Introduction

Basically a drafting machine is a device for constructing a line of predetermined length either through a single point at a predetermined angle with respect to some base line, or, alternatively, through a pair of predetermined points. Thus there are only three operations with which the draftsman must contend in normal operation of his machine: (1) parallel motion, (2) base-line setting, and (3) angle setting. VEMCO standard-size machines with either Standard (Models 2100 and 4100) or Civil Engineer's (Models 3100 and 5100) heads, as well as VEMCO compact-size machines (Model 3300 and 3500) achieve parallel motion with a band-and-pulley linkage from the clamp to the head, VEMCO V-Track drafting machines accomplish this purpose with two carriages moving in mutually perpendicular tracks. For information on these machines, please request brochure.

This booklet describes the installation, operation and adjustments of the VEMCO Models 2100, 4100, 3100, 5100, 3300 and 3500. The 2100 and 4100 are identical except that the latter is equipped with VERSATILT counterpoise, a spring counterpoise for use on tables inclined up to 25 degrees. The 3100 and 5100 models are, respectively, the same as the 2100 and 4100 except that they have protractor heads, which are especially suitable for civil engineering work and are, therefore, called Civil Engineer's machines. The 3300 and 3500 are smaller (and less expensive) machines, which, however, are built to the same standards of precision as the larger 2100. It also has a brake at the clamp and is thus suitable for use on horizontal, or boards inclined up to ten degrees.

Unless one is already familiar with the operation of VEMCO elbow-type drafting machines, the user should read the sections of this booklet entitled "Preparation for Use" and "Operation." The sections on "Adjustments" and "Maintenance and Repairs" deal with adjustments that, if the machine is treated with care will arise very infrequently. Although the illustrations in this booklet were prepared showing the 2100 (or 4100) machine, the mechanisms of the 3300 and 3500 are so similar to those on the larger machine that the user of the latter drafter will have no difficulty following the instructions given herein.

Warranty

VEMCO Drafting Machines Are Guaranteed Unconditionally against defects in material or workmanship for a period of twenty-four months after receipt by the original user. When returned to the factory, the machine will be repaired without charge. Freight charges to the factory are to be paid by the customer with return freight charges to the customer to be paid by VEMCO.

This warranty does not cover damages from such causes as abuse, accident, neglect or fire.

Preparation for Use

A. Attachment to the table (Figure 1)

1. Hold the drafting machine as shown in the figure, with the elbow to the rear of the drafting board and supported by the right hand, while the drafting head rests on the board near its upper edge and the clamp rests in the left hand. Now press the clamp snugly against the upper edge of the board and tighten the screw securely. This is important, as the clamp establishes the reference direction for the work. Throughout this operation hold the elbow high, keeping the load off the clamp until it has been tightened.
2. If the machine is not equipped with the VERSATILT counterpoise, you need not hold the elbow to the rear of the board. However, the elbow must be supported so as to keep the load off the clamp until it has been pressed snugly against the board and tightened.
3. Except on long boards, most draftsmen place the clamp just far enough from the left-hand edge to keep the elbow from projecting off the board. However the clamp can be readily released and moved to any other position.
4. Check the tightness of the clamp screw occasionally, as it may become loose by compressing the wood of the drawing board.

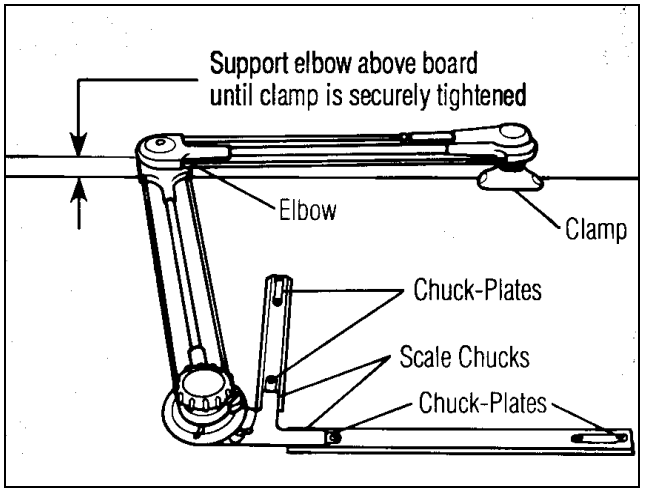


Figure 1

B. Scale Insertion and Removal (Figure 2)

1. To insert a scale in the instrument, place it flat on the board in line with the scale chuck on the machine. Firmly press, but do not drive, the chuck-plate on the scale into the chuck.
2. The scale can readily be released by means of the scale wrench as shown in Fig. 3. With the pin side of the wrench downwards, slip the wrench over the screw Ø and turn clockwise, thus pressing the curved section B strongly against section A of the scale chuck. It no scale wrench is available the scale can be removed as follows: steady the drafting head with the left hand while the outer edge of the right hand strikes the scale a sharp blow with a sliding movement away from the head.

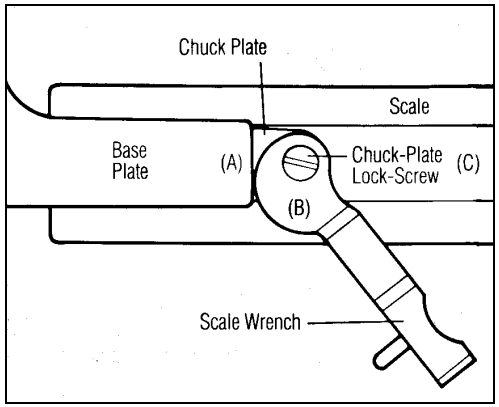


Figure 2

Preparation for Use (Cont.)

C. Aligning Scales (Figures 3 & 4)

1. To adjust the scales at right angles to each other, first remove both scales from the machine and make certain that their flat-head screws are tight and their round-head screws are loose, Note that there is a convenient screwdriver on the end of the scale wrench, which can be used to turn the chuck plate screws. Adjust one of the chuck plates on the horizontal scale so that the round-head screw is near the center of the elongated hole in the chuck plate; then tighten this round head screw. Insert this chuck plate into the horizontal chuck, and also insert the vertical scale. With the protractor reading zero, draw a reference line with the horizontal scale as straight-edge. Turn the horizontal scale end for end, align the scale parallel to the reference line, and tighten the other round-head screw.
2. Now index the head 90 degrees clockwise, as shown in Fig. 3, and adjust the vertical scale in the same manner and along the same reference line.
3. For satisfactory results the screws on the scales must be tight and the chuck-plates on the scales firmly pressed into the chucks.

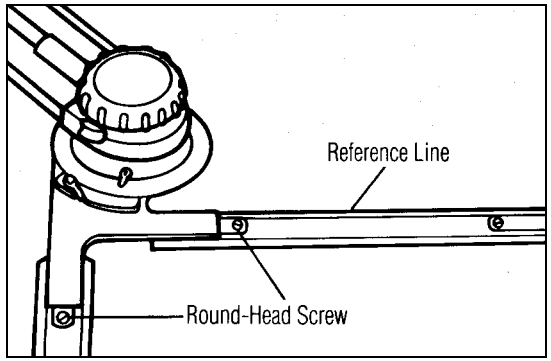


Figure 3

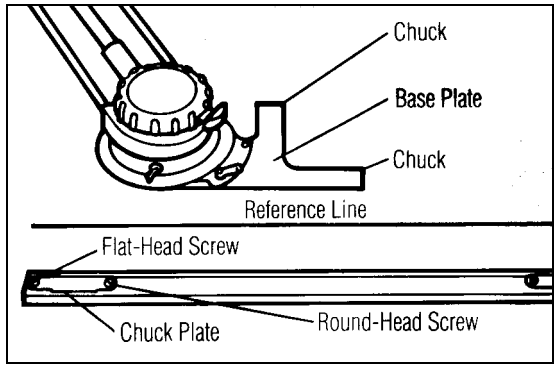


Figure 4

Preparation for Use (Cont.)

D. Adjusting Brakes (Figure 5)

1. Brakes have been provided at the support and elbow (support brake only for Models 3300 and 3500) to prevent the machine from sliding down a moderately inclined drawing board. The rounded edge of the scale wrench is a convenient tool to adjust these brakes, and the draftsman will have no difficulty in tightening them such that the head will not slide when it is placed in an area of the board which he is using. Do not tighten the brakes any more than necessary.
2. Machines without Versatilt (2100 and 3100), or elbow brakes (3300and 3500), should not be inclined above 8 degrees.

