S-T INDUSTRIES, INC.
SCHERR-TUMICO

INSTRUCTION MANUAL

24" HORIZONTAL BEAM OPTICAL COMPARATOR

2450 SERIES

MADE IN U.S.A.

20-2450 SERIES
24" OPTICAL COMPARATOR

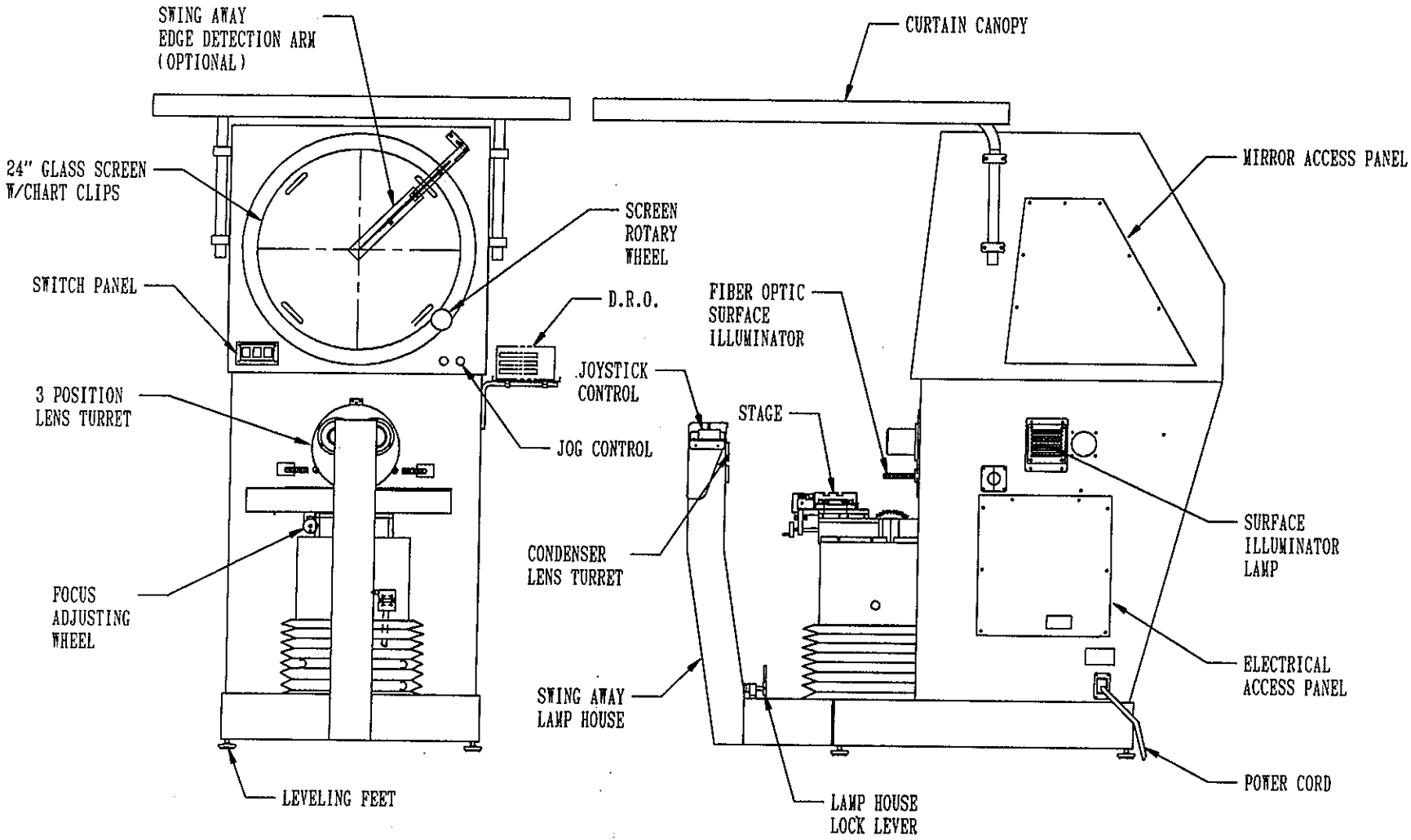
INSTRUCTION MANUAL

INTRODUCTION

This manual contains the instructions for the installation, operation and maintenance of the SCHERR-TUMICO 20-2450 Series horizontal beam optical comparator.

TABLE OF CONTENTS

20-2450 SERIES
NOMENCLATURE



SPECIFICATIONS

Machine Dimensions
Length..... 64" (1625 mm)
Width..... 31" (787 mm)
Height..... 83" (2108 mm)
Height to Screen Center.. 59.5" (1511 mm)

Work Table
Length..... 24" (600 mm)
Width..... 5" (125 mm)

Clamping Slots..... 2
Allowable Workload..... 200 lb. (90 Kg)

Measuring Capacity
X-axis..... 12" (300 mm)
Y-axis..... 8" (200 mm)
Focus..... 3" (75 mm)
Scale Resolution.....00005" (.001mm)

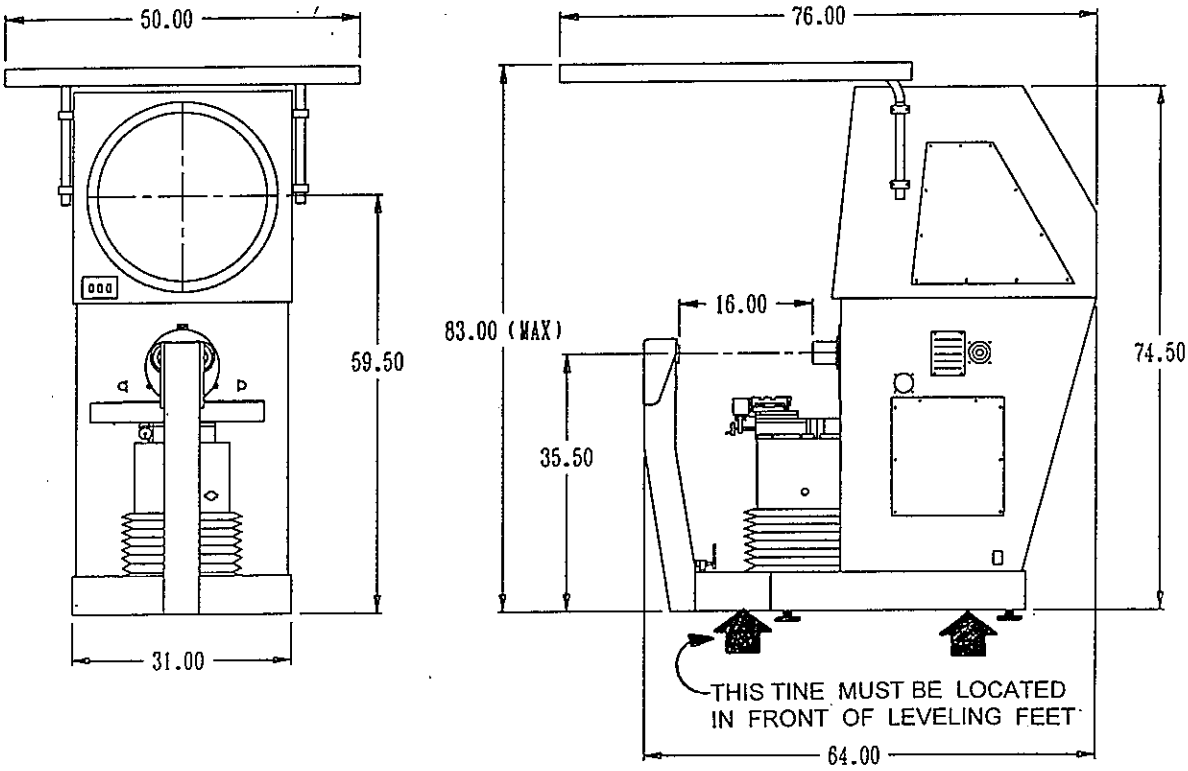
Screen Size..... 24" (600 mm)

Digital Protractor Resolution..... 1 minute

Magnification Lenses
5X, 10X, 20X, 25X, 50X, 100X

Electrical
Voltage.....100-240v, 50 or 60 Hz
Current.....3 amps
Lamps (Tungsten-Halogen)
Profile Illum.....150 watt, 24 volt
Surface Illum.....150 watt, 21 volt (2)

Weight
Comparator.....1000 lb. (455 Kg)
Crated Comparator..... 1250 lb. (568 Kg)

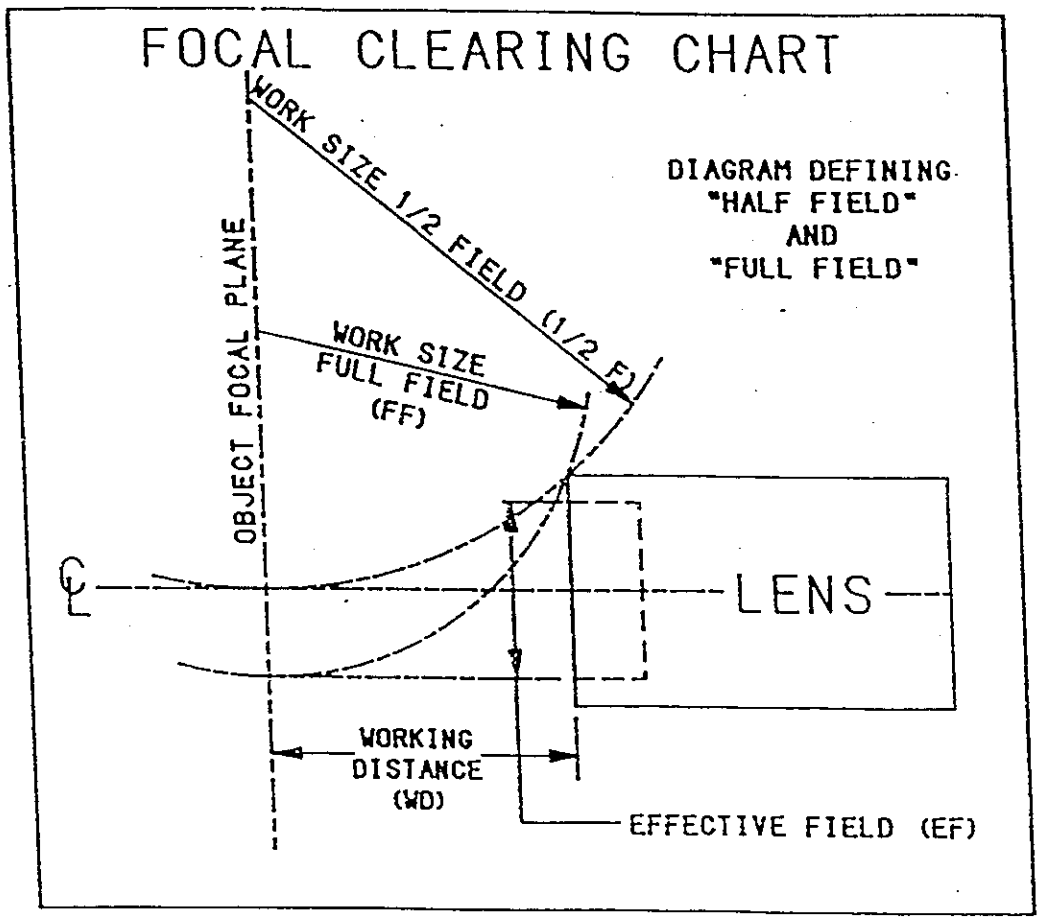


LEGEND: FORK LIFT TINE LOCATION

Focal Clearing Chart

24" OPTICAL COMPARATORS

MAG.	WD	EF	DIA 1/2F	DIA FF
10X	5.4" (137mm)	2.4" (61mm)	18.3" (465mm)	13.8" (351mm)
20X	5.4" (137mm)	1.2" (30mm)	17.9" (455mm)	17.9" (455mm)
25X	4.7" (119mm)	1.0" (25mm)	18.3" (465mm)	15.0" (381mm)
50X	3.9" (99mm)	0.5" (13mm)	16.6" (422mm)	14.9" (378mm)
100X	1.9" (48mm)	0.24" (6mm)	5.6" (142mm)	5.0" (127mm)



INSTALLATION SITE

The SCHERR-TUMICO 2450 is a precision optical instrument and should be installed in a clean, vibration free location. Dust, oil and other contaminants may coat the lenses and mirrors and cause distortion or otherwise reduce image quality. Extremes in temperature may cause excessive expansion or contraction of the comparator and parts to be measured resulting in inaccuracy of part measurement. High humidity may result in condensation and fogging of the mirror, lenses and screen. It is recommended to install the comparator in an air-conditioned room with a lower than normal light level.

SETUP

The SCHERR-TUMICO 2450 requires only minimal setup upon receipt. Avoid rough handling which could cause misalignment and inaccuracy of measurement.

UNPACKING

IMPORTANT...If you have any questions about unpacking or setup, contact S-T Industries or local S-T distributor.

1. Remove wood sides from pallet. Remove canopy top and any loose accessories and set aside. Remove plastic bag covering optical comparator. Unbolt brackets holding comparator on pallet.

2. Pick up comparator with a fork lift. **Be sure to lift at marked positions.** While still being held by the forklift, remove wood beams from under comparator and install leveling feet (4) under base of comparator. Place in position for operation and remove forklift.

3. Adjusting leveling feet until comparator is level and stable. Remove any packaging material from around lenses, screen and lamphouse.

4. Check for shipping damages. Document shortages and damages and report to S-T Industries including the Model number and Serial number.

5. Wipe down the comparator with clean dust rags. **CAUTION:** Do not use shop air hoses to blow dirt from the comparator. Flying particles can damage mirror surfaces or optics.

Do not connect power to the comparator until setup is complete

INSTALLATION

CANOPY TOP INSTALLATION

1. Loosen clamps holding canopy support arms. Swing them both straight forward and push them up to the desired height. Lightly tighten clamps to hold the arms in position.

2. Remove canopy top from packaging material. Remove bottom half of 4 clamps on canopy top. Place canopy on arms so the curved ends of the curtain rails are forward and the clamps fit over the arms.

3. Replace the bottom half of the clamps and lightly tighten in place. Adjust canopy position and arm positions if necessary. Tighten all clamps. **Do not over tighten.**

4. Hang curtains on curtain rails. Install with hooks facing inward.

DRO INSTALLATION

1. Locate arm and tray for digital readout on right side of comparator. Loosen clamps and rotate tray and arm until in desired position to support DRO. Tighten clamps to hold in position. **Do not over tighten.**

2. Locate Digital Readout. Place on tray. Unwrap cords on side of comparator and plug into digital readout. Plug cables marked X axis and Y axis into the X axis and Y axis connectors on the back of the digital readout. Plug the unmarked cable into the 'Q' axis connector on the back of the digital readout. Plug in power cord to DRO. **CAUTION:** If you have the edge detection option, be careful not to overbend small fiberoptic bundles.) Secure cables to arm with wire ties if necessary.

Note: If the comparator is configured with the QC 4215 DRO, there will be a different setup for the DRO tray. See section on CNC option.

