OPERATION

MAINTENANCE

AND REPAIR PARTS

of the

BROWN & SHARPE

No. 4

AUTOMATIC SCREW MACHINE

B·S

PRICE $2.50

OPERATION, MAINTENANCE AND REPAIR PARTS

for

BROWN & SHARPE

No. 4 AUTOMATIC SCREW MACHINE

For Machines Beginning Serial No. 542-4-176

FOREWORD

This book offers a practical working knowledge of the Brown & Sharpe No. 4 Automatic Screw Machine. It will enable the machine operator to obtain continuous and accurate production of work that requires close tolerances and good finish.

Repair parts are listed and illustrated in the second part and are shown as far as possible in correct relation to each other to facilitate identification and assembly.

Chapter 1 on Machine Installation covers hoisting, connecting to power supply, lubrication and coolant requirements. The floor plans on page 8 should be considered before permanent location for the machine is chosen.

Detailed explanations are presented in Chapter 2 for each set-up adjustment and operating control of the machine and its standard equipment.

We strongly urge the reader to note the contents of Chapter 3 on Preventive Maintenance and the schedule of regular inspection.

Chapter 4 on Maintenance Adjustments will be a valuable aid to the maintenance man and also will be of help to the operator to better understand the use and care, sharpening instructions etc. of blades used in screw machine tools.

BROWN & SHARPE MFG. CO.
PROVIDENCE 1, R. I., U. S. A.

Printed in U.S.A.

5C-8-57

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PART II — REPAIR PARTS

Cam Service.

Brown & Sharpe will design and cut cams for you. Send a drawing giving all dimensions or a sample of the work together with the size and serial number of the machine for which the cams are to be made. Fast service and reasonable cost are features of Brown & Sharpe cam service.

Cam and Tool Design Course.

Brown & Sharpe holds several courses of instruction each year. Each course consists of approximately 40 hours (one work week) of class instruction. There is no charge for this training. Reservations for enrollment must be made in advance through our nearest sales office or representative.

Screw Machine Tools.

Brown & Sharpe designs and manufactures a complete line of highest quality screw machine tools. Good tools properly used is one of the first requirements for production of accurate work. Set-up time is less when the tools are B&S.

Screw Machine Attachments.

Brown & Sharpe stocks a wide selection of screw machine attachments, the use of which makes it possible to perform auxiliary operations while other work is being done by the machine also saves time of second handling and eliminates the need of a machine for second operations. Used singly or in combination these attachments simplify and speed-up production of many screw machine products.

Maintenance Course.

Brown & Sharpe conducts several screw machine maintenance courses each year. Each course consists of approximately 3 days of classroom instruction where a machine is disassembled and explained. Instruction in preventative maintenance is also given. There is no charge for this course. Reservations for enrollment must be made in advance through our nearest sales office or representative.

Replacement Parts Service.

Brown & Sharpe has made genuine replacement parts available with no delay. We have appointed "Authorized Brown & Sharpe Replacement Parts Distributors" in key industrial areas. These distributors carry a large stock from which you may procure genuine parts for routine or emergency requirements. See listing below for distributor nearest you.

Chandler & Farquhar Co., Inc.
900 Commonwealth Ave.
Boston 15, Mass.

Frey Industrial Supply Co.
3828 Santa Fe Ave.
Los Angeles 58, Calif.

Screw Machine Supply Co.
118 North Aberdeen St.
Chicago 7, Ill.

Ray H. Morris Co., Inc.
69 Prospect Ave.
West Hartford 6, Conn.

B. H. Tool & Supply Co.
570 W. 8 Mile Rd.
Detroit 20, Mich.

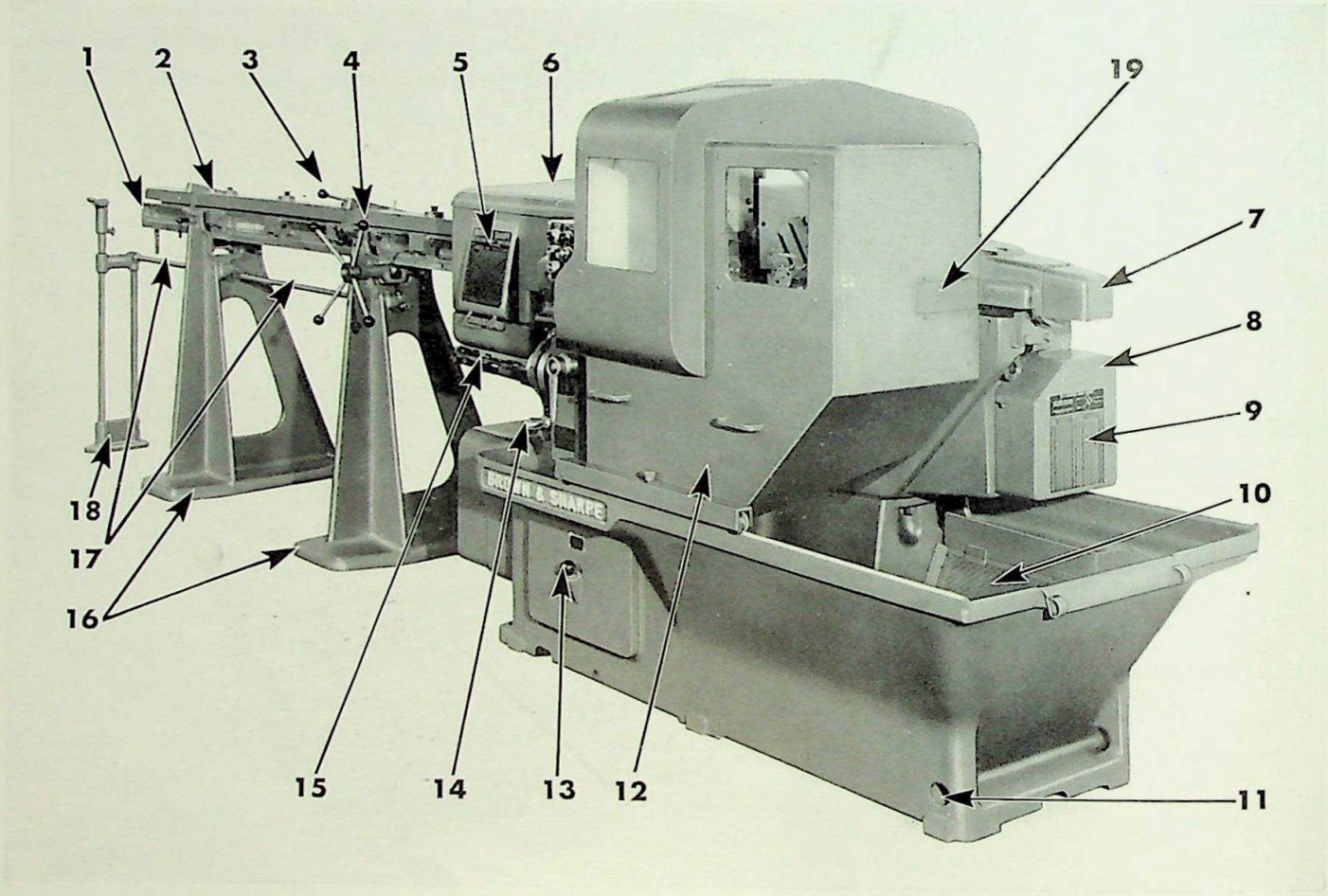
Chapin-Owen Co., Inc.
205 St. Paul St.
Rochester 4, N. Y.

Dayton Supply & Tool Co.
520 East First St.
Dayton, Ohio

Mid-Island Supply Co.
29-08 39th Ave.
Long Island City 1, N. Y.

Cleveland Tool & Supply Co.
1427 — 37 W. Sixth St.
Cleveland 13, Ohio

Operating Controls and Principal Parts of the No. 4 Automatic Screw Machine



Front View

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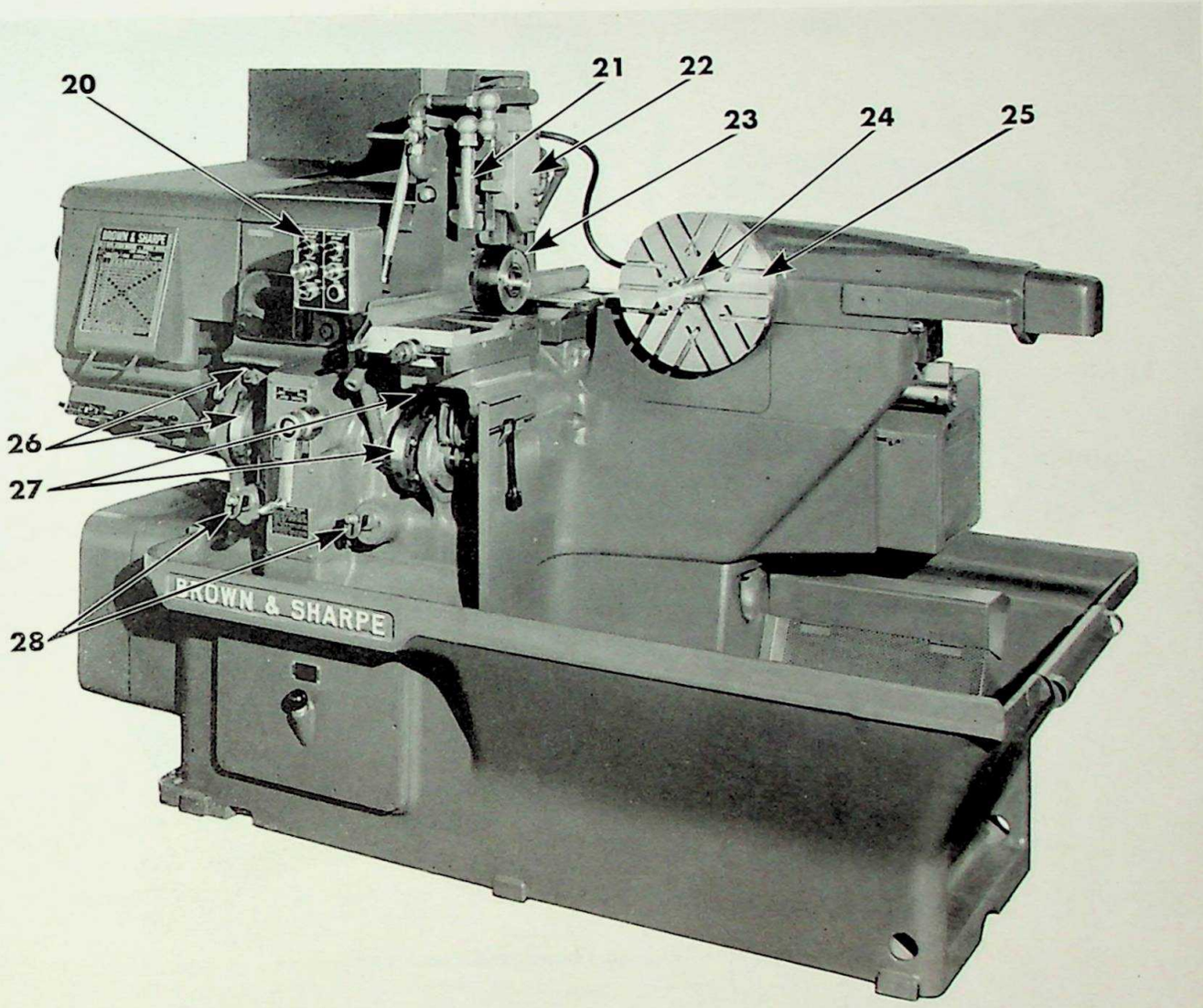

Front View — Without Guard and Stockloader

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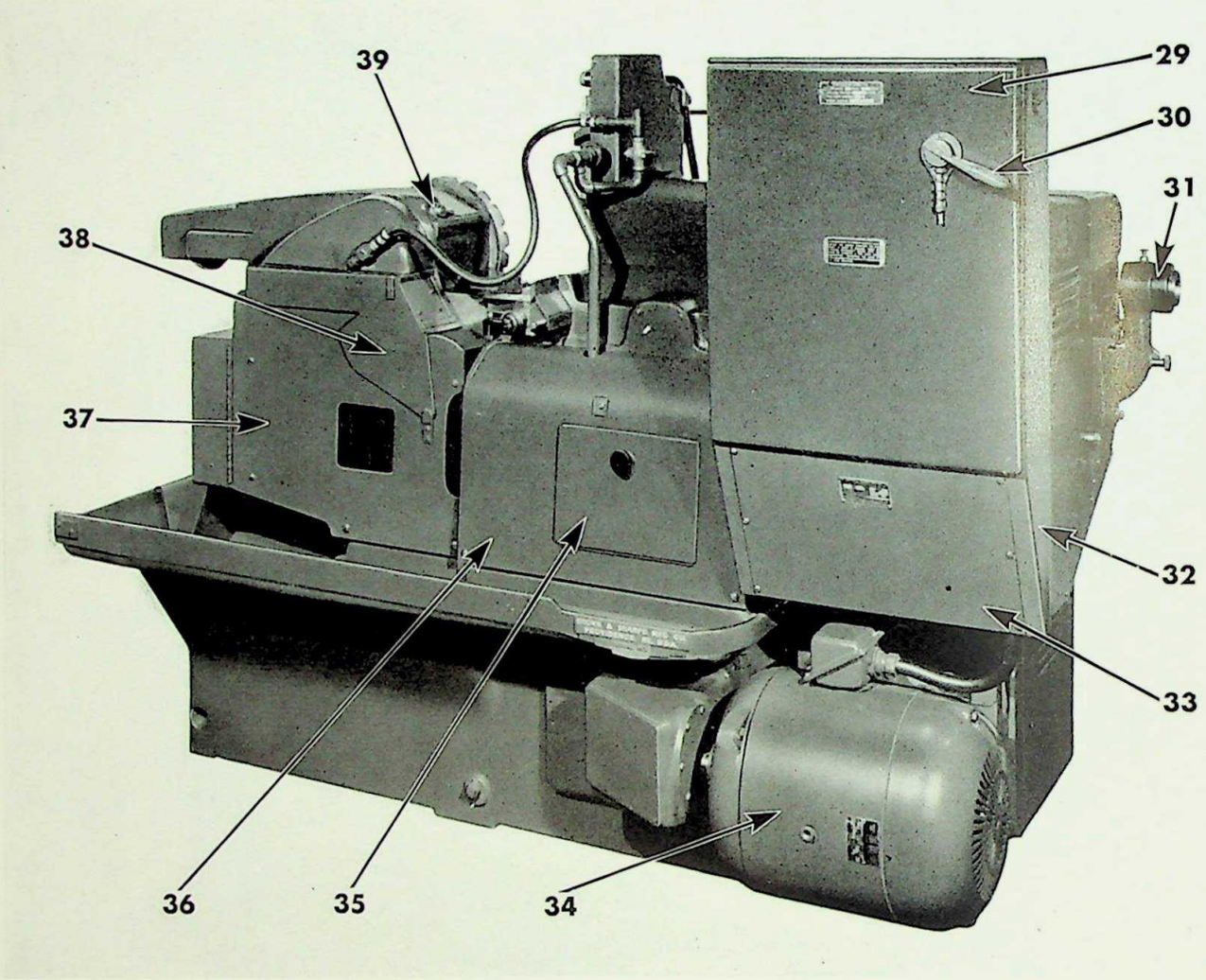

Rear View — Without Guard and Stockloader

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STANDARD EQUIPMENT

Lining tube for stock under 1" diameter; No. 26M Master Spring Collet; No. 26M Master Feeding Finger; outside master feeding finger and pads for 2⅜" diameter stock; outside feed bar; rotating stock stop; speed and feed change gears; two tool posts and two raising blocks; set of wrenches; stock loader and splash guard.

Table of Machine Capacities

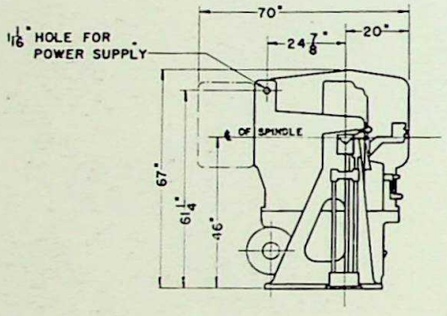
Hole through spindle	Diameter 2½"
Hole through feed tube	Diameter 2⅛"

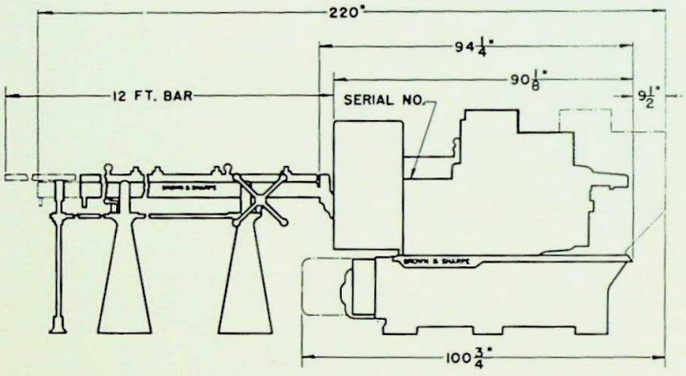
RANGE OF STOCK SIZES

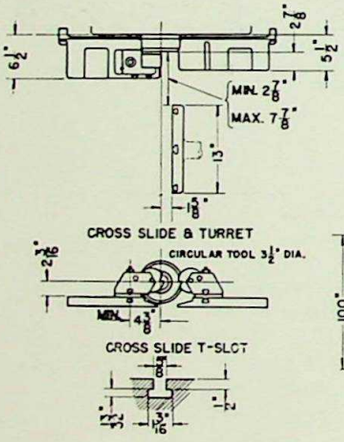
Master Spring Collet with interchangeable pads	Round	¾" to 2"	inclusive
	Square	¾" to 1 11/16"	inclusive
	Hex	¾" to 1¾"	inclusive
No. 26 Regular Spring Collet	Round	2 1/16" to 2⅜"	inclusive
Master Feeding Finger with interchangeable pads	Round	¾" to 1¾"	inclusive
	Square	¾" to 1 7/16"	inclusive
	Hex	¾" to 1½"	inclusive
No. 26 Regular Feed Finger	Round	1 13/16" to 2"	inclusive
Outside Master Feeding Finger with interchangeable pads	Round	2 1/16" to 2⅜"	inclusive
	Square	1½" to 1 11/16"	inclusive
	Hex	1 13/16" to 2"	inclusive
Feed Tube Bushings (for use on brass or light cuts)	Round	1⅛" to 2"	inclusive

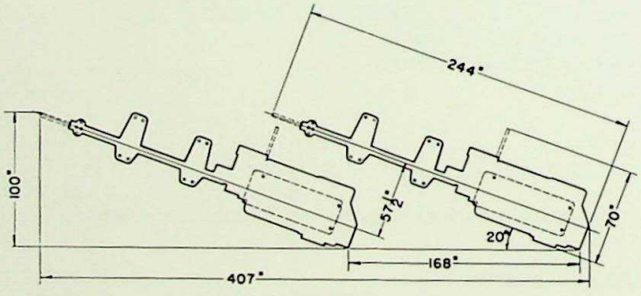
Lining Tube (for stock sizes less than 1" round)		
Greatest length that can be turned		5"
Greatest length that can be fed		6"
Movement of cross slide		2½"
Minimum distance from turret to nose of spindle		2⅞"
Maximum distance from turret to nose of spindle		7⅞"
Driving Shaft, R.P.M.		120
Number of Spindle Speeds (two-speed combinations)		168
Spindle Speeds, R.P.M.	Fastest	1965
	Slowest	17
Number of High Speeds		16
Spindle Speeds, R.P.M. (High speed range)	Fastest	1965
	Slowest	180
Number of Low Speeds (in combination for each high speed)		10
12 Ratios of High to Low Speeds		2:1 to 13:1
Change Gears give one revolution of cam	Fastest	12
	Slowest	800
Time required to feed stock or index turret		2 seconds
H.P. required at maximum capacity		
Spindle		10
Operating Mechanism		½
Pump and Lubricating System		½
Distance from center of spindle to floor		46"
Floor Space	Length	244"
	Width	70"
Net Weight, Lbs. (approx.)		7410

Machine Dimensions

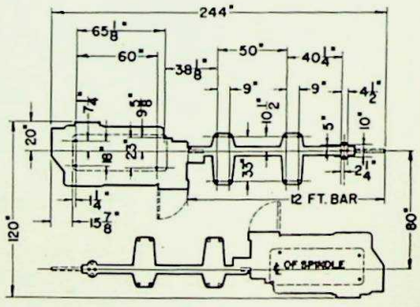








NO.1 FLOOR PLAN



NO.2 FLOOR PLAN

CHAPTER I

Machine Installation

Machine Installation. In lifting or moving the machine, remove the oil guard. It is recommended that the hoisting rope for the machine be rigged as shown in Figs. 1 and 2. The hoisting rope for the stock loader should be rigged as shown in Figs. 3 and 4.

The machine should be placed on a level and as firm a foundation as possible, and clearance should be allowed for operating, restocking and for any other factor peculiar to the installation.

After levelling, bolt the machine firmly to the floor with six lag screws. The six holes in the base are easily located.

It is essential that the machine itself be level both lengthwise and crosswise. To test for this a spirit level should be placed across both cross slides. When the machine is level it can be connected to the source of power supply according to the instructions on the inside of the switch compartment cover.

Stock Loader Installation. Bring the stock loader (Fig. 14) up to the machine and rotate the spider wheel advancing the stock loader rail as far as it will go and the spindle control switch actuator contacts the stock loader safety switch (Fig. 15) on machine. Advance a bar of stock through the feed tube and feed finger to the chucking position. Ad-

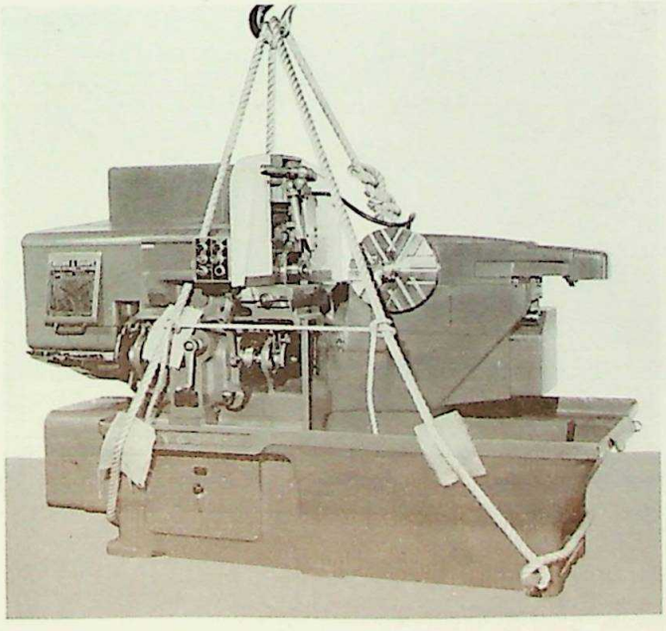


Fig. 1. Method of Rigging Machine.
Front View.

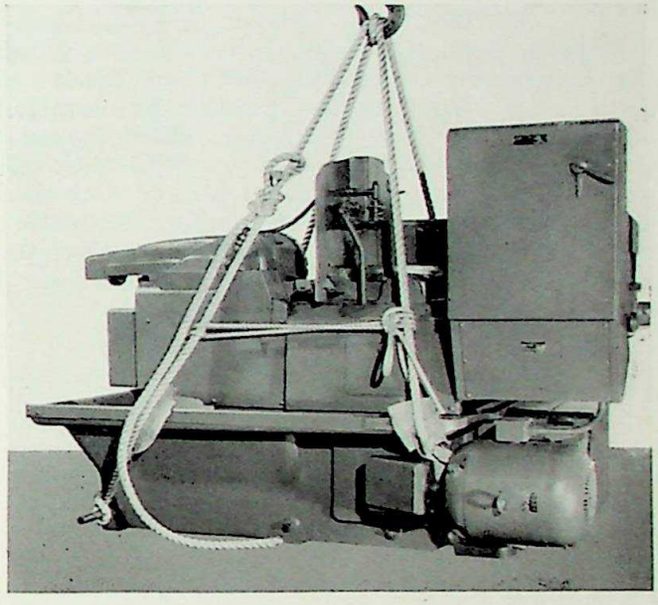
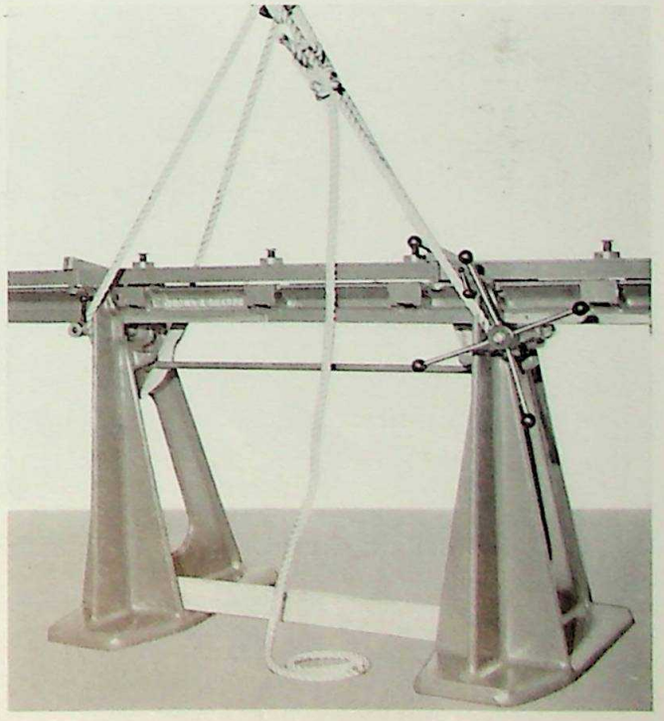


Fig. 2. Method of Rigging Machine.
Rear View.

Fig. 3. Method of Rigging Stock Loader.
Front View.



just the support screws at the front and back located under the stock loader rail (Fig. 14) until all the rolls contact the bar. Also use a spirit level across top of the bar and sight along the centerline of the machine. When the support is properly aligned the bar should contact all the rolls in the stock loader rail.

Put the spindle clutch in neutral position, grasp the stock nearest the feed tube with both hands and rotate stock. Find the free position by elevating or lowering the stock loader rail. When the position has been determined, lag down the stock rail stands. The starting of the machine is controlled by the spindle control switch actuator contacting the stock loader safety switch (Fig. 15). When the machine fails to start advance the spindle control switch actuator until the contact is made.

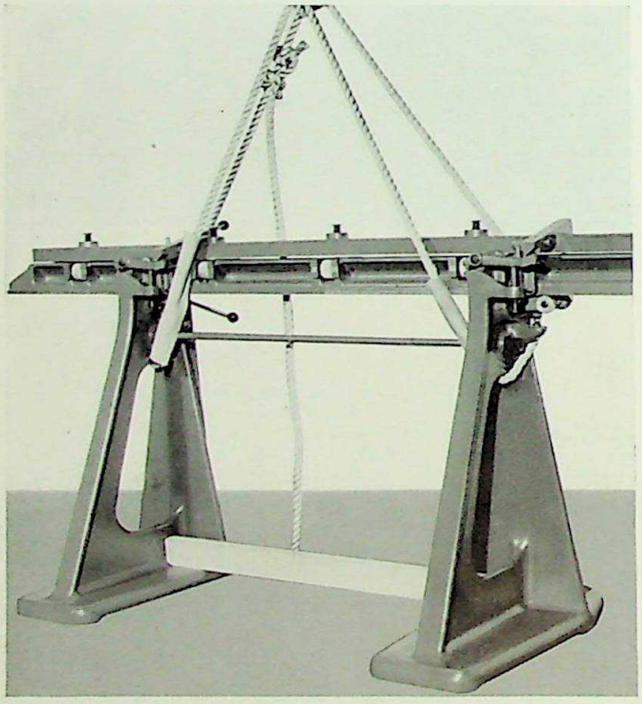


Fig. 4. Method of Rigging Stock Loader. Rear View.

*Electrical Controls

Connecting to Power Supply. The controls are housed in a cabinet at the rear of the machine (Fig. 25) and the power wires are led into the cabinet at the bottom through a $1\frac{1}{16}$" diameter hole. The machine should be connected to the power line through the circuit breaker and must be properly grounded. The power supply must be the same as indicated on nameplate mounted on control cabinet cover.

Check Direction of Motor Rotation. Before making permanent connection to power supply, test the direction of rotation of the motors. With spindle friction clutch in neutral and with no cams on the camshaft, start the spindle motor (See Note — "Starting the Machine", page 13). Then jog the driveshaft motor to check the camshaft rotation. This must run with the top coming, (clockwise rotation when viewed from the left end).

If necessary, transpose two of the wires of the incoming power supply to obtain this condition. Caution:—If jog button is held down so that the turret indexing cycle commences, complete indexing before releasing button.

Lubrication

The lubrication diagram (Fig. 5) shows the location for oiling and greasing, also instructs when to service locations under operating conditions.

A chain driven mechanical oiler (Fig. 6) behind the back guard cover (item 35, page 6) provides forced feed lubrication to spindle bearings and to mechanisms throughout machine, except those in the base. The base mechanisms are lubricated by a splash system. The oiler operates whenever the machine spindle is running. Fill the oiler reservoir with a good grade mineral oil S.A.E. 20. The reservoir capacity is $1\frac{1}{2}$ gallons. Service instructions for this unit are supplied by the manufacturer, a copy of which is included with each machine. We wish to call attention to the instructions for cleaning, etc. which should be followed for long trouble-free operation.

Fill the base oil reservoir, supplying lubrication to driving chains and gears. Lift the spindle cover and pour the oil down into the base or fill at the oil-level gage in the base front cover directly below the driving shaft handcrank. Use a good mineral oil S.A.E. 50. The reservoir capacity at high level is 6 gallons. Check oil level frequently and never run the machine with oil level below the low mark on the gage.

Remove worm wheel opening cover adjacent to the driving shaft handcrank at the front of the machine and half fill worm housing with S.A.E. 20 lubricating oil.

Add approximately one-half pint of oil S.A.E. 20 to the turret worm housing oil reservoir at the rear of the machine (Fig. 6). A drain hole located at the rear of the reservoir automatically sets the oil level.

Oil spindle sprocket bearings through clutch lever slots in clutch body. The bearings should be manually oiled approximately every four hours of running.

Fig. 5. Lubrication Diagram.

A — Clean and Grease Annually (Ball Bearing Motor) Good Grade Ball Bearing Grease.

D — Oil Daily — Good Grade Machine Oil — S.A.E. No. 20.

F — Fill to Gage — Good Grade Machine Oil — S.A.E. No. 20.

M — Inspect Every Month (Sleeve Bearing Motor) Good Grade Machine Oil — S.A.E. No. 20.

N — Bearings Permanently Sealed.

X — Fill to Gage — Good Grade Machine Oil — S.A.E. No. 50 — Oil Sliding Spindle Parts, Driving Clutches, Cam Lever Rolls and Chuck Fork Sleeve Ball Bearing Daily, and Dip Ball Bearing End of Feed Tube in Clean Oil Monthly.

LOCATION

D_1, D_2, D_3 and D_5 — Rail Cover Screw

D_4 — Rail Driving Pinion Shaft

D_6 — Driveshaft Handcrank

D_7 — Cam Rolls

D_8 — Vertical Slide Ways and Roller

D_9 — Rail Pinion Shaft — Rear
AMN_1 and AMN_2 — Motor Permanent Seal

F — Lubricator — Behind Cover

X — Base Filler Opening and Gage

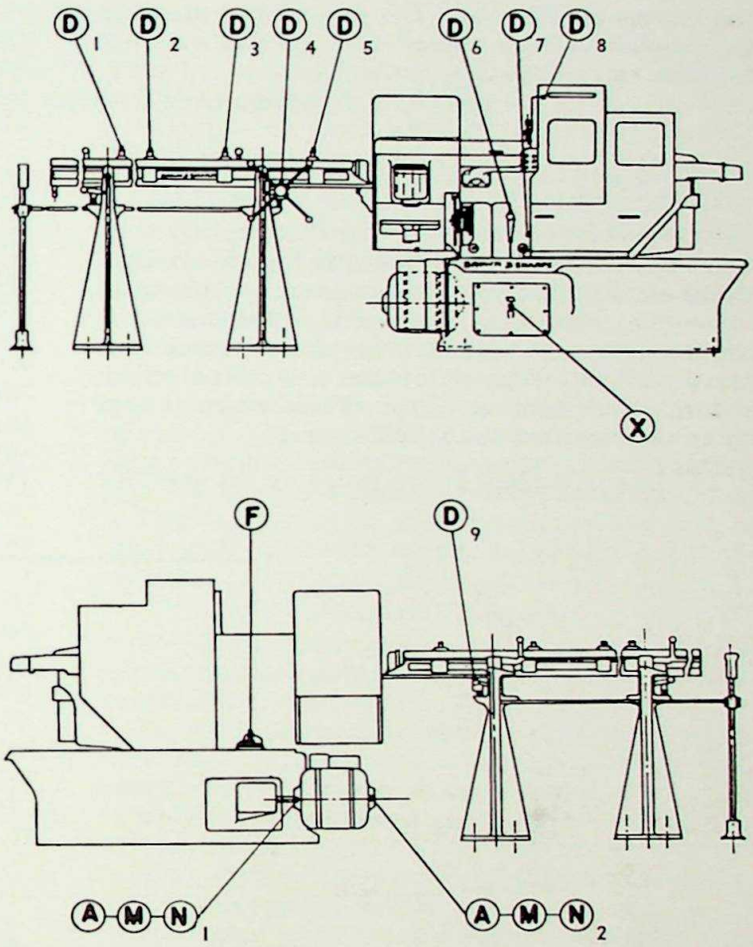
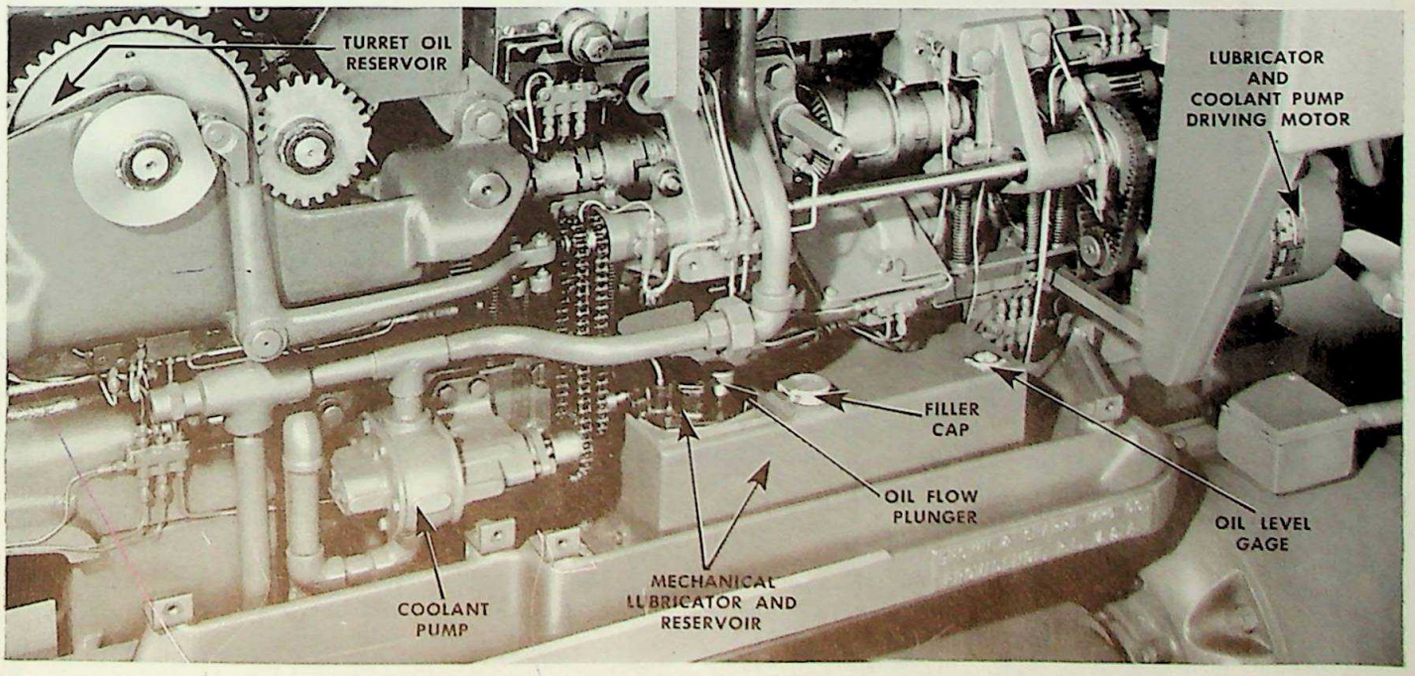


Fig. 6. Rear of Machine with Guards Removed — Coolant Pump and Mechanical Oiler.