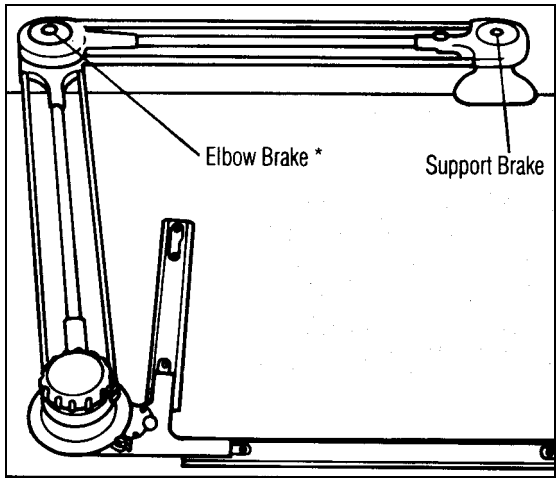


Figure 5

E. VEMCO VERSATILT (Figure 6)

In the VEMCO VERSATILT, the support brake is replaced by a spring counterbalance. By adjusting the tension of the spring this machine can be used on boards tilted at angles up to 25 degrees. To change the tension, slip the rounded edge of the scale wrench into the slot in the tension screw and turn. Make the adjustment with the elbow brake loose, changing the tension until the machine balances in the position shown in the figure. If the drafting head slides when placed in some other position, correct this by tightening the elbow brake a little.

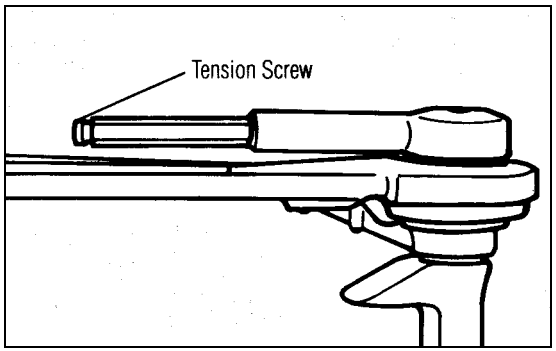


Figure 6

Good Drafting Machine Practice

The VEMCO drafter, like other precision instruments, will give good service it properly handled. An effective technique can be acquired only by practice, but it is hoped that the following suggestions will be of assistance:

1. In ruling lines, press the pencil lightly against the edge of the scale. Because of the leverage resulting from their length, the scales may be deflected by pressure near their tree ends. Therefore, when working near the tree end of a scale it is important to hold the scale near the middle with one hand while ruling with the other,
2. Do not subject the mechanism to sudden shocks as they may disturb some adjustment. Shocks may result from bringing the head violently down upon the drafting board, throwing the scale arm sharply to the desired angle when indexing, or from bumping the scales into the clamp or some heavy object on the drawing board. Such bumping may nick the edge of any scale or break a plastic scale in two.
3. Use of the machine at steeper board angles than it was designed for may result in repeatability problems and will place undue stress on bands and pulleys.

Operation

A. Indexing (Figure 7)

The baseplate, or protractor arm, can be indexed readily at multiples of 15 degrees. To change the setting from one of these angles to another, first make sure that the protractor brake wing nut is released: then press the indexing thumb-piece with the left thumb, rotate the base-plate to the desired position, and release the thumb-piece, permitting the indexing mechanism to tall into place and lock.

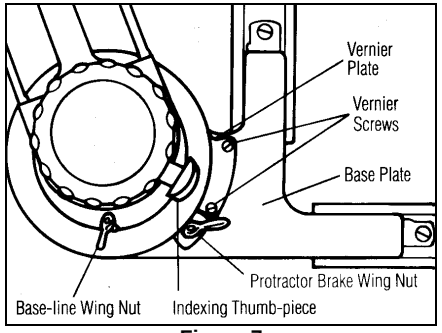


Figure 7

B. Intermediate Angles (Figure 8)

To set oft an angle other than a multiple of 15 degrees, first disengage the indexing mechanism by pressing the indexing thumb-piece, moving it vertically downward, and releasing it, as indicated by the bent arrow in Fig. 8. Rotate the protractor arm with the right hand on the tar end of the horizontal scale until the desired angle is indicated by the vernier. Now lock the arm by means of the protractor brake wing nut. To re-engage the indexing mechanism, press the thumb-piece, move it vertically up, and release it.

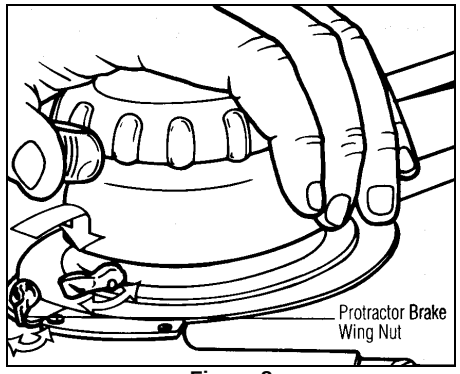


Figure 8

C. Base-Line Setting (Figure 9)

With the indexing mechanism locked at zero, release the base-line wing nut. Now set one of the scales in alignment with any desired base-line and lock the setting by tightening the wing nut. The base-line wing nut must be tight to prevent the adjustment from slipping and to clear the protractor brake wing nut. It can be loosened, even when very tight, by bearing against the wing nut with the stiff left thumb, and rotating the hand about the handle held in the fingers

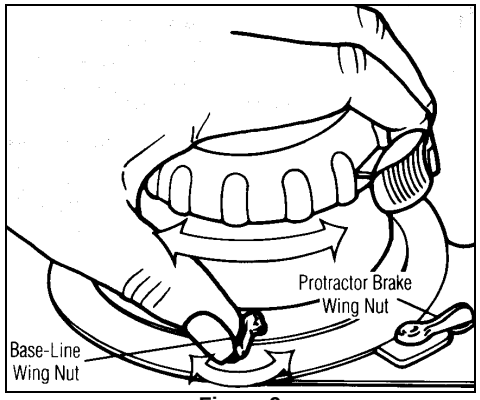


Figure 9

Operation (cont.)

D. Use of Vernier (Figure 10)

Although most draftsmen are familiar with the use of a vernier, many students and other beginners have never used this convenient device for reading and setting sub-divisions of a basic scale unit. The protractors of VEMCO Models 2100, 4100, 3300 and 3500 drafting machines are divided into one-degree units with verniers which enable the draftsman to make readings to 5 minutes, while the Civil Engineer's machines have half-degree protractors and one-minute verniers. The vernier principle will be illustrated with the standard one-degree protractor.

READING ANGLES:

We will assume the vernier is set at a positive angle. First note that the reading is between 7º and 8º. Then find the 5-minute mark on the upper half of the vernier which is most closely in alignment with a degree mark on the protractor -in this case, the 40-minute mark. The correct reading is 7º40'. The procedure is only slightly different for reading negative angles. In this case the lower half of the vernier is used and the reading is 4º25'.

SETTING ANGLES:

Suppose one wishes to set an angle of 7º40'. First release the protractor brake and disengage the indexing mechanism as previously described. Rotate the protractor arm until the zero of the vernier is at 7º. Then slowly rotate the protractor arm counter-clockwise until the 40-minute mark on the upper half of the vernier is precisely aligned with the nearest degree mark on the protractor. Finally, lock the protractor brake. Again the procedure for setting negative angles is essentially the same except that the protractor arm is rotated clockwise from the 4-degree mark until the 25-minute mark on the lower halt of the vernier is aligned with the nearest degree mark on the protractor.