STAGE SETUP

1. Remove shipping brackets from stage. Replace any screws and washers which are end stops for ballways.

2. Locate joystick and install on joystick mount on lamphouse. Plug in connector to joystick connection in front of stage assembly.

POWER UP

Insert main power cord into power entry module in the side of the comparator and plug into outlet. Turn on main power. Check fan and DRO operation. Turn on profile and surface illumination and check operation.

POWER SWITCHES

There are 3 switches locate on the right side of the comparator.

1. The main power switch controls all power to the lamps, fans and digital readout.

2. The Profile Illumination switch controls power to the profile lamp. High and Low positions.

3. The Surface Illumination switch controls power to the surface illumination lamps. High and Low positions.

Note: The fans will operate when the main power switch is turned on.

PROFILE AND SURFACE ILLUMINATION

Profile and surface illumination each have their own light sources and respective ON-OFF switches.

The profile illuminator projects a light beam past a part on the stage, creating an accurately magnified image of the part profile on the screen when focused. This allows precise measurements of the features of a part either by comparison to a chart or by positional measurement using a digital readout. The condenser lens turret is located in front of the profile lamp. The condenser lens turret holds two condenser lenses, one for 10X, 20X and 25X and the other for 50X and 100X. magnifications lenses. To select , simply rotate the turret by hand until you reach the stop.

The surface illuminator projects light through two fiber optic bundles onto the front surface of a part. The reflection can be seen on the screen and the image can be measured using the comparison or positional method. To adjust each fiber optic bundle, loosen the respective thumb screws and position the bundle to obtain desired illumination and retighten thumbscrews. **CAUTION** Do not overtighten thumbscrews.

MAGNIFICATION LENSES and LENS TURRET

There are several optional lens magnifications available with the ST 2450 optical comparator.

20-1310-00	5X Magnification	20-1313-00	10X Magnification
20-1310-00	20X Magnification	20-1313-00	25X Magnification
20-1310-00	50X Magnification	20-1313-00	100X Magnification

The standard ST 2450 is equipped with a 3 position manual lens turret. The lenses that are ordered with the optical comparator will be installed and preset at the factory. To select a magnification, rotate left or right to a stop. Then adjust the focus control until the part to be measured is in focus. It may be necessary to also select a different condenser lens by rotating the condenser turret. (The larger condenser lens is for 10X - 25X and the smaller condenser lens is for 50X and 100X lenses. To choose a different magnification lens, rotate the turret until the desired lens is at the bottom and allow the spring button to seat firmly into the slot on the turret.
The standard system comes with 3 lens mounting adapters. The short adapters are for the 10X, 20X and 25X lenses. The long adapters are for 50X and 100X lenses. If more than 3 lenses are desired, you may need to obtain an additional lens mount adapter.

NOTE: If the system is ordered with a 5X lens, there will be no turret. Instead, a single lens mount with adapters to fit all lenses.

STAGE OPERATION

JOYSTICK CONTROL

The X and Y axes are driven by stepper motors and controlled with a 2 axis joystick. (See Nomenclature Figure) The joystick is mounted to the right side of the lamphouse. It can be easily removed and handheld if desired. To move the screen image, deflect the joystick in the desired direction. The more the joystick is deflected, the faster the image will move. By pressing and releasing the top button of the joystick, the speed will be switched to slow speed. Press again to return to normal speed. (The left button on the joystick base has the same function as the button on top of the joystick. The forward button on the joystick base has no function.)

Note: The buttons on the joystick may have different functions with the CNC option.

JOG WHEELS

In addition to the joystick, there are individual jog wheels for precise control of the X and Y axis. These are located just to the lower right of the screen. By rotating these wheels, the stage can be very accurately positioned. The joystick will overridethe jog wheels if you attempt to use the jog wheels and the joystick at the same time.
IMPORTANT - The operation of the joystick and jog wheels has been programmed into the stepper amplifier control at the factory. The software and interface cable has been included for your use, should it ever be necessary to update or change these settings. Consult the factory before doing this.

FOCUS

The focus is manually controlled by the focus knob located below and left of the stage.

HELIX STAGE

The horizontal axis can be pivoted +/- 15° to measure along the helix of threads. By rotating the stage, the part stays parallel to the top plate and accurate linear measurements can be made. To pivot the stage, first move the top plate to the far left to expose the protractor scale on the right end of the X-axis bearing way. Loosen the clamp screw under the bearing way to release the horizontal axis. Rotate the stage to the desired angle and retighten the clamp screw. Return the top plate to the desired position for measuring.

SWING-AWAY LAMPHOUSE

To accommodate long parts which must be measured straight on rather than along their length, the 2450 is equipped with a swing-away lamphouse. Loosen the large clamp screw located at the bottom of the lamphouse and gently swing the lamphouse to the right. Remove the joystick if necessary. It will be necessary to clamp the part firmly in a vise, V-block or other suitable fixture and to use surface illumination in order to make accurate measurements. To return the lamphouse to its normal position, swing the lamphouse gently back into the stop bracket and tighten the clamp screw.

OPTIONS

FiberOptic Edge Detection Option

This option provides a fast, accurate means of measuring by sensing the edge of an image when it passes by a fiberoptic probe on the optical comparator screen. In this way, X-Y coordinates can be automatically entered into geometric functions (Points, Circles, Lines, etc.). This is available with the QuadraChek 2000, 3000 and 4000 series digital readouts. See catalog of price list for ordering information.

This option includes a swing-away arm which holds the fiberoptic sensor on the screen. It can be moved out of the way when not in use.

CNC Control Option

The CNC control option provides automatic measurement by driving the part to be measured to preprogrammed positions and taking points either by fiberoptic edge detection or by manually targeting the edge of the part with the crosshair. The CNC control option is available with the QuadraChek 3000 and 4000 series digital readouts. Consult you QuadraChek manual or contact your S-T representative for more information. See catalog of price list for ordering information. If this comparator is configured with the QC4215 PC digital readout (CNC or non-CNC), there will be a large, monitor and keyboard tray which will be installed on the right side of the comparator. In addition, there is a CPU bay which will hang on the lower right of the comparator which will house the CPU section of the computer.

PROTRACTOR SCREEN OPERATION

The screen is rotated by turning the screen control knob located at the lower right of the screen. The screen can be locked in place using the screen lock located just above the screen control knob. Angle readings are viewed on the digital readout. Consult DRO manual for operation.

Absolute Zero Setting

The following procedure may be necessary if the glass screen is replaced:

1. Rotate the screen so the horizontal line is approximately level.
2. Focus a pointer on the screen with its tip on the left end of the horizontal screen line.
3. Move the stage so the image of the point is on the right end of the screen.
4. Observe the space between the tip of the pointer and the horizontal screen line.
5. Move the stage so the tip moves closer to the line by one half of the observed space.
6. Rotate the screen so the horizontal line is on the tip of the pointer.
7. Move the stage so the image of the point is on the left edge of the screen.
8. Repeat steps 4-7, alternating sides, until the tip remains on the horizontal line.
9. Loosen the reference marker on the right side of the screen and align with horizontal line. Consult digital readout manual for establishing Zero set point.

ANGULAR MEASUREMENTS (WITH DIGITAL SCREEN PROTRACTOR)

Consult Digital Readout manual for information on Digital Protractor operation

Incremental Method

1. Secure part to stage.
2. Focus image and position as required.
3. Align a screen reference line with an edge or feature which is a datum. Zero the incremental 'Q' or ANGLE axis display on DRO.
4. Rotate screen reference line to feature to be measured, align by moving stage if necessary and read angle on incremental 'Q' axis display.

Absolute Method

1. Focus image and position as required.
2. Align datum on part with reference line on screen. Secure part to stage.
3. Rotate screen reference line to feature to be measured, align by moving stage if necessary and read angle on absolute 'Q' axis display.

MEASURING TECHNIQUES

The optical comparator has 2 basic measuring means. Direct Optical Comparison and Measured Linear Displacement.

If necessary, secure parts to stage top. Do not attempt to get accurate measurements unless parts are stable. S-T Industries offers several standard stage fixtures and builds special fixtures for unusual parts according to customer specifications. Contact S-T Industries sales department for information.

Direct Optical Comparison

Precise measurements can be made by comparing accurately magnified images to scaled drawings or shapes superimposed or overlaid on the image.
Irregular contours, angles, radii, tapers, etc., together with high quantity measurements get compared best by use with master charts.

Three ways of chart preparation

1. To-scale part or feature drawings. Hand or CAD produced drawings on mylar to a scale matching the lens magnification. Be sure lines are thin; .005"-.010" for best comparison accuracy.
2. Hand traced master. Focus a part or feature on the screen at the desired magnification. Use the chart clips or tape to secure a sheet of mylar or drafting film to the surface of the glass screen. Using a fine point lead pencil, trace the profile. Care must be taken not to rotate the screen or move the part while tracing. Protect pencil lines by spraying a thin coat of a clear fixative.
3. Custom and standard overlay charts. S-T Industries, Inc. can supply precision overlay charts made to order as well as a full line of standard charts.

Charts can be held in place using the chart clips attached to the glass screen.

Measured Linear Displacement

The standard measuring stage allows accurate linear measurements in 2 axis, X and Y. The X axis travel is 12" (300 mm) and the Y axis travel is 8" (200 mm). The stage is equipped with .00005"/.001mm resolution glass scale encoders and one of several available digital readouts.

Procedure

1. Secure the part to the stage and focus area to be measured.
2. Be sure that screen is set at 0^{o} and align first edge to be measured with either the vertical or horizontal screen line.
3. Zero the appropriate axis on the digital readout.
4. Move the stage until the second edge to be measured aligns with the same screen line.
5. Read the linear measurement in the digital readout.
   This method can be greatly enhanced with the use of QuadraChek Geometric Digital Readouts.

The X and Y display value or coordinate is used to directly calculate geometric features such as points, lines, circles, distances and angles. Also, fiberoptic edge detection and CNC control add speed, accuracy and reliability to these measurements.

DIGITAL READOUT SYSTEMS

The 2450 series 24" optical comparator comes with several optional digital readout systems:

#20-2450-01 24" optical comparator with standard digital readout system. S-T's model 20-7000 DRO features X, Y and angle axis. Also includes INCH/MM, INC/ABS and PRINT features.

#20-2450-02 24" optical comparator with QuadraChek 2210 geometric digital readout system. DRO has all standard features plus geometric calculations including point, line, circle, distance, angle and skew and programmability.

#20-2450-03 24" optical comparator with QuadraChek 2215 geometric digital readout system. DRO has all features of above system plus fiber optic edge detection.

#20-2450-04 24" optical comparator with QuadraChek 3215 geometric digital readout system. DRO has all features of QC 2215 plus more sophisticated programming system, more memory and video display monitor.

#20-2450-05 24" optical comparator with QuadraChek 4215 computerized geometric digital readout system. DRO has all features of above system and includes PC computer with latest WINDOWS^{R} based QC 4215 software. Includes graphic representation of part features, mouse controlled commands, CAD-like graphical user interface and unlimited programmability.

CALIBRATION

MAGNIFICATION

The screen magnification can be calibrated by using S-T Industries' 74-0413-10 Master Ball Checker and 74-0321-10 10" magnification scale.

1. Locate appropriate ball for lens to be checked. (Scale is marked with diameters and magnifications)
2. Focus ball in center of screen.
3. Using magnification scale, check size of image left to right.
4. Repeat check top to bottom.
5. Edge of image should ideally split lines on checking scale. This may vary from the inside of both lines to the outside of both lines.
6. Record the results and move the image to the upper right corner of the screen. Repeat the check.
7. Move to the remaining three corners of the screen and repeat check for all.
   If the magnification is incorrect, the mirror may need adjustment.

NOTE: It may be determined that the mirror is correct and that a lens needs adjustment.

For assistance in these procedures, contact S-T Industries, Inc. or your local S-T distributor.

CAUTION

Do not disassemble a lens system to adjust or clean internal glass surfaces. Assembly and calibration of these systems requires special alignment equipment and procedures. Notify your S-T representative if you have a lens problem.

MEASURING STAGE

The measuring stage linear accuracy can be calibrated by using S-T Industries' 74-0500-00 calibration plate.

1. Place the calibration plate on the stage so the longer side is parallel with the X axis.
2. Focus on the 6" or 150mm scale.
3. Be sure that the screen is set to 0^{o}.
4. Move the stage back and forth to see that the scale line stays on the crosshair. Adjust the calibration plate if necessary.
5. Align the '0' end of the calibration scale with the screen crosshair.
6. Zero the X axis display on the DRO and move the stage until the other end of the scale aligns with the crosshair.
7. The X axis display should read the same as the scale length; 6.00000" or 150.000mm. If it does not, consult your DRO manual and adjust LEC (Linear Error Correction) until the reading is correct.
8. Return to the '0' end of the scale, zero the X axis display, if necessary, and move to the next increment on the scale (1.0" or 10mm). Record the value and repeat for each increment. Without moving the stage, carefully slide the calibration plate until the '0' line is aligned with the vertical screen line. Continue measuring to end of travel (X axis only).
9. For Y axis, move top plate to center position. Stand stage calibration plate on end. Follow steps 4-8 using the Y axis.

The measuring stage squareness can be calibrated by using S-T Industries' 74-0500-00 calibration plate.

1. Place the calibration plate on the stage so the longer side is parallel with the X axis.
2. Focus on the 6" or 150mm scale.
3. Be sure that the screen is set to 0^{o}.
4. Move the stage back and forth to see that the scale line stays on the crosshair. Adjust the calibration plate if necessary.
5. Move the stage until the end of the vertical axis of the calibration plate is aligned with the screen crosshair.
6. Zero the X and Y axis displays on the DRO.
7. Move the stage in the Y direction only until you reach the end of the scale or the end of stage travel. If the line has moved away from the crosshair in the X direction, move the stage until it lines up again.
8. The squareness is the deviation of the X axis divided by the length of travel along the Y axis.

For assistance in this procedure contact S-T Industries, Inc. or your local S-T distributor.

MAINTENANCE

Care and cleaning of the Optical System

External Lens Cleaning

1. Remove all dust from external glass surfaces. Use a clean, soft brush (preferably a lens brush sold in camera stores) or clean cotton to avoid scratching. Turn the cotton each stroke to keep wiped dust particles from the lens.

2. With the dust removed use a mild glass cleaner and clean absorbent cotton to clean the lens surface.

CAUTION
Never immerse a lens system in any cleaning solution. Moisten the cotton with the glass cleaner slightly; not soaking wet.

Mirror Cleaning

Remove either top side panel to access mirrors.

Remove dust from mirror with a brush, described previously. If necessary, use a clean cotton cloth and a mild glass cleaner for more thorough cleaning. Wipe gently in straight line motion across the mirror surface, turning the cotton with each pass across the mirror. Due to the delicate nature of the mirror coating, try to keep mirror cleaning to a minimum.

Projection Screen

Clean the projection screen with isopropanol (**not water or glass cleaner**). Use a clean, soft cloth. Do not use paper towels as they may contain abrasives.

