

TECHNICAL MANUAL

**OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT
AND GENERAL SUPPORT MAINTENANCE MANUAL
(INCLUDING REPAIR PARTS LIST)**

FOR

**MILLING MACHINE, VERTICAL
MODEL 747VS
(WELLS-INDEX CORPORATION)
(NSN 3417-00-764-7993)**

HEADQUARTERS, DEPARTMENT OF THE ARMY

JULY 1981

Technical Manual

No. 9-3417-213-14&P

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 10 July 1981

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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2, located in the back of this manual direct to: Commander, US Army Armament Materiel Readiness Command, ATTN: DRSAR-MAS, Rock island, IL 61299. A reply will be furnished direct to you.

NOTE

This manual is published for the purpose of identifying an authorized commercial manual for the use of the personnel to whom this milling machine is issued.

Manufactured by: Wells-Index Corporation
Div. of Wells Mfg. Corp.
1100 W. Broadway
Three Rivers, MI 49093

Procured under Contract No. DAAA09-75-M-8587

This technical manual is an authentication of the manufacturers' commercial literature and does not conform with the format and content specified in AR 310-3, Military Publications. This technical manual does, however, contain available information that is essential to the operation and maintenance of the equipment.

INSTRUCTIONS FOR REQUISITIONING PARTS

NOT IDENTIFIED BY NSN

When requisitioning parts not identified by National Stock Number, it is mandatory that the following information be furnished the supply officer.

- 1 - Manufacturer's Federal Supply Code Number - 30456
- 2 - Manufacturer's Part Number exactly as listed herein.
- 3 - Nomenclature exactly as listed herein, including dimensions, if necessary.
- 4 - Manufacturer's Model Number - 747VS
- 5 - Manufacturer's Serial Number (End Item)
- 6 - Any other information such as Type, Frame Number, and Electrical Characteristics, if applicable.
- 7 - If DD Form 1348 is used, fill in all blocks except 4, 5, 6, and Remarks field in accordance with AR 725-50.

Complete Form as Follows:

(a) In blocks 4, 5, 6, list manufacturer's Federal Supply Code Number 30456 followed by a colon and manufacturer's Part Number for the repair part.

(b) Complete Remarks field as follows:

Noun: (nomenclature of repair part)

For: NSN: 3417-00-764-7993

Manufacturer: Wells-Index Corp.

Div. of Wells Mfg. Corp.

1100 W. Broadway

Model: 747VS Three Rivers, MI 49093

Serial: (of end item)

Any other pertinent information such as Frame Number, Type. Dimensions, etc.

8 speed head with quick,
easy speed adjustment,
HP NEMA motor

RAM & TURRET MILLING MACHINE

MODEL 747VS

3³/₈" quill and optional
#30MMT quick-change
spindle nose (#9B & S or
R-8 also available)

New heavy-duty overarm

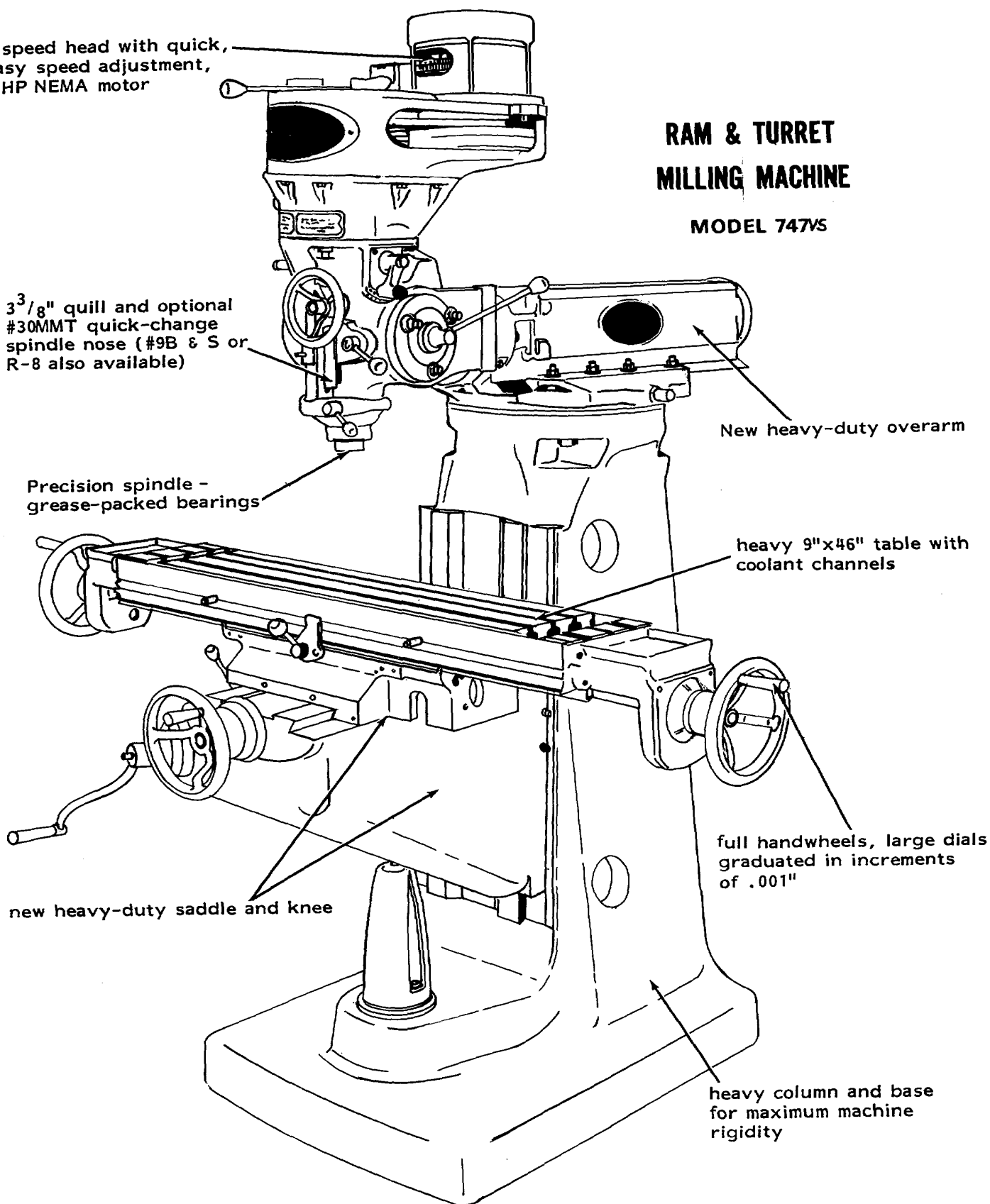
Precision spindle -
grease-packed bearings

heavy 9"x46" table with
coolant channels

full handwheels, large dials
graduated in increments
of .001"

new heavy-duty saddle and knee

heavy column and base
for maximum machine
rigidity



SPECIFICATIONS

TABLE

Overall size	9"x 46"
T-slots: number and size.....	Three 5/8"
Distance between T-slots	2 1/4"
Handwheel dial graduations.....	.001"

TRAVELS

Longitudinal	32"
Cross	12"
Vertical (knee)	17"
Quill	5 1/4"
Overarm.....	21"

THROAT DIMENSIONS

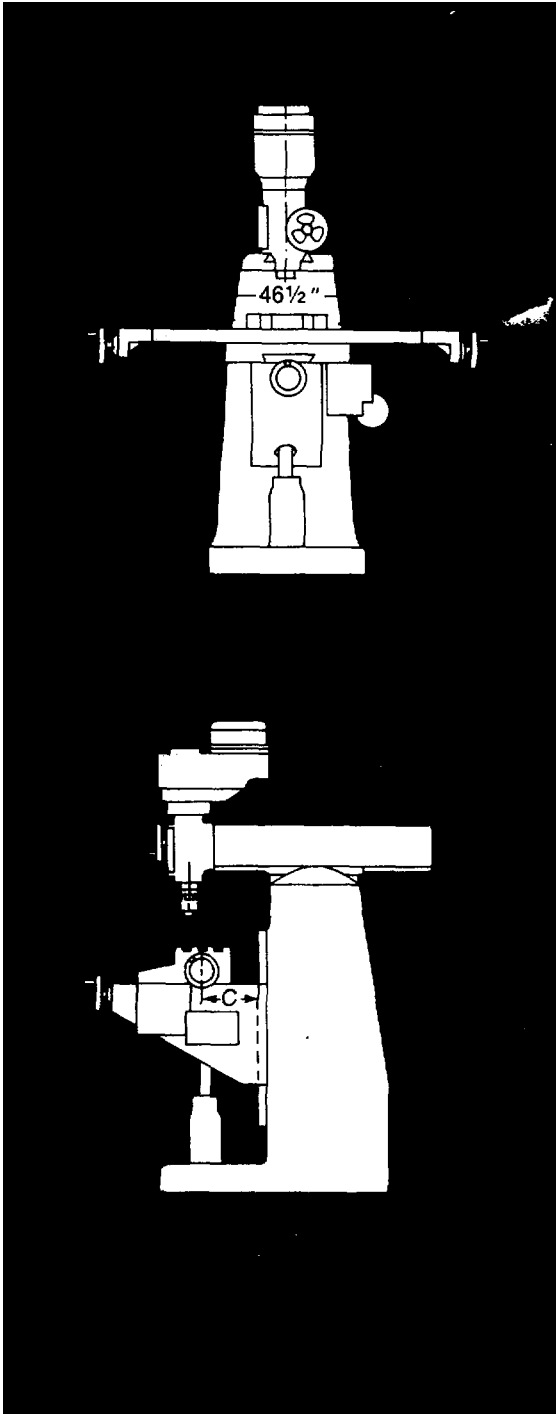
Canter of spindle to column face	.2 3/4" min., 23 3/4" max.
Center of table to column face	
(Standard)	5" min., 15" max.
(Optional)	17" max.
Spindle nose to top of table	0" min., 17" max.

HEAD, QUILL, SPINDLE AND TURRET

Turret and overarm, around turret	rotation 360°
Head tilt (front to back)	45°-0-45°
Head tilt (side to side)	180°-0-180°
Spindle taper	
(Standard)	R-8 or #9 B & S
(Optional)	#30 MMT- quick change
Spindle speeds	
(Standard) - in back gear	75,125, 210, 355
In direct drive.....	600, 1000,1675, 2850 rpm
(Optional) - in back gear	variable 50 to 525
In direct drive	400 to 4200
Reverse	Yes
Quill outside diameter	3 3/8"
Quill feeds - (3)	
Per spindle revolution.....	.0015", .003", .006"

MOTORS

Spindle (single speed)	1 h.p.
Table Feed (optional)	1/4 h.p.
SHIPPING WEIGHT (approx.).....	2100 lbs.



INSTRUCTION MANUAL & PARTS LIST HORIZONTAL & VERTICAL MILLING MACHINES

Machine Serial No. _____

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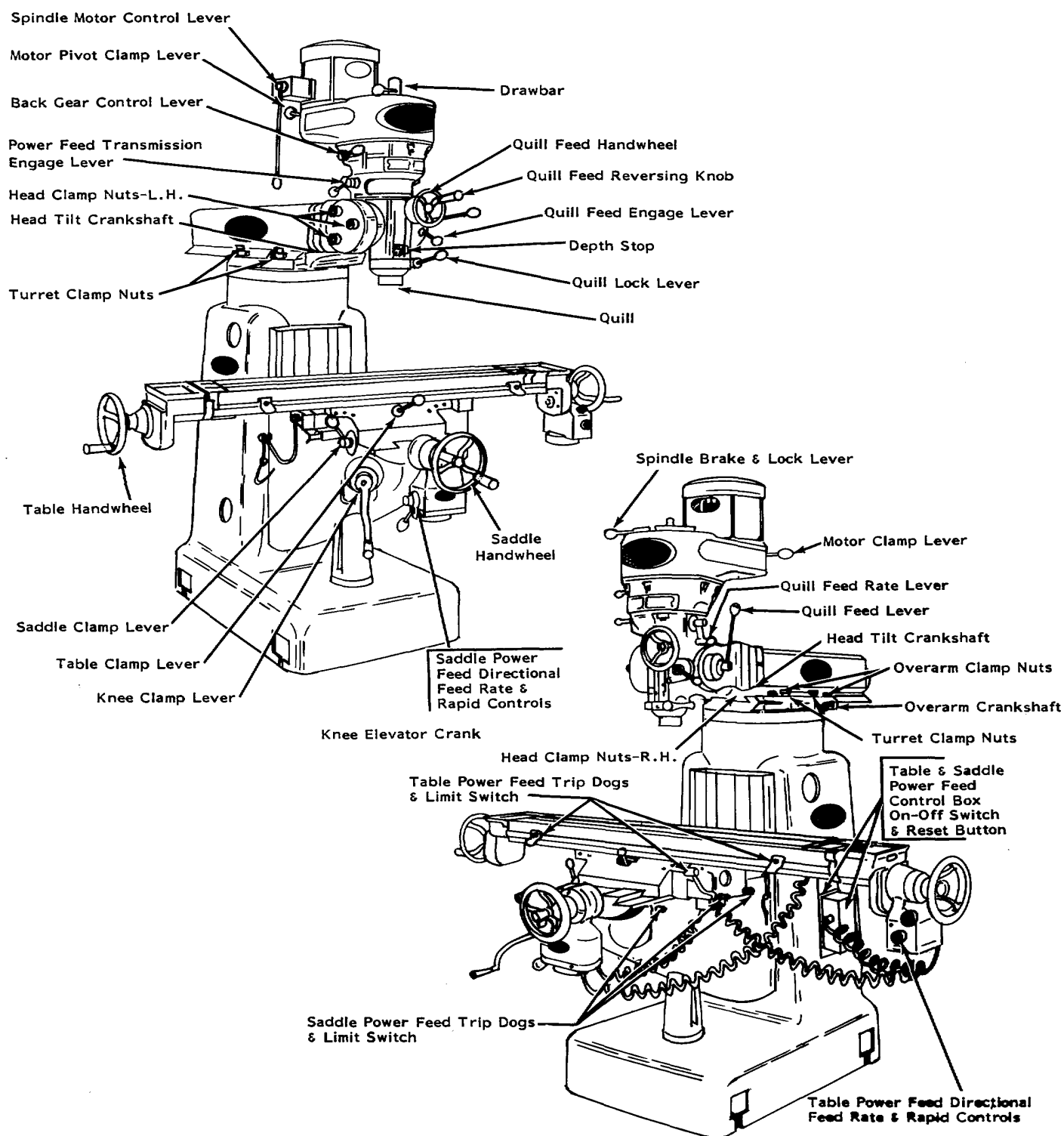
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101-180-209	Sand. Ass'y V.S.D. all Gear-860
101-212-202	Head & Quill Ass'y.
101-212-204	Sandwich Ass'y.
101-218-201	Var. Speed Sandwich Ass'y.
101-346-101	Knee Ass'y
101-436-101	Table & Saddle Ass'y.
101-670-101	1 H.P. 3 PH. Motor
101-671-101	2 H.P. Motor
101-672-101	1 H.P. 1 PH. Motor

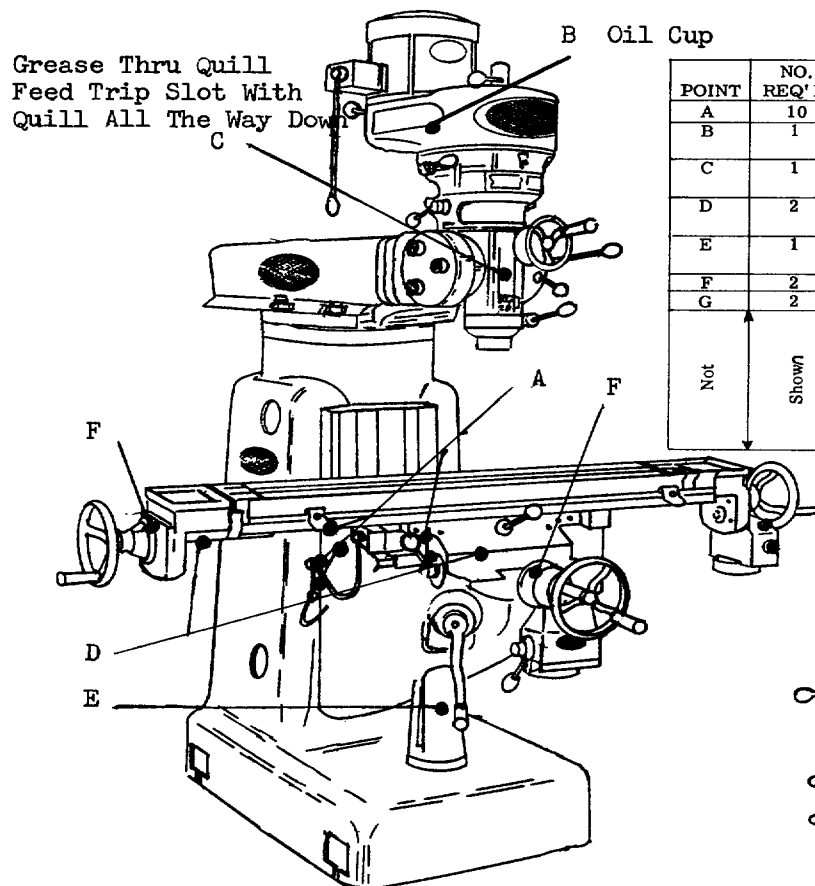
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I. LOCATION OF CONTROLS & ADJUSTMENTS FOR MILLING MACHINES



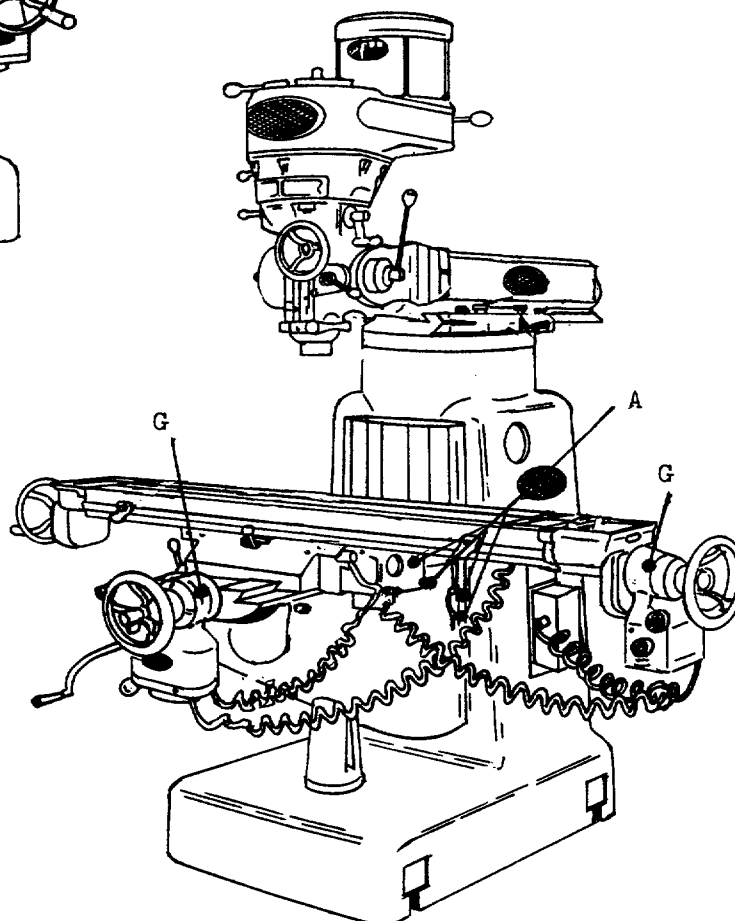
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II. RECOMMENDED LUBRICATION FOR MILLING MACHINE



POINT	NO. REQ'D	NAME	MOBIL NO.	FREQUENCY
A	10	Ways	Vactra Oil #2	Weekly
B	1	Mill Head	Vactra Oil #2	Few Drops Twice Weekly
C	1	Spindle Spline	Mobil Grease Special	Weekly
D	2	Lead Screw	Mobil Grease Special	Weekly
E	1	Elev. Screw	Mobil Grease Special	Weekly
F	2	Lead Screw Brg's.	Mobilux Grease #2	6 Months
G	2	Table Feed Box	Mobilux Grease #2	Check Weekly
Not ↓ Show		Spindle Bearings	Mobil Grease BRB Lifetime	When Re- Placing Brg.
		One-Shot Lube	Vactra Oil #2	Weekly
		Horizontal Drive Transmission	SAE #10 Motor Oil	Check Weekly
		Overarm Arbor Support	Vactra Oil #4	Daily

NOTE: Wipe Lube Fittings Clean Before Greasing.
Do Not Overlubricate Ball Bearings.



