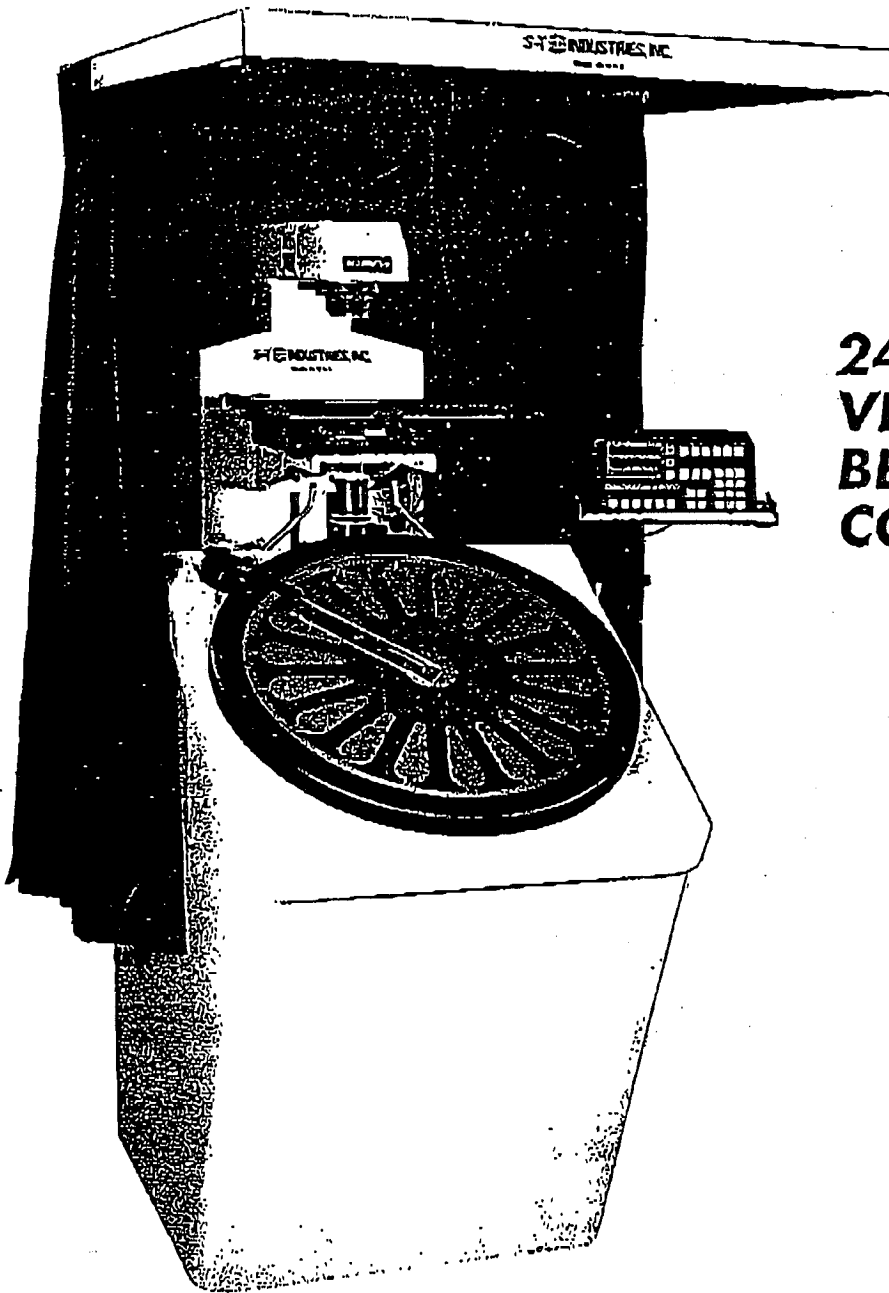


2400



INSTRUCTION MANUAL



**24"
VERTICAL
BEAM OPTICAL
COMPARATOR**

S-T  **INDUSTRIES, INC.**
SCHERR-TUMICO

See the *Quality*

20-2400 SERIES 24" OPTICAL COMPARATOR

INSTRUCTION MANUAL

INTRODUCTION

This manual contains the instructions for the installation, operation and maintenance of the SCHERR-TUMICO 20-2400 Series vertical beam optical comparator. Due to S-T Industries' policy of continued improvement of products, the right to change without notice is reserved. The information contained in this manual may vary somewhat from the machine with which it is to be used. To fully utilize the capabilities of this optical comparator, a comprehensive study of this manual is necessary. The 20-2400 Series 24" optical comparator sets new standards in functional design, ease of use, rigidity and accuracy. Over 50 years of manufacturing experience combined with worldwide factory service make S-T Optical Comparators your best buy.

TABLE OF CONTENTS

| | |
|---|----|
| Nomenclature..... | 3 |
| Specifications..... | 4 |
| Focal Clearing Chart..... | 5 |
| Installation and Setup..... | 6 |
| Illumination Systems..... | 7 |
| Power Switches..... | 7 |
| Power Up..... | 8 |
| Magnification Lenses and Lens Turret..... | 8 |
| Stage Operation..... | 8 |
| Options..... | 9 |
| Protractor Screen Operation..... | 10 |
| Measuring Techniques..... | 11 |
| Digital Readout Systems..... | 12 |
| Calibration - Magnification..... | 13 |
| Calibrations - Stage..... | 14 |
| Maintenance..... | 14 |
| Fuse..... | 15 |
| Lamp Replacement..... | 16 |
| Parts List..... | 17 |

20-2400 Series Nomenclature

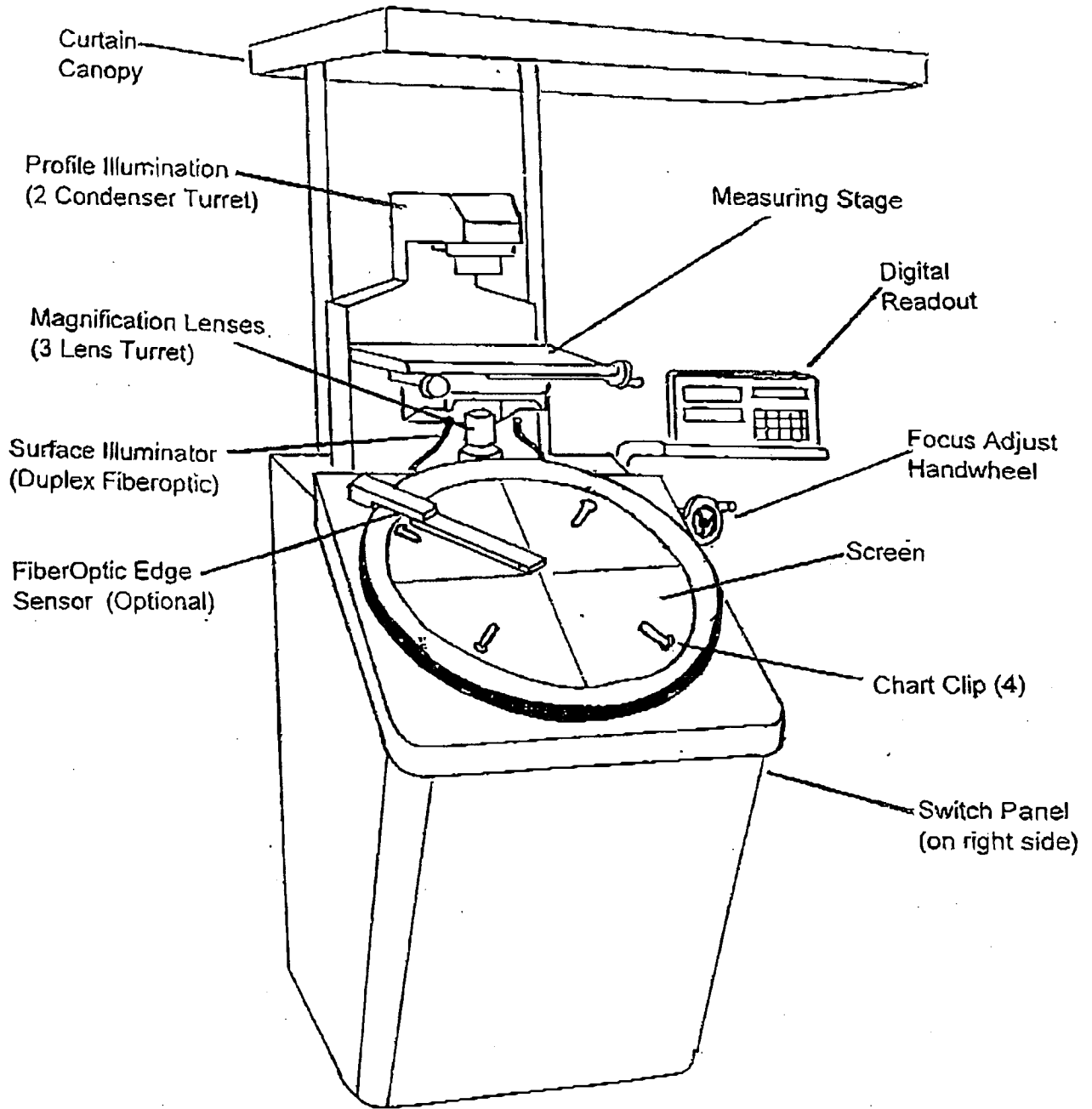


Figure 1

SPECIFICATIONS

Machine Dimensions

Length..... 47" (1194 mm)
 Width..... 31" (787 mm)
 Height..... 81" (2057 mm)
 Height to Screen Center.... 40" (1016 mm)

Work Table

Length..... 14" (355 mm)
 Width..... 10" (254 mm)
 Glass Size..... 5" x 9" (127 mm x 228 mm)
 Clamping Slot..... 1
 Allowable Workload..... 25 lb. (11 Kg)

Measuring Capacity

X-axis..... 8" (200 mm)
 Optional 12" (300 mm)
 Y-axis..... 4" (100 mm)
 Focus..... 4" (100 mm)
 Scale Resolution..... .00005" (.001mm)
 (for digital stages)