Fuse Protection

A 5 amp fuse (3 amp for 220-240 volt) protects all electric circuits in the 20-2450 optical comparator. The fuse is located in the power input module located at the rear of the comparator. To change, remove the power cord from the power entry module and, using your finger, unsnap the fuse drawer and pull out. Change fuse and replace fuse drawer.

Lamp Replacement

When a lamp fails, wait 5 minutes before replacing to allow fans to cool off lamp area. After this time turn off main power and disconnect main power cord.

Profile Lamp (Part No. 48-7271-00)

1. Remove joystick from mount.
2. Remove cover of profile lamphouse.
3. Carefully, slide burned lamp from the socket. Be careful, the lamp may still be hot.
4. Carefully, install a new lamp into the socket using a clean cloth or gloves to keep from touching the lamp. Rock slightly to seat in the socket and center the filament to the optics as close as possible.
5. Check cooling fan on left side of lamphouse and clean if necessary.
6. Replace power cord and check lamp operation.

Surface Illumination Lamp (Part No. 48-8086-00)

1. To access the lamps, remove left or right panel (for lamp to be changed).
2. To remove lamp, pull on ejector lever. Ease the lamp out of the socket into a cloth or glove.
3. Carefully slide the new lamp parallel into the socket. Keep the front face of the lamp parallel against the bracket front. Center the lamp front on the bracket opening.
4. Check the cooling fan on the rear of the comparator; clean if necessary.
5. Replace cover panel.
6. Reconnect power cord and check lamp.

Lubrication

Lubricate V-ways and ball bearings of measuring stage with light oil occasionally, to prevent corrosion and keep motion smooth. Use a light grease preferrably with Teflon^{R} to lubricate leadsrews.

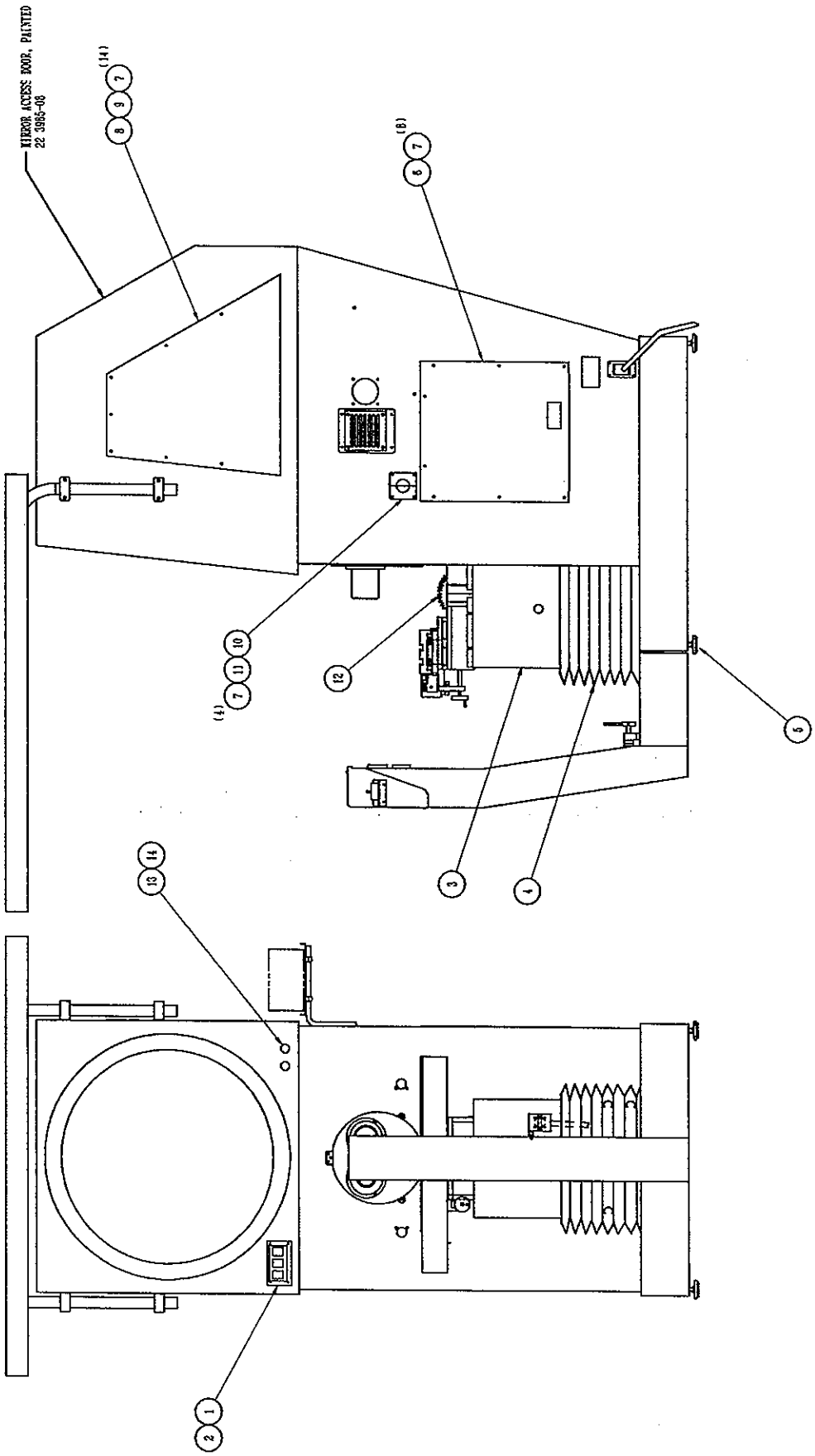
Parts Identification

Compare the part numbers on sub-assembly and part illustrations with their respective parts lists to identify parts.

Parts Ordering

1. Furnish the comparator model and serial number
2. State the part number, description and quantity of each part required.
3. State shipping instructions.

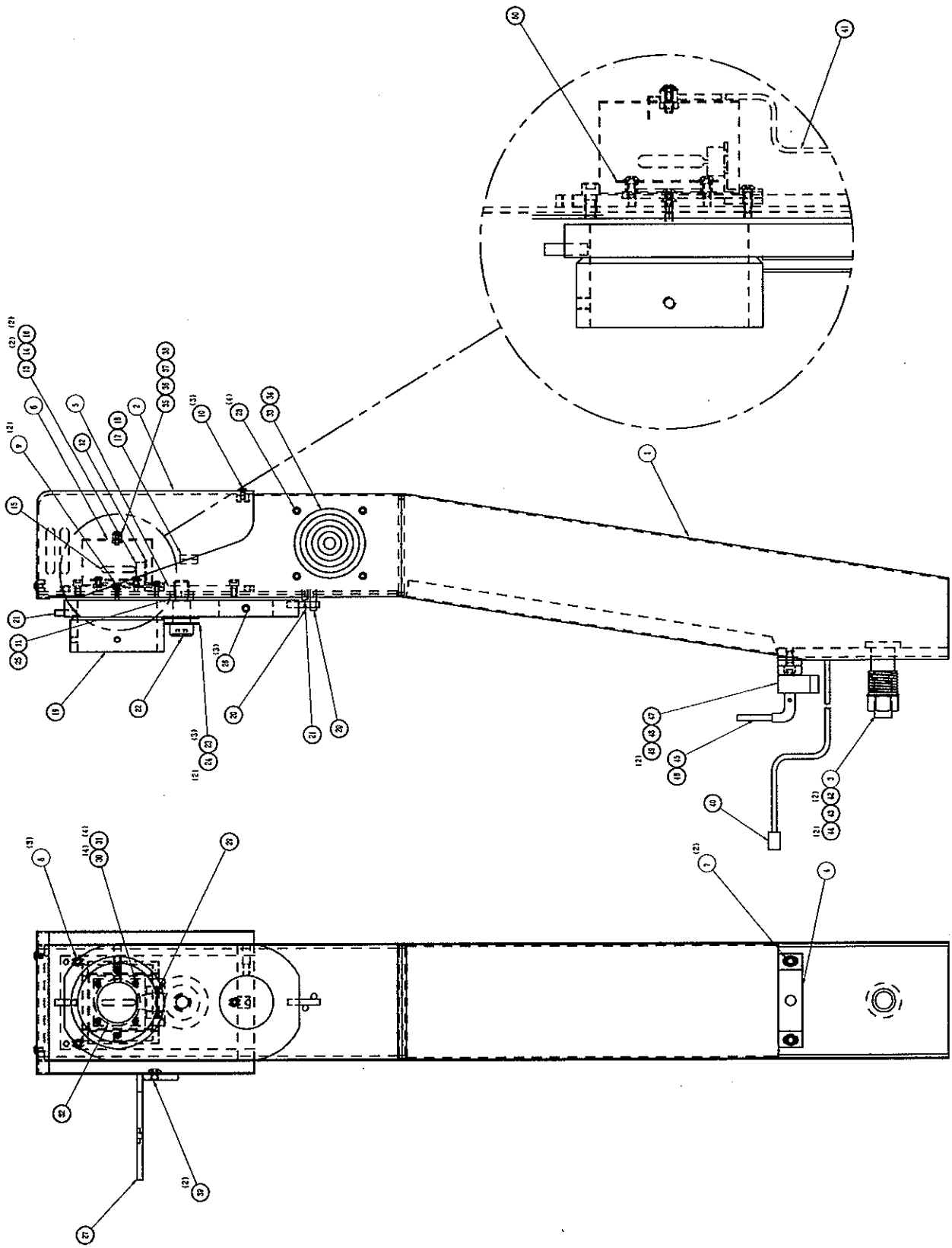
MAIN BODY ASSY.



MAIN BODY ASSY.

QTY.	ITEM	PART NO.	DESCRIPTION
2	14	48 7764	KNOB
2	13	22 3863	ENCODER ASSY.
1	12	48 8202	WAY COVER
1	11	48 7945	RUBBER GROMMET
1	10	22 3710-08	OUTLET PLATE
1	9	22 3985-05	TOP PANEL L.H.
1	8	22 3985-04	TOP PANEL R.H.
26	7	48 5106	SCREW, BHCS 10-32 X 1/4 LG.
1	6	22 3976-09	BOTTOM PANEL, PAINTED
4	5	48 5980	LEVELERS
1	4	22 3976-1588	BELLOWS
1	3	22 3976-14	BAG TIN
4	2	48 6421	SCREW, BHCS 6-32 X 3/8 LG.
1	1	22 3985-00	SWITCH PLATE

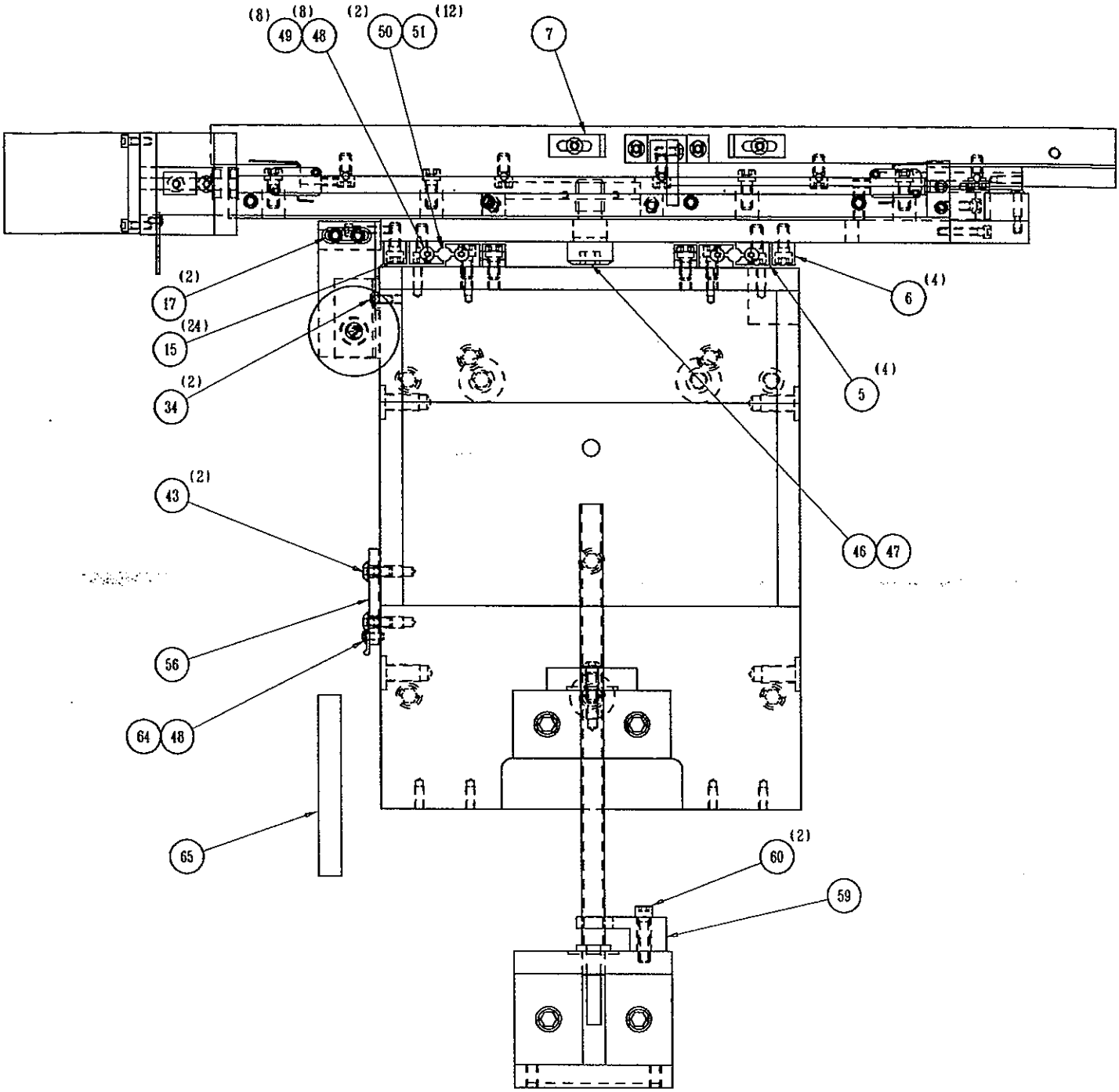
LAMPHOUSE ASSY。



LAMPHOUSE ASSY.