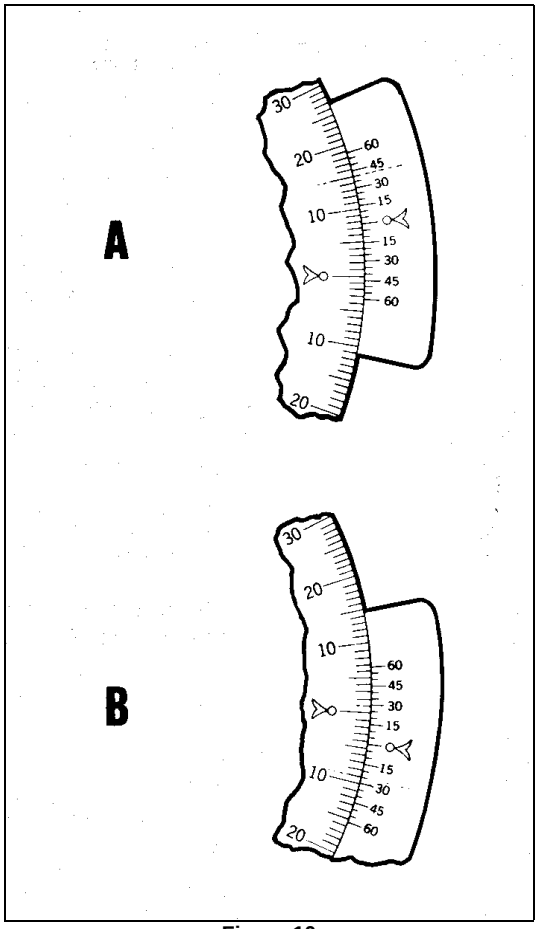


Figure 10

Adjustments

A. Elbow Elevation (Figures 11 & 12)

The object of this adjustment is to so fix the height of the elbow so that the scales on the protractor arm will lie flat as they are moved over the table. Since the machine has been adjusted at the factory on a perfectly flat surface and the adjustment is held rather securely, one should not be hasty in making any change, but should first test it in the following manner.

1. Clamp the machine to the table, place the drafting head so that the arms are at approximately 90 degrees to each other, and attach the scales in the usual manner. Now press the indexing thumb piece and swing the scales about the drafting head until the horizontal scale points away from the lower arm and approximately parallel to it as shown. If this scale now slides in and out of its chuck without raising either scale or baseplate, the elbow elevation is correct. If the baseplate must be raised to insert the scale, then the elbow is too high, similarly, if the scale must be raised, the elbow is too low.
2. If the discrepancy is large, then it probably results, for the most part, from a warped table Usually it can be corrected by strips of cardboard under the clamp. If the discrepancy is small, it may be corrected by adjusting the elbow elevation as described in the following paragraph.
3. The elbow elevation is controlled by means of the adjusting screws as shown on Fig. 12. First loosen the lower screw slightly with a screw-driver, then loosen the upper screw by hand a halt turn or so. Now adjust the elbow by means of the lower screw, using the screw-driver. Loosening this screw lowers the elbow, while tightening it raises the elbow. It is best to support the elbow by hand while adjusting this screw in order to take the load off the lower screw.
4. When the elbow elevation is correct, tighten the upper screw by hand. Then, in order to tighten the lower screw without disturbing the adjustment, proceed by first slightly loosening it and then further tightening the upper screw before finally setting the lower screw tight.

NOTE: It is important that the clamp be secure and firmly seated against the edge of the board. Some boards have depressed edges and require the use of a shim to achieve flush mounting. A shim is included with each machine along with instructions for its use.

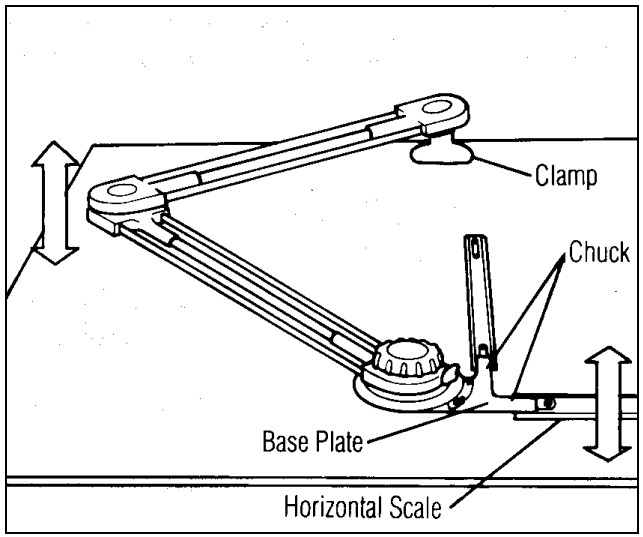


Figure 11

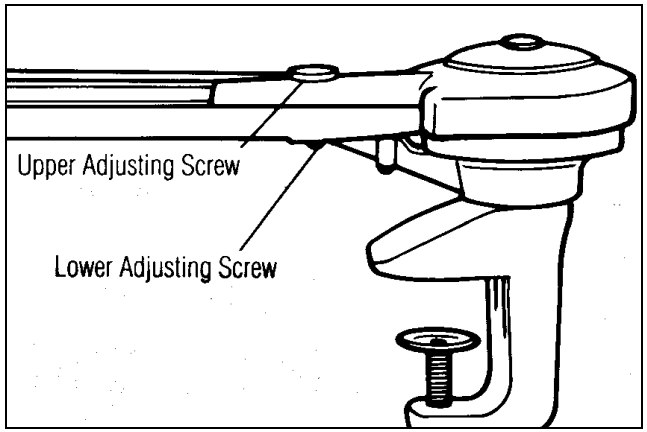


Figure 12

Adjustments (cont.)

B. Removing Band Covers (Figure 13)

Grasp the band cover near the center with the thumb and forefinger of one hand and raise it firmly so that it bows upward as shown in Fig. 13. When approximately the central third of the cover is raised clear of the band, swing it slowly but firmly to the side away from the tubular arm, at the same time working one end free from the bracket by means of the thumb and forefinger of the free hand. The other end can then be withdrawn from its bracket. When installing, put one end down over the band and slide into the adjacent bracket, then do the same with the other end and work the central part down over the band. Work the cover along until the projections near the ends are equidistant from their respective brackets.

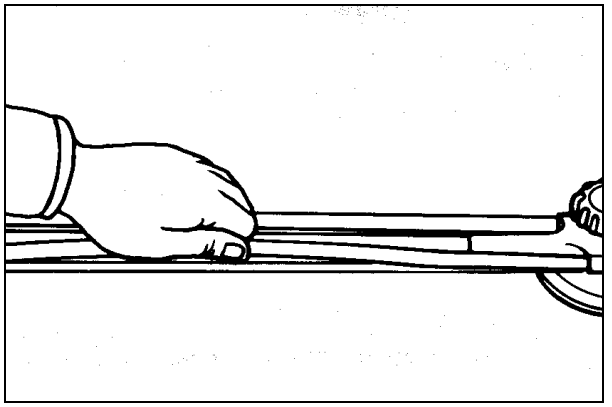


Figure 13

C. Band Tension (Figure 14)

1. To adjust the tension of one of the bands, insert the pin of the scale wrench in a pin hole of the upper or lower elbow bracket, and then place the short end of the tube wrench in the hole of the corresponding arm, While pressing the pin firmly into the pinhole, rotate the tube by means of the longer end of the tube wrench until the pin seats itself. Continued rotation will now tighten or loosen the band. As one looks along an arm in the direction of the elbow, a counter-clockwise rotation of the tube will tighten the band.
2. You will probably find it best to remove the band covers before attempting this adjustment in order to estimate the tension of the bands. The band should be tightened until it gives a distinctly audible humming note when plucked with the fingers. Nothing is gained by tightening the band beyond the point where it is secure against slipping about the pulleys. Excessive tension of the lower band may cause the head to bind. With a little experience the band tension can be tested with the band covers in place by squeezing them upon the bands.
3. If the band has not been made sufficiently tight it may work out of the pulley grooves. This is indicated by errors in alignment. Correct the difficulty by loosening the band in accordance with the instructions in the foregoing paragraph and then sliding the band along the pulley until it is properly seated in the groove, then tighten the band

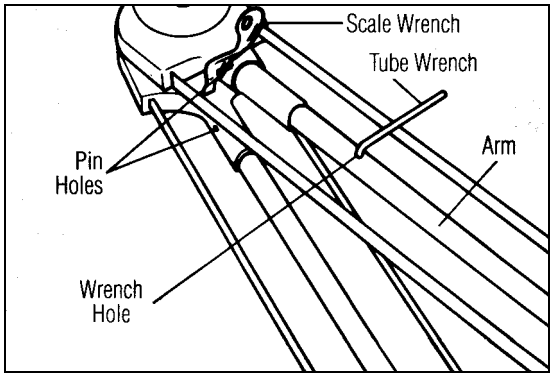


Figure 14

Adjustments (cont.)