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..... 600 lb. (273 Kg)

Crated Comparator..... 830 lb. (377 Kg)

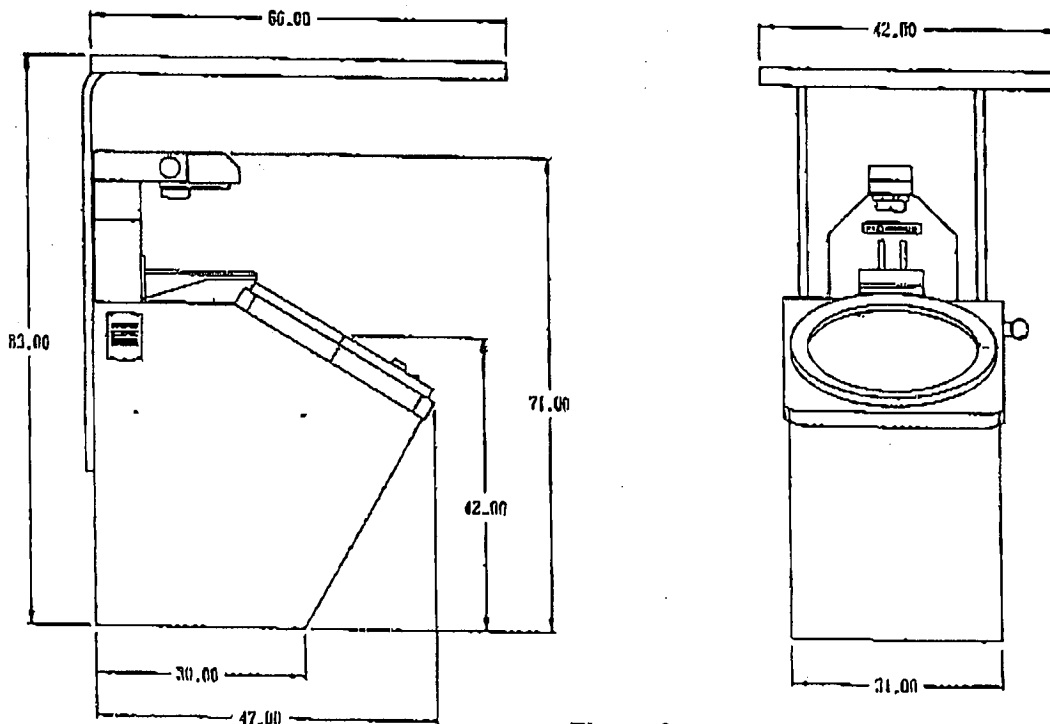


Figure 2

FOCAL CLEARANCES FOR 24" OPTICAL COMPARATOR

| | | | | | |
|------------------|-------|-------|------|------|------|
| Magnification | 10X | 20X | 25X | 50X | 100X |
| Working Distance | 5.4" | 5.4" | 4.7" | 3.9" | 1.9" |
| Effective Field | 2.40" | 1.20" | .96" | .48" | .24" |

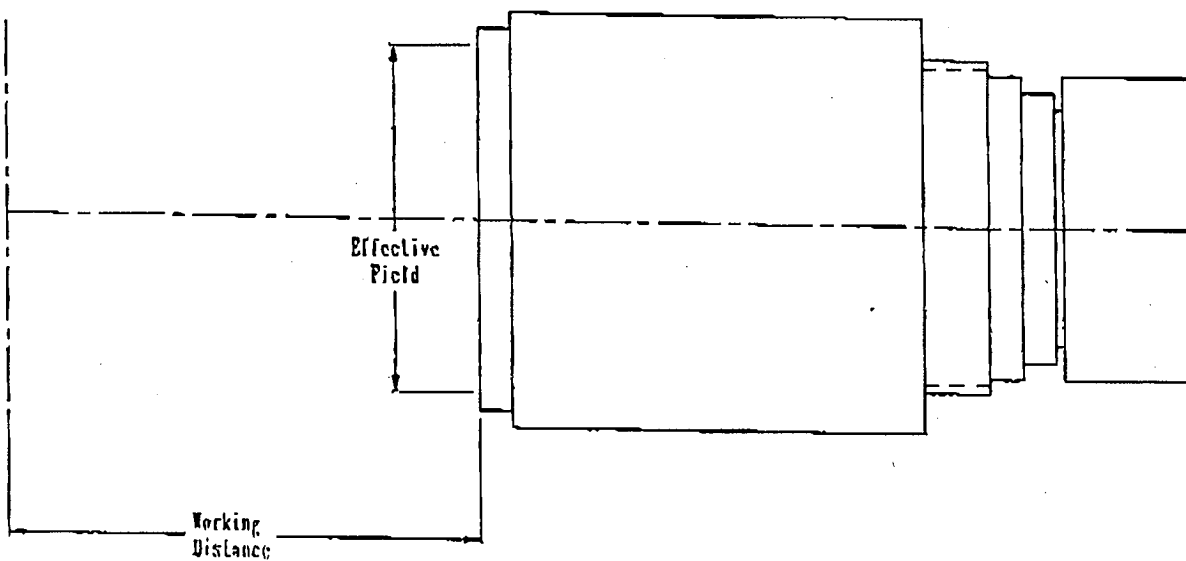


Figure 3

INSTALLATION SITE

The SCHERR-TUMICO 2400 is a precision optical instrument and should be installed in a clean, temperature and humidity controlled, vibration free location. Dust, oil and other contaminants will coat the lenses and mirror and cause distortion or otherwise reduce image quality. Extremes in temperature will 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 a clean, air-conditioned room with a lower than normal light level.

SETUP

The SCHERR-TUMICO 2400 is shipped complete except for the digital readout and accessories. It is aligned and tested at the factory and is ready to use upon receipt and setup. Leave the comparator on the pallet until it arrives at the installation site to help avoid rough handling which could cause misalignment and inaccuracy of measurement. Save the shipping container and packing material for future use.

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

Remove wood sides and top from pallet. Remove canopy top and any loose accessories and set aside.

1. Unbolt comparator from pallet.
2. With the help of 2 to 4 strong people, move the comparator to its work station. Use handles to move. Install leveling feet. Remove handles and install plugs in holes.
3. Check for shipping damages. Document shortages and damages and report to S-T Industries including the Model number and Serial number.

Do not connect power to the comparator until setup is complete

Installation

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. Adjust leveling feet until comparator is level and stable.

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.
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 edge detection option, be careful not to overbend small fiberoptic bundles.) Secure to arm with wire ties if necessary.

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 on the screen when focused. This allows precise measurements of peripheral features of a part either by comparison to a chart or by positional measurement using a digital readout. The condenser lens turret is located above 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.

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.
 3. The Surface Illumination switch controls power to the surface illumination lamps.
- Note: the fans will operate when the main power switch is turned on.

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.

MAGNIFICATION LENSES and LENS TURRET

There are several optional lens magnifications available with the ST 2400 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 2400 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, grasp the top of the lens and lift straight up until it stops. Then, rotate left or right to a stop. Then rotate focus hand wheel until 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 lens until it can slide down into the projection tube. Carefully, slide the lens down until it reaches the bottom of the tube. Rotate the turret until the desired lens is at the front and allow the spring button to seat firmly into the slot on the turret. Raise the lens into position as before.

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

The X-axis is controlled by turning a hand crank at the right of the top plate and a quick release mechanism in front of the stage. Rotate the lever on the quick release down to allow free stage motion left or right. Rotate the lever to its free, horizontal position and use the hand crank for fine movements. The Y-axis is controlled with the handcrank on the lower left of the stage. The focus axis is controlled by turning the focus handle on the right of the comparator housing. (See Nomenclature Figure)

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.

Motor Control Option

The motor control option greatly speeds the measuring process and replaces the effort of turning hand cranks with the ease of joystick operation. The motor control option includes a 2-axis joystick mounted on the right side of the comparator housing and 2 separate jog wheels for fine positioning of the X and Y axes independently. The joystick is normally used to measure quickly with edge detection or to bring the image close to a line or DRO value. The jogwheels are use to precisely position the image to a line or DRO value.

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 operates like the motor control option when it is not under program control. Consult you QuadraChek manual or contact your S-T representative for more information.

PROTRACTOR SCREEN OPERATION

Absolute Zero Setting

See figure 4 to help you with the following procedure:

- 1) Rotate the screen so the horizontal line is approximately level.
- 2) Focus a pointer on the screen with its tip on the left of the horizontal screen line.
- 3) Move the stage so the image of the point is on the right edge 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.

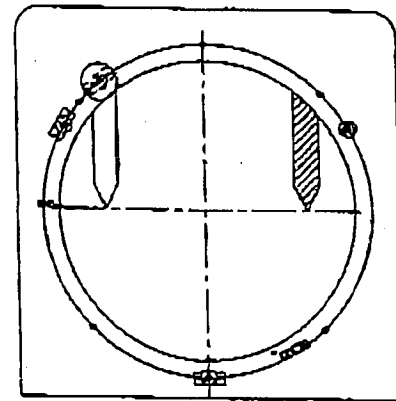


Figure 4

Angular Measurements (with Digital Screen Protractor)

Consult Digital Readout manual for information on Digital Protractor operation

Differential 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 a group of 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.

Four 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. Photographic method. Similar to hand traced master except photographic film is used to produce overlay. Film emulsion must be against glass surface. Some trial and error will be necessary to produce acceptable quality charts.
4. 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.

Measured Linear Displacement

The standard measuring stage allows accurate linear measurements in 2 axis, X and Y. The X axis travel is 8" (200 mm) or 12" (300 mm) and the Y axis travel is 4" (100 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° 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.

DIGITAL READOUT SYSTEMS

The 4" x 8" (100 mm x 200 mm) measuring stage comes with several optional digital readout systems.

#20-4648-21 4" x 8" travel stage 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.

