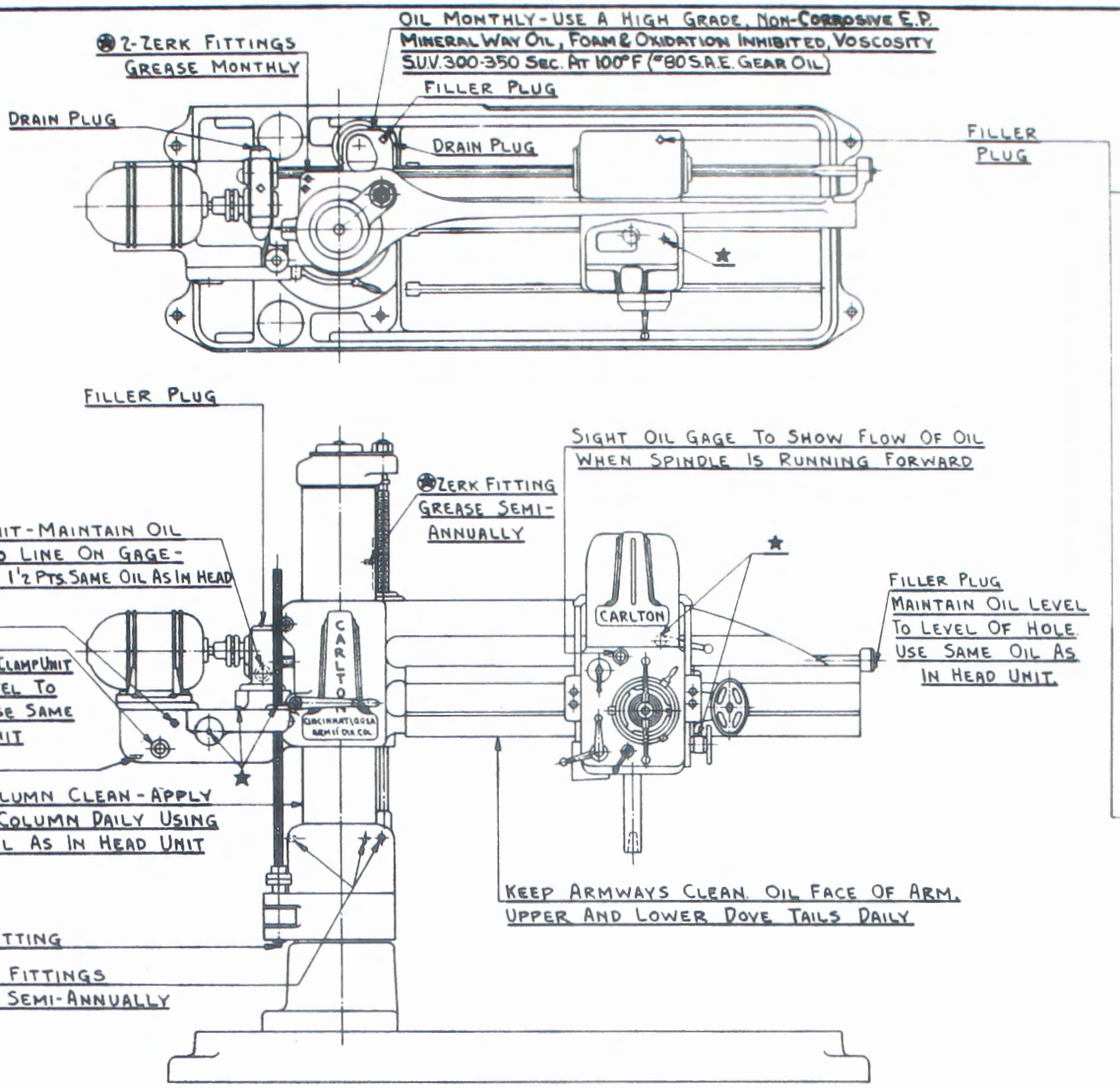
DRAWING NO. 15035



DIMENSIONS				
SIZE	A	B	C	D
~~3 FT.~~	~~57~~	~~73½~~	~~77½~~	~~93¼~~
4 FT.	69	85½	89½	105¼
~~5 FT.~~	~~81~~	~~97½~~	~~101½~~	~~117¼~~
~~6 FT.~~	~~93~~	~~109½~~	~~113½~~	~~129¼~~

★ FURNISHED BY CUSTOMER

BASE 11" DIA. COL.	FOUNDATION & FLOOR PLAN FOR 11" DIA. COL. MACH.		
E.D.H. 10-13-55	1A		
E.D.H. 10-13-55			
	THE CARLTON MACHINE TOOL CO.		17265-1 C



RECOMMEND DRAINING
FROM UNITS EVERY SIX
NTHS & REFILLING WITH NEW OIL

★ OIL CUPS - OIL WEEKLY - USE SAME OIL AS IN HEAD
ZERK GREASE FITTINGS - USE A HIGH GRADE CALCIUM SOAP BASE GREASE NO. 1 N.L.G.I. CONSISTENCY

WHEN DRILL IS RUNNING OIL MAY DROP BEL
LEVEL LINE ON GAGE DUE TO CIRCULATION OF
OIL LEVEL AND REFILL ONLY WHEN DRILL I

THE CARLTON MACHINE TOOL CO.
DR. E.R.B. 11-18-57 CINCINNATI, O. U.S.A.

MAXIMUM DRILLING CAPACITIES

SIZE OF MACHINE	MILD STEEL	CAST IRON	PIPE TAP CAST IRON
TYPE 0A 9" DIA. COLUMN 3 FT. & 4 FT. ARMS 9 SPINDLE SPEEDS	1/2 INCHES	3/4 INCHES	1 1/2 INCHES
TYPE 1A-9" DIA. COLUMN 3 FT. & 4 FT. ARMS 12 SPINDLE SPEEDS	3/4 INCHES	2 INCHES	2 INCHES
TYPE 1A-11" DIA. COLUMN 3 FT., 4 FT. & 5 FT. ARMS	2 INCHES	2 1/4 INCHES	3 INCHES
TYPE 3A-13"-15"&17" DIA. COLUMNS 4FT-5FT-6FT. & 7FT. ARMS	3 INCHES	4 INCHES	6 INCHES
TYPE 4A-19" DIA. COLUMN 6 FT.-7FT. & 8 FT. ARMS	4 INCHES	4 INCHES	8 INCHES
TYPE 5A-22"&26" DIA. COLUMNS 7FT. TO 12 FT. ARMS INC.	4 INCHES	4 INCHES	10 INCHES

THE VARIOUS SIZE MACHINES DIFFER IN CAPACITY ACCORDING TO THE NATURE OF THE WORK AND ACCURACY REQUIRED. THE RIGIDITY OF THE RADIAL VARIES WITH DIFFERENT COLUMN DIAMETERS AND ARM LENGTHS. IT IS IMPOSSIBLE TO RECOMMEND THE EXACT CAPACITY OF EACH SIZE RADIAL, WHEN THE NATURE OF THE WORK IS NOT KNOWN.

DRAWING NO. 13026 | DR. SIZE B

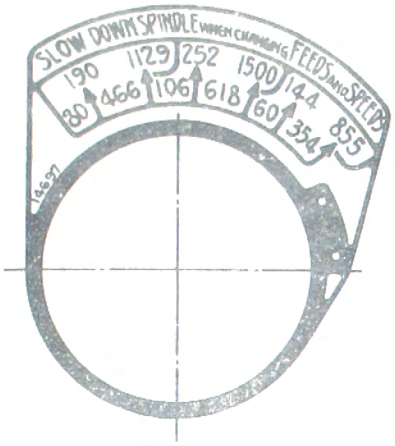
SUPERSEDES Pc. No. 16088-D DR. K.Y.T. -5-2-47