INSTRUCTION MANUAL

III. PRELIMINARY INFORMATION

A. UNCRATING:

Carefully remove the protective crating and skid so that the machine and parts are not marred, scratched or otherwise damaged. In the event of any damage in transit, report it immediately. The machine should be lifted from the base of the crate by placing a sling under the overarm.

B. SHORTAGES:

Inspect the complete shipment carefully against the itemized packing list to make sure that all items are present. In the event shortages are noticed they should be reported immediately, with a clear indication as to which parts have not been received.

C. CLEANING:

Thoroughly clean the rust preventive materials from the machine with gasoline, kerosene, or other suitable solvents. Do not move the table, saddle, knee or other moving parts until all of the sliding way surfaces have been well cleaned and lubricated. After cleaning carefully move to a limit stop in one direction the table, saddle and knee, and clean and lubricate the exposed way surfaces. Then move each of these units to the opposite limit stop and similarly clean and lubricate the exposed way surfaces. Loosen the four bolts to unlock the overarm and move this forward and backward to the extreme position in order to clean and lubricate.

D. FOUNDATION:

For best performance it is important that the machine be placed on a solid foundation and that it be level. A solid concrete floor is desirable, but a firm wooden floor, free from vibration, may be suitable. If the machine is to be located on an upper floor or balcony it should be placed as close as possible to a strong supporting pillar or column.

E. LEVELING:

The machine is provided with four bolt holes one at each corner of the base. Steel wedges or steel plates should be used for leveling. A good machinist's level should be used in the leveling process and the bubble should have adequate time to come to rest. The level should be placed both lengthwise and crosswise on the machine table.

F. VERTICAL HEAD ON OVERARM: (EXPORT ONLY)

The is positioned on the overarm with the spindle up and the motor down. Before operating the machine it is necessary that the head be returned to its normal operating position by loosening the 4-5/8 hexagonal nuts located at the head end of the overarm. It will then be possible to tilt the head into normal operating position by using a crank on the 1 in stud located on the right side of the front end of the overarm. Because of the heavy overhung weight involved, the tilting of the head back to its normal position will be greatly facilitated if a second person can help push it into position. The head may then be trammed in as described in Section V, paragraph H-I.

G. VERTICAL HEAD ON OVERARM

The vertical head is tilted back on the overarm. Before operating the machine it is necessary that the head be returned to its normal operating position and trammed in as described in Section V, Paragraph H-I.

INSTRUCTION MANUAL

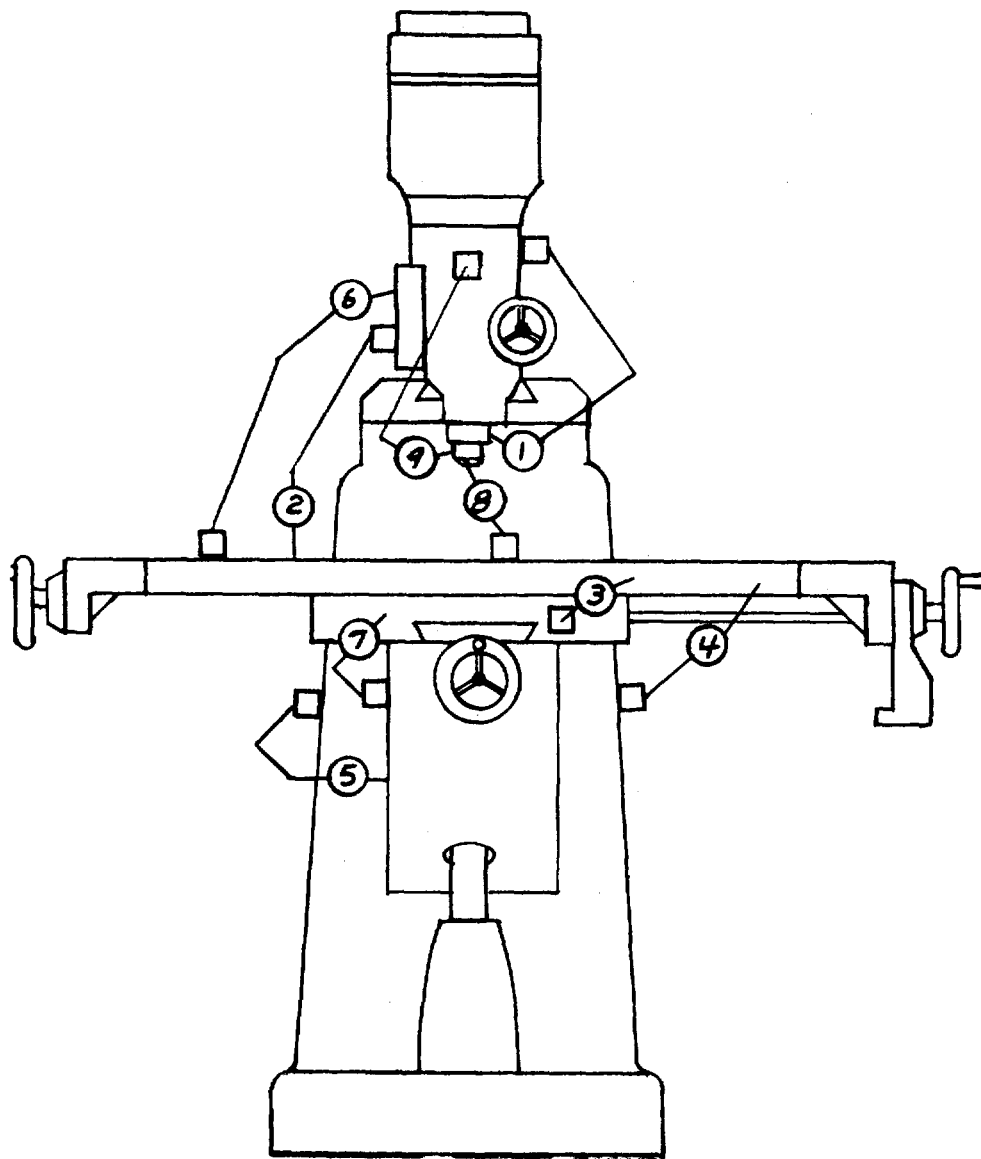


FIGURE 1

INDICATOR POSITION DRAWING

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IV. ADJUSTMENTS

A. PROPER GIB ADJUSTMENT PROCEDURE MUST BE DONE AFTER 40-HOURS ON NEW MILLS

Each 700 and 800 series of mills have three gibs. One at front dovetail of table; one on left dovetail of saddle; one on left dovetail of knee.

Each gib is supplied with two lock or adjustment screws.

The table gib has a lock screw on the right front of the saddle and the adjusting screw is on the left front of the saddle.

The saddle gib lock screw is at the rear of saddle on the left side, the adjusting screw is at the front of the saddle on the left side.

The knee gib lock screw is on the bottom of the knee on the left side, the adjusting screw is on the top on the left side.

Loosen the table gib lock screw several turns and tighten the adjusting screw until you feel the gib pressing against table dovetail, then tighten the lock screw, Never get this lock screw too tight as it will distort the gib.

Run the table back and forth and check for drag.

Repeat this adjustment for the saddle and the knee gib.

Now to check the gibs with an indicator, the following checks must be made: (See Figure 1 for reference)

1. With indicator mounted as in Position 3, the table gib can be tested for shake by pulling back and forth on the end of the table.
Anything over .0015 is too much, also the table should snap back to "0" each time.
2. To check the saddle gib, the indicator should be mounted as in Position 7 and the same tolerance should exit here.
3. The knee gib will be checked as in Position 5 by grasping the end of the table and lifting up and pushing down. Deflection here should not be more than .0003.

Now as a final check use Position 2 and run the table to its extreme right and left position.
The indicator runout should not be more than .0015.

B. QUILL FEED CLUTCH:

This clutch has been tested by drilling a 5/8 dia. drill in mild steel. After testing, the clutch is then adjusted to a minimum setting. If in operation, larger pressures are developed which cause the clutch to ratchet, it may be well to readjust the clutch using the steps below. If still larger pressures are needed after readjusting, you may assist the Quill Feed by applying a downward pressure on the hand feed lever.

PROCEDURE FOR ADJUSTING THE CLUTCH

Reference drawing 101-212-202, Section K-K

1. in the rear of the head between the head and the adapter is a hex nut (100-002-906) with a No.10-24 x 1/2 socket head cap screw for a lock.
 - a. First unscrew this lock screw until it is freely rotated with the fingers.
2. The minimum clutch tension is the position shown in the drawing. If more tension is desired, rotate the hex nut (100-002-906) up to 180° from its present position, and relock the No. 10-24 socket head screw.
3. It may also be desirable to adjust the travel of the clutch plunger:
 - a. This is done by means of the 1/4 20 x 3/4 socket set screw immediately behind the (100-004-543) feed cam housing as shown in Section F-F.
 - b. With the clutch disengaged tighten the set screw until a little roughness can be felt when moving the quill down by means of the hand lever.

INSTRUCTION MANUAL**C. PROCEDURE FOR REMOVING AND REPLACING QUILL COUNTER-BALANCE SPRING**

(Extreme caution should be exercised in this operation and instructions followed closely as this spring is 11 foot long when unwound.)

Using drawing (101-212-202) which is the head and quill assembly refer to section K-K and (101-112-101) base assembly refer to B-B and view Z:

1. The safest way to perform this operation is to first drop the quill assembly (101-212-307) down until the rack on the quill clears the pinion on the (100-004-546) cross shaft.
 - a. This is performed by first removing the drawbar and the (100-027-771) vernier holder and then the two 5/16-18 x 7/8 socket heads in the (100-002-917) quill block.
 - b. Holding the left hand on the bottom of the spindle and the right hand on the hand feed lever (101-212-312) slowly run the quill down out of the head casting by rotating the hand lever counter-clockwise (When the quill rack clears the pinion, the quill is free to fall and the hand lever may unwind very rapidly causing injury if not held tight and unwound slowly.)
2. Referring to drawing (101-112-101) section B-B remove the two 7/16-14 x 2 socket head screws which hold the (100-007-100) plate to the (100-009-202) adapter.
3. Remove the three 5/8 hex nuts which bolt the (100-007-100) plate to the head casting.
4. Grasp the (100-007-100) in such a way that the thumb can be pressed against the (100-002-910) cover shown in section K-K and gently pull the entire assembly away from the head. It may be necessary to gently tap this plate with a soft hammer to break the initial contact with the head.
5. After this assembly is removed from the head and layed on a bench, very carefully lift the (100-002-910) cover off the spring by holding it in place and pulling the (100-002-909) coupling away from the assembly.
6. Very carefully pry the shield (100-002-911) away from the spring assembly.
7. Now the spring can be pushed out of the (100-004-542) housing from the bottom of the inside.
8. When the new spring is installed, it will have to be in the right direction so that the hook on the spring is in the same direction as the slot in the (100-002-909) coupling.
9. When the three 5/8 nuts are put back on, they should be snug until the (100-007-100) plate is securely fastened to the (100-009-202) adapter by means of the two 7/16-14 x 1-1/2" socket head cap screws.
10. When the quill is replaced in the head, the counter-balance spring must be wound up tight by moving the hand lever (101-212-312) counter clockwise to its limit and then engage the quill rack with the cross shaft pinion.

NOTE

This spring is not intended to return the quill to its upper position, it is merely to cancel out the weight of the quill assembly.

D. QUILL FEED TRIPS & DEAD STOP ADJUSTMENT:

Refer to drawing #101-212-202. The Vertical Mill is provided with a means for setting an adjustable automatic feed trip device for the downward movement of the quill. Feed trip rod #100-002-961 actuates feed trip plunger #100-002-958 through feed trip arm #100-002-952 to disengage clutch. Disengagement occurs when quill feed trip key #100-002-917 contacts quick shift dial sleeve nut #100-002-763.

Downward feed adjustment is made by loosening knurled thumb screw #056-033-152 and repositioning quick shift dial sleeve nut #100-002-763.

E. DRIVE BELTS:

Refer to drawing #101-212-204. To provide the necessary slack for shifting of belt it is only necessary to loosen the motor clamp handle #100-002-955 (on right rear of pulley guard) and move motor forward. Increase belt tension by moving motor back and tightening motor clamp handle. To replace worn or broken belt remove 6 socket head screws from top of #111-212-002 drive pulley cartridge and lift off #111-212-002 cartridge, (2 tapped holes provided for jack screw if req'd.)

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F. SPINDLE BRAKE - VARIABLE SPEED HEAD

Refer To Drawing #101-218-201 (Sect. AA).

TO ADJUST THE SPINDLE BRAKE:

1. Start the spindle.
2. Turn 1/4-20 set screw #010-102-576 in until you hear the brake rubbing, then back the set screw out just enough to stop rubbing. Lock in place with jam nut.
3. Turn complete brake handle ass'y. so that 111-218-204 shaft rotates clockwise until you hear the brake rubbing, then turn counter clockwise just enough to stop rubbing & allow the handle to be hanging down. If the handle is pointing up when properly adjusted, knock the 3/16 dia. spiral, tin #010-454-512 out, reverse the handle 180° & replace the 3/16 dia. pin, so that the handle is hanging down.

V. OPERATION

A. VERTICAL SPINDLE

1. The spindle Start Stop Reverse Control is located at the upper left on the motor.
2. On the standard V-belt drive head the spindle brake lever is located at the top left of the pulley guard assembly. Move it to the left or right to engage the brake.
After moving to the left or right this lever may be raised to maintain brake engagement and hold the spindle in a fixed radial position for tool changing.
3. On the variable speed drive head the spindle brake is located at the bottom left of the pulley guard. It is engaged by pulling the control lever out away from the pulley guard. This camming action actuates the caliper type brake and will hold it in engagement until the control lever is returned back to its normal position flush with the pulley guard.

CAUTION

Always be sure spindle brake is completely disengaged before attempting to start spindle rotation in either direction.

4. Spindle speeds on the standard V-belt drive are changed by changing the position of the V-belt connecting the motor pulley to the spindle pulley and by shifting the back gear lever (high, low, or neutral).
5. Spindle speeds on the variable speed drive head are even more readily changed by moving the control lever from left to right or right to left with the spindle motor running and by shifting the back gear (high low or neutral).

CAUTION

Always be sure spindle motor is running before attempting to move variable speed adjustment lever.

B. BACK GEAR (See Drawing #101-212-204)

The back gear lever (shift lever #100-002-900) is located on the upper left side of the head. The lever has 3 positions; high, low, and neutral. in the high (out) position, spindle drive is geared directly from spindle pulley to spindles (dog clutch #100-002-991 is in up position, in contact with drive cone pulley hub #100-002-999). in the low (in) position, spindle drive is geared through back gear #100-002-985 (dog clutch #100-002-991 is in down position, back gear #100-002-991 is in mesh with back gear #100-004-557).

NOTE

¹ **Because of back gear construction, when machine is running in low speed range, spindle rotation is opposite to that of high speed range. Therefore, forward on reversing switch becomes reverse when in low speed range.**

NOTE

² **When shifting from neutral to high or low, turn spindle by hand while pushing back gear lever into position. This allows gears to line up in low speed and dog clutch to line up in high speed. When shifting into high, it is imperative to have the spindle brake in the brake on position.**

C. POWER FEED TRANSMISSION ENGAGEMENT (See Drawing #101-212-202).

The power feed engagement lever #100-002-900 is located directly below the back gear lever. This lever has 2 positions; in, to engage spindle power feed transmission, and out to disengage spindle power feed transmission.

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CAUTION

Always be sure spindle motor is stopped before attempting to move this lever to the in or engaged (upper) position.

NOTE

Disengage spindle power feed transmission when it is not being used. This will stop unnecessary wear on power feed worm gear.

D. QUILL (See Drawing #101-212-202)

1. The quill may be locked in a given vertical location by turning the quill-clamp in a clockwise direction. Lever is located at bottom of right side of head.

CAUTION

Do not engage quill feed with quill-clamp lever fully tightened.

2. The quill (or spindle) hand feed lever #100-002-107 can be adjusted to any one of six operating positions by moving outwards (to the right) on the lever hub and rotating to the desired position. The hand feed lever is held on by a spring plunger and can be pulled off when not in use.
3. Any one of three power feeds (in either an upward or downward direction) may be selected by moving the feed shift lever, located on right side of head, to the desired feed (.0015", .003" or .006") per spindle revolution. A neutral position is provided between each of these feed settings. If power feed is not being used it is wise to place the feed shift lever in one of the neutral positions. It may be somewhat easier to change the position of the feed selector lever when the spindle is rotating.
4. The fine feed handwheel #100-004-545 is placed in operating condition by locating the feed shift lever in a neutral position and engaging the power feed engaging lever #100-002-953. The fine feed handwheel is held on by a spring plunger and can be pulled off when not in use.
5. The knob on the shaft located in the center of the feed handwheel is used to select downfeed (pushed-in position), neutral (mid-position) or upfeed (pulled-out position) for either the power feed or the handwheel feed.

NOTE

Positions noted are for clockwise rotation of spindle. Counter clockwise rotation reverses these positions.

E. VERTICAL SPINDLE DRAWBAR (See Drawing #101-212-202)

Use spindle brake to restrict spindle rotation when tightening or loosening drawbar.

1. To install collet or tool holder in spindle - first, remove drawbar by pulling it out of spindle from top. Then, place collet or tool holder into spindle. Put drawbar back into spindle and tighten into collet or tool holder, using discretion.
2. To remove tool from spindle--loosen drawbar 3 or 4 turns and tap on end to free tool.

CAUTION

Do not loosen drawbar less than 4 or more than 5 turns when removing tool. If drawbar is too loose, the threads may be stripped when tapping on end.

F. HORIZONTAL SPINDLE DRAWBAR (See Drawing #101-180-207 (101-180-203 old)

Use spindle brake located at back of machine to restrict spindle rotation when tightening or loosening drawbar. (Otherwise it is the same as the Vertical Spindle Drawbar).

G. HORIZONTAL SPINDLE:

1. Spindle direction is set by forward-reverse switch located on left side of column. (Otherwise it is the same as the Vertical Spindle see paragraph V-A-3 & V-A-5)

H. HEAD: (See Drawing 101-112-101)

1. Tilting of the head in a front to back plane (turret and overarm models) is readily accomplished by loosening the 3 nuts at the right hand side of the head (around the hand feed lever) and the 3 nuts on the left side of the head, and applying crank to forward head tilting worm stud #100-002-963, located at bottom rear of head -left side.

INSTRUCTION MANUAL

CAUTION

When returning head to vertical position, sweep the table with an indicator attached to spindle to make sure head is square to table.

2. To tilt head from side to side, loosen the hex nuts which clamp the head to the overarm or the machine column (whichever the case may be). Then tilt head the desired amount by applying crank to the sidewise tilting worm stud at the right to the rear of the spindle head.

CAUTION

When returning head to vertical position, sweep the table with an indicator attached to spindle to make sure head is square to table.

- I. OVERARM OR RAM: (See Drawing 101-112-101 & 101-180-101)

The back to front position of the head and overarm is readily changed by loosening the 4 hex nuts which clamp the overarm to the turret. Apply a crank to the overarm adjustment shaft extension and move to desired position.

- J. TURRET (Vertical Mill) : (See Drawing 101-112-101)

To index the entire turret-overarm-head assembly loosen the 4 hex nuts, 2 on either side of the overarm which clamp the turret to the top of the column. Then swing the turret to the desired position and reclamp.

NOTE

It is highly recommended that all clamping nuts and bolts (turret to column, overarm to turret, head side-wise tilt and head forward-back tilt) be securely tightened before any machining cuts are taken. Always check these points before starting a cut. Also, when returning overarm to normal position, attach an indicator to the overarm, and slide the overarm in and out, with the indicator riding against a square, which has been squared to front of table to make sure overarm is square with table.

- K. TURRET (Horizontal Mill) : (See Drawing 101-180-101)

1. The turret can be rotated on the column a full 360°.
2. The locating pins are effective only when the ram is used with the overarm support for the horizontal spindle. The vertical spindle at this time would be at rear of machine. It may be necessary to tilt the vertical head slightly for clearance at the rear of the machine when the machine is set for horizontal milling with a long milling cutter arbor.

NOTE

It is highly recommended that all clamping nuts and bolts (turret to column, overarm to turret, head side-wise tilt and head forward-back tilt) be securely tightened before any machining cuts are taken. Always check these points before starting a cut.