QTY.	ITEM	PART NO.	DESCRIPTION
1	50	22 4028-02	APPERATURE PLATE
2	49	48 5984	SCREW, 5/16-18 X 7/8 LG.
1	48	22 3985-01	ADJ. LOCK BAR
1	47	48 5401	SCREW, SHCS 1/4-20 X 1 1/2 LG.
1	46	48 8189	HANDLE
1	45	48 6035	WASHER
2	44	48 6173	JAM NUT
1	43	22 3985-16	COMPRESSION SPRING
2	42	48 8186	WASHER
1	41	48 7785	FIBER OPTIC CABLE (EDGE DETECTION OPTION)
1	40	22 3981-16	LAMPHOUSE CABLE ASSY.
2	39	48 8102	SCREW, BHCS 5/16-18 X 3/8 LG.
1	38	48 5196	HEX NUT 8-32
1	37	48 5339	SCREW, BHCS 4-40 X 1/4 LG.
1	36	48 5126	SCREW, BHCS 8-32 X 1/2 LG.
1	35	22 4028-06	CLAMP, FIBER OPTIC
1	34	48 6778	FAN GUARD
1	33	22 3426	FAN
1	32	48 8165	HEAT ABSORBING LENS D30, 792
4	31	48 8032	SCREW, FLANGE 8-32 X 3/8 LG.
4	30	22 3948-05	STAND OFF
2	29	48 5126	SCREW, BHCS 8-32 X 1/2 LG.
4	28	48 6479	SCREW, BHCS 10-32 X 1/2 LG.
1	27	22 3981-15	RC MOUNT PLATE
3	26	48 5952	SET SCREW 1/4-20 X 1/4 LG.
1	25	48 8115	NYLON WASHER
2	24	48 8116	WAVE WASHER
3	23	48 8114	WASHER 3/4 ID X 1 1/4 OD X 1/16 THK.
1	22	48 8113	SHOULDER SCREW 3/4 X 1" LG.
2	21	48 5317	DOWEL PIN 1/4 X 3/4 LG.
2	20	48 6258	DOWEL PIN 1/4 X 1 1/4 LG.
1	19	22 3946-00	BASE PLATE WELDMENT
2	18	48 6189	PIN
2	17	48 7273	1 CIRCUIT RECEPTACLE
2	16	48 7991	SPACER
1	15	48 7271	BULB 150W 24V
2	14	48 5319	SCREW, SHCS 6-32 X 1/2 LG.
1	13	48 7425	SOCKET
1	12	22 3948-03	SOCKET MOUNT, BULB
1	11	22 3981-13	SPACER
3	10	48 5106	SCREW, BHCS 10-32 X 1/4 LG.
2	9	48 5111	SCREW, BHCS 8-32 X 1/4 LG.
3	8	48 5321	SCREW, SHCS 1/4-20 X 1/2 LG.
2	7	48 5403	SCREW, SHCS 5/16-18 X 5/8 LG.
1	6	22 3981-12	BULB COVER
1	5	22 3981-11	LAMPHOUSE ADJUSTING PLATE
1	4	22 3981-10	WELDMENT, LOCK BAR
1	3	22 3981-08	PIVOT PIN
1	2	22 3976-13	LAMPHOUSE COVER, PAINTED
1	1	22 3981-01	WELDMENT, LAMPHOUSE

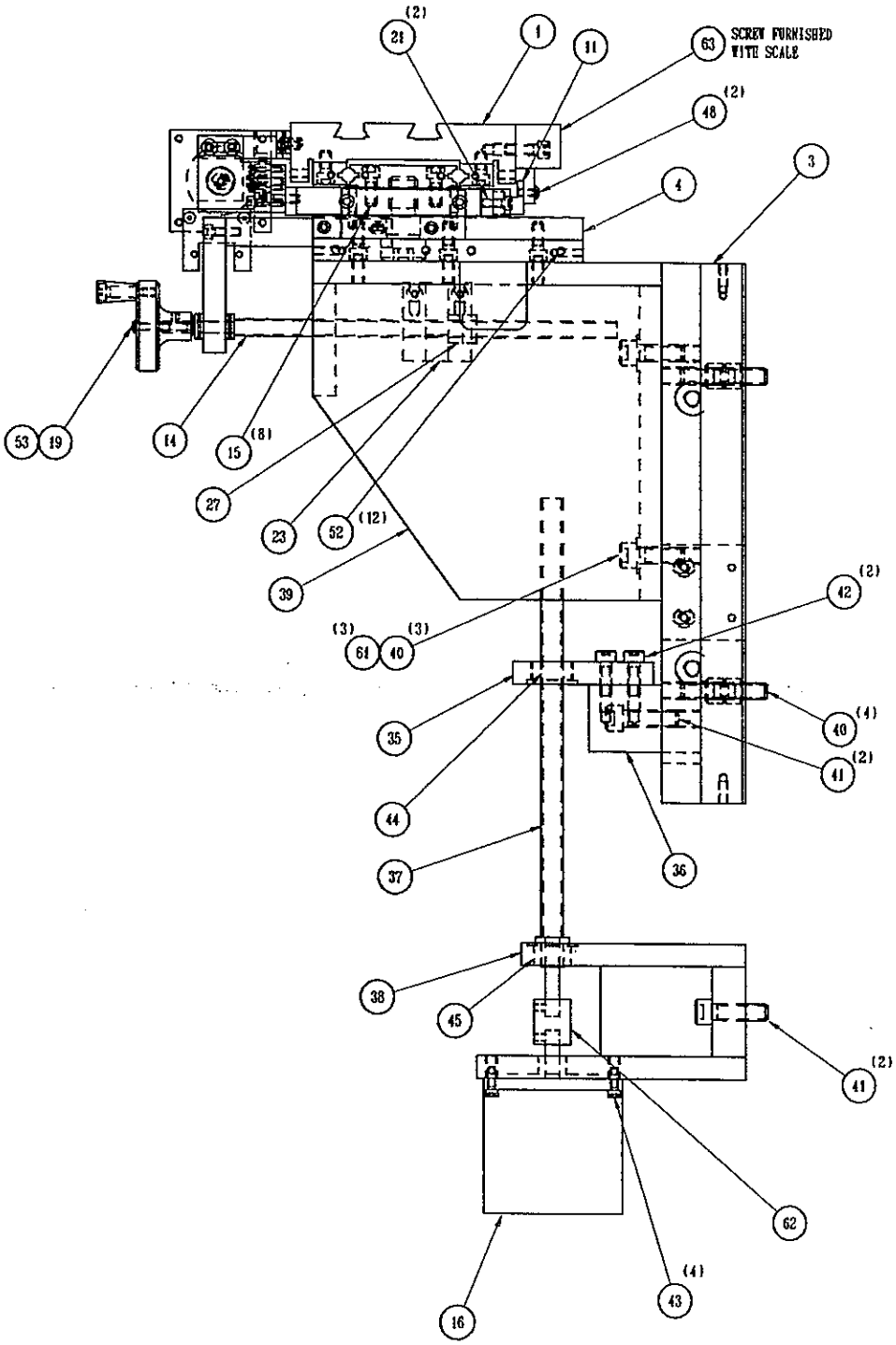
STAGE "FRONT VIEW"



STAGE "FRONT VIEW"

QTY.	ITEM	PART NO.	DESCRIPTION
1	65	48 7797	Y-AXIS ENCODER 8"
1	64	48 8140	CABLE TIE
2	60	48 5051	SCREW, SHCS 1/4-20 X 1" LG.
1	59	22 3977-49	VERT. SCREW STOP
1	56	22 3977-41	VERT. ENCODER MOUNT
12	51	48 7679	BALL
2	50	22 3977-42	BALL RETAINER (FOCUS)
8	49	48 7693	WASHER
9	48	48 5438	SCREW, BHCS 8-32 X 3/8 LG.
2	47	48 8173	WAVE WASHER
1	46	48 8172	SHOULDER SCREW 3/4 DIA. X 1/2 LG.
2	43	48 6425	SCREW, BHCS 1/4-20 X 1/2 LG.
2	34	48 5358	SCREW, BHCS 10-32 X 3/8 LG.
6	17	48 6784	SCREW, SHCS 10-32 X 5/8 LG.
24	15	48 5160	SCREW, SHCS 1/4-20 X 5/8 LG.
2	7	22 3977-08	LIMIT SWITCH STOP
4	6	22 3977-45	BACK-UP BAR
4	5	22 3977-44	FOCUS GIB

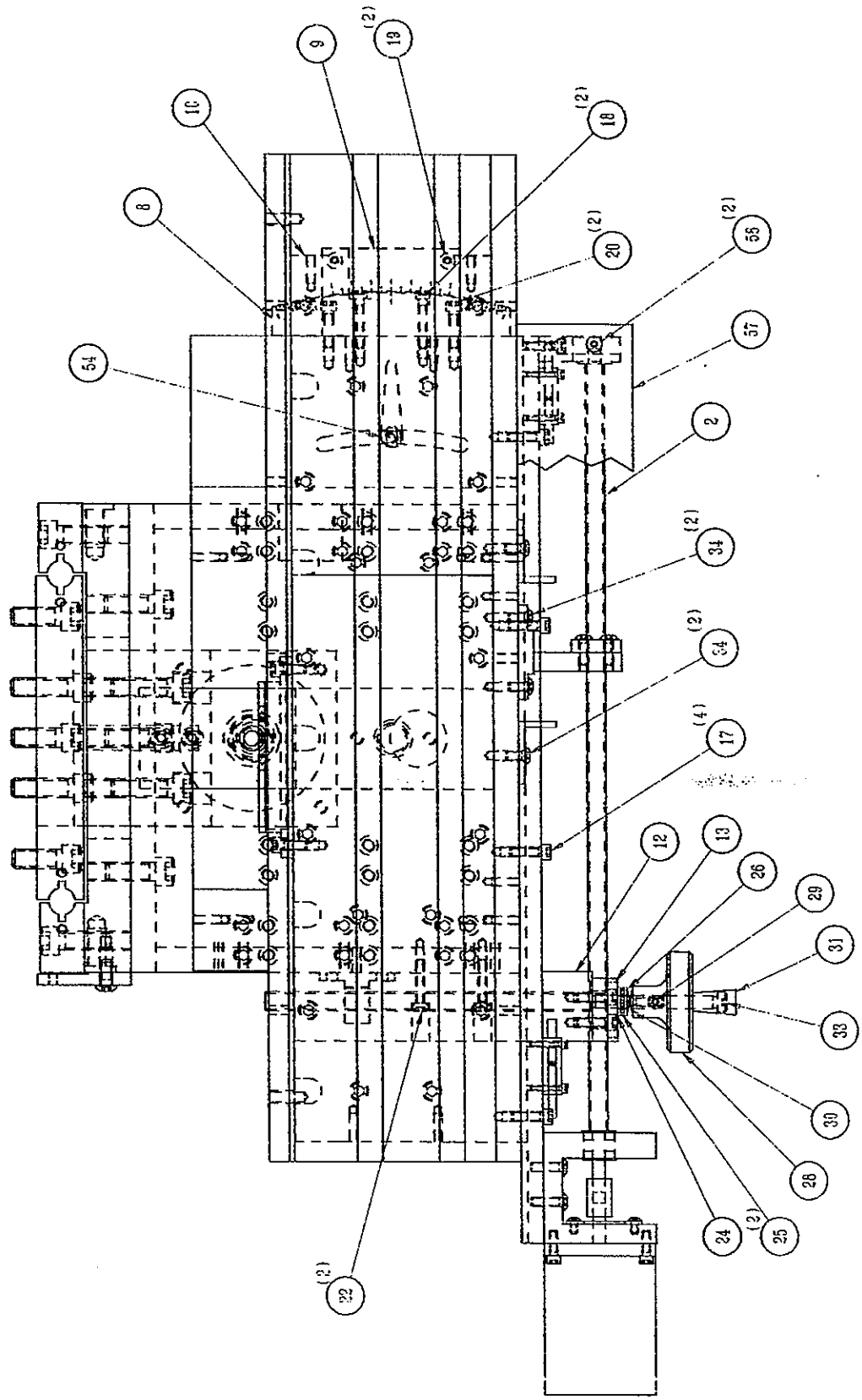
STAGE "SIDE VIEW"



STAGE "SIDE VIEW"

QTY.	ITEM	PART NO.	DESCRIPTION
1	63	48 7796	X-AXIS ENCODER 12"
1	62	48 8171	COUPLING
3	61	48 5979	WASHER
1	53	48 6083	WASHER
12	52	48 5068	SET SCREW 10-32 X 1/4 LG.
2	48	48 5438	SCREW, BHCS 8-32 X 3/8 LG.
1	45	48 8072	BEARING
1	44	48 8212	PLASTIC NUT
4	43	48 6425	SCREW, BHCS 1/4-20 X 1/2 LG.
2	42	48 5057	SCREW, SHCS 1/4-20 X 3/4 LG.
4	41	48 5047	SCREW, SHCS 3/8-16 X 1 1/4 LG.
7	40	48 5115	SCREW, SHCS 3/8-16 X 1.00 LG.
1	39	22 3977-23	STAGE MOUNT
1	38	22 3977-28	WELDMENT, MOTOR MOUNT
1	37	22 3977-33	LEAD SCREW & BUSHING ASSY.
1	36	22 3977-40	BEARING BLOCK
1	35	22 3977-39	BEARING PLATE
1	27	48 7655	ANTI-BACKLASH NUT
1	23	22 3977-19	FOCUS BLOCK
2	21	48 5297	SCREW, SHCS 10-32 X 1/2 LG.
1	19	48 6819	SCREW, BHCS 8-32 X 7/8 LG.
1	16	22 3977-48	VERT. MOTOR & WIRE ASSY.
8	15	48 5160	SCREW, SHCS 1/4-20 X 5/8 LG.
1	14	22 3977-22	"Y" AXIS LEAD SCREW
1	11	22 3977-20	ENCODER MOUNT "X" AXIS
1	4	22 3977-13	SPACER PLATE
1	3	22 3977-50	VERTICAL GIB ASSY.
1	1	22 3977-01	CENTER PLATE ASSY.