DR. SIZE B

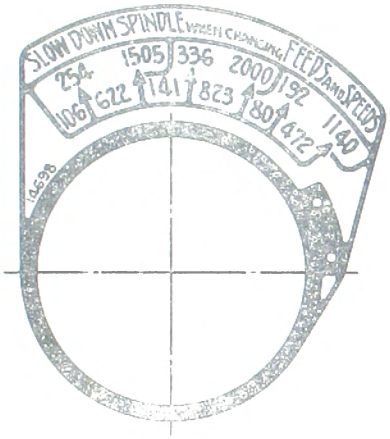
DRAWING NO. 17926

SPEEDS AND FEEDS AVAILABLE ON A 9" & 11" DIA. COLUMN 5 H.P. MOTOR "1A" RADIAL

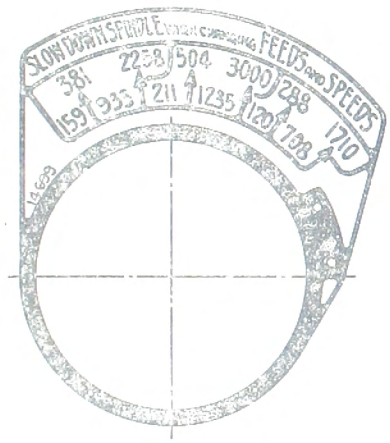
LOW

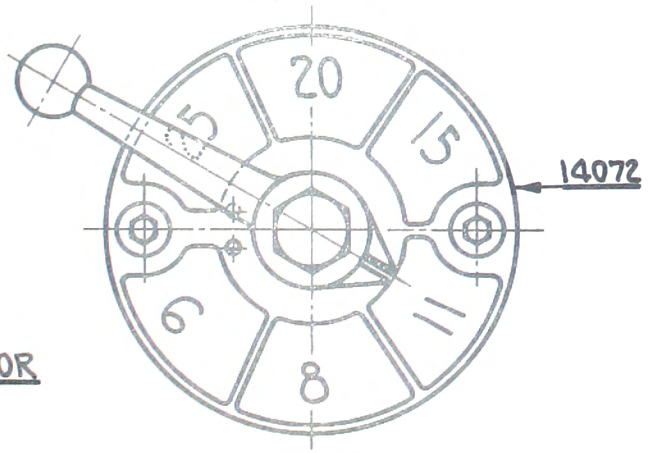


STANDARD



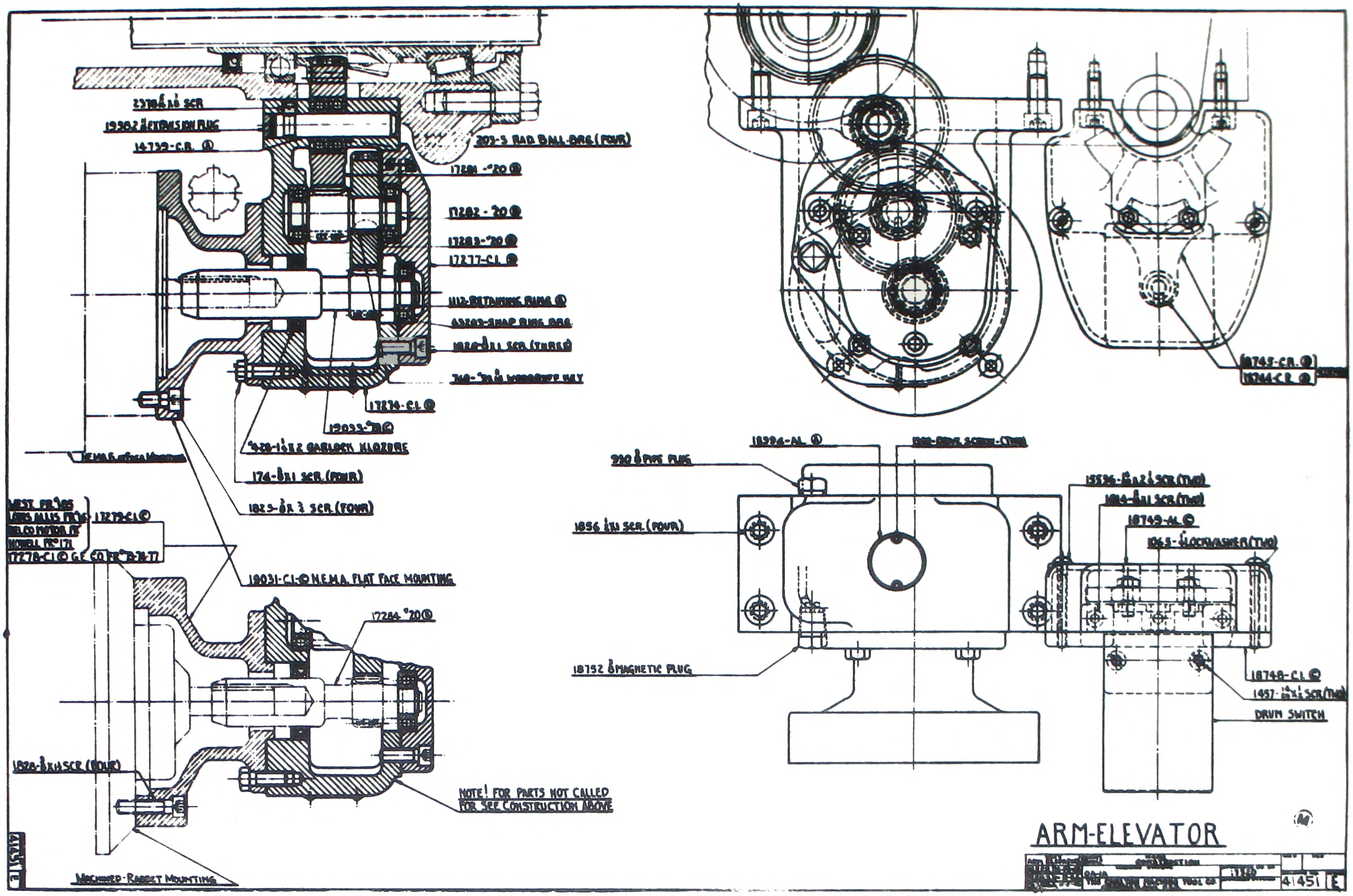
HIGH



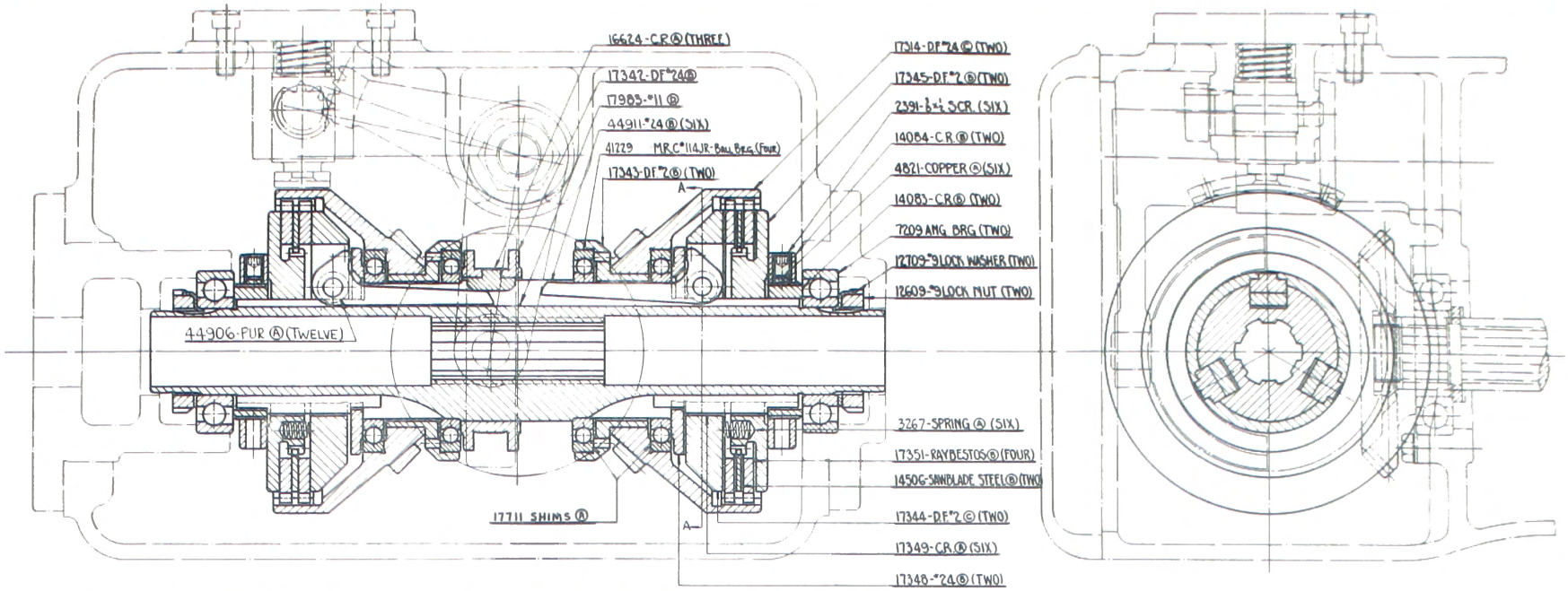


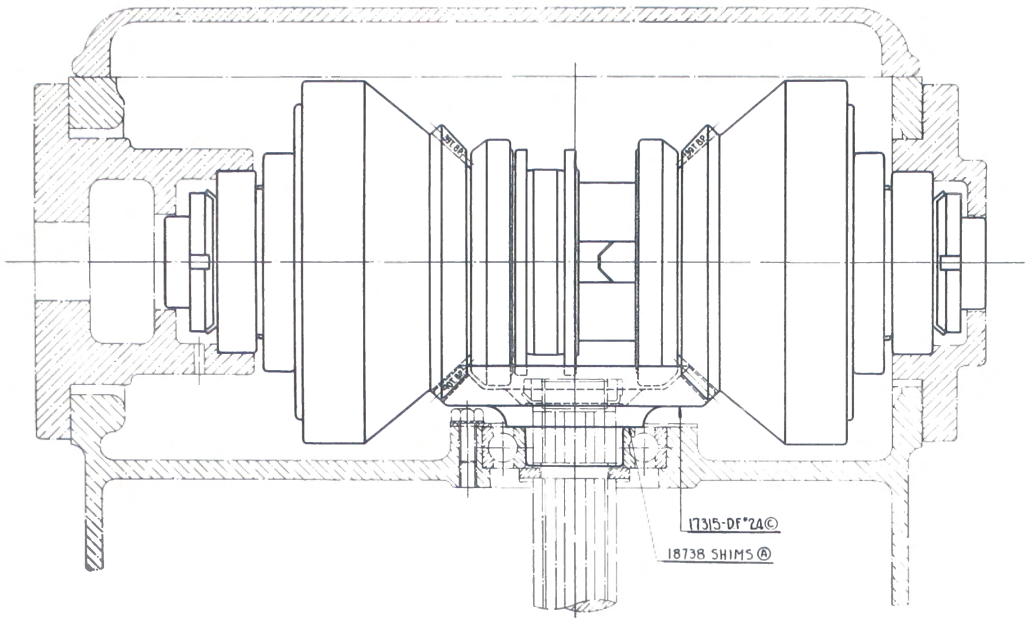
FOR 9" & 11" DIA.
COLUMN 5 H.P. MOTOR
"1A" RADIAL

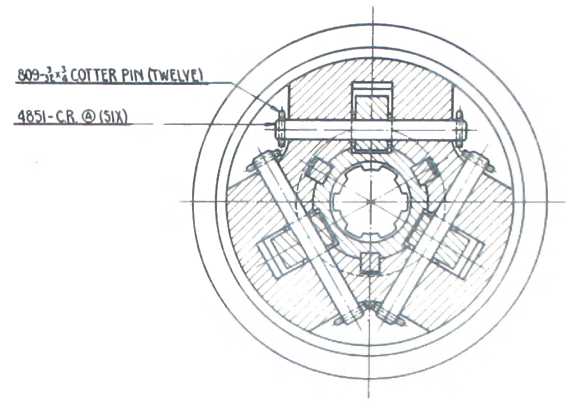
3532	Oil Gage Window
3632	Oil Gage Ring
3864	3/8 x 3/8 x 2 Square Key
14220	Body
14232	1/2 x 1/2 x 3 1/4 Square Key
14358	Sleeve
14556	Bushing
17228	Cover
17231	Bearing Cap
17232	Small Bearing Retainer
17233	Large Bearing Retainer
18992	Instruction Plate


ARM-ELEVATOR
203-S RAD BALL-BRG (FOUR)
17282 - 20
17277-CL
1112-RETAINING RING
17274-CL
19031-CL NEMA FLAT FACE MOUNTING
17284 20
NOTE! FOR PARTS NOT CALLED FOR SEE CONSTRUCTION ABOVE
MACHINED-RABBET MOUNTING
18394-AL
18752 MAGNETIC PLUG
18749-AL
18748-CL
DRUM SWITCH
41451 E

14739	Idler Gear Stud
17274	Body
17277	Cap
17278	Motor Adapter
17279	Motor Adapter
17281	Idler Gear
17282	Compound Pinion
17283	Compound Gear
17284	Motor Pinion
18744	Drum Switch Fork Hub
18745	Drum Switch Fork (45^{o} Throw)
18748	Drum Switch Bracket
18749	Drum Switch Guard
18994	Instruction Plate
19031	Motor Adapter
19033	Motor Pinion







SECTION A-A

REVERSE

Head Trans. Reverse
Dr. A.J. 8-8-39
Tr. R.R.B. 12-23-39
Ck. [illegible] 12-28-39

1A

Construction

THE CARLTON MACHINE TOOL CO.

17370

4821	Copper Plug
4851	Toggle Pin
14083	Threaded Spacer
14084	Adjusting Nut
14506	Driving Disc
16624	Toggle Shoe
17314	Driving Spiral Bevel Gear
17315	Driven Spiral Bevel Gear
17342	Spool
17343	Bearing Container Bush
17344	Toggle
17345	Friction Driving Gear
17348	Thrust Plate
17349	Key
17351	Friction Disc
17983	Sleeve
44906	Toggle Washer
44911	Toggle

14296	Pump Cover
14370	Bracket
14379	Shifter Segment
14391	Reverse Shifter Shaft
14392	Triple Gear Shifter
14393	Clutch Gear Shifter
14394	Clutch Sleeve Gear Shifter
14427	Brake Shoe
14448	Reducing Gear
14456	32 T. Change Gear
14457	Clutch Gear
14458	Clutch Sleeve Gear
14459	Sliding Gear Shaft
14590	Clutch Sleeve
17012	Bush
17055	24 T. Change Gear
17056	28 T. Change Gear

14105-CR-Ⓐ
17156-CR-Ⓑ
14050-MECHANITE Ⓒ
2578-⅝x⅜-SCR
1410-⅝x2 SCR
17601-AL-Ⓑ
1392-DRIVE SCREW (FOUR)
747-6 JAM NUT (TWO)
17975-MECHANITE-Ⓒ
17974-BRO-Ⓑ
14391-CR-Ⓒ
4958-CR-Ⓐ
14296-CR Ⓐ
14294-SPRING Ⓑ (TWO)
14295-CR-Ⓐ (TWO)
1462-¼x¼ SCR (THREE)
1065-4 LOCK WASHER (FOUR)
14295-CI-Ⓑ
17512-CR-Ⓑ
17134-⅛ OUTLET PLUG-Ⓐ
14232-⅛x6 NIPPLE
100-⅛ TEE
14733-⅛x7 NIPPLE
950-⅛ PIPE PLUG
1820-⅜x1¼ SCR (SIX)
17064-CI-Ⓒ
12606-⅜ LOCK NUT
12706-⅜ LOCK WASHER
1109-⅜x4 SCR Ⓐ (FOUR)
1066-⅜ LOCK WASHER (FOUR)
17734-STL ST-Ⓒ
17399-"20-Ⓑ
17575-"24 Ⓒ
14291-CR-Ⓑ
209-5 RAD BALL BRG.
206-5F LUBR SEAL BALL BRG.
206-5 RAD BALL BRG.
206-5 RAD BALL BRG.
14448-"24-Ⓑ
17012-BRO-Ⓐ
985-⅛ ELBOW
14734-⅛x9 NIPPLE
17359-AL-Ⓑ LH
17352-AL-Ⓑ RH
1826-⅜x1 SCR (EIGHT)
14210-"18 TIMKEN SHIM .005 THICK (FOUR)
17364-CI-Ⓑ
172-⅜x¾ SCR-(FOUR)
14890-"1004 I-CUNO FILTER & GASKET Ⓑ
951-¼ PIPE PLUG
12606-⅜ LOCK NUT
12706-⅜ LOCK WASHER
206-5 RAD BALL BRG.
17056-"24-Ⓑ
17055-"24-Ⓐ
14456-24-Ⓐ
14291-CR-Ⓑ
14459-"24-Ⓑ
13361-"24-Ⓐ
3635-CR-Ⓐ (TWO)
14457-"24-Ⓒ
14458-"24-Ⓒ
15368-"36-Ⓐ (TWENTY FIVE)
14590-"24-Ⓒ
7016T-CR-Ⓑ
2578-¼x⅜ SCR
208-5 RAD BALL BRG.
305-5 RAD BALL BRG.
4498-CR-Ⓑ
820-⅜x1¼ COTTER PIN
202-¼x1½ SCR (TWO)
14370-35-Ⓑ
14379-MECHANITE Ⓒ
4497-CR-Ⓑ
809-⅜x¾ COTTER PIN (TWO)
14104-CR-Ⓐ
14102-"27-Ⓐ
14592-BRO Ⓒ
14103-CR-Ⓐ
14593-BRO Ⓒ
1801-¼x¾ SCR (FOUR)
625-"2 x1¼ TAPER PIN (TWO)
14394-BRO Ⓒ
14415-MOLDED RAYBESTOS-Ⓐ
4569-⅜ BRASS RIVETS-Ⓐ (FOUR)
17361-"20-Ⓑ
14529-SPRING-Ⓐ
14092-CI-Ⓒ
1826-⅜x1 SCR (THREE)
17991-VELLUMOID-Ⓐ
809-⅜x¾ COTTER PIN
14427-ASSEMBLY @ { 14108-CR Ⓐ / 14109-CR Ⓐ }

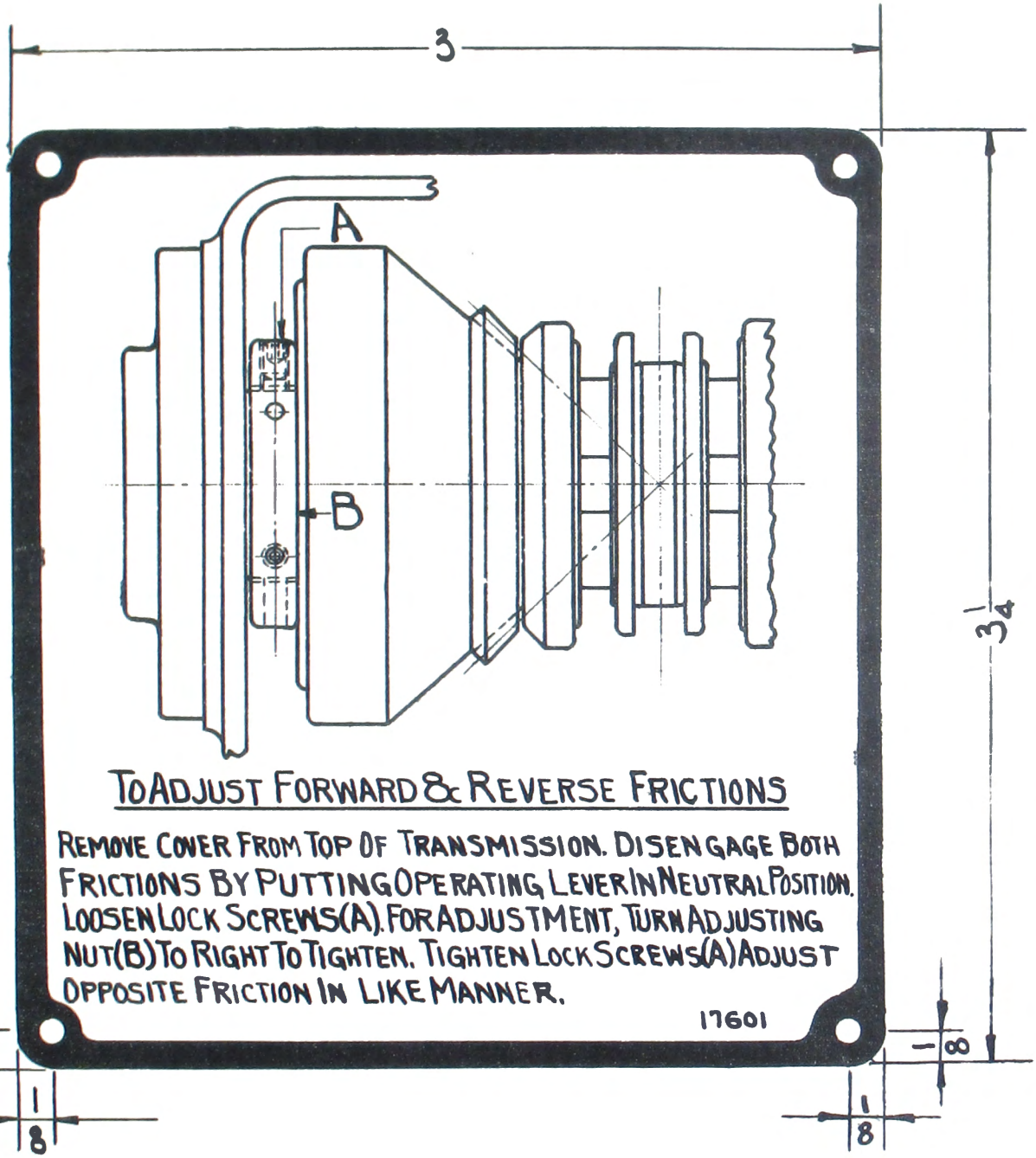
HEAD-TRANSMISSION

HEAD TRANSMISSION, SERIAL 1-5-40 1A TO SERIAL 1-17-40 1A — CONSTRUCTION — THE CARLTON MACHINE TOOL CO. — DRAWING NO. 17360 F