To flood the oil lines of a machine, press down the plunger (Fig. 6). The lubricator pressure gage should have a minimum of 15 lbs. with the by-pass valve open 1½ turns.

*Coolant

Fill Coolant Reservoir. The capacity of the coolant reservoir in the base, up to the level of the sheet metal plates, is 24 gallons.

As the pump (Fig. 6) must never be run dry, sufficient coolant must be poured into the base to cover the pump strainer (or the pump driving chain can be removed) for initial running of the machine. The oil drains into the reservoir through a perforated metal strainer. The coolant system operates whenever the spindle runs.

The flow of coolant is controlled by the operator at the front of the machine. An additional supply of coolant can be fed directly to the turret tools by removing an oil stop from the turret tool oiling head (Fig. 20) and inserting a piece of ⅜" outside diameter copper tubing of sufficient length to extend through the shank of the tool.

The reservoir should be full so that when machine is running and chips have collected over the strainer thus causing the lubricant to return slowly, there will still be enough coolant in the reservoir at all times to meet all requirements.

The oil must be thin enough to flow easily and penetrate to the cutting point in order to cool the work and tools and to remove chips. Cutting oil must be freely used. It is impossible to avoid having the upper parts of the machine oil covered, therefore avoid oil compounds or oil emulsions that thicken and gum up the machine or cause rusting.

CHAPTER II

Set-Up Adjustments and Operating Controls

This chapter explains the purpose and use of the controls and adjustment in setting-up and operating the No. 4 Automatic Screw Machine.

A study of the material on the preceding pages will furnish a general familiarity with the machine and simplify the identification of the operating controls and principal parts.

Starting the Machine. A push button assembly (Fig. 7) for the operation of the spindle and the drive shaft is located directly above the hand operating shaft crank. Control buttons enable the operator to start, stop or "jog" the drive shaft, and start, stop or change the direction of the spindle rotation.

The identification and purpose is clearly indicated above each button on the push button panel. The three buttons on the left of the panel control the action of the spindle. The three buttons on the right control the action of the driving shaft.

NOTE: In order to energize the pushbutton controls at the front of the machine, the stock loader safety switch must be closed. The stock rail must be advanced and the safety switch actuator button properly set to close the switch. If the stock loader is not in position, other means may be improvised to hold the switch closed.

Fig. 7. Push Button Controls.

Drive. The machine is driven by a 10 horsepower motor mounted on the left of the base at the rear of the machine. The drive to spindle is transmitted through chain and sprockets to speed and ratio change gears in the speed case and thence by sprockets to the spindle.

Two ½ horsepower motors are located above the main motor. One is for driving the coolant pump and mechanical oiler and operates whenever the spindle is running. The other operates the drive shaft which provides for automatic turret indexing, spindle speed change and stock feeding.

The driving shaft runs at a constant rate of 120 R.P.M., and operates all mechanism except the spindle, coolant pump and lubricator.

*Safety Devices

The stock loader and the machine itself is protected against damage by the following safety features:

The stock loader rail cannot be advanced to contact the stock loader safety switch unless the rail cover is in the down position. The rail cover arms, to which the handles are attached, come up against pads on the rail cover arm pressure levers, thus making forward movement of the rail impossible while the cover is raised.

The stock loader safety switch is normally open, thus cutting off the power supply to the machine controls. Conversely, the switch must be depressed to energize the controls. The feed slide is protected by two $\frac{1}{16}$" shearing pins located one in each of the feed slide plunger sleeves.

Cross slides are protected by two $\frac{5}{32}$" shearing pins, one in each cross slide dial.

The turret mechanism is also protected by two shearing pins, one of which is $\frac{3}{16}$" diameter and is located between the gear and hub of the turret intermediate shaft gear (Part No. 42-15909, Page 64, protecting the turret rotating mechanism), the other ¼" diameter is in the outer end of the turret feed slide operating shaft (Part No. 42-14439, Page 62, protecting the turret sliding mechanism). The vertical slide cam lever has a $\frac{7}{32}$" diameter shearing pin protecting the vertical slide mechanism.

Overall protection is provided by the adjustable overload relays in the electrical control cabinet.

*Spindle

Spindle. The machine is furnished with an antifriction bearing spindle (Fig. 9) of unit type con-

struction and may be readily removed if necessary. It is mounted in boxes which are supported in the bed of the machine. The spindle has a 2½" diameter hole.

Spindle Speeds. One hundred and sixty-eight 2-speed combinations are provided, with a range from 1965 to 17 R.P.M. There are sixteen high speeds available, from 1965 to 180 R.P.M.; and for each high speed, any one of ten low speeds can be used in combination. Twelve ratios of high to low spindle speeds range from 2.2:1 to 13:1.

This broad range of high speeds, plus the exceptionally wide choice of corresponding low speeds, permits equally high cutting efficiency on materials ranging from tough alloy steels to free-cutting plastics, and on the widest ranges of work diameters.

High and low speeds can be either forward or backward, and all but the six combinations giving highest total R.P.M. can be used in opposite directions. See the spindle speed plate (Fig. 10) located at the front of the machine on the spindle cover.

Spindle change gears (Fig. 8) for changing the spindle speed are located in the left end of the base and stored in the compartment door.

The gears are removed by loosening a clamp nut enough to slip off the slotted washer and lift the gear from the splined shaft. For gear installation, reverse this procedure.

Method of Selecting Two-Speed Combinations. The shafts (Fig. 11) on which the spindle change gears are arranged have numbers from 1 to 5 inclusive.

1 Spindle change gear shaft
2 Spindle driving shaft, fast
3 Ratio change gear shaft
4 Ratio change gear shaft
5 Spindle driving shaft, slow

To select the change gears, refer to the spindle speed plate (Fig. 10). If a spindle high speed of 1965 R.P.M. is required, the set of gears to be selected are seventy-three teeth, gear B (Fig. 11)

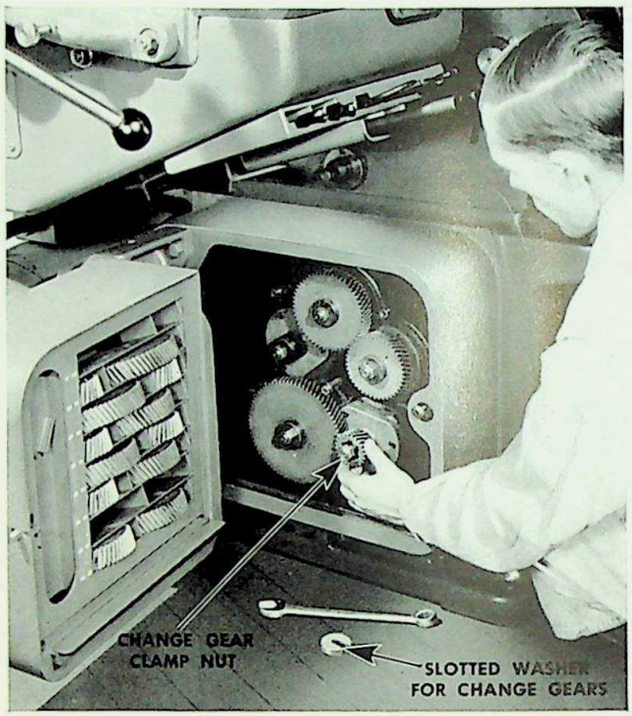


Fig. 8. Installation of Spindle Speed Change Gears.

and twenty-two teeth, gear C. Install gear B on shaft one and gear C on shaft two. Any one of ten low speeds can be used in combination with the high speed gears B and C.

For example, to obtain a 2.2:1 ratio, the low speed is 890 R.P.M. and the change gears to be used are sixty teeth, gear D and thirty-five teeth, gear E. Install gear D on shaft 3 and gear E on shaft 5. With this arrangement (Fig. 11) the spindle will run in the same direction for high and low speeds.

There are one hundred and sixty-eight two-speed combinations that can be used forward or backward. With the exception of the six combinations giving the highest R.P.M. total, the balance of the two-speed combinations can be run in opposite

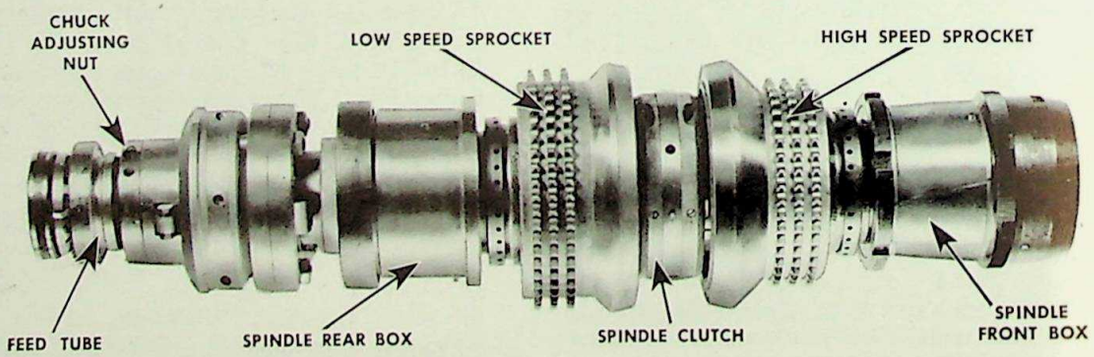


Fig. 9. Spindle Unit — Assembled.

direction. This is accomplished by transferring change gear D from shaft 3 to shaft 4. The running of the spindle in reverse is controlled by a selector switch (Fig. 7) that actuates the spindle motor starter and reversing switch (Fig. 25), causing the spindle to run either forward or backward.

Feed change gears (Fig. 12) governing the cycle time are located at the right-hand end of machine and provide fifty-two rates of production, from twelve to eight hundred seconds per cycle of the cam shaft. Gears not in use are kept in the gear compartment door. The feed change gear table (Fig. 13) is located on the outside of the door.

Four gears (Fig. 12) are used and the ratios are determined by the time in seconds required to make one piece. The driver gear is located on the driving shaft and runs with the front gear located on a stud. In back of the front gear is another gear located on the same stud. Driven gear runs with the rear gear on the stud.

This gear arrangement showing their proper relation is in accordance with the table for laying out cams on page 36.

No. 4 AUTO. SCREW MACHINE — SPINDLE SPEEDS

HIGH SPEEDS	LOW SPEEDS												
RATIO CHANGE GEARS (UPPER / LOWER)	35/60	39/56	42/53	46/49	49/46	53/42	56/39	60/35	64/31	67/28	70/25	73/22
OPPOSITE DIRECTION												
SAME DIRECTION												
73 - 22	1965	690	745	655	585	485	410	360	305	250	215	185	
70 - 25	1660	750	630	550	465	410	345	305	255	210	185		130
67 - 28	1420	640	535	470	400	350	295	260	220	180		135	115
64 - 31	1225	555	465	405	345	305	255	225	190		135	115	97
60 - 35	1015		385	340	285	250	210	185		130	110	97	81
56 - 39	850	385		285	240	210	180		130	110	94	80	68
53 - 42	750	340	285		210	185		135	115	96	82	70	59
49 - 46	630	285	240	210			130	115	97	81	70	59	50
46 - 49	555	250	210	185			115	100	86	71	61	52	44
42 - 53	470	210	180		130	115		86	72	60	52	44	37
39 - 56	415	185		135	115	100	86		84	53	45	39	33
35 - 60	345		130	115	97	86	72	64		44	38	33	27
31 - 64	285	130	110	96	81	71	60	53	44		32	27	23
28 - 67	250	110	94	80	70	61	52	45	38	32		23	20
25 - 70	210	96	80	70	60	52	44	39	33	27	23		17
22 - 73	180	81	68	60	50	44	37	33	27	23	20	17	
APPROX. RATIO HIGH TO LOW		2.2	2.6	3	3.3	4	5	5.5	6.5	8	9	11	13

• THESE COMBINATIONS NOT TO BE RUN IN OPPOSITE DIRECTIONS.

DO NOT RUN SPROCKETS IN OPPOSITE DIRECTIONS WHEN THE SPINDLE IS USED CONSTANTLY IN ONE DIRECTION.

Fig. 10. Spindle Change Gear Plate.

Stock Loader

The stock loader (Fig. 14) includes a stock rail unit that carries the bar of stock. The illustration shows the loader equipped with a lining tube for use with stock less than 1" round. The rail cover can be raised back and out of the way by using the rail cover lever. The stock is placed on the rolls of the stock rail and the spider wheel controls the movement of the stock. The stock enters the feed

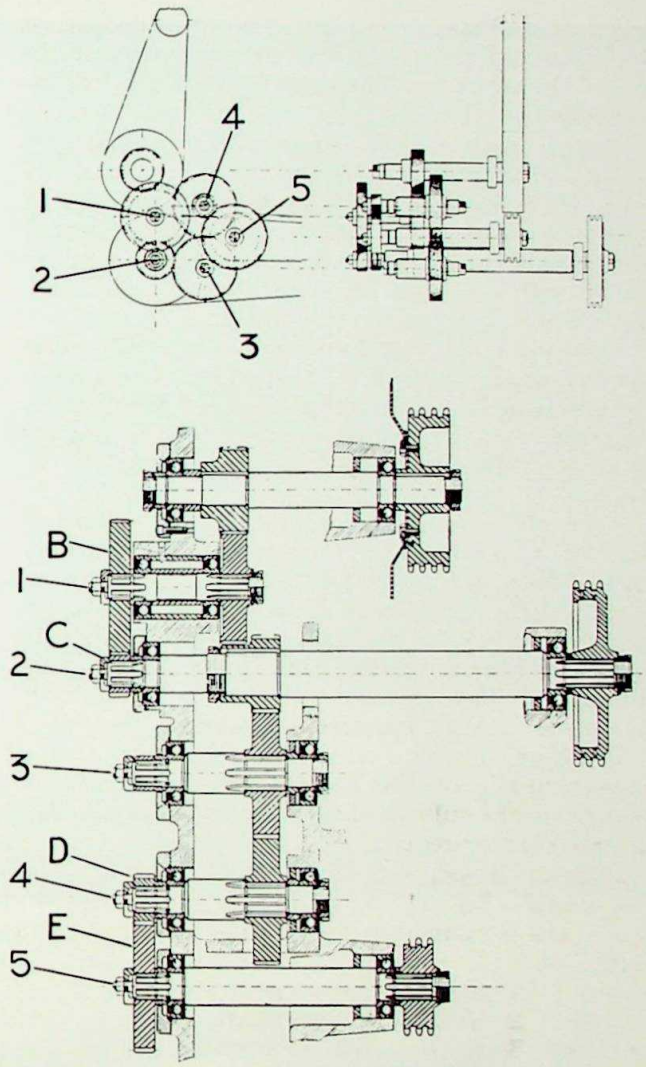


Fig. 11. Developed Section through Speed Case.

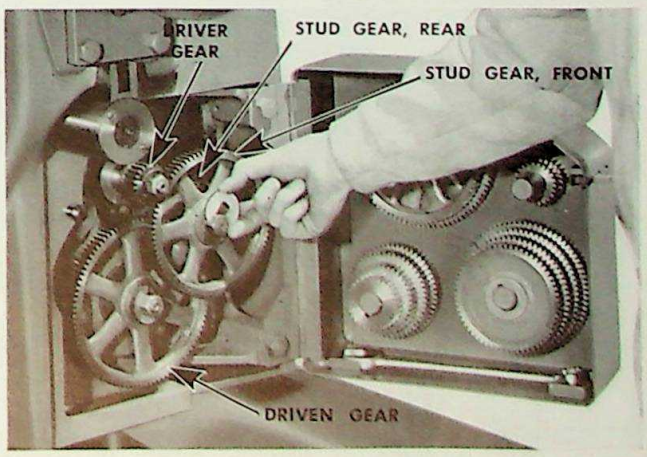
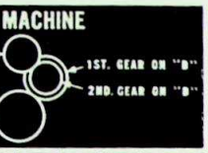


Fig. 12. Installation of Feed Change Gears.

No. 4 AUTOMATIC SCREW MACHINE

FEED CHANGE GEAR TABLE
DRIVING SHAFT AT 120 R.P.M.

BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I. U. S. A.



TIME IN SECONDS TO MAKE ONE PIECE	GEAR ON "A"	1'ST GEAR ON "B"	2'ND GEAR ON "B"	GEAR ON "C"	GROSS PRODUCT IN ONE HOUR	TIME IN SECONDS TO MAKE ONE PIECE	GEAR ON "A"	1'ST GEAR ON "B"	2'ND GEAR ON "B"	GEAR ON "C"	GROSS PRODUCT IN ONE HOUR
12	60	50	24	30	300	195	25	50	75	65	18
14	75	70	30	50	257	210	25	50	75	70	17
16	60	50	24	40	225	225	25	40	60	75	16
18	60	75	40	55	200	240	25	50	75	80	15
20	50	60	40	30	180	255	25	50	75	85	14
22	60	50	24	55	166	270	25	50	75	90	13
24	75	50	30	60	150	285	25	50	75	95	12
26	60	50	24	65	138	305	30	23	60	70	11
30	60	50	24	75	120	325	25	30	65	75	11
35	60	50	30	70	102	345	25	30	65	80	10
40	60	50	30	80	90	365	24	30	70	75	9
45	60	50	30	90	80	385	24	30	65	85	9
50	60	40	30	80	72	405	23	30	70	80	8
55	60	25	30	55	65	425	22	30	70	80	8
60	50	40	30	80	60	450	22	30	70	85	8
70	60	25	30	70	51	475	25	30	75	95	7
80	30	50	60	40	45	500	24	25	75	80	7
90	60	25	30	90	40	530	24	25	75	85	6
100	50	30	40	75	36	560	24	25	75	90	6
110	30	50	60	55	32	590	23	25	75	90	6
120	50	40	60	80	30	620	25	23	75	95	5
130	30	50	60	65	27	655	23	24	80	90	5
140	30	50	60	70	25	690	23	24	80	95	5
150	30	50	60	75	24	720	22	24	80	95	5
165	25	40	55	60	21	760	22	24	65	95	4
180	30	50	60	90	20	800	22	23	65	95	4

Fig. 13. Feed Change Gear Plate.

tube when the spider wheel is turned clockwise. The stock rail end support provides rigid support to the outer end of the stock when loading.

To obtain maximum efficiency, spools are used for round stock over 2″ diameter and are recommended for all sizes other than round. Steps to operate the stock loader are as follows:

1. Retract the stock loader rail as far as possible and lift the rail cover.
2. Place the stock on the rolls and push the stock stop upward.
3. Line up and level the bar with the spindle hole by means of the rail adjusting support screws.
4. Close the rail cover and advance the stock through the feeding finger. NOTE: Capacity of the stock loader is $2\frac{3}{8}$″ round, $1\frac{11}{16}$″ square, and $1\frac{3}{4}$″ hex. Spools are obtainable for round, square or hex stock.

Safety devices prevent the machine from running until the rail cover is closed and the stock rail advanced so as to lock cover securely over stock. Cover cannot be opened while machine spindle is running.

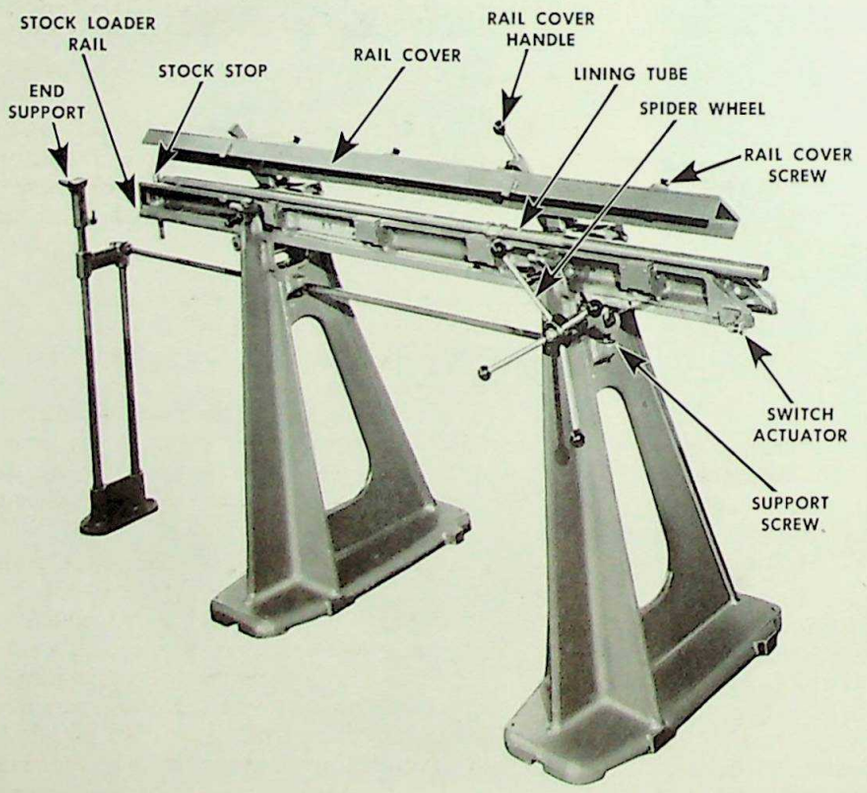


Fig. 14. Stock Loader equipped with Lining Tube — Provides rigid support for stock with positive spindle alignment.

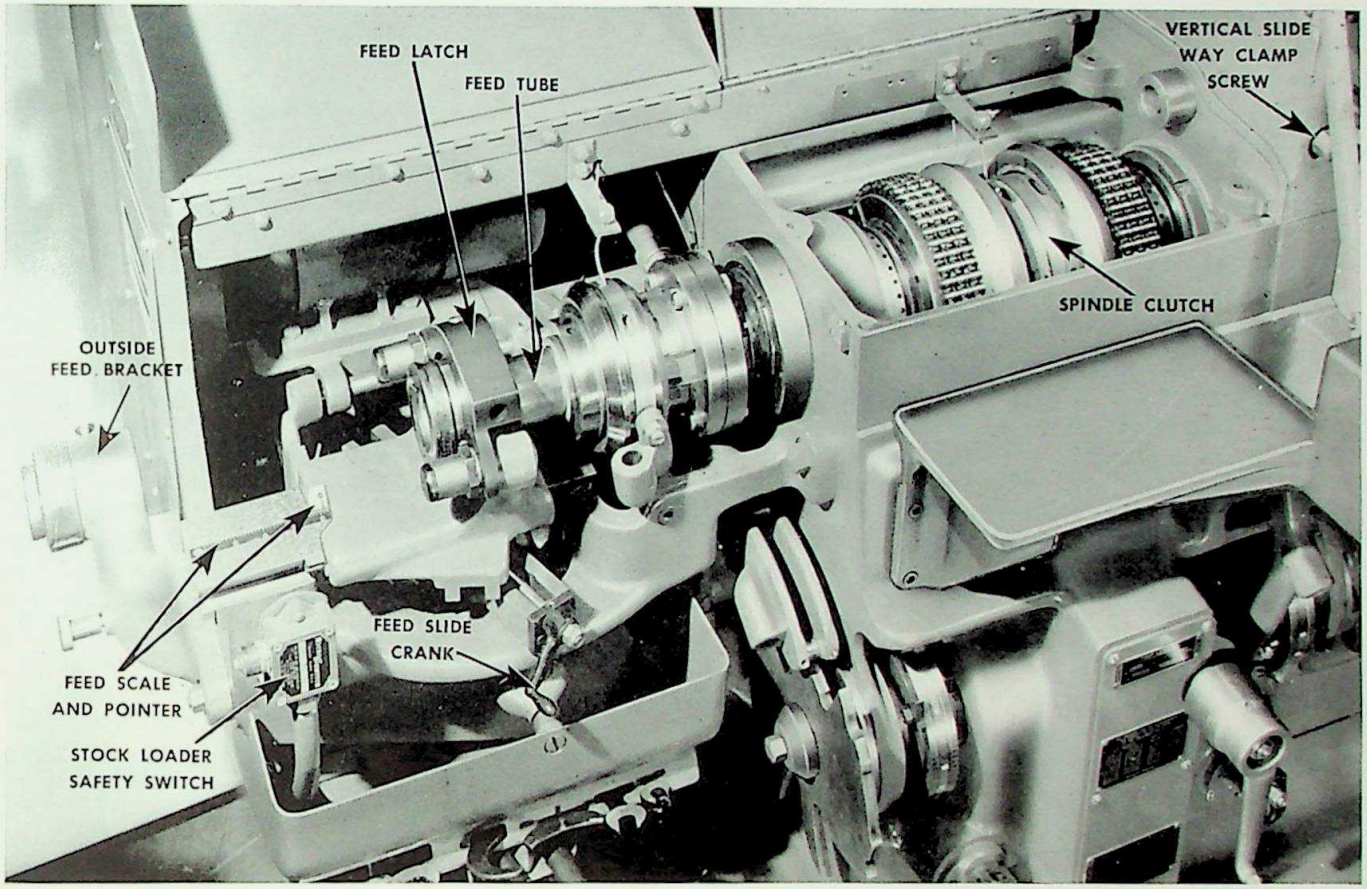


Fig. 15. Spindle and Feed Adjusting Mechanism — Guards Raised.

Outside Feeding Mechanism

The outside feeding mechanism used in place of the regular feed tube has an outside master feeding finger and pads that permit operations to be performed on round stock $2\frac{1}{16}$" to $2\frac{3}{8}$", square $1\frac{1}{2}$" to $1\frac{11}{16}$", and hex $1\frac{13}{16}$" to 2".

To set up the mechanism, proceed as follows:—

First, remove the regular feed tube and feeding finger from the spindle and swing the feed bracket up into position and lock with the locking pin knob.

Next, lower the front end of the stock loader rail (Fig. 14) (by means of the rail support adjusting screws) so the feed rod knob will clear the rolls. If the stock loader was set up with spools, this is not necessary.

Insert the feed finger in feed slide. Push the feed rod through the bracket hole while holding out the locking plunger at the top of the bracket.

Stock will be fed until the flange of the feed rod contacts the feed bracket mechanism.

Chuck Operating and Stock Feeding Mechanism. The chuck clutch trip lever L controls the chuck clutch M (Fig. 28) that operates these mechanisms through gearing to the chuck cam shaft. The chuck and feed cam on this shaft operates the chuck fork which causes the collet to open, stock to be advanced and collet to close in correct relation.

The stock is advanced automatically by a feed slide. The opening and closing of the chuck prior to the advancement of the stock is controlled by adjustable dogs on dog carriers which start the stock feeding. The time required to feed stock is two seconds. One operating cycle feeds any length to six inches. The feed slide is protected by two $\frac{1}{16}$" shearing pins located in the plunger sleeves.

Adjust Feed Slide for Length of Stock. A crank (Fig. 15) on the feed slide provides means for changing the length of stock that is fed whenever the stock feeding mechanism operates, and a scale on the feed slide bracket shows the approximate length fed. This should be set to allow not over $\frac{3}{8}$" more than length desired. The stock should be set to feed out to the stock stop which has already been set. When the feed slide has been set, engage the latch and stock is ready to be fed.

The Master Spring Collet. The collet is designed to be used with interchangeable pads, round up to 2", square to $1\frac{11}{16}$", and hex to $1\frac{3}{4}$", to accommodate varied sizes of work.

In like manner the master feeding finger also is used with interchangeable pads for different sizes of work. The pads are used for holding the following stock: round, $\frac{3}{4}$" to $1\frac{3}{4}$" inclusive; square, $\frac{3}{4}$" to $1\frac{7}{16}$" inclusive; and hexagonal, $\frac{3}{4}$" to $1\frac{1}{2}$" inclusive.

The chuck adjusting nut (Fig. 9) controls the tension of the collet on the bar.

Replace Pads in Collet or Feeding Finger. A set of pads is composed of three parts. Each part has a tapped hole. Three screws pass through the collet or feeding finger and hold each part of a set in place. When the three screws are removed, the pads can be taken out and a different set installed with the same screws. If pads still hold firm when screws are removed, tap collet or finger and the pads will be quickly released.

The outside feeding finger pads handle the following stock: round, $2\frac{1}{16}$" to $2\frac{3}{8}$" inclusive (sizes graduated in 16ths); square, $1\frac{1}{2}$" to $1\frac{11}{16}$" inclusive; and hexagonal, $1\frac{13}{16}$" to 2" inclusive.

The bar of stock is gripped firmly in the spindle by a set of pads in the master spring collet located in a sleeve at the extreme front of the spindle so that the stock may be held at a point as close as possible to the tools. The shoulder of the collet bears against the ground inner surface of the chuck nut which is screwed tight against the nose of the spindle. Due to this arrangement, the collet has no end movement, hence it does not slide the bar along in closing and cause inaccuracies in feeding. The size of the collet pads will correspond with the size of the bar.

The collet is closed when chuck fork sleeve L (Fig. 26) is at its left position and its operation is as follows: The sleeve L slides to the left over the two chuck levers J, forcing the chuck sleeve forward upon the taper of the spring collet and closing the collet pads firmly upon the work. On releasing chuck levers J, through the movement of sleeve L to the right, the spring and taper of the collet are sufficient to slide the chuck sleeve back and the collet opens. The inner surface of the spindle nose centers the sleeve and collet.

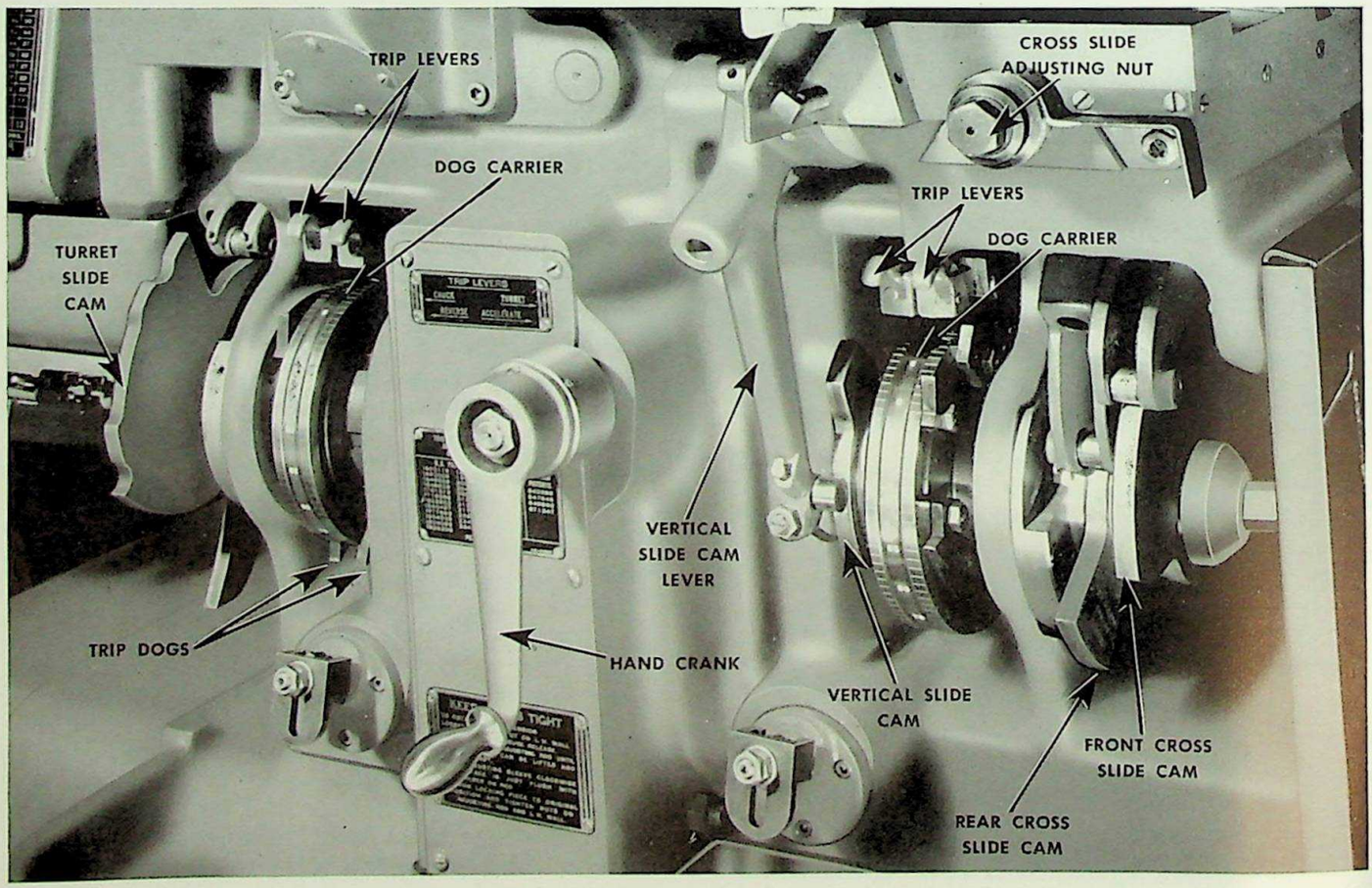


Fig. 16. Cam Shaft — Dog Carriers, Cams and Trip Levers Control Timing of All Operations.

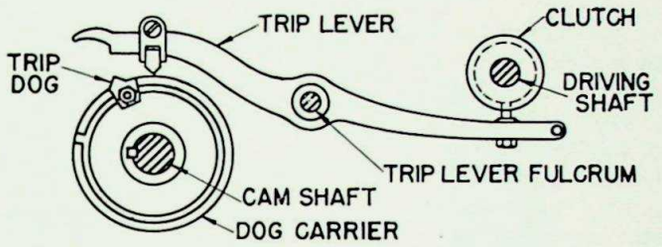


Fig. 17. Trip Lever and Dog Carrier.

Cam Shaft

This shaft (Fig. 16) is driven from the driving shaft through a set of feed change gears. The cam shaft speed depends on the change gears used and are selected to give one revolution for each piece of work produced. Trip dogs on the left dog carrier lift trip levers that release a jaw clutch on the driving shaft. The trip dogs on the right dog carrier perform a similar operation. When released, the clutch will snap into engagement for 4 revolutions, long enough to complete one turret index, one feed of the stock or a spindle reversal. The dog carriers and the trip lever mechanism on the machine control these functions.

The two cross slide cams, vertical slide cam and turret slide cam are quickly changed. A hole in each cam lever permits cross slide, vertical slide and turret slide to be operated by a handle when setting-up. The graduated dog carriers and the finger grips on the trip levers above the dog carriers, provide for manual control during set-up.

The cams are positively positioned by means of holes and locating pins, assuring correct timing. Graduations on both carriers to hundredths of a revolution simplify both the layout of a new job and duplication of previous set-ups.