#20-4648-22 4" x 8" travel stage 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.

#20-4648-23 4" x 8" travel stage with QuadraChek 2215 geometric digital readout system. DRO has all features of above system plus fiber optic edge detection.

#20-4648-24 4" x 8" travel stage 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.

#20-4648-25 4" x 8" travel stage 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.
- 8) If the magnification is on in middle and off on the outside, the mirror should be tilted to correct. If the magnification is even, but incorrect, the mirror should be raised or lowered to correct.

NOTE: It may be determined that the mirror is correct and that a lens needs adjustment. The lens may be removed from the tube by first loosening the set screw in the side of the projection tube and then unscrewing the lens from the projection tube. The ring at the bottom of the lens can be adjusted up or down to change magnification. First loosen the set screws, then rotate the ring. Make small adjustments, replace the lens in the projection tube and check magnification. Repeat this process until the magnification is correct. Then, retighten the setscrews holding the ring and after replacing the lens, retighten the setscrew on the projection tube.

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 with the X axis.
- 2) Focus on the 6" or 150mm scale and move to one end of the scale.
- 3) Be sure that the screen is set to 0° and move the stage until you see the other end of the scale.
- 4) Adjust the image by moving one end of the plate on the stage until the scale line remains on the crosshair as the stage is moved back and forth.
- 5) Align the '0' end of the calibration scale with the screen crosshair or the vertical line.
- 6) Zero the X axis display on the DRO and move the stage until the end of the scale aligns with the reference line.
- 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 and move to the next increment on the scale. Record the value and repeat for each increment.
- 9) For Y axis, locate scale along short side of plate. Do not reposition plate since Y axis is square to X axis. Repeat steps 5-8 using 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

Always store lenses in a clean, safe place when not in use. An accidental drop to a hard surface or severe jolt to a lens system may not crack the glass, but may cause a shift in lens position which results in out-of-tolerance magnification.

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 side panel to access mirror.

Remove dust from mirror with a brush, described previously. If necessary, use clean cotton 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 20-2400 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

1. Remove front cover of profile lamphouse.
2. Remove inner cover from lamp socket.
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 the inner lamp cover and main lamphouse cover.
7. Replace power cord and check lamp.

Surface Illumination Lamp

1. To access the lamps, remove left or right panel (for lamp to be changed).
2. To remove lamp, pull up 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

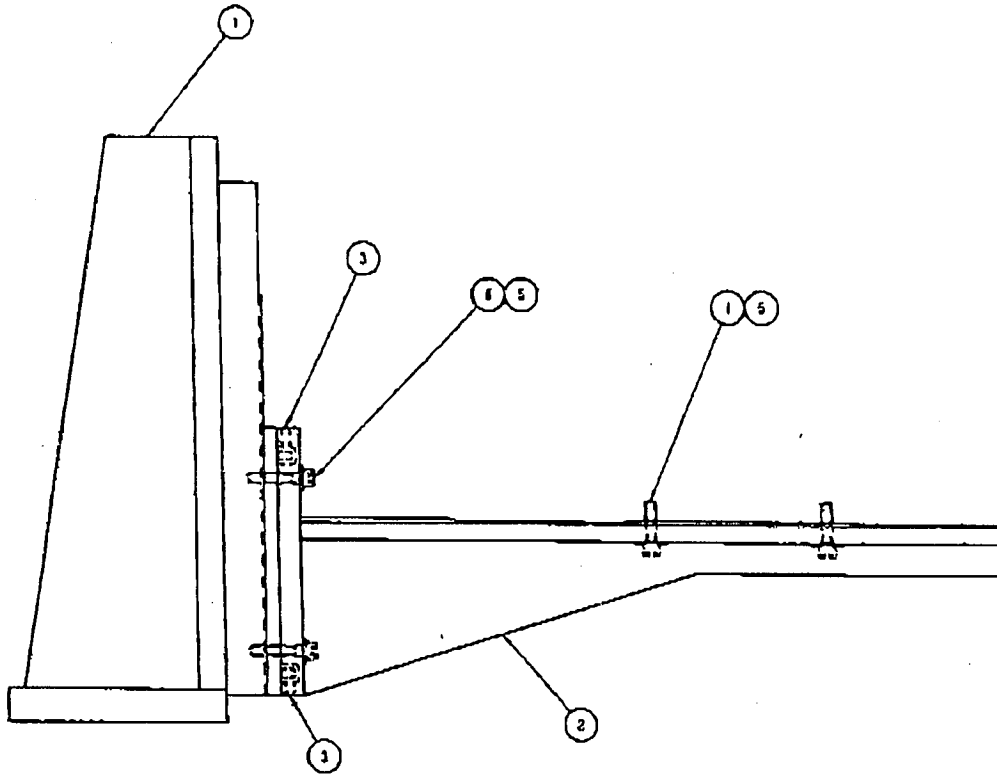
Lubricate V-ways and ball bearings of measuring stage with light oil occasionally, to prevent corrosion and keep motion smooth. Vertical ways can be lubricated by removing rear cover.

Parts Identification

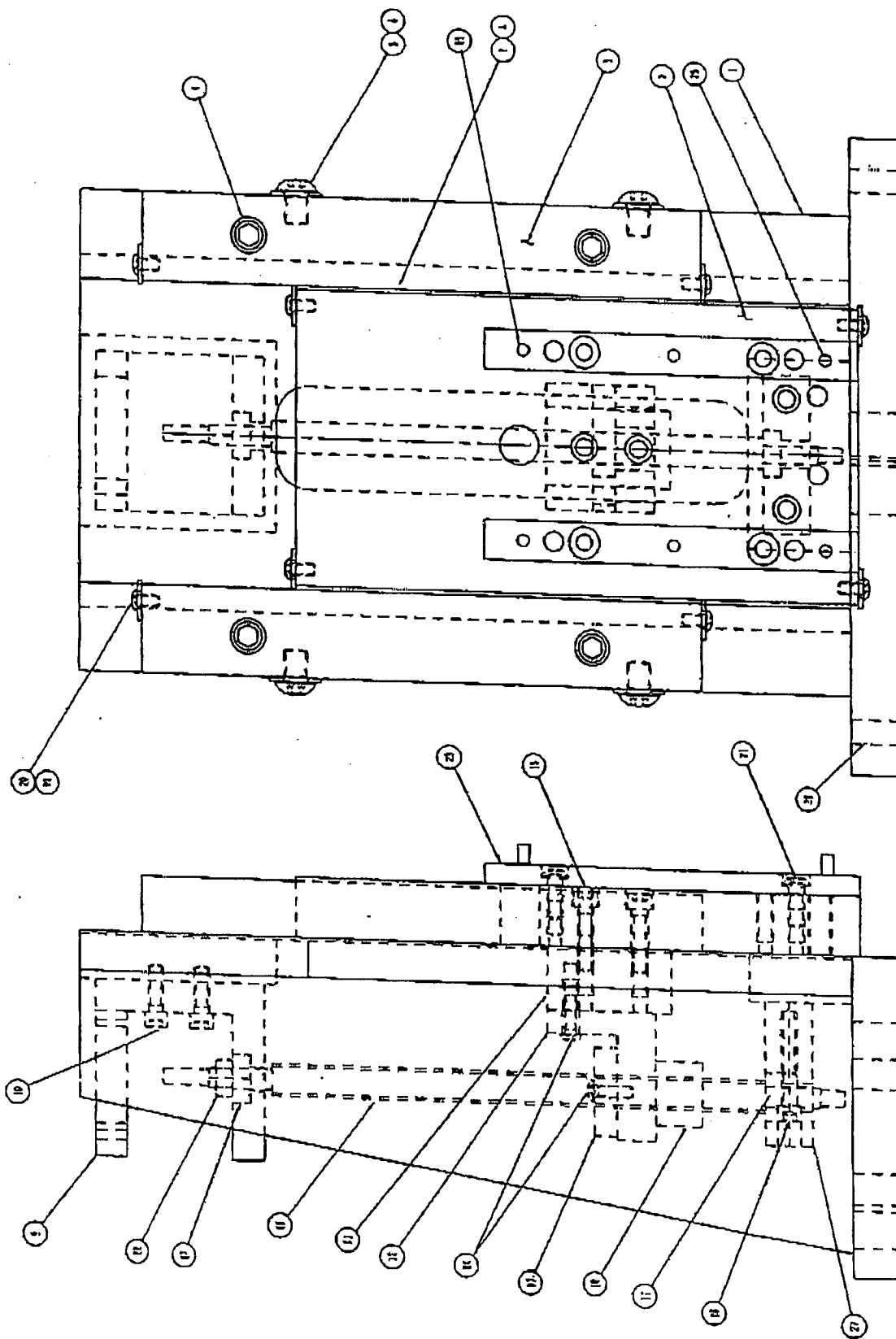
Compare the part numbers on sub-assembly and part illustrations with their respective parts lists to identify parts.

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.