D. Changing Bands (Figure 15)

1. If it becomes necessary to change bands, proceed as follows: First remove the band covers as already described, Then loosen the band in the manner indicated under "Band Tension," making certain that the end of the tube is pressed tightly toward the elbow while being rotated. Otherwise the thrust screw head will poll away from the band-tightening pin which has been inserted in the pin hole. The tube should be rotated until it actually comes to a stop. Now press the elbow bracket and the head bracket, or the support bracket, as the case may be, as closely together as possible and slide the band down out of its groove in the head pulley or mast pulley. In removing the lower band, it is necessary to rotate the entire head so that the base-line wing nut (Fig. 15) is approximately under the arm in order that it not interfere with the band when it is slid downward out of its groove. Next, remove the band from its groove in the elbow pulley and you will find that there is sufficient slack in the band to permit its removal from the elbow bracket. This operation is easiest to perform it the protractor head is placed near the clamp so that there is only a small angle between the arms. After this step, the parts can be separated.
2. In assembling, simply reverse the process. Before finally tightening the band, check again to make certain that the band is in the pulley grooves, also see that the base-line wing nut is conveniently positioned as described in the next paragraph.

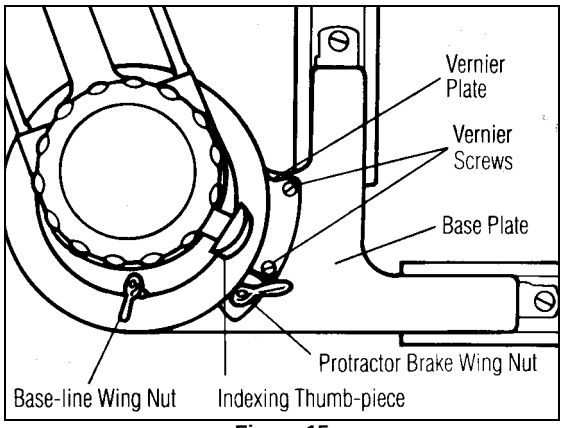


Figure 15

E. Base-Line Wing Nut Position (Figure 15)

For greatest convenience, the base-line wing nut should occupy a position approximately as shown on Fig. 15. The drafting machine is usually clamped at the back edge of the table as previously shown. However, some draftsmen prefer to have it attached to the left-hand edge and when this is done the base-line wing nut may be near the vernier, a very undesirable position. To position this wing nut properly, it is only necessary to loosen the band as previously described, rotate the entire head until the wing nut is properly positioned, and then tighten the band.

Adjustments (cont.)

F. Vernier Adjustment

Set one of the zero points on the protractor opposite the zero point on the vernier and lock it there by means of the thumb-controlled indexing mechanism. If these two zero points are not exactly opposite each other, loosen the vernier plate screws (Fig. 16), and press the vernier-plate away from the protractor. Now insert two small pieces of thin paper between the protractor and either end of the vernier-plate to give clearance; press the latter against the protractor lightly and partly tighten the screws. By lightly tapping with a pencil, or with a small wooden block, slide the vernier plate until the two zero points are exactly opposite and tighten the screws. Now remove the pieces of paper and the protractor will be found to work sufficiently close to the vernier for good reading and without binding.

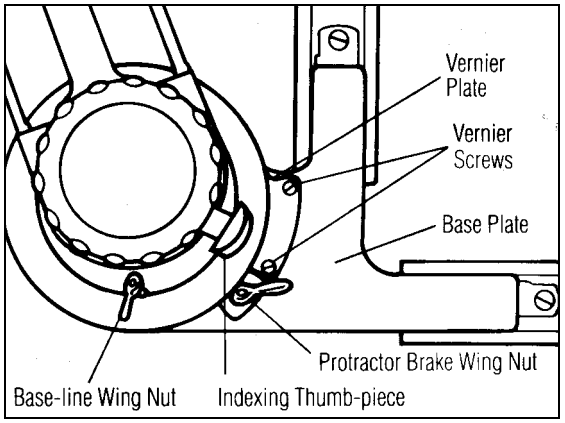


Figure 16

Maintenance and Repairs

It difficulty develops in the operation of a VEMCO drafting machine, in most cases a minor adjustment will correct the situation. The user wil I be able to make the following examinations and corrections himself, but if he is unsuccessful in obtaining satisfactory operation, he should refer to the section of Factory Service below.

A. Alignment:

If the scales of head seem loose, or if, for any reason, the parallel motion of the machine appears faulty the following points should be checked:

1. THE SUPPORT CLAMP: See that the clamp is tight and snug against the edge of the board. If the board is too thin it may be necessary to place a block of wood between the lower surface of the board and the clamp screw washer.
2. THE SCALES: Make sure that the scales are set firmly in their chucks, that they are aligned as previously described, and that both scale screws are tight. A damaged scale chuck plate may not seat itself properly in the chuck, and it may be necessary to replace it.
3. BAND TENSION: It the bands are not sufficiently tight the pulleys can slip and cause alignment error. The bands can be tightened as previously described, but they should not be over-tightened.

B. Scales

If the scales do not lie flat on the drafting board, check the following points]

1. FLATNESS OF BOARD: The board can be tested for sags and ridges by means of a straight-edge. Badly warped boards will not give satisfactory surface and can cause the scales to not lie flat in certain positions. Sometimes the difficulty can be partially corrected by placing strips of cardboard under the clamp.
2. FAULTY SCALES: Make sure the scales are of approximately the same thickness and are straight. It is possible to straighten an aluminum scale, but a badly warped plastic or wooden scale may have to be replaced.
3. FLATNESS OF BASE PLATE~ Unclamp the machine and place it on a table bottom side up. Check the flatness of the base plate with a scale, and look for bending particularly where the scale chucks project from the baseplate. With care, these parts may be straightened by hand.
4. ELBOW ELEVATION: This can be tested and corrected as previously described.

C. Factory Service

If a difficulty develops which cannot be corrected by the above procedures, the user should contact his dealer or write the factory to explain the problem. It factory service is required; the machine should be properly packed and insured to cover possible damages in shipping.

Vemco Drafting Products Corporation is not responsible for damage due to packaging or shipping.

Civil Engineer's Machine

The only differences between Civil Engineer's machines (Models 3100 and 5100) and the Standard Machine are in the construction of the protractor head. The Civil Engineer's protractor is divided in half degrees and is marked 0-360 degrees in addition to the usual 0-90 degree quadrant numbering. The vernier is made to permit readings accurate to one minute, and the machine is equipped with a magnifying glass. Also, the Civil Engineer's head has no indexing mechanism but is equipped with a micrometer knob and gear to permit precise angular settings to be made easily and quickly.

All of the instructions in this booklet except those pertaining to the indexing mechanism apply to Civil Engineer's machines. Although inserting and aligning scales is accomplished in essentially the same manner as previously described, it should be noted that, because the Civil Engineer's machine has no indexing mechanism, it is necessary to use the protractor brake when turning the baseplate 90 degrees for aligning the vertical scale.

This machine duplicates on a map the operations of a transit in the field, the edge of the scale taking the place of the line of collimation of the telescope. The motion of the scale arm relative to the protractor represents the “upper motion”. The motion of the protractor relative to the pulley represents the “lower motion”. The "upper motion" is clamped, or released, by the protractor brake wing nut (Fig. 17). Similarly, the "lower motion" is clamped, or released, by the base-line wing nut.