Acceleration. The speed of the cam shaft can be accelerated to a twenty second cycle regardless of change gears used on the machine by the use of a trip dog mounted on the left side of the right dog carrier that lifts the accelerating lever. Added speed is obtained when pick-up cams that are not designed for the particular job are used. When operations on the lead cam are not being utilized such as turning, drilling, etc., rapid acceleration is used.

***The Automatic Operating Mechanism.** The driving shaft at rear of machine is driven at 120 R.P.M. regardless of spindle speed. By means of clutches on this shaft, it controls the operation of all movements of the machine such as feeding stock, driving cam shaft, indexing turret, longitudinal and transverse feeds. The driving clutches which are fastened to the driving shaft have teeth on the faces to engage the sliding clutch members. Inside the body of the sliding members is a strong coil spring, which is held under compression when the clutch is disengaged. When the trip lever (Fig. 17) is raised by a dog on the carrier, the back end of the lever is depressed engaging the clutch teeth. The clutch is disengaged after one revolution. Simultaneously with the disengagement of the clutch the spring is compressed ready to operate the clutch again.

Trip Dogs. Bolted in a T-slot on the side of the carrier the trip dogs (Fig. 17) are adjustable circumferentially. The clutch on the driving shaft is engaged when the toe of the lever trip dog reaches the high point of carrier trip dog.

The chuck and feed trip dogs are fastened to the left side of the left carrier (Fig. 16) and operate the chuck clutch trip lever. They should be set to trip the lever just as the cutting-off tool clears the diameter of the stock.

The turret indexing trip dogs are clamped to the right side of the right carrier (Fig. 16). Set the dogs so that they will trip the turret clutch trip lever when the cam roll on the lead lever reaches the top of the lobe on the lead cam and set the next indexing trip dog in the same manner.

*Cross Slides

Both the front A and back B cross slides (Fig. 18) are mounted in ways on the machine bed. Tapered gibs with adjusting screws provide adjustment for both slides to compensate for wear.

Installed on the cam shaft are cams (Fig. 16) that control the feed of the front and rear cross slides. Holes at the front of the cam levers permit the operator to insert a pin wrench and lift the levers to manually operate the cross slides during setting-up.

Both cross slides (Fig. 18) have a rack C with a lever and segment which imparts movement in accordance with the outline of its respective cam. When a slide is advanced, a coiled spring D is compressed to return the slide quickly and keep the cam lever roll bearing on the periphery of the cam. Both slides have an adjusting screw E that is furnished with a dial F. This arrangement provides means for adjusting the tool posts H and J toward or away from the work without changing the position of the cam levers and insures cutting to exact depth with a forming tool. A cold rolled steel $^{5}/_{32}$" shearing pin G fastens the dial on the adjusting screw and prevents other parts being broken in case of jams.

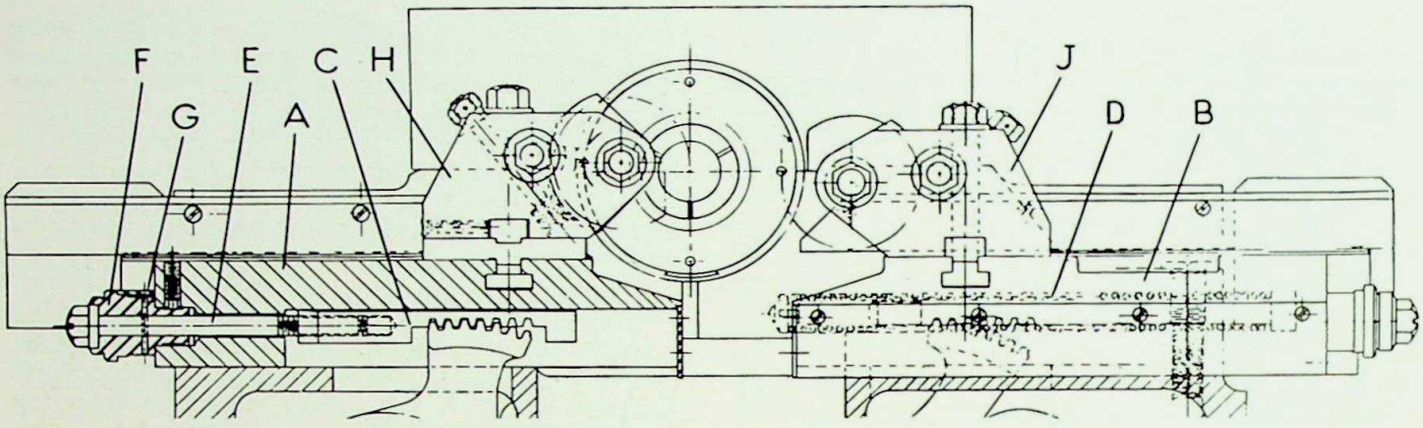


Fig. 18. Section Through Cross Slides and Tool Posts.

*Turret

The turret (Fig. 20) is indexed from one tool position to the next by a Geneva movement. Power for this is taken from the drive shaft through a clutch, gearing-provided with overload protection, worm shaft and worm wheel.

It is automatically locked at each tool position by a taper pin which engages bushings set in the rear face of the turret directly in back of each working position. Adjustable dogs on the dog carriers start the turret indexing mechanism.

This turret presents a large flat surface in a vertical plane, with six sets of three parallel T-slots milled radially in the face. By having the turret face in a vertical plane, ample room is available for indexing large overhanging tools into position without interfering with the cross slides, while the triple T-slots permit multiple tooling for simultaneous cuts at each turret postion. The manner of bolting the tools (Fig. 20) directly to the face of the turret provides a firm support for heavy cuts. In the case of extra long work, a turret position can be left open and the piece of work set out past the turret face and then cut off.

The time required to index each position is two seconds.

Turret Indexing. When the turret trip lever K (Fig. 28) is lifted, there is a direct gear drive to the indexing mechanism. This mechanism, after the turret slide has withdrawn from its working position, indexes the turret $\frac{1}{6}$ of a turn. As a safeguard against damage to this mechanism, a $\frac{3}{16}$" cold rolled steel shearing pin is located in the turret intermediate shaft gear P (Fig. 28). When setting up by using hand crank or the drive shaft jog button on the control panel, the driving shaft must be operated through the complete cycle for each tool position.

The turret locking pin operating handle (item 39, page 6) at the top of the turret slide, eliminates the need of holding the locking pin while rotating the turret by hand.

Turret Stock Stop. The stop has a fine adjustment for length and is set in a bracket that is clamped to the face of the turret by two screws that are set in the T-slots on the turret face.

Set Stock Stop for Length. Using the turret locking pin operating handle (item 39, page 6), hold out the turret locking pin and revolve the turret until the stop is in line with the spindle. From the front edge of the cutting-off tool in the vertical slide, measure a distance equal to the length of the work piece. Set the stock stop to this point and clamp securely.

Final setting is made by loosening the clamping nut on the stock stop holder and screwing the holder in or out as desired. Set the clamping nut against the bracket to secure the adjustment.

Turret Slide. The turret slide upon which the turret is mounted slides on scraped surfaces on the machine bed. A tapered gib with adjusting screws provides means for adjustment to compensate for wear.

The slide is moved toward or away from the spindle and works through the lead cam, segmented lead lever, gear and racked turret slide operating shaft.

A strong coil spring within the turret slide returns the turret to index position. This return of the turret takes place as the lead lever roll comes down on a cam drop on the periphery of the lead cam.

A $\frac{1}{4}$" diameter shearing pin in the turret slide operating shaft protects the slide operating mechanism against damage during feeding.

Use of the accelerating mechanism as described on Page 19, disengages the drive of the cam shaft from the feed change gearing. It engages a direct drive, through gearing, from the machine drive

shaft thus eliminating unproductive time, particularly if pick-up lead cams are used.

Independent Stops. Each of the turret tool positions is provided with an independent stop screw (Fig. 15). When properly set, the stop screws allow accurate duplication of each advance of the turret to the desired stopping point. The stop disk holds 3 short and 3 long stop screws to meet the different adjustments required, depending on the length of work. The lower stop screw corresponds with the tool to be fed. When the slides is advanced, the stop screw comes up against the turret slide stop plate and is held against it by the feeding rise on the lead cam lobe.

To adjust the stop screws, back off the clamp nut (Fig. 21) on the stop screw. Advance the turret slide by hand crank or by jogging the drive shaft until the lead lever has reached the top of the cam lobe. Then turn the stop screw clockwise (with wrench provided) until it comes up against the stop plate with a few thousandths preload to remove any backlash in the feed mechanism. Tighten the nut, thereby locking the adjusted stop screw.

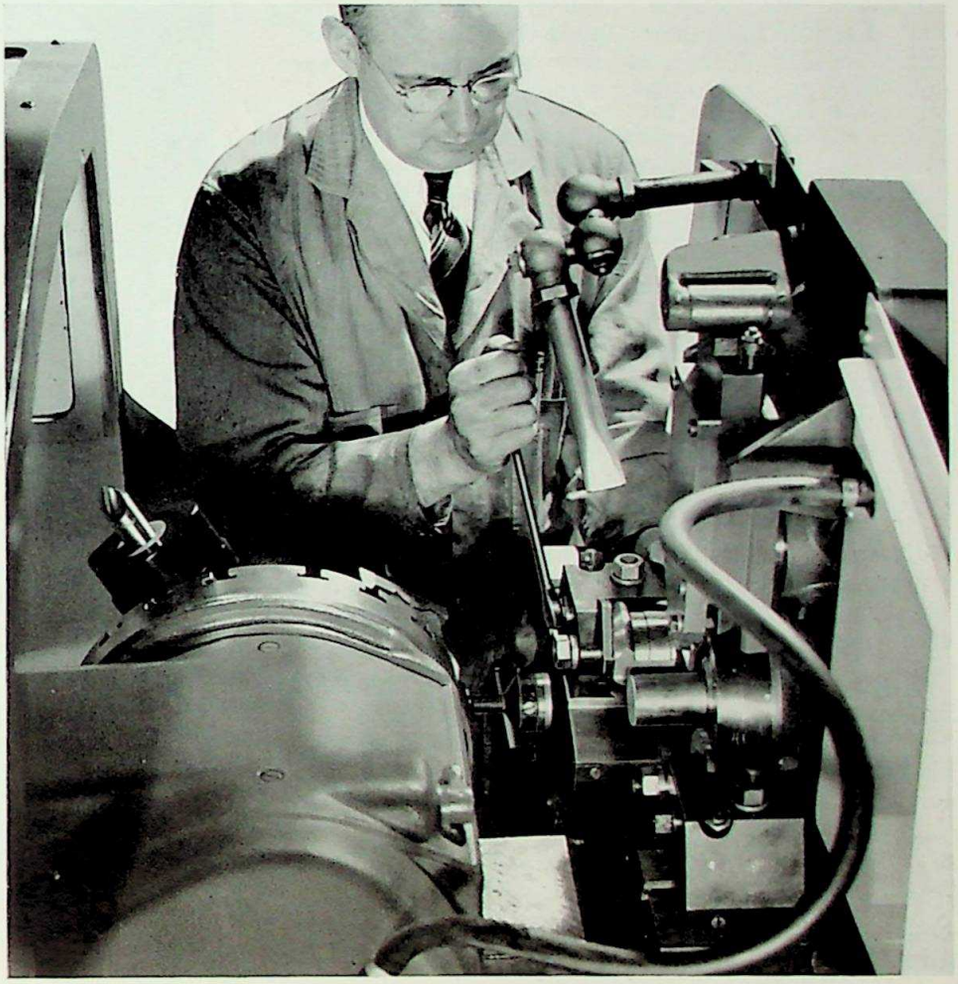


Fig. 19. Oil Guard Rolled Back when Setting-Up.

Fig. 20. Turret Tools, Oiling Head and Oil Steps.

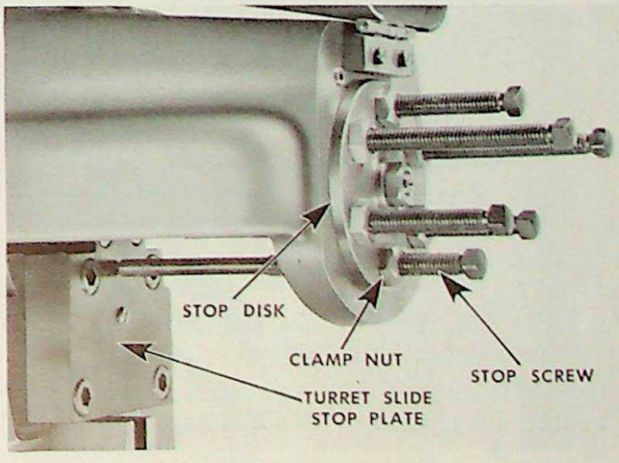


Fig. 21. Independent Stop Screws for Turret.

Vertical Slide. This slide (Fig. 22) gives an additional tool position. Usually used for a cut-off tool, it leaves both cross slides free for other tooling. Cutting-off can be accomplished with the spindle running in either direction.

The vertical slide cam lever (Fig. 16) is provided with a $\frac{7}{32}$" knurled shearing pin in case of overload or jamming and has a hole at the front where a handle can be inserted to operate the slide by hand when setting-up.

The segment link adjusting nut (part 42-14538, page 72) provides means to compensate for minor inaccuracies in the periphery of the cam by changing the amount of throw in the linkage between the cam lever (Fig. 16) and the slide (Fig. 22).

The vertical slide stop screw (Fig. 22) is a positive stop against the advance of the slide beyond the point which is determined by the cam lobe.

The cutting-off blade can be reversed to cut in either spindle direction. To do this, loosen the vertical slide way clamp screw 42-14526, page 72, then remove the tool holder and reverse the blade.

Replace the tool holder and blade on the slide and swivel the slide to centralize the blade. To complete the change, tighten the vertical slide way clamp screw. The vertical slide cam has elongated holes for the clamp screws to allow rotation of the cam for timing. If the cam is not used, the clamp screws should be removed from the dog carrier.

A tapered gib, held by adjusting nuts, provides means to keep the slide and slide way in proper alignment.

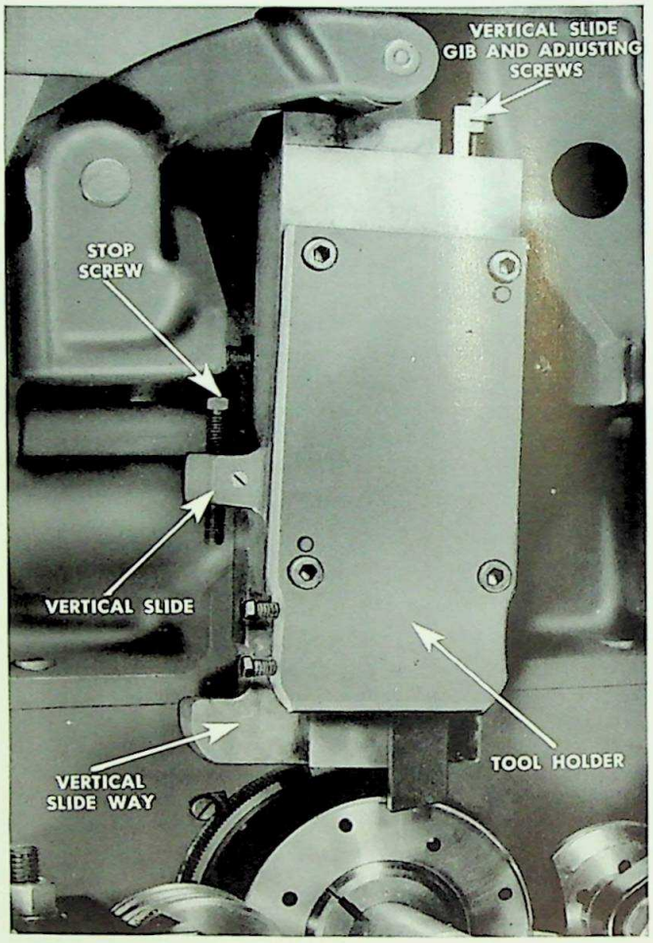


Fig. 22. Vertical Slide — With Positive Stop and Gib Adjustment.

Set-Up Procedure

The following steps are briefly outlined for the procedure in setting-up for a job.

1. Select and install the proper collet and feeding finger for the job. See page 18.
2. Choose and install the spindle change gears as directed on page 14.
3. Install the cams on the cam shaft. See the separate booklet "Cam Design and Standard Tools."
4. Select and install feed change gears. See page 15.
5. Set the trip dogs on the dog carriers for the required operations. See page 19.
6. Install the stock stop and turret tools for the required operations. See the separate booklet in item 3.
7. Adjust the tension of the spring collet as described on page 18.

Additional Equipment
(Furnished at Extra Cost)

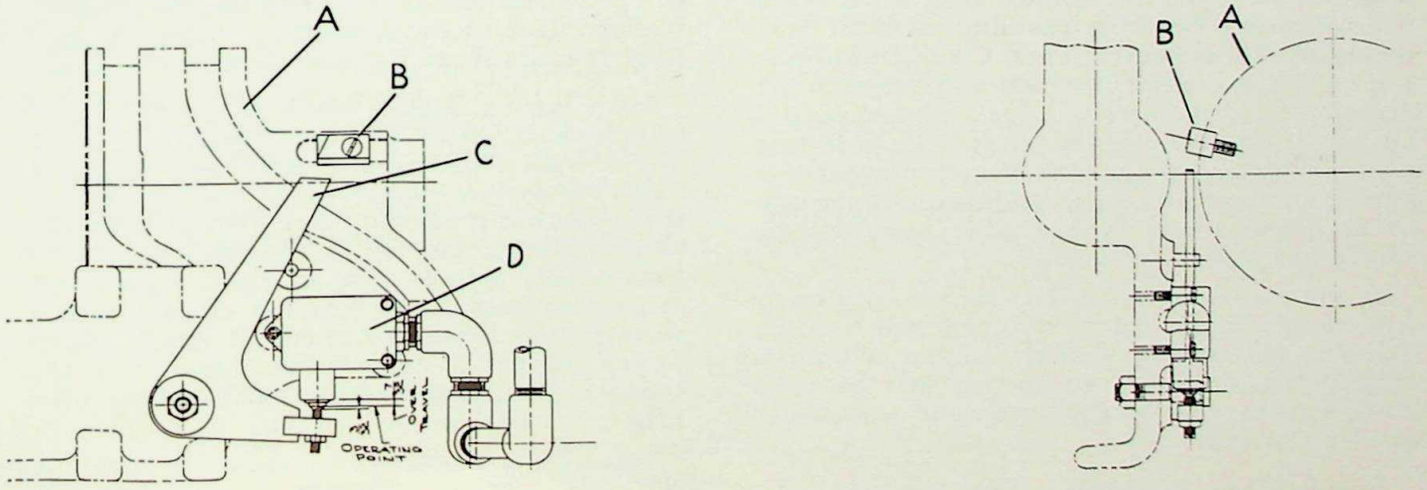
Second Operation Work. When the machine is to be used for second operation work, it is necessary to arrange the opening and closing of the chuck so that the first time the chuck trip lever L (Fig. 28) is raised, the chuck will remain in an open position, allowing time to insert a piece of work. The second time the chuck trip lever is raised the collet will close. This causes the chuck clutch M to be disengaged at every half cycle. The chuck clutch M makes four revolutions to complete the feeding of stock. Therefore, by stopping this clutch every two revolutions it will cause the chuck to complete one-half a cycle at each movement of the trip lever L.

To accomplish the above movements it is necessary to make the following minor adjustments and install a few additional parts.

Remove the chuck and feed cam rod from the chuck and feed cam, reducing the drive shaft revolutions from 4 to 2, and install trip dogs on the left side of the left dog carrier (Fig. 16) to actuate the chuck.

A stopping block B (Fig. 23) is installed in a groove on the chuck and feed cam. As the cam A is making one revolution the stopping block B on the cam moves the lever C that contacts the second operation switch D and shuts off the driving shaft motor. When ready to start the drive shaft motor again, push the drive shaft starting button.

Fig. 23. Second Operation Work — Diagram Below Illustrates Minor Changes Required on Machine.



CHAPTER III

Preventive Maintenance

Preventive maintenance leads to better efficiency of machine and improved quality of products, also reduces service costs and down time for repairs. This machine was operated and adjusted at our factory under conditions as close as practicable to normal operation without actually producing pieces. We, therefore, recommend that you do not alter adjustments until after machine is placed in production and it is determined that readjustments are necessary.

If existing conditions necessitate a change, follow instructions in chapters on Installation and Maintenance. Read those instructions carefully before installing and starting machine. Make certain lubricating oil reservoirs are filled with good mineral oil of proper grades and power wires connected per instructions. Latter precaution very important to prevent damage to machine mechanisms. Examine oil lines to clutch sleeve and chuck sleeve rings to determine that bottom ends are in place in rings.

Spindle Bearings. The spindle is mounted on roller bearings in front box and precision preloaded ball bearing in rear box. End thrust taken by ball bearing. Front box has adjustment for wear by means of a removable liner. Check front bearing for lift at regular intervals and maintain lift at recommended tolerance. See maintenance instructions for tolerance and for methods of testing and adjusting. Make initial test after machine is run for approximately one week, then once a month or at longer intervals depending upon spindle speeds and severity of operation.

If end play develops in the rear box, check setting of spindle nut before replacing ball bearing. Turn up lug on lock washer and try to tighten spindle nut. Original setting may not be tight enough to prevent end movement of component parts on spindle.

Spindle Clutch Mechanism. Keep frictions tight. Loose frictions will result in slipping, accelerated wear and excessive heat. When oiling sprockets observe that oil line to clutch sleeve is in place, once a month check ring and sleeve for wear; see that screws are tight in clutch sleeves. Also examine clutch levers and clutch shoes for wear until expected wear life is determined. When replacing clutch levers, examine clutch lever spindle inserts. If heel on levers is worn, it is likely that inserts need replacing. Backlash or play in these parts reduces travel of clutch sleeve. When replacing levers, shoes or inserts, always install two. Do not attempt to use a new part with one that is worn.

When running for long intervals on one sprocket, adjust tension on driving side tighter than when using both sprockets. This reduces vibration of parts and adds to wear life of spindle inserts, clutch levers and clutch shoes. Run idle sprocket at slower rate of speed in same direction. Also, once every day or two disengage the clutch from driving sprocket so roller bearings in spindle can change position. This can be done easily when oiling sprocket bearings and will increase life of bearings.

Chuck Operating Mechanism. Examine chuck fork sleeve and chuck levers once a month or at longer intervals depending on rate of wear. Do not use worn levers or chuck fork sleeve in which bearing surfaces for levers are worn or rounded. There is an extra pair of slots in sleeve so wear life can be extended by rotating sleeve 90°. Check screws in outer race and tighten if necessary. If sleeve is operated with screws loose, outer race will be ruined quickly. While making these examinations, look at chuck lever fulcrum and chuck lever fulcrum shoes. Replace when worn.

Miscellaneous Spindle Hints. Keep front end of spindle clean. Do not permit fine chips to accumulate between chuck nut and spindle nose oil guard. Clean regularly. Usually this is done when changing collets but if runs are long, remove chuck nut occasionally to clean out foreign matter. At same time remove spindle nose oil guard to clean out chips that may have collected against sealing washer. Hole in washer should fit spindle closely to prevent dirt or chips washing into front box. It may be necessary to replace sealing washer after long intervals.

Clean stock immediately before inserting into spindle to remove foreign matter that may have accumulated on stock while in storage. This will help to keep spindle clean, resulting in less maintenance and extend wear life of feeding fingers and collets.

An extra spindle is a good investment when there is a battery of machines employed. This will lessen down time when spindle requires overhauling. The complete spindle unit can be installed quickly and spindle removed from machine repaired when convenient and held in reserve until

needed again. Avoid use of worn collets, chuck sleeves and chuck nuts. These result in poor work and can cause damage to operating parts.

Spindle Driving Chain. It is essential to operate chains at proper tension to obtain maximum wear life. Check tension twice daily for first 50 hours of operation as instructed on plate adjacent to adjustment stations and then gradually extend time until correct interval is determined. It will be governed by spindle speeds employed and severity of operation.

Maintain correct level of oil in base so chains as well as mechanical mechanisms in base receive constant and ample lubrication. Chains will ruin quickly from lack of oil. Examine oil slinger in base occasionally and without fail if a chain breaks. The slinger throws the oil for lubricating chains and entire mechanism in base. Stiffness of chain link and presence of reddish substance (fretting corrosion) on chains and sprockets usually indicates insufficient tension or lack of lubrication.

Do not attempt to check tension of chains by flexing chains by hand. Loosen nut on idle sprocket arm shaft, strike sharp blow on nut to free shaft in bearing and follow instructions on plate previously mentioned. Method is described in section on maintenance. Drain and clean base reservoir at least every six months and replace with fresh oil of grade recommended.

Tool Slides. Check gibs after first week and adjust if necessary following the maintenance instructions. Loose slide result in poor work, also uneven wear on slides and slide ways. Do not force gib screws. This will distort gib and bind slide. Do not allow chips to pile up in trough between slides so that slides drag across chips. See that cross slides are free of chips when installing tool posts.

After first week check turret nut and thereafter check at intervals of 3 to 4 months unless turret shows signs of looseness before this period. Examine complete assembly of slide 2 or 3 times a year for worm parts, loosened screws, etc. Avoid excessive clamping of the turret tools against the turret face. Distortion can cause the turret to bind resulting in broken shearing pins.

General. At least twice a year make a general inspection of machine. Examine condition of clutches, and readjust whenever teeth of driving and driven members strike together. See maintenance instructions for adjustment.

Inspect electrical system as recommended, under "Maintenance".

Keep guards in place. These protect machine mechanisms as well as operator.

Keep machine clean. An accumulation of chips on slides, tool pans and guards is detrimental to machine.

Coolants. We recommend mineral cutting oils with inactive sulphur content. Replace or filter oil frequently. If possible, avoid water soluble oils or oils with active sulphur content but if used flush slides with oil at weekends or before shut down for long period. Vapor rising from hot cutting zone or from chips where water emulsions are used is practically water and if it condenses on under surfaces of slides is likely to cause rusting or sticking of slides. Oils with active sulphur have a corrosive action on the bronze gibs so slides will require more frequent attention.

Lubrication. Importance of lubrication cannot be overstressed. Follow lubrication diagram. Use good mineral oils of grades recommended and maintain proper level in reservoir for mechanical lubricator and in base reservoir.

Guide for Setting Up Regular System for Maintenance Inspections

The following intervals of time are tentative and may be extended or shortened, according to conditions under which machine is operated.

Machines operated at fast speeds and rapid time cycles or heavy work load will require more frequent inspections than machines operated at low speeds and long time cycles and light work load.

First Week —

Spindle sprocket chains: check and adjust tension twice daily for first 50 hours, and thereafter as conditions require (Page 30).
Spindle: inspect for lift and end play (Pages 29 and 30).
Turret Nut — Keep tight.

Every Month —

Lift in spindle front box and end play.
Turret slide gib (Page 31).
Cross slide gib (Page 31).
Clutch levers (Page 31).
Clutch shoes (Page 24).
Chuck fork sleeve (Page 24).
Chuck and feed levers (Page 24).
Clutch and chuck sleeves and rings, and inspect oil lines to rings. (It is advisable to observe these lines when oiling sprockets to see that ends are in place in rings.)

Every 3 Months —

Turret indexing mechanism including locking pin and bushings.
Caution: If any parts are removed observe steps No. 1-3 — Page 31.

Every Six Months —

General inspection of electrical system (Page 27).
General inspection of mechanical mechanism (Pages 27 through 32).
Observe condition and adjustment of clutches (Page 31).
Drain lubricating oil from base, clean base, and refill with fresh oil of grade recommended. (Pages 10 and 11).

CHAPTER IV

Maintenance-Adjustments

Electrical Controls

Trouble Shooting. Overload relay units (Fig. 24) are installed to insure the stopping of the machine due to overload. The overload relay is shown in automatic reset position and the reset plunger is locked in place by the point of the wire loop which fits into a hole in the relay frame. In this condition the overload relay will stop the machine if any motor is overloaded. As soon as the heater has cooled, the relay resets automatically and the machine can be restarted.

If the machine continues to stop after short intervals, it is necessary to determine which motor is overloaded. To perform this check, change all overload relays to manual reset by removing the point of the wire loop from the position shown and inserting the point in the hole at the left of its present location. (This removes spring pressure from the reset plunger and after an overload the relay must be reset manually by pushing in by finger pressure.) Then operate the machine until the overload condition is encountered. This will trip the overload relay. After the relays have had time to cool, push in each reset plunger in turn until one is found that clicks or permits the starting of the machine by the spindle start button. This permits identification of the overloaded motor. If the machine does not start after pressing the overload relay resets, then press the transformer thermal reset.

The pointer shown in Fig. 24 is normally set at the 100 mark to take care of normal full load motor current. If the machine should stop, due to overload, with the pointer at this setting, check motor conditions to determine which motor is affected. If conditions are normal and the motor is not overheating, then the pointer may be advanced to the 115 mark. (This permits 15% overloading of the motor.) In some cases it is desirable to protect the motor more closely, and then the pointer is turned to the 85 mark. (This causes tripping of the heater at 85% of the full load motor current.)

The elementary and wiring diagrams furnished with the machine will aid in further tracing of machine troubles. If it becomes necessary to disconnect any wires, they should be replaced according to the wiring diagram and the numbers on the terminals.

Cleaning Contacts. Electrical equipment should be inspected about twice a year. At this time or when trouble shooting, the contacts of the switches

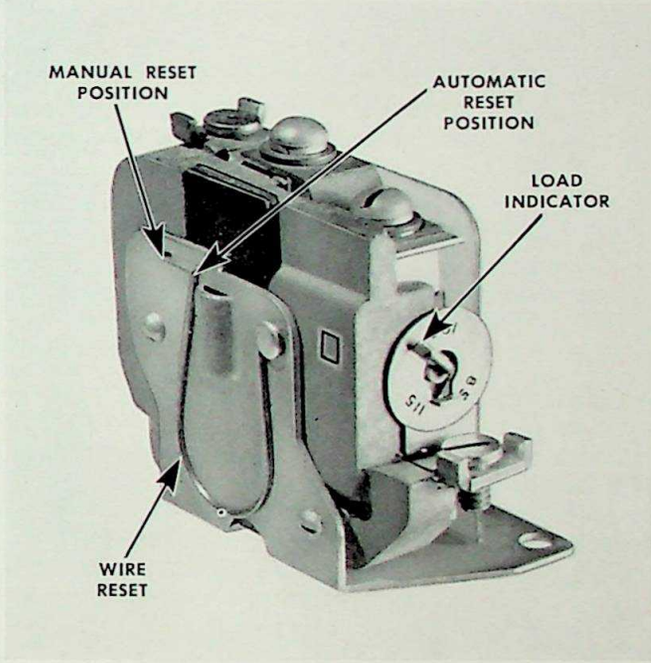


Fig. 24. Overload Relay Unit.

may be cleaned, if necessary, with a rag. Never use sandpaper or emery for this purpose because particles might adhere to the surface of the contacts, causing serious trouble during operation. If cleaning with a rag is not satisfactory, use a very fine file. Note that the black substance on the contacts does no harm, and that removing this deposit will merely shorten the life of the contacts.

Coolant

The coolant requirements outlined in chapter 1 should be maintained at all times. Occasionally, especially if fine chips are produced, the coolant tank should be drained and wiped out and the strainer thoroughly cleaned. This is most advisable if the run is on plastics.

The pump relief valve setting must not exceed 30 lbs. per square inch. The valve should be set so that the head of the adjusting screw is $1\frac{3}{32}$" from face of valve under the washer.

Safety Devices

If a new turret intermediate shaft gear shearing pin is to be installed, the following procedure must be used otherwise the mechanism will be out of time and the new pin will shear off.

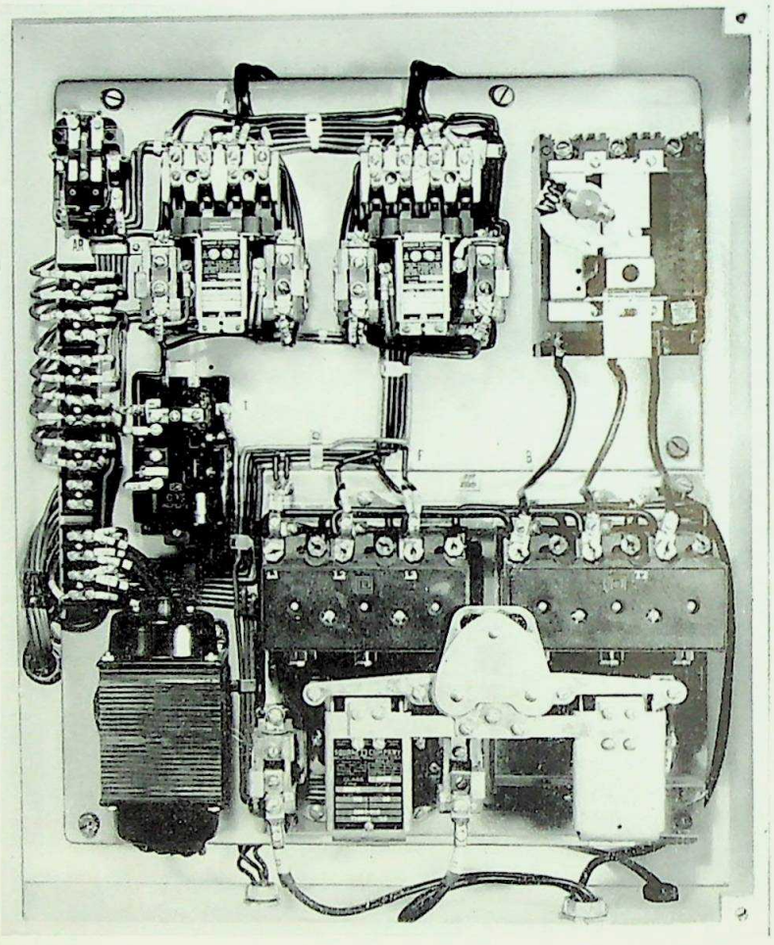
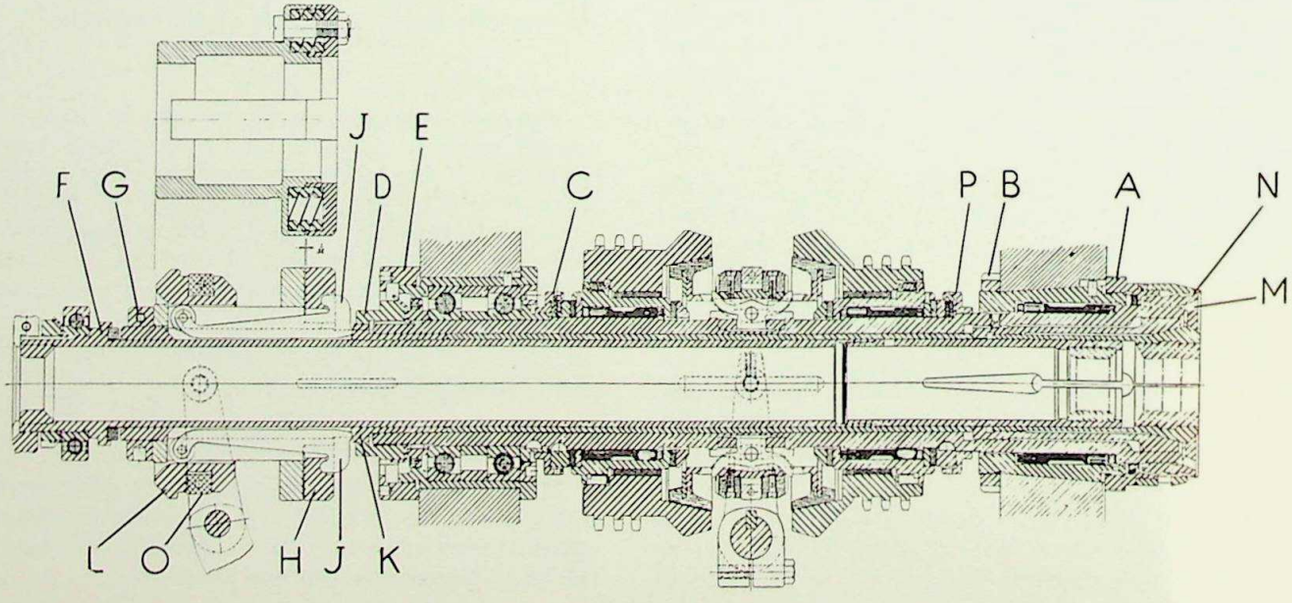


Fig. 25. Electrical Panel

Fig. 26. Section through Spindle.