Also, when returning overarm to position for vertical milling, attach an indicator to the overarm, and slide the overarm in and out, with the indicator sliding against a square which has been squared to front of table to make sure overarm is square with table.

3. The complete horizontal spindle, turret, overarm & arbor bearing may be positioned 30° either side of normal horizontal milling position by loosening the four 5/8 hex. hd. screws (two on either side of the spindle, slightly below the C/L of the spindle) and swing the entire top unit to the desired angular position.

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VI. PREVENTIVE MAINTENANCE

A. INSPECTIONS:

1. Inspect taper of spindle for cleanliness and freedom from chips of foreign matter. Frequency Each time tool holder is inserted. Inspection by machine operator. No special equipment required.
2. Inspect and adjust gibs of slide ways. Frequency every 160 hours. More often if looseness is noted by operator. Inspection and adjustment by machine operator or machine maintenance man. No special equipment required other than allen wrench. (See gib adjustment instructions item IV-A)
3. Inspect for general cleanliness of machine, paying particular attention to keep dirt and chips from slide ways. Do not use air to remove such dirt and chips -but wipe off ways or keep them covered. Flood ways with light oil and work slide movements back and forth to wash out foreign matter. Then re-lubricate machine according to lubrication instructions. Frequency Constantly, as far as wiping off chips and dirt are concerned. Every 40 hours ways should be flooded with oil and cleaned as above. No special equipment required.
4. Inspect drive belts for wear, hard spots at splice, etc.
Frequency Every 40 hours.
Inspection by machine operator or machine maintenance man.
No special equipment required.
5. Inspect to see if vertical head is square with table, by mounting indicator on spindle and sweeping table. Frequency Every 80 120 hours, or after head has been tilted. Inspection by machine operator or machine maintenance man. Special equipment required consists of (1) A short accurate arbor to insert in spindle. (2) A clamp for use in clamping a 6" bar to above arbor in a horizontal position. (3) 6" bar approximately 1/2" in diameter. (4) An accurate dial indicator to clamp to above 6" bar in position so when spindle is revolved by hand, nib of indicator in contact with table, sweeps table in a full circle and indicates out of squareness.

NOTE

Table is intentionally left .0005" high in front. This will gradually decrease as machine is used.

6. Inspect electrical equipment. Frequency in accordance with standard plant policy. Inspection by machine maintenance man. No special equipment required.

B. PARTS REPLACEMENT:

None except as indicated by wear or malfunction.
Frequency or replacement only as above.

C. LUBRICATION (See Lubrication Sheet Page 2)

VII. TROUBLE SHOOTING NOTE

NOTE

Ordinarily trouble will not manifest itself except when actually working with machine.

1. Slide ways working hard or binding.
 - a. Cause gibs out of adjustment, either too tight or too loose. In the lattercase causing gib to "wedge". Remedy Adjust gibs.
 - b. Cause Dirt in slide ways. Remedy - Wash out slide ways with light oil.

INSTRUCTION MANUAL

2. Chatter or vibration when cutting.
 - a. Cause Dirt in spindle taper, causing bad fit between tool holder shank and spindle taper. Remedy Clean spindle taper and shank of tool holder.
 - b. Cause Faulty shank on tool holder. Remedy Replace shank or dress off burrs, if due to nicks or burrs.
 - c. Gibs poorly adjusted on slide ways, or dirty. Remedy Adjust as in IV-A.
 - d. Work improperly clamped to table of machine. Remedy Check for rocking or movement, and correct by proper clamping.
 - e. Improper grind on cutting tool. Remedy Replace or re-grind tool.
 - f. Hard spot at splice of drive belts or worm belts. Remedy Replace belts.
 - g. Spindle quill worn in quill head. Remedy Tighten quill head lock slightly.
 - h. Incorrect spindle speed, table feed, or both. Remedy Ordinarily increase spindle speed and/or increase or decrease feed to break up vibration period. Experiment by using hand feed to feed table.
 - i. Drive pulleys worn in grooves or loose on shafts. Remedy replace pulleys.
3. Boring or milling out of square or at an angle.
 - a. Cause Head not properly aligned with table. Remedy Check head for alignment and correct.
 - b. Work improperly set up; i.e. not square and flat. Remedy Check and re-align work.
4. Failure to hold center distance when locating for boring.

Cause Failure to take back-off tension on lead screw after coming up to indicator reading, causing table to "creep", or failure to lock up slide ways with same amount of tension after moving table to new position.

VIII. SPARE PARTS RECOMMENDED

SET OF DRIVE BELTS FOR ALL DRIVES; (See Parts List)

IX. SPECIAL MAINTENANCE

Should it become necessary to disassemble certain major elements of the machine the following suggestions may prove helpful.

- A. TO REMOVE VERTICAL SPINDLE PULLEY (Drive Cone Pulley), SPINDLE BEARINGS; AND SPINDLE BEARING SUPPORT:
 1. Refer to drawing #101-212-204
 2. Remove 6 socket head screws holding drive pulley cartridge #111-212-002 to pulley guard. (2 tapped holes provided in this part for jack screws if req'd.
 3. Lift out drive pulley cartridge (containing drive cone pulley, spindle bearings and spindle bearing support).
 4. Remove cartridge bearing lock nut #100-003-000.
 5. Put drive pulley cartridge in an arbor press, locating on bottom face of drive cone pulley #111-212-003. Drive out drive cone pulley hub #111-212-201. This frees drive cone pulley (spindle pulley).
 6. Remove cartridge bearing retaining plate #111-212-004 by removing 4 socket head screws.
 7. Flip drive pulley cartridge #111-212-002 over on arbor press and drive out spindle bearings.

INSTRUCTION MANUAL

B. TO REMOVE MILLING MACHINE TABLE & LEAD SCREW. (See Drawing #101-436-101)

1. Remove handwheels #111-438-001, dials #111-346-008 & end plates #111-436-005 from each end of table.
2. Remove retaining cap #111-436-006 from left end.
3. If machine has a table power feed, disassemble by removing the bronze gear inside the power feed, (4) screws & R.H. end plate #111-436-005.
4. Disconnect end brackets #111-436-003 & #111-436-004 by removing 4 screws.
5. The table can now be removed by sliding in either direction.

C. TO REMOVE SADDLE (See Drawing #101-346-101)

1. First remove the table, as in "B" above.
2. Remove handwheel #111-438-001 & dial #111-346-008.
3. If machine has independent saddle power feed unit, disassemble by removing the bronze gear inside the power feed & 4 screws.

Remove plate #111-346-003 replace the handwheel & turn until lead screw is free of nut.

4. Remove lead screw nut #111-436-012 shown on drawing #101-436-101. It may be necessary to pry the nut loose from two roll pins which position the nut.
5. The saddle can now be removed by sliding forward.

D. PROCEDURE FOR REPLACING OIL SEAL in BACK GEAR HOUSING OF ALL GEAR HEAD MODELS 823 and IRD-125 1

1. To make this job relatively simple, it is advisable to remove the spindle motor first. This is accomplished as follows after shutting off the power and moving the speed lever to 4200 RPM.
 - a. Remove the two 3/8 hex cap screws which hold the motor bracket to the pulley guard assembly (111-180-303).
 - b. Slide the motor forward toward the spindle as far as possible. Then by working the variable speed belt over the edge of the bottom sheave of the motor pulley, the motor will then be free of the belt.
 - c. The spindle motor can then be lifted off the pulley guard.
2. Now remove the 1/2-13 hex nuts (3) which holds the back gear housing (101-180-305) to the top of the head.
3. Run the quill all the way to the bottom of its travel by means of the (101-212-312) hand feed lever.
4. Now lift the entire back gear housing (101-180-305) and pulley guard assembly (101-180-303) off the spindle spline and the top of the head, and lay onto a suitable work bench with the three studs in the (101-180-305) back gear housing at the top and the mounting surface for the spindle motor on the bottom.
5. Remove the eight 1/4-20 x 7/8 socket heads which hold the (101-180-305) back gear assembly to the (101-180-303) pulley guard assembly and lift the back gear housing (101-180-305) away from the (101-180-303) pulley guard.
6. This exposes the (111-180-220) drive shaft which can be removed by lifting out of the back gear housing thus exposing the top side of the (058-010-088) oil seal which can then be tapped out of the casting, being very careful not to damage the (077-103-003) 2815 INA bearing.
7. Now put the (111-180-220) drive shaft back into the back gear housing and, being very careful, start the new (058-010-088) oil seal back into the back gear housing with the lip of the inner race of the seal setting properly against the OD of the (111-180-220) drive shaft.
8. Now, reassemble in reverse order.

INSTRUCTION MANUAL

E. PROCEDURE FOR ELIMINATING SHAKE IN QUILL FEED HAND LEVER

Shake in the quill feed is usually caused by shipping vibration. The proper way to eliminate this is as follows:

1. Shift the speed range into the direct drive or up position on the back gear lever.
2. Run the spindle speed at approximately 1200 RPM with the quill fully retracted into the head casting.
3. Loosen the three 1/2" nuts which hold the back gear housing (100-009-204) to the top of the head, thus allowing the back gear and pulley guard assembly to "float".
4. Then by tightening the 1/2" nuts, preferably the front one first, the back gear assembly will tend to center itself. (NOTE A little experimenting may have to be done if tightening the front nut first does not eliminate the shake.)
5. In rare cases, the pulley guard housing could have been shaken out of line from the (100-009-204) back gear housing.

In this case, the eight 1/4-20 x 7/8 socket heads which hold these two assemblies together will have to be loosened slightly and the unit allowed to center itself as explained in Step 4.

F. PROCEDURE FOR CHANGING R-8 PIN 745, 747, 756,757, 847, 856, 857, 760,860, and 887

1. Loosen 10/32 socket set screw on the bottom and read of the quill body.
2. Unscrew the(100-002-972) or(100-002-977) nut from the end of the quill using a spanner wrench with 5/32 or 3/16 lugs.
3. Pull or pry the (100-002-974) brass retainer down over the taper end of the spindle thus exposing the head of the R-8 pin which can then be pulled out of the spindle.
4. Replace the pin and reassemble in reverse order.

G. PROCEDURE FOR CHANGING HEADS 745,747,845,847,760,860,887

CAUTION

Before loosening all four 5/8" nuts on front of overarm, have a sling on the head to prevent falling.

1. Remove motor from pulley guard for VSD, see Step 5.
2. Remove (010-222-378) tilt shaft which will free up the (056-008-053) Boston worm gear and allow it to fall free of the overarm.
4. Remove three of the 5/8 hex nuts which hold the 100-009-202) adaptor to the front of the overarm.
5. Then after a hoist or sling is attached around the head or pulley guard, the remaining 5/8 nut may be loosened. (Caution: The head is then free to fall to either side.)
6. Then pull straight out on the head assembly to clear the (100-004-569) tilt gear and the (100002-904) T bolts.
7. Reassemble in reverse order.

H. STEPS TO TAKE TO CHANGE MOTORS ON VARIABLE SPEED HEADS

1. Speed shift lever set at 4200 RPM.
2. Remove two 3/8 16 x 1-1/4 hex head cap screws which hold the motor to the pulley guard.
3. Slide motor as far as possible toward the spindle and work the belt over the motor pulley.
4. Remove motor from the pulley guard housing.
5. Remove pulley from defective motor and reassemble in reverse order.
6. It may be necessary to force the motor pulley flanges apart a little to facilitate slipping the belt over the pulley.

INSTRUCTION MANUAL

I. INSTRUCTIONS FOR CHANGING SPINDLES IN THE FOLLOWING MODELS 745, 747, 756, 757, 845, 847, 856, 857, 760, 860, and 887.

1. Remove drawbar.
2. Drop knee and move saddle to rear so as to provide clearance for quill removal.
3. Remove (100-027-771) adjustable vernier blade holder.
4. Remove two 5/16-18 x 7/8 socket head cap screws in (100-002-917) quill feed trip key and remove key.
5. Put right hand on (101-212-312) spindle feed handle arm and left hand on the bottom of the quill, and by moving the (101-212-312) handle in a counter clockwise direction, run the quill down until the rack on the quill clears the pinion on the cross shaft.
6. When this happens, the (101-212-312) hand lever will unwind very rapidly. If released, it could cause injury. So it must be unwound slowly.
7. Let the quill slide down out of the head casting and put it in a vise, being sure to use brass or lead jaws in the vise.
8. Release the locking ear of the W-07 lock washer in the N-07 locknut or snap ring in the top of the quill and remove nut from the spindle. (See Paragraph 11)
9. Remove (100-002-972) front bearing retainer from quill after first releasing the 10/32 socket set screw in the lower rear of the quill. (NOTE: in the case of #30 MMT, the number is 100002-977.)
10. Remove quill from the vise and strike spline or upper end of spindle against a solid piece of wood laying against a solid surface, such as the floor. The spindle and the two lower spindle bearings and spacers will then come out of the quill.
11. Replace new spindle and assembly in reverse order making very sure that the N-07 locknut is tight enough so as to put tension on the 2968 spacer on serial number before approximately 17105 on R8 spindles and approximately 17360 on #9 B & S and #30 MMT spindles. After this serial number make sure the locknut is tight against the bearing.
12. When putting the quill back into the head casting, first start the quill into the bore of the casting by gentle pressure and care (do not force).
13. Line up the spline of the spindle with the spline of the (100-004-576) drive hub by turning the spindle after it goes up against the bottom of the (100-004-576) hub.
14. Next, wind the 101-212-312 counter clockwise to the end of its spring tension and push quill up until the rack of the quill engages the pinion of the cross shaft and use (101-212-312) hand lever to raise quill up to the top of its travel.

J. PROCEDURE FOR FREEING UP BACK GEAR TO DIRECT DRIVE 745, 756, 760, 845, 856, 747, 757, 860, 847, and 857

This particular problem is usually caused by the (111-218-001) pulley guard being jolted out of line during shipment and can usually be remedied as follows:

1. Shift the back gear lever into the direct drive or upper range and set the speed at about 1500 RPM.
2. Loosen the eight 1/4-20 x 7/8 socket head cap screws which hold the (111-218-001) belt guard to the (111-218-212) assembly)
3. Turn on the spindle motor, move the (111-218-001) belt guard a very slight distance in several directions. The dowel pin hole in the front of the pulley guard can be used with 1/4" allen wrench to move the pulley guard back and forth.
4. The pulley guard will actually tend to center itself if reasonable care is exercised when retightening the eight socket heads that hold the belt guard to the back gear housing.

INSTRUCTION MANUAL

K. PROCEDURE FOR ELIMINATING CREEP IN VSD SHIFTER

- I. Referring to drawing (101-218-201) variable speed drive sandwich assembly, lower right hand drawing at the extreme top of the head you will notice four 10/32 x 7/8 button head screws which hold the (111-218-002) shift lever assembly to the (111-218-003) cam housing.

These four screws keep enough tension on the 1056-004-451) cup washers to provide the proper friction between the shift lever and the housing to prevent creeping.

This creeping is easily remedied by tightening these four button head screws.

L. METHOD OF CHANGING PRESENT SPINDLE FOR OLDER TYPES WITH 2968, 2969, AND 2970 SPACERS

1. Remove N-07 lock nut from top of spindle.
2. Loosen 10/32 lock screw from bottom of quill.
3. Remove 2972 quill nut by turning counter clockwise.
4. Tap splined end of spindle on block of hard wood and spindle and two lower bearings will come out.
5. Discard spacer 2968.
6. Put 200-039 spacer on splined end of spindle against the thrust bearings of new spindle.
7. Press entire assembly in quill and install quill nut.
8. Install snap ring on top of spindle.
9. If old spindle bearings are used, discard spacers 2969 and 2970.

M. PROCEDURE FOR CHANGING BRAKE SHOES ON VARIABLE SPEED HEAD ASSEMBLY

1. With spindle motor running shift spindle speed to highest RPM then remove spindle motor as described in paragraph "H".
2. Referring to drawing 101-218-201 in the service manual remove the 111-218-002 speed shift lever by removing the four (4) socket head cap screws which hold it against the 111-218-205 ring.
3. Remove the six (6) 1/4 20 x 3/4 socket heads which hold the 111-218-003 cam housing to the pulley guard and remove housing from pulley guard.
4. Now by reaching through the holes in the sides of the pulley guard, the lower pulley sleeve can be worked up out of the pulley guard casting, thus exposing the brake shoes.
5. Now the 3/8 x 3-1/4 roll pins can be driven in to clear the brake shoes. (Note: The pins must be driven all the way to clear the pulley guard casting and fall free.)
6. Unscrew the 111-218-204 brake pull rod and remove old shoes.
7. Reassemble in reverse order making sure the 056-009-636 cog belt is around the drive hub. This is made simpler if the cog hub is slowly rotated while being pushed or tapped down into its proper position.
8. After reassembly is completed, the shoes can be properly adjusted by first tightening the 1/4 20 x 1-1/4 socket set screw above the brake handle until the shoe makes contact with the outer race of the pulley and then backing off to just clear. Then the 111-218-004 brake pull rod should be turned clock wise until contact is made with the inner pulley race and then backed off to clear.

INSTRUCTION MANUAL**N. PROPER WAY TO CHECK FOR POSSIBLE LOOSENESS OF QUILL IN HEAD CASTING AND FOR LOOSENESS OF SPINDLE IN QUILL HOUSING**

Once in a while there is a complaint on what appears to be looseness in the head and or quill assembly.

In 99% of these cases this is caused by loose gibs and has nothing to do with the fit of the spindle and quill in the head casting.

However, in the event that a check is to be made, it should be done as in Figure 1, Position 1 & 9 with the indicator base mounted solidly on the head itself.

If a reasonable amount of force is applied to the, spindle, a reading of up to .0005 is not out of line, with the Quill retracted.

X. RECOMMENDED SPEEDS FOR HIGH SPEED FAST SPIRAL END MILLS:

SIZE	TOOL STEEL AND FORGINGS	MACHINE STEEL C.R. STEEL	CAST IRON AND FREE CUTTING STEEL
1/8"	1675	2850	2850
3/16"	1000	1675	1675
1/4"	1000	1000	1675
5/16"	600	1000	1000
3/8"	600	600	1000
7/16"	600	600	600
1/2"	355	600	600
5/8"	355	355	600
3/4"	355	355	600
7/8"	210	355	355
1"	210	355	355

The foregoing should be regarded as approximate, as many factors control the efficient operation of end mills. Always keep cutters sharp, and a steady flow of oil or compound directly on the working point will allow much higher cutting speed. Keep rate of feed consistent with finish required.