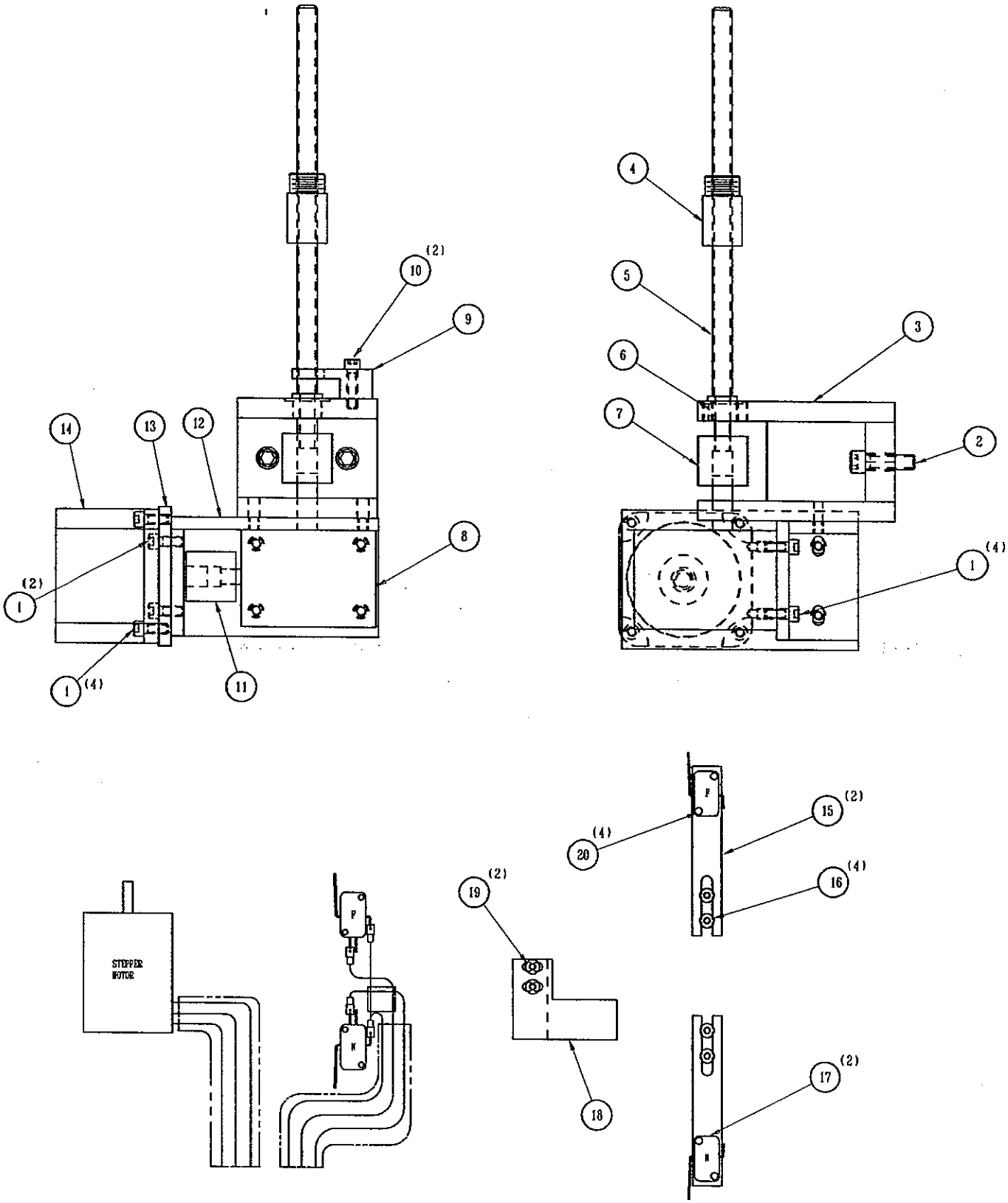
STAGE "TOP VIEW"



STAGE "TOP VIEW"

QTY.	ITEM	PART NO.	DESCRIPTION
2	58	48 5111	SCREW, BHCS 8-32 X 1/4 LG.
1	57	22 3977-47	"X" AXIS LEAD SCREW COVER
1	54	48 8196	THREADED HANDLE
4	34	48 5358	SCREW, BHCS 10-32 X 3/8 LG.
1	33	48 5131	SHOULDER SCREW
1	31	22 1007	HANDLE
1	30	48 6135	NYLON WASHER
1	29	48 5011	SET SCREW 8-32 X 1/8 LG.
1	28	22 3102	KNOB
1	26	48 6630	WAVE WASHER
2	25	48 7646	BEARING, THRUST
1	24	48 7437	BEARING, FLANGE
2	22	48 8019	SCREW, SHCS 8-32 X 7/8 LG.
2	20	48 5016	SCREW, SHCS 10-32 X 5/8 LG.
2	19	48 6819	SCREW, BHCS 8-32 X 7/8 LG.
2	18	48 5156	SCREW, SHCS 8-32 X 1.00 LG.
4	17	48 6784	SCREW, SHCS 10-32 X 5/8 LG.
1	13	22 3977-17	FOCUS KNOB SUPPORT
1	12	22 3977-18	FOCUS KNOB MOUNT
1	10	22 3977-14	VERNIER MOUNT
1	9	22 3977-15	VERNIER PLATE
1	8	22 3977 16	DEGREE PLATE
1	2	22 3977-02	"X" AXIS MOUNT BAR ASSY.

VERTICAL MOTOR DRIVE

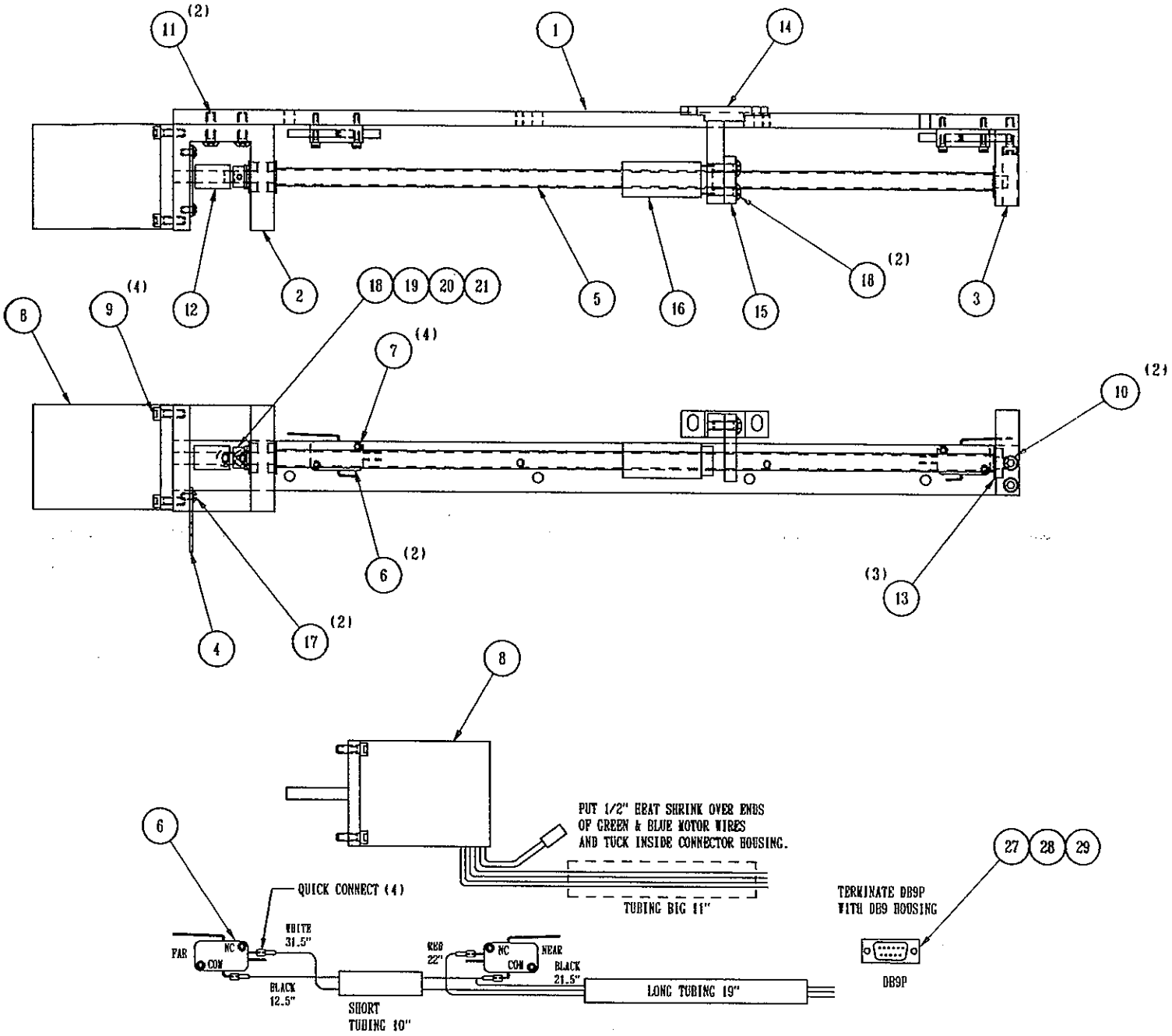


VERTICAL MOTOR DRIVE

QTY.	ITEM	PART NO.	DESCRIPTION
4	20	48 6760	SCREW, BHCS 4-40 X 5/8 LG.
2	19	48 5275	SCREW, BHCS 10-32 X 3/4 LG.
1	18	22 3985-13	VERT. SWITCH STOP
2	17	48 8044	MICRO LIMIT SWITCH
8	16	48 6425	SCREW, BHCS 1/4-20 X 1/2 LG.
2	15	22 3985-14	VERT. SWITCH MOUNT
1	14	22 3985-28	VERT. MOTOR & WIRE ASSY.
1	13	22 3985-25	MOTOR MOUNT PLATE
1	12	22 3985-26	GEAR BOX WELDMENT
1	11	48 8236	COUPLER
2	10	48 5051	SCREW, SHCS 1/4-20 X 1" LG.
1	9	22 3977-49	VERT. SCREW STOP
1	8	22 3985-22	SPEED REDUCER
1	7	48 8171	COUPLER
1	6	48 8072	BEARING
1	5	22 3985-24	VERT. LEAD SCREW
1	4	48 5760	BALL NUT
1	3	22 3985-27	WELDMENT, MOTOR MOUNT
2	2	48 5047	SCREW, SHCS 3/8-16 X 1 1/4 LG.
10	1	48 5160	SCREW, SHCS 1/4-20 X 5/8 LG.

LIST OF MATERIALS

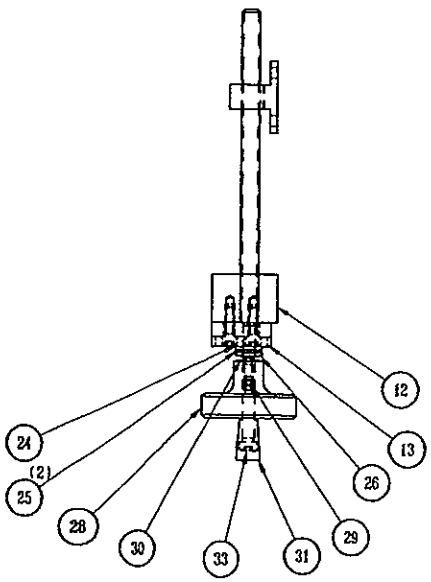
"X" AXIS MOUNT BAR ASSY.



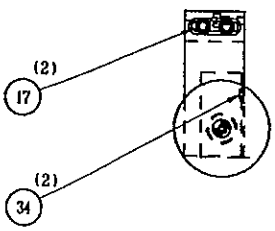
"X" AXIS MOUNT BAR ASSY.

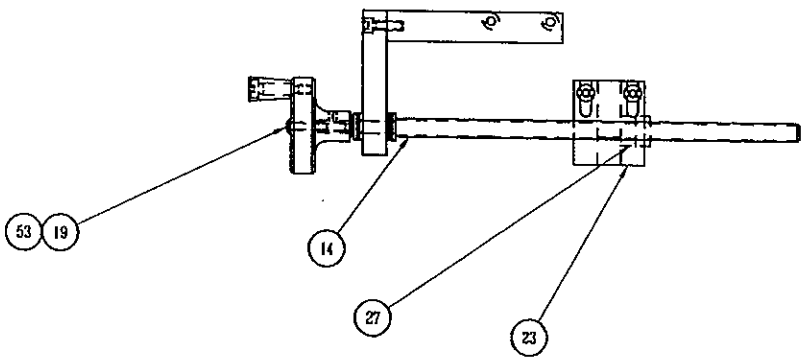
QTY.	ITEM	PART NO.	DESCRIPTION
11"	32	48 5660	TUBING (BIG)
29"	31	48 8054	TUBING
	30		
1	29	48 7658	DB9P CONNECTOR
1	28	48 7659	DB HOUSING
1	27	48 8079	DB LONG HARDWARE
31.5"	26	48 7415	WHITE WIRE #22
22"	25	48 7413	RED WIRE #22
34"	24	48 7416	BLACK WIRE #22
4	23	48 7994	QUICK CONNECT TERMINAL
	22		
1	21	48 5813	SET SCREW 4-40 X 1/8 LG.
1	20	22 2761	COLLAR, SPINDLE
1	19	48 6630	WASHER, WAVE
1	18	48 6000	WASHER
2	17	48 5137	SCREW, BHCS 6-32 X 1/4 LG.
1	16	48 8177	SUPERNUT
1	15	22 3977-09	NUT MOUNT
1	14	22 3977-10	NUT BRACKET
3	13	48 7928	BEARING
1	12	48 8170	COUPLING
2	11	48 5329	SCREW, BHCS 10-32 X 5/8 LG.
2	10	48 5157	SCREW, SHCS 8-32 X 5/8 LG.
4	9	48 5061	SCREW, SHCS 8-32 X 1/2 LG.
1	8	22 3977-52	STEPPER MOTOR
4	7	48 6760	SCREW, BHCS 4-40 X 5/8 LG.
2	6	48 8044	LIMIT SWITCH
1	5	22 3977-21	"X" AXIS LEAD SCREW
1	4	22 3924-04	CONNECTOR, HORIZ. MOTOR
1	3	22 3977-06	END BEARING BLOCK
1	2	22 3977-07	BEARING & MOTOR MOUNT
1	1	22 3977-05	"X" AXIS MOUNT BAR

FOCUS SCREW ASSY.