1. Release the turret locking pin and rotate turret by hand until the roll on the turret timing cam lever is at the center of the flat surface of the timing cam (part no. 42-14186, page 64).

2. Next, if necessary for clearance, remove the turret timing cam lever; then, by handcrank, rotate machine driveshaft until "0" markings on the driving shaft turret gear (part no. 42-14452, page 52) and turret intermediate shaft gear (part no. 42-14299, page 64) are lined up.

3. Remove gear and hub from shaft and replace shearing pin (part no. 4085, page 64). Next install gear and hub with "0" marks (see step 2) lined up.

4. Finally, replace the turret timing cam lever if removal for clearance was necessary.

Spindle

Adjustment of Spindle Friction Clutch. The spindle clutch has a constant length of movement and the driving sprockets are adjusted up to it whenever necessary. Each sprocket is threaded on its sleeve, providing adjustment toward or away from the clutch. The high speed sprocket is nearest to the front bearing and the low speed sprocket is nearest to the rear bearing. A special face spanner wrench is used to adjust the sprockets, and a spring plunger locks each sprocket to its sleeve after adjustment is made.

Spindle Front Box Adjustment. The recommended adjustment of the front box is zero to .0002″ play at maximum operating temperature. When it is necessary to reduce excessive play to within these limits—

1. Slacken the spindle driving chains.
2. Remove right-hand nut A Fig. (26) from the spindle front box.
3. Support the base of a dial indicator securely on the most satisfactory surface available and locate the indicator point on top of spindle, next to the box. Using a short, light bar supported horizontally on a block on the cross slide, press alternately and lightly up with the bar and down by hand on the spindle near the box. The total indicator reading shows the play in the front box.
4. Remove the liner and reduce its thickness by three times the difference between the actual and recommended spindle play. Do not attempt to adjust the box without reducing liner thickness.
5. Replace liner, tighten the left-hand nut B until box is solid on liner.
6. Recheck play and if satisfactory, tighten right-hand nut A by hand only, and lock it.

If a new spindle has been installed, it should be tested at room temperature for front box play before running and the dial indicator reading should be within .0002″ to .0004″. Retest after running to maximum operating temperature and adjust if necessary to obtain a reading of zero minimum to .0002″ maximum.

We suggest that the thermometer be inserted into a lump of putty placed on top of the spindle nose oil guard to obtain an accurate temperature reading. Maximum operating temperature is 110° F. plus room temperature.

We recommend the use of a thermometer having a reading from 0 to 220° F. such as a Taylor #21418 or its equivalent.

End Thrust. End thrust is taken by the preloaded precision ball bearings mounted in the rear box. Correct preload is established at initial assembly when nut D (Fig. 26) is tightened and locked on the end of the spindle. Do not attempt to adjust these bearings, for the heavy load capacity of the bearings assures a long life, and no adjustment is required or provided.

If end play is suspected, check the nut D and tighten if necessary, as described in the following paragraph.

If it should be necessary to take the spindle unit apart, tighten nut D as tight as possible in reassembling and lock in place. In case a tongue of the lock washer should not be opposite a slot in the nut after tightening, tighten the nut still further until it can be locked, rather than back it off for this purpose. This procedure is essential in order to secure the required preload on the bearings.

Removing Spindle Unit. The vertical slide bracket and slide are first removed, then open the spindle driving chains and hook the ends to prevent them from falling into the base of the machine.

Next remove the bearing caps holding the spindle, then disconnect the spindle chuck fork and clutch fork.

The spindle can now be lifted out with sprockets and boxes attached.

Disassembling Spindle Unit. In taking apart the spindle assembly, first remove the complete unit from the machine. The unit should then be taken apart piece by piece, working from the left end. Never attempt to remove the parts collectively by forcing the spindle, as this would result in serious damage.

First, unscrew chuck adjusting nut G (Fig. 26). This leaves sleeve H, sliding sleeve L, chuck lev-

ers J and chuck lever fulcrum shoes K free to come off the spindle. Remove spindle nut D and rear box nut E. The low speed spindle sprocket can now be removed as a unit.

Take off the clutch sleeve ring and by taking out four screws remove clutch sleeve. Next, remove the clutch levers and clutch lever fulcrum. The clutch body will now slide off easily. The clutch body keys are then removed and marked for identification so that they will be later put back in their same location.

Next for removal is the right spindle sprocket. Then remove the spindle sprocket bushing thrust nut and the roller bearing box will come off with ease. To reassemble, reverse this procedure.

NOTE:—Adjust friction clutch as described on page 29. End thrust of the spindle sprockets is from .006 to .008.

Chains

Positive drive of the spindle by chain at all speeds insures the delivery of required power throughout the full speed range for all operations within the capacity of the machine.

Attention to lubrication and chain tensions will result in long chain life.

Chain Adjustment. To obtain proper adjustment, loosen the idler sprocket arm shaft nut that is located on the left-hand wall above the spindle change gear compartment. The following procedure can now be used at both adjustment stations. Loosen nut on the idler adjusting rod (Fig. 27) until the idler adjustment rod lock swings freely on the rod. Turn the idler adjusting rod sleeve clockwise until the face is flush with the shoulder on the adjusting rod. Return the rod lock to its original position and tighten the nut on the adjusting rod. Now tighten the idler sprocket arm shaft nut.

If, after long service, slack in the chain has become so great as to make further tension adjustment impossible, the chain should be shortened or replaced.

When shortening the chain *two* links must be removed. Follow instructions in the first and last paragraphs under "Replacing Chain", taking care after opening the connecting link to hook the open ends to prevent them from falling into the base.

Replacing Chain. In replacing a spindle driving chain, first loosen the idler sprocket arm shaft nut on the left hand wall above the spindle change gear compartment. Loosen the nuts on the adjusting rod (Fig. 27), lift and swing the rod lock out of the way and turn the tension adjusting sleeve counterclockwise to move the idler sprocket as far as possible to the rear.

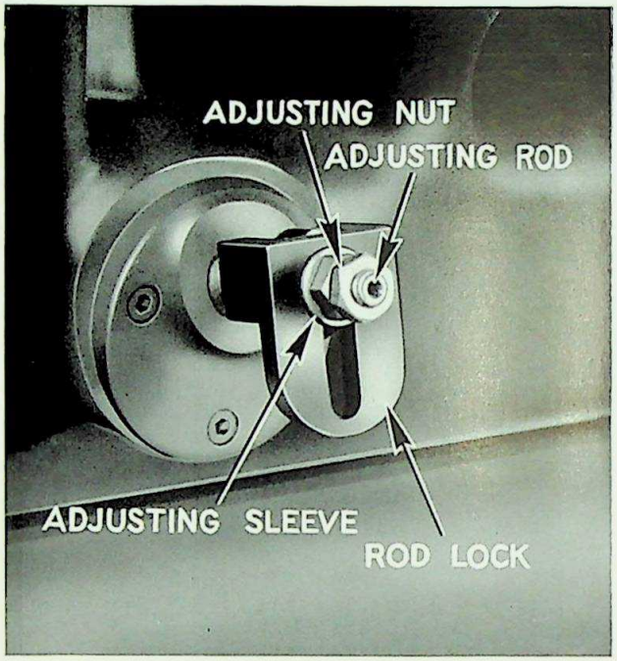


Fig. 27. Chain Tension Adjustment.

Take off the cover plate at the front of the base. Lead one end of the chain down in back of the spindle sprocket to the base, taking care to mesh the chain correctly over the teeth on the idler sprocket. Allow the chain to pass down until only the end remains above the spindle sprocket. Wire this end to any convenient part of the machine to prevent dropping.

Next, lead a wire or cord down in *front* of the spindle sprocket and through the opening at the front of the base. Attach the end of the wire to the loose end of the chain; then pull the chain up to the spindle sprocket.

Bring both ends of the chain into engagement with the spindle sprocket teeth so that one pitch length remains to be completed by the connecting link. Thread the connecting link pins through the rolls, taking care to enter the loose middle plates and the side plate as the connecting link is advanced. Finally, snap the spring clip on the ends of the connecting link pins. Before starting the machine, adjust the chain tension.

The Automatic Operating Mechanism

Removing Driving Shaft. First remove the motor chain and feed change gear. Do not attempt to remove the driving shaft H (Fig. 28) by removing the driving shaft sleeve A, for this will result in throwing the automatic operating mechanism out of time. The shaft can be easily and quickly removed in the following manner:

Remove the feed change gear B by removing the nut and slotted washer from end of the shaft. Drive out reverse and chuck clutch pins C, hand operating gear pin D, stop collar pin E and driving shaft acceleration pin F. The shaft can now be drawn out from the driving shaft gear end.

In putting the clutch members back, it is sometimes easier to compress the springs and fasten the parts together with a clip, while the whole group of parts is held in position and the shaft pushed through.

The clutches on the driving shaft are engaged by a coil spring and are withdrawn by the action of a cam surface against the follower screw in the trip lever (Fig. 17). When the spring forces the screw back into the groove, the front end of the lever is again depressed into position for the trip dogs to engage. The follower screw is eccentric, providing for adjustment of the sliding clutch member away from the fixed member. Whenever end play in the driving shaft has been taken up, the screws in the trip levers should be examined to prevent interference when the follower screw withdraws the clutch teeth. Clutch teeth clearance is .025. When adjusting the follower screw, bear in mind that it takes one complete turn to bring the eccentric back to the same position again.

Trip Lever Abutments. Side pressure of the clutch spring against the follower screw in the trip lever is supported by the hardened abutment plugs in the machine bed. Adjust as follows:

1. Lift the front end of the trip lever to disengage the follower screw from the sliding clutch operated by the trip lever concerned.

2. Loosen the locking nut and turn the hardened screw to allow .002″ clearance between the head of the screw and the abutment plug.

3. Tighten the locking nut to complete the adjustment.

Cross Slides

Gib Adjustment. If gibs are badly worn the slides can lift and chips may enter the bearing surfaces aggravating the condition. If gibs are too tight the slides might bind and not pull out properly causing damage to tooling.

A good sliding fit is required for proper operation. To adjust for a worn condition loosen the inner adjusting screw and tighten the outer screw a little at a time until the desired adjustment is made. Make sure both screws are tight against the gib to complete the adjustment.

Turret

Turret Index Timing. If for any reason the turret has been removed or a new turret installed, it is necessary to set the turret timing. When the taper on the locking pin seats in the taper bushing in the rear face of the turret for each tool position, the timing must be adjusted by the two screws in the turret disk adjusting collar 42-14179 page 66 so that no backward or upward movement of the turret occurs.

Setting figures for a forward (direction of rotation) motion at each of the six tool positions when locking pin engages is 0 to .015″. Test as follows:

1. Place a dial indicator on one of the cross slides so that a reading can be taken close to the edge of the turret nearest the machine spindle. Use a suitable surface, such as a turret tool or a straightedge clamped to the turret face for this purpose.

2. Disengage the locking pin and rotate the turret to a tool position and place indicator (set at 0) in position.

3. Release locking pin and determine from indicator if timing adjustment is necessary. Repeat at each of the six tool positions, recording the amount of correction and position. Determine which position is furthest from setting figure and adjust this one. Others which need correction will then be within setting figures.

Turret Slide Gib. If the gib is badly worn the slide can lift and chips can enter the bearing surfaces aggravating the condition. If the gib is too tight, the turret might not index properly. Either condition can cause damage to tooling and the machine, as well as producing poor work. A good sliding fit is required for proper operation.

Two adjusting screws, one in each end of the turret slide ways beneath the slide, provide means for adjustment.

To adjust for a worn condition, loosen the forward screw (nearest spindle) and tighten rear screw a little at a time until the desired adjustment is made. Make sure both screws are tight against the gib to complete the adjustment.

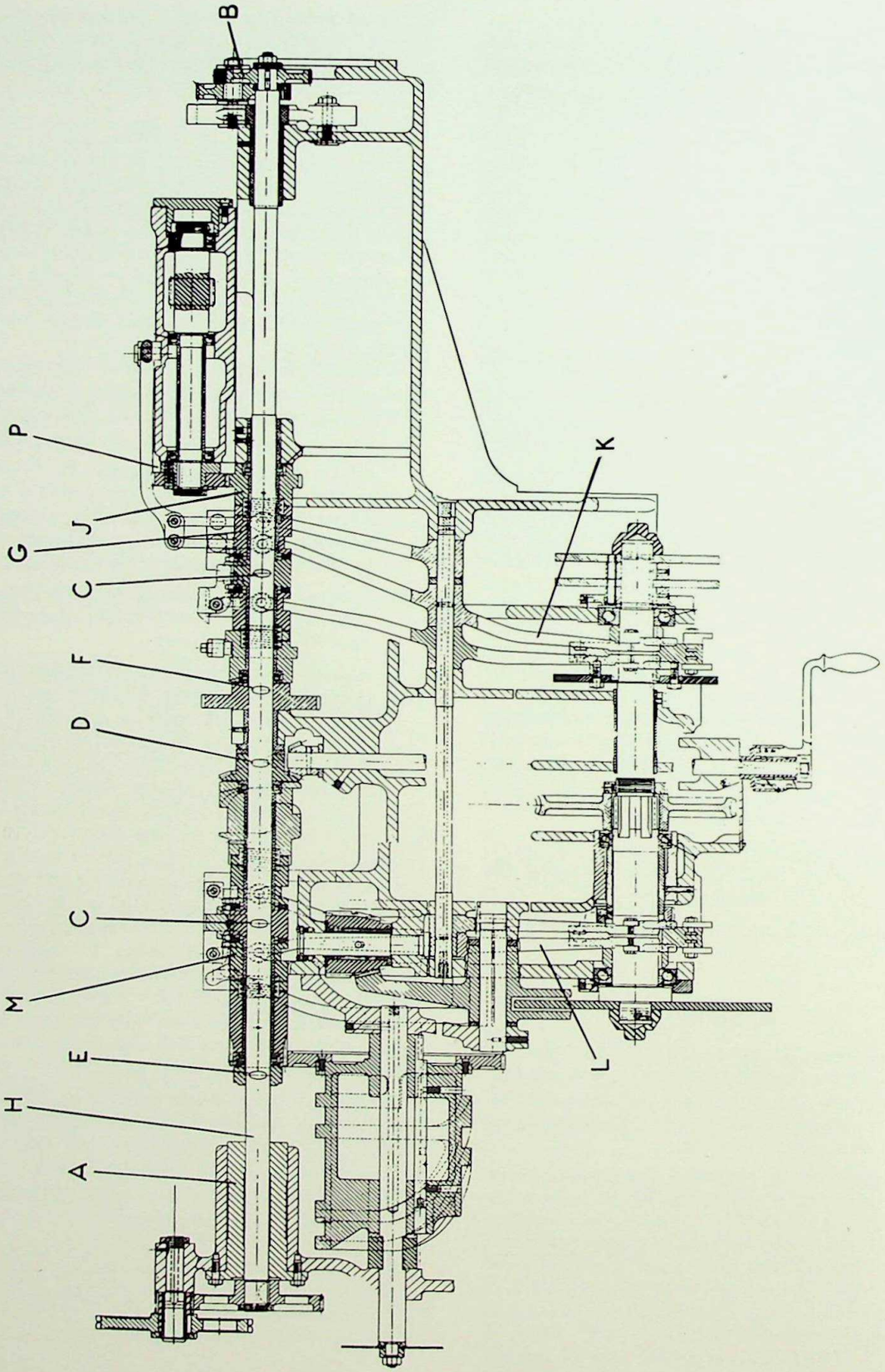


Fig. 28. Section of Machine through Driving Shaft.

Care and Use of Blades

Balance Turning Tool Blades. Fig. 29 shows both tangential and radial blades, but the tangential blade offers the advantage of easier and finer adjustment. To set a radial blade for a different diameter it is necessary to adjust it by moving the blade directly in or out, while the tangent blade is swung up or down.

Grind the blades so that the cutting edge C, Fig. 29, is square with the face D and when ground

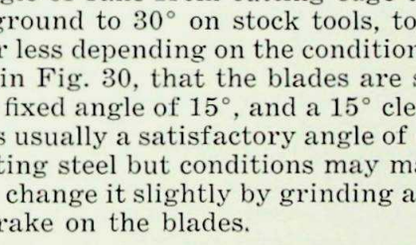


Fig. 29.

this way the tool will leave a square shoulder on the work. It is often necessary to have some rake to this edge and this can be determined only by trial.

The angle of rake from cutting edge to back of blade is ground to 30° on stock tools, to be made greater or less depending on the conditions. It will be noted in Fig. 30, that the blades are set in the body at a fixed angle of 15°, and a 15° clearance at F. This is usually a satisfactory angle of clearance when cutting steel but conditions may make it advisable to change it slightly by grinding a different angle of rake on the blades.

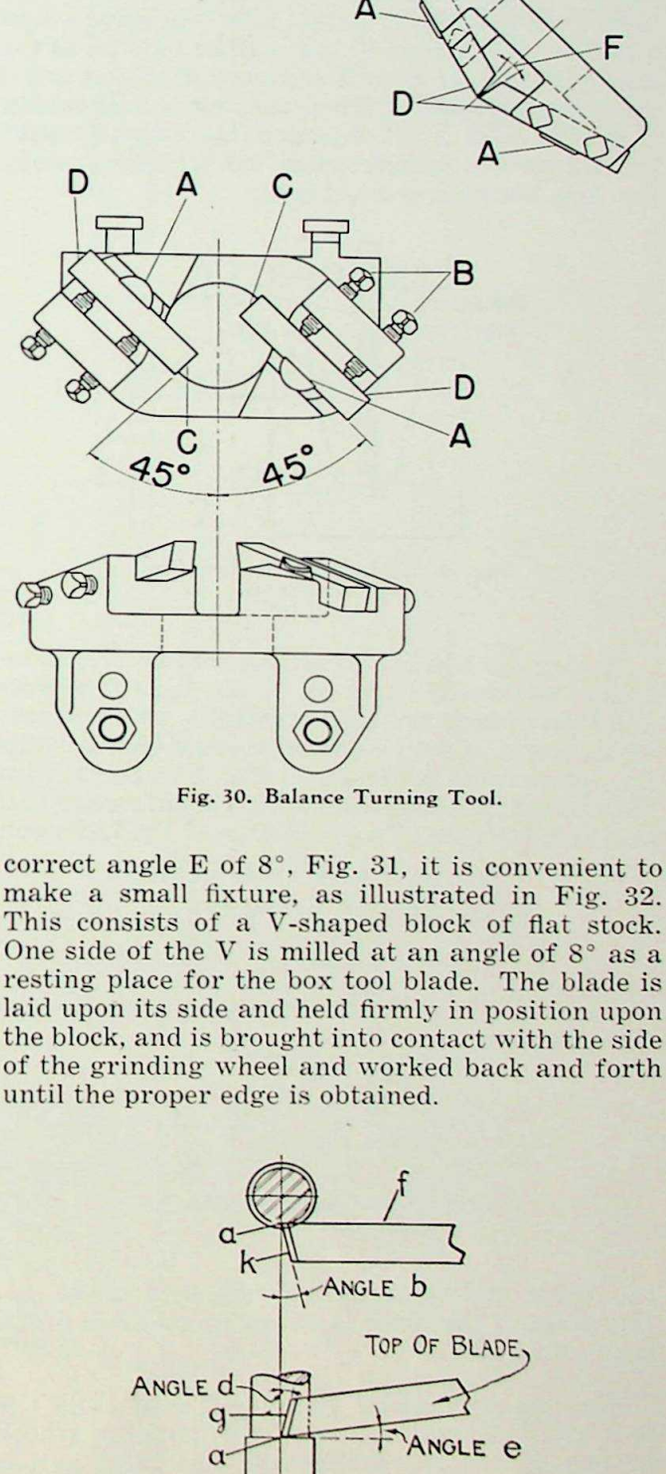


Fig. 30. Balance Turning Tool.

Cutting Angles of Box Tool Blades. Box tool blades are cut tangentially. Fine adjustment is of great value in the use of box tools and so are preferred to all others as finishing tools.

The cutting point A, Fig. 31, should be set on the diameter of the work which is perpendicular to the face F of the blade. This applies in general to roughing and finishing cuts on all metals. The edge K may be ground square with face F, or slightly tipped back to give a small angle B. This edge should never lean forward of the cutting point A.

The blade is not set at a right angle with the axis of the work, but is set back on the rear end for clearance, the angle E being 8° for all blades. The face G should be ground back from the square sufficiently to give a good chip cleaving action; usually making the angle D from 15° to 40° will be sufficient, a satisfactory angle not being difficult to obtain. Sometimes even less than 15° for angle D will give satisfactory results, especially on brass.

Sharpening the Blades. To grind a number of blades, when grinding face G and maintaining the correct angle E of 8°, Fig. 31, it is convenient to make a small fixture, as illustrated in Fig. 32. This consists of a V-shaped block of flat stock. One side of the V is milled at an angle of 8° as a resting place for the box tool blade. The blade is laid upon its side and held firmly in position upon the block, and is brought into contact with the side of the grinding wheel and worked back and forth until the proper edge is obtained.

Fig. 31. Angles of Box Tool Blades in Relation to Work.

With the tool ground and set in place, face G, Fig. 31, would be parallel to the axis of work and is suitable for cutting brass, but for other materials grind a sufficient rake to produce an angle of from 15° to 40° at D, commencing at a point about 1/32" back from the cutting point. This will leave a land of about 1/32" on face G, that will be parallel to the axis of work and permit sufficient drag to leave a good turning finish. When turning to a shoulder, if a slight fillet is not objectionable, a small radius ground on the cutting point will greatly prolong the time between sharpenings.

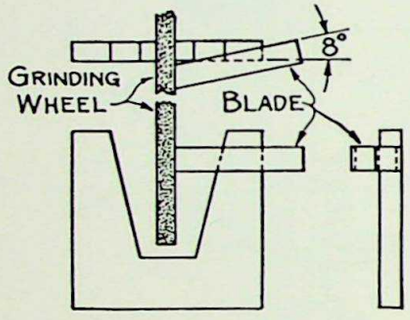


Fig. 32. Fixture — When Grinding Box Tool Blades.

Setting the Blades. In setting, reduce the diameter to the desired size by taking light trial cuts and then setting the blade centrally with the axis of the work. A very effective method that permits fine adjustment is shown in Fig. 33. By this arrangement the blade rests upon a small rocker that acts as a fulcrum. Two screws hold the tool upon

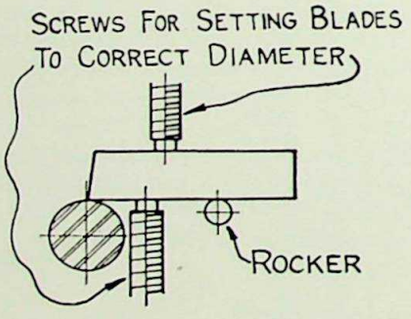


Fig. 33. Method of Adjusting Box Tool Blades.

the rocker and by adjusting these screws the cutting point of the blade is swung up or down to the desired position.

Sharpening Circular Forming Tools. Hold the tool by hand against a straight grinding wheel, preferably using a machine with a tool rest, so that it will be ground square with the sides. It will not give the exact measurements to which the tool was

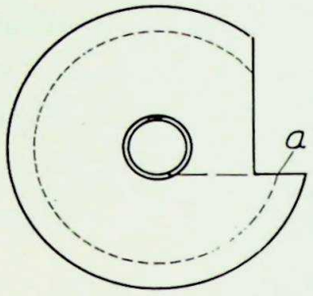


Fig. 34. Method of Grinding Face of Circular Tool.

laid out but it is near enough for shop practice and is the method usually followed. The cutting face A, Fig. 34, is flat and on a straight line which if prolonged would be tangent to the inside diameter of the threaded hole in the center.

Wide form tools are usually held in a vise and sharpened on a surface grinding machine.

Turret Tool Post Blade Arrangement. The blade Fig. 35, is set on a radius and is perpendicular to the center line of the bar of stock. In general, the end clearance A, side clearance C, and top rake B, are about 15°. This may be varied; for instance, on a tough stock the angles probably need be less, so the cutting point will be better supported.

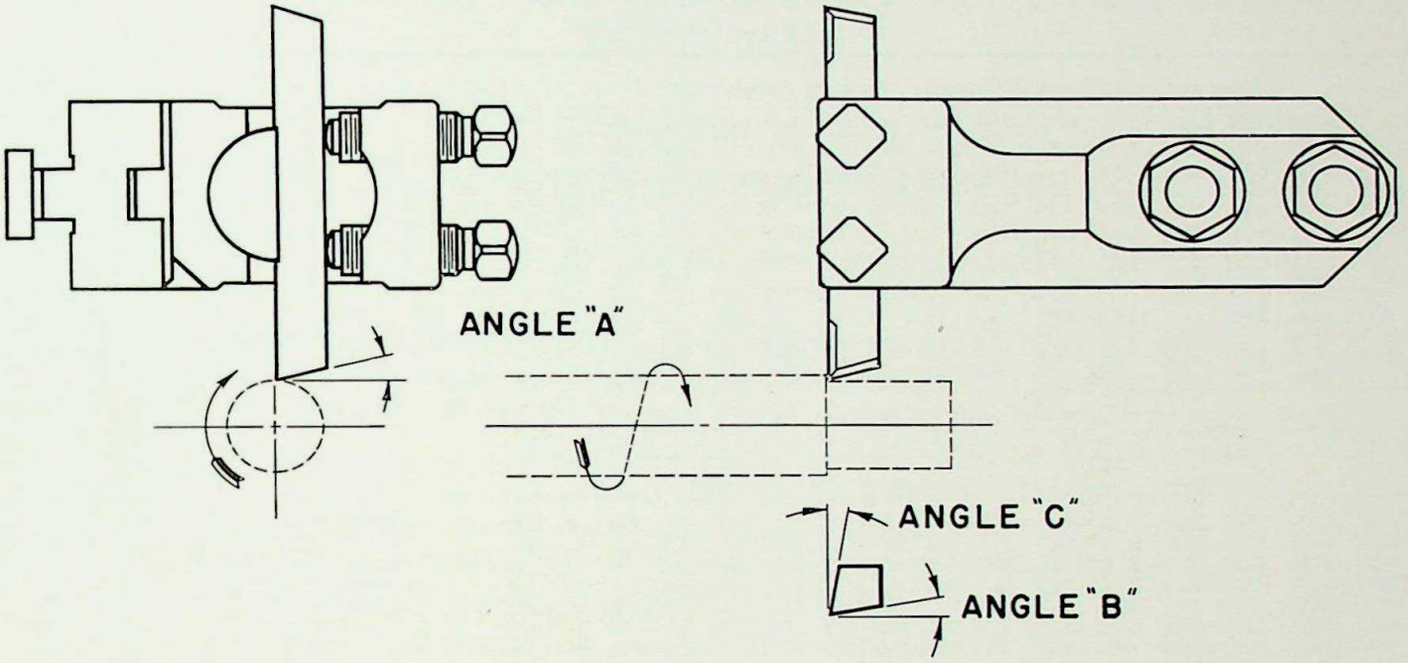
The two adjusting screws and a rocker are for swinging the cutting point ahead or behind the center line of the work, and are not for adjusting the blade to the correct diameter. This is done by moving the blade in or out with the two adjusting screws.

Grinding Swing Tool Blades. The swing tool blade Fig. 36, is inclined to the left about 12°. Thus in order to bring the top face B to a horizontal plane it must be ground off 12° on the back. This is the only surface which requires grinding. For brass and soft materials this surface should be made horizontal by grinding off about 12° from the square; harder materials may cut better if the angle is slightly greater.

The cutting edge D is formed to the required angle when used on taper or form turning. It is also of advantage in some cases to grind off the back corner of the cutting edge, as indicated at C, leaving 1/16" to 1/8" of the cutting edge. This width will be sufficient to give the desired finish. Side clearance on the blade, as indicated at E, will prevent rubbing; about 8° on the side toward the cutting point will be sufficient on turning operations; for forming, about 1/2° to 1° on either side.

For heavy longitudinal cuts only, grind off the front corner of the cutting edge indicated at F, 60° to 75°.

Fig. 35. Turret Tool Post in Relation to Bar of Stock.



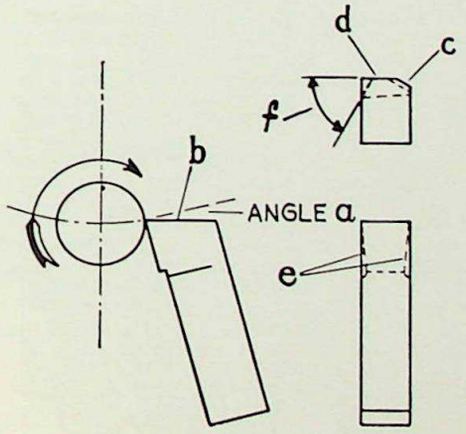


Fig. 36. Swing Tool Blade.

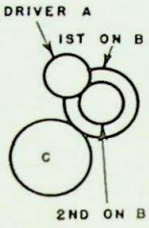
Table for Laying Out Cams

Driving Shaft 120 R.P.M.

High Spindle Speeds in Combination with Low Speeds																Ratio
1965	1660	1420	1225	1015	850	750	630	555	470	415	345	285	250	210	180	
†890	†750	640	555		385	340	285	250	210	185		130	110	96	81	2.2
†745	630	535	465	385		285	240	210	180		130	110	94	80	68	2.6
†655	550	470	405	340	285		210	185		135	115	96	80	70	60	3
†555	465	400	345	285	240	210			130	115	97	81	70	60	50	3.3
†485	410	350	305	250	210	185			115	100	86	71	61	52	44	4
410	345	295	255	210	180		130	115		86	72	60	52	44	37	5
360	305	260	225	185		135	115	100	86		64	53	45	39	33	5.5
305	255	220	190		130	115	97	86	72	64		44	38	33	27	6.5
250	210	180		130	110	96	81	71	60	53	44		32	27	23	8
215	185		135	110	94	82	70	61	52	45	38	32		23	20	9
185		135	115	97	80	70	59	52	44	39	33	27	23		17	11
	130	115	97	81	68	59	50	44	37	33	27	23	20	17		13
Revolutions at Max. Speed to Feed Stock or Index Turret — 2 Seconds																
65.5	55	47	41	34	28	25	21	18.5	15.7	14	11.5	9.5	8.3	7	6	
Revolutions of Spindle at Max. Speed to Make One Piece																
393	332	284	245	203	170	150	126	111	94	83	69	57	50	42	36	
459	387	331	286	237	198	175	147	130	110	97	81	67	58	49	42	
524	443	379	327	271	227	200	168	148	125	111	92	76	67	56	48	
590	498	426	367	304	255	225	189	167	141	124	104	86	75	63	54	
655	553	473	408	338	283	250	210	185	157	138	115	95	83	70	60	
721	609	521	449	372	312	275	231	204	172	152	127	105	92	77	66	
786	664	568	490	406	340	300	252	222	188	166	138	114	100	84	72	
852	719	615	530	440	368	325	273	241	204	180	150	124	108	91	78	
983	830	710	612	507	425	375	315	278	235	207	173	143	125	105	90	
1146	968	828	715	592	496	438	368	324	274	242	201	166	146	123	105	
1310	1107	947	817	677	567	500	420	370	313	277	230	190	167	140	120	
1474	1245	1065	919	761	637	563	473	416	352	311	259	214	187	158	135	
1638	1383	1183	1021	846	708	625	525	463	392	346	288	238	208	175	150	
1801	1522	1302	1123	930	779	688	578	509	431	380	316	261	229	193	165	
1965	1660	1420	1225	1015	850	750	630	555	470	415	345	285	250	210	180	
2293	1937	1657	1429	1184	992	875	735	648	548	484	403	333	292	245	210	
2620	2213	1893	1633	1353	1133	1000	840	740	627	553	460	380	333	280	240	
2948	2490	2130	1837	1522	1275	1125	945	833	705	622	518	428	375	315	270	
3275	2767	2367	2042	1692	1417	1250	1050	925	783	692	575	475	417	350	300	
3603	3043	2603	2246	1861	1558	1375	1155	1018	862	761	633	523	458	385	330	
3930	3320	2840	2450	2030	1700	1500	1260	1110	940	830	690	570	500	420	360	
4258	3597	3077	2654	2199	1842	1625	1365	1203	1018	899	748	618	542	455	390	
4585	3873	3313	2858	2368	1983	1750	1470	1295	1097	968	805	665	583	490	420	
4913	4150	3550	3062	2537	2125	1875	1575	1388	1175	1037	863	713	625	525	450	
5404	4565	3905	3369	2791	2337	2063	1733	1526	1292	1141	949	784	687	578	495	
5895	4980	4260	3675	3045	2550	2250	1890	1665	1410	1245	1035	855	750	630	540	
6386	5395	4615	3981	3299	2762	2438	2048	1804	1527	1349	1121	926	812	683	585	
6878	5810	4970	4287	3552	2975	2625	2205	1943	1645	1452	1208	998	875	735	630	
7369	6225	5325	4594	3806	3187	2813	2363	2081	1762	1556	1294	1069	937	788	675	
7860	6640	5680	4900	4060	3400	3000	2520	2220	1880	1660	1380	1140	1000	840	720	
8351	7055	6035	5206	4314	3612	3188	2678	2359	1997	1764	1466	1211	1062	893	765	
8843	7470	6390	5512	4567	3825	3375	2835	2498	2115	1867	1553	1283	1125	945	810	
9334	7885	6745	5819	4821	4037	3563	2993	2636	2232	1971	1639	1354	1187	998	855	
9989	8438	7218	6227	5160	4321	3813	3203	2821	2389	2110	1754	1449	1271	1068	915	
10644	8992	7691	6635	5498	4604	4063	3413	3006	2546	2248	1869	1544	1354	1138	975	
11299	9545	8165	7044	5836	4887	4313	3623	3191	2702	2386	1984	1639	1437	1208	1035	
11954	10098	8638	7452	6174	5171	4563	3833	3376	2859	2524	2099	1734	1521	1278	1095	
12609	10651	9111	7860	6513	5454	4813	4043	3561	3016	2663	2214	1829	1604	1348	1155	
13264	11205	9585	8268	6851	5737	5063	4253	3746	3172	2801	2329	1924	1687	1418	1215	
13919	11758	10058	8677	7189	6021	5313	4463	3931	3329	2939	2444	2019	1771	1488	1275	
14738	12450	10650	9187	7612	6375	5625	4725	4163	3525	3112	2588	2138	1875	1575	1350	
15556	13141	11241	9698	8035	6729	5938	4988	4394	3721	3285	2731	2256	1979	1663	1425	
16375	13833	11833	10208	8458	7083	6250	5250	4625	3917	3458	2875	2375	2083	1750	1500	
17358	14663	12543	10820	8965	7508	6625	5565	4903	4151	3665	3048	2518	2208	1855	1590	
18340	15493	13253	11433	9473	7933	7000	5880	5180	4386	3873	3220	2660	2333	1960	1680	
19323	16323	13963	12045	9980	8358	7375	6195	5458	4621	4080	3393	2803	2458	2065	1770	
20305	17153	14673	12658	10488	8783	7750	6510	5735	4856	4288	3565	2945	2583	2170	1860	
21451	18121	15501	13372	11080	9279	8188	6878	6059	5131	4530	3766	3111	2729	2293	1965	
22598	19090	16330	14087	11672	9775	8625	7245	6383	5404	4772	3968	3278	2875	2415	2070	
23580	19920	17040	14700	12180	10200	9000	7560	6660	5640	4980	4140	3420	3000	2520	2160	
24890	21026	17986	15516	12856	10766	9500	7980	7030	5953	5256	4370	3610	3166	2660	2280	
26200	22133	18933	16333	13533	11333	10000	8400	7400	6267	5533	4600	3800	3333	2800	2400	

Time in Seconds To Make One Piece	*Gross Product Per Hour	Gear on A	1st Gear on B	2nd Gear on B	Gear on C	Hundredths of Cam Surface to Feed Stock
12	300	60	50	24	30	16½
14	257	75	70	30	50	14
16	225	60	50	24	40	12½
18	200	80	75	40	55	11
20	180	50	60	40	30	10
22	166	60	50	24	55	9
24	150	75	50	30	60	8½
26	138	60	50	24	65	8
30	120	60	50	24	75	6½
35	102	60	50	30	70	5½
40	90	60	50	30	80	5
45	80	60	50	30	90	4½
50	72	60	40	30	80	4
55	65	60	25	30	55	3½
60	60	50	40	30	80	3
70	51	60	25	30	70	3
80	45	30	50	60	40	3
90	40	60	25	30	90	3
100	36	50	30	40	75	3
110	32	30	50	60	55	3
120	30	50	40	60	80	3
130	27	30	50	60	65	3
140	25	30	50	60	70	3
150	24	30	50	60	75	3
165	21	25	40	55	60	3
180	20	30	50	60	90	3
195	18	25	50	75	65	3
210	17	25	50	75	70	3
225	16	25	40	60	75	3
240	15	25	50	75	80	3
255	14	25	50	75	85	3
270	13	25	50	75	90	3
285	12	25	50	75	95	3
305	11	30	23	60	70	3
325	11	25	30	65	75	3
345	10	25	30	65	80	3
365	9	24	30	70	75	3
385	9	24	30	65	85	3
405	8	23	30	70	80	3
425	8	22	30	70	80	3
450	8	22	30	70	85	3
475	7	25	30	75	95	3
500	7	24	25	75	80	3
530	6	24	25	75	85	3
560	6	24	25	75	90	3
590	6	23	25	75	90	3
620	5	25	23	75	95	3
655	5	23	24	80	90	3
690	5	23	24	80	95	3
720	5	22	24	80	95	3
760	4	22	24	85	95	3
800	4	22	23	85	95	3

Feed Change Gears



Accelerated Speed of Camshaft, One Revolution in 20 Seconds

The "time in seconds" to make one piece is obtained from the formula:

$$50 \times \frac{\text{2nd gear on B}}{\text{gear on A}} \times \frac{\text{gear on C}}{\text{1st gear on B}} = \text{"time in seconds."}$$

Care should be taken to select combinations that will mesh but not interfere.