17360

3635	9/16 x 1 Body Fit Screw
4197	Upper Shifter Interlock
4498	Lower Shifter Interlock
4952	Oil Retainer
13361	Thrust Washer
13362	S-444Q Bantam Roller
14088	Triple Gear Shifter Crank
14092	Brake Body
14102	Shifter Guide Rod
14103	Triple Gear Shifter Link
14104	3/8 x 1 7/16 Drilled Straight Pin
14105	Crank Pin
14108	Brake Shoe
14109	Brake Plunger
14291	Stop Washer
14293	Pump Body
14295	Pump Vane
17064	Cover
17196	Center Teat Key
17352	Reverse Cap R.H.
17353	Reverse Cap L.H.
17359	Bevel Gear Shaft
17361	Brake Pinion
17364	Body
17512	Pump Rotor
17575	Triple Sliding Gear
17601	Instruction Plate
17734	Bearing Retainer
17974	Reverse Shifter Fork
17975	Reverse & Brake Shifter
17991	Brake Body Gasket
70767	Coupling

PLATE DOUBLE SIZE - ACTUAL SIZE 3"x3¼"
ROUND CORNERS & STAMP 4-$\frac{3}{32}$ HOLES FOR ESCUTCHEON PINS

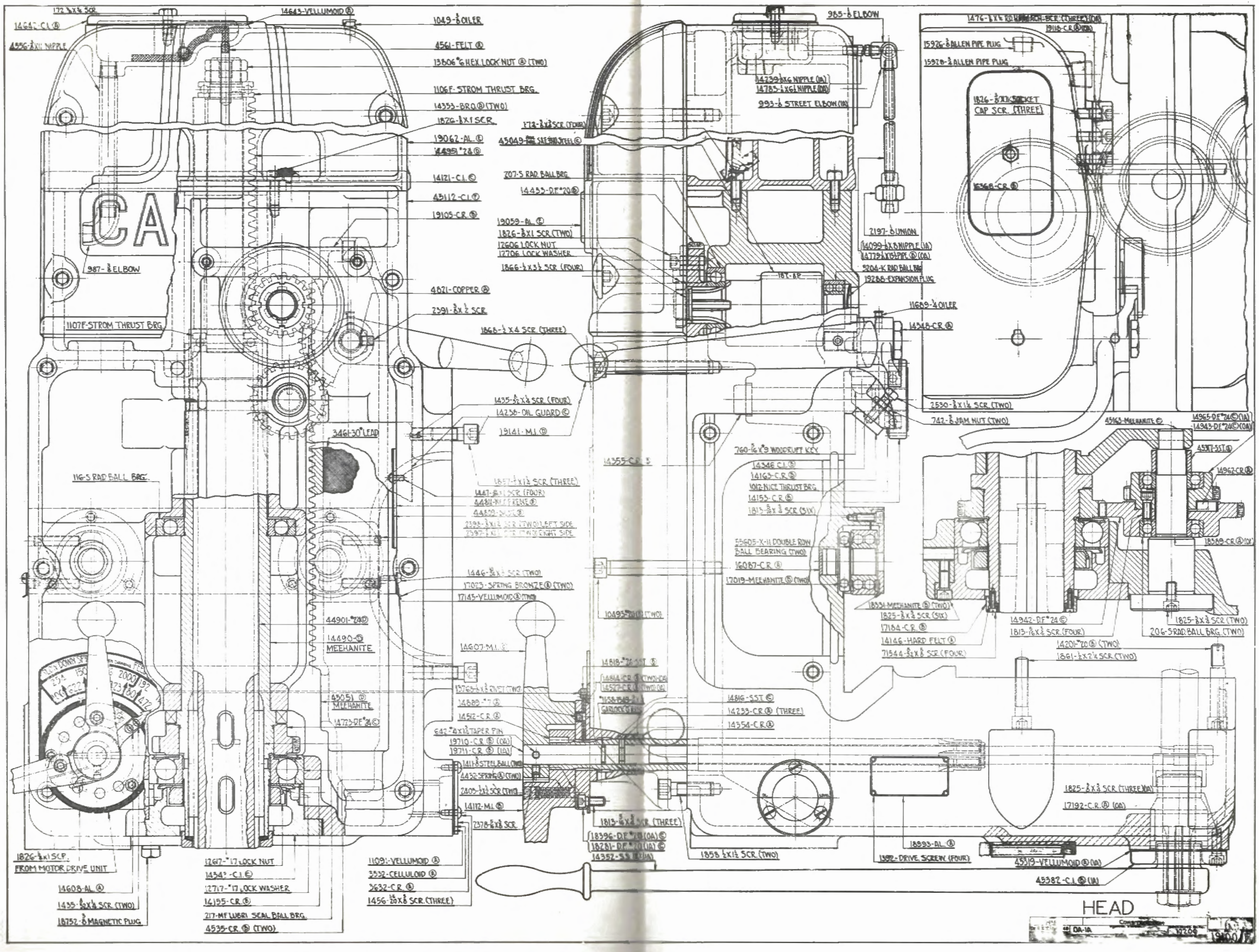


TO ADJUST FORWARD & REVERSE FRICTIONS

REMOVE COVER FROM TOP OF TRANSMISSION. DISENGAGE BOTH FRICTIONS BY PUTTING OPERATING LEVER IN NEUTRAL POSITION. LOOSEN LOCK SCREWS (A). FOR ADJUSTMENT, TURN ADJUSTING NUT (B) TO RIGHT TO TIGHTEN. TIGHTEN LOCK SCREWS (A) ADJUST OPPOSITE FRICTION IN LIKE MANNER.

17601

17601	UNIT: TRANSMISSION	NAME: TRANSMISSION INSTRUCTION PLATE	MAT.: AL.	USE: 22 GAUGE (.025 THICK)
DR. L.E.S. 2-15-40	MACHINE SYMBOL: 1A-4A-5A-3A	SUPERSEDES PC. NO.: 14028	PIECE NO.: 17601	DR. SIZE: B
TR. L.E.S. 2-15-40	THE CARLTON MACHINE TOOL CO. CINCINNATI, O., U.S.A.	SUPERSEDED BY PC. NO.		
CH:				


CA
HEAD
1049-⅜ OILER
4561-FELT Ⓐ
13606-⅝ HEX. LOCK NUT Ⓐ (TWO)
1106F-STROM THRUST BRG.
14353-BRO.Ⓐ (TWO)
1826-⅜X1 SCR.
19062-AL. Ⓔ
14499-"24Ⓐ
14121-C.I. Ⓒ
45112-C.I. Ⓕ
19105-CR. Ⓑ
19059-AL. Ⓔ
1826-⅜X1 SCR. (TWO)
17606 LOCK NUT
12706 LOCK WASHER
1866-¼X3½ SCR. (FOUR)
4621-COPPER Ⓐ
2391-⅜X⅞ SCR.
1868-¼ X 4 SCR. (THREE)
1435-⅝X⅜ SCR. (FOUR)
14236-OIL GUARD Ⓒ
19141-M.I. Ⓑ
3461-30° LEAD
1867-¼X1½ SCR. (THREE)
1447-⅝X1 SCR. (FOUR)
4480-WICK FELT Ⓐ
44850-SCUTE Ⓐ
2398-¼X1½ SCR. (TWO) LEFT SIDE
2397-¼X1½ SCR. (TWO) RIGHT SIDE
1446-⅜X⅞ SCR. (TWO)
17023-SPRING BRONZE Ⓐ (TWO)
17145-VELLUMOID Ⓐ (TWO)
44901-"24Ⓐ
14490-Ⓑ MEEHANITE
14505 Ⓑ MEEHANITE
14773-DF"24Ⓒ
14607-M.I. Ⓒ
13768-½X⅞ DWT. (TWO)
14889-"7 Ⓑ
14512-C.R. Ⓑ
642-"4X1½ TAPER PIN
19710-C.R. Ⓑ (OA)
19711-C.R. Ⓑ (1A)
1411-⅝ STEEL BALL (TWO)
4452-SPRING Ⓐ (TWO)
2405-½X1½ SCR. (TWO)
14112-M.I. Ⓑ
2378-⅝X⅞ SCR.
1826-⅜X1 SCR. FROM MOTOR DRIVE UNIT
14608-AL. Ⓐ
1435-⅝X⅜ SCR. (TWO)
18752-⅜ MAGNETIC PLUG
12617-"17 LOCK NUT
14342-C.I. Ⓒ
12717-"17 LOCK WASHER
14155-C.R. Ⓑ
217-MF LUBRI. SEAL BALL BRG.
4535-CR. Ⓑ (TWO)
1109:-VELLUMOID Ⓐ
3532-CELLULOID Ⓐ
3632-C.R. Ⓑ
1456-16/20X⅝ SCR. (THREE)
116-S RAD. BALL BRG.
987-⅜ ELBOW
1107F-STROM THRUST BRG.
172-¾X⅝ SCR.
14642-C.I. Ⓑ
4556-¾XII NIPPLE
14643-VELLUMOID Ⓐ
985-⅜ ELBOW
14239-⅜XG NIPPLE (2A)
14785-¼XG NIPPLE (2B)
993-⅜ STREET ELBOW (2B)
2197-⅜ UNION
14099-¼X6 NIPPLE (1A)
14778-¼XS-PIPE Ⓑ (OA)
5204-K RAD. BALL BRG.
19288-EXPANSION PLUG
11689-¼ OILER
14348-CR. Ⓑ
760-⅜X⅜ WOODRUFF KEY
14346-C.I. Ⓑ
14165-C.R. Ⓑ
1012-NICE THRUST BRG.
14155-C.R. Ⓑ
1813-⅜X⅜ SCR. (SIX)
55605-X-11 DOUBLE ROW BALL BEARING (TWO)
16087-C.R. Ⓐ
17019-MEEHANITE Ⓑ (TWO)
14355-C.R. Ⓑ
10495-[illegible] (TWO)
14618-"28-SST Ⓑ
14814-CR. Ⓑ (TWO) (OA)
14572-C.R. Ⓑ (TWO) (OA)
"1158-B48-2 Ⓐ
GASKET SET
14816-SST Ⓒ
14239-CR. Ⓑ (THREE)
14354-C.R. Ⓑ
1815-⅝X⅝ SCR. (THREE)
18396-DF"18 (OA) Ⓒ
18281-DF-"11 (1A) Ⓒ
14352-SST (2A)
1858 ¼X1½ SCR. (TWO)
1476-¾X⅝ REDUCING BCR. (2 THREE) (TWO)
19116-C.R. Ⓑ (2A)
15926-⅜ ALLEN PIPE PLUG
15928-¾ ALLEN PIPE PLUG
1826-⅜X1½ SOCKET CAP SCR. (THREE)
16368-CR. Ⓑ
2530-⅜X¼ SCR. (TWO)
742-⅜ JAM NUT (TWO)
45163-MEEHANITE Ⓒ
14965-DF"24 Ⓒ (1A)
14943-DF"24 Ⓒ (OA)
45387-SST Ⓐ
14962-CR. Ⓑ
18589-CR. Ⓑ (2A)
8551-MEEHANITE Ⓑ (TWO)
1825-⅜X⅜ SCR. (SIX)
17184-C.R. Ⓑ
14146-HARD FELT Ⓐ
71544-⅝X⅝ SCR. (FOUR)
14942-DF"24 Ⓒ
1813-⅝X⅜ SCR. (FOUR)
1825-⅜X⅜ SCR. (TWO)
206-S RAD. BALL BRG. (TWO)
14201-"20 Ⓑ (TWO)
1861-¼X2¼ SCR. (TWO)
1825-⅜X⅜ SCR. (THREE) (2A)
17192-C.R. Ⓑ (OA)
18993-AL. Ⓐ
1392-DRIVE SCREW (FOUR)
45519-VELLUMOID Ⓑ (OA)
45382-C.I. Ⓑ (1A)

3532	Oil Gage Window
3632	Oil Gage Ring
4535	Spindle Gear Sleeve Key
4921	Copper Plug
10493	9/16 x 3-11/16 Body Fit Screw
11611	Oil Gage Gasket
14112	Shifter Tube Lever
14121	Spindle Sleeve Outer Bush
14146	Felt Spindle Wiper
14153	Clamping Nut
14155	Oil Retainer
14163	Gib
14201	9/16 x 1 7/8 Body Fit Screw
14233	3/16x5/16 Straight Pin
14343	Large Bearing Retainer
14346	Gib Clamp
14348	Clamping Lever Stud
14352	Friction Reverse Lever (1A)
14353	Spindle Sleeve Bush
14354	Shifter Tube Thrust Collar
14355	Clamping Stud
14433	Rack Pinion Gear
14942	42 T. Gear
14943	25 T. Gear (OA)
14962	3/8 x 3/8 x 3/4 Round End Key
14965	27 T. Gear (1A)
16087	Plug
16368	Conduit Pipe Adapter
17019	Eccentric Stud
17023	Shear Wiper
17145	Shear Wiper Pad
17184	Spindle Wiper Retainer
17192	Plug (OA)
18281	Index Bush (1A)
18331	Eccentric Stud Retainer
18389	Spacer (OA)
18396	Index Bush (OA)
18993	Instruction Plate
19059	Front Cover
19062	Hood
19105	Rack Pinion Gear Retainer
19118	Control Cover
19141	Clamping Lever
19710	Shifter Shaft (OA)

INSTRUCTIONS FOR REMOVING & REPLACING QUICK RETURN UNIT, SPINDLE & COUNTERWEIGHT ON 0A-1A MACHINES

TO REMOVE QUICK RETURN UNIT

Remove Shifter Lever Assembly By Pulling Straight Out After Taking Out 3 Screws "A". Then Remove Push Button Box Screws, When Present, And Cover "B". Be Sure That Nose Of Spindle Is Flush With Bottom Of Head. Then Screw Eyebolt For Crane Hook In Tapped Hole In Top Of Quick Return Unit. Remove Screws And Lift Complete Unit Off Of Head.