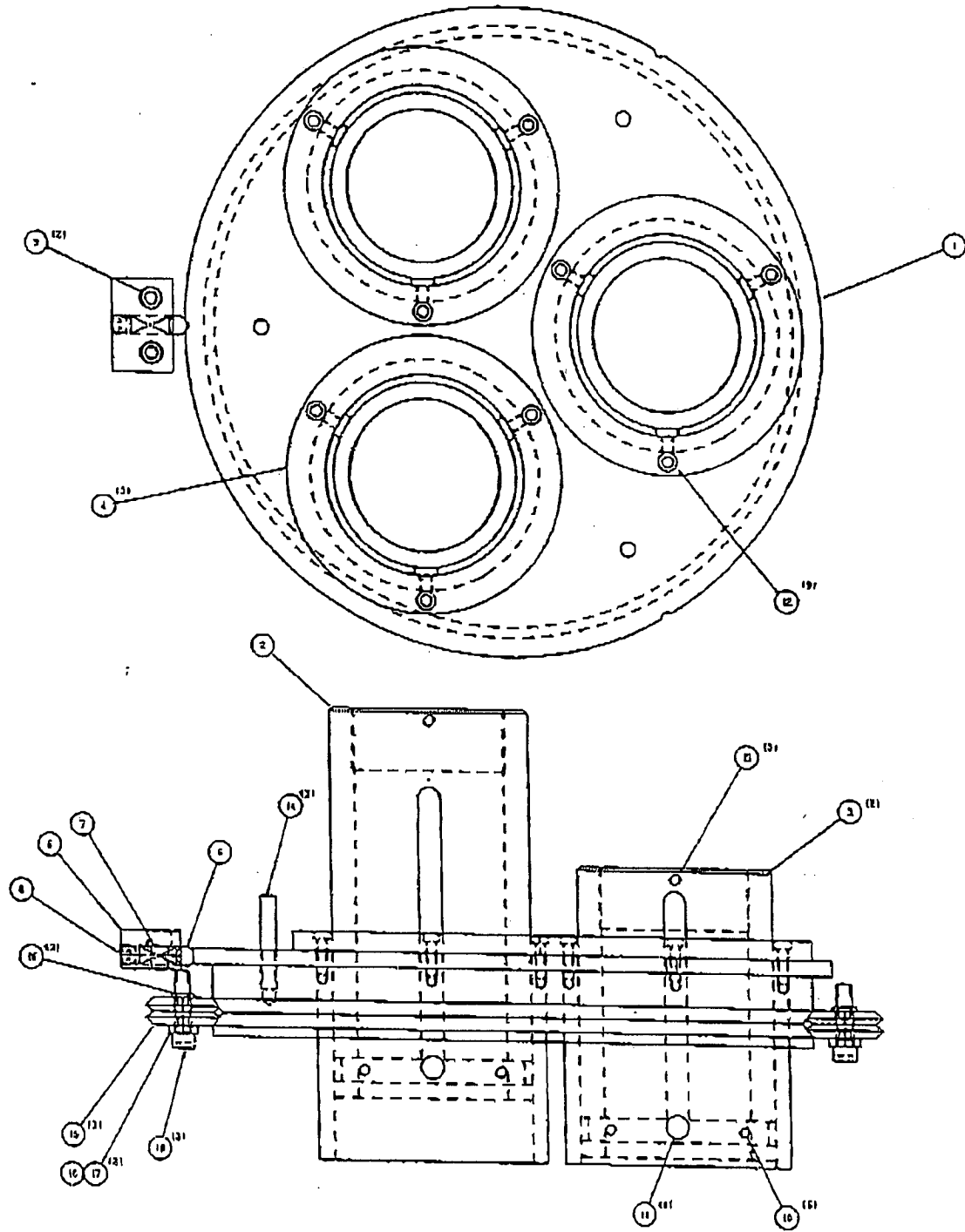
| | | | |
|-------------------|-------|------------|--------------------------------|
| 4 | 6 | 48 5262 | SCREW, SHCS 1/4-20 X 1 1/4 LG. |
| 8 | 5 | 48 6069 | WASHER |
| 4 | 4 | 48 5051 | SCREW, SHCS 1/4-20 X 1" LG. |
| 2 | 3 | 48 5101 | SET SCREW 10-32 X 5/16 LG. |
| 1 | 2 | 22 3947-04 | PLATFORM ASSY. |
| 1 | 1 | 22 3943-00 | VERTICAL LIFT & STAGE MOUNT |
| QTY. | (REV) | PART NO. | DESCRIPTION |
| LIST OF MATERIALS | | | |



Vertical Lift Assembly

| | | | |
|------|------|------------|---------------------------------------|
| 1 | 27 | 22 3943-13 | BOTTOM LEAD SCREW MOUNT |
| 4 | 26 | 48 8096 | SET SCREW 1/2-20 X 3/4 LG. FLAT POINT |
| 2 | 25 | 48 5381 | DOVEL PIN 3/16 X 5/8 LG. |
| 4 | 24 | 48 5430 | SCREW, BHCS 1/4-20 X 3/8 LG. |
| 2 | 23 | 22 3943-12 | PLATFORM SPACER |
| 2 | 22 | 48 7850 | HEX NUT |
| 8 | 21 | 48 8083 | WASHER |
| 8 | 20 | 48 5358 | SCREW, BHCS 10-32 X 3/8 LG. |
| 1 | 19 | 48 8097 | SUPER NUT (SK5D10X) |
| 1 | 18 | 22 3943-11 | LEAD SCREW |
| 2 | 17 | 48 8095 | BEARING XR638-22 (BOCA) |
| 2 | 18 | 48 6592 | SCREW, SHCS 1/4-20 X 2" LG. |
| 2 | 16 | 48 5051 | SCREW, SHCS 1/4-20 X 1" LG. |
| 4 | 14 | 48 5622 | SCREW, BHCS 10-32 X 5/8 LG. |
| 1 | 13 | 22 3943-10 | ADJ. NUT PLATE |
| 1 | 12 | 22 3943-09 | VERTICAL NUT MOUNT |
| 1 | 11 | 22 3943-08 | VERTICAL NUT SPACER |
| 4 | 10 | 48 5057 | SCREW, SHCS 1/4-20 X 3/4 LG. |
| 1 | 9 | 22 3943-07 | TOP LEAD SCREW MOUNT |
| 8 | 8 | 48 5400 | BALL |
| 2 | 7 | 22 1232 | BALL RETAINER |
| 4 | 6 | 48 6084 | FLAT WASHER |
| 4 | 5 | 48 5377 | SCREW, BHCS 3/8-24 X 1/2 LG. |
| 4 | 4 | 48 5047 | SCREW, SHCS 3/8-16 X 1 1/4 LG. |
| 1 | 3 | 22 1048 | GIBS, MATCHED PAIR |
| 1 | 2 | 22 3762-06 | SLIDE PLATE |
| 1 | 1 | 22 3943-01 | STAGE MOUNT |
| QTY. | ITEM | PART NO. | DESCRIPTION |