*Net will vary with factory conditions and the character of the work.

†These combinations not to be used in opposite directions.

PART II

REPAIR PARTS

for

No. 4 AUTOMATIC SCREW MACHINE

For Machines Beginning Serial No. 542-4-176

THE parts are arranged in the illustrations so far as possible in the same relative positions as in the machines. This is to facilitate stripping and assembling as well as identifying the parts.

The parts are shown separated to make the construction of the machines more readily understood and to show each part to best advantage. In some cases, when a particular part is ordered, not only that part but one or more supplementary parts also may be sent when, from our experience, this is known to be advisable for a more satisfactory repair job.

Repair parts, in some cases, will require fitting and therefore may need holes to be drilled, shoulders to be squared or similar machining in order to make them fit properly.

A scale of inches is located at the lower part of each Repair Parts illustration. This scale will be useful in determining the approximate size of the parts illustrated on that particular page.

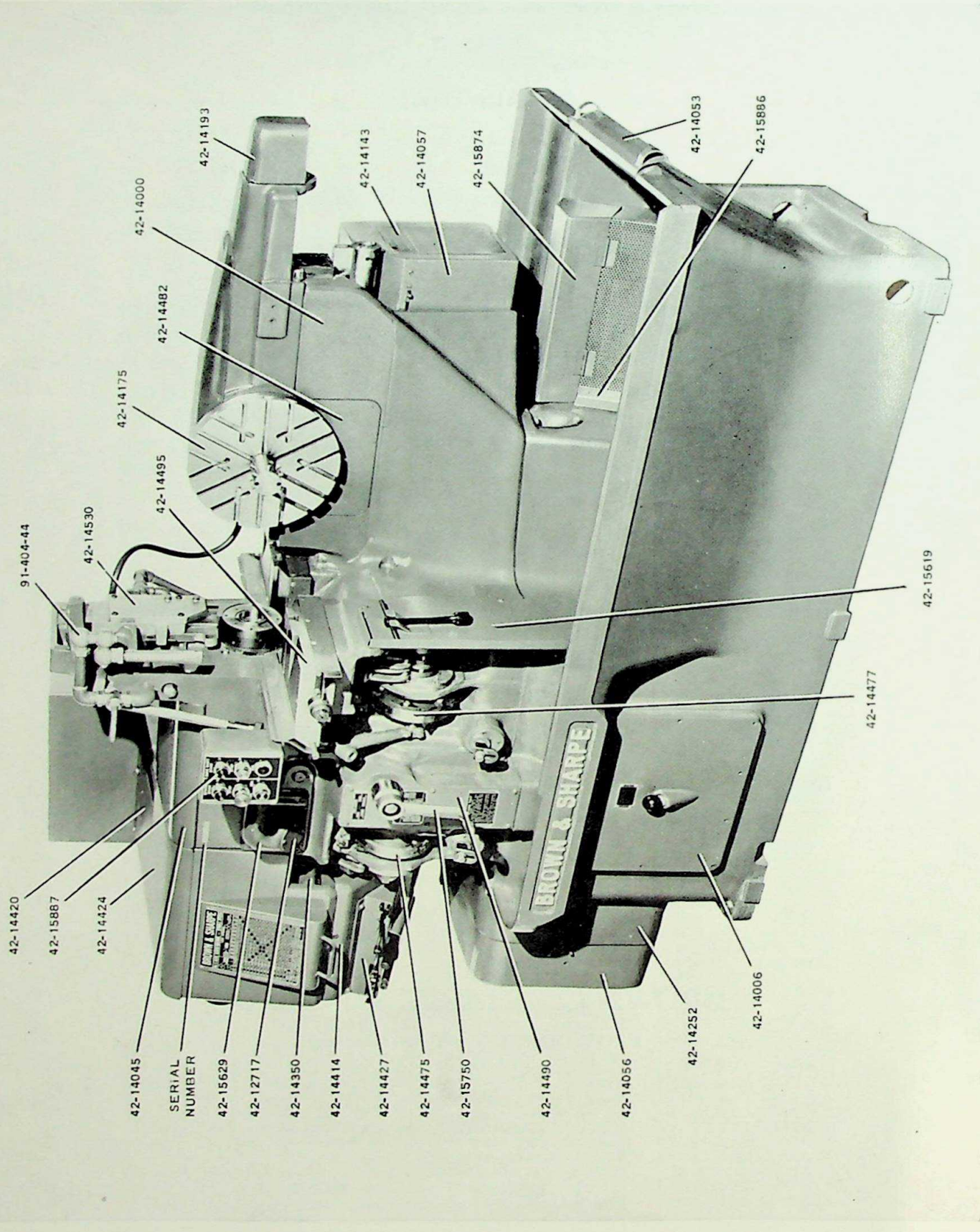
HOW TO ORDER REPAIR PARTS

This information is essential:

1 — Quantity, Part Number and Name

2 — Size, Style and Serial Number of Machine
This will be found on the front or rear of the machine.

BROWN & SHARPE MFG. CO.
PROVIDENCE 1, R. I., U. S. A.


42-14420
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42-14424
42-14045
SERIAL NUMBER
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42-12717
42-14350
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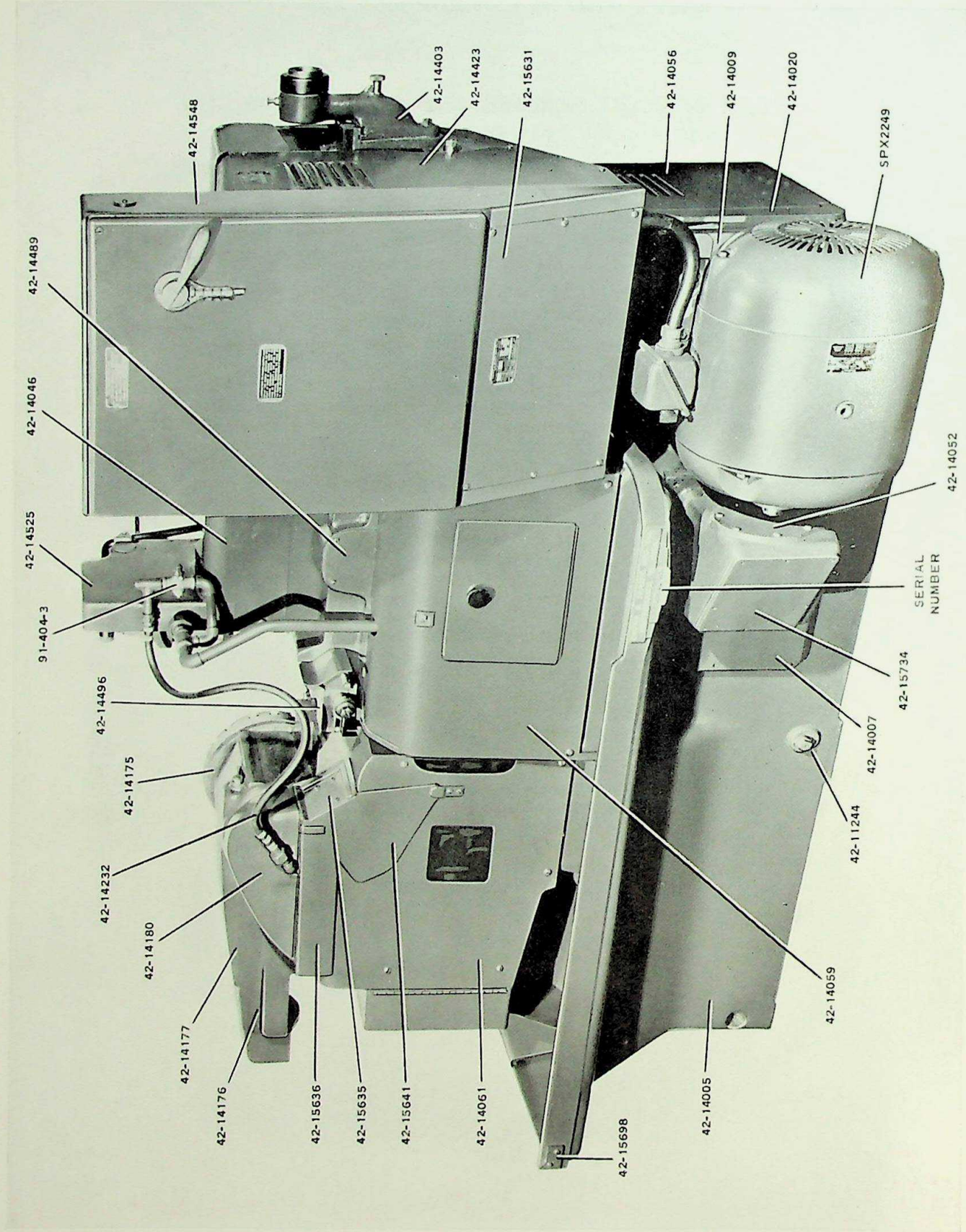
42-15750
42-14490
42-14056
42-14252
42-14006
42-14477
42-15619
91-404-44
42-14530
42-14495
42-14175
42-14482
42-14000
42-14193
42-14143
42-14057
42-15874
42-14053
42-15886
BROWN & SHARPE

Front View

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Front View

42-12717	Receptacle Box Plate
42-14000	Bed
42-14006	Base Cover, Front
42-14045	Spindle Cover
42-14053	Base Plate
42-14056	Spindle Change Gear Cover
42-14057	Feed Change Gear Cover (Includes 42-14143)
42-14143	Feed Change Gear Plate
42-14175	Turret
42-14193	Turret Stop Screw Guard
42-14252	Speed Case
42-14350	Feed Slide Bracket
42-14414	Feed Slide Bracket Guard, Front (Includes 42-14427)
42-14420	Drive Shaft Motor Guard
42-14424	Spindle Guard
42-14427	Wrench Rack
42-14475	Chuck and Reverse Dog Carrier
42-14477	Acceleration and Turret Dog Carrier
42-14482	Bed Hand Hole Cover
42-14490	Worm Wheel Opening Cover
42-14495	Cross Slide, Front
42-14530	Vertical Tool Holder
42-15619	Chip Guard
42-15629	Push Button Bracket
42-15750	Hand Operating Shaft Crank
42-15874	Oil Strainer Guard
42-15886	Oil Strainer Guard Extension
42-15887	Push Button Assembly, Complete
91-404-44	Special Universal Swing Joint


42-14548
42-14403
42-14423
42-15631
42-14056
42-14009
42-14020
SPX2249
42-14489
42-14046
42-14525
91-404-3
42-14496
42-14175
42-14232
42-14180
42-14177
42-14176
42-15636
42-15635
42-15641
42-14061
42-15698
42-14005
42-14059
42-11244
42-14007
42-15734
SERIAL NUMBER
42-14052

Rear View

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

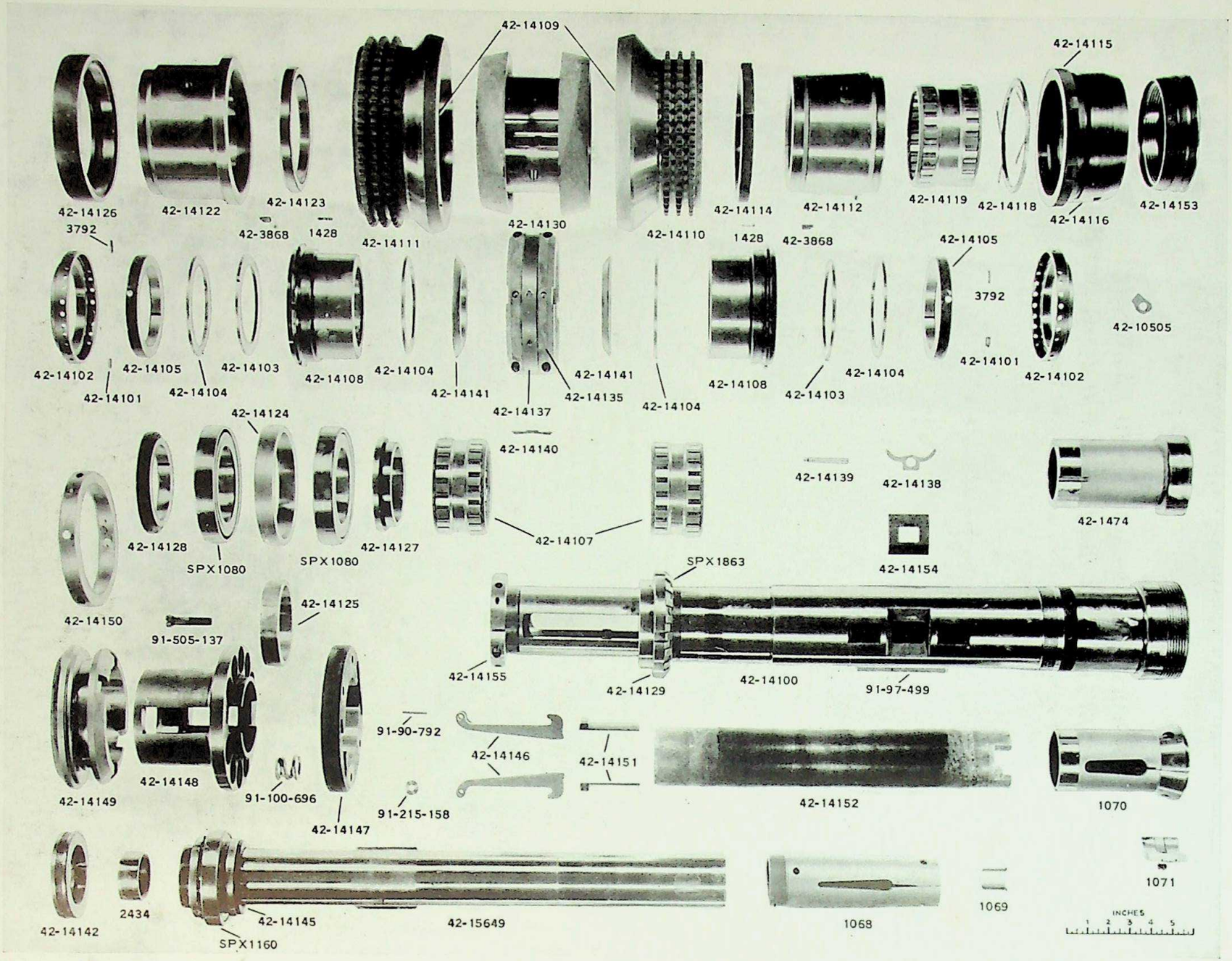
Rear View

42-11244	Tank Table Drain Plug
42-14005	Base
42-14007	Base Cover, Rear
42-14009	Spindle Motor Bracket
42-14020	Spindle Change Gear Cover Bracket
42-14046	Spindle Box Cap Rear Cover
42-14052	Motor Sprocket Oil Guard
42-14056	Spindle Change Gear Cover
42-14059	Back Guard, Left
42-14061	Back Guard, Right
42-14175	Turret
42-14176	Turret Slide
42-14177	Turret Slide Cover
42-14180	Turret Disk Guard, Upper
42-14232	Turret Lubricant Supply Hose
42-14403	Feed Bracket
42-14423	Chain Opening Cover
42-14489	Reversing Lever Cover
42-14496	Cross Slide, Back
42-14525	Vertical Slide Bracket
42-14548	Electrical Control Cabinet
42-15631	Pump Driving Motor Opening Cover
42-15635	Back Cover (Right) Wiper Plate
42-15636	Turret Disk Guard Extension
42-15641	Indexing Mechanism Chip Guard, Large
42-15698	Oil Guard Stop Plate
42-15734	Motor Sprocket Cover
91-404-3	Special Straight Cock Lever Handle
*SPX2249	Main Driving Motor

NOT SHOWN

*SPX2280	Pump and Lubricator Motor
*SPX2912	Driving Shaft Motor

*Give complete motor name plate data.


42-14109
42-14115
42-14126
3792
42-14122
42-14123
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1428
42-14111
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42-14114
1428
42-14112
42-3868
42-14119
42-14118
42-14116
42-14153
42-14105
3792
42-14101
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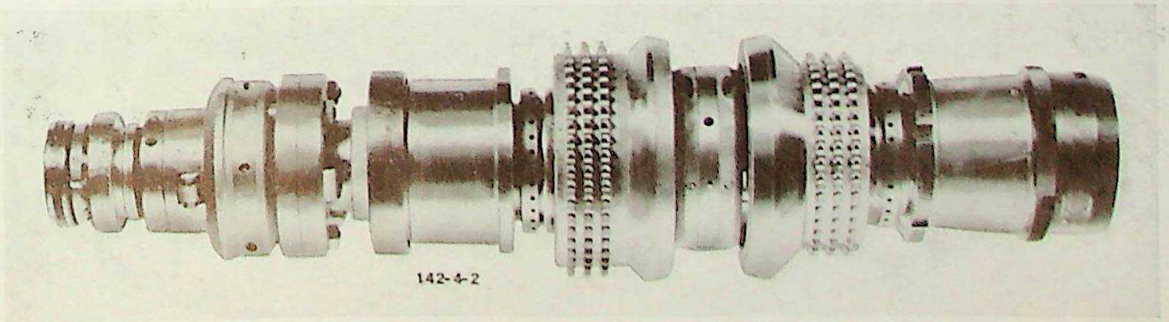
42-14124
42-14140
42-14139
42-14138
42-1474
42-14128
SPX1080
SPX1080
42-14127
42-14107
42-14150
42-14154
SPX1863
42-14125
91-505-137
42-14155
42-14129
42-14100
91-97-499
91-90-792
42-14146
42-14151
42-14149
42-14148
91-100-696
42-14147
91-215-158
42-14152
1070
42-14142
2434
42-14145
42-15649
SPX1160
1068
1069
1071
INCHES
1 2 3 4 5

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.

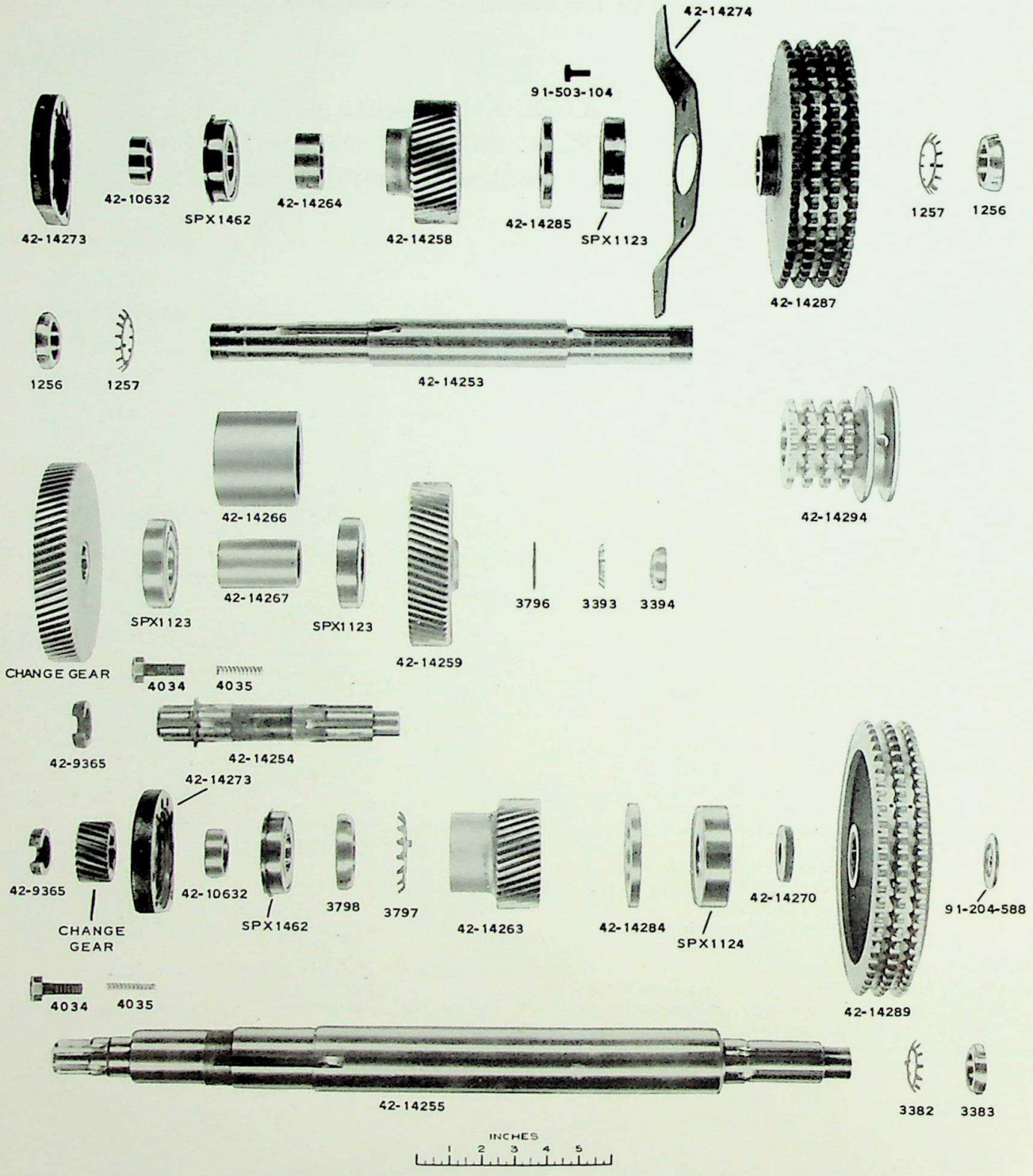
(See instructions "How to order Repair Parts" in this book.)

Spindle Assembly and Parts

1068	Feed Finger (See Brown & Sharpe Catalog)
1069	Feed Finger Pad (See Brown & Sharpe Catalog)
1070	Spring Collet (See Brown & Sharpe Catalog)
1071	Spring Collet Pad (See Brown & Sharpe Catalog)
1428	Spindle Sprocket Plunger Spring
2434	Feed Tube Bushing (See Brown & Sharpe Catalog)
3792	Spindle Sprocket Washer Plunger Spring
42-1474	Chuck Sleeve
42-3868	Spindle Sprocket Plunger
42-10505	Spindle Front Box Nut Lock
42-14100	Spindle (Includes 42-1474, 42-14154 and 91-97-499)
42-14101	Spindle Sprocket Washer Plunger
42-14102	Spindle Sprocket Bushing Thrust Nut
42-14103	Spindle Sprocket Washer
42-14104	Spindle Sprocket Thrust Washer
42-14105	Spindle Sprocket Bushing Washer
42-14107	Spindle Sprocket Roller Bearing
42-14108	Spindle Sprocket Bushing
42-14109	Spindle Sprocket Bronze Bushing
42-14110	Spindle Sprocket, Right (Includes 1428, 42-3868, 42-14108 and 42-14109)
42-14111	Spindle Sprocket, Left (Includes 1428, 42-3868, 42-14108 and 42-14109)
42-14112	Spindle Front Box (Includes 42-14114 and 42-14115)
42-14114	Spindle Front Box Nut, Left
42-14115	Spindle Front Box Nut, Right
42-14116	Spindle Nose Oil Guard
42-14118	Spindle Labyrinth Seal Ring
42-14119	Spindle Front Box Roller Bearing
42-14122	Spindle Rear Box
42-14123	Spindle Rear Box Bearing Retainer
42-14124	Spindle Thrust Bearing Spacer, Large
42-14125	Spindle Thrust Bearing Spacer, Small
42-14126	Spindle Rear Box Nut
42-14127	Spindle Bearing Spacer, Inner
42-14128	Spindle Bearing Spacer, Outer
42-14129	Spindle Thrust Nut
42-14130	Clutch Body, Complete
42-14135	Clutch Sleeve
42-14137	Clutch Sleeve Ring
42-14138	Clutch Lever
42-14139	Clutch Lever Fulcrum
42-14140	Clutch Shoe
42-14141	Clutch Body Washer
42-14142	Feed Tube Nut
42-14144	Feed Tube
42-14145	Feed Tube Washer
42-14146	Chuck Lever (Includes 91-90-792 and 91-215-158)
42-14147	Chuck Lever Fulcrum
42-14148	Chuck Lever Fulcrum Sleeve (Includes 42-14147, 91-100-696 and 91-505-137)
42-14149	Chuck Fork Sleeve
42-14150	Chuck Fork Ring
42-14151	Chuck Lever Fulcrum Shoe
42-14152	Chuck Closing Tube
42-14153	Chuck Nut
42-14154	Clutch Lever Spindle Insert
42-14155	Chuck Adjusting Nut
42-15649	Feed Tube, Complete (Includes 2434, 42-14142, 42-14144, 42-14145 and SPX1160)
91-90-792	Chuck Lever Roll Pin
91-97-499	Clutch Body Key
91-100-696	Chuck Lever Fulcrum Sleeve Spring
91-215-158	Chuck Lever Roll
91-505-137	Chuck Lever Fulcrum Sleeve Screw
142-4-2	Spindle Assembly, Complete
SPX1080	Spindle Rear Box Ball Bearing (Matched Pair)
SPX1160	Feed Tube Ball Bearing
SPX1863	Spindle Rear Box Lockwasher



142-4-2



Spindle Drive

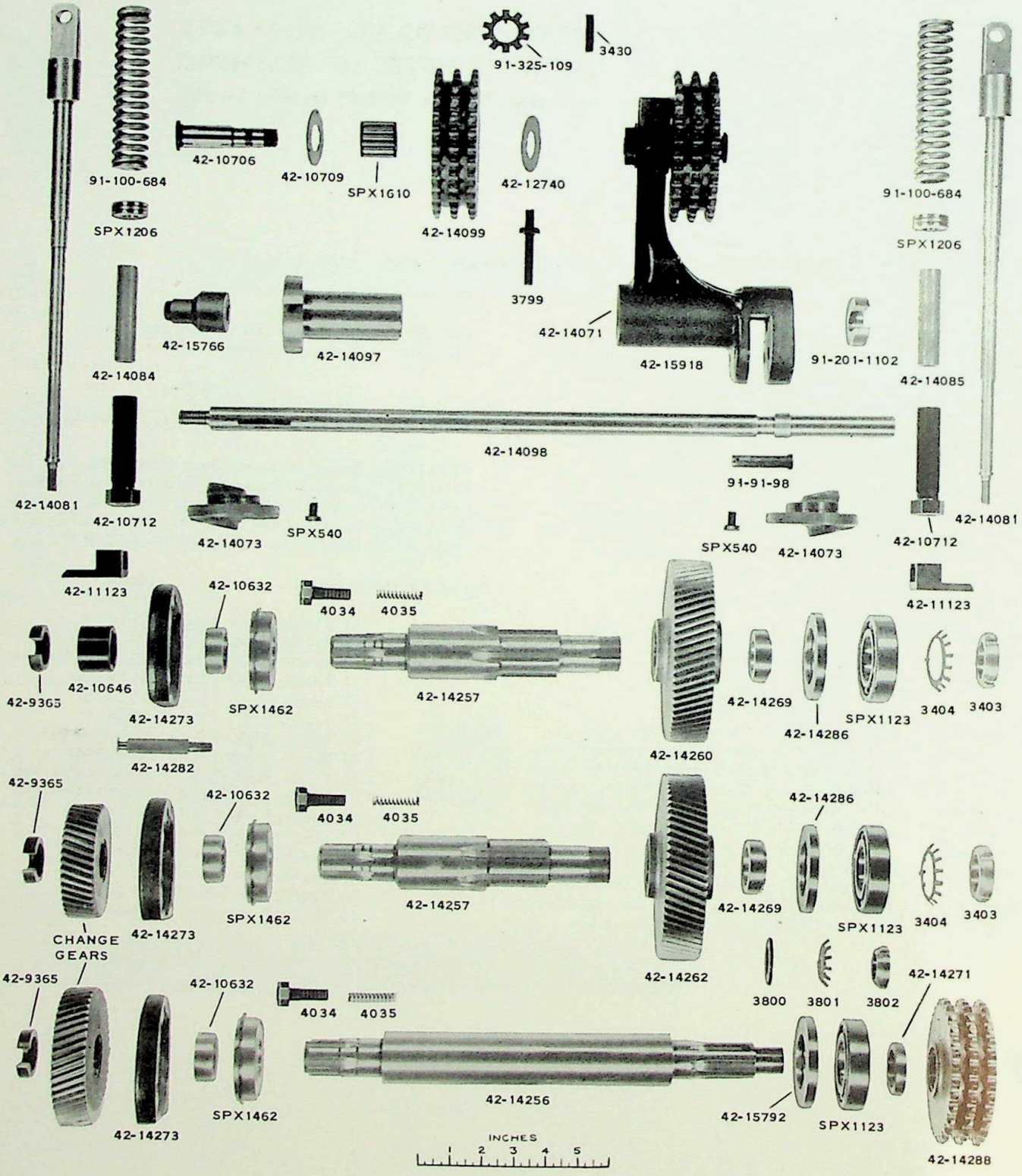
ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Spindle Drive

1256	Intermediate Driving Shaft Nut
1257	Intermediate Driving Shaft Lockwasher
3382	Spindle Driving Shaft Lockwasher
3383	Spindle Driving Shaft Nut
3393	Spindle Change Gear Shaft Lockwasher
3394	Spindle Change Gear Shaft Nut
3796	Spindle Change Gear Shaft Washer
3797	Driving Shaft Intermediate Gear Lockwasher
3798	Driving Shaft Intermediate Gear Nut
4034	Spindle Change Gear Clamp Screw
4035	Change Gear Clamp Screw Spring
42-9365	Spindle Change Gear Washer
42-10632	Spindle Driving Shaft (Fast) Collar
42-14253	Intermediate Driving Shaft
42-14254	Spindle Change Gear Shaft
42-14255	Spindle Driving Shaft, Fast
42-14258	Spindle Driving Gear
42-14259	Spindle Change Gear Shaft Gear
42-14263	Spindle Driving Shaft Intermediate Gear
42-14264	Intermediate Shaft Bearing Spacer, Inner
42-14266	Spindle Change Gear Shaft Spacer, Large
42-14267	Spindle Change Gear Shaft Spacer, Small
42-14270	Spindle Driving Sprocket Spacer, Large
42-14273	Driving Shaft Bearing Retainer
42-14274	Oil Slinger
42-14284	Spindle Driving Shaft (Fast) Bearing Plate
42-14285	Intermediate Driving Shaft Bearing Plate
42-14287	Intermediate Driving Shaft Sprocket
42-14289	Spindle Driving Sprocket, Large
42-14294	Motor Sprocket
91-503-104	Oil Slinger Bolt
91-204-588	Spindle Driving (Large) Sprocket Washer
SPX1123	Intermediate Driving Shaft Ball Bearing
SPX1123	Spindle Change Gear Shaft Ball Bearing
SPX1124	Spindle Driving Shaft (Fast) Ball Bearing
SPX1462	Spindle Driving Shaft (Fast) Ball Bearing
SPX1462	Intermediate Driving Shaft Ball Bearing

Spindle Change Gears

22 Teeth, Right Hand	42-14246
25 Teeth, Right Hand	42-14247
28 Teeth, Right Hand	42-14234
31 Teeth, Right Hand	42-14236
35 Teeth, Right Hand	42-14238
39 Teeth, Right Hand	42-14240
42 Teeth, Right Hand	42-14242
46 Teeth, Right Hand	42-14244
49 Teeth, Left Hand	42-14245
53 Teeth, Left Hand	42-14243
56 Teeth, Left Hand	42-14241
60 Teeth, Left Hand	42-14239
64 Teeth, Left Hand	42-14237
67 Teeth, Left Hand	42-14235
70 Teeth, Left Hand	42-14250
73 Teeth, Left Hand	42-14249