INSTRUCTION MANUAL

XI. GENERAL SPEED RECOMMENDATIONS:

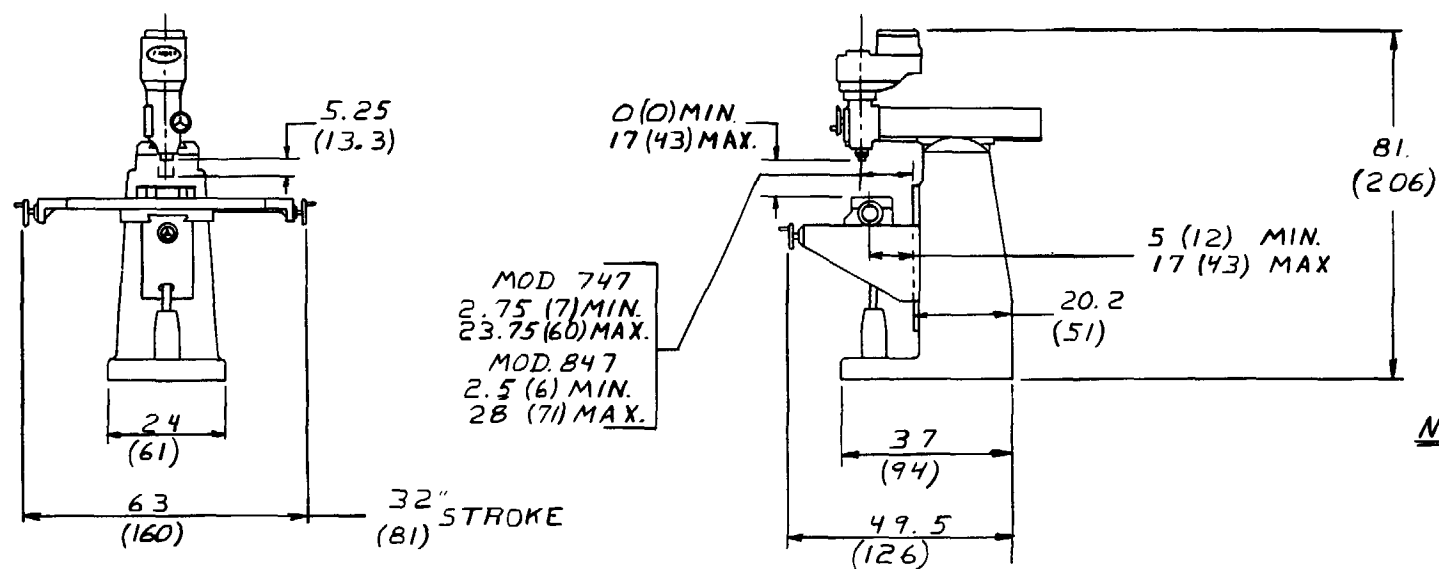
FEET PER MINUTE

MATERIAL TO BE CUT	ROUGH CUT	ROUGH AND FINISH	LIGHT AND FINISH CUT
Cast Iron-Soft-(Under 200 Brinnell)	70	80-90	120
Cast Iron-Med.-(200-300 Brinnell)	55	60-70	90
Cast Iron-Hard-(over 200 Brinnell)	40	50-60	70
Steel (Chrome Nickel 40-45 Shore)	30	40	50
Steel (Stainless)	60	80	90
Steel (Low Carbon)	80	90	140
Steel (High Carbon)	40	50	70
Bronze (Medium)	90	120	150
Bronze (Hard)	65	90	130
Brass (Hard)	100	150	200
Copper	150	200	300
Duraluminum	400	---	600
Aluminum	600	---	1000

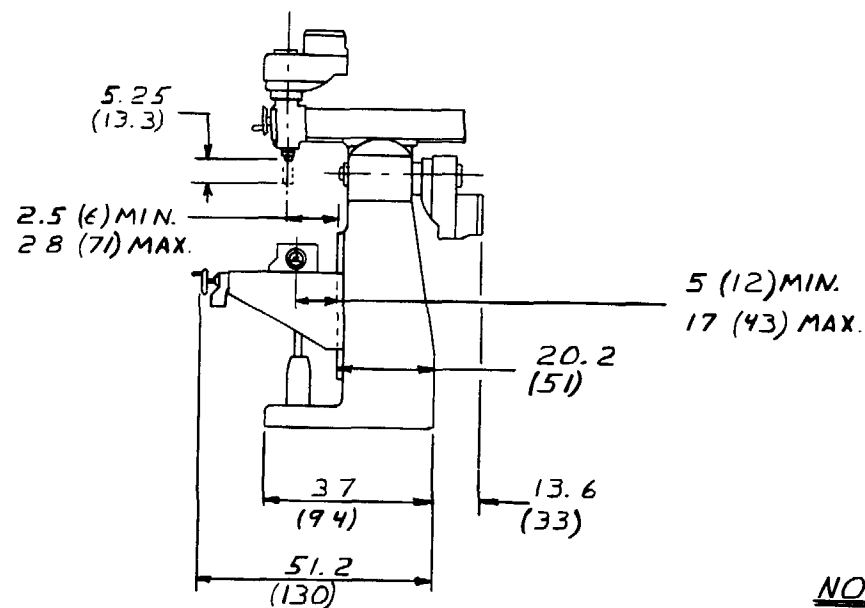
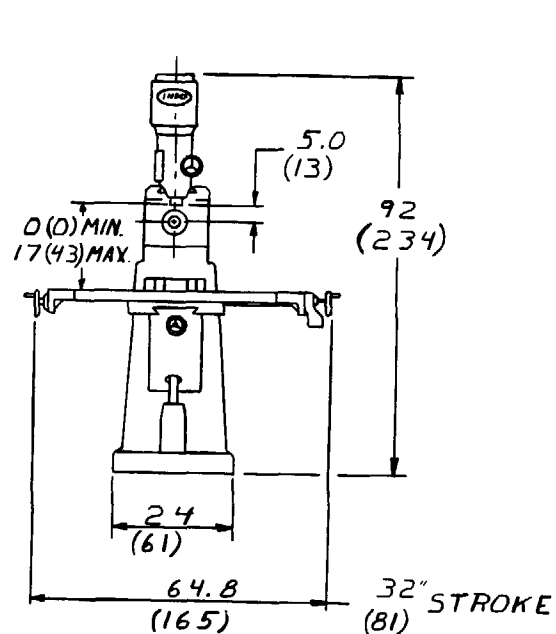
XII. TABLE OF CUTTING SPEEDS AND FEEDS

FEET PER MINUTE	15	20	25	30	40	50	60	70	80	90	100
-----------------	----	----	----	----	----	----	----	----	----	----	-----

DIAMETER, INCHES	REVOLUTIONS PER MINUTE										
1/16"	917	1222	1528	1833	2445	3056	3667	4278	4889	5500	6112
1/8"	458	611	764	917	1222	1528	1833	2139	2445	2750	3056
3/16"	306	407	509	611	815	1019	1222	1426	1630	1833	2037
1/4"	229	306	382	458	611	764	917	1070	1375	1375	1528
5/16"	183	244	306	367	489	611	733	856	978	1100	1222
3/8"	153	204	255	306	407	509	611	713	815	917	1019
7/ 16"	131	175	218	262	349	437	524	611	698	786	873
1/2"	115	153	191	229	306	382	458	535	611	688	764
5/8"	91	122	153	183	244	306	367	428	489	550	611
3/ 4"	76	102	127	153	204	255	306	357	407	458	509
7/8"	65	87	109	131	175	218	262	306	349	393	437
1"	57	76	95	115	153	191	229	267	306	344	382
1-1/8"	50	67	84	102	136	170	204	238	272	306	340
1-1/4"	45	61	76	91	122	153	183	214	244	275	306
1-3/8"	41	55	69	83	111	139	167	194	222	250	278
1-1/2"	38	50	63	76	102	127	153	178	204	229	255
1-5/8"	35	47	58	70	94	118	141	165	188	212	235
1-3/4"	32	43	54	65	87	109	131	153	175	196	218
1-7/8"	30	40	50	61	81	102	122	143	163	183	204
2"	28	38	47	57	76	95	115	134	153	172	191

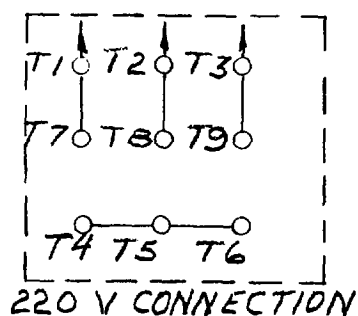
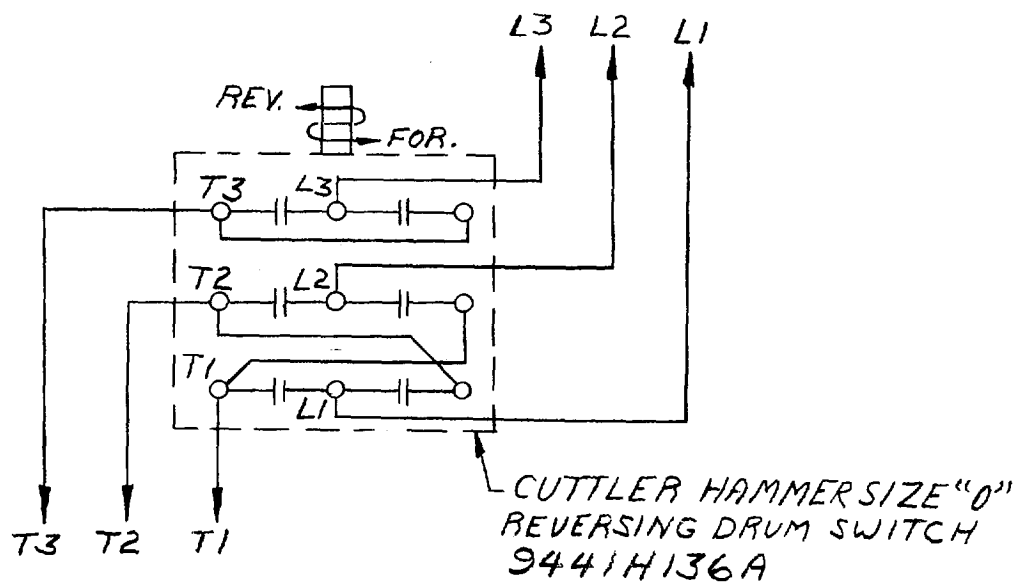


FLOOR PLAN		models
		747-847
8	900-011	

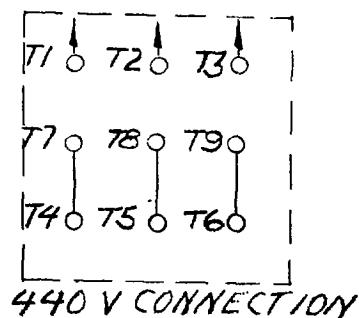


NOTE
ALL METRIC DIMENSIONS
ARE IN CENTIMETERS (XX)

FLOOR PLAN - Model 860	
B	900-012

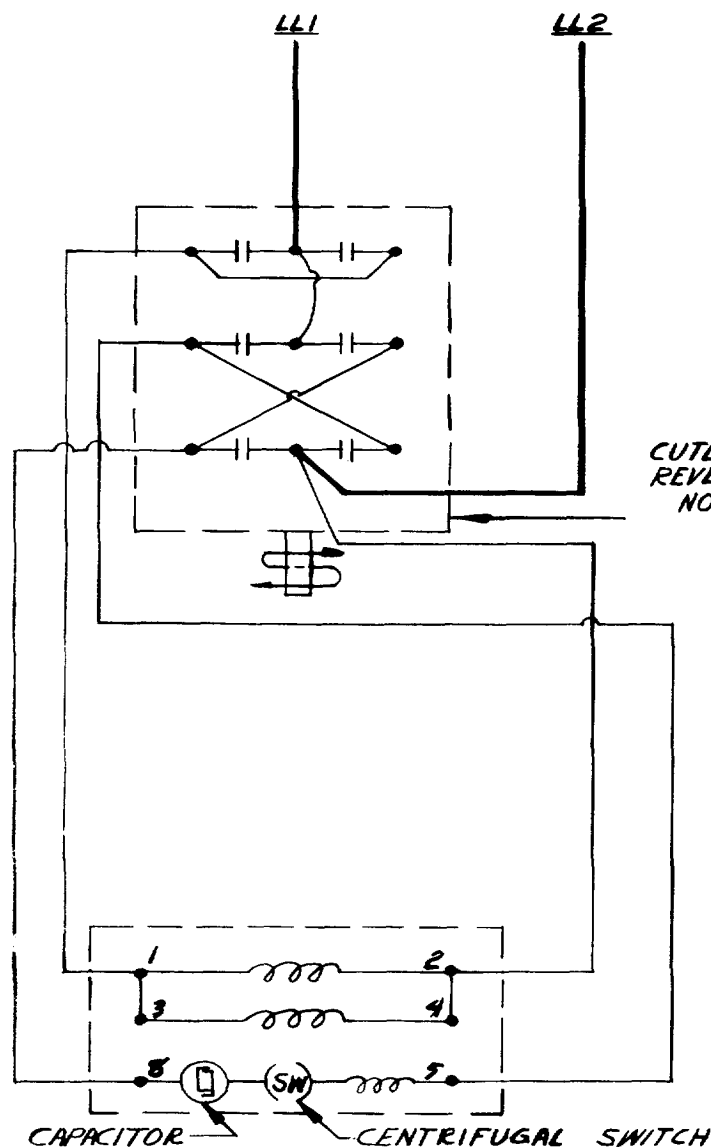


MOTOR
TERMINAL
BLOCK



(CONNECTIONS FOR HEAD MOTOR) 14 FEB 57 RJP 2032

WIRING DIAGRAM FOR 220/440 V
60 CY, 3 PH, 1 & 2 HP MOTOR
45 MILL & 645



CUTLER-HAMMER SIZE "0"
REVERSING DRUM SWITCH #9441H136A

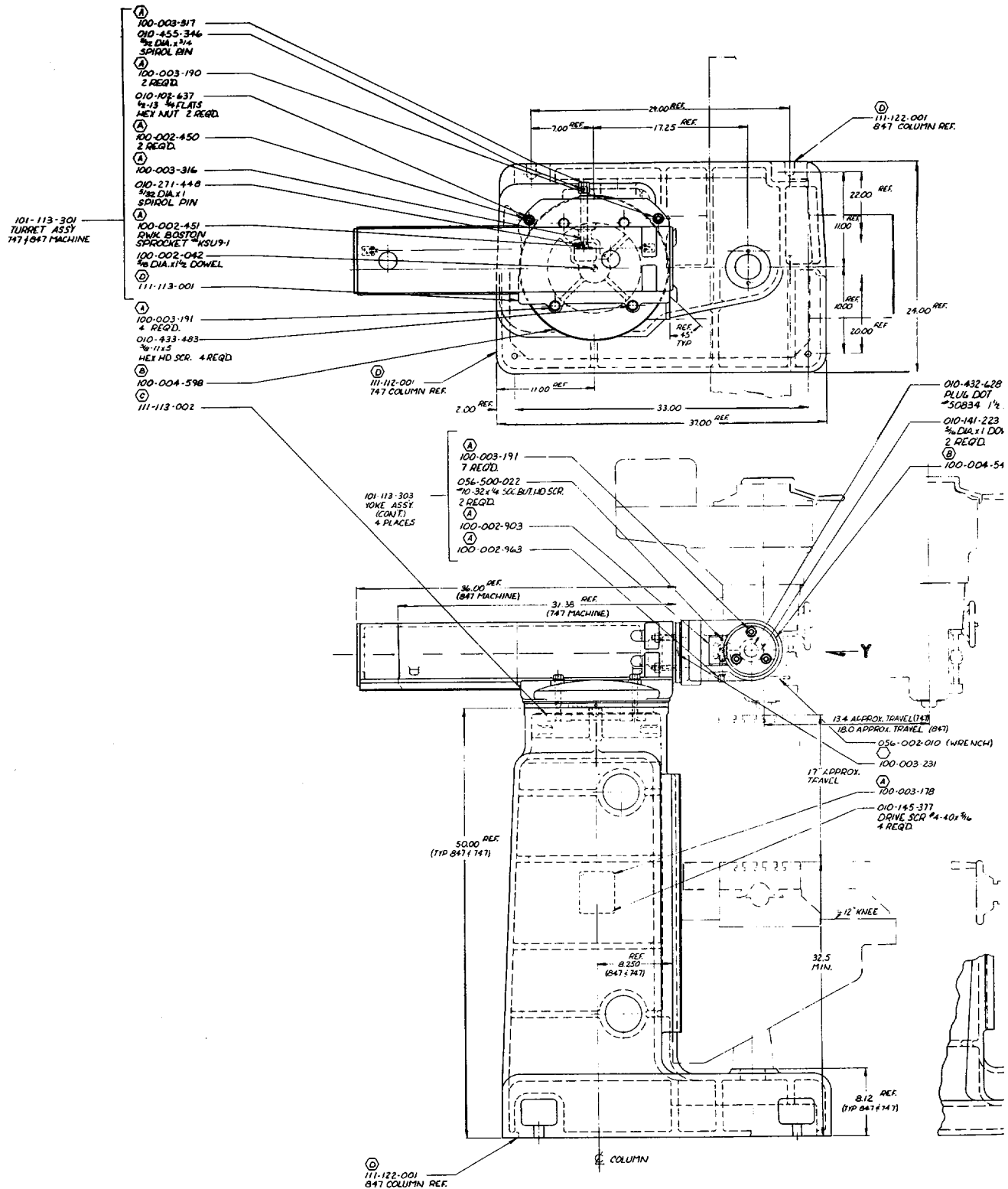
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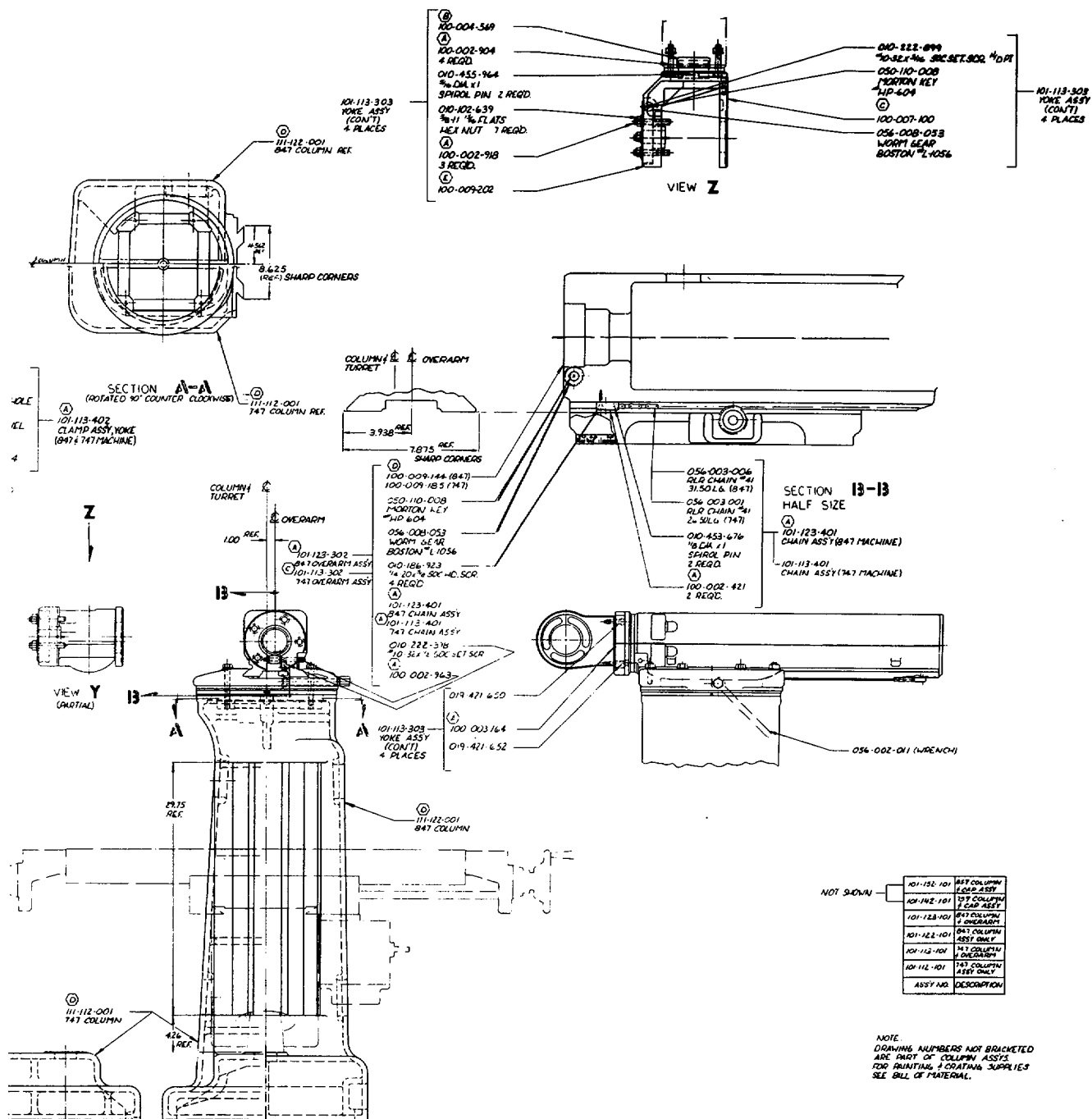
SAME AS DWG. 2611 EXCEPT
FOR NEW NEMA STD.