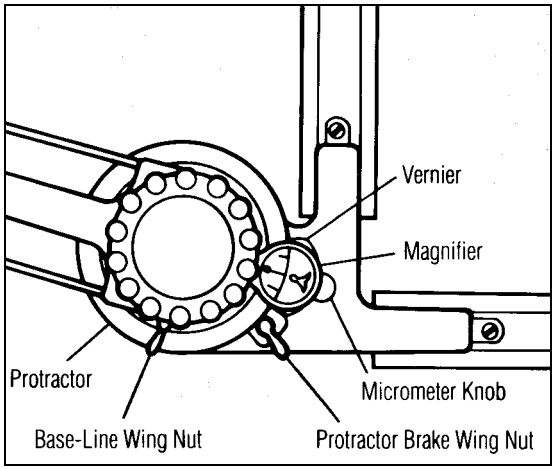


Fig 17

The main purpose of the Civil Engineer's machine is to set off accurate angles with respect to a line, which may occupy any azimuth in the entire circle. This is accomplished as follows:

- Release the protractor brake wing nut (Fig. 17) and tighten the base-line wing nut.

With the left hand placed on the handle to steady it, place the right hand on the remote end of the horizontal scale and move it until the vernier is precisely at the zero position of the protractor. The final adjustment may be made with the micrometer knob,

Civil Engineer's Machine (cont.)

Caution. Never force the micrometer screw (Fig. 17). If the protractor brake wing nut is tight, the parts of the head cannot move, and forcing the micrometer screw may result in some injury to the machine.

- Next, tighten the protractor brake wing nut and release the base-line wing nut. Again, with the left hand on the handle, place the right hand on the remote end of the scale and rotate it until it is in precise alignment with the line from which one or more angles are to beset off, then tighten the base-line wing nut.
- To set the scale at a given angle, release the protractor brake nut and set the vernier at this angle, either by rotating the scale as described above or by means of the micrometer knob,

The user may occasionally find it necessary to adjust to a new base line, which has a definite angular relationship with an original base line. This may be accomplished by either of the two following methods:

METHOD 1. Release the protractor brake, set the vernier at the required angle, and rule a line with the horizontal scale. Then return the vernier setting to zero, release the base-line wing-nut and set the horizontal scale on the ruled line.

METHOD 2. It one is not already available, rule a line to represent the original base line. Release the protractor brake, set the vernier at an angle, which is the negative of the new base-line angle, and tighten the brake. Release the base-line wing-nut and set the horizontal scale along the original base line. A zero vernier reading will now correspond to the horizontal scale being parallel to the new base line.

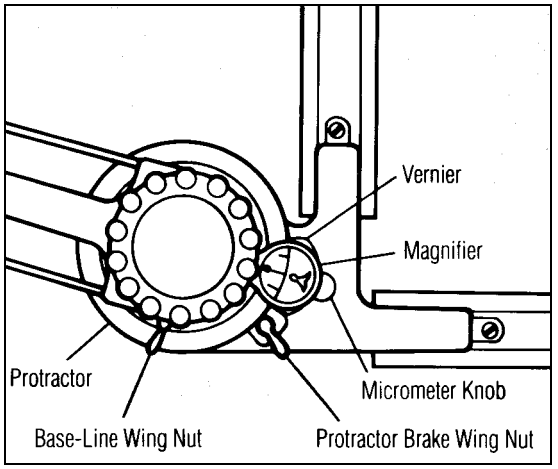
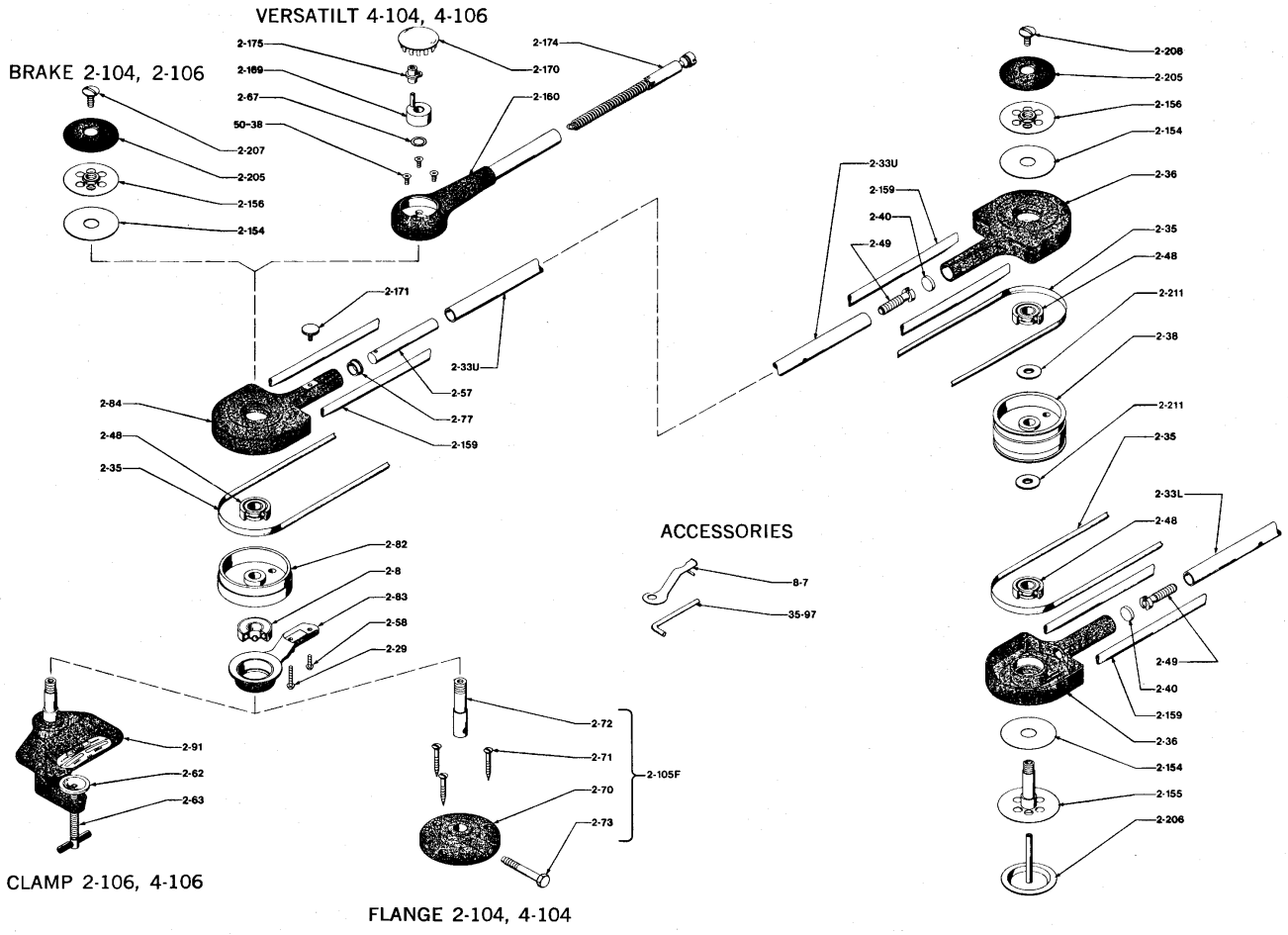


Fig 17

Models 2100, 3100, 4100, 5100
Drafting Machine Parts List



MAST ASSEMBLIES

NOTE: Specify color (black or gray) when ordering plastic or painted parts.