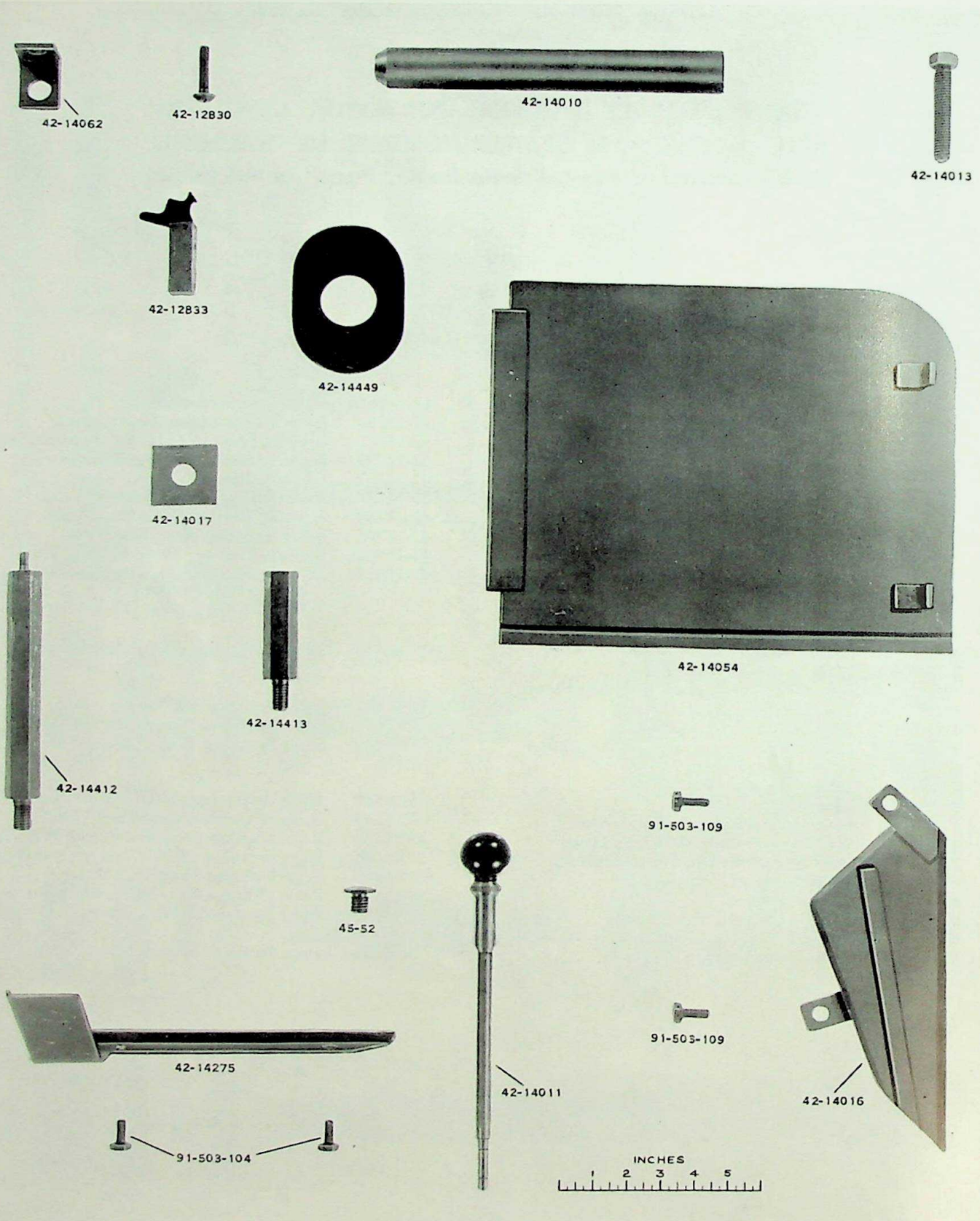
Spindle Drive (cont'd)

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Spindle Drive (cont'd)

3403	Ratio Change Gear Shaft Nut
3404	Ratio Change Gear Shaft Lockwasher
3430	Idler Sprocket Stud Nut
3799	Idler Sprocket Arm Stop
3800	Spindle Driving Shaft (Slow) Washer
3801	Spindle Driving Shaft (Slow) Lockwasher
3802	Spindle Driving Shaft (Slow) Nut
4034	Spindle Change Gear Clamp Screw
4035	Change Gear Clamp Screw Spring
42-9365	Spindle Change Gear Washer
42-10632	Spindle Driving Shaft Collar
42-10646	Ratio Change Gear Collar
42-10706	Idler Sprocket Arm Stud
42-10709	Idler Sprocket Bearing Retainer, Outer
42-10712	Idler Adjustment Rod Screw
42-11123	Idler Adjustment Rod Lock
42-12740	Idler Sprocket Bearing Retainer, Inner
42-14071	Idler Sprocket Arm
42-14073	Idler Adjusting Rod Support
42-14081	Idler Adjusting Rod
42-14084	Idler Adjusting Rod Sleeve, Short
42-14085	Idler Adjusting Rod Sleeve, Long
42-14097	Idler Sprocket Arm Shaft Bushing
42-14098	Idler Sprocket Arm Shaft
42-14099	Idler Sprocket
42-14256	Spindle Driving Shaft, Slow
42-14257	Ratio Change Gear Shaft
42-14260	Ratio Driven Gear
42-14262	Ratio Intermediate Gear
42-14269	Ratio Change Gear Shaft Spacer
42-14271	Spindle Driving Sprocket Spacer, Small
42-14273	Driving Shaft Bearing Retainer
42-14282	Change Gear Oiler
42-14286	Ratio Change Gear Bearing Plate
42-14288	Spindle Driving Sprocket, Small
42-15766	Idler Sprocket Arm Shaft Nut
42-15792	Spindle Driving Shaft Bearing Plate
42-15918	Idler Sprocket Arm, Complete (Includes 3430, 42-10706, 42-10709, 42-12740, 42-14071, 42-14099, 91-325-109 and SPX1610)
91-91-98	Idler Adjusting Rod Fulcrum
91-100-684	Idler Adjustment Spring
91-201-1102	Idler Sprocket Arm Shaft "C" Washer
91-325-109	Idler Sprocket Stud Lockwasher
SPX540	Idler Adjusting Rod Support Screws
SPX1123	Spindle Driving Shaft Ball Bearing
SPX1123	Ratio Change Gear Shaft Ball Bearing
SPX1206	Idler Adjustment Rod Thrust Bearing
SPX1462	Idler Driving Shaft Ball Bearing
SPX1462	Ratio Change Gear Shaft Ball Bearing
SPX1610	Idler Sprocket Roller Bearing

Spindle Change Gears (See page 45)

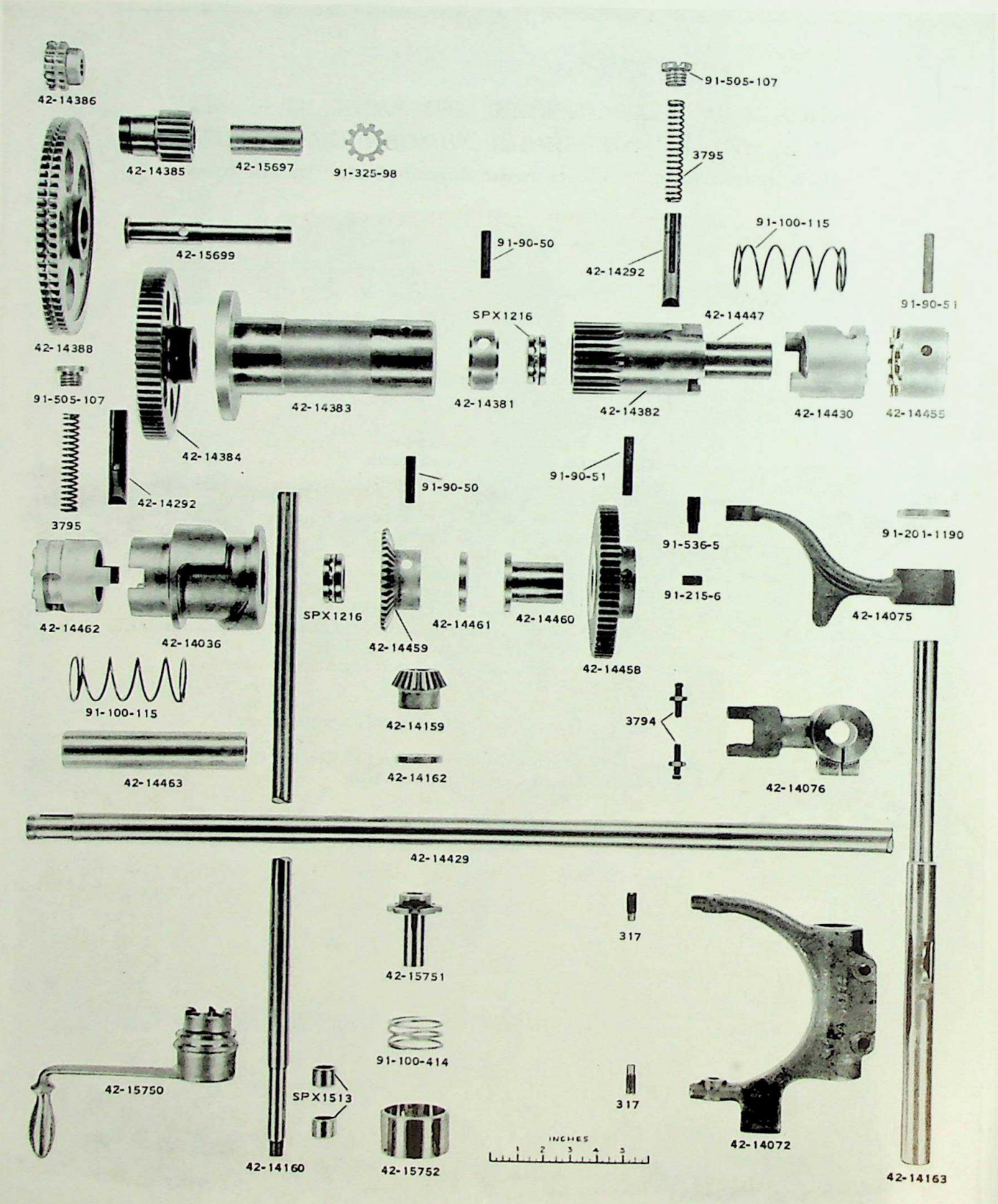


Miscellaneous Base Parts

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Miscellaneous Base Parts

42-12830	Catch Adjusting Screw
42-12833	Change Gear Cover Latch
42-14010	Motor Bracket Fulcrum
42-14011	Oil Gage Rod
42-14013	Worm Case Adjusting Screw
42-14016	Speed Case Oil Trough
42-14017	Bed Shim
42-14054	Base Plate Extension
42-14062	Back Guard Bracket
42-14275	Driving Sprocket Chain Oil Trough
42-14412	Control Cabinet Support Stud, Long
42-14413	Back Guard Support Stud, Short
42-14413	Control Cabinet Support Stud, Short
42-14449	Oil Seal (Leather)
45-52	Driving Clutch Guard Adjustment Screw
91-503-104	Driving Sprocket Chain Oil Trough Bolt
91-503-109	Speed Case Oil Trough Bolt

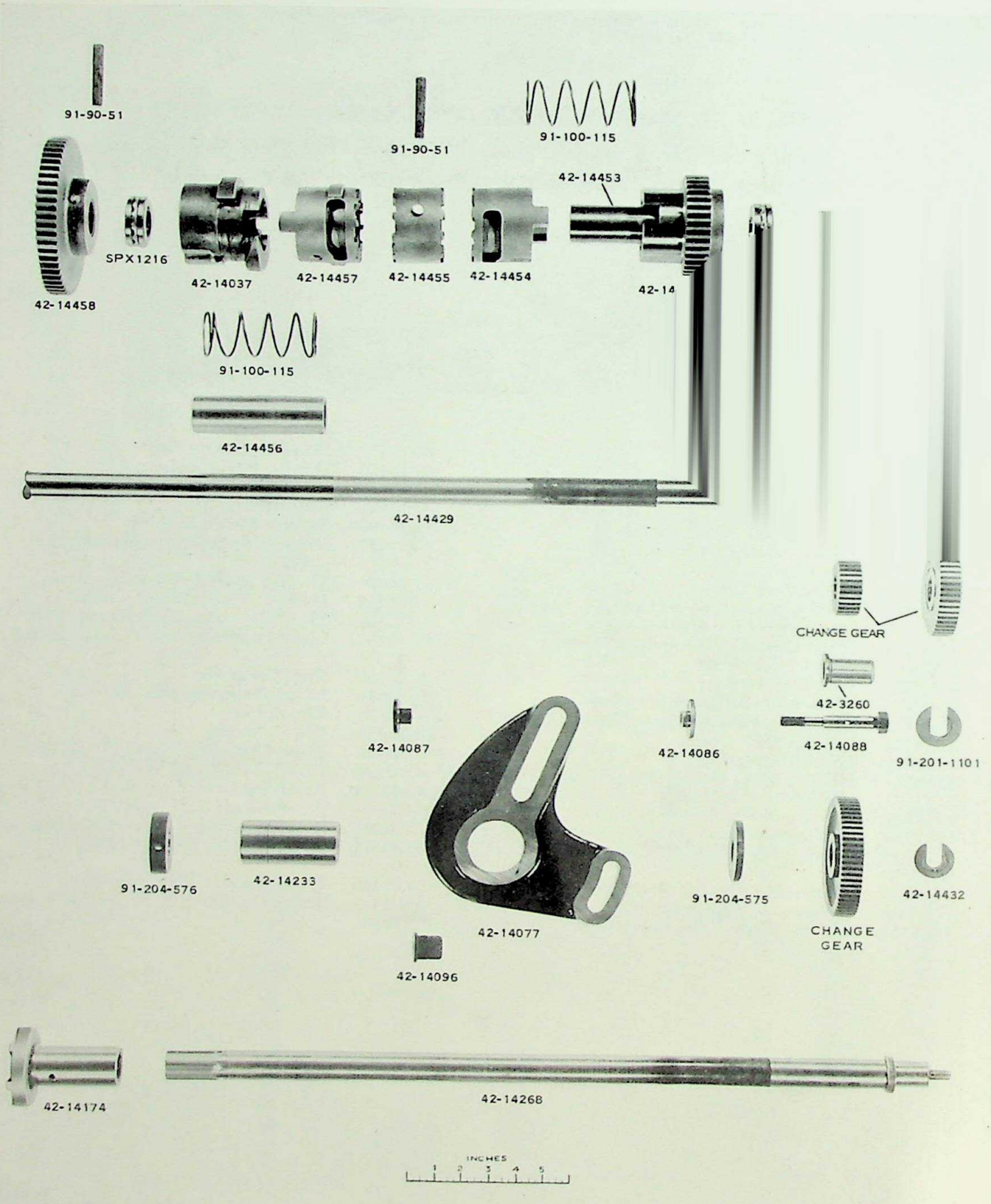


Driving Mechanism, Left Half

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Driving Mechanism, Left Half

317	Clutch Fork Screw
3794	Clutch Fork Lever Screw and Nut
3795	Cam Stop Plunger Spring
42-14036	Reverse Cam (Includes 42-14463)
42-14072	Spindle Clutch Fork (Includes 317)
42-14075	Reversing Lever
42-14076	Clutch Fork Lever
42-14159	Hand Operating Shaft Gear
42-14160	Hand Operating Shaft (Length 27")
42-14162	Hand Operating Shaft Gear Washer
42-14163	Clutch Fork Shaft
42-14292	Cam Stop Plunger
42-14381	Driving Shaft Clutch Stop Collar
42-14382	Chuck Cam Driving Gear (Includes 42-14447)
42-14383	Driving Shaft Sleeve
42-14384	Driving Shaft Gear
42-14385	Driving Shaft Intermediate Pinion (Includes 42-14388 and 42-15697)
42-14386	Driving Shaft Motor Sprocket
42-14388	Driving Shaft Intermediate Sprocket
42-14429	Driving Shaft (Length 71")
42-14430	Chuck Clutch
42-14447	Chuck Cam Driving Gear Bushing
42-14455	Reverse and Chuck Clutch
42-14458	Driving Shaft Acceleration Gear
42-14459	Hand Operating Gear
42-14460	Driving Shaft Bushing, Left
42-14461	Hand Operating Shaft Thrust Washer
42-14462	Reverse Clutch
42-14463	Reverse Clutch Bushing
42-15697	Driving Shaft Intermediate Pinion Bushing
42-15699	Driving Shaft Intermediate Stud
42-15750	Hand Operating Shaft Crank
42-15751	Hand Operating Shaft Crank Clutch
42-15752	Hand Operating Shaft Clutch Sleeve
91-90-50	Stop Collar Pin
91-90-50	Hand Operating Gear Pin
91-90-51	Clutch Pin
91-100-115	Clutch Spring
91-100-414	Hand Operating Crank Clutch Spring
91-201-1190	Clutch Fork Shaft Washer
91-215-6	Reversing Lever Cam Roll
91-325-98	Intermediate Stud Lockwasher
91-505-107	Cam Stop Plunger Spring Retainer
91-536-5	Reverse Lever Cam Roll Screw
SPX1216	Driving Shaft Thrust Bearing
SPX1513	Hand Operating Shaft Needle Bearing



Driving Mechanism, Right Half

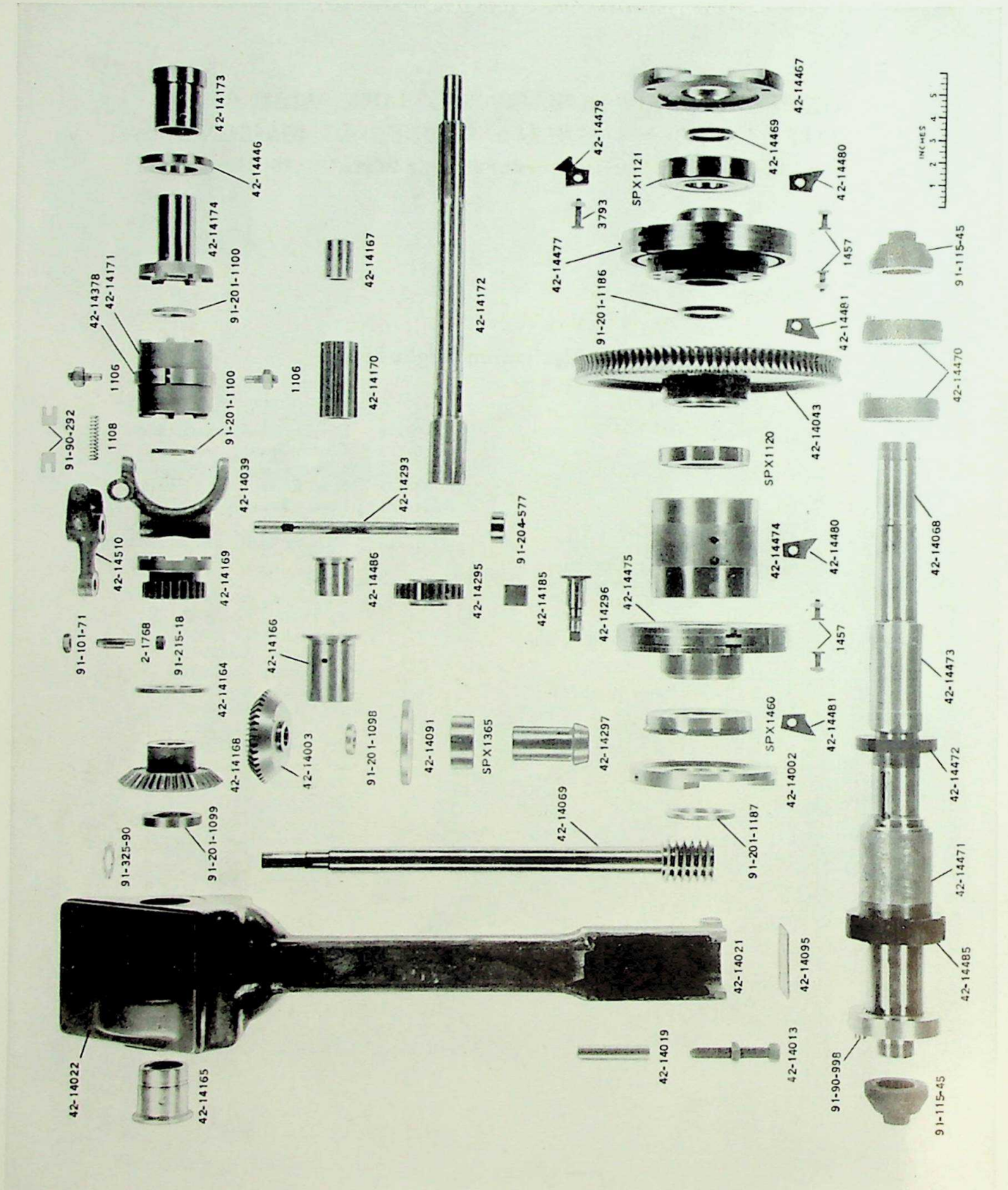
ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Driving Mechanism, Right Half

42-3260	Change Gear Bushing
42-14037	Acceleration Cam (Includes 42-14456)
42-14077	Change Gear Arm
42-14086	Change Gear Stud Collar
42-14087	Change Gear Stud Nut
42-14088	Change Gear Stud
42-14096	Change Gear Arm Clamping Insert
42-14161	Driving Shaft Bushing, Center
42-14174	Feed Change Gear Shaft Clutch (Includes 42-14167, see Page 49)
42-14233	Feed Change Gear Shaft Bushing, Right
42-14268	Feed Change Gear Shaft
42-14429	Driving Shaft (Length 71")
42-14431	Driving Shaft Change Gear Washer
42-14432	Change Gear "C" Washer
42-14433	Driving Shaft Bushing, Right
42-14452	Driving Shaft Turret Gear (Includes 42-14453)
42-14453	Driving Shaft Turret Gear Bushing
42-14454	Turret Clutch
42-14455	Turret and Accelerator Clutch
42-14456	Accelerator Clutch Bushing
42-14457	Accelerator Clutch
42-14458	Driving Shaft Acceleration Gear
91-90-51	Clutch Pin
91-90-51	Driving Shaft Acceleration Gear Pin
91-100-115	Clutch Spring
91-201-1101	Change Gear Stud Washer
91-204-575	Feed Change Gear Shaft Washer
91-204-576	Feed Change Gear Shaft Collar
SPX1216	Driving Shaft Thrust Bearing

Change Gear, Feed

22 Teeth	42-15046
23 Teeth	42-15047
24 Teeth	42-15048
25 Teeth	42-15049
30 Teeth	42-15050
40 Teeth	42-15051
50 Teeth	42-15052
55 Teeth	42-15053
60 Teeth	42-15054
65 Teeth	42-15055
70 Teeth	42-15056
75 Teeth	42-15057
80 Teeth	42-15058
85 Teeth	42-15059
90 Teeth	42-15060
95 Teeth	42-15061

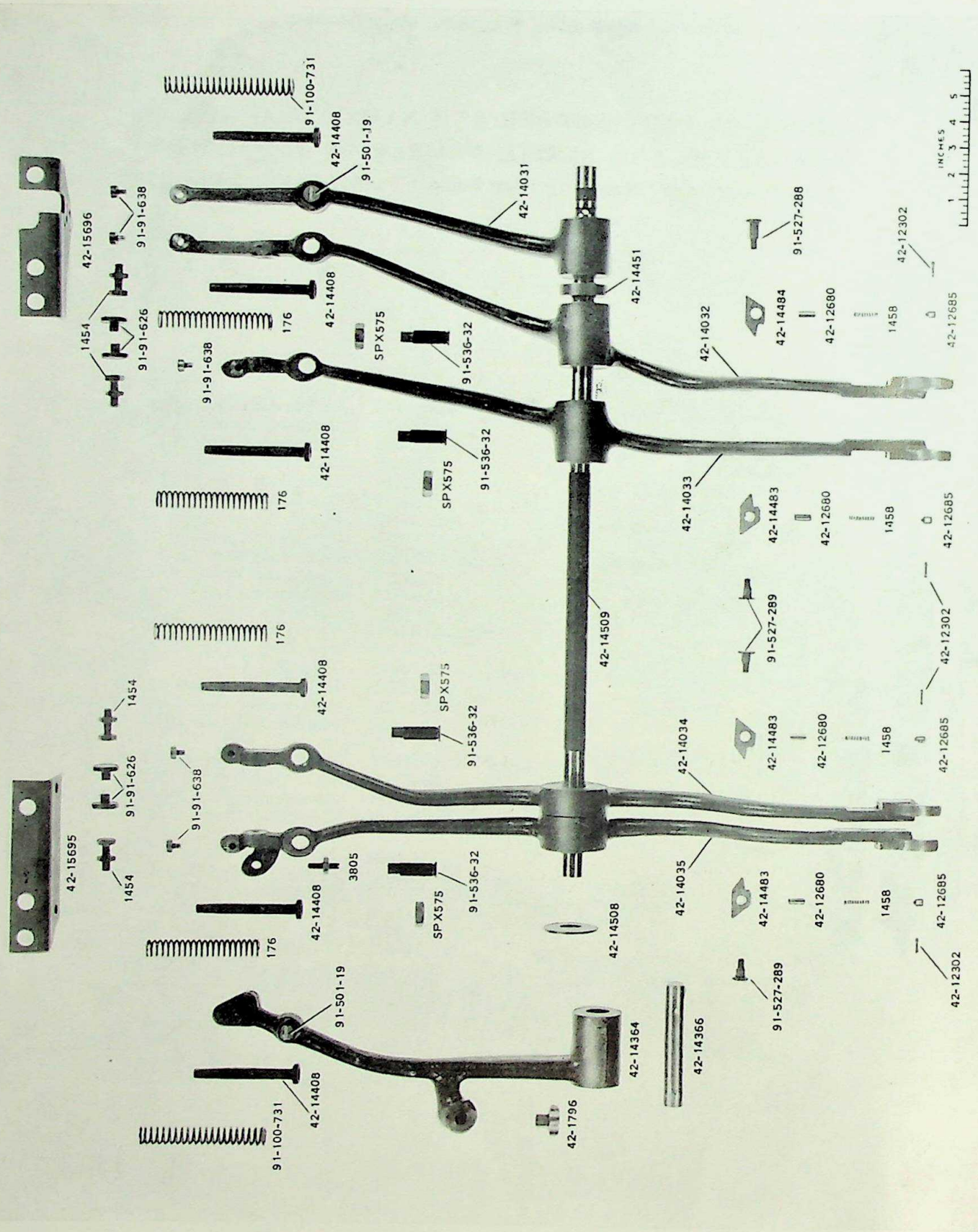


Timing Mechanism

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Timing Mechanism

1106	Acceleration and Clutch Fork Screw and Nut
1108	Acceleration and Clutch Fork Spring
1457	Trip Dog Bolt and Nut
3793	Turret Trip Dog Bolt and Nut
2-1768	Feed Drive Clutch Fork Eccentric Screw
42-14002	Cam Shaft Bearing Retainer
42-14003	Worm Shaft Gear
42-14013	Worm Case Adjusting Screw
42-14019	Worm Adjusting Plunger Pin
42-14021	Worm Shaft Bearing (Includes 42-14022)
42-14022	Worm Mitre Gear Cover
42-14039	Acceleration and Change Gear Clutch Fork
42-14043	Worm Wheel
42-14068	Cam Shaft (Includes 91-90-993)
42-14069	Worm Shaft
42-14091	Worm Shaft Ball Bearing Retainer
42-14095	Worm Shaft Bearing End Plate
42-14164	Worm Shaft Bearing Spacer
42-14165	Worm Driving Gear Shaft Bushing, Left
42-14166	Worm Driving Gear Shaft Bushing, Center
42-14167	Worm Driving Gear Shaft Bushing, Right
42-14168	Worm Driving Gear
42-14169	Acceleration Gear Clutch (Includes 42-14486)
42-14170	Worm Driving Gear Shaft Sleeve
42-14171	Worm Driving Gear Shaft Clutch
42-14172	Worm Driving Gear Shaft
42-14173	Feed Change Gear Shaft Bushing, Left
42-14174	Feed Change Gear Shaft Clutch (Includes 42-14167)
42-14185	Accelerator Intermediate Gear Bushing
42-14293	Accelerating Cam Lever Fulcrum
42-14295	Accelerator Intermediate Gear (Includes 42-14185)
42-14296	Acceleration Intermediate Gear Stud
42-14297	Worm Shaft Bearing Bushing
42-14378	Acceleration Clutch Fork Ring
42-14446	Change Gear Shaft Clutch Washer
42-14467	Cam Shaft Bearing Cap
42-14469	Cam Holder Spacer
42-14470	Cross Slide Cam Holder
42-14471	Cam Shaft Bearing Spacer
42-14472	Worm Wheel Adjusting Nut
42-14473	Cam Shaft Sleeve
42-14474	Cam Shaft Bearing Housing
42-14475	Chuck and Reverse Dog Carrier
42-14477	Accelerating and Turret Dog Carrier (Includes 91-201-1186)
42-14479	Turret Trip Dog, High
42-14480	Trip Dog, Right
42-14481	Trip Dog, Left
42-14485	Dog Carrier Adjusting Nut
42-14486	Acceleration Gear Clutch Bushing
42-14510	Acceleration Cam Lever
91-90-292	Acceleration Spring Plunger
91-90-998	Lead Cam Driving Pin
91-101-71	Acceleration Cam Lever Eccentric Nut
91-115-45	Cam Shaft Nut
91-201-1098	Worm Shaft Gear Fitting Washer
91-201-1099	Worm Driving Gear Thrust Washer
91-201-1100	Worm Driving Gear Shaft Washer
91-201-1186	Cross Slide Cam Aligning Washer
91-201-1187	Lead Cam Aligning Washer
91-204-577	Acceleration Clutch Fork Spacer
91-215-18	Acceleration Lever Cam Roll
91-325-90	Worm Shaft Nut Lockwasher
SPX1120	Cam Shaft Ball Bearing, Center
SPX1121	Cam Shaft Ball Bearing, Right
SPX1365	Worm Shaft Ball Bearing
SPX1460	Cam Shaft Ball Bearing, Left

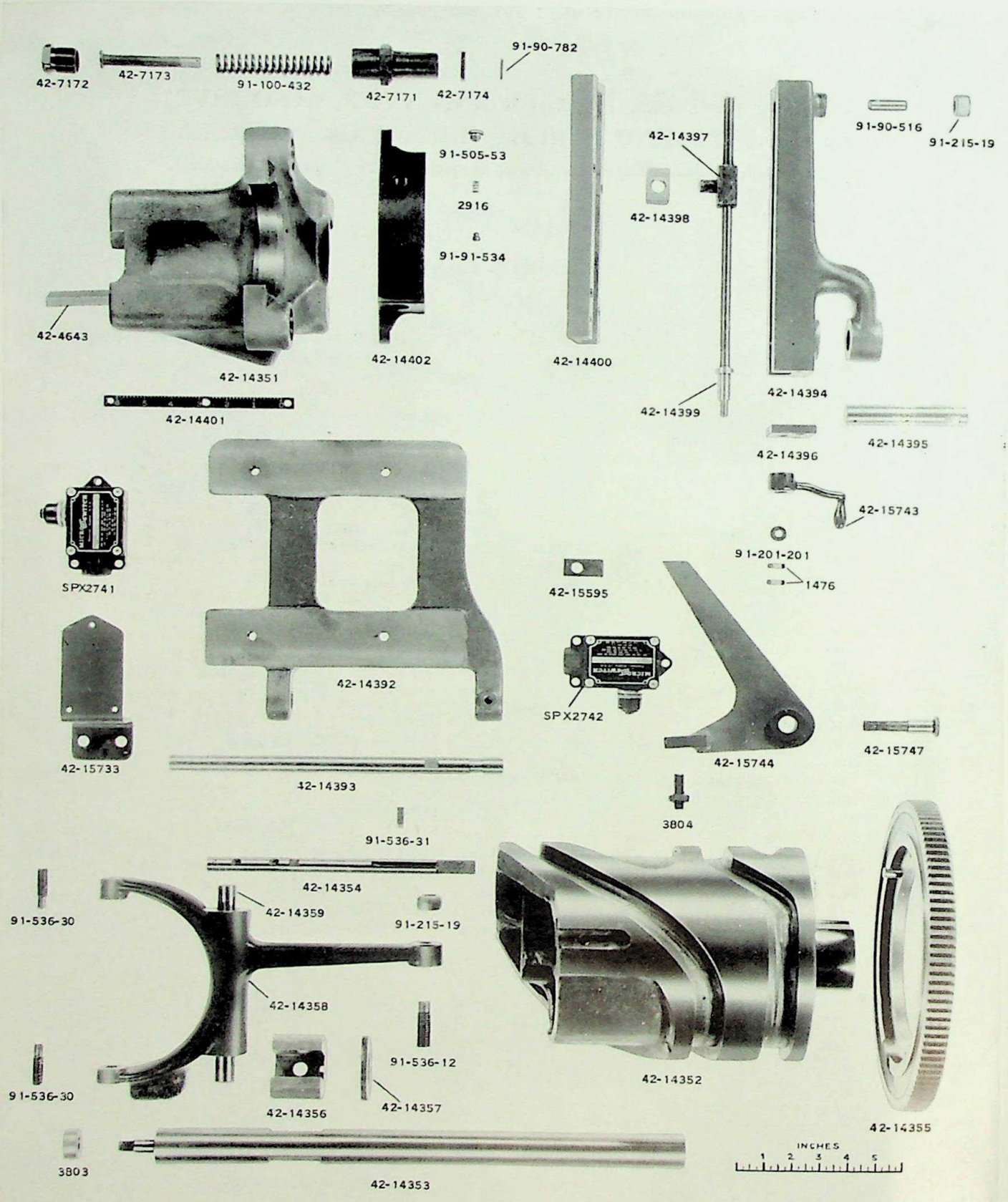


Clutch Trip Levers

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Clutch Trip Levers

176	Trip Lever Springs, Reverse, Speed and Chuck Clutch
1454	Trip Lever Screw and Nut, Reverse, Speed and Chuck Clutch
1458	Trip Lever Dog Spring
3805	Trip Lever Adjusting Screw and Nut
42-1796	Chuck Clutch Stop Lever Shoe
42-12302	Spring Retainer Pin
42-12680	Trip Lever Dog Spring Plunger
42-12685	Trip Lever Dog Spring Retainer
42-14031	Turret Clutch Stop Lever (Includes 91-91-638 and 91-501-19)
42-14032	Turret Clutch Trip Lever (Includes 1454, 1458, 42-12302, 42-12680, 42-12685, 42-14484, 91-91-638, 91-527-288, 91-536-32 and SPX575
42-14033	Acceleration Clutch Trip Lever (Includes 1454, 1458, 42-12302, 42-12680, 42-12685, 42-14483, 91-91-638, 91-527-289, 91-536-32 and SPX575)
42-14034	Reverse Clutch Trip Lever (Includes 1454, 1458, 42-12302, 42-12680, 42-12685, 42-14483, 91-91-638, 91-527-289, 91-536-32 and SPX575)
42-14035	Chuck Clutch Trip Lever (Includes 1454, 1458, 3805, 42-12302, 42-12680, 42-12685, 42-14483, 91-91-638, 91-527-289, 91-536-32 and SPX575)
42-14364	Chuck Clutch Stop Lever (Includes 42-1796 and 91-501-19)
42-14366	Chuck Clutch Stop Lever Fulcrum
42-14408	Clutch and Stop Lever Spring Plunger
42-14451	Turret Clutch Stop Lever Spacer
42-14483	Clutch Trip Lever Dog
42-14484	Turret Clutch Trip Lever Dog
42-14508	Chuck Clutch Trip Lever Spacer
42-14509	Clutch Lever Fulcrum
42-15695	Spring Plunger Support, Reverse and Chuck Levers
42-15696	Spring Plunger Support, Turret and Accelerating Levers
91-91-626	Trip Lever Abutment Plug
91-91-638	Stop and Trip Lever Pin
91-100-731	Clutch and Stop Lever Plunger Spring
91-501-19	Clutch Stop Adjusting Screw
91-527-288	Trip Lever Dog Stud, Long
91-527-289	Trip Lever Dog Stud, Short
91-536-32	Clutch Follower Screw
SPX575	Clutch Follower Screw Nut