Vertical Lift Assembly

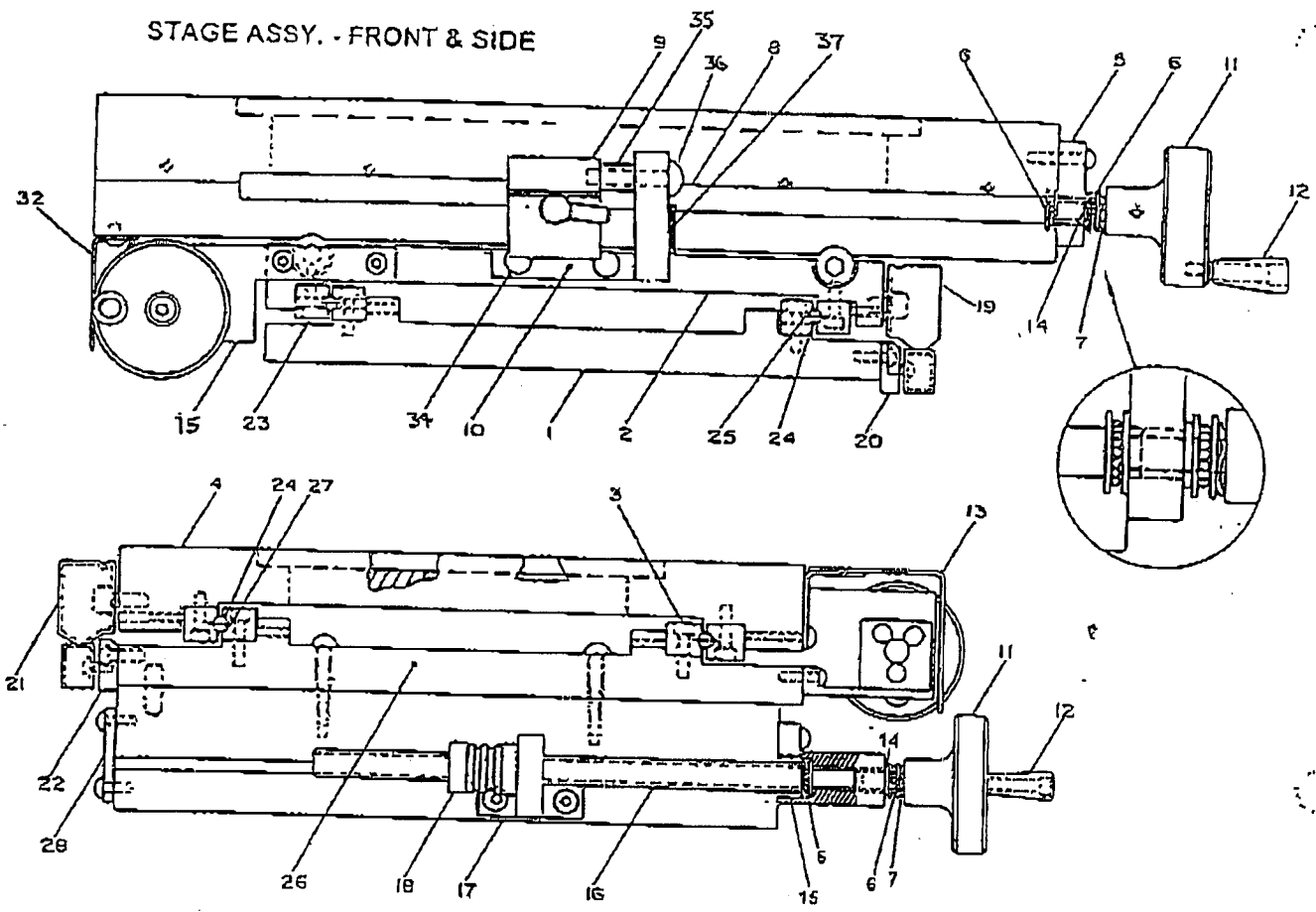


Lens Turret Assembly

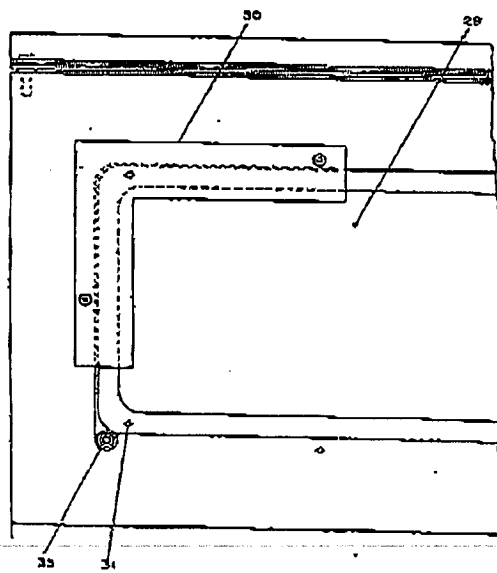
| | | | |
|------|------|--------------|---------------------------------|
| 3 | 19 | 48 5051 | SCREW, SHCS 1/4-20 X 1.00 LG. |
| 1 | 18 | 48 8109 | BUSHING ADJUSTABLE |
| 2 | 17 | 48 8108 | BUSHING STATIONARY |
| 6 | 16 | 48 6069 | WASHER |
| 3 | 15 | 48 8107 | DUAL-V-WHEEL |
| 3 | 14 | 22 3944-07 | STAND OFF |
| 3 | 13 | 22 0244-0088 | SET SCREW, NYLON |
| 9 | 12 | 48 5007 | SCREW, SHCS 10-32 X 3/8 LG. |
| 9 | 11 | 22 3944-06 | REST SCREW |
| 6 | 10 | 48 6224 | SET SCREW NYLOC 10-32 X 3/8 LG. |
| 2 | 9 | 48 5160 | SCREW, SHCS 1/4-20 X 5/8 LG. |
| 1 | 8 | 48 5357 | SET SCREW 5/16-24 X 5/16 LG. |
| 1 | 7 | 48 8110 | SPRING |
| 1 | 6 | 48 8111 | 5/16 STEEL BALL |
| 1 | 5 | 22 3944-05 | TURRET STOP BLOCK |
| 3 | 4 | 22 3944-04 | LENS HOLDER |
| 2 | 3 | 22 3944-03 | LENS TUBE 10X, 20X, & 25X |
| 1 | 2 | 22 3944-02 | LENS TUBE 50X & 100X |
| 1 | 1 | 22 3944-01 | TURRET RING |
| QTY. | ITEM | PART NO. | DESCRIPTION |