PARTS LIST

Part No.	Name
2-29	Bracket Support Screw
2-33-24	Tube 24″ Upper (Short)
2-33-25	Tube 24″ Lower (Long)
2-33-30	Tube 30″ Upper (Short)
2-33-31	Tube 30″ Lower (Long)
2-33-36	Tube 36″ Upper (Short)
2-33-37	Tube 36″ Lower (Long)
2-35-24	Standard Band 24″
2-35-30	Standard Band 30″
2-35-36	Standard Band 36″
2-36	Std. Elbow Brkt. Assembly (with 2-48 Bearing)
2-38	Standard Elbow Pulley
2-40	Standard Thrust Plug
2-49	Standard Thrust Screw
2-57	Standard Tube Support
2-58	Lower Elevation Screw
2-62	Std. Clamp Screw Washer
2-63	Std. Clamp Screw Assy.
2-67	Spindle Shim (.003, .005, .010, or .015 thick)
2-70	Flange Mounting
2-71	Flange Mounting Screw
2-72	Flange Mast Mounting
2-73	Flange Screw
2-77	Std. Thrust Washer
2-82	Standard Mast Pulley
2-83	Bracket Support Assy. (with 2-8 Bearing)
2-84	Std. Mast Bracket Assy. (with 2-48 Bearing)
2-91	Standard Clamp Assy. (including 2-62 and 2-63)
2-154	Std. Brake Lining
2-155	Std. Elbow Spindle Assy.
2-156	Std. Elbow Nut Assy.
2-159-24	Std. Band Cover 24″
2-159-30	Std. Band Cover 30″
2-159-36	Std. Band Cover 36″
2-160	Spring Housing Assy.
2-169	Crank Nut Assembly
2-170	Standard Snap Cap
2-171	Upper Elevation Screw
2-174	Spring Assy.
2-175	Link Assembly
2-203	Name Plate
2-204	Drive Screw
2-205	Upper Brake
2-206	Lower Brake Assembly
2-207	Std. Mast Brake Screw
2-208	Std. Elbow Brake Screw
2-211	Elbow Brake Washer
8-7	Scale Wrench Assembly
35-97	Tube Wrench
50-38	Spring Retainer Screw

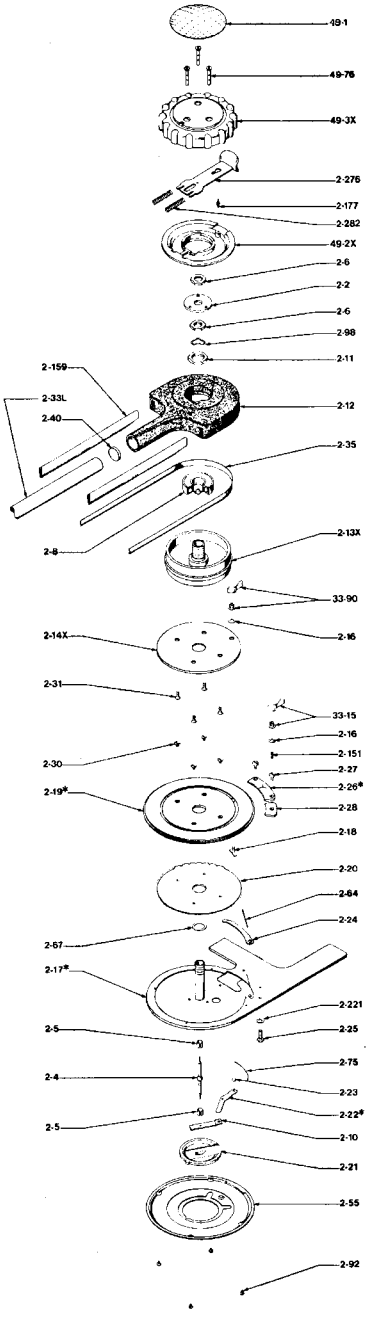
ASSEMBLIES:

2-102	Std Elbow Assy.
2-104	Mast Assy. w/Flange Mtg.
2-105F	Standard Flange Base
2-106	Std. Mast Clamp Assy.
4-104	V. Mast Assy. w/Flange
4-106	V. Mast-Clamp Assy.

Models 2100 & 4100
Drafting Head Assembly Parts List

NOTE: Specify color (black or gray) when ordering plastic or painted parts.

2-101 Head Assembly



PARTS LIST

	Part No.*	Name
	2-2	Handle Plate
	2-4	Lock Pivot Assembly
	2-5	Pivot Spacer
	2-6	Half Nut
	2-10	Link
	2-11	Lock Nut
	2-12	Std. Head Bracket Assembly (with 2-8 Bearing)
▶	2-13X	Head Pulley w/Bushing
▶	2-14X	Standard Lock Plate
	2-16	Wing Nut Washer
	2-17	Base Plate Assembly
	2-17LH	Base Plate Assembly
	2-18	T-Slot Screw
	2-19	Standard Protractor
	2-19LH	Standard Protractor
	2-20	Standard Index Plate
	2-21	Skid Button
	2-22	Lock Lever Assy.
	2-22LH	Lock Lever Assy.
	2-23	Lock Roller
	2-24	Standard Index Pawl
	2-25	Brake Screw
	2-26	Std. Vernier Plate
	2-26LH	Std. Vernier Plate
	2-27	Vernier Screw
	2-28	Std. Protractor Brake
	2-30	Index Plate Screw
	2-31	Lock Plate Screw
‡	2-33-24	Tube 24" Upper (Short)
‡	2-33-25	Tube 24" Lower (Long)
‡	2-33-30	Tube 30" Upper (Short)
‡	2-33-31	Tube 30" Lower (Long)
‡	2-33-36	Tube 36" Upper (Short)
‡	2-33-37	Tube 36" Lower (Long)
‡	2-35-24	Standard Band 24"
‡	2-35-30	Standard Band 30"
‡	2-35-36"	Standard Band 36"
‡	2-40	Standard Thrust Plug
	2-55	Standard Shield
	2-55LH	Standard Shield
	2-64	Pawl Spring
	2-67	Spindle Shim
	2-75	Roller Spring
	2-92	Shield Screw
	2-98	Spring Washer
	2-151	Wing Nut Spring
‡	2-159-24	Std. Band Cover 24"
‡	2-159-30	Std. Band Cover 30"
‡	2-159-36	Std. Band Cover 36"
	2-177	Release Pin
	2-221	Brake Lock Washer
†	2-276	Release Slide Assy.
†	2-282	Coil Lock Spring
	33-15	Wing Nut Handle Assy. (with Bushing)
	33-90	Baseline Wing Nut Assy. (with Bushing)
	49-1	Handle Cover
	49-2X	Lower Handle
	49-3X	Upper Handle
	49-76	Handle Screw

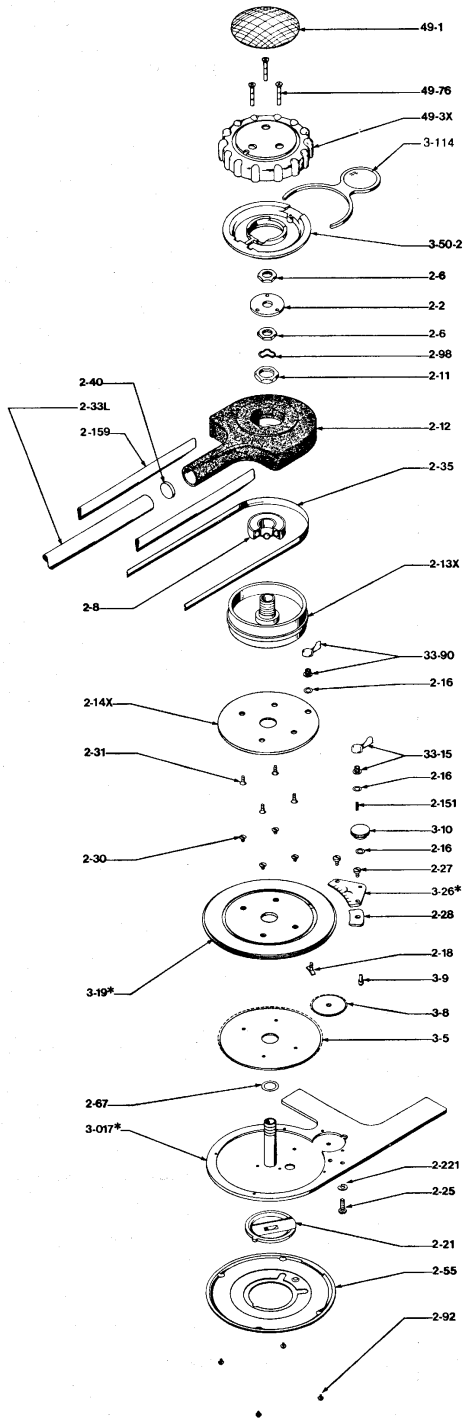
* "LH" in a part number refers to the corresponding part for a left-handed machine.

▶ When the pulley, bushing or lock plate must be replaced on machines made before about Jan. 1, 1973, it is necessary to replace all of these parts with 2-13X and 2-14X.

† Not present on machines with serial numbers less than Z690,000. For these machines, order 2-176 Release ($1.80) and 2-182 Coil Lock Spring ($.40).

‡ Not included in 2-101 Assembly.

Models 3100 & 5100
Drafting Head Assembly Parts List



NOTE: Specify color (black or gray) when ordering plastic or painted parts.