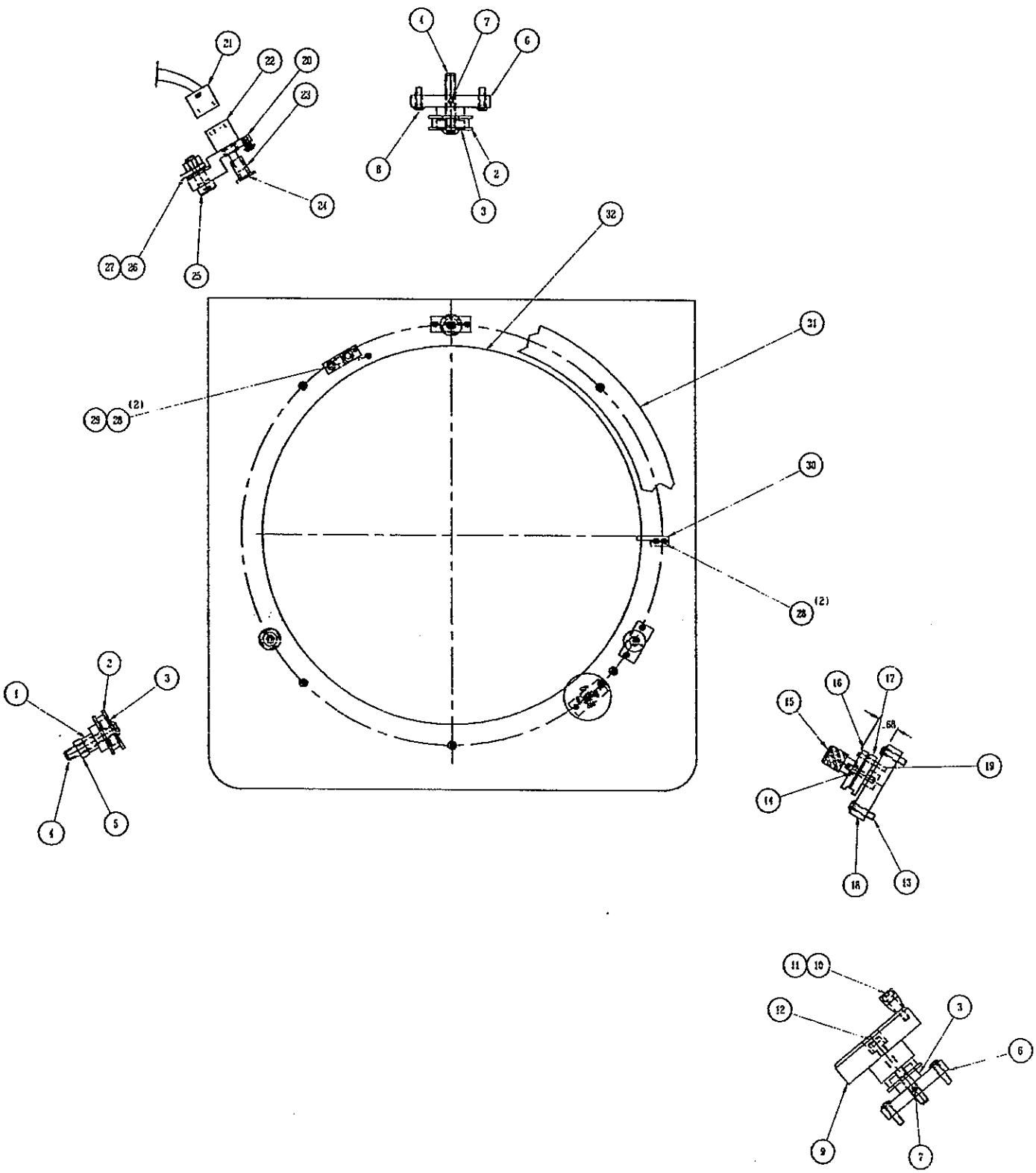


QTY.	ITEM	PART NO.	DESCRIPTION
1	53	48 6083	WASHER
6	34	48 5358	SCREW, BHCS 10-32 X 3/8 LG.
1	33	48 5131	SHOULDER SCREW
1	31	22 1007	HANDLE
1	30	48 6135	NYLON WASHER
1	29	48 5011	SET SCREW 8-32 X 1/8 LG.
1	28	22 3102	KNOB
1	27	48 7655	BACKLASH NUT
1	26	48 6630	WAVE WASHER
2	25	48 7646	BEARING, THRUST
1	24	48 7437	BEARING, FLANGE
1	23	22 3977-19	FOCUS BLOCK
3	19	48 6819	SCREW, BHCS 8-32 X 7/8 LG.
6	17	48 6784	SCREW, SHCS 10-32 X 5/8 LG.
1	14	22 3977-22	"Y" AXIS LEAD SCREW
1	13	22 3977-17	FOCUS KNOB SUPPORT
1	12	22 3977-18	FOCUS KNOB MOUNT





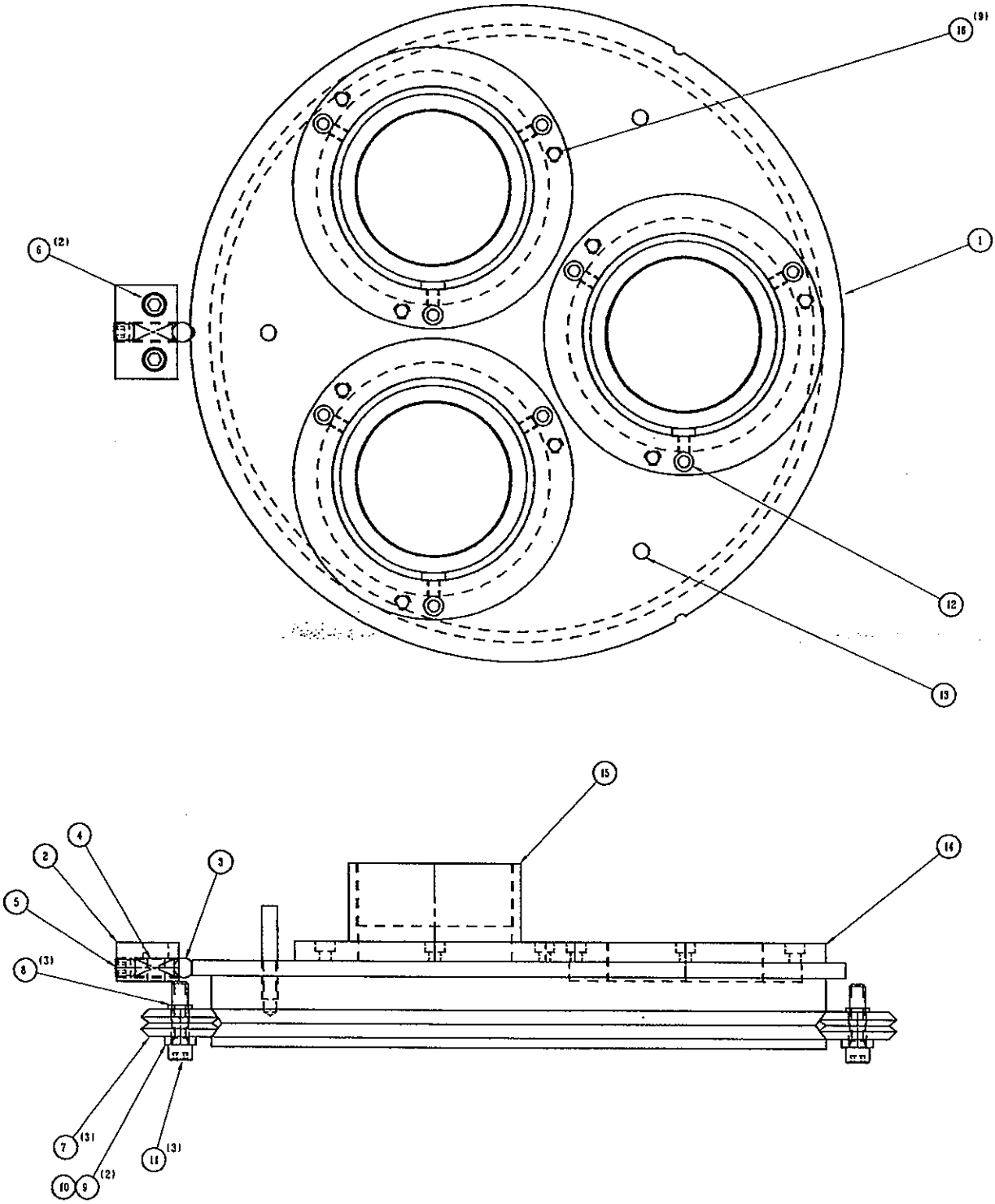
24" SCREEN ASSY.



24" SCREEN ASSY.

QTY.	ITEM	PART NO.	DESCRIPTION
1	32	74 0432-2425	GLASS SCREEN ASSY.
1	31	22 3939-1688	BLACK PLASTIC SCREEN COVER
1	30	22 3941-10	SCREEN POINTER
1	29	22 3941-12	SPRING
4	28	48 5106	SCREW, BHCS 10-32 X 1/4 LG.
1	27	48 6737	WAVE WASHER
2	26	48 6070	NYLON WASHER
1	25	48 6658	SHOULDER SCREW, 3/8 X 1/2 LG.
1	24	22 3711-26	ENCODER WHEEL
1	23	48 5813	SET SCREW 4-40 X 1/8 LG.
1	22	48 7692	ENCODER
1	21	22 3723-03	CABLE ASSY. ENCODER
1	20	22 3941-11	ENCODER MOUNT
1	19	48 8106	DOWEL PIN 1/8 X 1" LG.
1	18	22 3941-04	SCREEN LOCK PLATE
1	17	22 3941-05	BOTTOM SCREEN LOCK
1	16	22 3941-06	TOP SCREEN LOCK
1	15	22 3941-08	LOCK SCREW
1	14	48 7604	SPRING
4	13	48 5275	SCREW, BHCS 10-32 X 3/4 LG.
1	12	48 8105	SCREW, SHCS 5/16-18 X 2 1/4 LG.
1	11	48 6131	SHOULDER SCREW 1/4 X 1/2 LG.
1	10	22 3711-32	SPINNER
1	9	22 3941-09	ROTARY KNOB, SCREEN
2	8	48 5622	SCREW, BHCS 10-32 X 5/8 LG.
2	7	48 5083	SET SCREW 8-32 X 3/8 LG.
2	6	22 3941-03	HAND WHEEL & TOP ROLLER BASE PLATE
1	5	48 5532	HEX NUT
2	4	48 8104	SCREW, BHCS 5/16-18 X 1 3/4 LG.
6	3	48 8103	BEARING
2	2	22 3941-01	SCREEN ROLLER
1	1	22 3941-02	SPACER

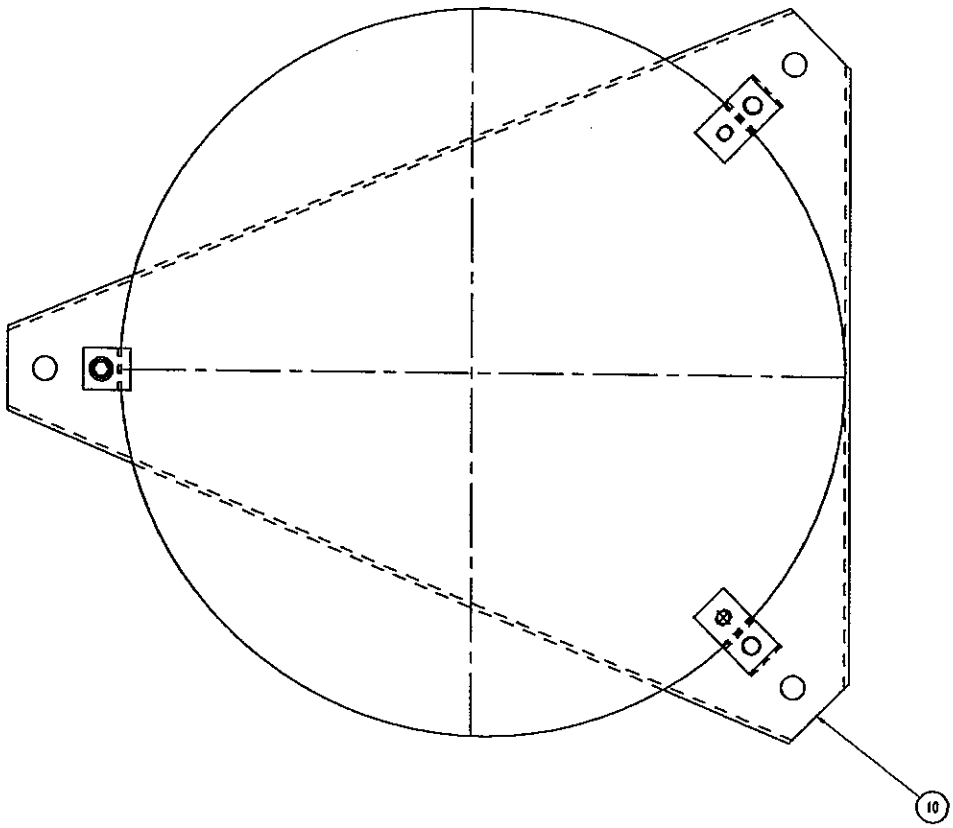
TURRET RING ASSY.

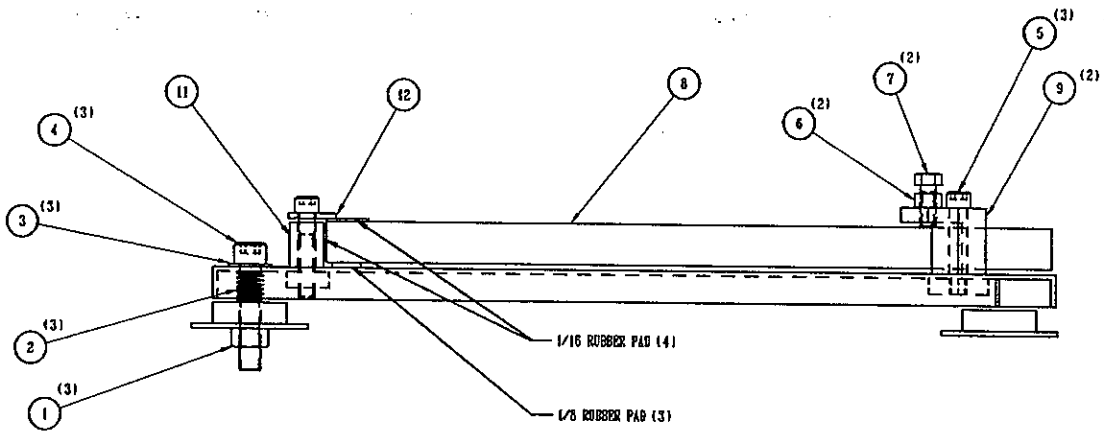


TURRET RING ASSY.