Lens Turret Assembly

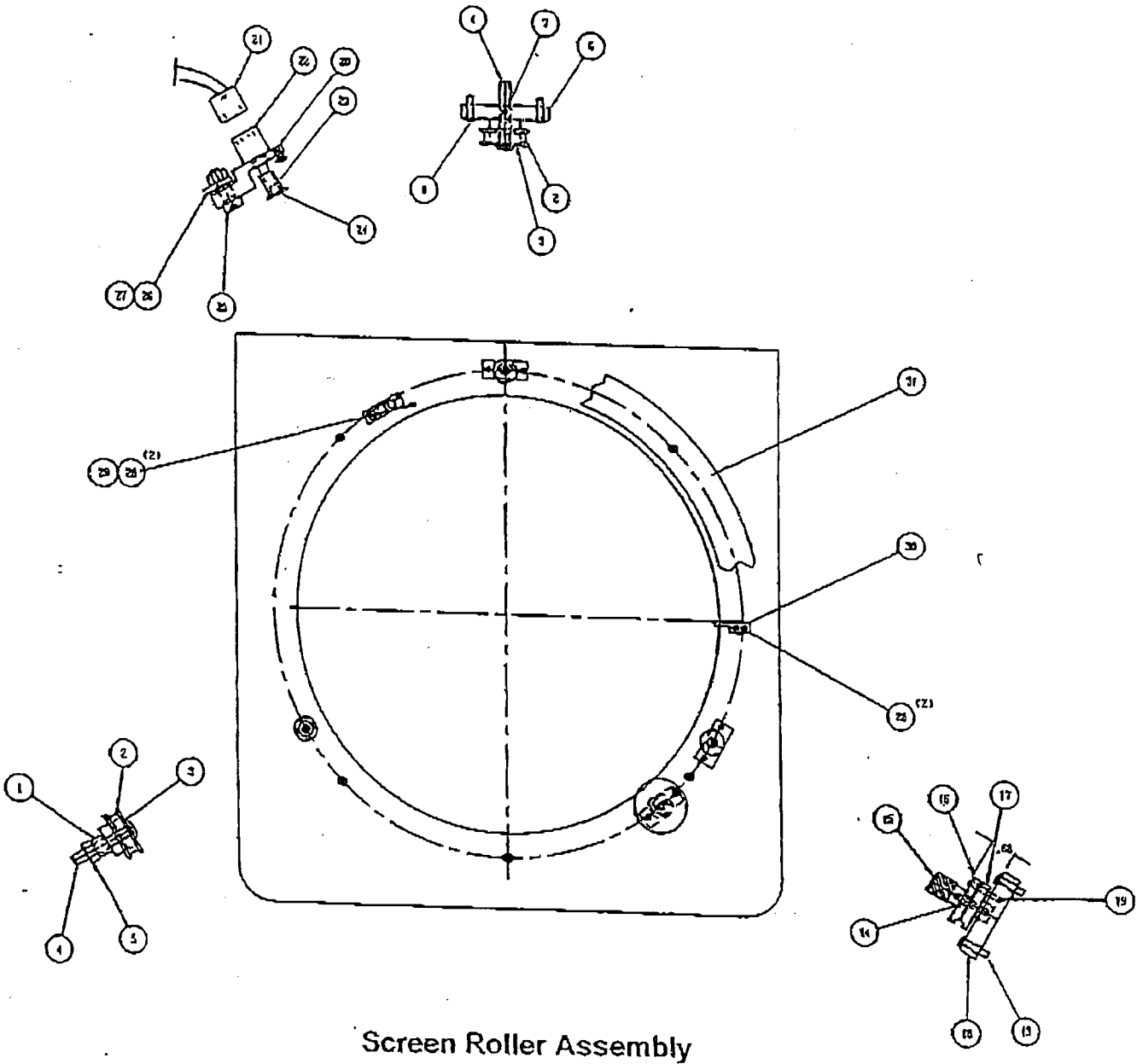
STAGE ASSY. - FRONT & SIDE



STAGE ASSY. - TOP



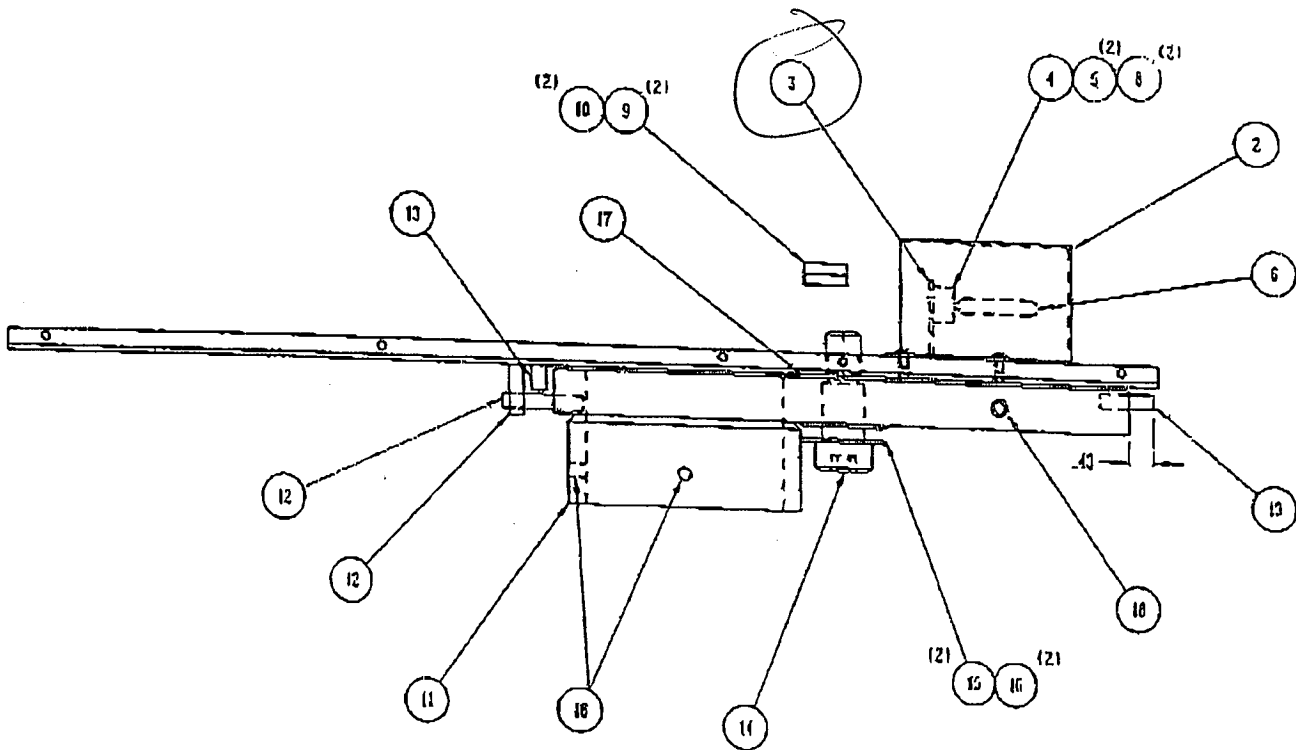
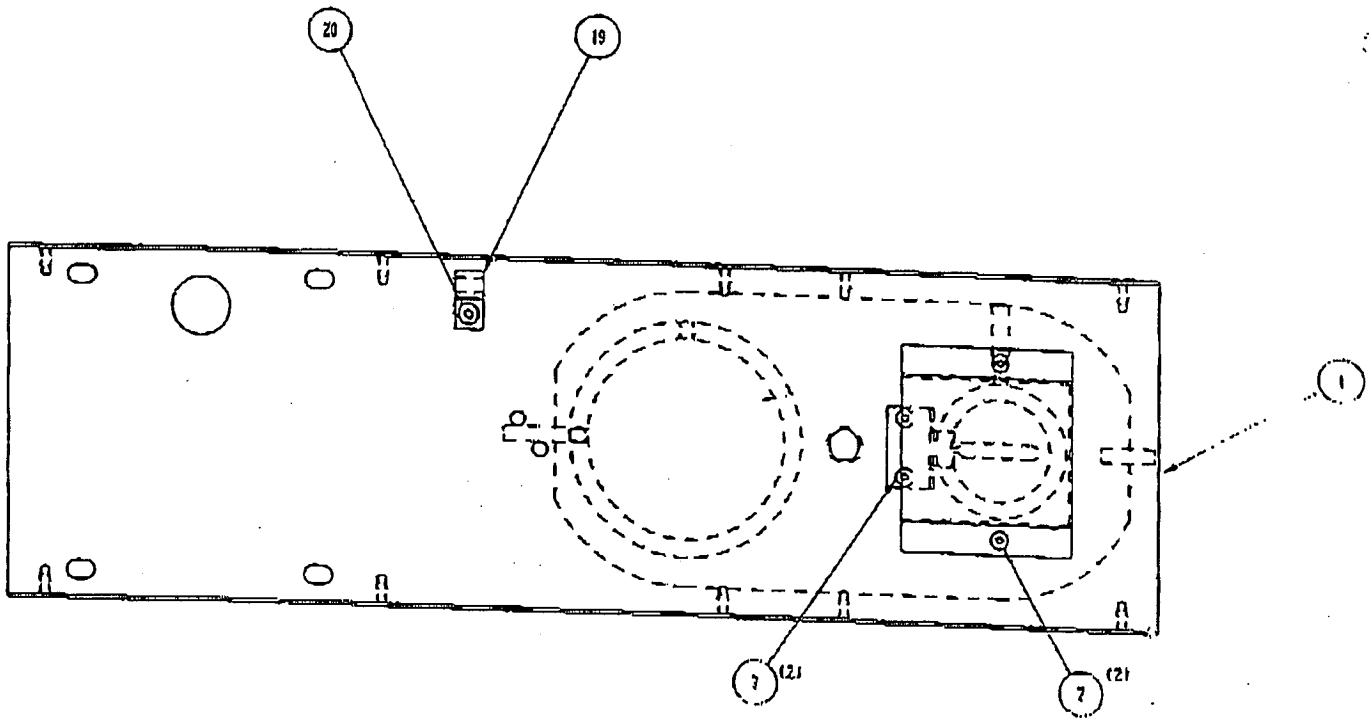
| PART NUMBER | DESCRIPTION | 4 X 8 MANUAL STAGE | 4 X 12 MANUAL STAGE |
|------------------|----------------------|--------------------------|---------------------------|
| 1. 22-3759-19 | BASE PLATE | 1 | 1 |
| 2. 22-3759-20 | LOWER SLIDE PLATE | 1 | 1 |
| 3. 22-3759-09 | GIBS. PAIRED | 1 | 1 |
| 4. 22-3759-10 | TOP PLATE 4 X 8 | 1 | |
| 22-3759-69 | TOP PLATE 4 X 12 | | 1 |
| 5. 22-3759-63 | KNOB MOUNT | 1 | 1 |
| 6. 48-7646-00 | THRUST BEARING | 4 | 4 |
| 7. 48-6630-00 | WAVE WASHER | 2 | 2 |
| 8. 22-3759-1688 | X AXIS LEAD SCR 4X8 | 1 | |
| 22-3759-6888 | X AXIS LEAD SCR 4X12 | | 1 |
| 9. 22-3844-00 | QUICK RELEASE | 1 | 1 |
| 10. 22-3759-80 | QUICK RELEASE MOUNT | 1 | 1 |
| 11. 22-3102-00 | KNOB | 2 | 2 |
| 12. 22-1007-00 | HANDLE | 1 | 1 |
| 13. 22-3759-56 | X AXIS COVER 4X8 | 1 | |
| 22-3759-64 | X AXIS COVER 4X12 | | 1 |
| 14. 48-7437-00 | FLANGE BEARING | 2 | 2 |
| 15. 22-3759-61 | Y AXIS KNOB MOUNT | 1 | 1 |
| 16. 22-3759-54 | Y AXIS LEAD SCREW | 1 | 1 |
| 17. 22-3759-03 | NUT MOUNT | 1 | 1 |
| 18. 48-7655-00 | BACKLASH NUT | 1 | 1 |
| 19. 48-8090-00 | SCALE FOR 4" | 1 | 1 |
| 20. 22-3759-15 | ENCODER MOUNT Y AXIS | 1 | 1 |
| 21. 48-7797-00 | SCALE 8" | 1 | |
| 48-7796-00 | SCALE 12" | | 1 |
| 22. 22-3759-01 | X AXIS ENCODER MOUNT | 1 | 1 |
| 23. 22-3759-12 | GIBS. PAIRED | 2 | 2 |
| 24. 48-5152-00 | BALL 3/16 DIA | 72 | 64 |
| 25. 22-3759-13 | BALL GUIDE | 2 | 4 |
| 26. 22-3759-02 | UPPER SLIDE PLATE | 1 | 1 |
| 27. 22-3759-08 | BALL GUIDE | 2 | |
| 28. 22-3759-29 | SHIPPING BRACKET | 4 | 2 |
| 22-3759-66 | SHIPPING BRACKET | | 2 |
| 29. 22-3759-1788 | GLASS PLATE 4 X 8 | 1 | |
| 22-3759-6788 | GLASS PLATE 4 X 12 | | 1 |
| 30. 22-3759-21 | SQUARE (OPTION) | 1 | 1 |
| 31. 48-5830-00 | NYLON SET SCREW | 4 | 4 |
| 32. 22-3759-11 | COVER "Y"AXIS | 1 | 1 |
| 33. 22-3759-18 | GLASS BUSHING | 2 | 2 |
| 34. 48-5329-00 | SCREW | 2 | 2 |
| 35. 22-3891-00 | STANDOFF | 2 | 2 |
| 36. 48-8055-00 | SCREW | 2 | 2 |
| 37. 22-3844-12 | FLANGE BEARING | 1 | 1 |



Screen Roller Assembly

| | | | |
|------|------|--------------|------------------------------------|
| 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 6650 | 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 "DOCA" MR600-2RS |
| 2 | 2 | 22 3941-01 | SCREEN ROLLER |
| 1 | 1 | 22 3941-02 | SPACER |
| QTY. | ITEM | PART NO. | DESCRIPTION |