DOERR 1HP, 115/230 V.
1740 RPM MOTOR TERMINAL
BOX FR66, TEFCBB

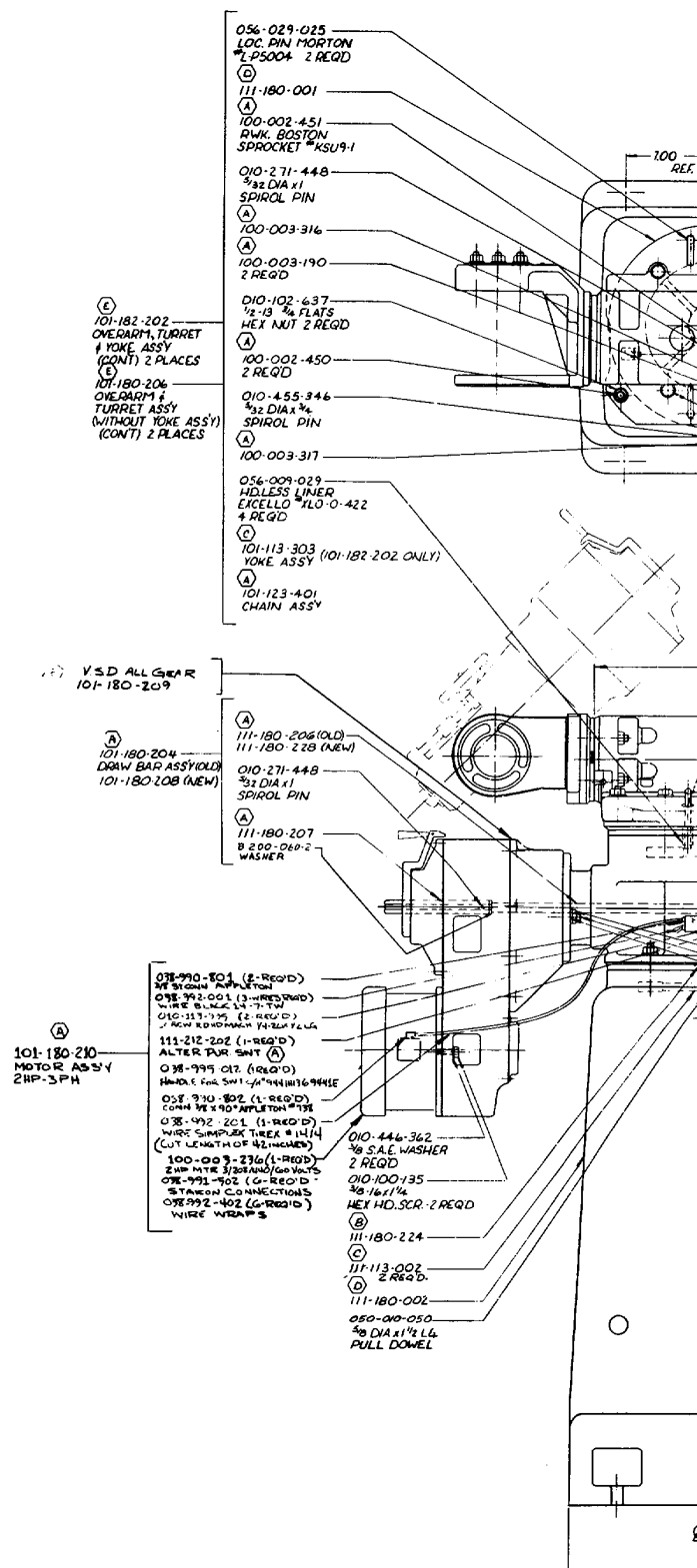
TO REVERSE ROTATION,
INTERCHANGE COIL LEADS
5 AND 8.

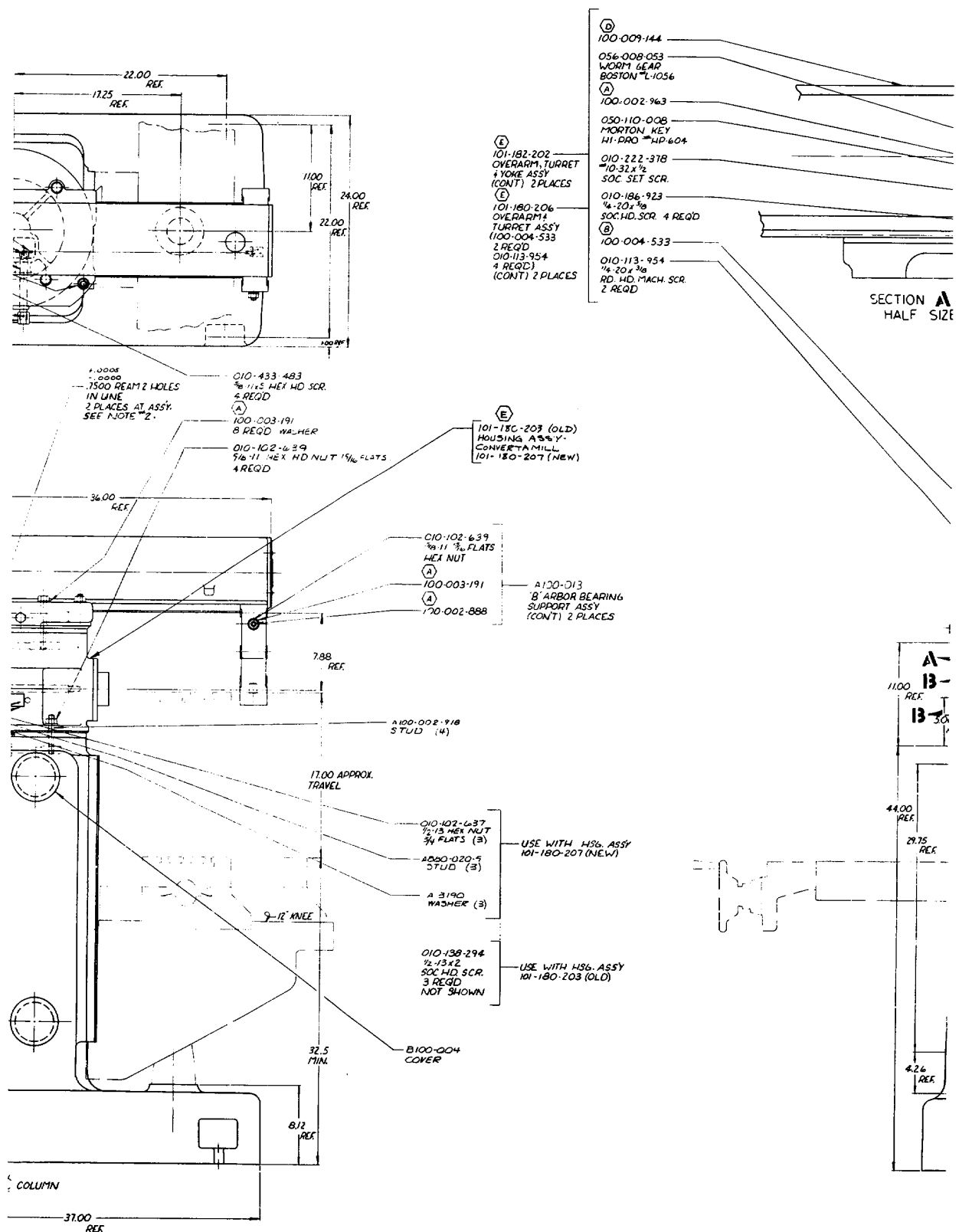
WIRING DIAGRAM - 115 V., 60 CYC., SINGLE PHASE - 1 HP. - DOERR MTR. - NEW NEMA STD.		
WEF 10 OCT. 69	A	100003360

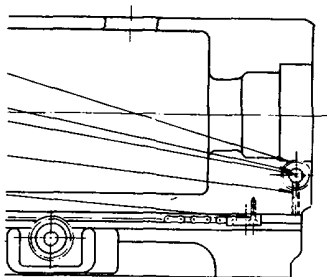




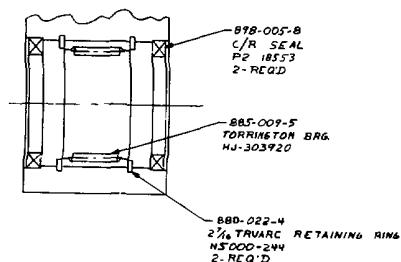
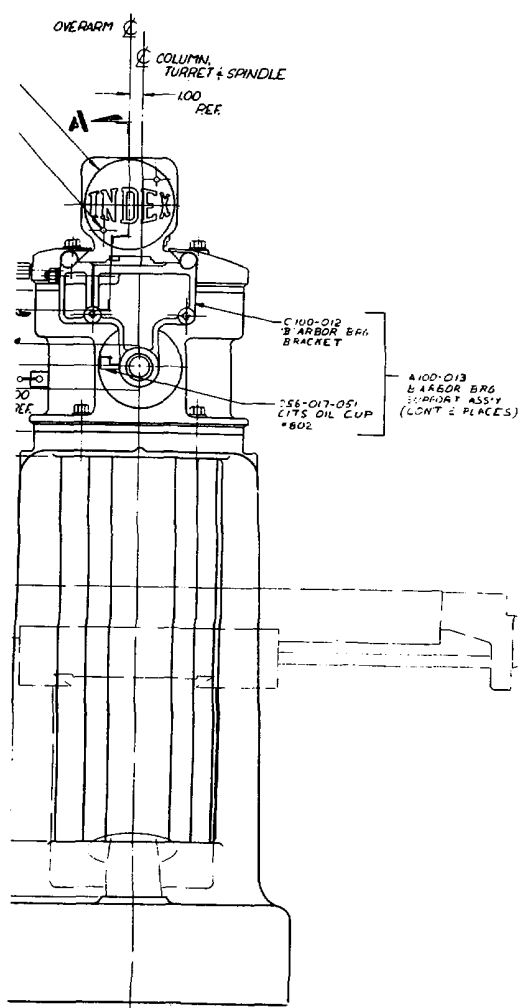
BASE ASS'YS	
E	101-112-101