TO REMOVE SPINDLE & COUNTERWEIGHT

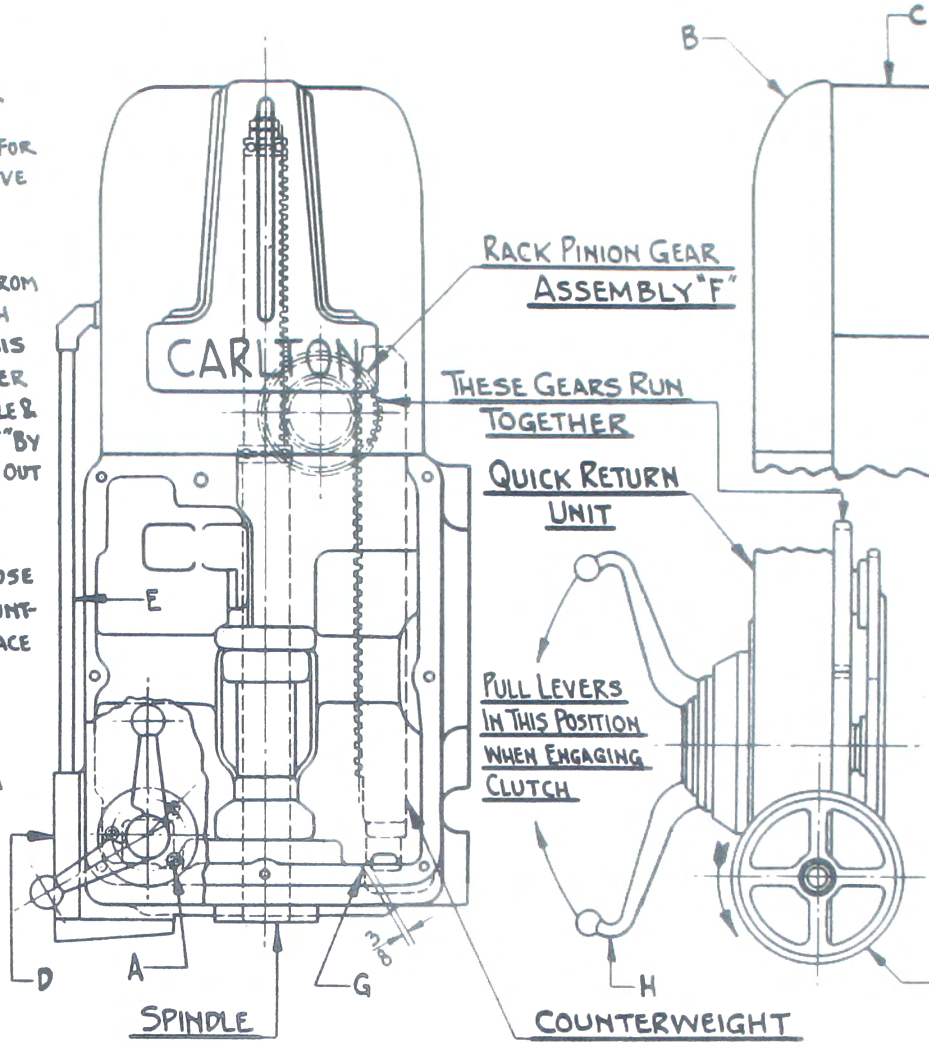
Remove Hood "C" - On 1A Machines First Remove Screws From Lamp Cover "D" And Swing Out. On Machines Equipped With Automatic Tapping Control Disconnect Wires From This Unit And Allow Them To Slide Through Conduit "E" After Threadless Fitting Has Been Released. Block Up Spindle & Counterweight And Remove Rack Pinion Gear Assembly "F" By Pulling Straight Out Then Lift Spindle Or Counterweight Out Of Top Of Head Using Tapped Eyebolt Hole In Top Of Each.

TO REPLACE SPINDLE AND COUNTERWEIGHT

Replace Spindle And Counterweight In Head And Be Sure Nose Of Spindle Is Flush With Bottom Of Head And That The Counterweight Is 3/8 From Head Body As Shown At "G". Then Replace Rack Pinion Gear Assembly "F". Thereafter Reverse Dismantling Procedure

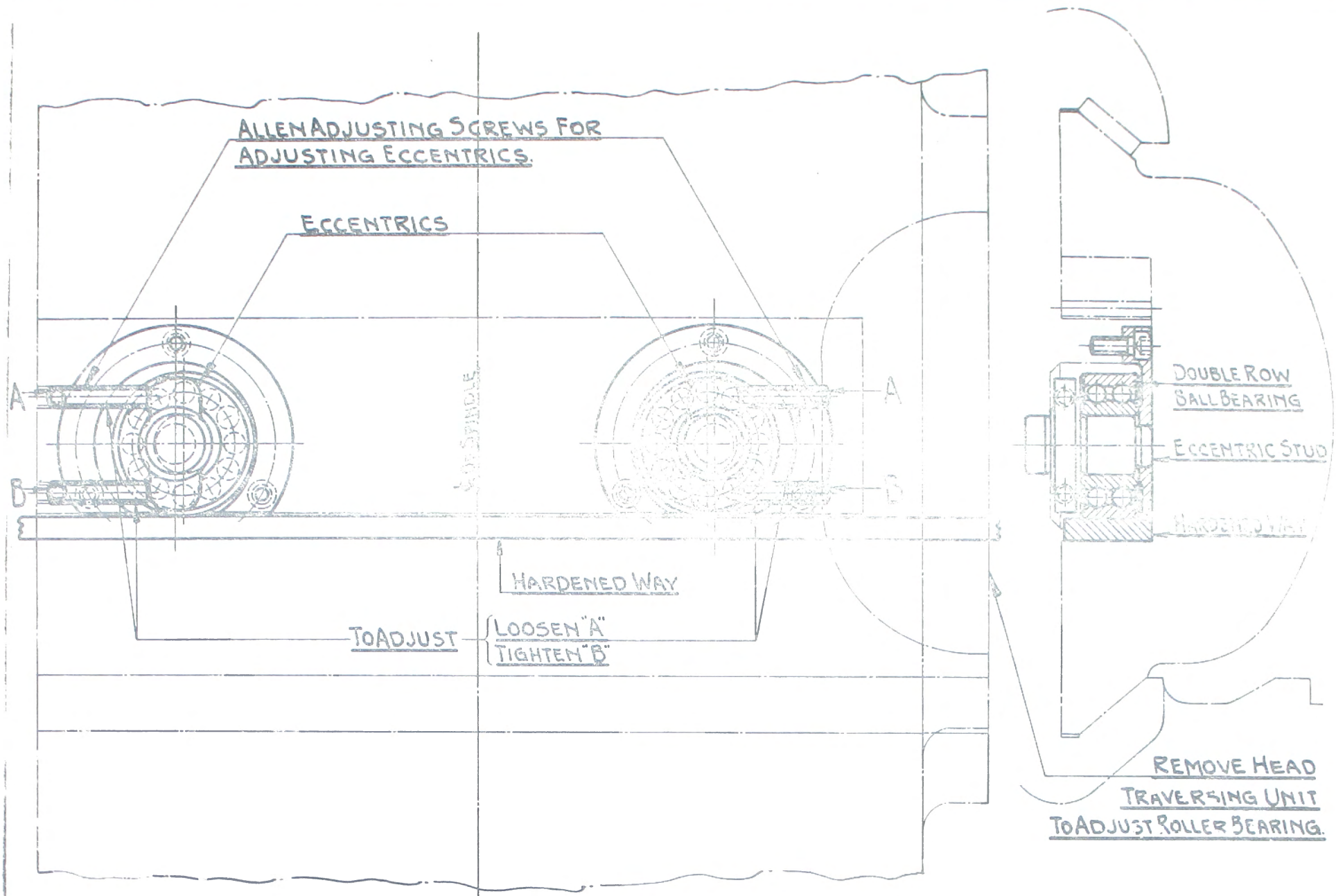
TO REPLACE QUICK RETURN UNIT

To Make Sure Automatic Stop For Spindle Will Function Properly Engage Quick Return Levers "H" And Turn Handwheel "J" In Direction Of Arrow Until Levers "H" Spring Outward Disengaging Clutch. Replace Quick Return Unit By Reversing Dismantling Procedure.



DR. R.T.T.	11-21-47	THE CARLTON MACHINE TOOL CO. CINCINNATI, O., U.S.A.	DRAW 19
CH.			

SUPERSEDES DRAW. NO 245



BALL BRG. HEAD ON HARDENED STEEL WAY ON ARM		DRAWING NO.	SIZE
DR. R.M.V. 1-6-38	THE CARLTON MACHINE TOOL CO. CINCINNATI · O · U.S.A.	17195	B

809-⅜x¾ COTTER PIN (SIX)

3780-C.R. Ⓐ
176-⅜x1½ SCR. (TWO)
18929-⅜x1¼ SCR.
14341*27 Ⓐ
18926-C.R. Ⓑ
13279-⅜x1 SCR. Ⓐ
14180-DE*1 Ⓑ
14184-C.I. Ⓑ
1813-⅜x¾ SCR. (TWO)
14185-C.I. Ⓑ
14171-S.S. Ⓓ
3562-SPRING Ⓐ
3765-C.R. Ⓐ
9737-⅜ ACORN NUT Ⓐ
1084*1220 SHAKEPROOF LOCK WASHER
SECTION "BB"

1813-⅜x¾ SCR. (TWO)
3528-C.R. Ⓑ
3532-CELLULOID Ⓑ
1109½-VELLUMOID Ⓑ
145C-4-20X6 C.R. (THREE)

14027-FEED INS. PLATE Ⓑ
1392-DRIVE SCR. (FOUR)
A
3774-DE*2 Ⓑ
B48-⅛x¾ STRAIGHT PIN (TWO)
13133-C.R. Ⓑ
2365-¼x¾ SCR.
12068-¼ x2¼ SCR. Ⓑ
19778-PUR. Ⓑ
321-4-40 x⅜ SCR. (TWO)
11GB2-¼ GITS OILER
41756-5102-1G8 TRUARC RET. RING
382-MIZZI MFG ROLLER BRG.
383-MOSE MFG ROLLER BRG.
41G97-5002-25C TRUARC RING
1306-¼ STEEL BALL (TWO)
4728-SPRING Ⓐ
18288-C.R. Ⓑ
41846-X5C-13C Nat. Ret. Ring
41497 SH. STEEL Ⓐ
41752-C.I. Ⓒ
4149G C.R. Ⓑ
5C7-110G-F THRUST BALL BRG.
1801-4x¾ SCR. (THREE)
14421-BRD. Ⓐ

14432-DE*20 Ⓑ
390-205 RND. BALL BRG.
371-206 RND. BALL BRG.
14164-C.R. Ⓑ
19142-BRD. Ⓑ
14557-MEEHANITE Ⓑ
179-⅜x2¼ SCR. (TWO)
14183-DE*1 Ⓒ
4432-SPRING Ⓐ (THREE)
14518-DE*24 Ⓑ
775-⅜ KD WOODRUFF KEY
392-207 RND. BALL BRG.
18886-SHIM Ⓐ
12707-1" LOCKWASHER
12607-1" LOCK NUT
742-⅜ NUT
2534-⅜x2¼ SCR.
2378-⅜ x⅜ SCR. (TWO)
12149-C.R. Ⓐ
14172-C.I. Ⓑ
41791-PUR. Ⓐ
1392 DRIVE SCR. (FOUR)
14526-PUR. Ⓑ
3493-C.I. Ⓐ (TWO)
204-¼x1¼ SCR. (TWO)
14173-C.R. Ⓒ
14179-⅜ S.A.E. NUT Ⓐ (TWO)
14178*7 Ⓑ (TWO)
14341*27 Ⓐ (TWO)
14175-C.R. Ⓑ (TWO)
14176*24 Ⓐ (TWO)
14177-C.R. Ⓑ (TWO)
2377-⅜x⅜ SCR. (SEVEN)
14452-DE*2 Ⓒ (TWO)
19057-C.I. Ⓔ
14182-DE*1 Ⓒ
SECTION "AA"

1634-½x3½ STRAIGHT PIN
3542-C.R. Ⓑ (TWO)
12197-MLL Ⓒ
PEEN IN NECK AS SHOWN
2391-⅜x½ SCR.
14450-C.R. Ⓐ
3551*7 C.R. Ⓐ

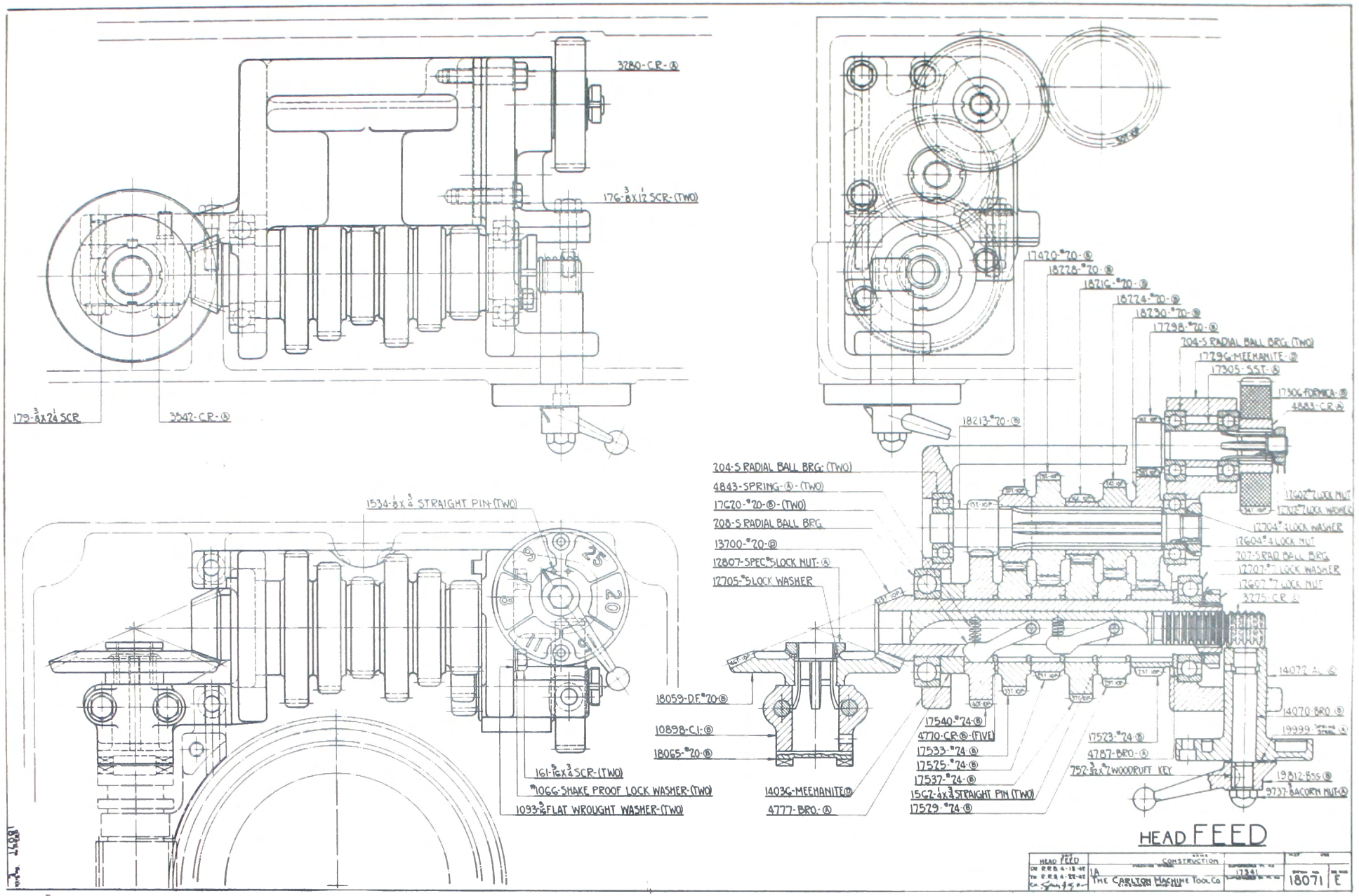
14131*20 Ⓑ
14187-BRD. Ⓐ
14521*2 Ⓑ
665*6x2 TAPER PIN
18233*20 Ⓒ