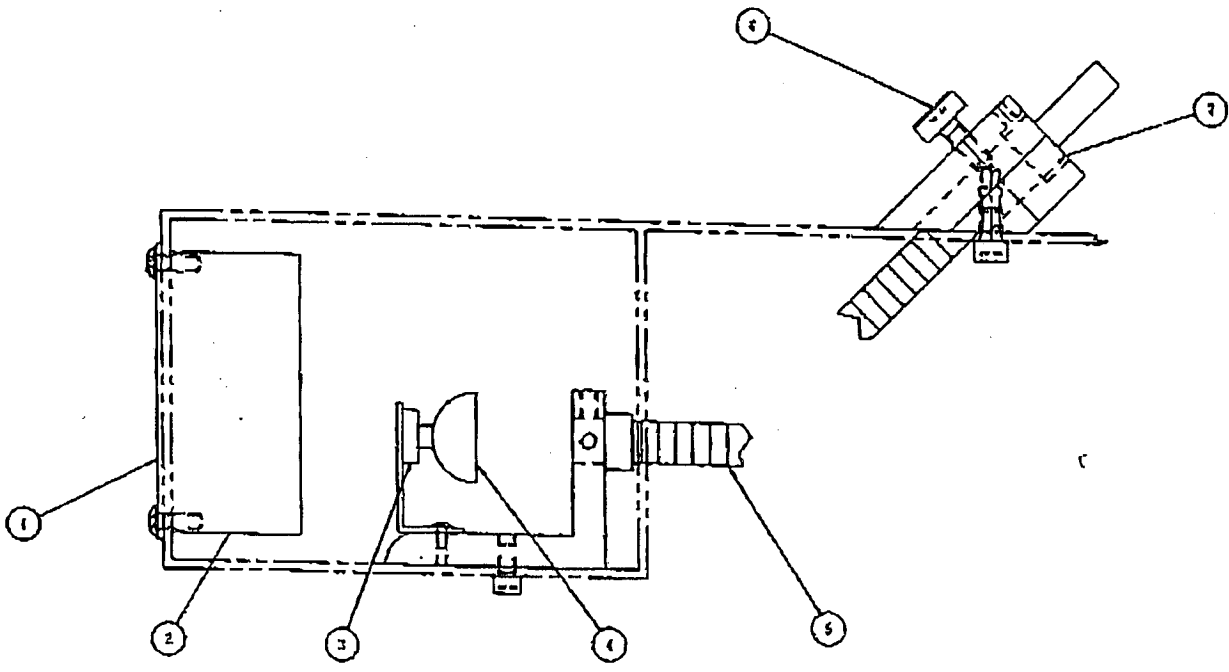
Screen Roller Assembly



Profile Lamphouse Assembly

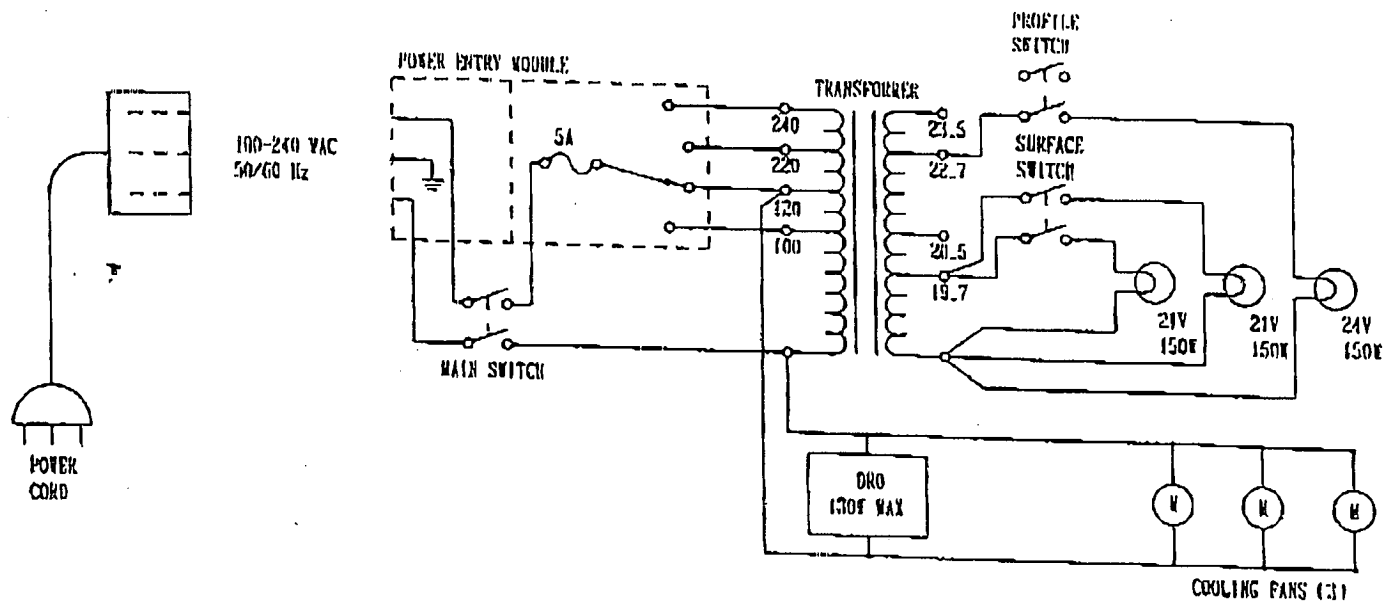
| | | | |
|------|------|------------|--------------------------------------|
| 1 | 20 | 48 6479 | SCREW, BHCS 10-32 X 1/2 LG. |
| 1 | 19 | 48 8140 | CABLE TIE |
| 3 | 18 | 48 5052 | SET SCREW 1/4-20 X 1/4 LG. |
| 1 | 17 | 48 8115 | WASHER, NYLON |
| 2 | 16 | 48 8116 | WAVE WASHER |
| 2 | 15 | 48 8114 | WASHER 3/4 ID X 1 1/2 OD X 1/16 THK. |
| 1 | 14 | 48 8113 | SHOULDER SCREW 3/4 X 1" LG. |
| 2 | 13 | 48 5317 | DOVEL PIN 1/4 X 3/4 LG. |
| 2 | 12 | 48 6258 | DOVEL PIN 1/4 X 1 1/4 LG. |
| 1 | 11 | 22 3946-00 | BASE PLATE WELDMENT |
| 2 | 10 | 48 6188 | PIN |
| 2 | 9 | 48 7274 | 1 CIRCUIT RECEPTACLE |
| 2 | 8 | 48 7991 | SPACER |
| 4 | 7 | 48 5111 | SCREW, BHCS 8-32 X 1/4 LG. |
| 1 | 6 | 48 7271 | BULB 150 WATT 24 V |
| 2 | 5 | 48 5319 | SCREW, SHCS 6-32 X 1/2 LG. |
| 1 | 4 | 48 7425 | SOCKET |
| 1 | 3 | 22 3948-03 | SOCKET MOUNT, BULB |
| 1 | 2 | 22 3948-02 | BULB COVER |
| 1 | 1 | 22 3948-01 | BASE PLATE-LAMPHOUSE |
| QTY. | ITEM | PART NO. | DESCRIPTION |

Profile Lamphouse Assembly

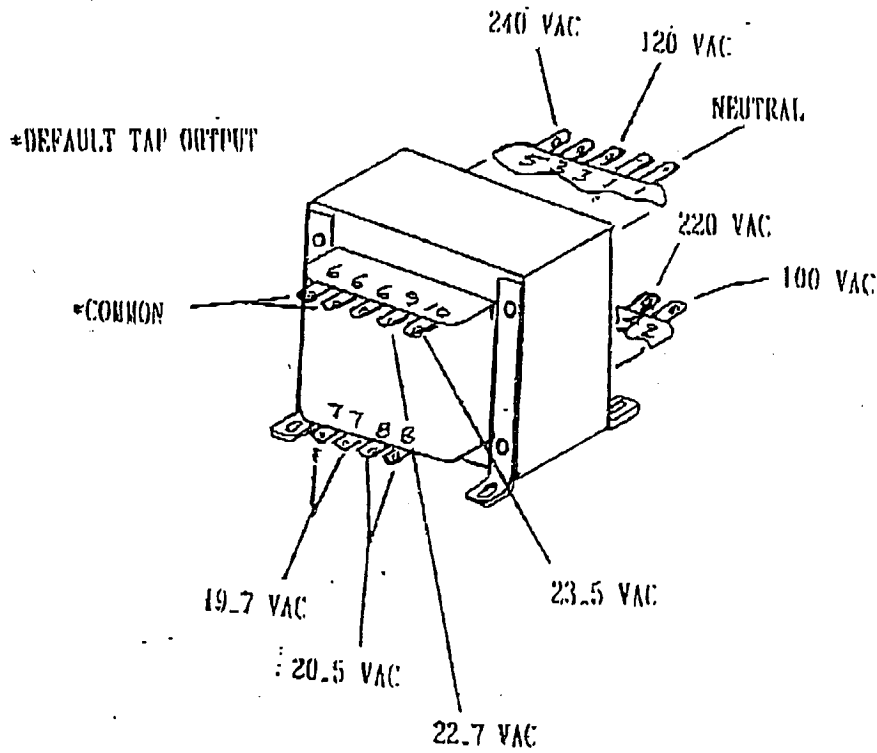


| | | | |
|------|------|--------------|-------------------------------|
| 2 | 7 | 22 3952-03 | STOP BUSHING |
| 2 | 6 | 22 2107-11 | THUMB SCREW |
| 2 | 5 | 22 3935-0088 | FIBER OPTIC BUNDLE |
| 2 | 4 | 48 8086 | LAMP, PROJECTION EKE 150W 21V |
| 2 | 3 | 48 8087 | LAMP, SOCKET #S-221 |
| 2 | 2 | 22 3426 | FAN |
| 2 | 1 | 48 6778 | FAN GUARD |
| QTY. | ITEM | PART NO. | DESCRIPTION |

ELECTRICAL SCHEMATIC



| | |
|-------------------|------------------------|
| 48 8123 | TRANSFORMER |
| 48 7443 | MAIN POWER SWITCH |
| 48 7443 | PROFILE ILLUM. SWITCH |
| 48 7443 | SURFACE ILLUM. SWITCH |
| 48 7291 | 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 |
| PART NO. | DESCRIPTION |
| LIST OF MATERIALS | |



TRANSFORMER 48 8123

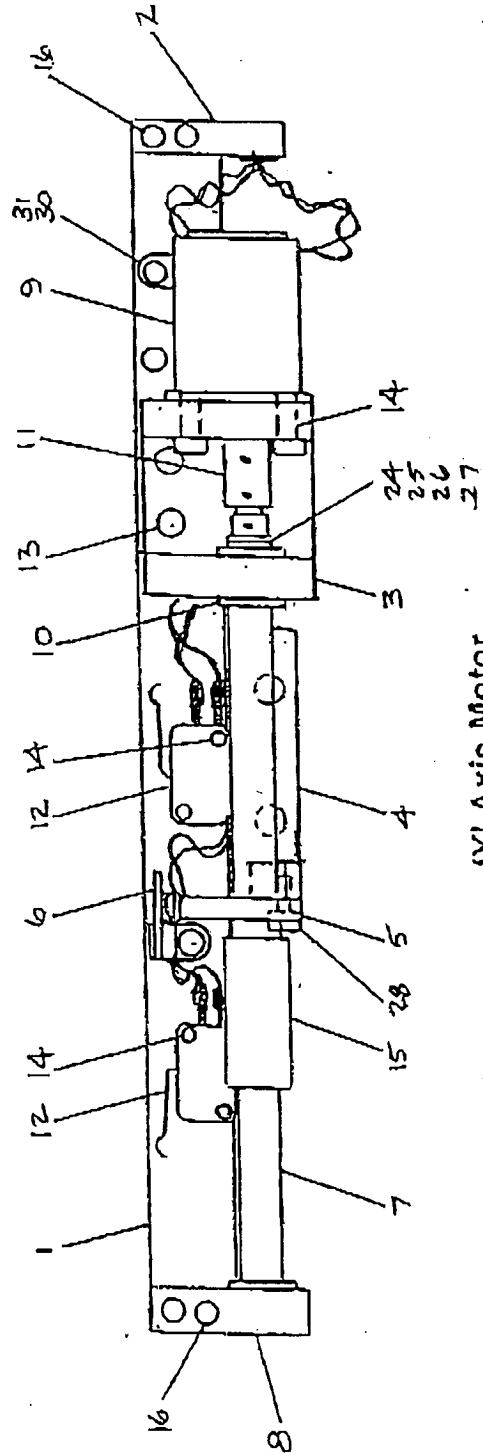
WIRE CONNECTIONS

FOR OPTICAL COMPARATOR SERIES 2400

| <u>PIN NO.</u> | <u>WIRE COLOR</u> | <u>FUNCTION</u> |
|----------------|-------------------|-----------------|
| 1 | BLUE | NEUTRAL LINE |
| 2 | YELLOW | 100 VOLT LINE |
| 3 | BROWN | 120 VOLT LINE |
| 4 | RED | 220 VOLT LINE |
| 5 | ORANGE | 240 VOLT LINE |
| 6 | RED-BLACK-WHITE | COMMON |
| 7 | *RED-WHITE | 19.7 VOLT LAMP |
| 8 | (RED-WHITE) | 20.5 VOLT LAMP |
| 9 | *BLACK | 22.7 VOLT LAMP |
| 10 | (BLACK) | 23.5 VOLT LAMP |

| | | | |
|------|-----|------------|---------------------------|
| 1 | 11 | 48 8077 | COUPLING |
| 3 | 10 | 48 7928 | BEARING |
| 1 | 9 | 48 8043 | STEPPING MOTOR PK245-01A1 |
| 1 | 8 | 22 3881-10 | BEARING MOUNT |
| 1 | 7 | 22 3882-02 | 1/4" AXIS LEAD SCREW |
| 1 | 6 | 22 3881-08 | STOP, LIMIT SWITCH |
| 1 | 5 | 22 3881-07 | WET PLATE |
| 1 | 4 | 22 3881-04 | NUT MOUNT BAR |
| 1 | 3 | 22 3881-03 | BEARING & MOTOR MOUNT |
| 1 | 2 | 22 3881-02 | SOCKET MOUNT |
| 1 | 1 | 22 3882-01 | 1/4" AXIS MOUNT BAR |
| QTY. | 103 | 748 DR. | DESCRIPTION |