QTY.	ITEM	PART NO.	DESCRIPTION
9	16	48 7356	SET SCREW 1/4-20 X 1/4 LG. F.P.
1	15	22 3982-02	LENS HOLDER 50X, 100X
2	14	22 3982-01	LENS HOLDER 10X, 20X, 25X
3	13	22 3944-07	STAND OFF
9	12	48 5161	SCREW, SHCS 8-32 X 3/8 LG.
3	11	48 5051	SCREW, SHCS 1/4-20 X 1.00 LG.
1	10	48 8109	BUSHING ADJUSTABLE
2	9	48 8108	BUSHING STATIONARY
6	8	48 6069	WASHER
3	7	48 8107	DUAL-V-WHEEL
2	6	48 5160	SCREW, SHCS 1/4-20 X 5/8 LG.
1	5	48 5357	SET SCREW 5/16-24 X 5/16 LG.
1	4	48 8110	SPRING
1	3	48 8111	5/16 STEEL BALL
1	2	22 3944-05	TURRET STOP BLOCK
1	1	22 3944-01	TURRET RING

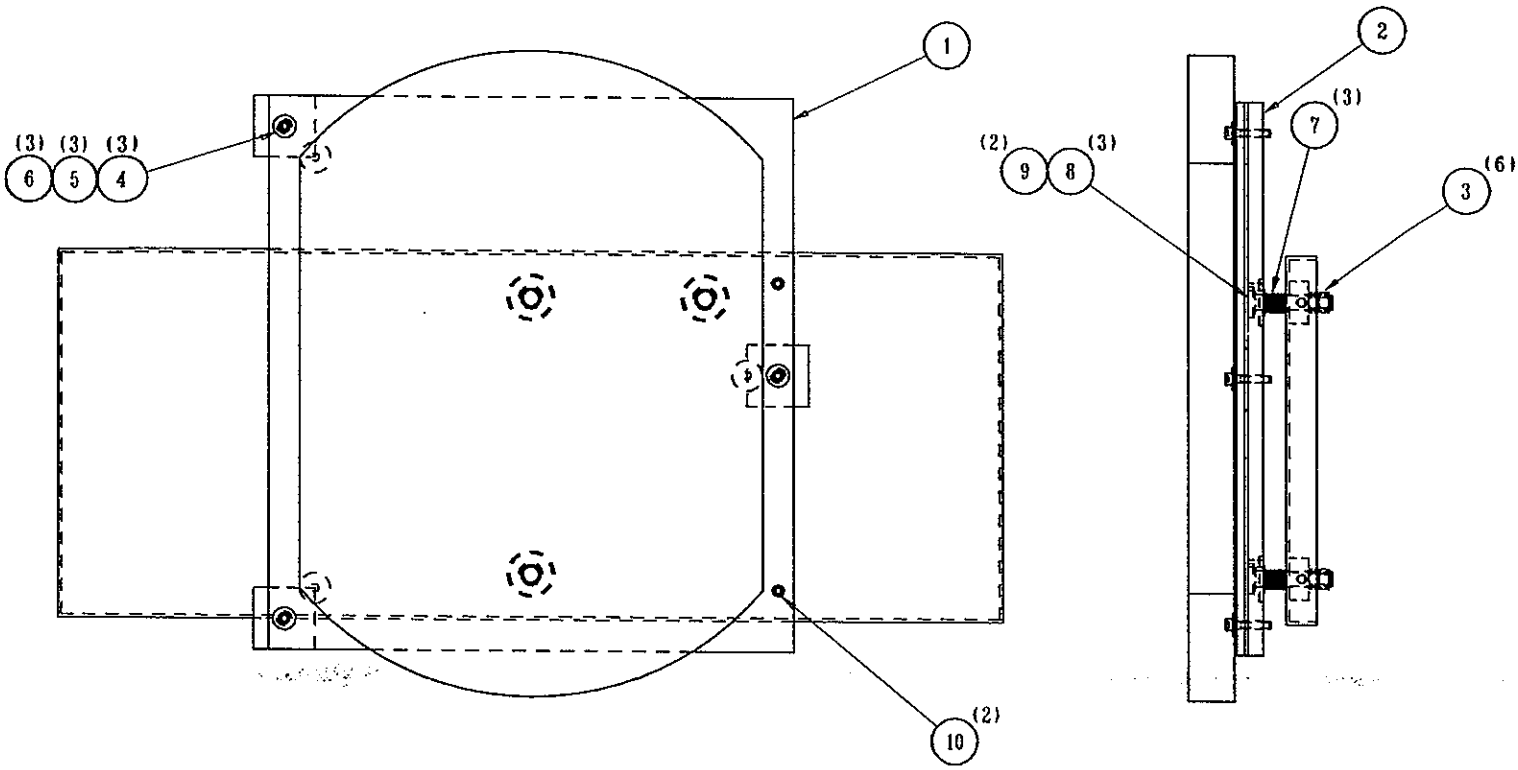
BOTTOM MIRROR ASSY.





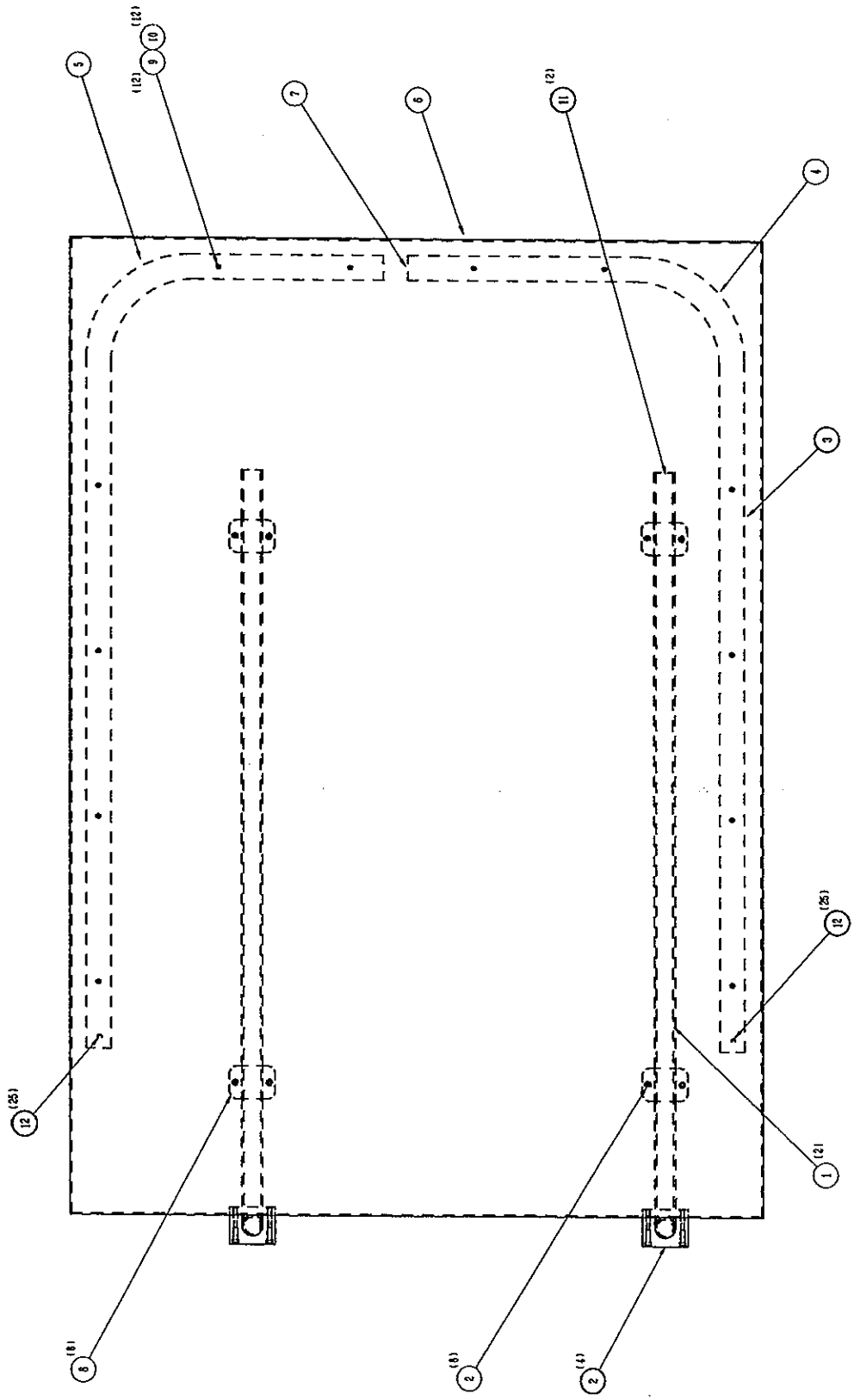
1	12	22 3989-02	MIRROR TAB
1	11	22 3989-01	MIRROR POST
1	10	22 3945-01	MIRROR PLATE
2	9	22 3945-03	MIRROR CLAMP
1	8	22 0470-0088	MIRROR
2	7	48 7941	BOLT, HEX HD. NYLON 3/8-16 X 1.00 LG.
2	6	48 5628	HEX NUT 3/8-16
3	5	48 6221	SCREW, SECS 3/8-16 X 2.00 LG.
3	4	48 8174	SCREW, SECS 1/2-20 X 2.00 LG.
3	3	48 6035	WASHER
3	2	22 0474-0088	COMP. SPRING
3	1	48 5035	HEX NUT 1/2-20
QTY.	ITEM	PART NO.	DESCRIPTION

TOP MIRROR ASSY.



2	10	48 6625	SCREW, SHCS 1/4-20 X 2 1/4 LG.
2	9	22 0473	SPHERICAL WASHER
3	8	22 0471	SPHERICAL SCREW
3	7	22 0474	SPRING
3	6	48 6033	WASHER
3	5	48 6077	WASHER, LOCK
3	4	48 5262	SCREW, SHCS 1/4-20 X 1 1/4 LG.
6	3	48 5035	HEX NUT 1/2-20
1	2	22 3983-03	TOP MIRROR PLATE
1	1	22 3983-01	TOP MIRROR & BACK PLATE ASSY.
QTY.	ITEM	PART NO.	DESCRIPTION

CURTAIN & CANOPY ASSY.

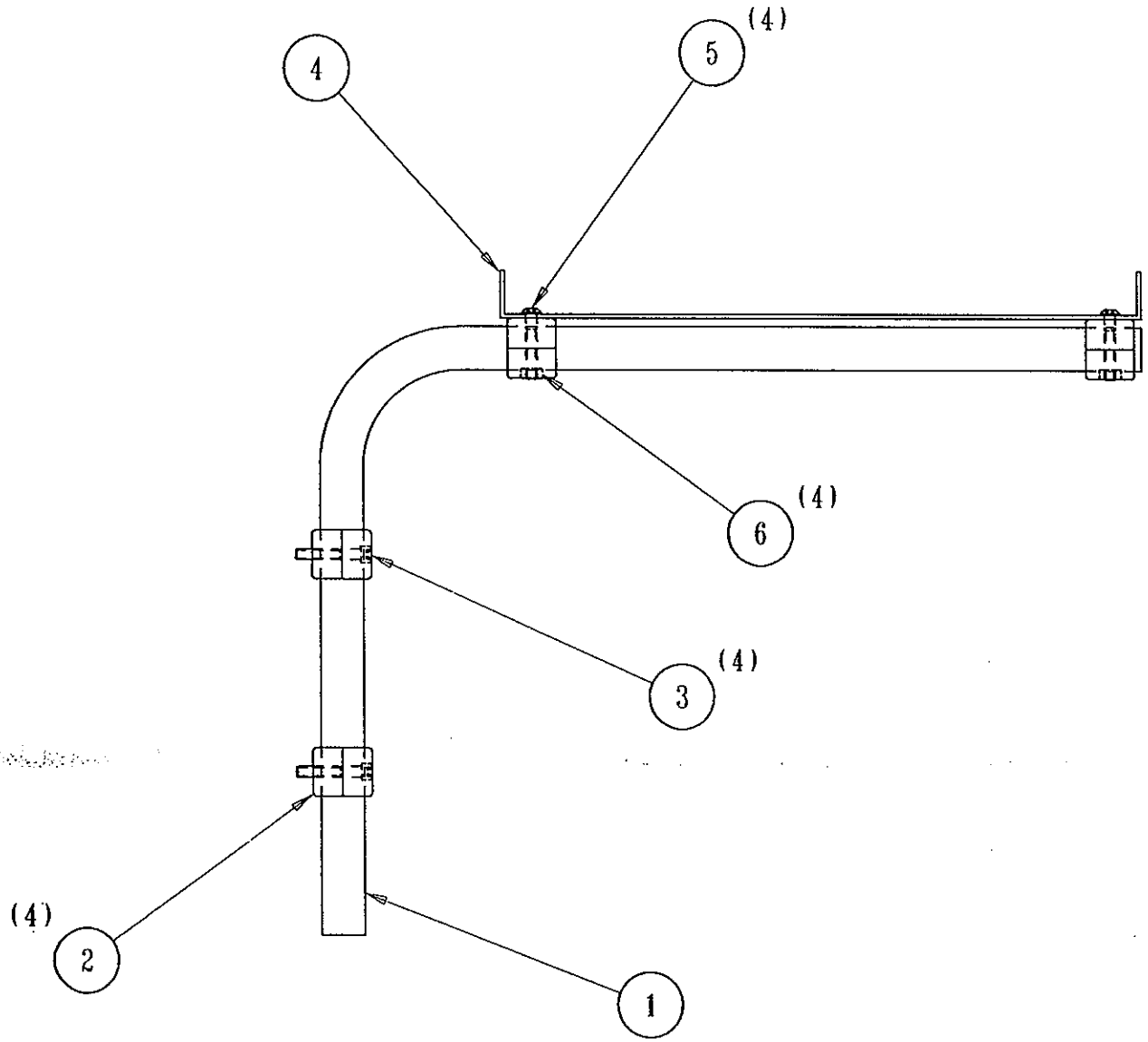


CURTAIN & CANOPY ASSY.

QTY.	ITEM	PART NO.	DESCRIPTION
REF	13	48 7768	S-T LABEL
50	12	48 5969	CARRIERS
2	11	48 7019-12	HOLE PLUG
12	10	48 5605	HEX NUT 6-32
12	9	48 5137	SCREW, BHCS 6-32 X 1/4 LG.
8	8	48 8120	CLAMP
4	7	48 5968	END CAPS
1	6	22 3976-10	CANOPY TOP
1	5	22 0452-0088	RIGHT HAND TRACK
1	4	22 0453-0088	LEFT HAND TRACK
2	3	22 0572	CURTAIN & HOOK ASSY.
16	2	48 6625	SCREW, SHCS 1/4-20 X 2 1/4 LG.
2	1	22 3976-11	CANOPY POST