3-101 Head Assembly

PARTS LIST

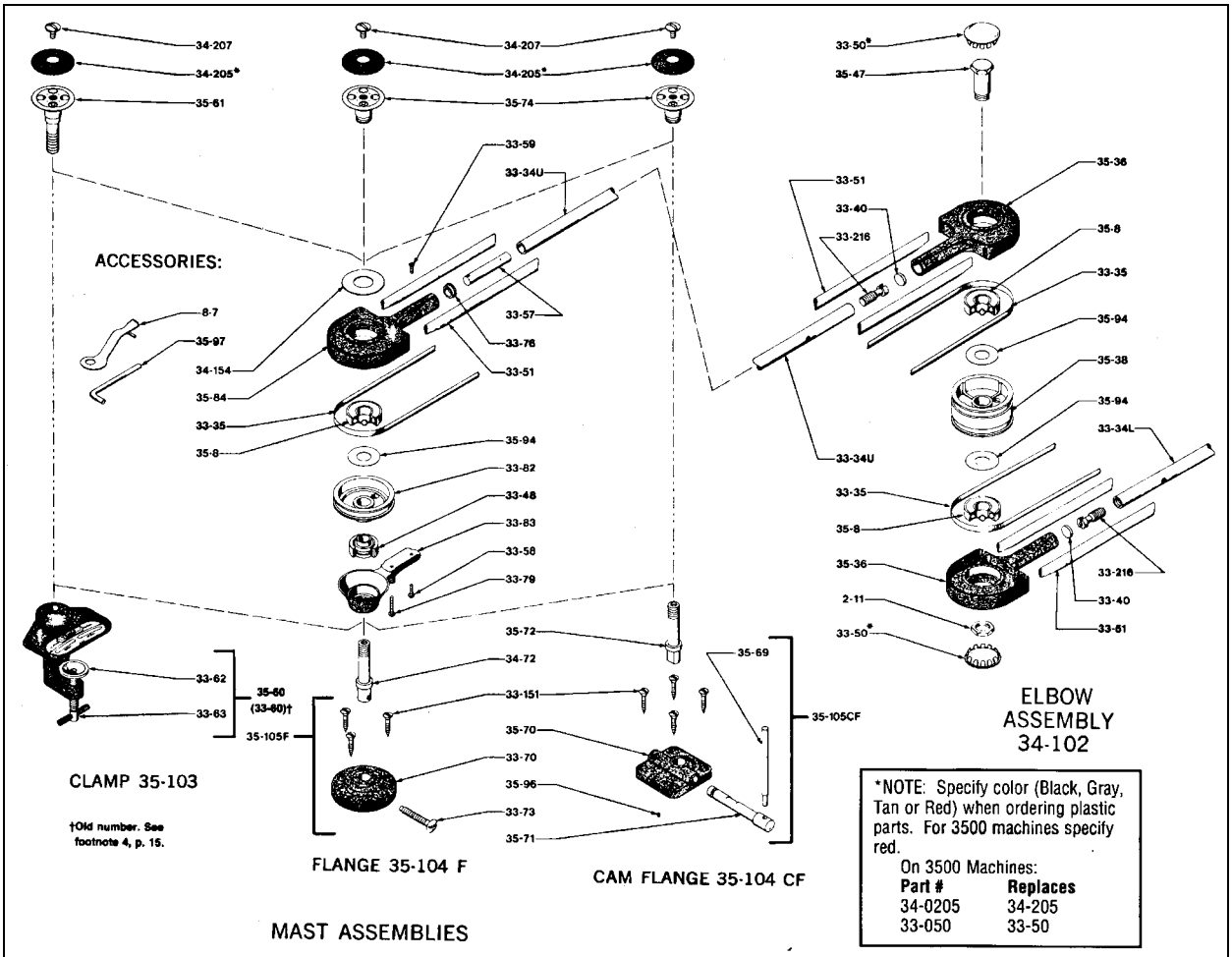
	Part No.*	Name
	2-2	Handle Plate
	2-6	Spindle Assembly
	2-11	Lock Nut
	2-12	Std. Head Bracket Assembly (with 2-8 Bearing)
▶	2-13X	Head Pulley w/Bushing
▶	2-14X	Standard Lock Plate
	2-16	Wing Nut Washer
	2-18	T-Slot Screw
	2-21	Skid Button
	2-25	Brake Screw
	2-27	Vernier Screw
	2-28	Std. Protractor Brake
	2-30	Index Plate Screw
	2-31	Lock Plate Screw
‡	2-33-24	Tube 24" Upper (Short)
‡	2-33-25	Tube 24" Lower (Long)
‡	2-33-30	Tube 30" Upper (Short)
‡	2-33-31	Tube 30" Lower (Long)
‡	2-33-36	Tube 36" Upper (Short)
‡	2-33-37	Tube 36" Lower (Long)
‡	2-35-24	Standard Band 24"
‡	2-35-30	Standard Band 30"
‡	2-35-36"	Standard Band 36"
	2-40	Standard Thrust Plug
	2-55	Standard Shield
	2-55LH	Standard Shield
	2-67	Spindle Shim
	2-75	Roller Spring
	2-92	Shield Screw
	2-98	Spring Washer
	2-151	Wing Nut Spring
‡	2-159-24	Std. Band Cover 24"
‡	2-159-30	Std. Band Cover 30"
‡	2-159-36	Std. Band Cover 36"
	2-221	Brake Lock Washer
	3-5	Master Gear
	3-8	Idle Gear
	3-9	Set Pinion
	3-10	Micrometer Knob
	3-017	CE Base Plate Assy.
	3-017LH	CE Base Plate Assy. LH
	3-19	CE Protractor
	3-19LH	CE Protractor LH
	3-26	CE Vernier
	3-26LH	CE Vernier LH
	3-50-2	CE Lower Handle
	3-114	Magnifier Assembly
	33-15	Wing Nut Handle Assy. (with Bushing)
	33-90	Baseline Wing Nut Assy. (with Bushing)
	49-1	Handle Cover
	49-3X	Upper Handle
	49-76	Handle Screw

* "LH" in a part number refers to the corresponding part for a left-handed machine.

▶ When the pulley, bushing or lock plate must be replaced on machines made before about Jan. 1, 1973, it is necessary to replace all of these parts with 2-13X and 2-14X.

‡ Not included in 2-101 Assembly.

Models 3300 & 3500
Drafting Machine Parts List



*NOTE: Specify color (Black, Gray, Tan or Red) when ordering plastic parts. For 3500 machines specify red.

On 3500 Machines:

Part #	Replaces
34-0205	34-205
33-050	33-50

PARTS LIST

Part No.	Name
2-11	Lock Nut
8-7	Scale Wrench
33-34-16	Tube Upper (Short) 16"
33-34-17	Tube Lower (Long) 16"
33-34-18	Tube Upper (Short) 18"
33-34-19	Tube Lower (Long) 18"
33-34-20	Tube Upper (Short) 20"
33-34-21	Tube Lower (Long) 20"
33-34-22	Tube Upper (Short) 22"
33-34-23	Tube Lower (Long) 22"
33-35-16	Jr. Band 16"
33-35-18	Jr. Band 18"
33-35-20	Jr. Band 20"
33-35-22	Jr. Band 22"
33-40	Jr. Thrust Plug
33-50	Jr. Snap Cap
33-51-16	Jr. Band Cover 16"
33-51-18	Jr. Band Cover 18"
33-51-20	Jr. Band Cover 20"
33-51-22	Jr. Band Cover 22"
33-57	Jr. Tube Support
33-58	Lower Elevation Screw

Part No.	Name
33-59	Upper Elevation Screw
33-62	Jr. Clamp Screw Washer
33-63	Jr. Clamp Screw Assembly
33-70	Jr. Flange Mounting
33-73	Jr. Flange Screw
33-76	Jr. Thrust Washer
33-79	Jr. Support Brkt. Screw
33-82	Jr. Mast Pulley
33-83	Bracket Support Assy. (with 33-48 Bearing)
33-151	Jr. Flange Wood Screw
33-216	Jr. Thrust Screw
34-72	Jr. Flange Mtg. Mast
34-73	Jr. Lock Flange Screw
34-154	Jr. Brake Lining
34-205	Jr. Upper Brake
34-207	Jr. Mast Brake Screw
34-217	Jr. Cover Cap LF
35-36	Jr. Elbow Bracket Assy. (with 35-8 Bearing)
35-38	Jr. Elbow Pulley
35-47	Jr. Elbow Spindle