150G-¼ STEEL BALL (TWO)
4728-SPRING Ⓐ
3503-BRG. Ⓑ
9737-⅜ ACORN NUT Ⓐ
14422-DE*1 Ⓑ
4674-*24 Ⓐ
752-⅜x2 WOODRUFF KEY (TWO)
12812-B.S.S. Ⓑ
12222-SPRING WASHER Ⓐ
3780-C.I. Ⓑ
14464-C.R. Ⓑ
4805-FELT WASHER Ⓐ
SECTION "CC"

HEAD QUICK RETURN

HEAD-QUICK RETURN	CONSTRUCTION		
DR. BY H. [illegible] 04-48		14470	
TR. BY [illegible]	THE CARLTON MACHINE TOOL CO.		41810 F
CH. BY [illegible]			

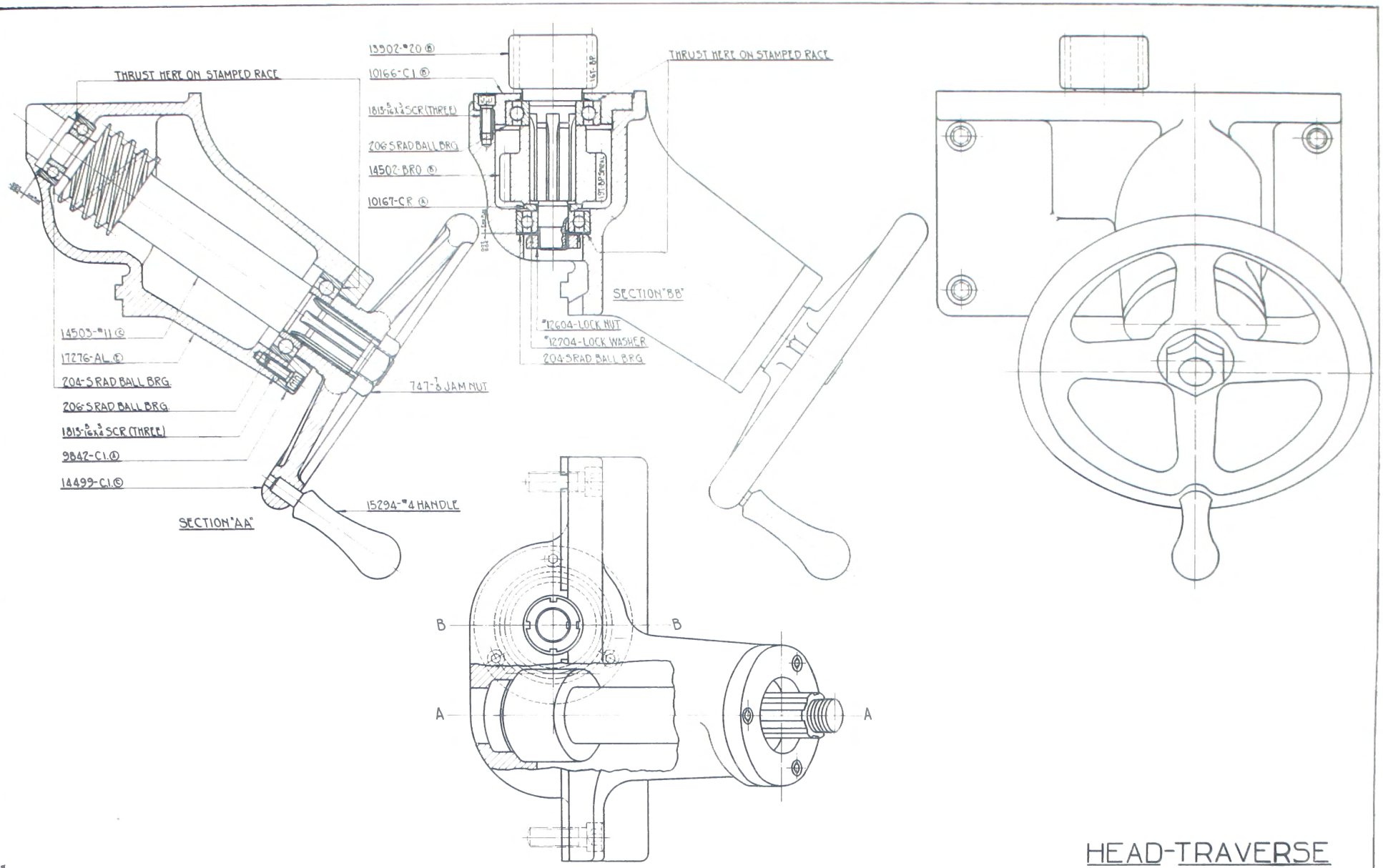
3280	7/16 Body Fit Screw
3493	Dial Guide Clamp
3503	Clutch Shifter
3528	Oil Gage Ring
3532	Oil Gage Window
3542	7/16 Body Fit Screw
3551	Cone Point Stop Screw
3765	Tapping Interlock Stud
3774	Binder Lever
3780	Clutch Shifter Lever
4674	Trip Pin
11091	Oil Gage Gasket
12149	Plug
12197	Clutch Release Lever
13133	Dial Binder
14164	Intermediate Gear Shaft
14171	Head
14172	Dial
14173	Plunger
14175	Roller Plunger
14176	Roller
[illegible]	Roller Pin
14450	Clutch Release Lever Pin
14452	Lever
14464	Clutch Shifter Stud
14518	Clutch Gear
14521	Worm
14526	Cutting Speed Chart
14557	Bracket
18288	Sliding Clutch
18299	Worm Shaft
18926	Depth Kickout
19057	Body
19142	Worm Shaft
19778	Indicator Plate
19812	Pointer Ball Lever
41496	Handwheel Bearing Container
41497	Thrust Washer
41752	Handwheel
41791	Spacer (#20 Ca. .032 Thick)



HEAD FEED

HEAD FEED	CONSTRUCTION		
DR R.R.B. 4-18-42			
TR R.R.B. 4-22-42	1A	17391	18071 E
CK Sept 95	THE CARLTON MACHINE TOOL CO.		

3275	Dive Key Shaft
3280	7/16 Body Fit Screw
3542	7/16 Body Fit Screw
4770	Change Gear Ring
4777	Thrust Collar
4787	Spacing Collar
4883	Spindle Driven Gear Hub
10898	Worm Drive Bearing
13700	Hollow Pinion
14036	Bottom Plate
14070	Dive Key Shifter Pinion
14072	Indicator Bush
17296	Top Plate
17298	14 T. Pinion Shaft
17305	Spacer
17306	Spindle Driven Gear
17420	20 T. Intermediate Gear
17523	23 T. Change Gear
17525	25 T. Change Gear
17529	29 T. Change Gear
17533	33 T. Change Gear
17537	37 T. Change Gear
17540	40 T. Change Gear
17620	Dive Key
18059	Bevel Gear
18065	Driving Clutch
18213	13 T. Intermediate Pinion
18216	16 T. Intermediate Gear
18224	24 T. Intermediate Gear
18228	28 T. Intermediate Gear
18230	30 T. Intermediate Gear
19812	Pointer Ball Lever
19999	Spring Washer

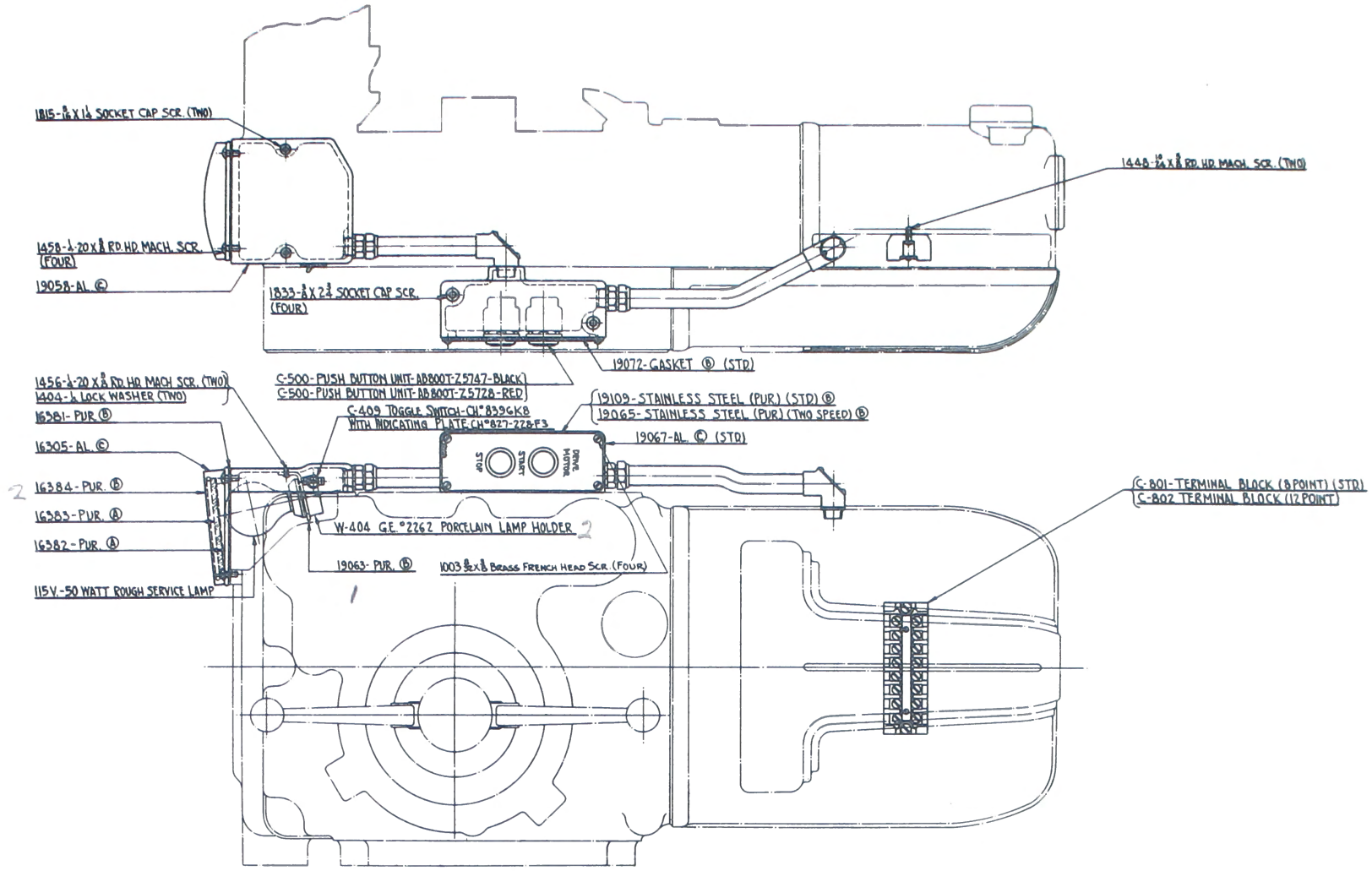


HEAD-TRAVERSE

UNIT	NAME	MAT.	SPEC.
HEAD TRAVERSE	CONSTRUCTION		
DR. RAV. 11-11-39 OA-1A	MACHINE SYMBOL		
TR. EDT 11-15-39	THE CARLTON MACHINE TOOL CO.		17275

17275

9842	Driving Shaft Cap
10166	Driven Shaft Cap
10167	Washer
13902	Rack Pinion
14499	Handwheel
14502	Driven Spiral Gear
14503	Driving Spiral Gear
17276	Body



PUSH BUTTON STATIONS WITH LIGHT

DRAG - Push Button Stations with Light		CONSTRUCTION	
DR. R.T.T.	2-23-52	1A-11'	
CH. R.T.T.	3-6-52	THE CARLTON MACHINE TOOL CO.	41431 E