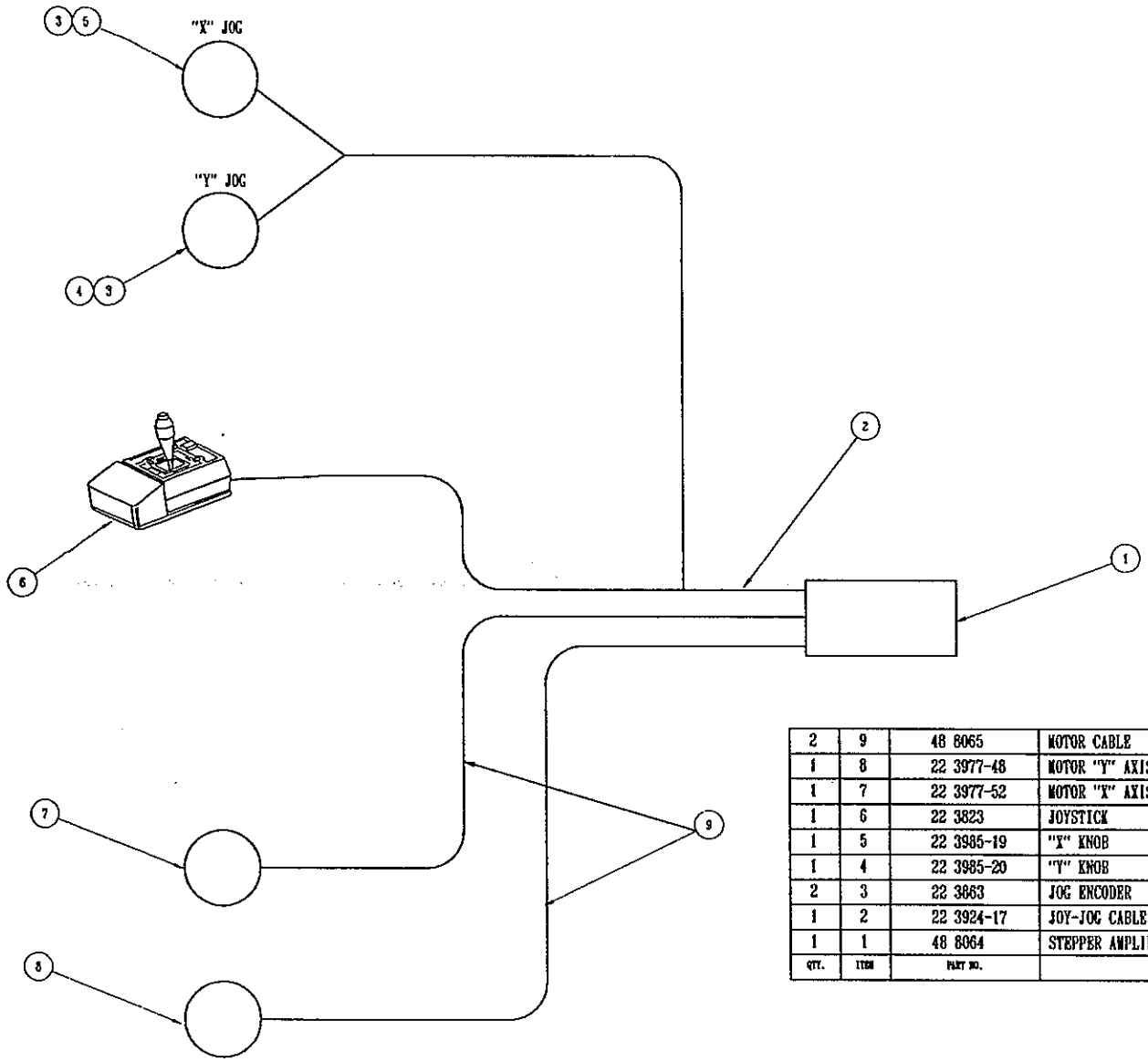
LIST OF MATERIALS

DRO ARM & TRAY



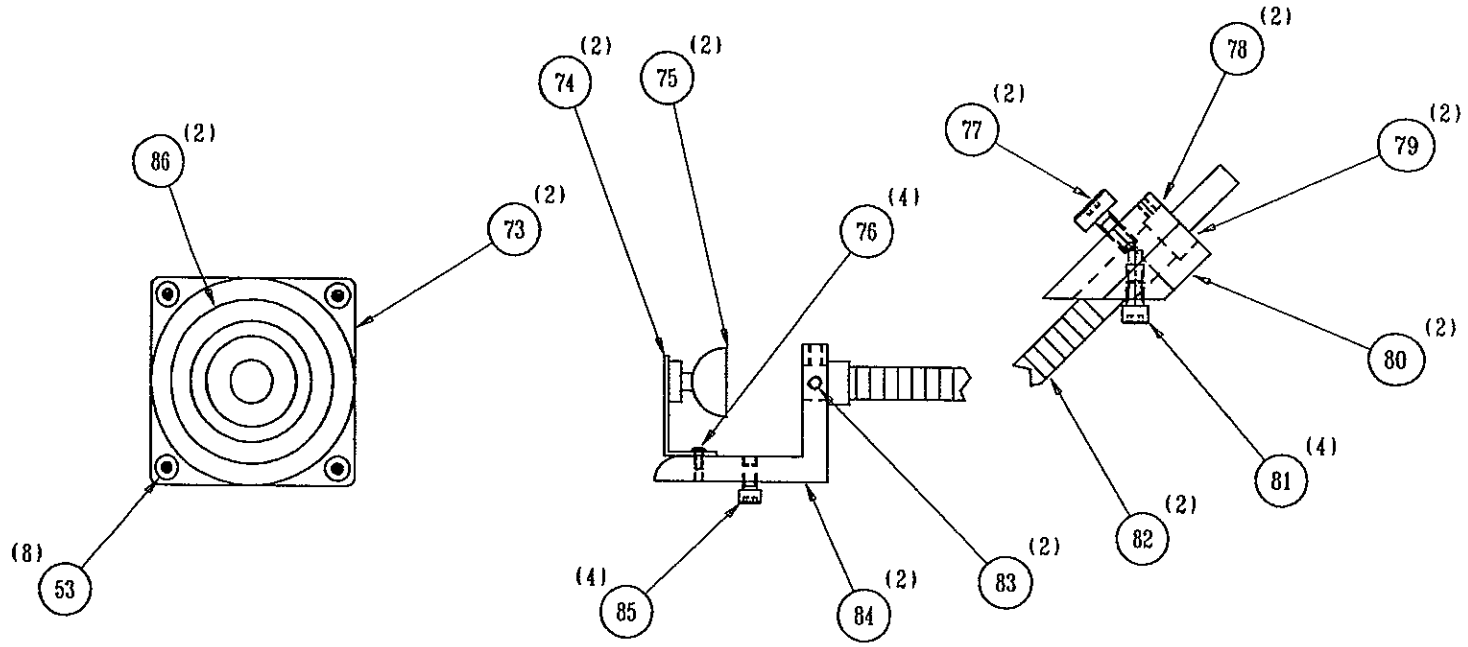
QTY.	ITEM	PART NO.	DESCRIPTION
4	6	48 6072	HEX NUT 1/4-20
4	5	48 8147	SCREW, BHCS 1/4-20 X 1 1/2 LG.
1	4	22 3778-73	DRO TRAY
4	3	48 5401	SCREW, SHCS 1/4-20 X 1 1/2 LG.
4	2	48 8121	CLAMP
1	1	22 3939-18	DRO ARM, PAINTED

MOTOR DRIVE WIRING ASSY.



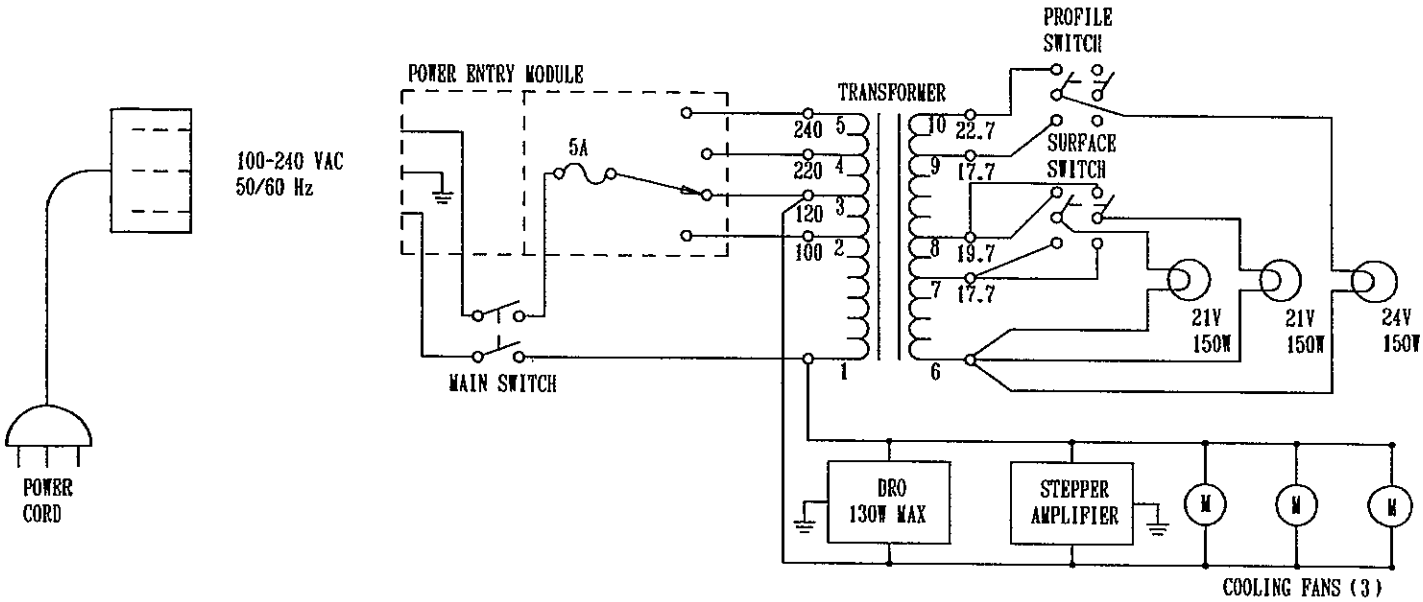
QTY.	ITEM	PART NO.	DESCRIPTION
2	9	48 8065	MOTOR CABLE
1	8	22 3977-48	MOTOR "Y" AXIS
1	7	22 3977-52	MOTOR "X" AXIS
1	6	22 3823	JOYSTICK
1	5	22 3985-19	"X" KNOB
1	4	22 3985-20	"Y" KNOB
2	3	22 3663	JOG ENCODER
1	2	22 3924-17	JOY-JOG CABLE
1	1	48 8064	STEPPER AMPLIFIER

SURFACE ILLUM. ASSY.



QTY.	ITEM	PART NO.	DESCRIPTION
2	86	48 6778	FAN GUARD
4	85	48 5007	SCREW, SHCS 10-32 X 3/8 LG.
2	84	22 3952-02	SOCKET MOUNT
2	83	48 5101	SOC. SET SCREW 10-32 X 5/16 LG.
2	82	22 3935-0088	FIBER OPTIC BUNDLE
4	81	48 5320	SCREW, SHCS 1/4-20 X 3/8 LG.
2	80	22 3952-01	FIBER OPTIC MOUNT
2	79	22 3952-03	STOP BUSHING
2	78	48 5013	SOC SET SCREW 8-32 X 1/4 LG.
2	77	22 2107-11	THUMB SCREW
4	76	48 5339	SCREW, BHCS 4-40 X 1/4 LG.
2	75	48 8086	PROJ. LAMP
2	74	22 3951-03	SOCKET ASSY. SURFACE ILLUM.
2	73	22 3426	TAPPED FAN ASSY.
8	53	48 6479	SCREW, BHCS 10-32 X 1/2 LG.

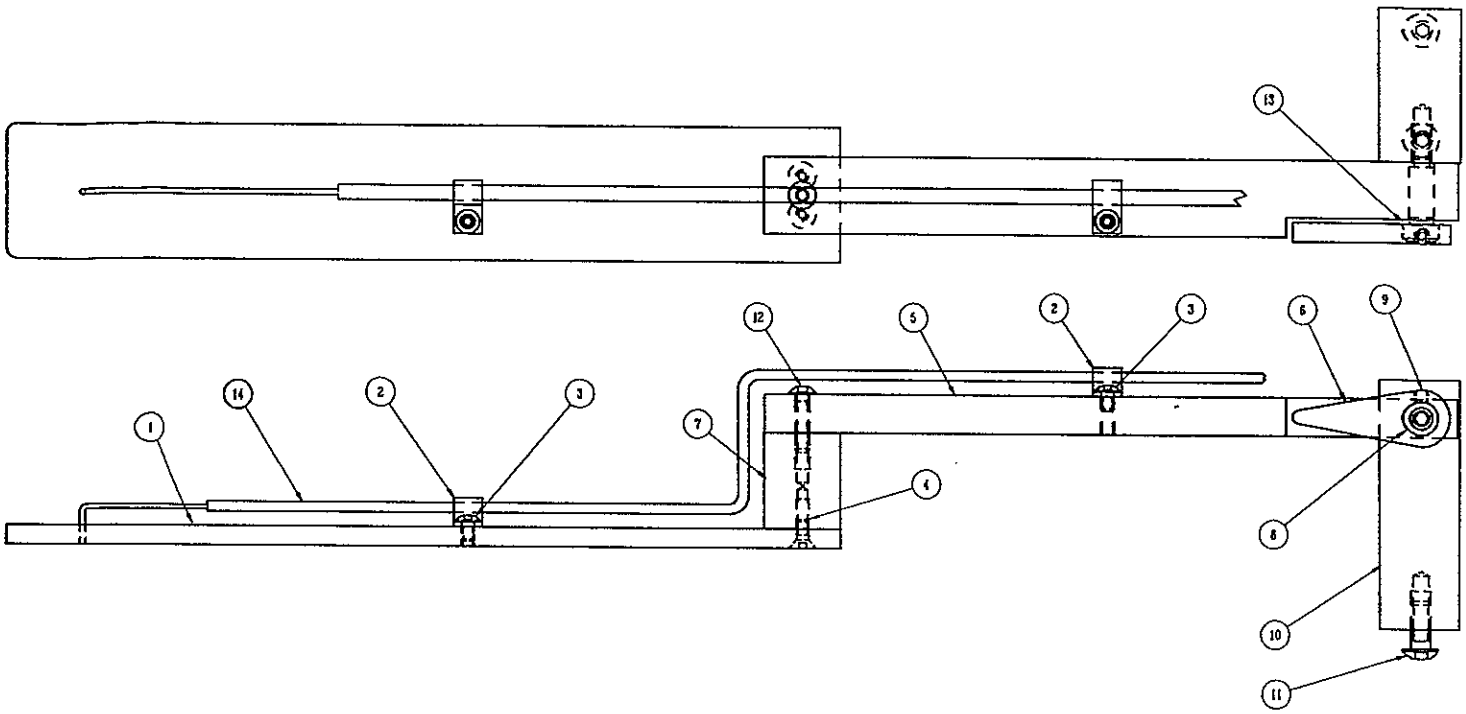
2450 ELECTRICAL WIRING SCHEMATIC



PART NO.	DESCRIPTION
48 8182	TRANSFORMER
48 8183	MAIN POWER SWITCH
48 8184	PROFILE ILLUM. SWITCH
48 8184	SURFACE ILLUM. SWITCH
48 7271	PROFILE BULB
48 8086	SURFACE BULB
22 3426	COOLING FAN
48 7444	POWER ENTRY MODULE
48 7445	FUSE DRAWER
48 6215	FUSE 5 AMP @ 120 VOLTS
48 7337	POWER CORD

LIST OF MATERIALS

OPTIC MOUNT ARM ASSY.



QTY.	ITEM	PART NO.	DESCRIPTION
1	14	48 7785	FIBER OPTIC CABLE (EDGE DETECTION OPTION)
1	13	48 6630	WASHER, WAVE
1	12	48 6684	SCREW, BHCS 10-24 X 3/4 LG.
2	11	48 5284	SCREW, BHCS 1/4-20 X 5/8 LG.
1	10	22 3986-01	RISER BLOCK
1	9	48 5244	SCREW, SET 8-32 X 3/16 LG.
1	8	48 7805	SHOULDER SCREW
1	7	22 3757-03	SPACER
1	6	22 3747-03	LEVER
1	5	22 3757-02	SWIVEL ARM
2	4	48 5382	SCREW, FHCS 8-32 X 3/8 LG.
2	3	48 5111	SCREW, BHCS 8-32 X 1/4 LG.
2	2	48 7352	CLAMP
1	1	22 3757-05	MOUNT, PLASTIC

WARRANTY

Within two years from the date of purchase, any repairs necessary due to defects in material or workmanship will be made without charge by S-T Industries, Inc. Normal wear and tear is not covered by this warranty. This warranty applies to the original purchaser only and is not transferable. No other warranty, either expressed or implied, shall be applicable to this equipment. S-T Industries, Inc. liability does not extend beyond the repair or replacement of this equipment.

S-T INDUSTRIES, INC.

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Phone (507) 375-3211 Fax 507-375-4503

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Rev. A