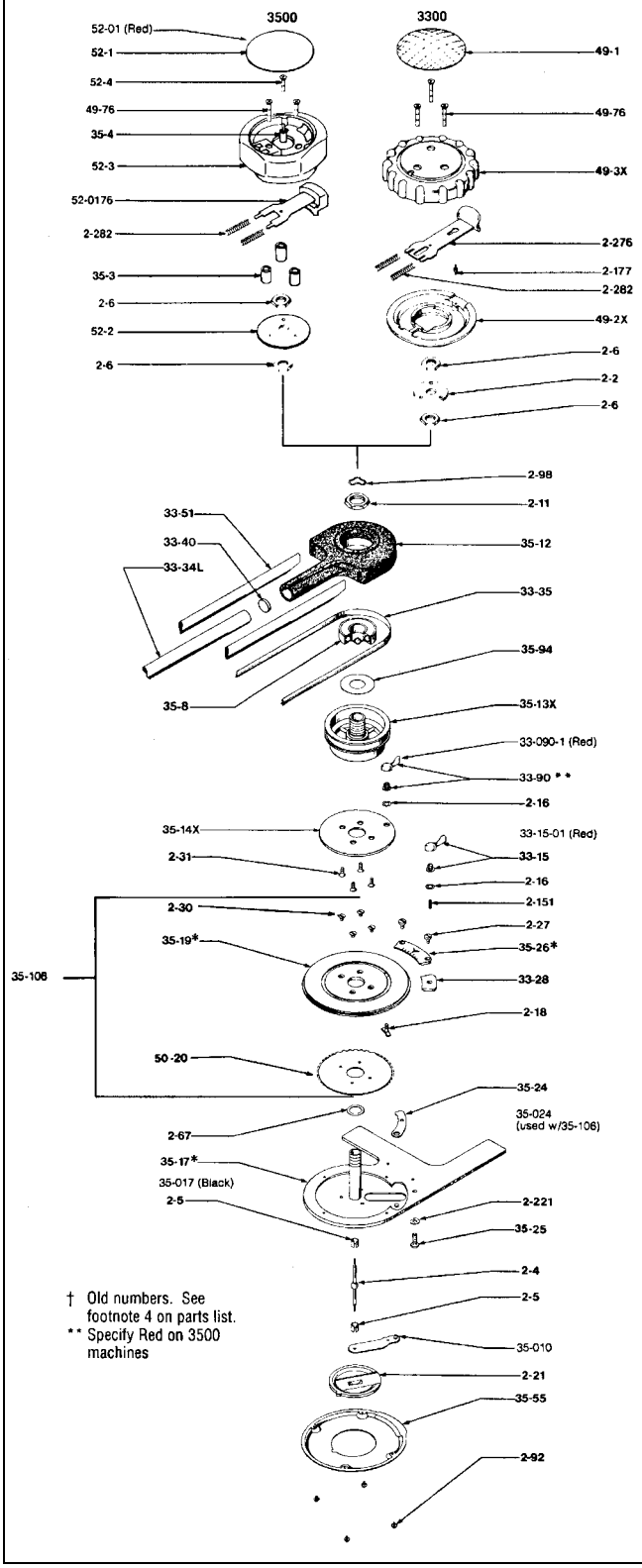
Part No.	Name
35-61	Jr. Mast Assembly
35-69	Cam Handle
35-70	Cam Flange Mounting
35-71	Cam Shaft
35-72	Cam Flange Mast
35-74	Jr. Brake Nut Assembly
35-84	Jr. Mast Bracket Assy. (with 35-8 Bearing)
35-94	Jr. Bearing Washer
35-96	Set Screw CF
35-97	Tube Wrench

ASSEMBLIES

34-102	Jr. Elbow Assembly
[1]35-60	Jr. Clamp Assembly (with 33-62 and 33-63)
35-103	Jr. Mast/Clamp Assy.
35-104F	Mast. Assy. w/Flange Mtg.
35-104CF	Mast. Assy. w/CF Mtg.
35-105F	Flange Base
35-105CF	Cam Flange Base

[1]See Footnote 4, p. 12

Models 3300 & 3500
Drafting Head Parts List



† Old numbers. See footnote 4 on parts list.
** Specify Red on 3500 machines

NOTE: Specify color (black or gray) when ordering plastic or painted parts.

PARTS LIST

Part No.*	Name
35-0101	HEAD ASSEMBLY 3500 Detailer
35-101	HEAD ASSEMBLY 3300
2-2	Handle Plate
2-4	Lock Pivot Assembly
2-5	Pivot Spacer
2-6	Half Nut
2-11	Lock Nut
2-16	Wing Nut Washer
2-21	Skid Button
2-27	Vernier Screw
2-31	Lock Plate Screw
2-67	Spindle Shim
2-92	Shield Screw
2-98	Spring Washer
2-151	Wing Nut Spring
2-177	Release Pin
2-221	Brake Lock Washer
[2] 2-276	Release Slide Assy.
[2] 2-282	Coil Lock Spring
33-15	Wing Nut Handle Assy. (With Bushing)
33-15-01	Wing Nut Handle Assy. (Red)
33-16	Wing Nut Bushing
33-28	Jr. Protractor Brake
[3] 33-34-16	Tube Upper (Short) 16"
[3] 33-34-17	Tube Lower (Long) 16"
[3] 33-34-18	Tube Upper (Short) 18"
[3] 33-34-19	Tube Lower (Long) 18"
[3] 33-34-20	Tube Upper (Short) 20"
[3] 33-34-21	Tube Lower (Long) 20"
[3] 33-34-22	Tube Upper (Short) 22"
[3] 33-34-22	Tube Lower (Long) 22"
[3] 33-35-16	Jr. Band 16"
[3] 33-35-18	Jr. Band 18"
[3] 33-35-20	Jr. Band 20"
[3] 33-35-22	Jr. Band 22"
[3] 33-40	Jr. Thrust Plug
[3] 33-51-16	Jr. Band Cover 16"
[3] 33-51-18	Jr. Band Cover 18"
[3] 33-51-20	Jr. Band Cover 20"
[3] 33-51-22	Jr. Band Cover 22"
33-90	Baseline Wing Nut Assy. (with Bushing)
33-090-1	Baseline Wing Nut Assy. (Red)
[4] 35-010	Jr. Link Assembly
35-3	Handle Spacer
35-4	Pivot Extender
35-12	Jr. Head Bracket Assy. (with 35-8 Bearing)
[1] 35-13X	Head Pulley (with Bushing)
[1] 35-14X	Jr. Lock Plate
[4] 35-017	Jr. Base Plate Assy.
[4] 35-017LH	Jr. Base Plate Assy. LH
[4] 35-024	Jr. Index Pawl
[4] 35-25	Brake Screw
35-26	Jr. Vernier
35-26LH	Jr. Vernier LH
35-55	Jr. Shield
35-94	Jr. Bearing Washer
[4] 35-106	Jr. Protractor w/Index Plate Assy. (includes T-Slot Screw)
49-1	Handle Cover
49-2X	Lower Handle
49-3X	Upper Handle
49-76	Handle Screw
50-20	Index Plate
52-0176	Release Slide Assy.
52-01	Release Slide Assy. (Red)
52-1	Handle Cover
52-2	Handle Plate
52-3	Upper Handle
52-4	Handle Screw (Short)

* "LH" in a part number refers to the corresponding part for a left-handed machine.

[1] When the pulley, bushing or loch plate must be replaced on machines made before about Jan. 1,1973, it is necessary to replace all of these parts with 35-13X and 35-14X.

[2] Not present on machines with serial numbers less than Z690,000. For these machines, order 2-176 Release and 35-182 Coil Loch Spring.

[3] Not included in 35-101 or 35-0101 Assemblies.

[4] Parts with these numbers are present only in machines with serial numbers larger than 834300 (May, 1984). For machines with smaller (earlier dates) serial numbers, refer to drawing.