-A

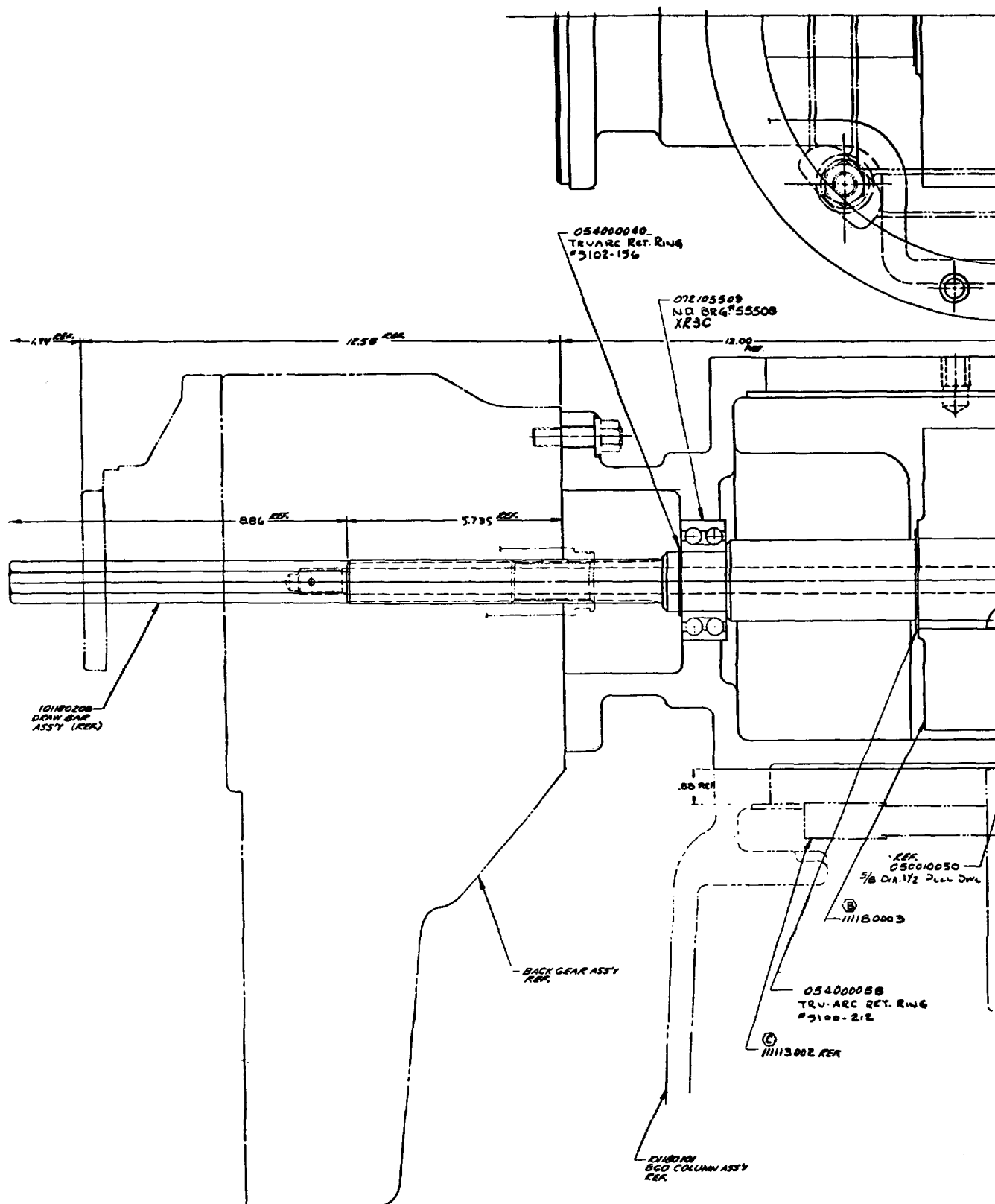


SECTION 1313

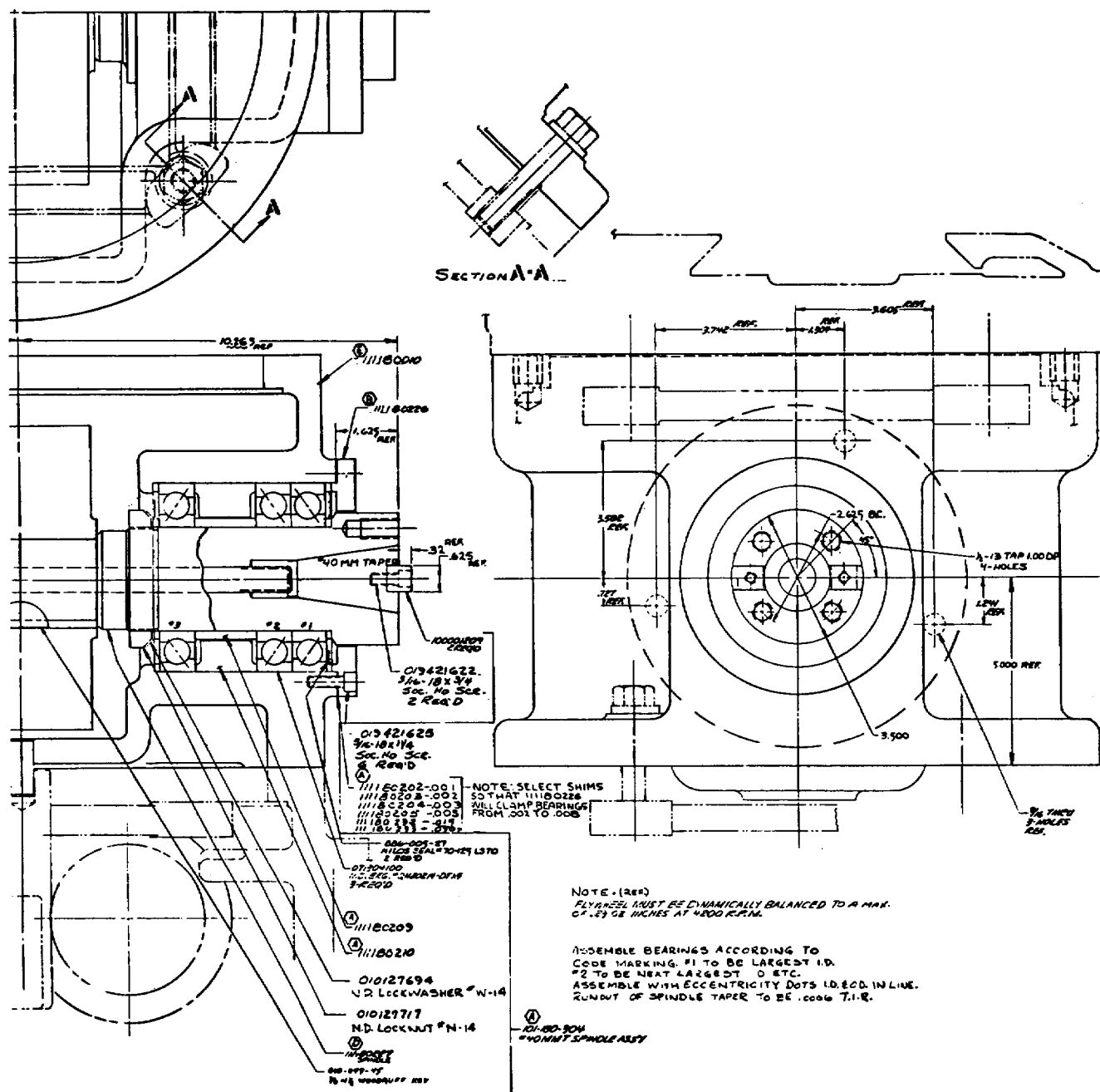
FULL SIZE

101-181-101	860 COL & O'ARM
101-183-101	860 COL & O'ARM
ASSY NO.	DESCRIPTION

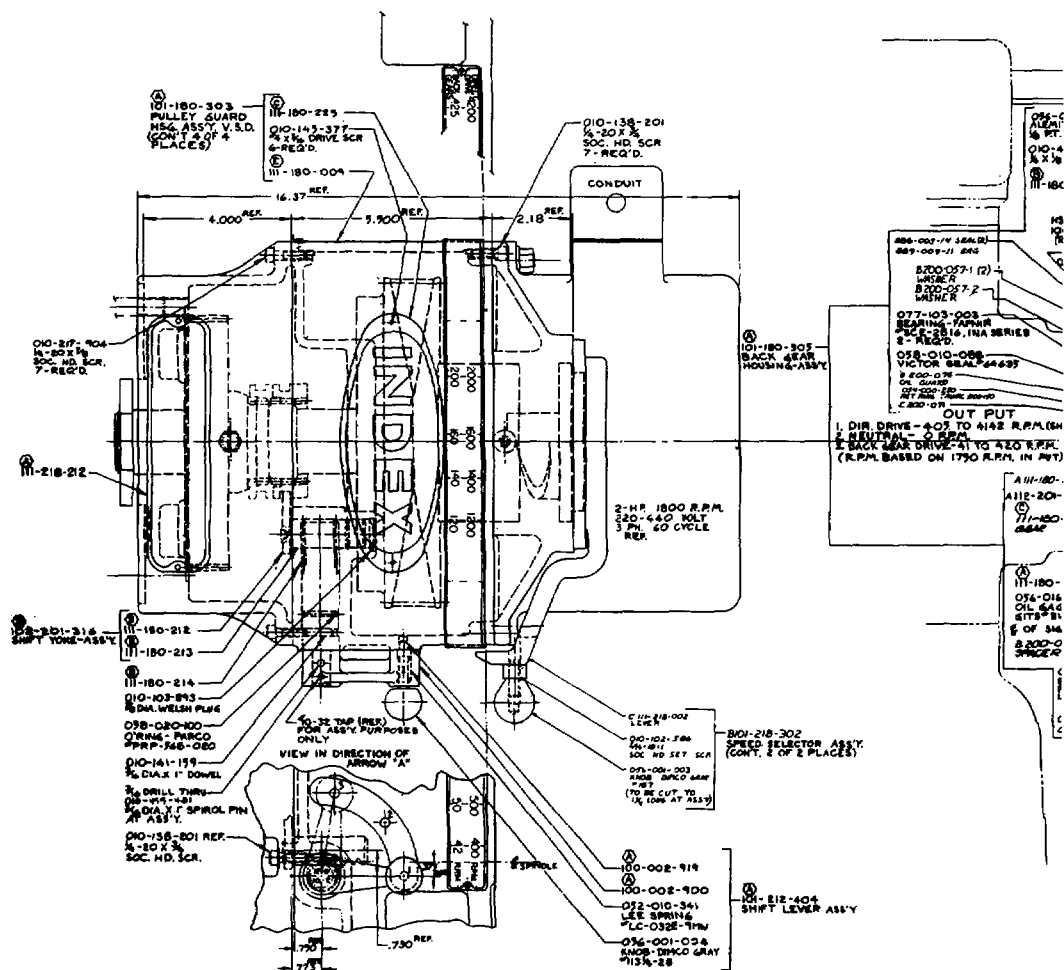
860 COLUMN & O'ARM ASS'Y	
E	101-180-101

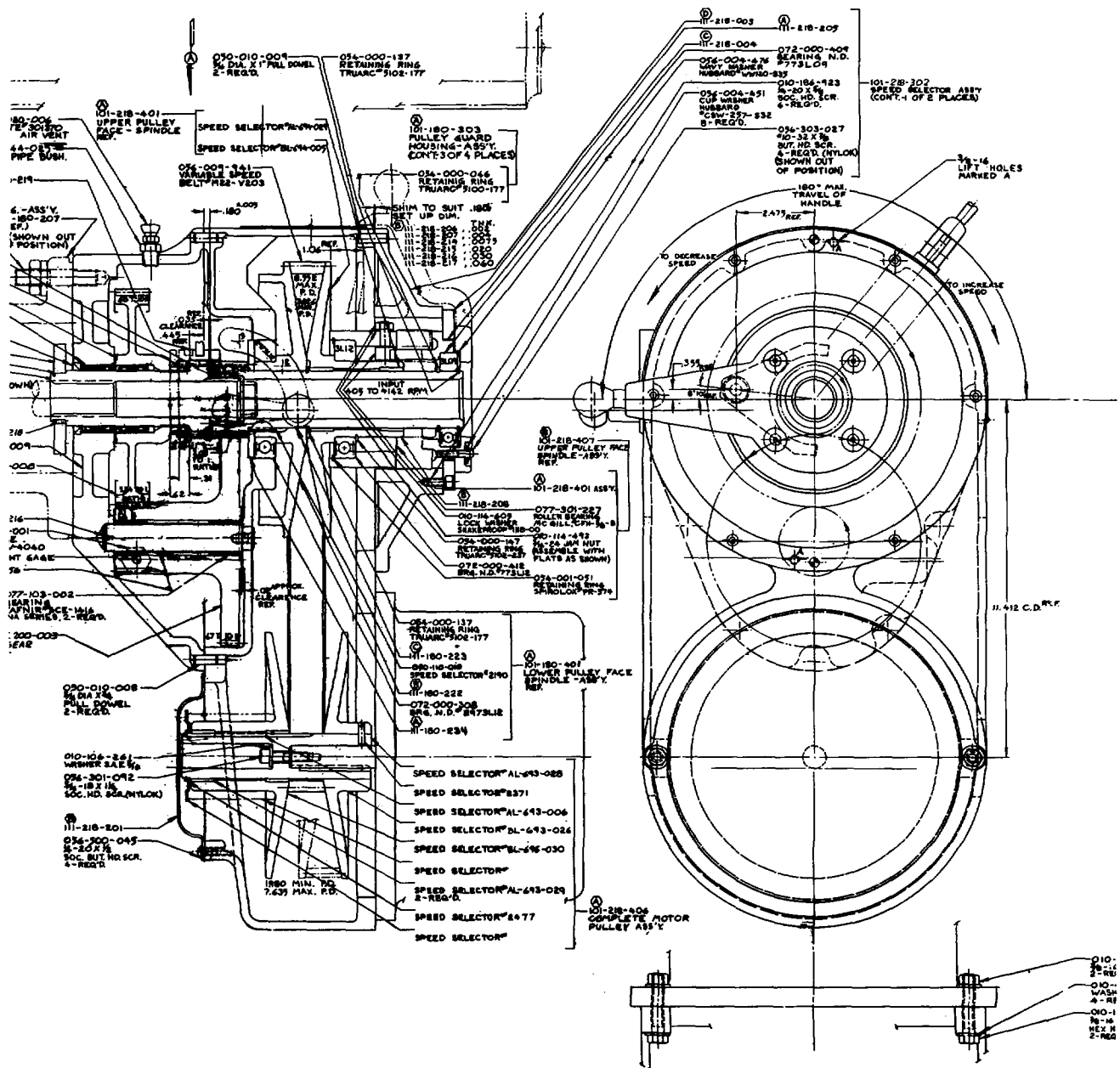


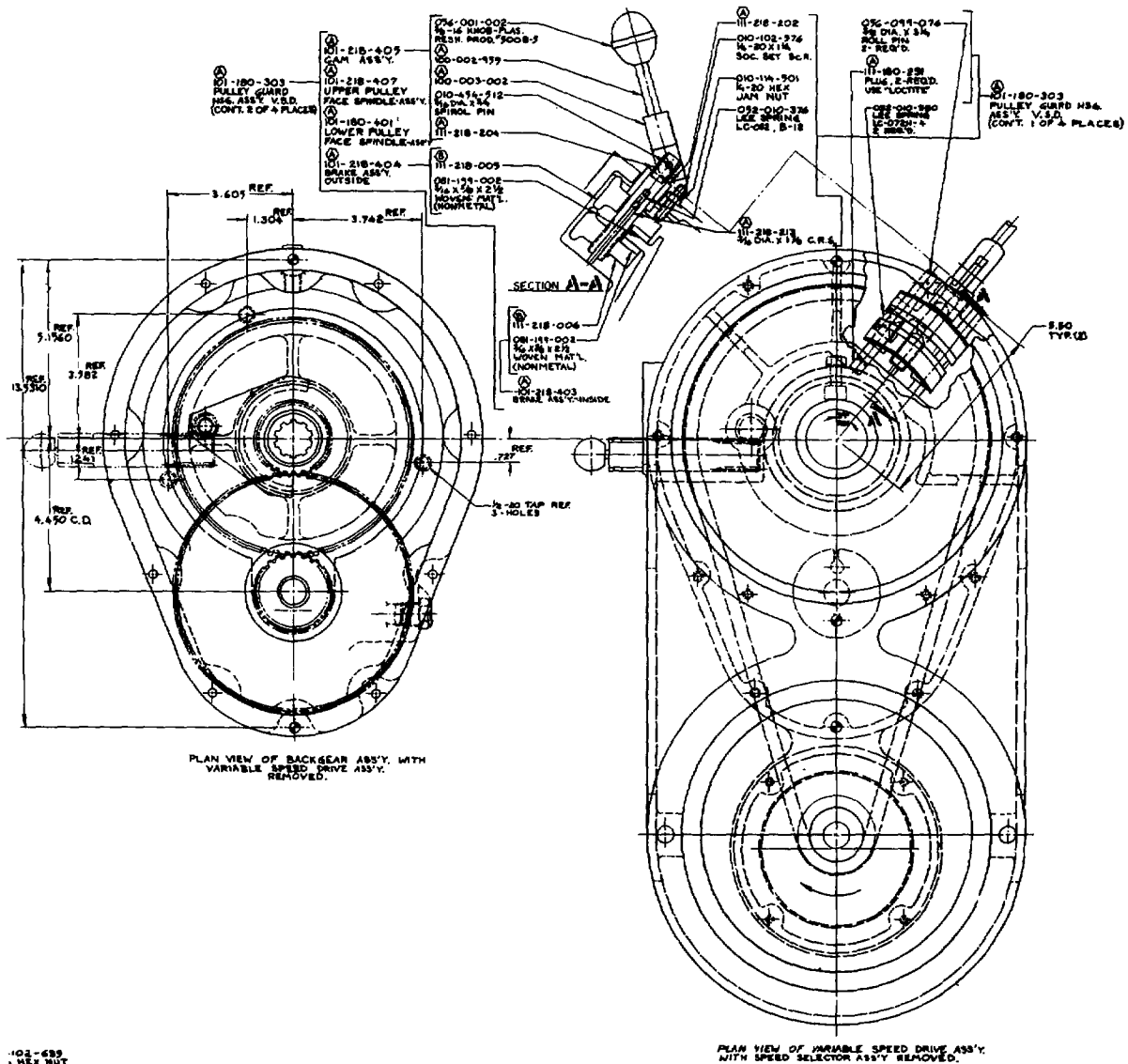
Sheet 1 of 2



SPINDLE HOUSING ASSY	
E 101-180-207	

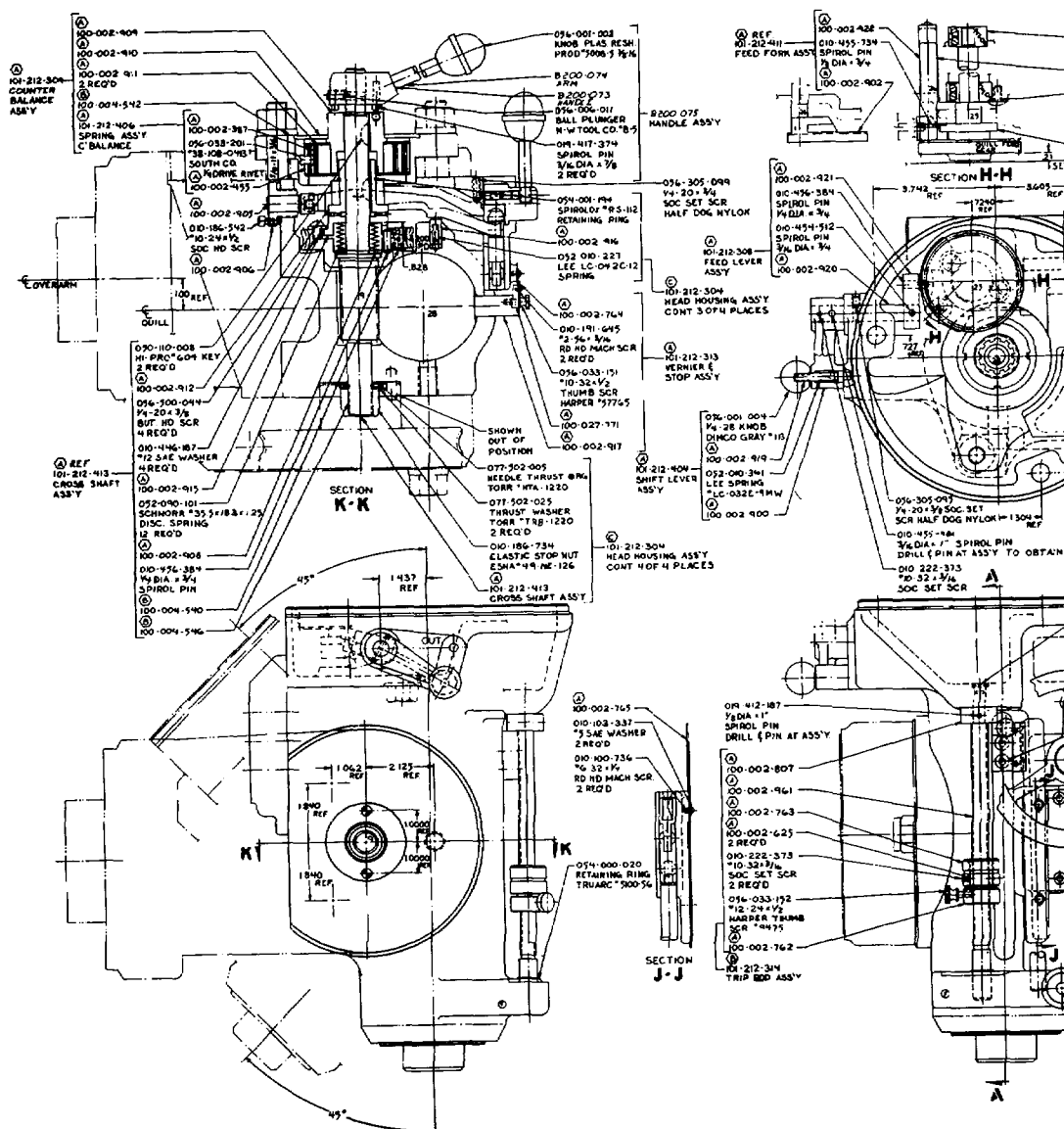


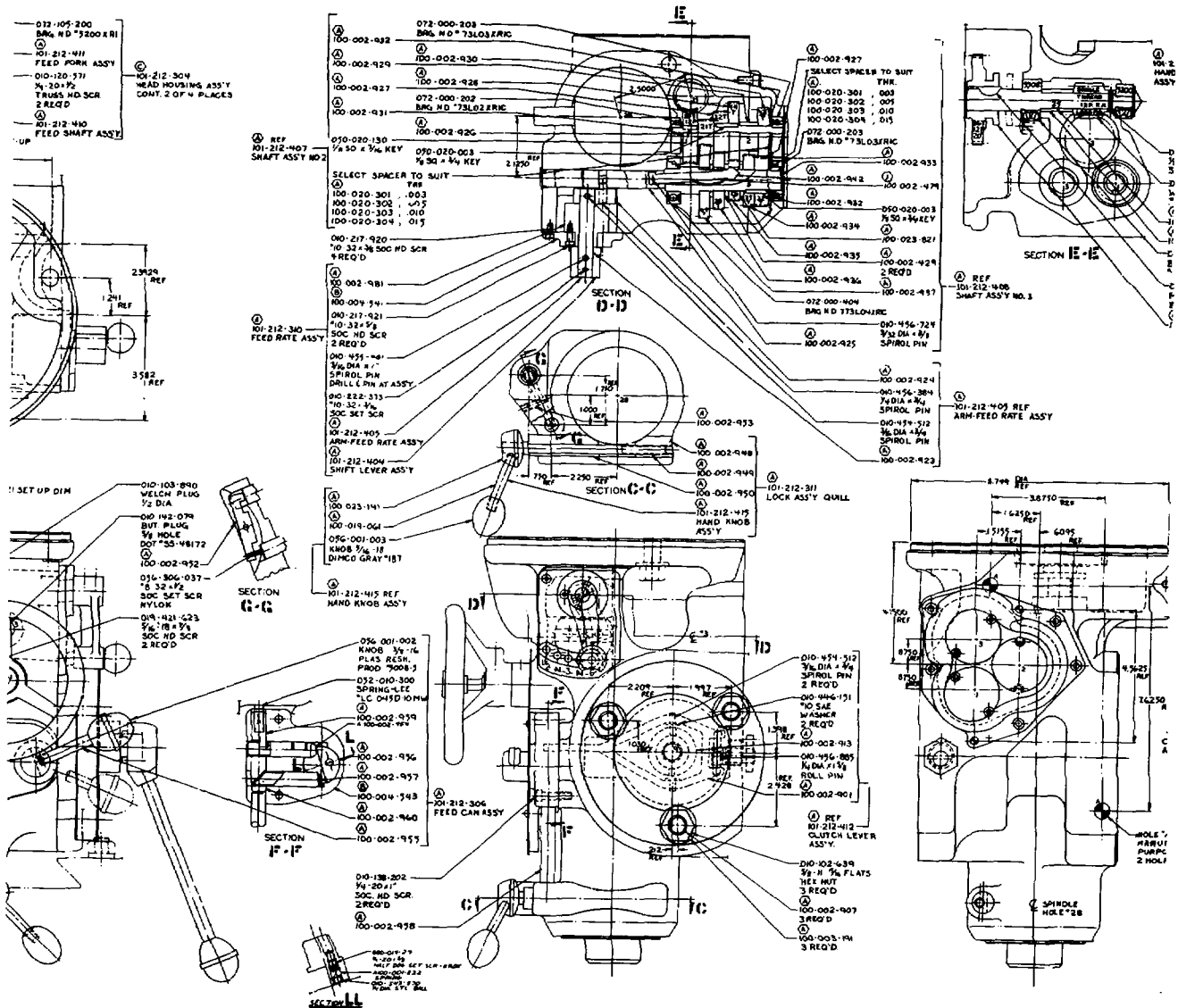




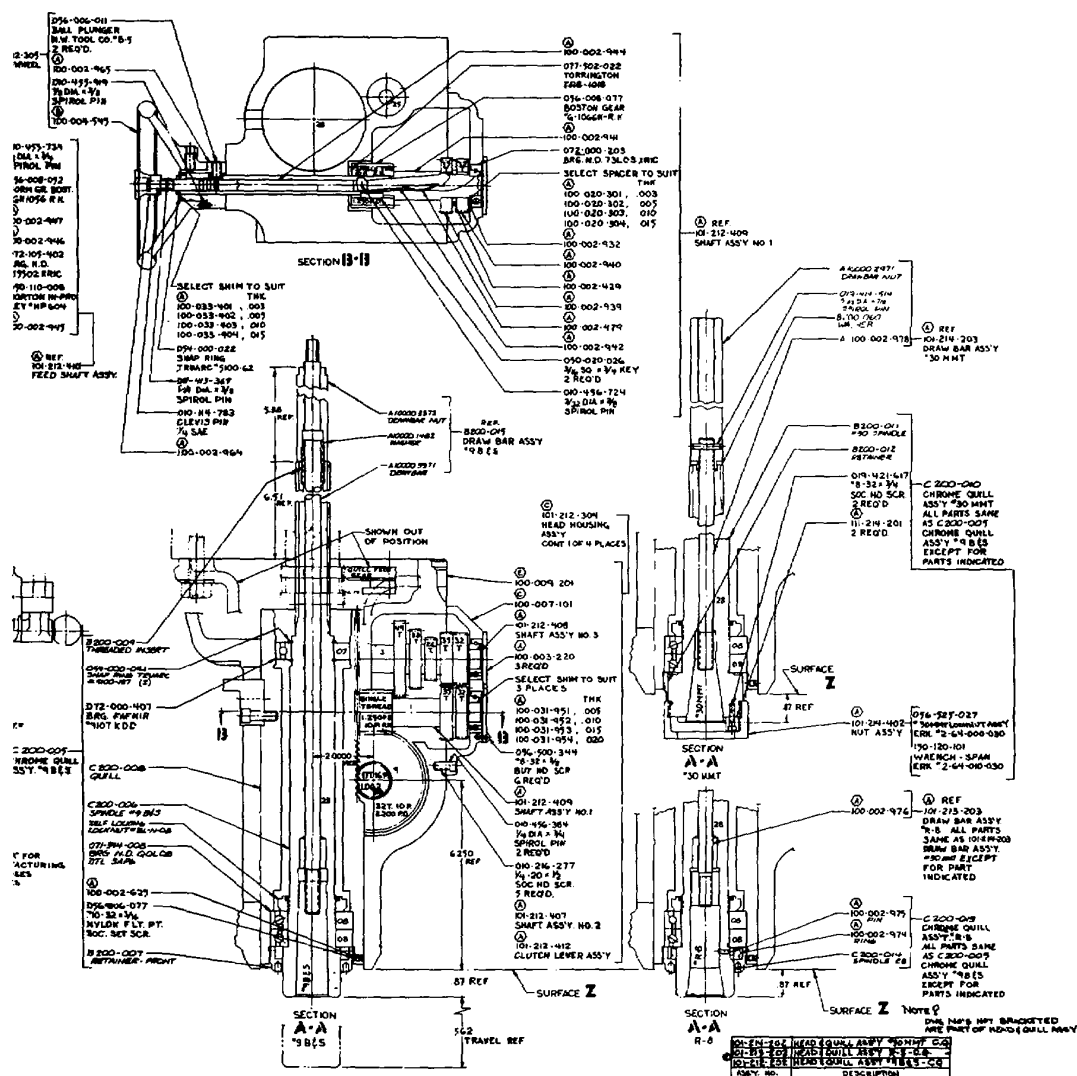
102-689
MEX MUT
XD.
446-362
ER 6
IC'D
30-247
X E
R SCR
FD.