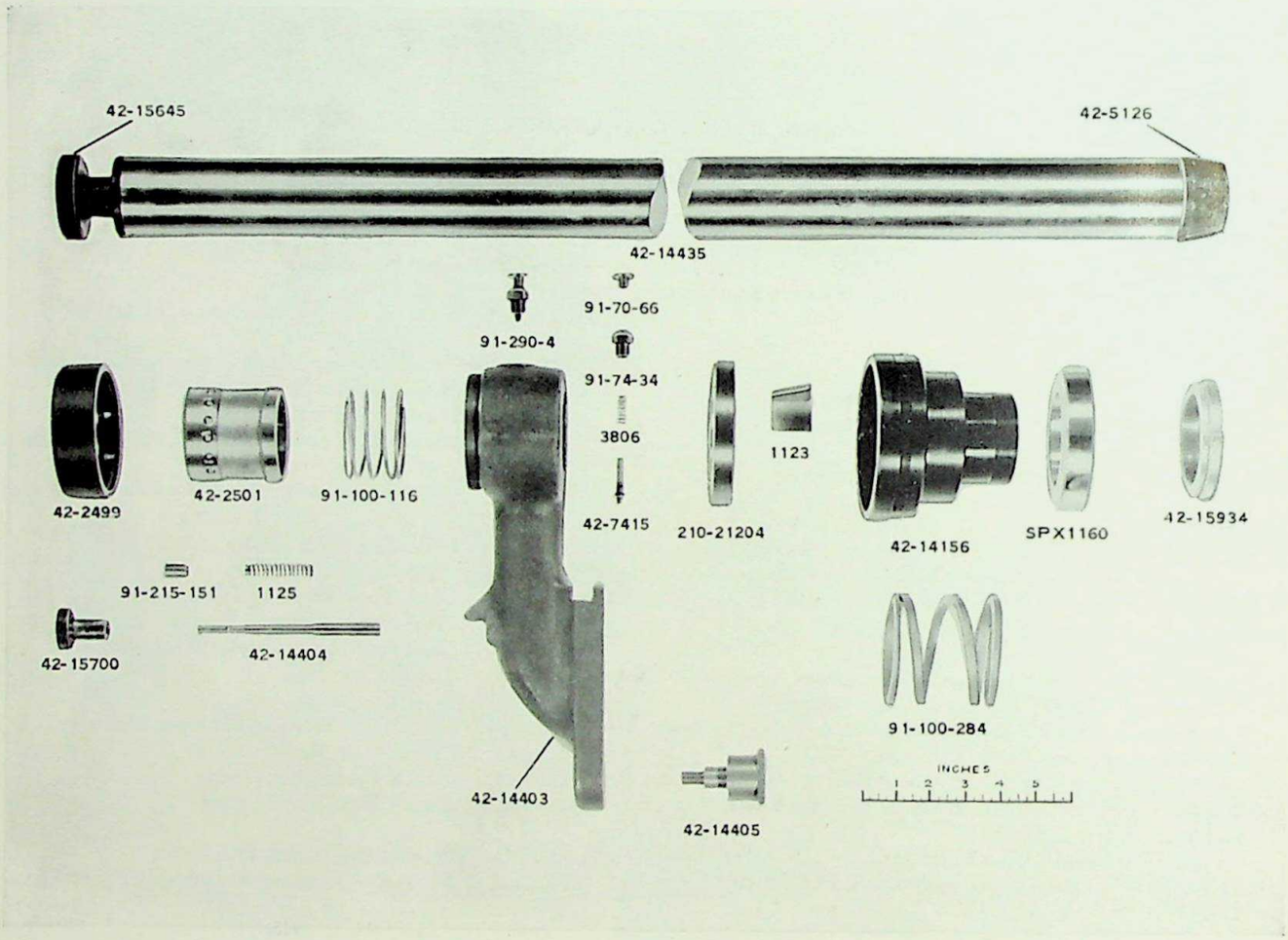
Chuck and Feed Operating Parts

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Chuck and Feed Operating Parts

1476	Feed Adjusting Screw Nuts
2916	Feed Tube Bearing Plunger Spring
3803	Chuck Cam Shaft Washer
*3804	Second Operation Switch Lever Screw and Nut
42-4643	Feed Slide Gib
42-7171	Feed Latch Plunger Sleeve
42-7172	Feed Latch Plunger Sleeve Nut
42-7173	Feed Latch Plunger
42-7174	Feed Latch Plunger Washer
42-14351	Feed Slide
42-14352	Chuck and Feed Cam (Includes 42-14354, 42-14355 and 91-536-31)
42-14353	Chuck Cam Shaft (Includes 3803)
42-14354	Chuck and Feed Cam Rod
42-14355	Chuck and Feed Cam Gear
42-14356	Chuck and Feed Cam Spacer
42-14357	Chuck and Feed Cam Washer
42-14358	Chuck Fork (Includes 91-536-12 and 91-536-30)
42-14359	Chuck Fork Fulcrum
42-14392	Driving Shaft Motor Bracket
42-14393	Driving Shaft Motor Bracket Pivot
42-14394	Feed Lever
42-14395	Feed Lever Fulcrum
42-14396	Feed Adjusting Screw Cap
42-14397	Feed Adjusting Screw Nut
42-14398	Feed Lever Block
42-14399	Feed Adjusting Screw
42-14400	Feed Nut Slide
42-14401	Feed Scale
42-14402	Feed Latch (Includes 2916, 91-91-534 and 91-505-53)
*42-15595	Cam Stopping Block (Second Operation Work)
42-15733	Stock Loader Safety Switch Bracket
42-15743	Feed Adjusting Crank
*42-15744	Second Operation Switch Lever (Includes 3804)
*42-15747	Second Operation Switch Lever Stud
91-90-516	Feed Cam Roll Stud
91-90-782	Feed Latch Shear Pin
91-91-534	Feed Tube Bearing Plunger
91-100-432	Feed Latch Plunger Spring
91-201-201	Feed Adjusting Crank Washer
91-215-19	Chuck Cam Roll
91-215-19	Feed Cam Roll
91-505-53	Feed Tube Bearing Plunger Screw
91-536-12	Chuck Cam Roll Stud
91-536-30	Chuck Fork Ring Screw
91-536-31	Chuck Feed Cam Screw
SPX2741	Stock Loader Safety Switch
*SPX2742	Second Operation Switch

*Extra Equipment.

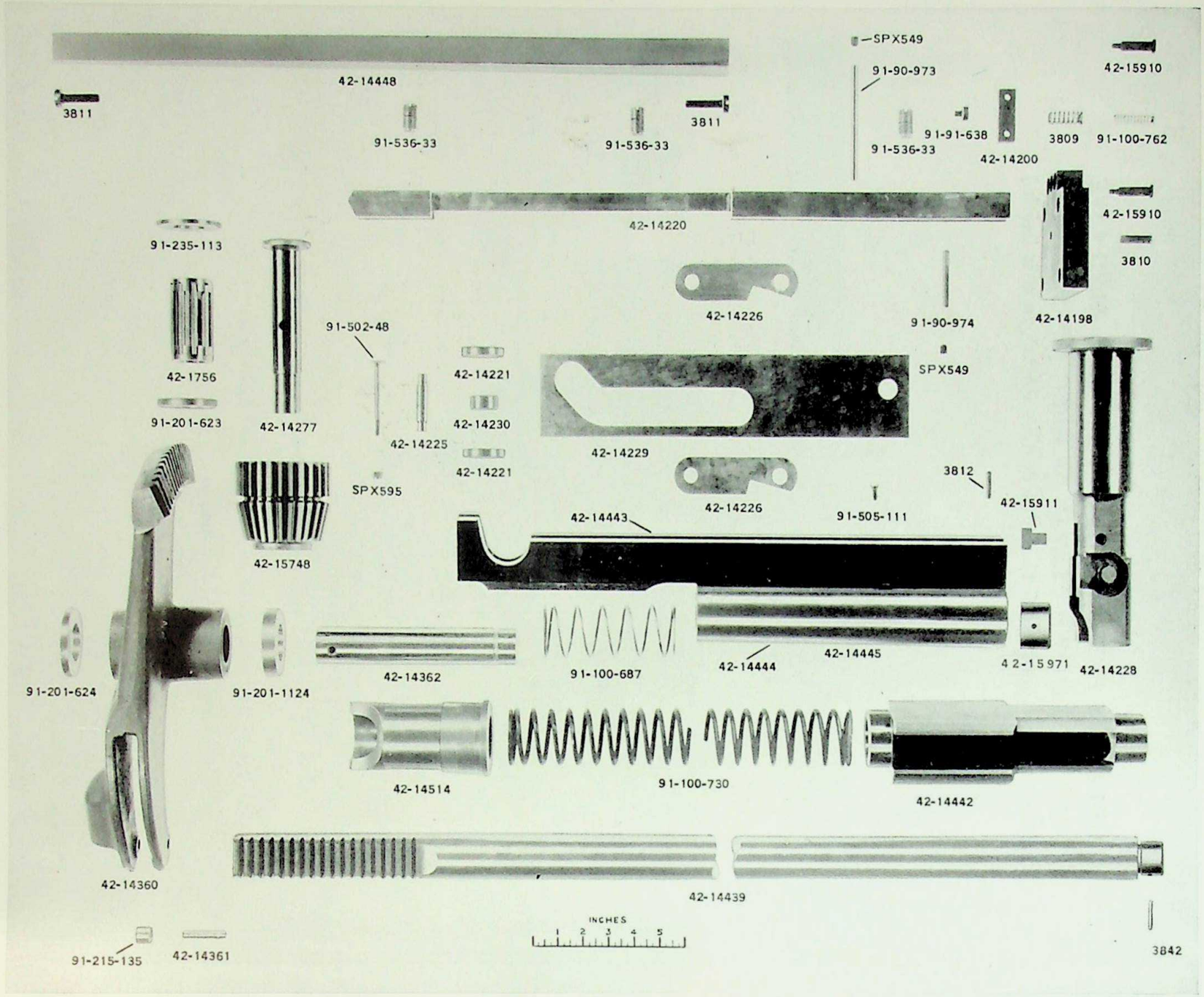


Outside Feeding Mechanism

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Outside Feeding Mechanism

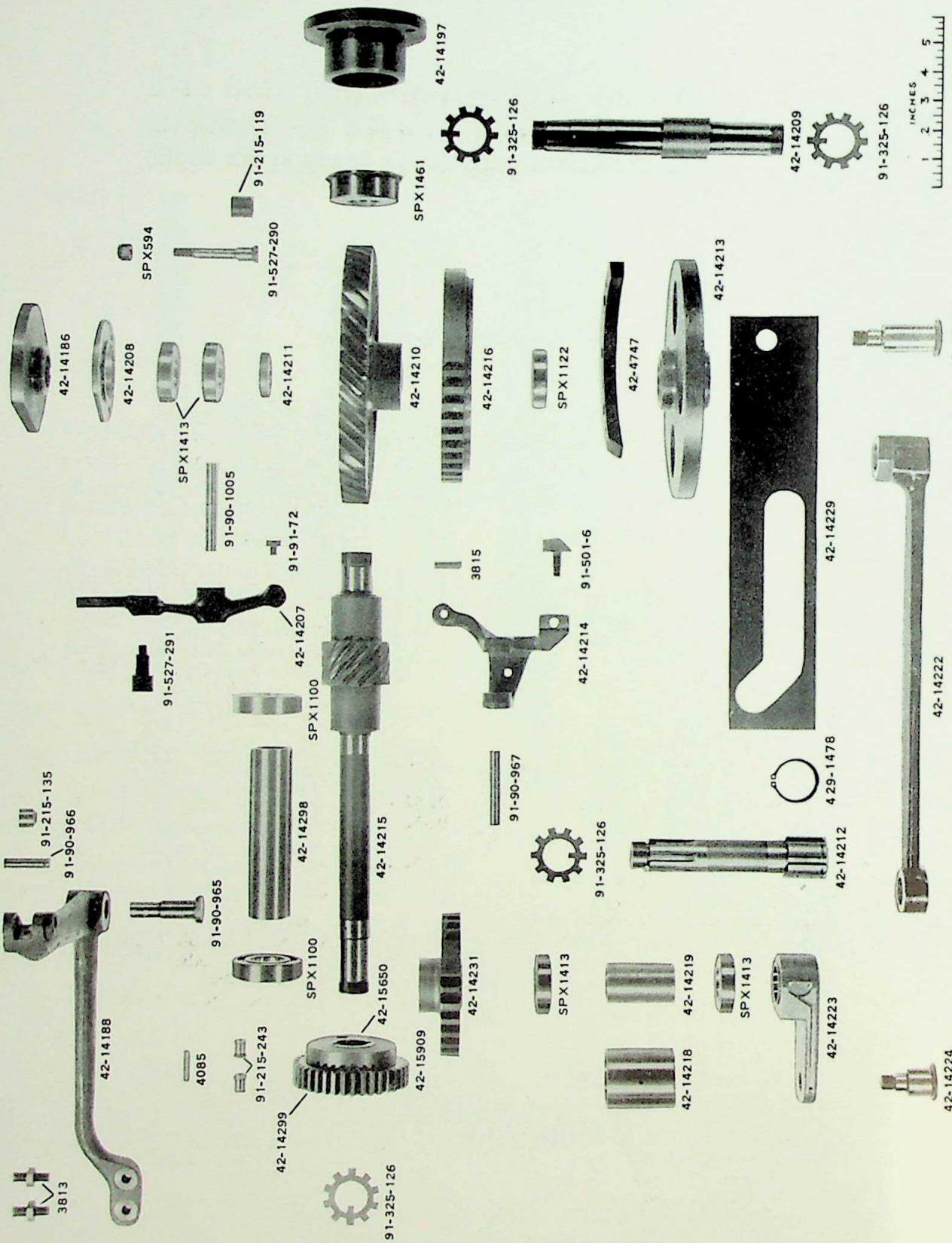
1123	Outside Master Feed Finger Pad (See Brown & Sharpe Catalog)
1125	Feed Bracket Locking Pin Spring
3806	Feed Bracket Plunger Spring
42-2499	Ball Thrust Nut
42-2501	Feed Ball Retainer
42-5126	Feed Rod End
42-7415	Feed Bracket Plunger
42-14156	Outside Master Feed Finger Body (Includes 1123, 42-15934, 91-100-284, 210-21204 and SPX1160)
42-14403	Feed Bracket (Includes 42-2499, 42-2501, 91-100-116, 91-215-151 and 91-290-4)
42-14404	Feed Bracket Locking Pin
42-14405	Feed Bracket Pivot Stud
42-14435	Feed Rod (Length 49"; Includes 42-5126 and 42-15645)
42-15645	Feed Rod Knob
42-15700	Feed Bracket Locking Pin Knob
42-15934	Feed Finger Body Locknut
91-70-66	Feed Latch Knob
91-74-34	Feed Latch Plunger Body
91-100-116	Feed Ball Retainer Spring
91-100-284	Pad Spring
91-215-151	Feed Bracket Bushing
91-290-4	Feed Bracket Plunger, Complete (Includes 3806, 42-7415, 91-70-66 and 91-74-34)
210-21204	Outside Master Feed Finger Adjusting Nut
SPX1160	Feed Rod Ball Bearing


42-14448
3811
3811
91-536-33
91-536-33
SPX549
91-90-973
42-15910
91-536-33
91-91-638
3809
91-100-762
42-14200
42-14220
42-15910
3810
91-235-113
42-14226
91-90-974
42-14198
42-1756
91-502-48
42-14221
SPX549
91-201-623
42-14277
42-14230
42-14225
42-14229
42-14221
SPX595
42-14226
91-505-111
3812
42-15911
42-15748
42-14443
42-14362
91-100-687
42-14444
42-14445
42-15971
42-14228
91-201-624
91-201-1124
42-14514
91-100-730
42-14442
42-14360
42-14439
INCHES
1 2 3 4 5
91-215-135
42-14361
3842

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Turret Operating Parts

3809	Turret Slide Cushion Block Spring, Outer
3810	Turret Slide Stop Plate Screw
3811	Turret Slide Gib Screw
3812	Turret Slide Operating Shaft Collar Pin
3842	Turret Slide Operating Shaft Shearing Pin
42-1756	Turret Driving Gear Roller Bearing
42-14198	Turret Slide Stop Plate
42-14200	Turret Slide Cushion Block
42-14220	Turret Slide Return Bar Guide
42-14221	Turret Slide Return Bar Roll
42-14225	Turret Slide Latch Sleeve
42-14226	Turret Slide Latch
42-14228	Turret Slide Index Post
42-14229	Turret Slide Return Bar
42-14230	Turret Slide Return Bar Roller
42-14277	Turret Driving Gear Stud
42-14360	Lead Lever (Includes 42-14361 and 91-215-135)
42-14361	Lead Lever Roll Pin
42-14362	Lead Lever Fulcrum
42-14439	Turret Slide Operating Shaft (Length 55 13/16") (Includes 3842 and 42-15971)
42-14442	Turret Slide Operating Shaft Sleeve
42-14443	Turret Slide Feed Bar
42-14444	Turret Slide Operating Shaft Collar
42-14445	Turret Slide Feed Bar, Complete (Includes 42-14443, 42-14444 and 91-505-111)
42-14448	Turret Slide Gib
42-14514	Turret Slide Operating Shaft Bushing, Left
42-15748	Turret Driving Gear
42-15910	Turret Slide Cushion Block Screw
42-15911	Turret Slide Index Post Elbow
42-15971	Shearing Pin Collar
91-90-973	Return Bar Guide Aligning Pin, Long
91-90-974	Return Bar Guide Aligning Pin, Short
91-91-638	Turret Slide Pin
91-100-687	Operating Shaft Collar Spring
91-100-730	Turret Slide Operating Shaft Spring (Length 48")
91-100-762	Turret Slide Cushion Spring, Inner
91-201-623	Turret Driving Gear Washer
91-201-624	Lead Lever Washer
91-201-1124	Lead Lever Thrust Washer
91-215-135	Lead Lever Roll
91-235-113	Turret Driving Gear Thrust Washer
91-502-48	Turret Slide Latch Bolt
91-505-111	Turret Slide Feed Bar Screw
91-536-33	Return Bar Guide Adjusting Screw
SPX549	Aligning Pin Set Screw
SPX595	Turret Slide Bolt Latch Stop Nut



Turret Operating Parts (cont'd)

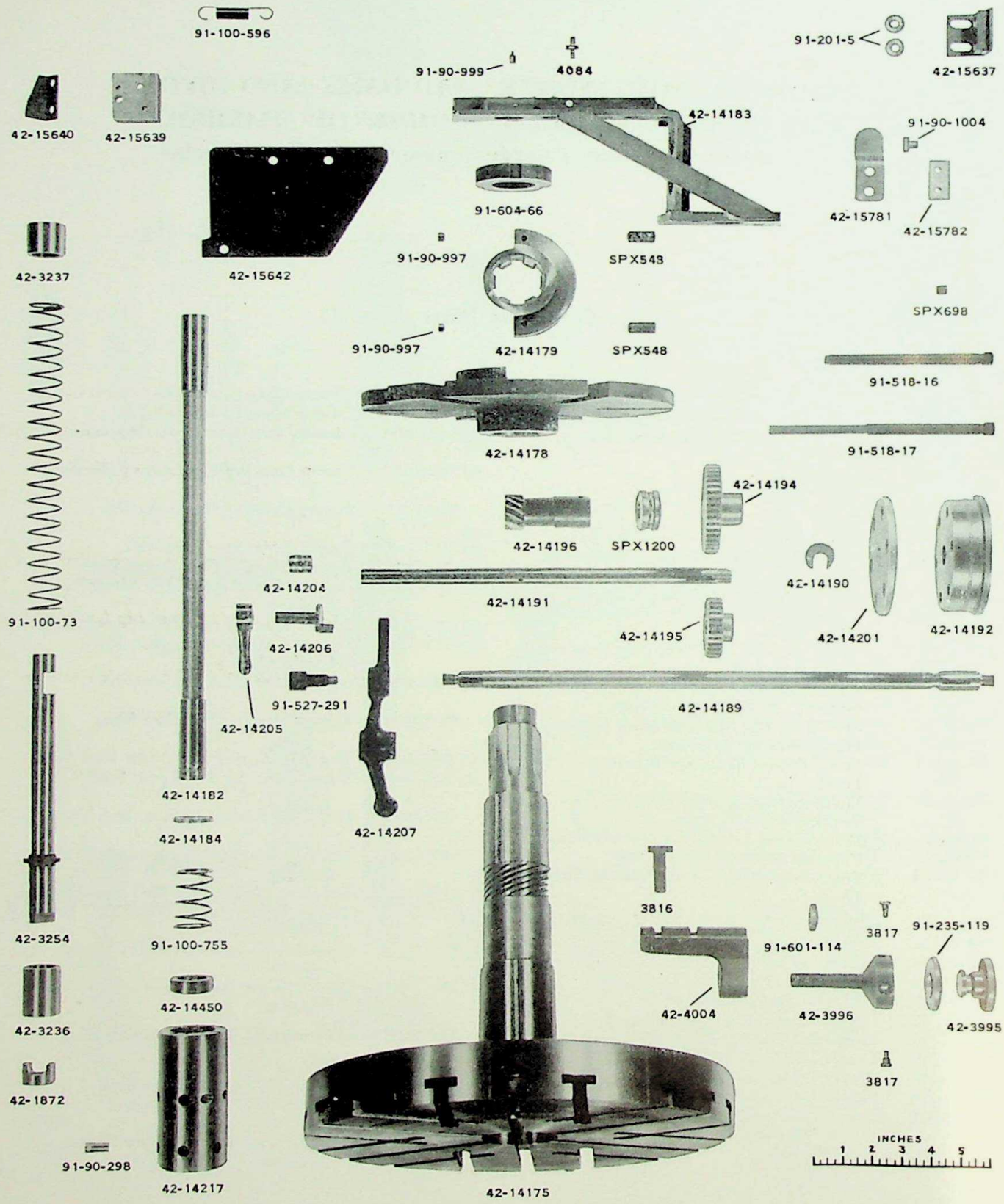
ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Turret Operating Parts (cont'd)

3813	Turret Timing Cam Lever Screw and Nut
3815	Locking Pin Cam Lever Adjustment Screw
4085	Intermediate Shaft Gear Shear Pin
42-4747	Turret Locking Pin Cam
42-14186	Turret Timing Cam
42-14188	Turret Timing Cam Lever (Includes 3813, 91-90-966 and 91-215-135)
42-14197	Intermediate Shaft Bearing Cap
42-14207	Turret Locking Pin Lever (Includes 91-91-72 and 91-527-291)
42-14208	Turret Indexing Shaft Bearing Retainer
42-14209	Index Gear Shaft
42-14210	Turret Indexing Gear (Includes 42-14216, 91-215-119, 91-527-290 and SPX594)
42-14211	Turret Indexing Shaft Bearing Spacer
42-14212	Turret Intermittent Shaft
42-14213	Turret Locking Pin Cam Wheel (Includes 42-4747)
42-14214	Locking Pin Cam Lever (Includes 3815 and 91-501-6)
42-14215	Turret Timing Cam Intermediate Shaft
42-14216	Turret Intermittent Gear, Large
42-14218	Turret Intermittent Shaft Bearing Spacer, Outer
42-14219	Intermittent Shaft Bearing Spacer, Inner
42-14222	Turret Return Bar Operating Arm
42-14223	Turret Return Bar Operating Link
42-14224	Return Bar Operating Arm Stud
42-14229	Turret Slide Return Bar
42-14231	Turret Intermittent Gear, Small
42-14298	Turret Intermediate Shaft Bearing Spacer
42-14299	Turret Intermediate Shaft Gear
42-14437	Turret Operating Arm Stud, Upper
42-15650	Turret Intermediate Shaft Gear Hub
42-15909	Turret Intermediate Shaft Gear, Complete (Includes 4085, 42-14299, 42-15650 and 91-215-243)
91-90-965	Timing Cam Lever Pin
91-90-966	Timing Cam Lever Roll Pin
91-90-967	Locking Pin Cam Lever Fulcrum
91-90-1005	Turret Locking Pin Lever Fulcrum
91-91-72	Turret Locking Pin Lever Pin
91-215-119	Turret Indexing Gear Roll
91-215-135	Turret Timing Cam Lever Roll
91-215-243	Intermediate Shaft Gear Shear Pin Bushing
91-325-126	Turret Intermittent Shaft Lockwasher
91-325-126	Timing Cam Intermediate Shaft Lockwasher
91-325-126	Index Gear Shaft Lockwasher
91-501-6	Turret Locking Pin Cam Shoe
91-527-290	Turret Indexing Disc Gear Roll Stud
91-527-291	Turret Locking Pin Lever Stud
SPX594	Stop Nut, Indexing Gear Roll Stud
SPX1100	Timing Cam Intermediate Shaft Ball Bearing
SPX1122	Indexing Gear Shaft Ball Bearing
SPX1413	Turret Intermediate Shaft Ball Bearing (Matched Pair)
SPX1413	Indexing Gear Shaft Ball Bearing (Matched Pair)
SPX1461	Timing Cam Intermediate Shaft Ball Bearing
429-1478	Intermittent Shaft Retaining Ring

NOT SHOWN

42-14187	Turret Timing Cam Bracket (Includes 42-14218)
42-15945	Timing Cam Intermediate Shaft Locknut



Turret Parts

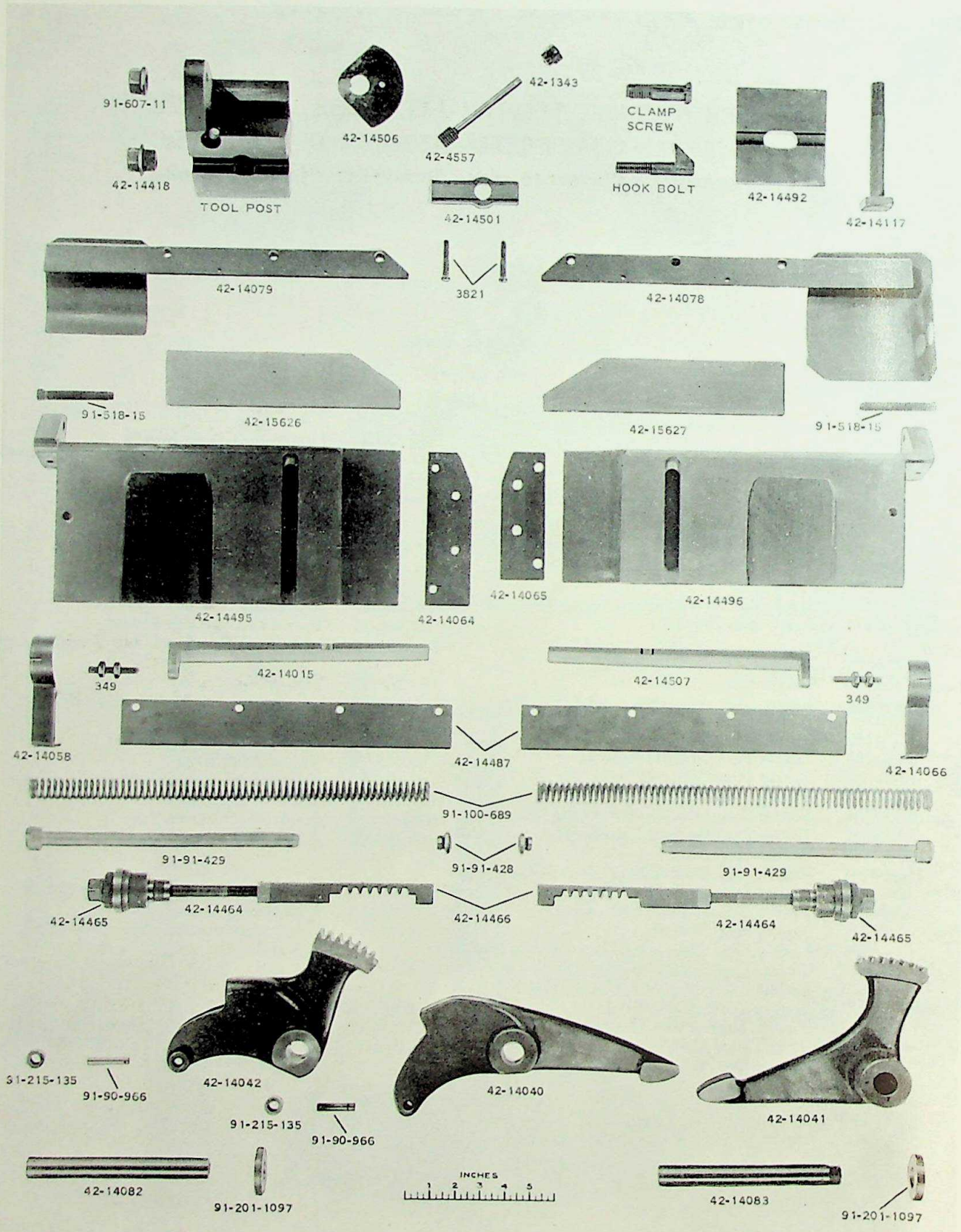
ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Turret Parts

3816	Stock Stop Bracket Screw
3817	Stock Stop Holder Screw
4084	Support Bracket Screw and Nut
42-1872	Turret Locking Pin Bushing
42-3236	Turret Locking Pin Sleeve
42-3237	Turret Locking Pin Sleeve, Back
42-3254	Turret Locking Pin (Includes 42-3236)
42-3995	Stock Stop
42-3996	Stock Stop Holder
42-4004	Stock Stop Bracket
42-14175	Turret
42-14178	Turret Disk
42-14179	Turret Disk Adjusting Collar (Includes SPX548)
42-14182	Turret Pipe (Includes 42-14450)
42-14183	Turret Pipe Support Bracket
42-14184	Turret Pipe Collar Bearing Spacer
42-14189	Turret Stop Disk Shaft
42-14190	Turret Stop Disk Shaft Locking Washer
42-14191	Turret Intermediate Stop Shaft
42-14192	Turret Stop Disk
42-14194	Turret Stop Disk Shaft Driving Gear
42-14195	Turret Stop Disk Shaft Gear
42-14196	Turret Intermediate Shaft Gear
42-14201	Turret Stop Disk Plate
42-14204	Locking Pin Operating Eccentric Bushing
42-14205	Turret Locking Pin Operating Handle
42-14206	Turret Locking Pin Operating Eccentric
42-14207	Turret Locking Pin Lever
42-14217	Turret Tool Oiling Head (Includes 91-90-298)
42-14450	Turret Pipe Collar
42-15637	Turret Disk Guard Extension Bracket
42-15639	Turret Disk Guard Extension Block
42-15640	Turret Slide Chip Guard
42-15642	Indexing Mechanism Chip Guard, Small
42-15781	Chip Guard Bushing Stop
42-15782	Chip Guard Bushing Stop Block
91-90-298	Oil Stop
91-90-997	Turret Disk Button
91-90-999	Turret Pipe Support Bracket Pin
91-90-1004	Indexing Chip Guard Fulcrum
91-100-73	Turret Locking Pin Spring
91-100-596	Indexing Mechanism Chip Guard (Large) Spring
91-100-755	Turret Pipe Spring
91-201-5	Turret Disk Guard Extension Bracket Washer
91-235-119	Stock Stop Thrust Washer
91-518-16	Turret Stop Screw
91-518-17	Turret Stop Screw, Long
91-527-291	Turret Locking Pin Lever Stud
91-601-114	Stock Stop Holder Nut
91-604-66	Turret Nut
SPX548	Turret Disk Adjusting Collar Set Screw
SPX698	Hex Socket Pipe Plug
SPX1200	Turret Intermediate Stop Shaft Ball Bearing

NOT SHOWN

42-4003	Rotating Stock Stop, Complete (Includes 3816, 3817, 42-3995, 42-3996, 42-4004, 91-235-119 and 91-601-114)



Cross Slides and Tool Posts

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Cross Slides and Tool Posts

349	Cross Slide Gib Adjusting Screw
3821	Swivel Screw
42-1343	Tool Post Worm Head
42-4557	Tool Post Worm
42-14015	Cross Slide Gib, Front
42-14040	Cross Slide Lever, Back (Includes 91-90-966 and 91-215-135)
42-14041	Cross Slide Segment
42-14042	Cross Slide Lever, Front (Includes 91-90-966 and 91-215-135)
42-14058	Cross Slide Dial Guard, Front
42-14064	Cross Slide Inner Guard, Front
42-14065	Cross Slide Inner Guard, Back
42-14066	Cross Slide Dial Guard, Back
42-14078	Cross Slide Chip Guard, Back
42-14079	Cross Slide Chip Guard, Front
42-14082	Cross Slide Lever Fulcrum
42-14083	Cross Slide Segment Fulcrum
42-14117	Tool Post Clamp Bolt
42-14418	Hook Bolt Nut
42-14464	Cross Slide Adjusting Screw (Includes 3843 and 42-14465)
42-14465	Cross Slide Dial
42-14466	Cross Slide Rack (Includes 42-14464)
42-14487	Cross Slide Side Guard
42-14492	Tool Post Raising Block
42-14495	Cross Slide, Front
42-14496	Cross Slide, Back
42-14501	Tool Post Swivel
42-14506	Tool Post Worm Segment
42-14507	Cross Slide Gib, Back
42-15626	Cross Slide Felt, Front
42-15627	Cross Slide Felt, Back
91-90-966	Cross Slide Lever Roller Pin
91-91-428	Cross Slide Spring Holder
91-91-429	Cross Slide Spring Plunger
91-100-689	Cross Slide Spring
91-201-1097	Cross Slide Lever Fulcrum Washer
91-215-135	Cross Slide Cam Lever Roll
91-518-15	Cross Slide Stop Adjustment Screw
91-607-11	Tool Clamp Screw Nut

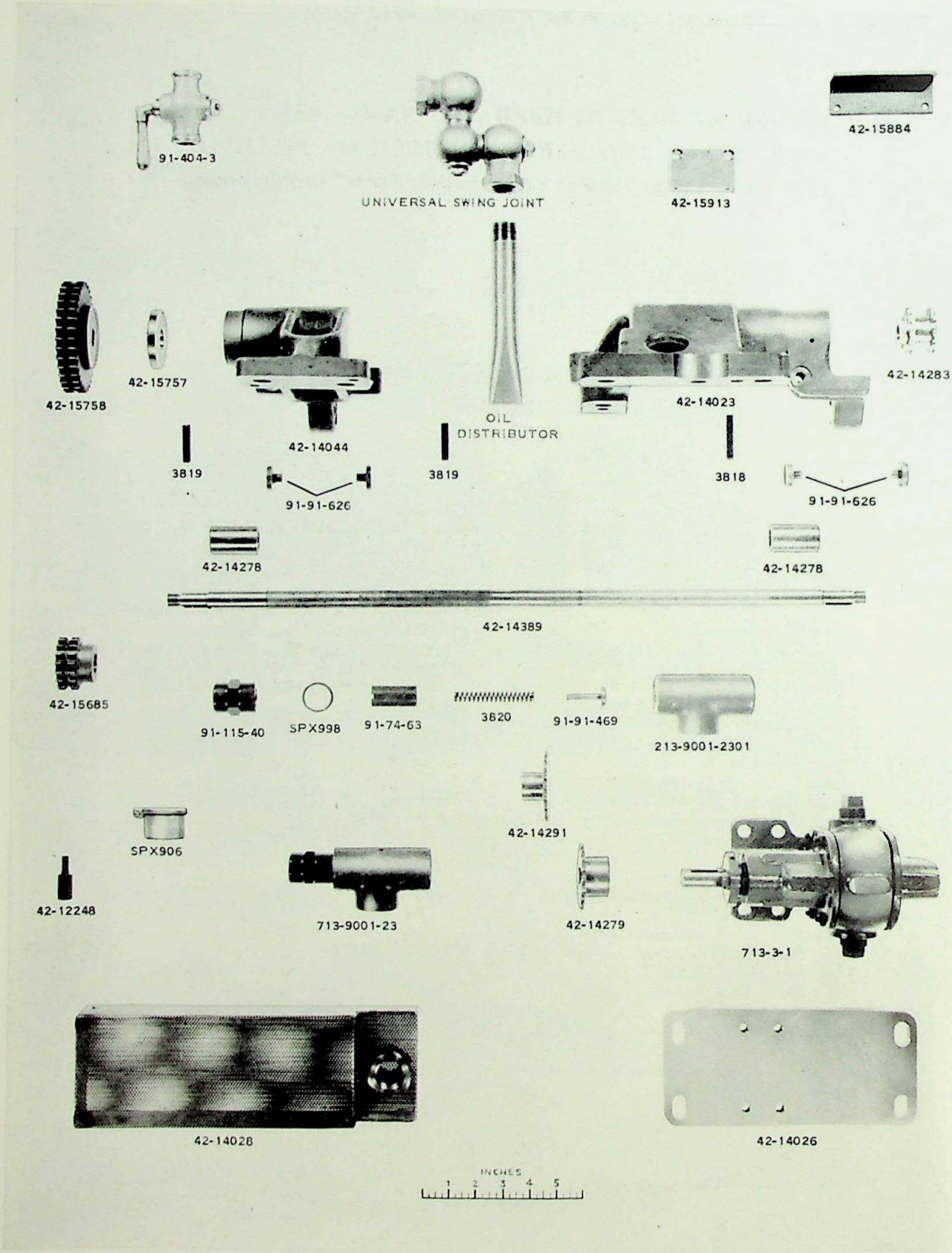
Tool Post
- 42-14493 (Front)
- 42-14494 (Back)