41431 E

16305 Lens Body

16381 Lens Body Casket

16382 Lens Gasket

16383 Lens

16384 Lems Retainer Ring

19058 Lamp Cover

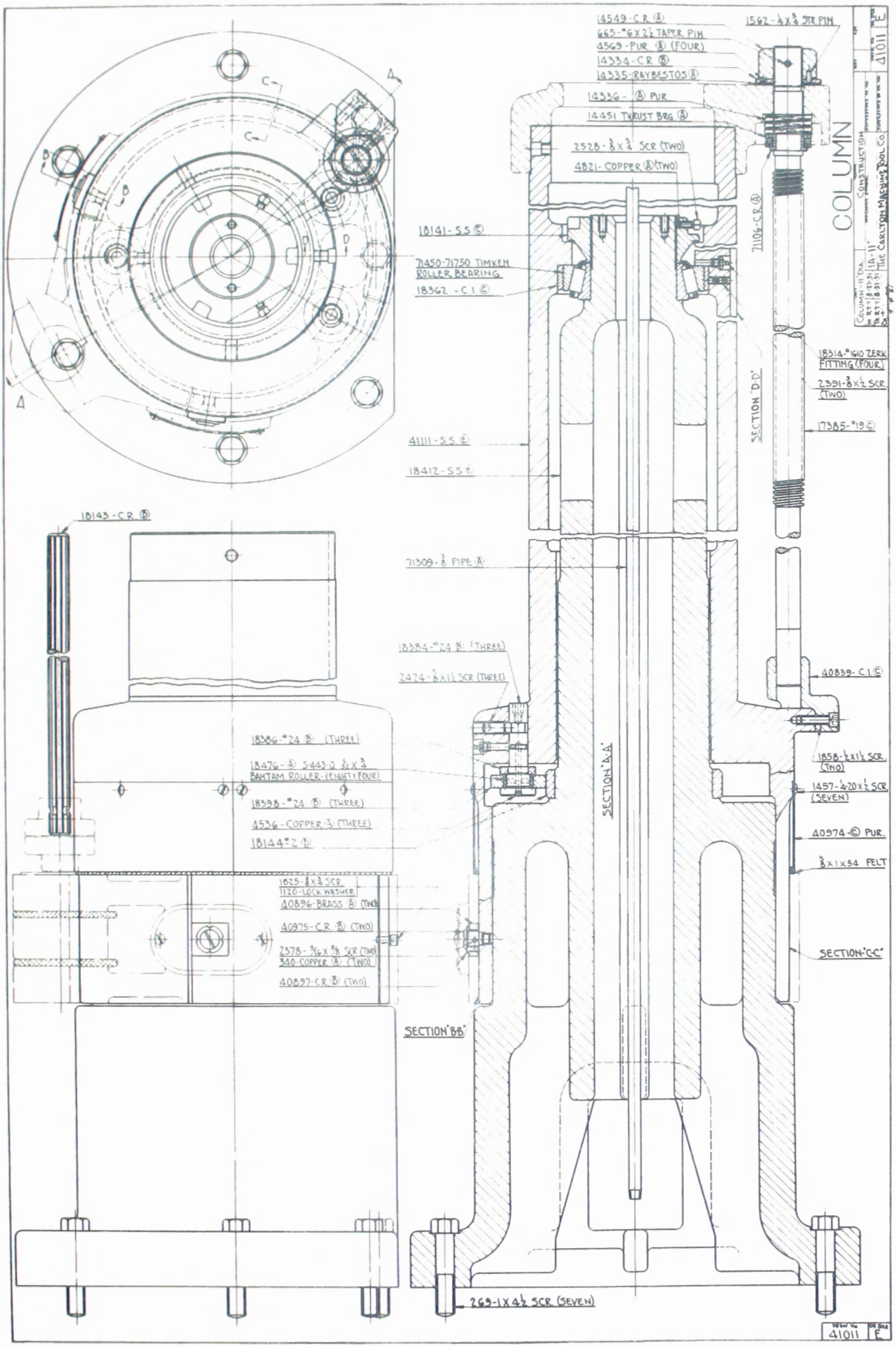
19063 Lamp Bracket

19065 Push Button Name Plate - L.H.

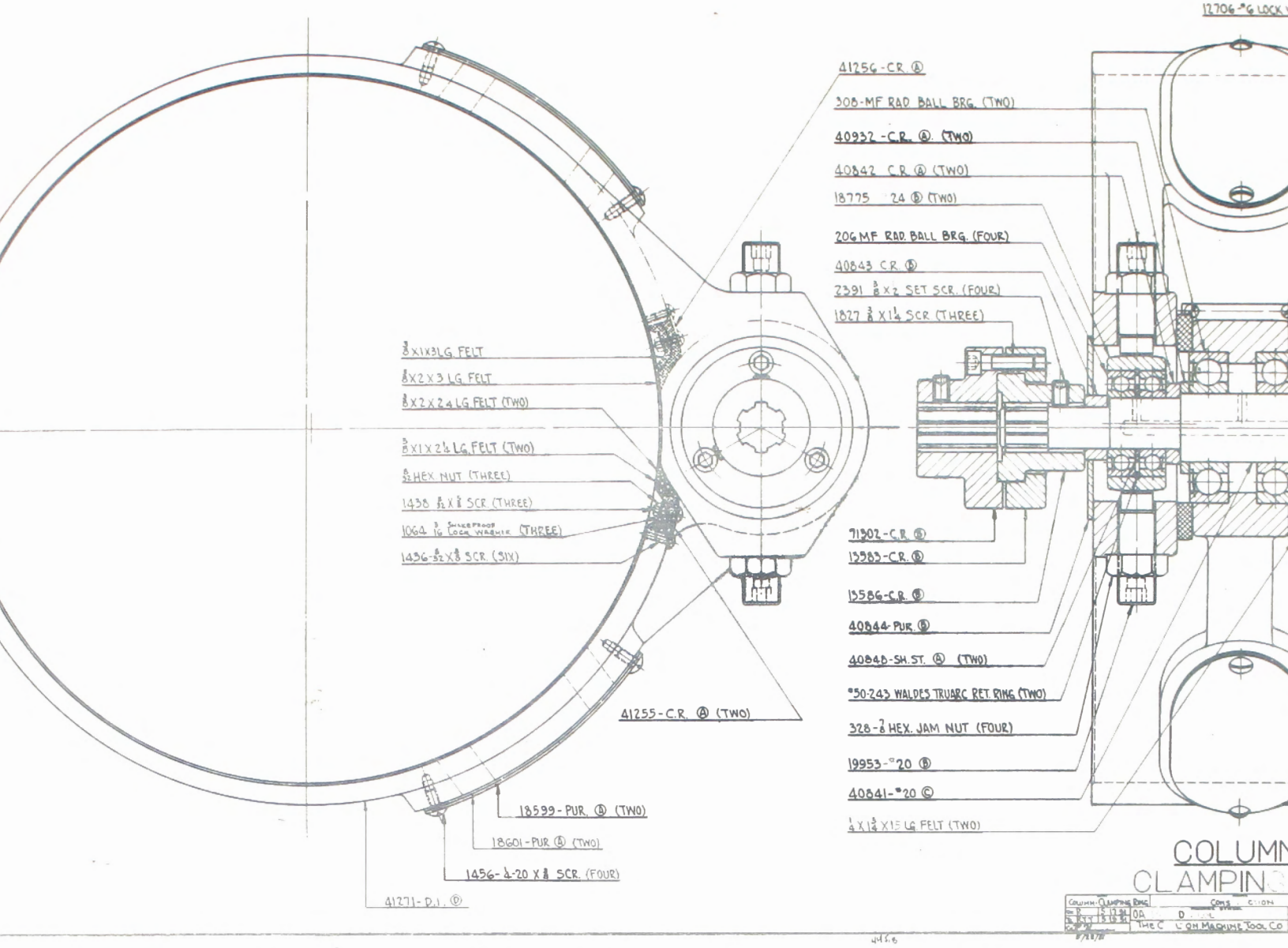
19067 Push Button Box - L.H.

19073 Gasket

19109 Push Button Name Plate - L.H.


14549-C.R. (A)
665-"6 x 2½ TAPER PIN
4569-PUR. (A) (FOUR)
14334-C.R. (B)
14335-RAYBESTOS (A)
14336-(A) PUR.
14451 THRUST BRG (A)
2528-⅜ x ¾ SCR (TWO)
4821-COPPER (A) (TWO)
1562-¼ x ¾ TR PIN
18141-S.S. (C)
71450-71750 TIMKEN ROLLER BEARING
18362-C.I. (C)
7110-C.R. (A)
COLUMN
18314-"610 ZERK FITTING (FOUR)
2391-⅜ x ½ SCR (TWO)
17385-"19 (C)
SECTION 'D-D'
41111-S.S. (E)
18412-S.S. (E)
18143-C.R. (B)
71309-⅜ PIPE (A)
18384-"24 (B) (THREE)
2474-⅜ x 1½ SCR (THREE)
40839-C.I. (C)
18386-"24 (B) (THREE)
18476-(B) S443-Q ⅝ x ¾ BANTAM ROLLER-(EIGHTY FOUR)
18398-"24 (B) (THREE)
4536-COPPER (B) (THREE)
18144-"2 (B)
SECTION 'A-A'
1858-½ x 1½ SCR (TWO)
1457-420 x ½ SCR (SEVEN)
40974-(C) PUR.
⅜ x 1 x 54 FELT
1825-⅜ x ¾ SCR.
1120-LOCK WASHER
40896-BRASS (A) (TWO)
40975-C.R. (B) (TWO)
2378-⅜ x ⅝ SCR (TWO)
340-COPPER (A) (TWO)
40897-C.R. (B) (TWO)
SECTION 'C-C'
SECTION 'B-B'
269-1 x 4½ SCR (SEVEN)
41011
E

340	Copper Plug
4536	Adjusting Screw Lock Plug
4569	5/16 Brass Tubular Rivet
4821	Copper Plug
14334	Elevating Screw Washer
14335	Friction Disc
14336	Elevating Screw Spring
14549	Elevating Screw Nut
17385	57-5/8" Long Elevating Screw
18141	Inner Column Nut
18143	44" Long Vertical Shaft
18144	Roller Band
18362	Bearing Bush
18384	Roller Eccentric
18386	Thrust Washer
18398	Outer Race
18412	11" Dia. Inner Column
40839	Elevating Screw Support
40896	Sliding Block
40897	Eccentric Bush
40974	Column Cover
40975	Support Stud.
41111	11" Dia. Outer Column
71106	Bearing Adapter

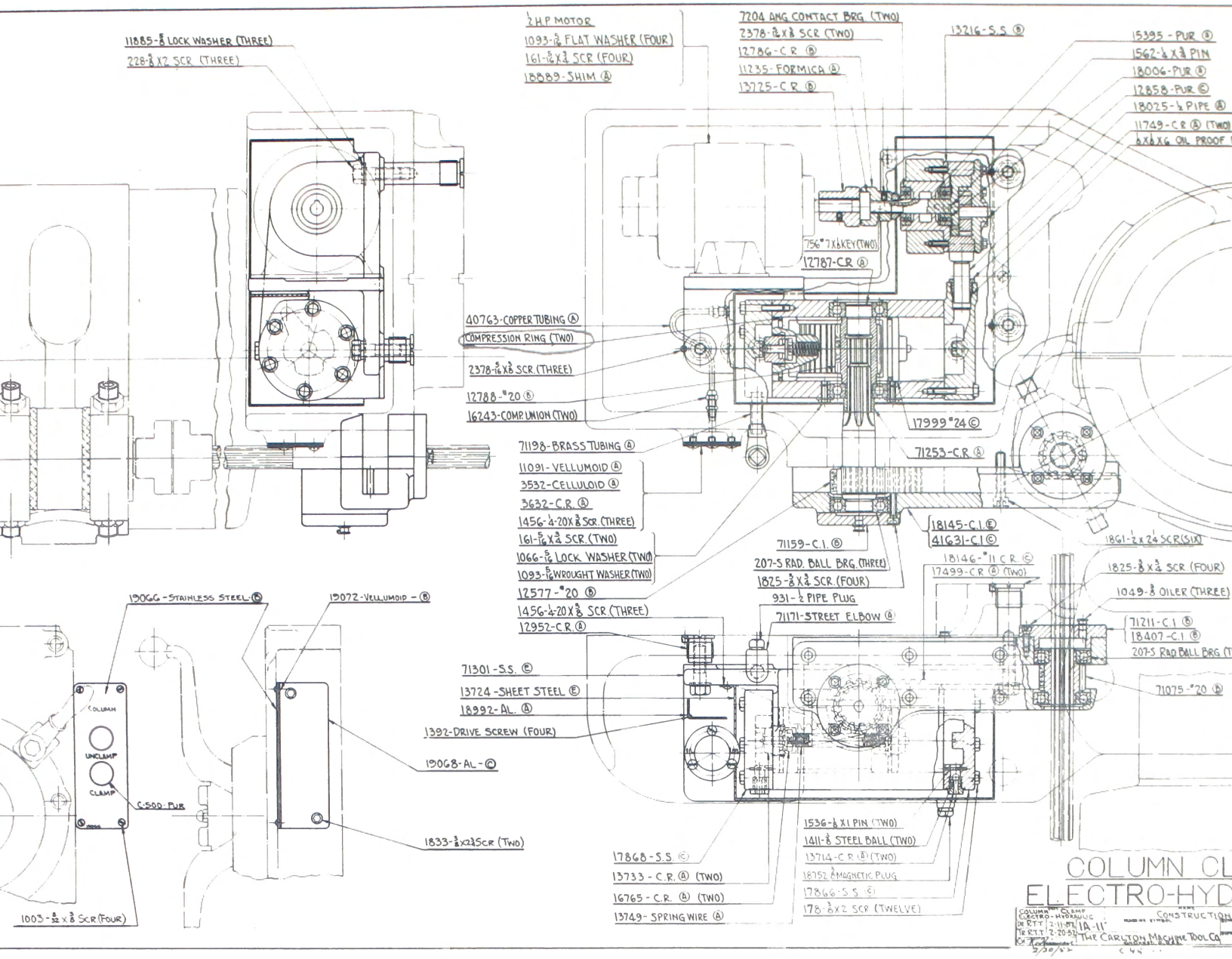

18314 ⅛ ZERK
12606 G LOCK
12706 *G LOCK
41256-C.R. Ⓐ
308-MF RAD BALL BRG. (TWO)
40932-C.R. Ⓐ (TWO)
40842 C.R. Ⓐ (TWO)
18775 24 Ⓑ (TWO)
206 MF RAD BALL BRG. (FOUR)
40843 C.R. Ⓑ
2391 ⅜ X 2 SET SCR. (FOUR)
1827 ⅜ X 1¼ SCR (THREE)
⅜ X 1 X 3 LG. FELT
⅜ X 2 X 3 LG. FELT
⅜ X 2 X 24 LG. FELT (TWO)
⅜ X 1 X 24 LG. FELT (TWO)
½ HEX NUT (THREE)
1438 ⅜ X ⅜ SCR (THREE)
1064 ⅜ LOCK WASHER (THREE)
1436-⅜-32 X ⅜ SCR. (SIX)
71302-C.R. Ⓑ
13983-C.R. Ⓑ
13586-C.R. Ⓑ
40844-PUR. Ⓑ
40840-SH. ST. Ⓐ (TWO)
*50-243 WALDES TRUARC RET. RING (TWO)
328-⅞ HEX. JAM NUT (FOUR)
19953-*20 Ⓑ
40841-*20 Ⓒ
¼ X 1⅜ X 15 LG FELT (TWO)
41255-C.R. Ⓐ (TWO)
18599-PUR. Ⓐ (TWO)
18601-PUR Ⓐ (TWO)
1456-¼-20 X ⅜ SCR. (FOUR)
41271-D.I. Ⓑ
COLUMN
CLAMPIN
COLUMN-CLAMPING RING
THE C LON MACHINE TOOL CO