SANDWICH ASS'Y. V.S.D.	
ALL GEAR	
E	101-180-209

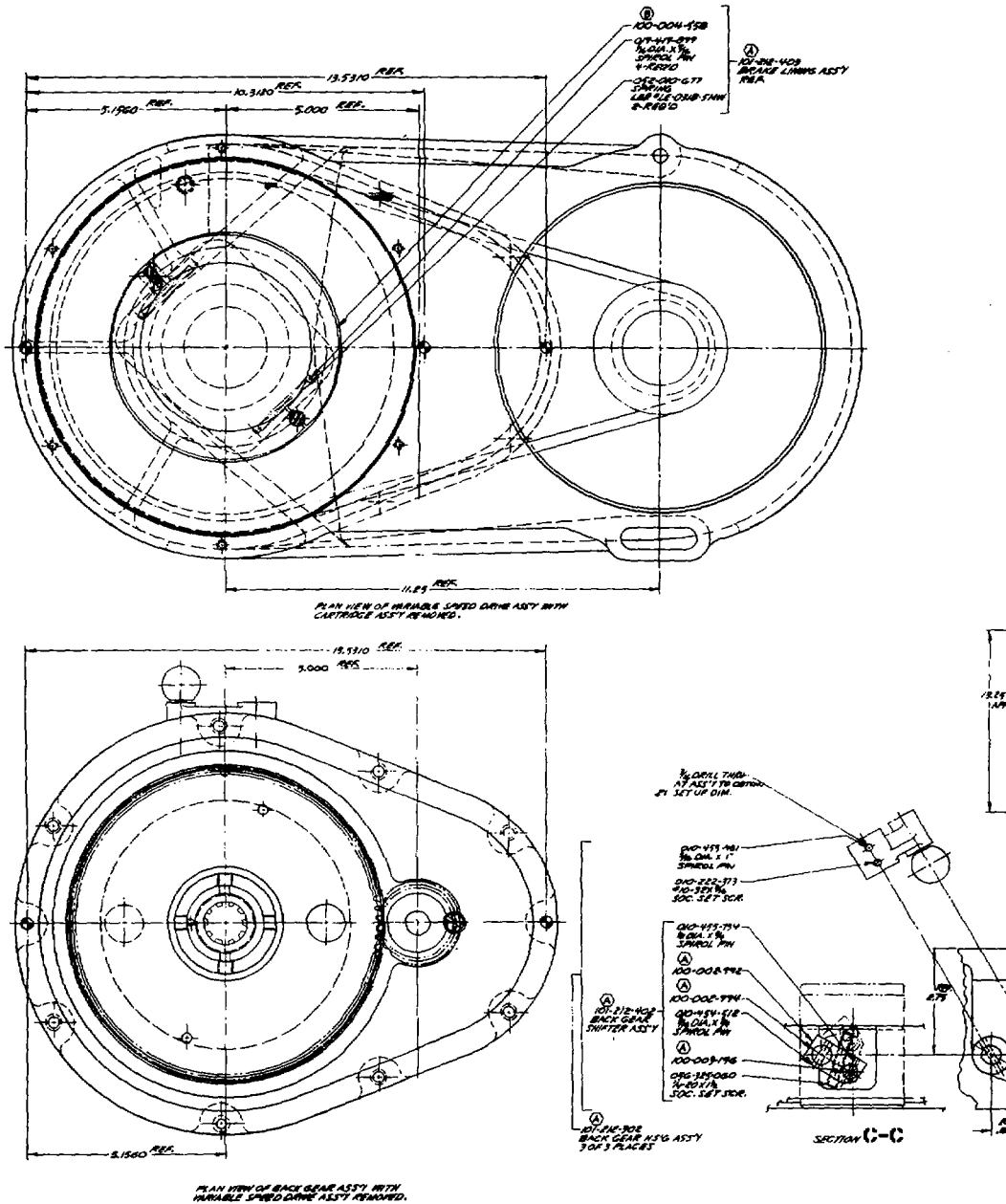


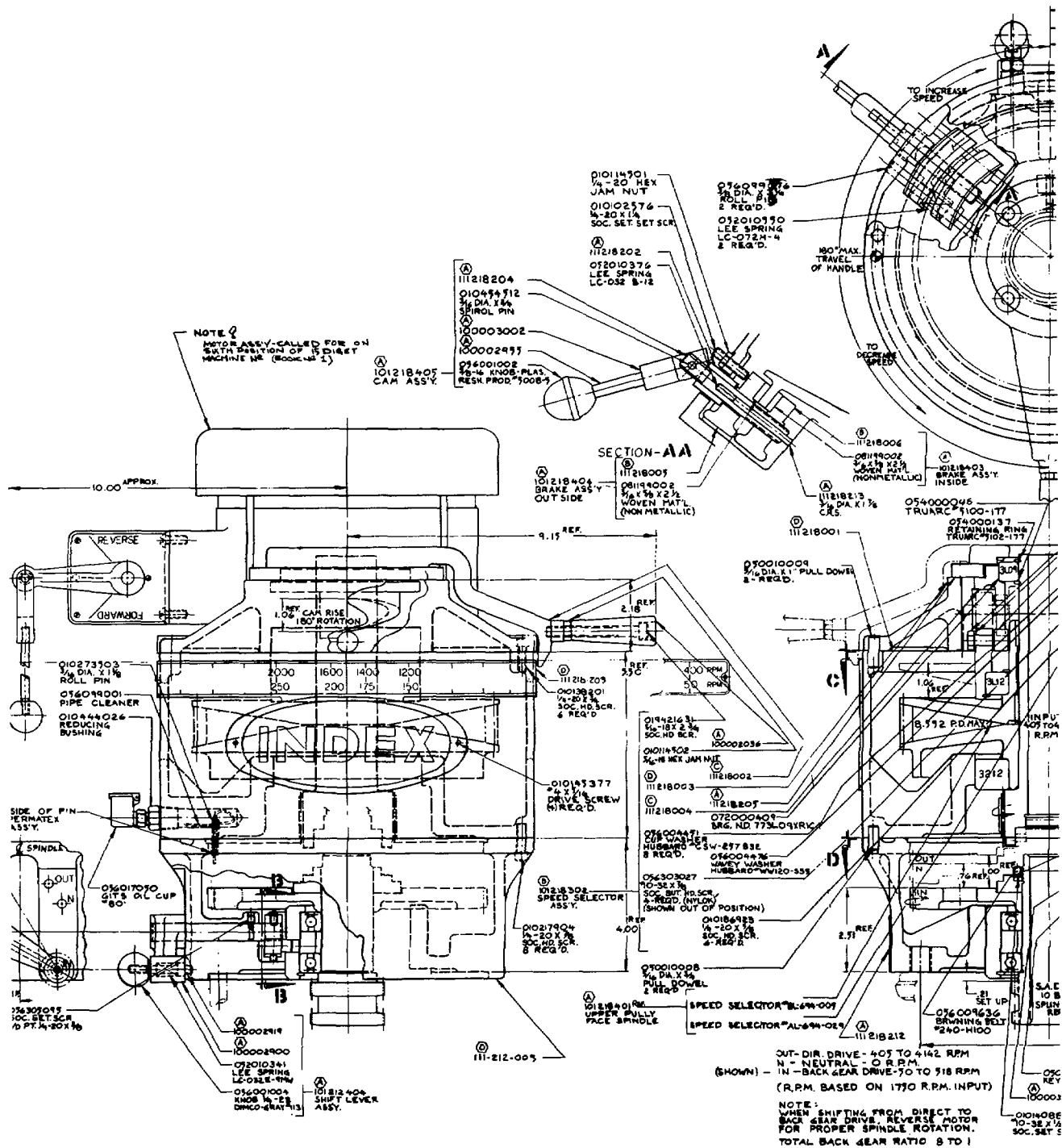


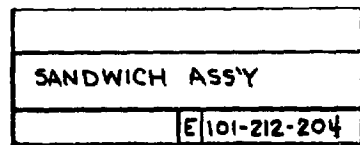
V.S.D. Drawbar Ass'y No.	
#9 B & S	B 200-016
R-8	A 101-003-353
#30 MMT	A 101-003-354

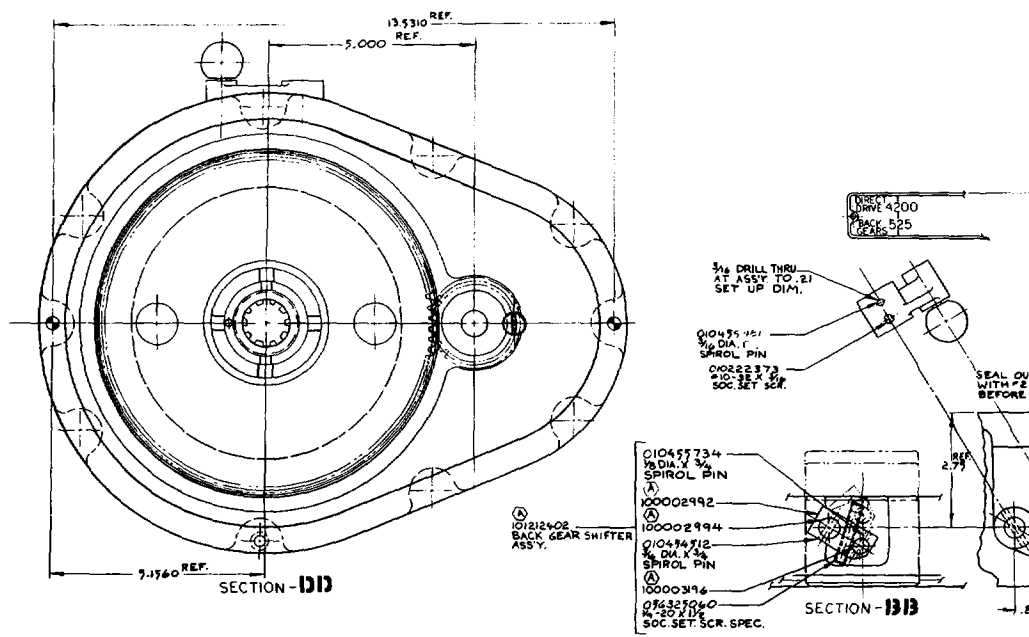
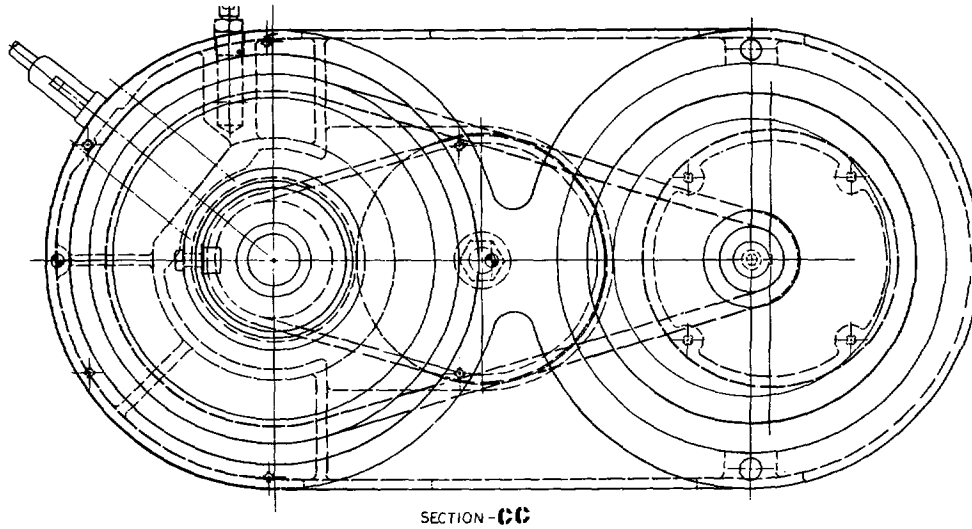