Hook Bolt
- 42-14502 (4¾" Long)
- 42-14503 (3¼" Long)

Clamp Screw, Tool
- 42-14504 (2 11/16" Long)
- 42-14505 (3⅜" Long)

NOT SHOWN

3843	Cross Slide Dial Shearing Pin
142-4-10	Back Tool Post, Complete
142-4-12	Front Tool Post, Complete



Lubricator and Coolant Parts

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Lubricator and Coolant Parts

3818	Driving Shaft Bracket Screw
3819	Abutment Block Screw
3820	Relief Valve Spring
42-12248	Lubricator Adjusting Screw
42-14023	Pump and Lubricator Driving Shaft Bracket (Includes 42-14278)
42-14026	Pump Mounting Plate
42-14028	Oil Strainer, Complete
42-14044	Chuck and Reversing Levers Abutment Block (Includes 42-14278)
42-14278	Pump Driving Shaft Bushing
42-14279	Pump Sprocket
42-14283	Pump and Lubricator Driving Sprocket
42-14291	Lubricator Sprocket
42-14389	Pump and Lubricator Driving Shaft
42-15685	Pump and Lubricator Motor Sprocket
42-15757	Pump Driving Shaft Sprocket Washer
42-15758	Pump Driving Shaft Sprocket
42-15884	Junction "A" Bracket, Lubricant Tubing
42-15913	Junction "B" Block
91-74-63	Relief Valve Adjusting Screw
91-74-469	Relief Valve Plunger
91-91-626	Trip Lever Abutment Plug
91-115-40	Adjusting Screw Cap
91-404-3	Special Straight Cock, Lever Handle
213-9001-2301	Relief Valve Body
713-3-1	Rotary Geared Pump
713-9001-23	Relief Valve ¾"
SPX906	Lubricator Tank Filler Cover
SPX998	Relief Valve Gasket

Oil Distributor

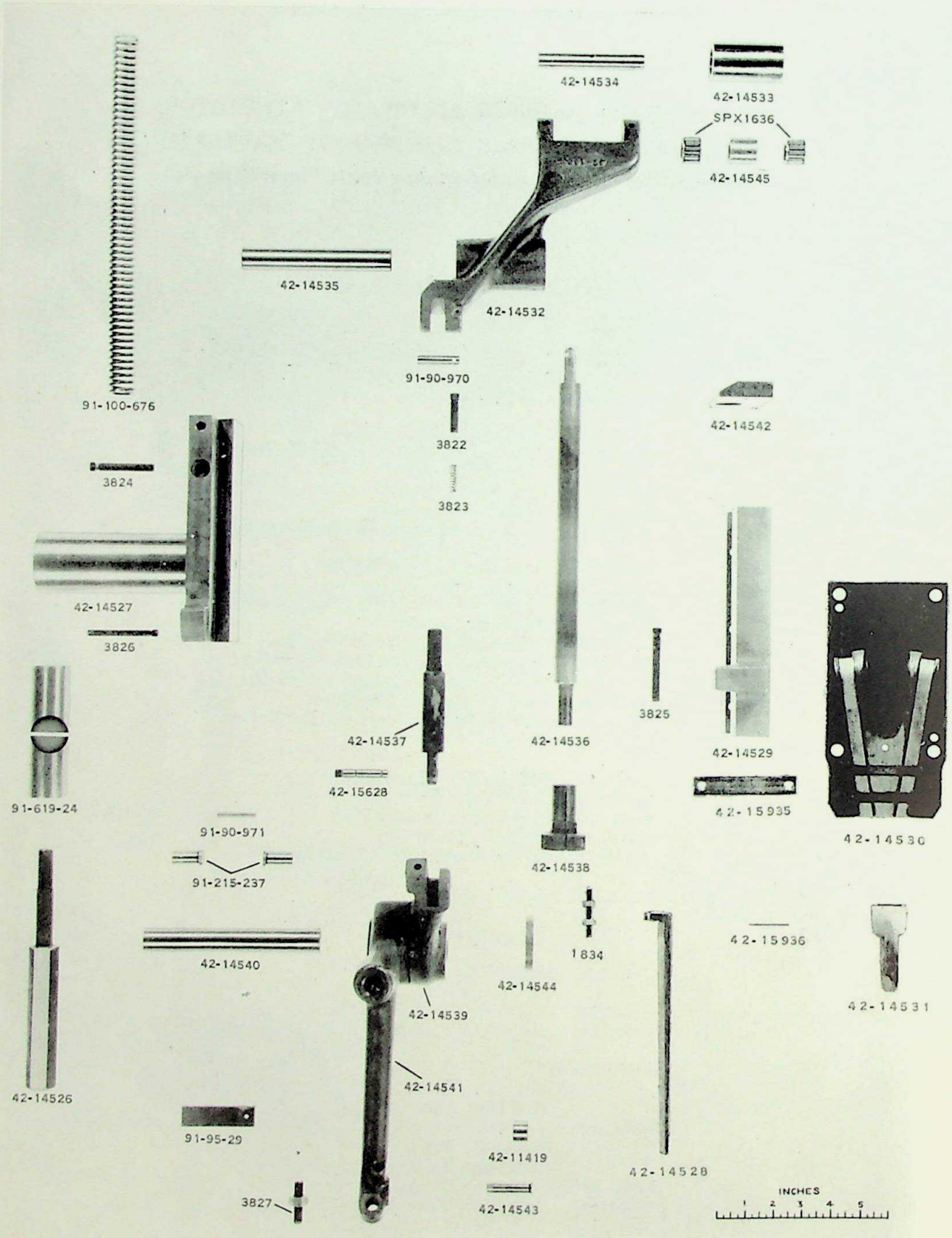
42-14027	Front
42-15962	Rear

Universal Swing Joint

91-404-33	Rear
91-404-44	Front

NOT SHOWN

42-14067	Lubricator Tank



Vertical Slide

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

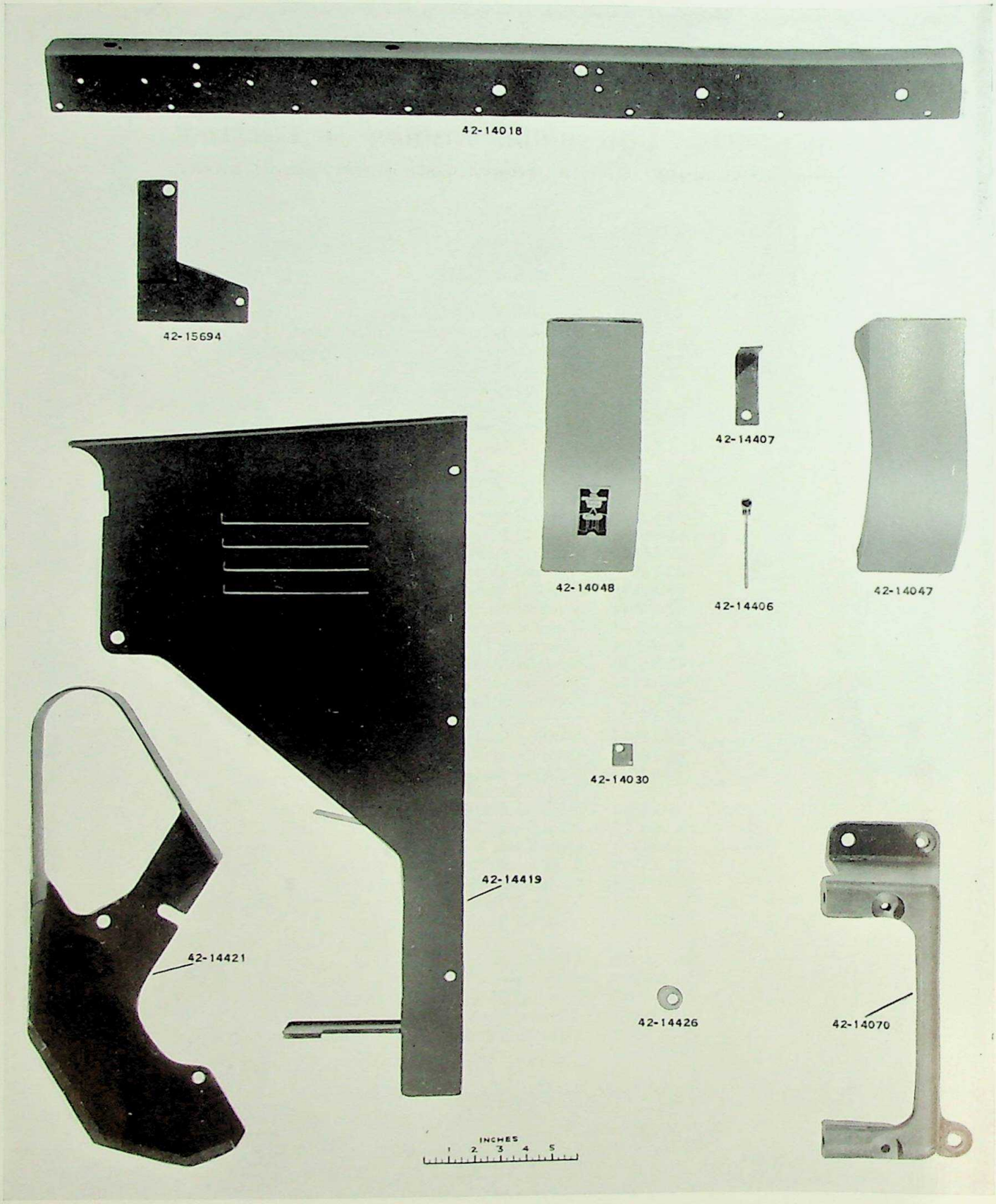
Vertical Slide

1834	Vertical Slide Way Gib Screw and Nuts
3822	Operating Lever Adjustment Screw
3823	Operating Lever Adjustment Screw Spring
3824	Vertical Slide Way Screw
3825	Vertical Slide Stop Screw
3826	Vertical Slide Bracket Screw
3827	Vertical Slide Cam Lever Screw and Nut
42-11419	Vertical Slide Cam Lever Roll
42-14526	Vertical Slide Way Clamp Screw
42-14527	Vertical Slide Way
42-14528	Vertical Slide Way Gib
42-14529	Vertical Slide
42-14530	Vertical Tool Holder
42-14531	Vertical Slide Tool Clamp
42-14532	Vertical Slide Operating Lever
42-14533	Vertical Slide Operating Lever Roll
42-14534	Operating Lever Roll Stud
42-14535	Vertical Slide Operating Lever Fulcrum
42-14536	Vertical Slide Operating Lever Link
42-14537	Operating Lever Segment Link
42-14538	Segment Link Adjusting Nut
42-14539	Vertical Slide Cam Lever Arm
42-14540	Cam Lever Arm Fulcrum
42-14541	Vertical Slide Cam Lever (Includes 42-14539, 91-90-971 and 91-215-237)
42-14542	Vertical Slide Spring Retaining Plate
42-14543	Cam Lever Roll Pin
42-14544	Cam Lever Fitting Washer
42-14545	Cam Lever Roller Bearing Spacer
42-15628	Operating Lever Segment Link Pin
42-15935	Vertical Tool Clamp Retainer
42-15936	Vertical Tool Clamp Spring
91-90-970	Operating Lever Link Stud
91-90-971	Cam Lever Shearing Pin
91-95-29	Vertical Slide Bracket Tongue
91-100-676	Vertical Slide Spring
91-215-237	Cam Lever Shearing Pin Bushing
91-619-24	Vertical Slide Way Clamp
SPX1636	Operating Lever Roller Assembly

NOT SHOWN

*711-360-124	Vertical Slide Cam Blank

*Parts finished to order upon receipt of drawing of work.



Miscellaneous Guards

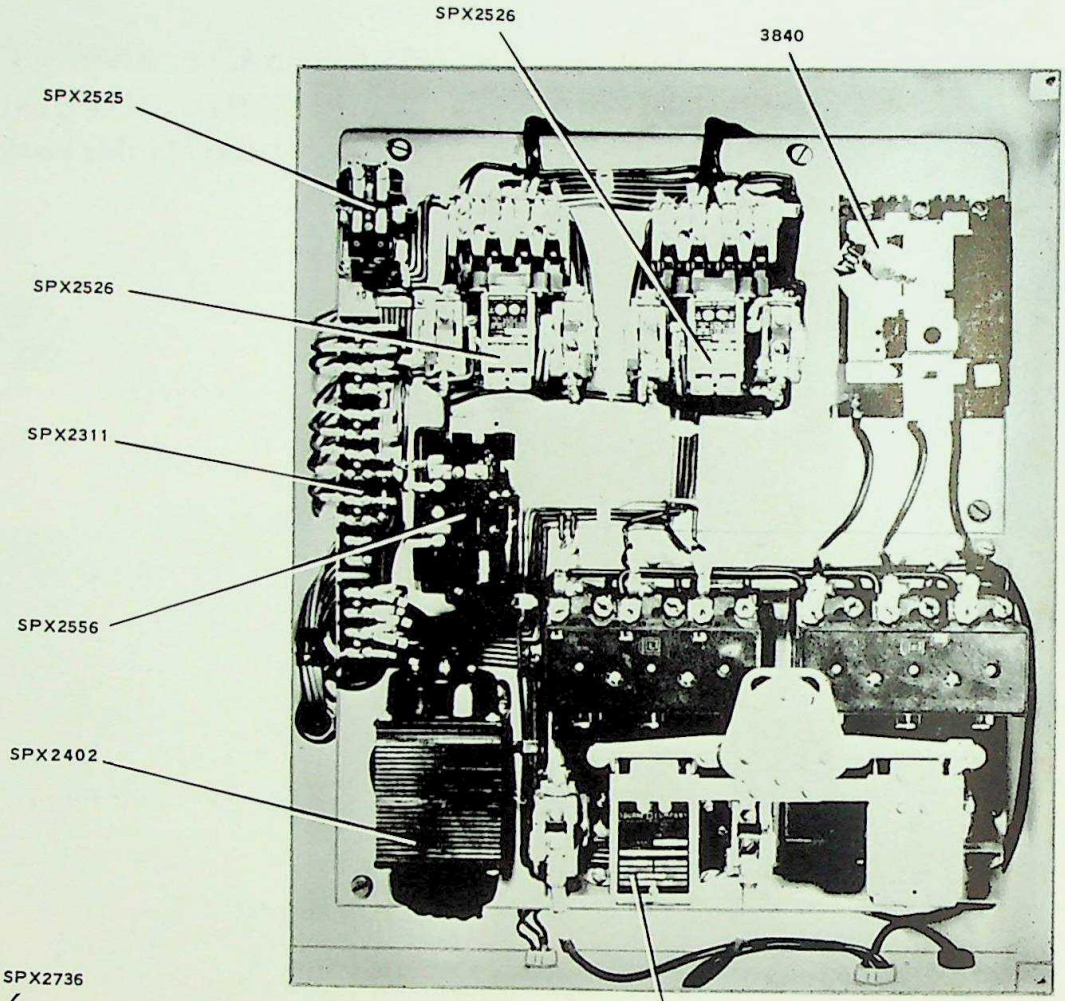
ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

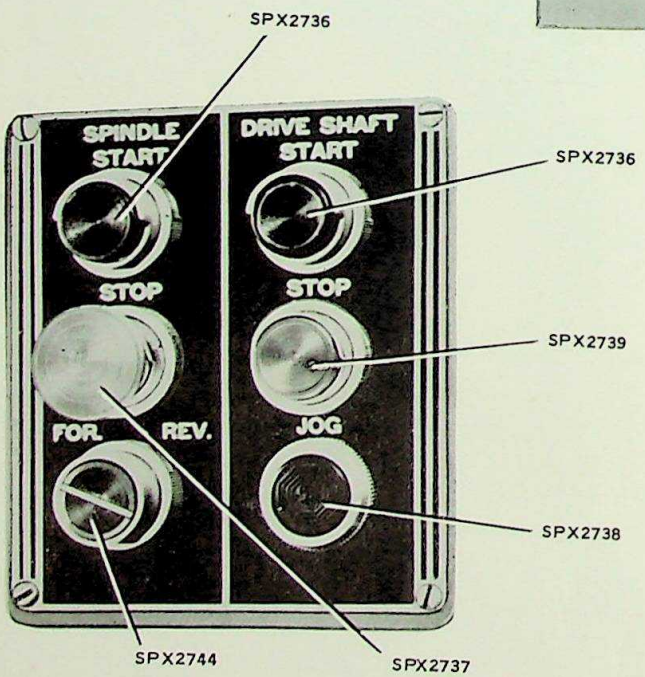
Miscellaneous Guards

42-14018	Guard Anchor Strip
42-14030	Spindle Guard Adjusting Block
42-14047	Spindle Sprocket Guard, Right
42-14048	Spindle Sprocket Guard, Left
42-14070	Feed Change Gear Cover Bracket
42-14406	Fork Ring Oil Tube, Complete
42-14407	Fork Ring Oil Tube Bracket
42-14419	Feed Slide Bracket Guard, Rear
42-14421	Drive Shaft Motor Chain Guard
42-14426	Spindle Guard Support
42-15694	Forward Oil Guard Side Extension

NOT SHOWN

42-14050	Rear Oil Guard Side
42-14051	Forward Oil Guard Side





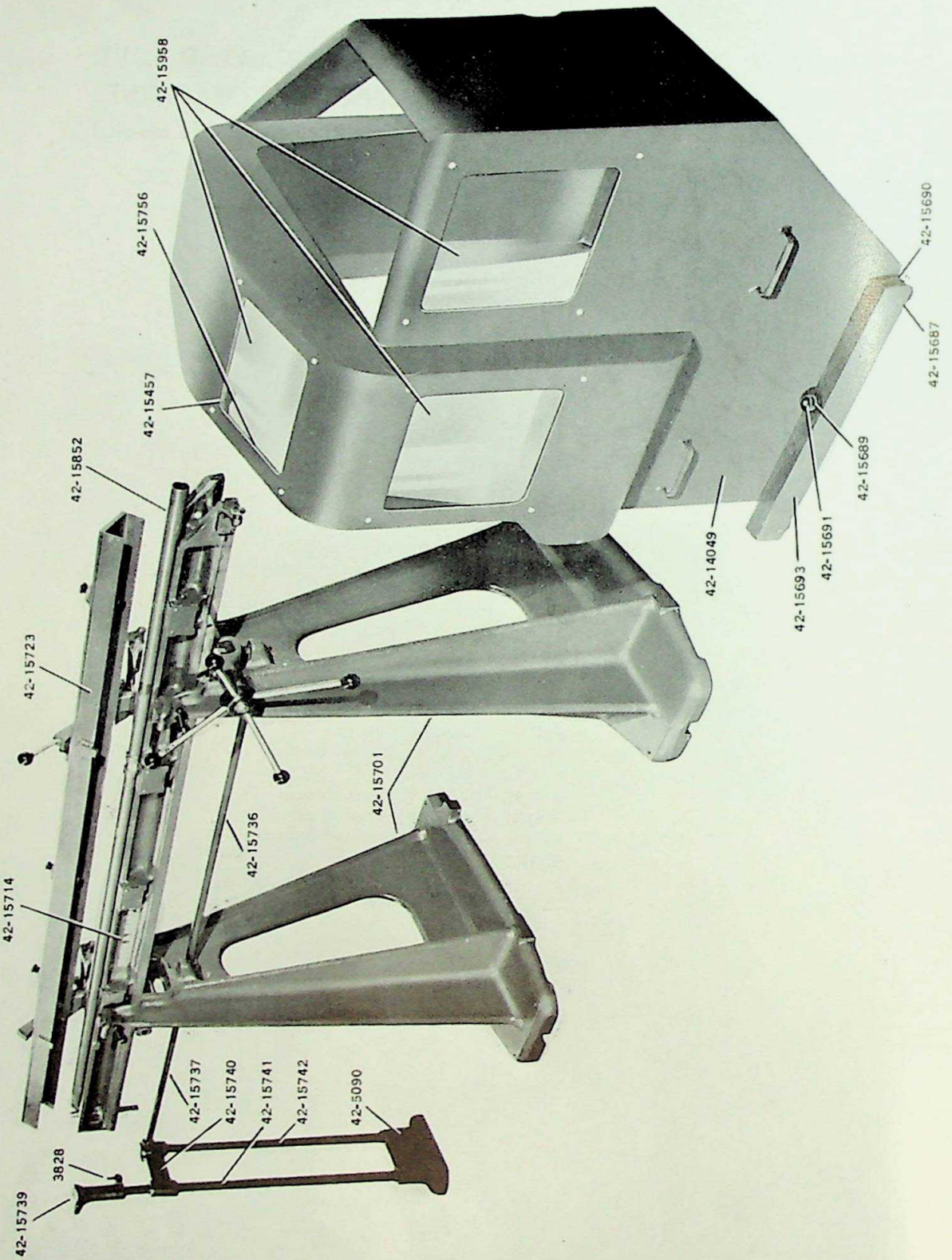
Electrical Controls

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Electrical Controls

*3840	Circuit Breaker
SPX2311	Terminal Block, 4 Pole
*SPX2402	Transformer
SPX2525	Jogging Relay
*SPX2526	Driving Shaft Motor Starter
*SPX2526	Pump Motor Starter
*SPX2527	Spindle Motor Starter and Reversing Switch
SPX2556	Timing Relay
SPX2736	Spindle Start Push Button
SPX2736	Driving Shaft Start Push Button
SPX2737	Stop Push Button
SPX2738	Driving Shaft Jog Push Button
SPX2739	Driving Shaft Stop Push Button
SPX2744	Spindle Direction Selector Switch

*Specify Volts, Cycles and Phase of Power Supply.

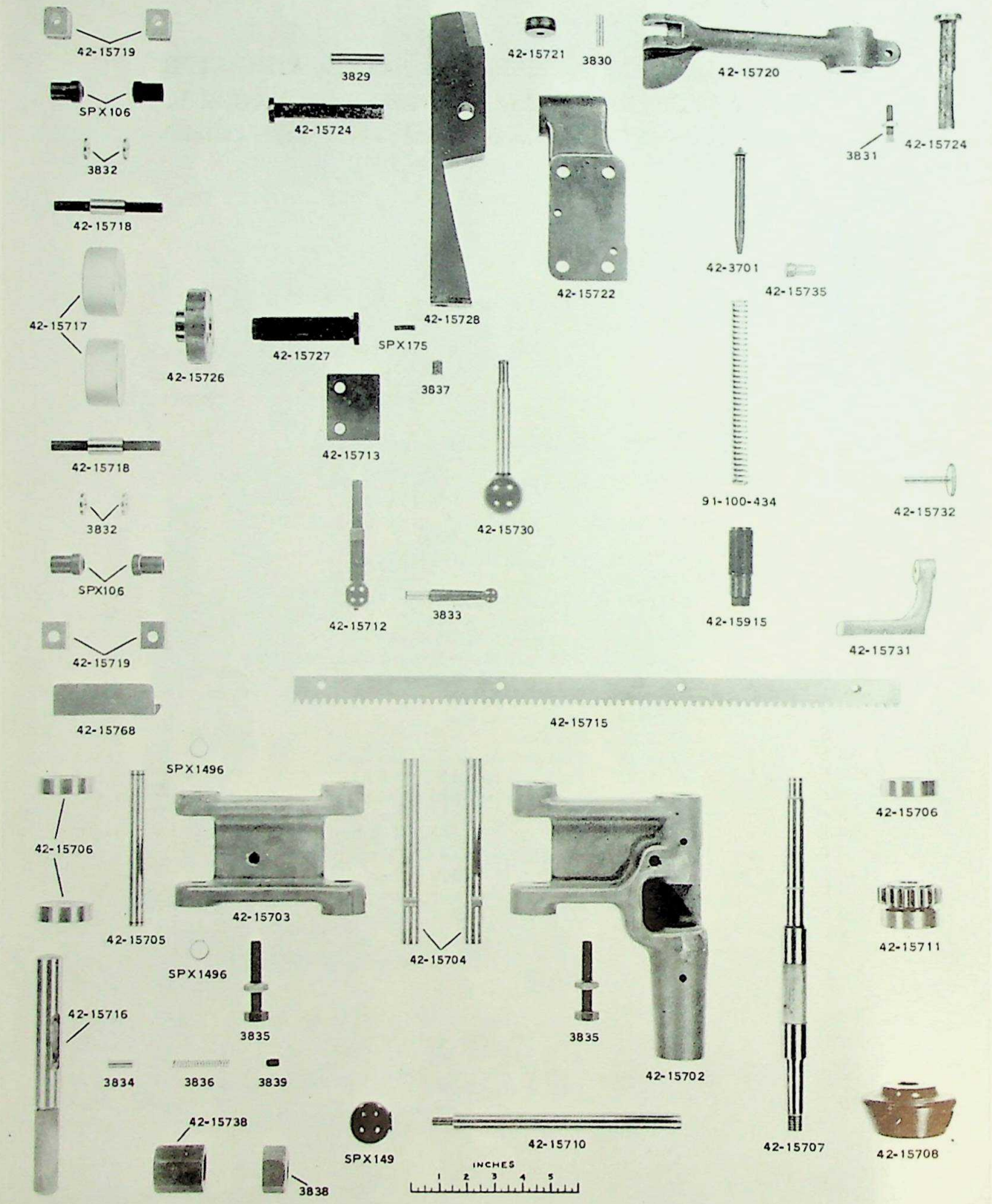


Stock Loader and Oil Guard

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Stock Loader and Oil Guard

3828	Stock Loader End Support Screw
42-5090	Floor Stand
42-14049	Oil Guard (Includes 42-15457, 42-15693, 42-15756 and 42-15958)
42-15457	Oil Guard Window Seal
42-15687	Oil Guard Roll Fulcrum
42-15689	Oil Guard Stop Plunger Knob
42-15690	Oil Guard Roll
42-15691	Oil Guard Stop Plunger
42-15693	Oil Guard Roller Block (Includes 42-15687, 42-15689, 42-15690 and 42-15691)
42-15701	Stock Rail Stand
42-15714	Stock Loader Rail
42-15723	Rail Cover
42-15736	Stock Rail Stand Tie Rod, Right
42-15737	Stock Rail Stand Tie Rod, Left
42-15739	Stock Loader End Support
42-15740	Stock Loader End Support Bracket
42-15741	Stock Loader End Support Bar, Front
42-15742	Stock Loader End Support Bar, Rear
42-15756	Oil Guard Window Frame
42-15852	Stock Loader Lining Tube
42-15958	Oil Guard Window



Stock Loader Parts

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

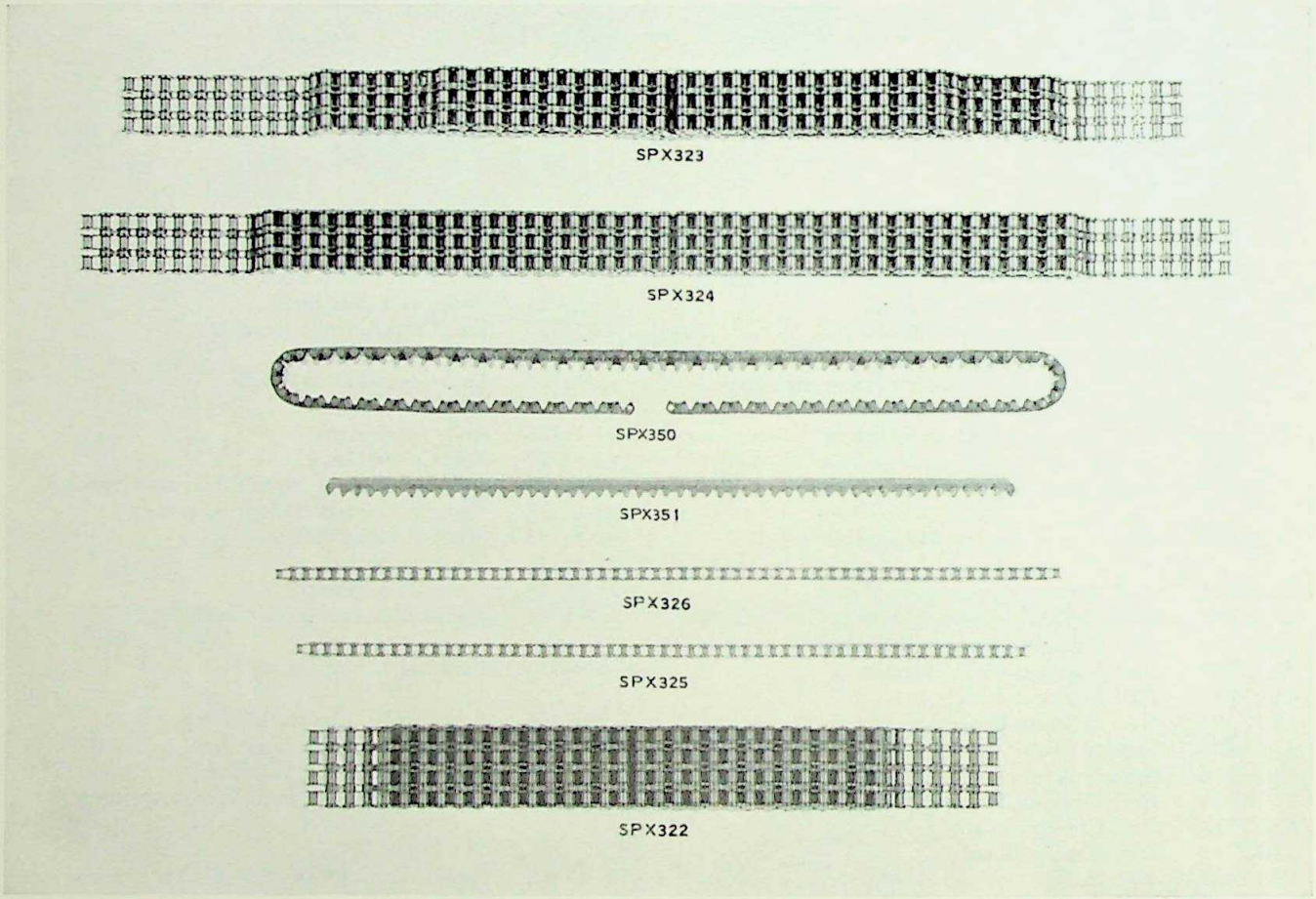
Stock Loader Parts

3829	Rail Cover (Right) Arm Pin
3830	Rail Cover Pressure Lever Pin
3831	Rail Cover Pressure Lever Screw and Nut
3832	Stock Roll Thrust Washer
3833	Rail Clamp Screw Handle
3834	Stock Stop Plunger Pin
3835	Rail Adjusting Support Screw and Nut
3836	Stock Stop Plunger Spring
3837	Rail Cover (Left) Arm Screw
3838	Stock Rail Stand Tie Rod Nut
3839	Stock Stop Pin Spring Screw
42-3701	Cam Lever Spring Plunger
42-15702	Rail Adjusting Support, Right
42-15703	Rail Adjusting Support, Left
42-15704	Rail Adjusting Support Fulcrum
42-15705	Rail Support Roll Fulcrum
42-15706	Rail Support Roll
42-15707	Rail Driving Pinion Shaft
42-15708	Spider Hub
42-15710	Spider Arm
42-15711	Rail Driving Pinion and Roll
42-15712	Rail Clamp Screw
42-15713	Rail Clamp Plate
42-15715	Rail Rack
42-15716	Rail Stock Stop
42-15717	Stock Roll
42-15718	Stock Roll Fulcrum
42-15719	Stock Roll Fulcrum Lock
42-15720	Rail Cover Arm Pressure Lever
42-15721	Pressure Lever Roll
42-15722	Rail Cover Hinge Bracket
42-15724	Rail Cover Fulcrum
42-15726	Rail Cover Screw Guide
42-15727	Rail Cover Screw
42-15728	Rail Cover Arm
42-15730	Rail Cover Handle
42-15731	Spindle Control Switch Actuator Bracket
42-15732	Spindle Control Switch Actuator
42-15735	Stock Loader Rail Stop
42-15738	Tie Rod Nut
42-15768	Stock Roll Guard
42-15915	Pressure Lever Spring Bushing
91-100-434	Pressure Lever Spring
SPX106	Stock Roll Fulcrum Bushing
SPX149	Spider Arm Gear Shift Ball
SPX175	Rail Cover Screw Wicking
SPX1496	Rail Support Fulcrum Retaining Ring

NOT SHOWN

*42-15861	Spool Blank (With instructions to complete for hex stock)
*42-15917	Spool (For round stock 2" to 2 3/8" inclusive)

*Extra Equipment.



Driving Chains

ORDER BY PART NUMBER AND NAME; ALSO GIVE *SIZE, STYLE* AND *SERIAL NUMBER* OF MACHINE.
(See instructions "How to order Repair Parts" in this book.)

Driving Chains

SPX322	**Spindle Motor Sprocket Chain** (American Standard F. 40 roller chain with 94 links including connecting link, run in)
SPX323	**Spindle Sprocket Chain, Right** (American Standard E. 40 roller chain with 194 links including connecting link, run in)
SPX324	**Spindle Sprocket Chain, Left** (American Standard E. 40 roller chain with 154 links including connecting link, run in)
SPX325	**Lubricator Sprocket Chain**
SPX326	**Pump Sprocket Chain**
SPX350	**Intermediate Driving Shaft Silent Chain**
SPX351	**Pump and Lubricator Shaft Silent Chain**

Notes On Main Driving Chains

The main driving chains are specified in general terms, being identified by American Standard Roller Chain standards. Notice that all these chains are *run in*. The stretch in a regular commercial chain (not run in) develops rapidly during the first hours of operation and adjustment must be made almost hourly. In addition it will probably be necessary to remove chain links during the first days of operation.

A chain which stretches and operates without proper tension will ride out on its sprocket and will permit the rollers to strike the tips of the sprocket teeth. When running in this manner a chain can be ruined during its first day of operation.

Even with "Run-In" chains regular checks on chain tension should be made, for maximum chain life cannot be obtained unless proper tension is maintained.

The Brown & Sharpe line includes the following:

Milling Machines — Universal, Plain and Vertical (including 3 Horsepower, 5 Horsepower) and the Omniversal; Manufacturing Type.

Attachments; Milling Cutters; Arbors; Adapters and Collets.

Grinding Machines — Universal; Plain; Face; Surface; Cutter and Tool; Universal and Tool. Attachments and Grinding Equipment.

Screw Machines — Automatic Screw and Automatic Cutting Off; Hand (semi-automatic); Polishing and Finishing Machine.

Attachments; Spring Collets; Feeding Fingers; Screw Machine Tools and Cams.

Other Brown & Sharpe Products:

Machinists' Tools; Electronic Measuring Equipment; Johansson Gage Blocks; Vises; Magnetic Chucks; Pumps; and other useful shop equipment.

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