13583	Coupling Clamp Ring
13586	Lower Coupling Flange
18599	Cover
18601	Cover Gasket
18775	Bearing Ring
19953	Threaded Shoe
40841	Eccentric
40842	Spacer
40843	Spacer
40844	Dust Shield
40848	Bearing Spacer
40932	Spacer
41255	Felt Retainer
41256	Felt Retainer
41271	Clamping Ring
71302	Upper Coupling Flange

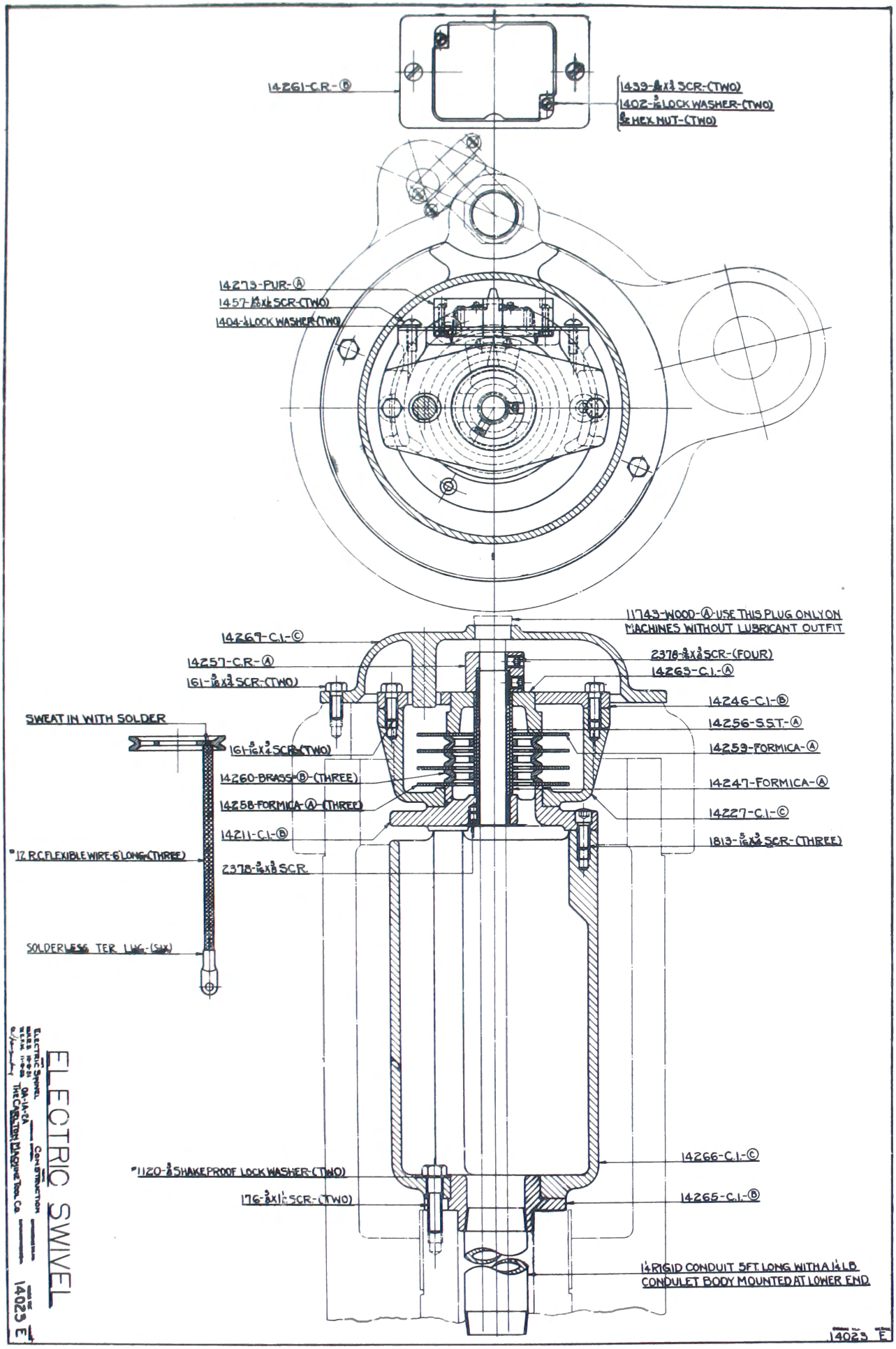
17501-SHEET STEEL Ⓑ
1456-¼-20X⅜ SCR. (FIFTEEN)
18314-⅛ ZERK FITTING "1010 (TWO)
14316-SHEET STEEL Ⓑ
1456-¼-20X⅜ SCR. (FOUR)
1010 NICE THRUST BRG. (TWO)
17182-C.I. Ⓑ
1458-¼-20X⅜ SCR. (TWO)
14749-C.I. Ⓒ
651-"5X1½ TAPER PIN (TWO)
14327-C.R. Ⓑ (TWO)
2391-⅜X½ SET SCR.
18747-C.R. Ⓐ (TWO)
18159-S.S. Ⓑ
653-"5X2 TAPER PIN
17183-C.I. Ⓑ
809-⅝X3¾ COTTER PIN (FOUR)
14341-"27 Ⓑ (TWO)
653-"5X2 TAPER PIN (TWO)
14895-"27 Ⓑ
14340-C.R. Ⓑ (TWO)
14202-C.I. Ⓑ (TWO)
41348-BRASS Ⓐ
4431-C.R. Ⓐ
4432-SPRING Ⓐ
4428-C.R. Ⓐ
1065-"1114 LOCK WASHER (TWO)
740-HEX. CHECK JAM NUT (TWO)
17289-MTG. HANITE Ⓑ
218-⅜X2 SCR. (FIVE)
17287-BRG. Ⓑ
17189-PUR. Ⓐ
1436-⅜X⅞ SCR.
1064-⅜ LOCK WASHER
17248-C.R. Ⓒ
17689-C.I. Ⓒ
1829-⅜X1¾ C.R. (THREE)
930-⅜ PIPE PLUG
17696-C.I. Ⓒ
12606-"G LOCK NUT
12706-"G LOCK WASHER
206-S RAD. BALL BRG.
1856-¼X1½ SCR. (TWO)
2391-⅜X½ SET SCR. (TWO)
1629-¼X2¼ PIN (TWO)
FELT
1536-¼X1 PIN (TWO)
18073-SHIM Ⓑ
3767-3720-TIMKEN ROLLER BRG.
300130-K OIL SEAL (TWO)
210-S RAD BALL BRG.
18065-"20 Ⓑ
3029-C.R. Ⓐ
18064-BRO. Ⓒ
1813-⅜X¾ SCR.
17186-C.R. Ⓑ
1102-¼X½ SCR. (TWO)
17044-STEEL Ⓑ
14894-C.R. Ⓐ (TWO)
736-⅜ HEX. NUT (TWO)
747-⅜ HEX. JAM NUT (TWO)
14896-FORG. Ⓑ (TWO)
14906-"27 Ⓐ
760-"3X⅜ WOODRUFF KEY
19189-C.I. Ⓑ
1010-NICE THRUST BRG. (TWO)
17504-S.S. Ⓒ
45047-SH. STEEL Ⓒ
4493G-"3600-A GITS OILER (TWO)
933-⅛ STR. ELBOW (TWO)
1827-⅜X1¼ SCR.
45046-SH. STEEL Ⓒ
955-¼X½ FLAT HD. SCRS. (TWENTY-THREE)
1825-⅜X¾ SCR.
1609-⅜X2¼ PIN Ⓑ (TWO)
1850-⅜X2 SCR. (THREE)
13904-"2 Ⓒ
CARLTON
4'ARM-11"COL.
45058-GARLOCK WIPING RING (TWO)
45048-SH. STEEL Ⓒ

ARM
CONSTRUCTION
THE CARLTON MACHINE TOOL CO.
45011 F

3029	3/8 x 3/8 x 1-1/4 Square Key
4428	1-1/8 Thread Plug
4431	Plunger
13904	4 Ft. Arm Rack
14202	Clamping Lever
14316	Cover
14327	Spiral Gear
14340	Roller
14341	1/2 x 2-5/8 Drilled Pin
14749	Spiral Gear Guard
14893	Cam Shaft
14894	Binder Washer
14896	Binder Bolt
14906	Operating Shaft
17044	Hardened Armway (55-1/4 long)
17182	Lower Binder Cam
17183	Upper Binder Cam
17186	Key
17189	Oil Slinger
17248	69" Long Backshaft
17287	Auxiliary Nut
17289	Elevating Nut Cap


11885-⅝ LOCK WASHER (THREE)
228-⅝ X2 SCR (THREE)
½ H.P MOTOR
1093-⅝ FLAT WASHER (FOUR)
161-⅝ X3 SCR (FOUR)
18889-SHIM Ⓐ
7204 ANG CONTACT BRG (TWO)
2378-⅝ X3 SCR (TWO)
12786-C.R Ⓑ
11235-FORMICA Ⓐ
13725-C.R Ⓑ
13216-S.S Ⓑ
15395-PUR Ⓑ
1562-¼ X ⅜ PIN
18006-PUR Ⓑ
12858-PUR Ⓒ
18025-½ PIPE Ⓐ
11749-C.R Ⓐ (TWO)
6X6X6 OIL PROOF
756"7 X 8 KEY (TWO)
12787-C.R Ⓐ
40763-COPPER TUBING Ⓐ
COMPRESSION RING (TWO)
2378-⅝ X8 SCR. (THREE)
12788-"20 Ⓑ
16243-COMP. UNION (TWO)
17999"24 Ⓒ
71198-BRASS TUBING Ⓐ
11091-VELLUMOID Ⓐ
3532-CELLULOID Ⓐ
3632-C.R. Ⓐ
1456-¼-20 X ⅜ SCR. (THREE)
161-⅝ X ⅜ SCR. (TWO)
1066-⅝ LOCK WASHER (TWO)
1093-⅝ WROUGHT WASHER (TWO)
12577-"20 Ⓑ
1456-¼-20 X ⅜ SCR (THREE)
12952-C.R. Ⓐ
71253-C.R Ⓐ
18145-C.I. Ⓔ
41631-C.I Ⓒ
71159-C.I. Ⓑ
207-S RAD. BALL BRG. (THREE)
1825-⅜ X ¾ SCR. (FOUR)
931-½ PIPE PLUG
71171-STREET ELBOW Ⓐ
18146-"11 C.R. Ⓒ
17499-C.R Ⓐ (TWO)
1825-⅜ X ¾ SCR (FOUR)
1049-⅜ OILER (THREE)
71211-C.I Ⓑ
18407-C.I Ⓑ
207-S RAD BALL BRG (T
71075-"20 Ⓑ
18G1-½ X 2¼ SCR (SIX)
19066-STAINLESS STEEL-Ⓒ
19072-VELLUMOID-Ⓑ
COLUMN
UNCLAMP
CLAMP
C-500-PUB
71301-S.S. Ⓒ
13724-SHEET STEEL Ⓔ
18992-AL. Ⓐ
1392-DRIVE SCREW (FOUR)
19068-AL-Ⓒ
1833-⅜ X 2¼ SCR (TWO)
1003-#32 X ⅜ SCR (FOUR)
17868-S.S. Ⓒ
13733-C.R. Ⓐ (TWO)
16765-C.R. Ⓐ (TWO)
13749-SPRING WIRE Ⓐ
1536-¼ X 1 PIN (TWO)
1411-⅜ STEEL BALL (TWO)
13714-C.R Ⓐ (TWO)
18752 MAGNETIC PLUG
17866-S.S Ⓒ
178-⅜ X 2 SCR (TWELVE)
COLUMN CL
ELECTRO-HYD
CONSTRUCTION
1A-11
THE CARLTON MACHINE TOOL CO.

3532	Oil Gage Window
3632	Oil Gage Ring
11091	Oil Gage Gasket
11235	Clutch Block
11749	Packing Nut
12577	Rack Pinion Shaft
12786	Clutch (11/16 Bore)
12787	Plug
12788	Piston Pinion
12858	Model 2CS Tuthill Pump
12952	Adapter Bush
13216	Pump Adapter
13714	Check Valve Seat
13724	Oil Pan
13725	Clutch (5/8 Bore)
13733	Valve Seat
15395	Laminated Shim
16765	Valve
17499	Long Adapter
17866	Cylinder Head
17868	Cylinder Can
17999	Piston
18006	Laminated Shim
18145	Rack Bracket
18146	Rack
18407	Alteration To Cap
18992	Instruction Plate
19066	Push Button Name Plate - R.H.
19068	Push Button Box - R.H.
19072	Gasket
41632	Rack Bracket Alteration
71075	Vertical Shaft Gear
71159	Rack Pinion Cap
71211	Vertical Shaft Gear Cap
71253	Spacer
71301	Mounting Plate


14261-C.R.-Ⓑ
1439-⅜x1¾ SCR.-(TWO)
1402-⅜ LOCK WASHER-(TWO)
⅜ HEX. NUT-(TWO)
14273-PUR.-Ⓐ
1457-#8x¾ SCR.-(TWO)
1404-#8 LOCK WASHER-(TWO)
11743-WOOD-Ⓐ-USE THIS PLUG ONLY ON MACHINES WITHOUT LUBRICANT OUTFIT
14269-C.I.-Ⓒ
14257-C.R.-Ⓐ
161-⅜x1¾ SCR.-(TWO)
2378-⅜x⅞ SCR.-(FOUR)
14263-C.I.-Ⓐ
14246-C.I.-Ⓑ
14256-S.S.T.-Ⓐ
14259-FORMICA-Ⓐ
SWEAT IN WITH SOLDER
161-⅜x¾ SCR.-(TWO)
14260-BRASS-Ⓑ-(THREE)
14258-FORMICA-Ⓐ-(THREE)
14247-FORMICA-Ⓐ
14227-C.I.-Ⓒ
14211-C.I.-Ⓑ
1813-⅜x⅝ SCR.-(THREE)
*12 R.C. FLEXIBLE WIRE-6' LONG-(THREE)
2378-⅜x⅞ SCR.
SOLDERLESS TER. LUG.-(SIX)
*1120-⅜ SHAKE PROOF LOCK WASHER-(TWO)
14266-C.I.-Ⓒ
176-⅜x1½ SCR.-(TWO)
14265-C.I.-Ⓑ
¼ RIGID CONDUIT 5FT. LONG WITH A 1¼ LB. CONDULET BODY MOUNTED AT LOWER END
ELECTRIC SWIVEL
ELECTRIC SWIVEL CONSTRUCTION
SERIES 1923
OA-1A-CA
THE CABLE-TEN MACHINE TOOL CO.
14023 E
14023 E