HEAD & QUILL ASS'Y	
E	101-212-202

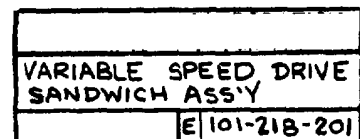


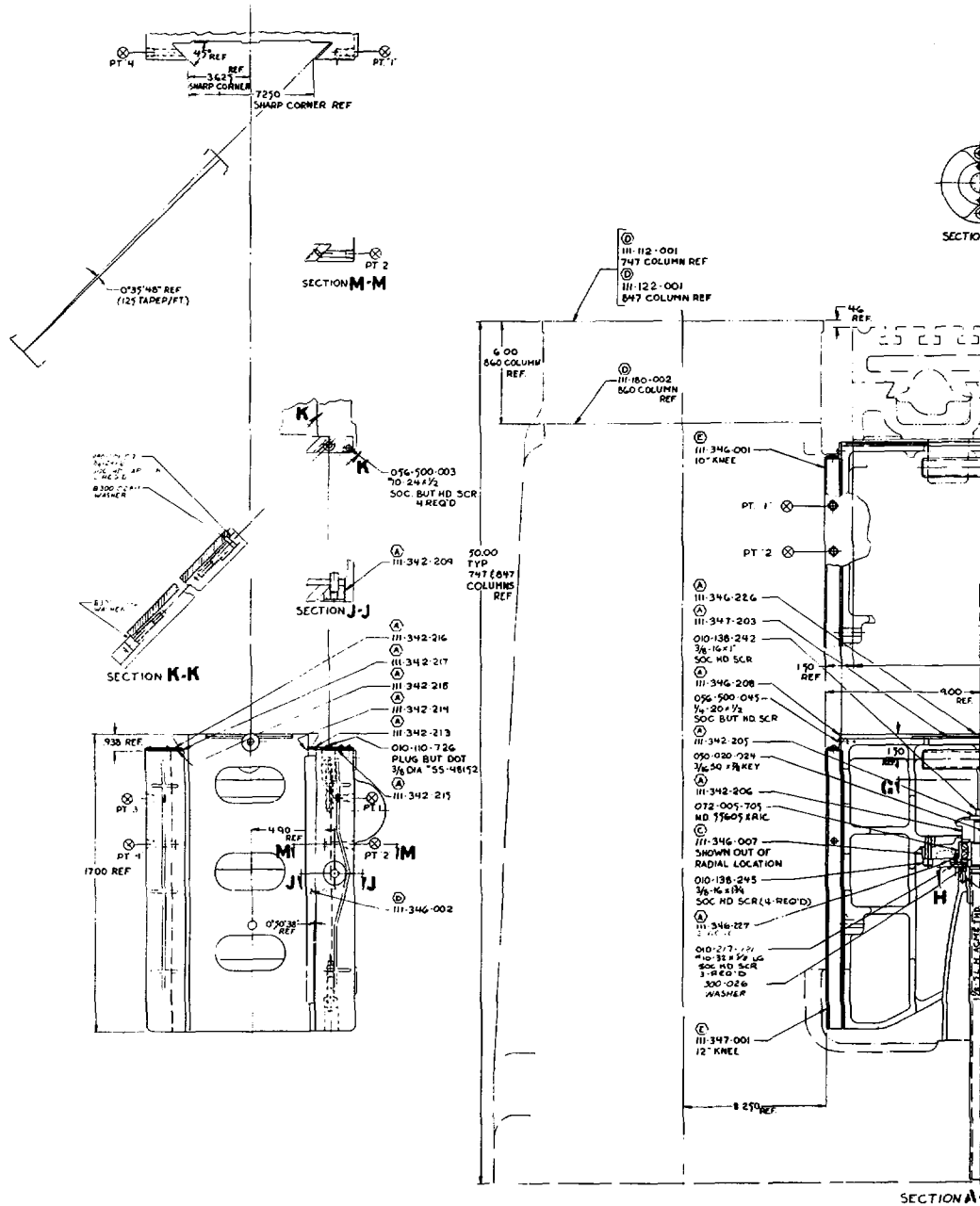


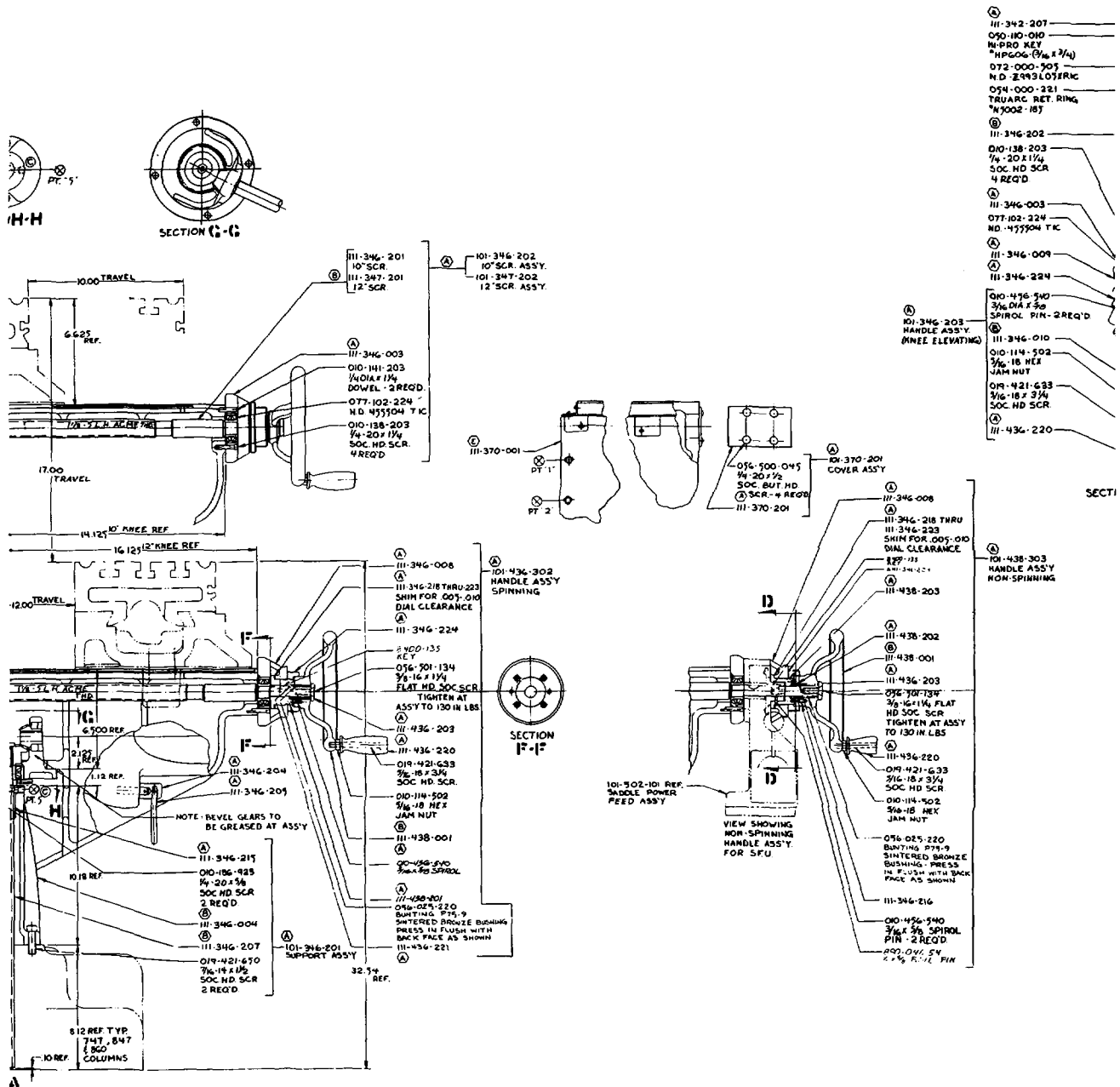


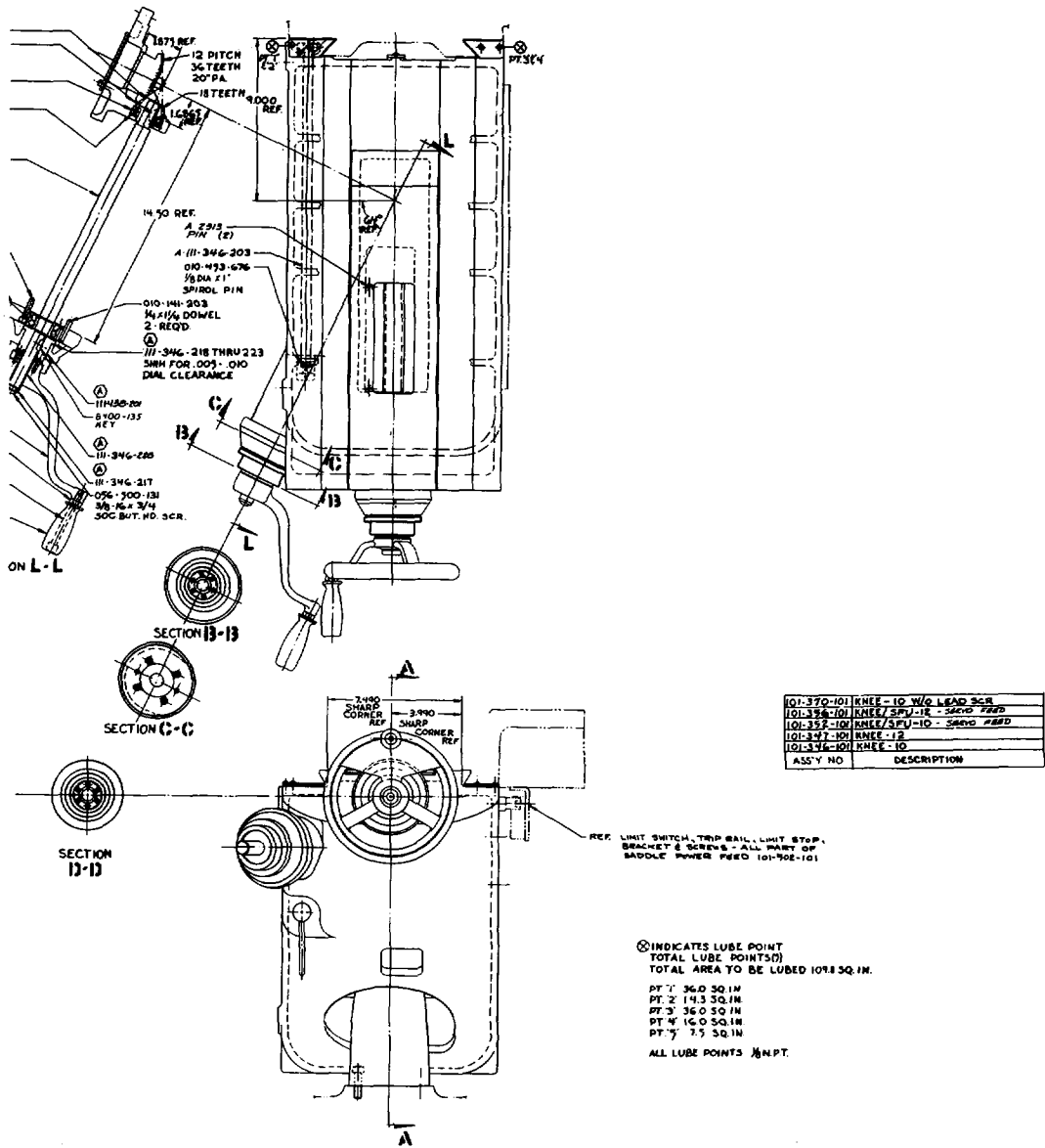




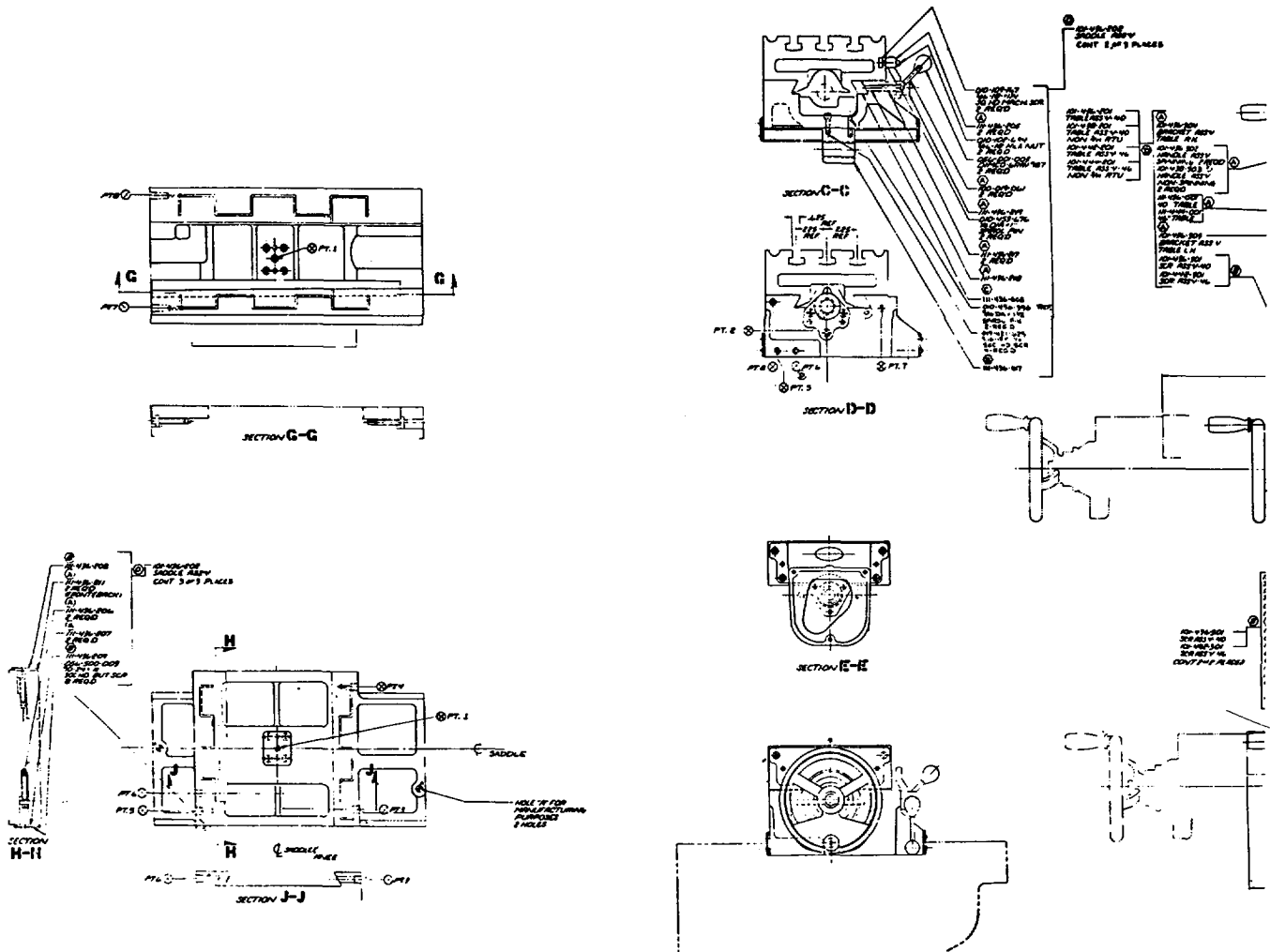


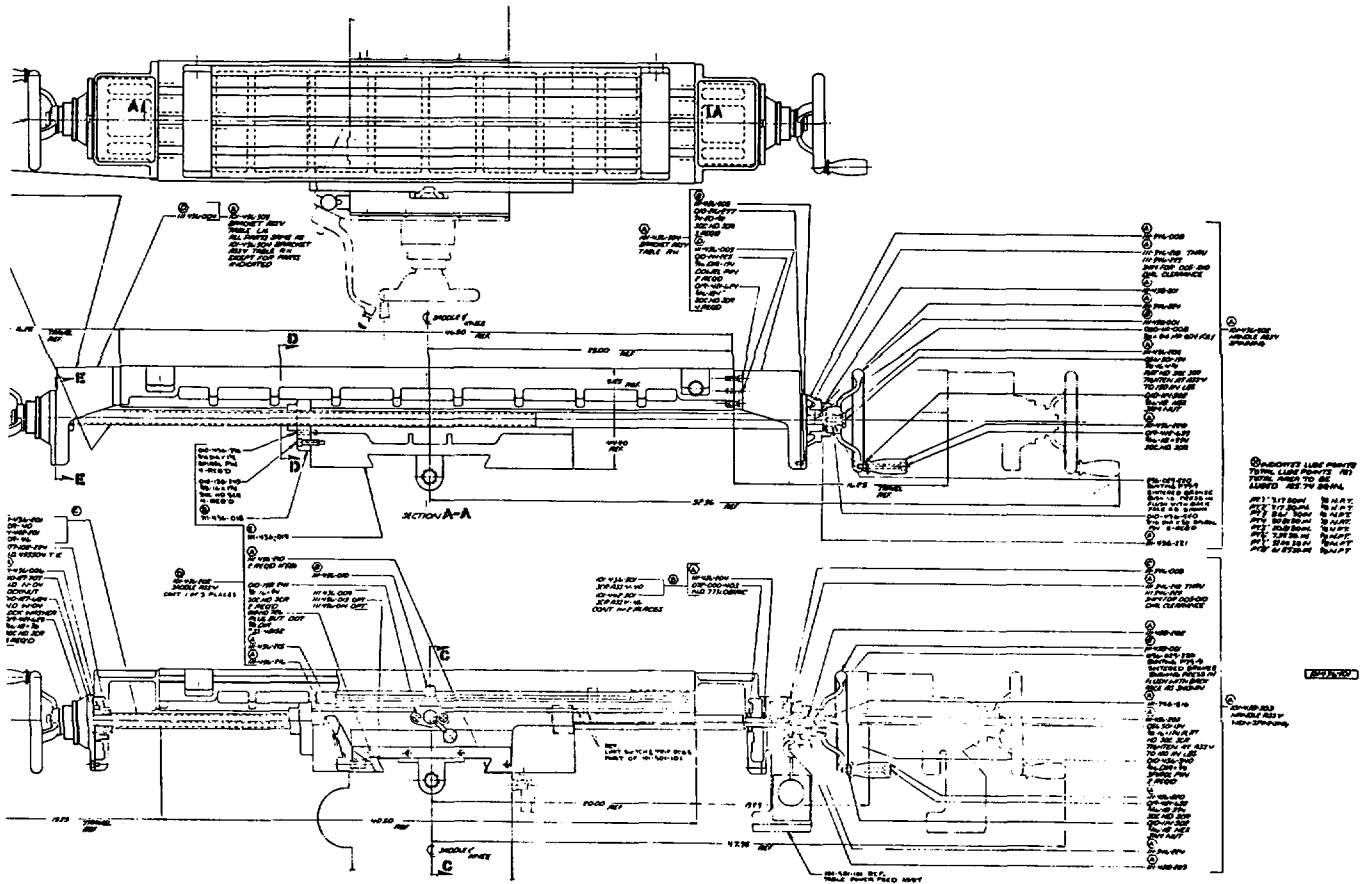






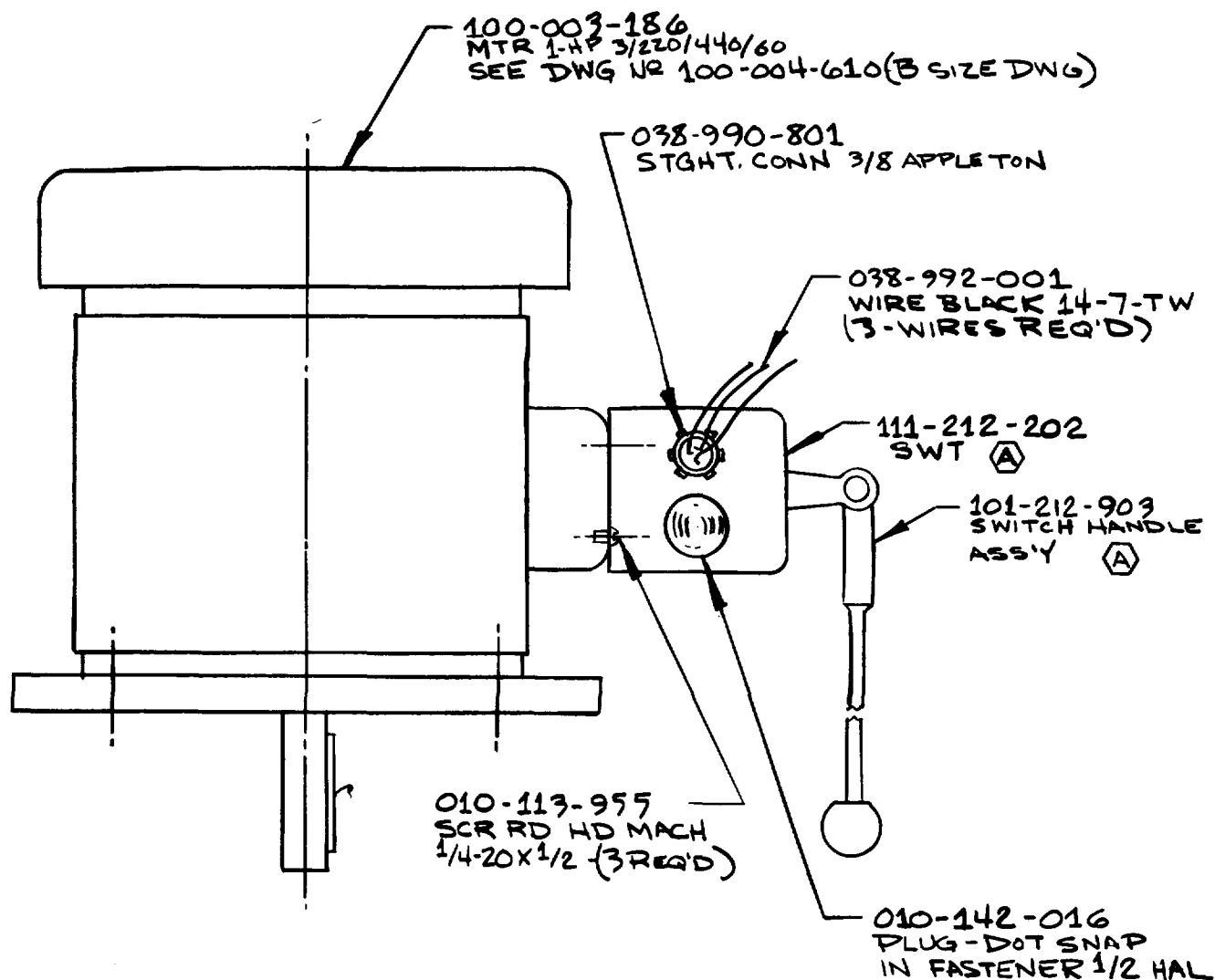
KNEE ASS'Y	
E	101-346-101





**TABLE & SADDLE
ASSEMBLY**

E 101-436-101



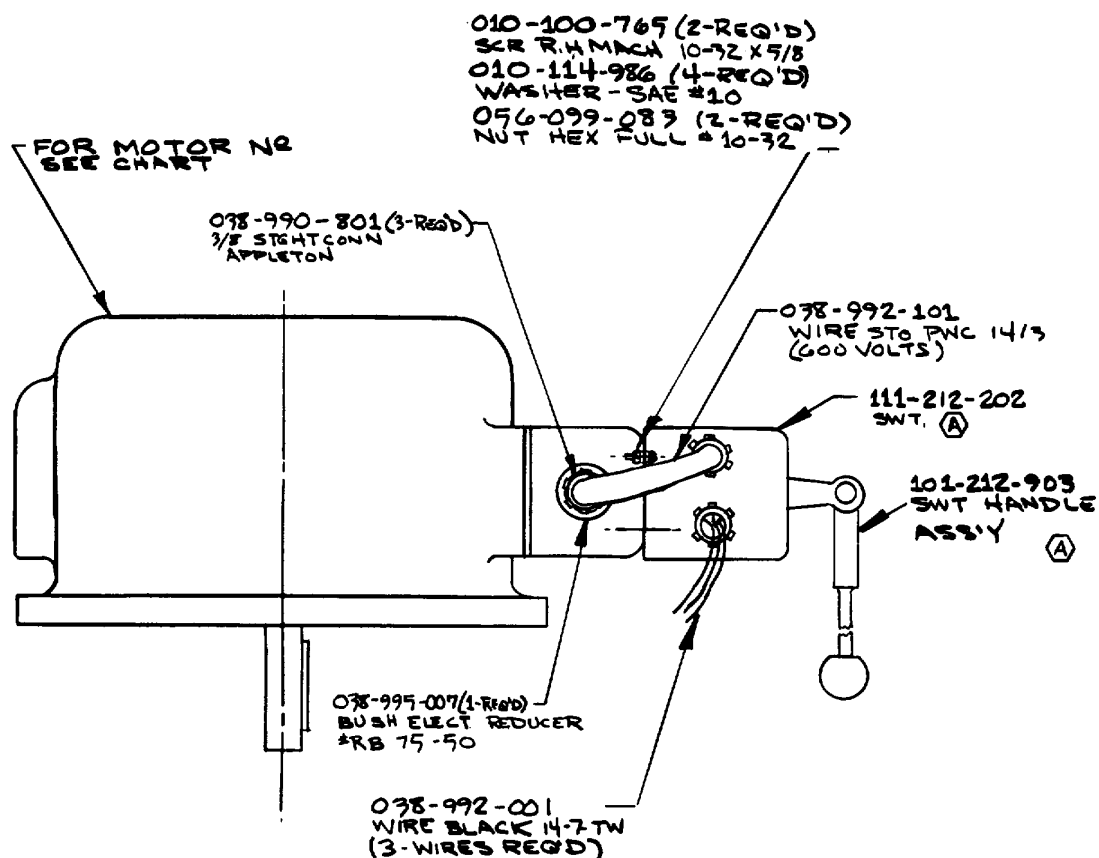
VIEW FROM BACK OF MOTOR

NOTE .

WIRING DIAGRAM NR 100-002-092
USE (6) STAKON CONN. INDEX NR
038-991-502 & ALSO USE (6)
WIRE WRAPS NR 038-992-401

1HP 3PH MOTOR ASS'Y	
B	101-670-101

MOTOR ASSY NR	DESCRIPTION	MOTOR NR	WIRING DIAGRAM NR
B-101-671-101	2HP 1800 RPM 3PH 220-440V/60	A-100-003-236	A-100-002-032
A-101-673-101	1 1/2 HP 1800 RPM 3PH 220-440V/60	A-100-003-350	A-100-002-032
A-101-674-101	2HP 3600 RPM 3PH 220-440V/60	A-100-003-364	A-100-002-032



VIEW FROM BACK OF MOTOR

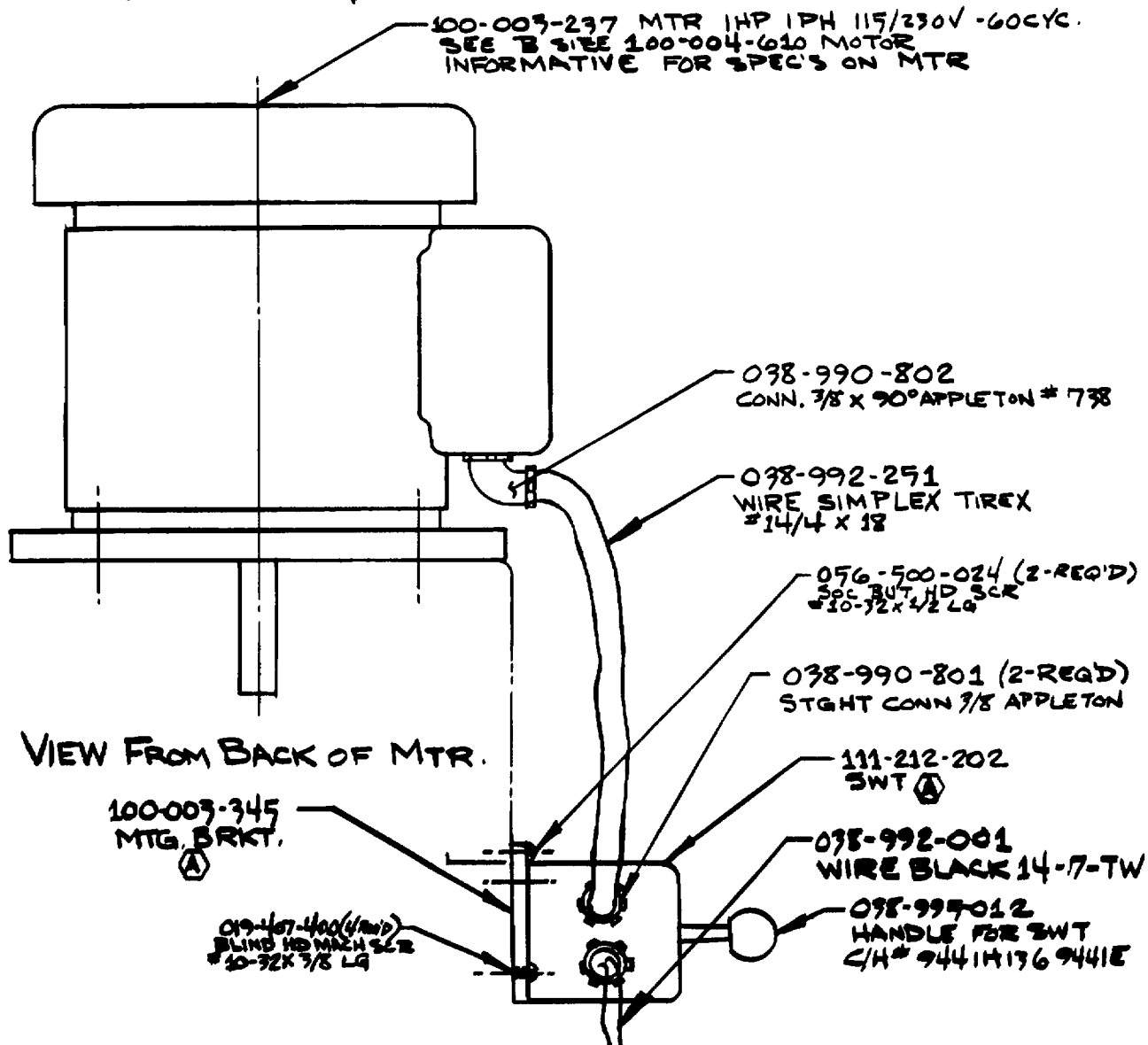
NOTE .

USE (6) STAKON CONNECTIONS
INDEX NR 038-991-502 &
ALSO USE (6) WIRE WRAP
CONNECTIONS INDEX NR
038-992-402

2 H.P. MOTOR ASS'Y
B 101-671-101

NOTE.

FOR WIRING DIAGRAM SEE A SIZE DWG NO 100-003-360
 USE (4) WIRE WRAPS TYPER SCOTCHLOCK INDEX NO 038-992-402
 USE (8) STA-KONS T&B 14-8 B-339-008 INDEX NO 038-991-502



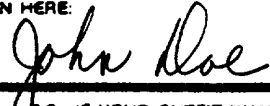
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