14211 Contact Ring Base

14227 Brush Holder Body

14246 Brush Holder Cover

14247 Insulating Sleeve

14256 Sleeve

14257 Sleeve Nut

14258 Contact Ring Insulator

14259 Cover Bush Insulator

14260 Contact Ring

14261 Bfush Block Holder

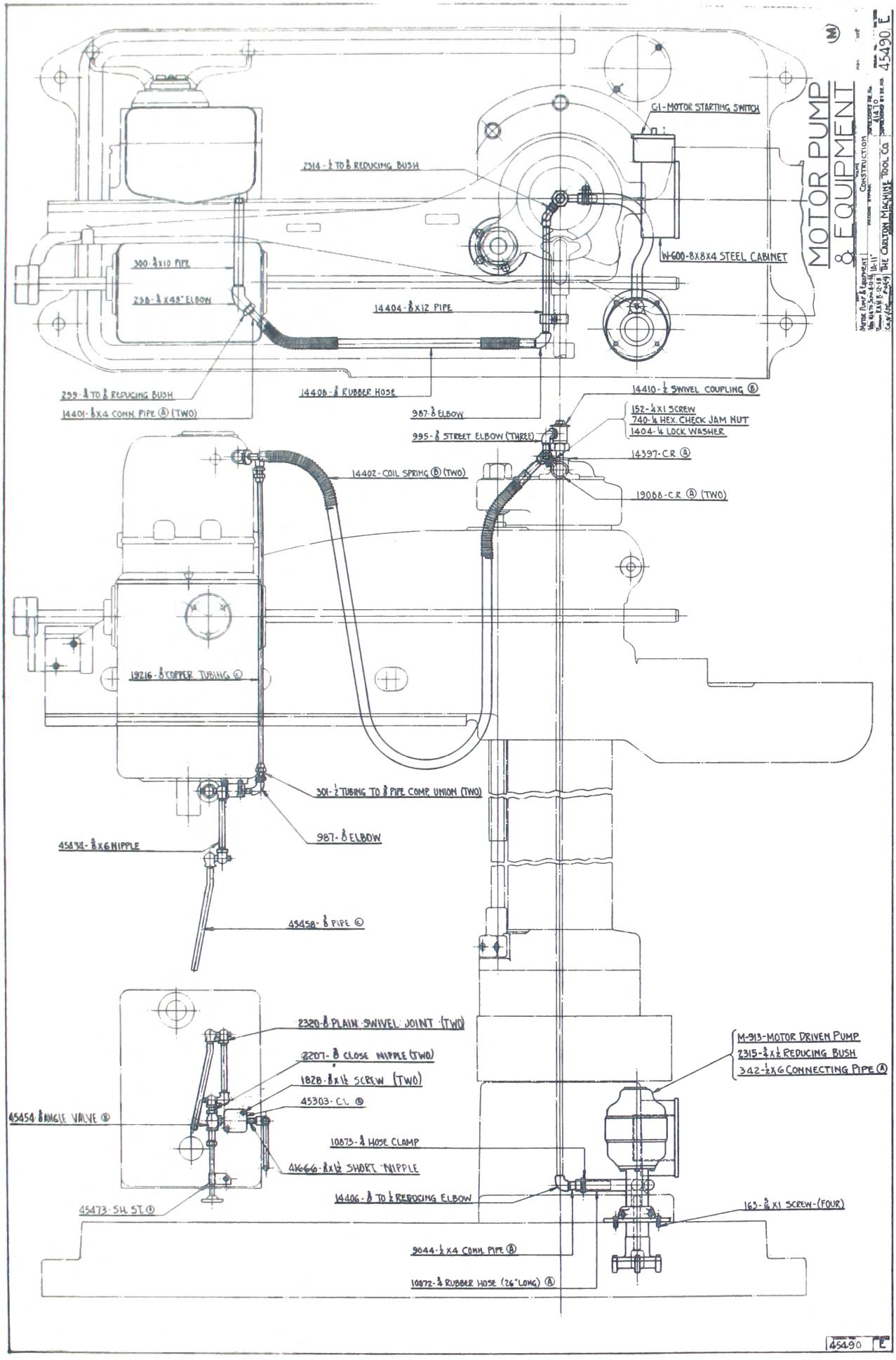
14263 Cover Bush (3Conductor)

14265 1 1/4" Conduit Support

14266 Swivel Support

14267 Cover

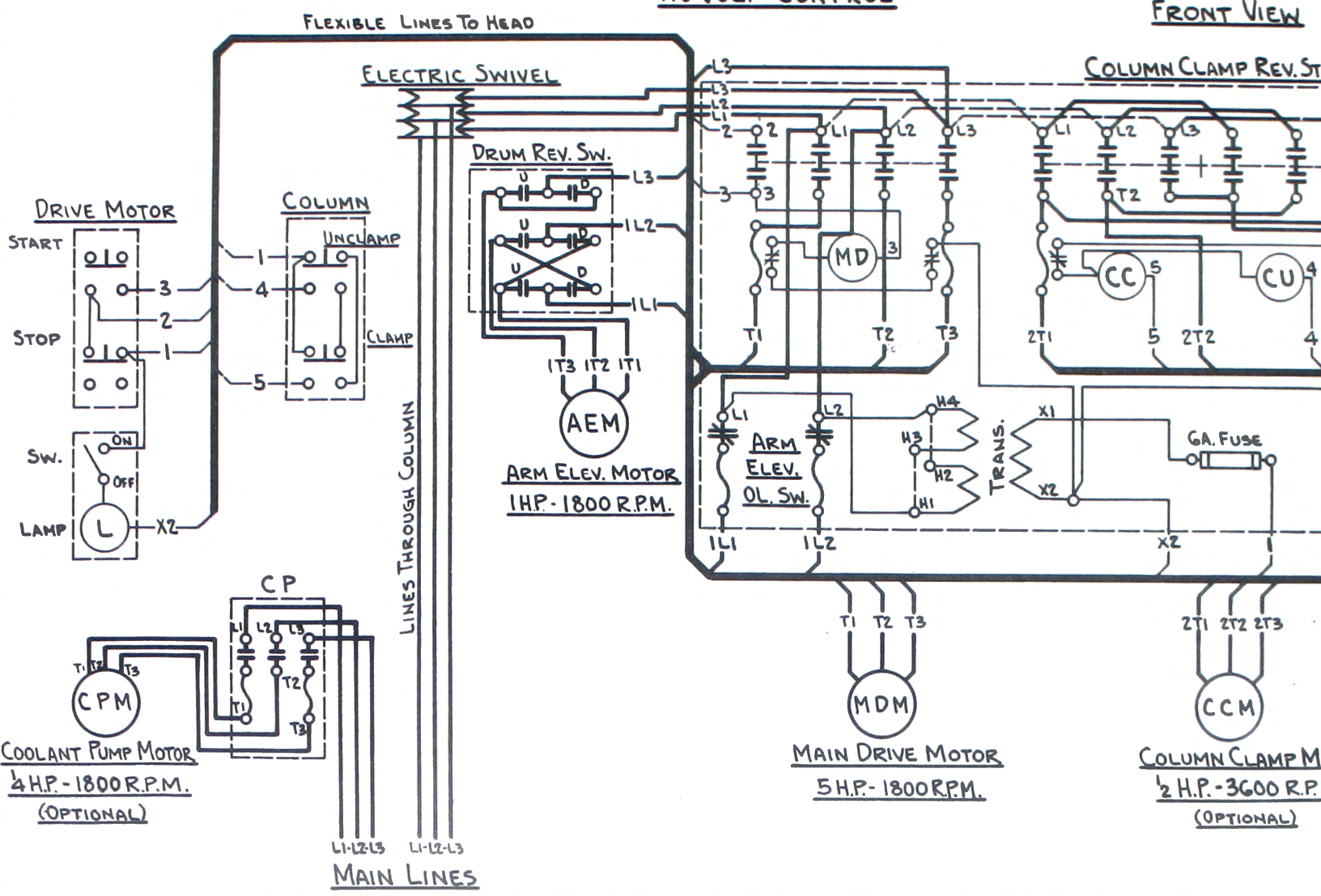
14273 Brush Block Assembly


MOTOR PUMP & EQUIPMENT
45490 E
G1-MOTOR STARTING SWITCH
2314-½ TO ⅜ REDUCING BUSH
W-600-8X8X4 STEEL CABINET
300-⅜X10 PIPE
298-⅜X45° ELBOW
14404-⅜X12 PIPE
299-⅜ TO ⅛ REDUCING BUSH
14401-⅛X4 CONN. PIPE Ⓐ (TWO)
14408-⅛ RUBBER HOSE
987-⅛ ELBOW
14410-½ SWIVEL COUPLING Ⓑ
152-¼X1 SCREW
740-¼ HEX. CHECK JAM NUT
1404-¼ LOCK WASHER
995-⅛ STREET ELBOW (THREE)
14397-C.R Ⓐ
14402-COIL SPRING Ⓑ (TWO)
19088-C.R Ⓐ (TWO)
19216-⅛ COPPER TUBING Ⓒ
301-½ TUBING TO ⅜ PIPE COMP. UNION (TWO)
987-⅜ ELBOW
45434-⅜X6 NIPPLE
45458-⅜ PIPE Ⓒ
2320-⅜ PLAIN SWIVEL JOINT (TWO)
2207-⅜ CLOSE NIPPLE (TWO)
1828-⅜X1½ SCREW (TWO)
45303-C.V. Ⓑ
45454-⅜ ANGLE VALVE Ⓑ
10873-⅜ HOSE CLAMP
46666-⅜X½ SHORT NIPPLE
45473-SW. ST. Ⓐ
14406-⅜ TO ½ REDUCING ELBOW
M-913-MOTOR DRIVEN PUMP
2315-⅜X½ REDUCING BUSH
3422-½X6 CONNECTING PIPE Ⓐ
163-⅝X1 SCREW-(FOUR)
9044-½X4 COMM. PIPE Ⓐ
10872-⅜ RUBBER HOSE (26" LONG) Ⓐ
THE CARLTON MACHINE TOOL CO.
45490 E

45490

14397	Drip Washer
19088	Pipe Spacer
45301	Pipe Support
45473	Valve Stem Bracket

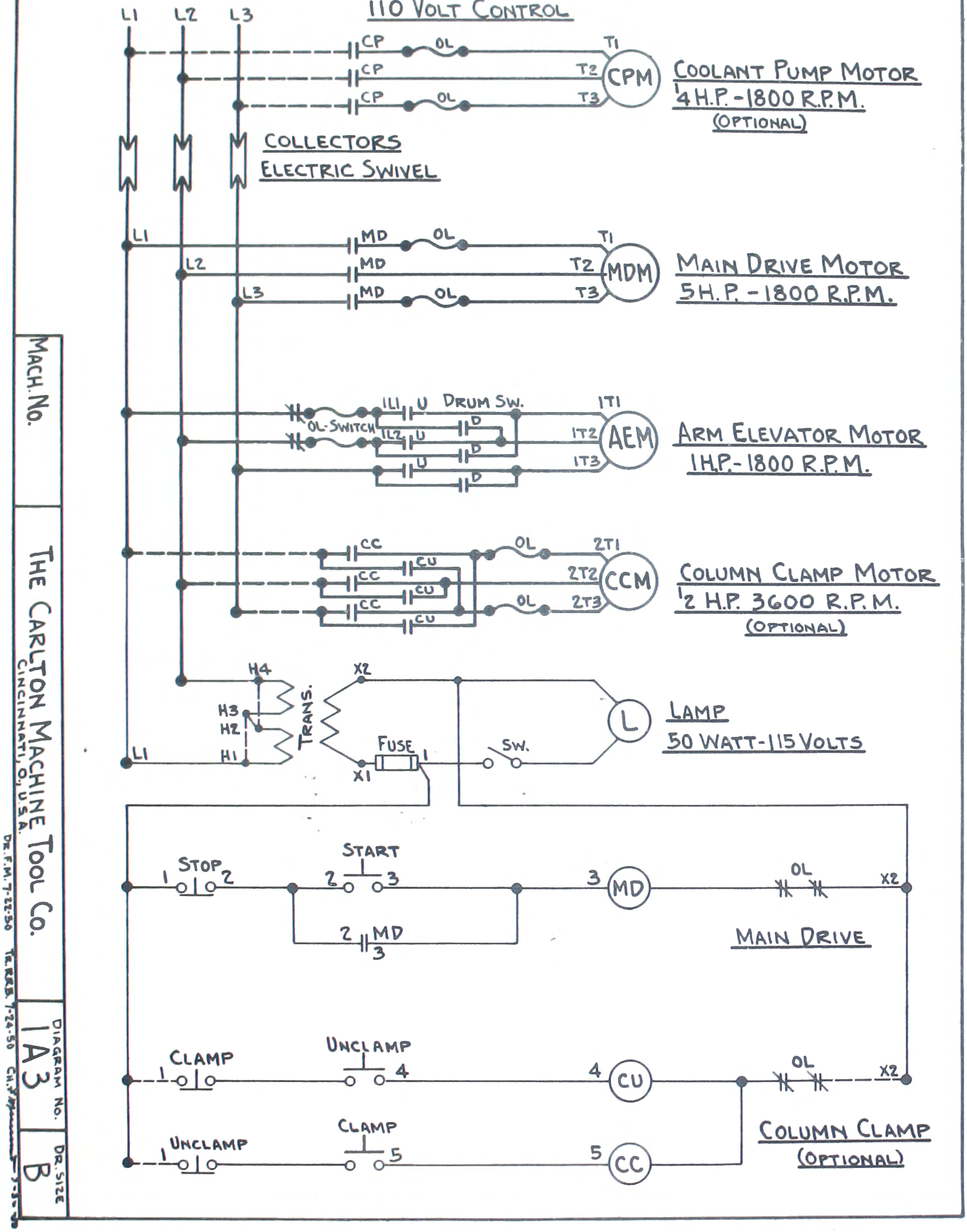
MAIN DIAGRAM
TYPE 1A RADIAL DRILL - 3 PHASE
110 VOLT CONTROL



MACH. NO.	THE CARLTON MACHINE TOOL CO. CINCINNATI, O., U.S.A.	DIAGRAM N 1A3-D

DR F.M. 7-22-50 TR. R.R.B. 7-24-50 CH.

ELEMENTARY DIAGRAM
TYPE 1A RADIAL DRILL - 3 PHASE
110 VOLT CONTROL



MACH. NO.

THE CARLTON MACHINE TOOL CO.
CINCINNATI, O., U.S.A.

DR. F.M. 7-22-50 TR. R.E.B. 7-24-50 CH.

DIAGRAM NO. 1A3

DR. SIZE B