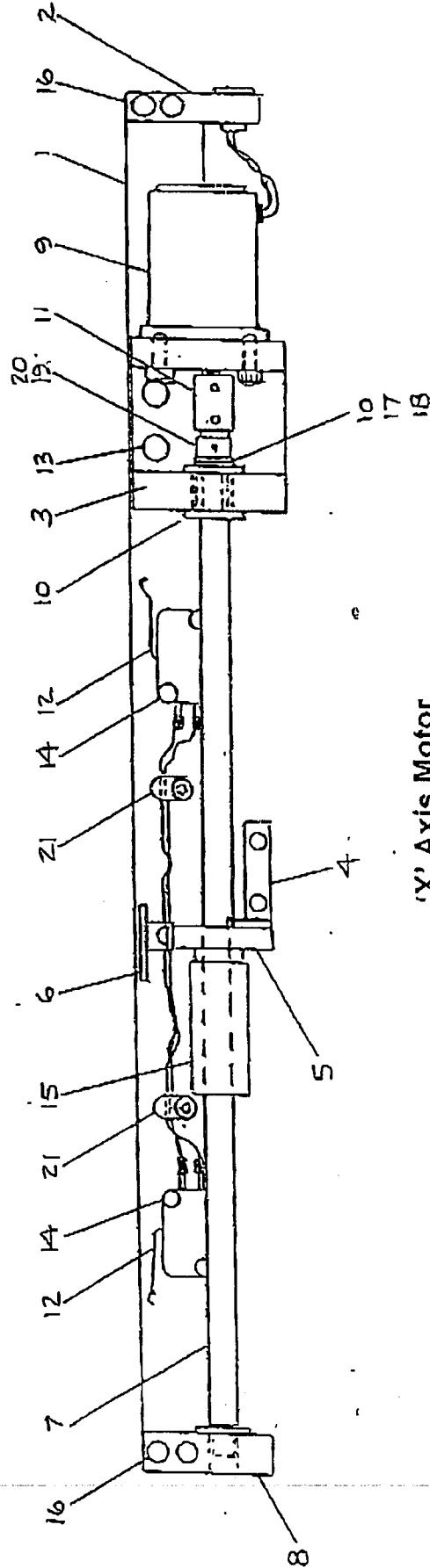
| | | | |
|------|------|---------|------------------------------|
| 4 | 31 | 48 8111 | SCREW, BHCS 8-32 X 1/4 LG. |
| 2 | 30 | 48 7352 | CABLE CLAMP |
| 2 | 28 | 48 7352 | SCREW, SHCS 8-32 X 3/8 LG. |
| 1 | 27 | 48 5810 | SET SCREW 4-40 X 1/8 LG. |
| 1 | 26 | 22 2761 | COLLAR, SPINDLE |
| 1 | 25 | 48 6630 | WASHER |
| 1 | 24 | 48 6000 | WASHER |
| 4 | 16 | 48 6665 | SCREW, SHCS 8-32 X 1 1/4 LG. |
| 1 | 15 | 48 7655 | ANTI-BACKLASH NUT |
| 8 | 14 | 48 5820 | SCREW, BHCS 4-40 X 1/2 LG. |
| 2 | 13 | 48 5126 | SCREW, BHCS 8-32 X 1/2 LG. |
| 2 | 12 | 48 8044 | LIMIT SWITCH |
| QTY. | 1108 | 748 DR. | DESCRIPTION |



'Y' Axis Motor Drive Assembly

| QTY. | UNIT | PART NO. | DESCRIPTION |
|-------------------|------|------------|---------------------------|
| 3 | 10 | 48 7928 | BEARING |
| 1 | 9 | 48 8013 | STEPPING MOTOR PX215-01AA |
| 1 | 8 | 22 3881-10 | BEARING MOUNT |
| 1 | 7 | 22 3881-09 | "X" AXIS LEAD SCREW |
| 1 | 6 | 22 3881-08 | STOP, LIMIT SWITCH |
| 1 | 5 | 22 3881-07 | WUT PLATE |
| 1 | 4 | 22 3881-04 | NUT MOUNT BAR |
| 1 | 3 | 22 3881-03 | BEARING & MOTOR MOUNT |
| 1 | 2 | 22 3881-02 | SOCKET MOUNT |
| 1 | 1 | 22 3881-01 | "X" AXIS MOUNT BAR |
| LIST OF MATERIALS | | | |

| QTY. | UNIT | PART NO. | DESCRIPTION |
|-------------------|------|----------|------------------------------|
| 3 | 21 | 48 7352 | CABLE CLAMP |
| 1 | 20 | 48 5813 | SET SCREW 4-40 X 1/8 LG. |
| 1 | 19 | 22 2761 | COLLAR, SPIRAL |
| 1 | 18 | 48 6630 | WASHER |
| 1 | 17 | 48 6000 | WASHER |
| 4 | 16 | 48 8885 | SCREW, BHCS 8-32 X 1 1/4 LG. |
| 1 | 15 | 48 7855 | ANTI-BACKLASH NUT |
| 8 | 14 | 48 5823 | SCREW, BHCS 4-40 X 1/2 LG. |
| 2 | 13 | 48 5126 | SCREW, BHCS 8-32 X 1/2 LG. |
| 2 | 12 | 48 8044 | LIMIT SWITCH |
| 1 | 11 | 48 8077 | COUPLING |
| LIST OF MATERIALS | | | |



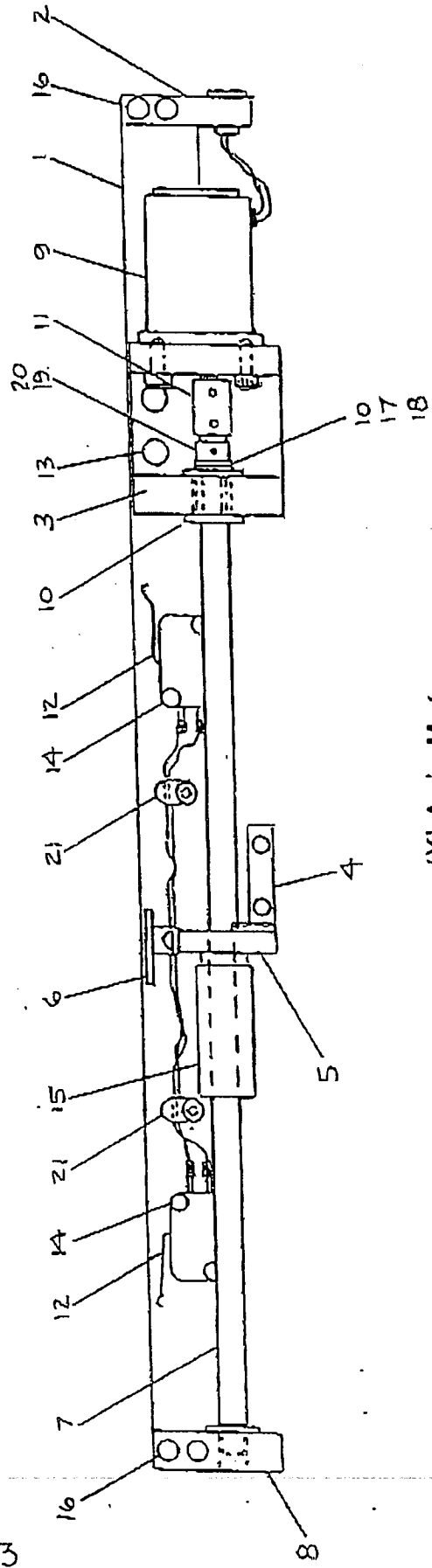
'X' Axis Motor
Drive Assembly (8")

| QTY. | UNIT | PART NO. | DESCRIPTION |
|------|------|------------|---------------------------|
| 3 | 10 | 48 7928 | BEARING |
| 1 | 9 | 18 8043 | STEPPING MOTOR PX245-011A |
| 1 | 8 | 22 3881-10 | BEARING MOUNT |
| 1 | 7 | 22 3882-09 | "X" AXIS LEAD SCREW |
| 1 | 6 | 22 3882-03 | STOP, LIMIT SWITCH |
| 1 | 5 | 22 3881-07 | NUT PLATE |
| 1 | 4 | 22 3881-04 | NUT MOUNT BAR |
| 1 | 3 | 22 3881-03 | BEARING & MOTOR MOUNT |
| 1 | 2 | 22 3881-02 | SOCKET MOUNT |
| 1 | 1 | 22 3882-07 | "Y" AXIS MOUNT BAR |
| QTY. | UNIT | PART NO. | DESCRIPTION |

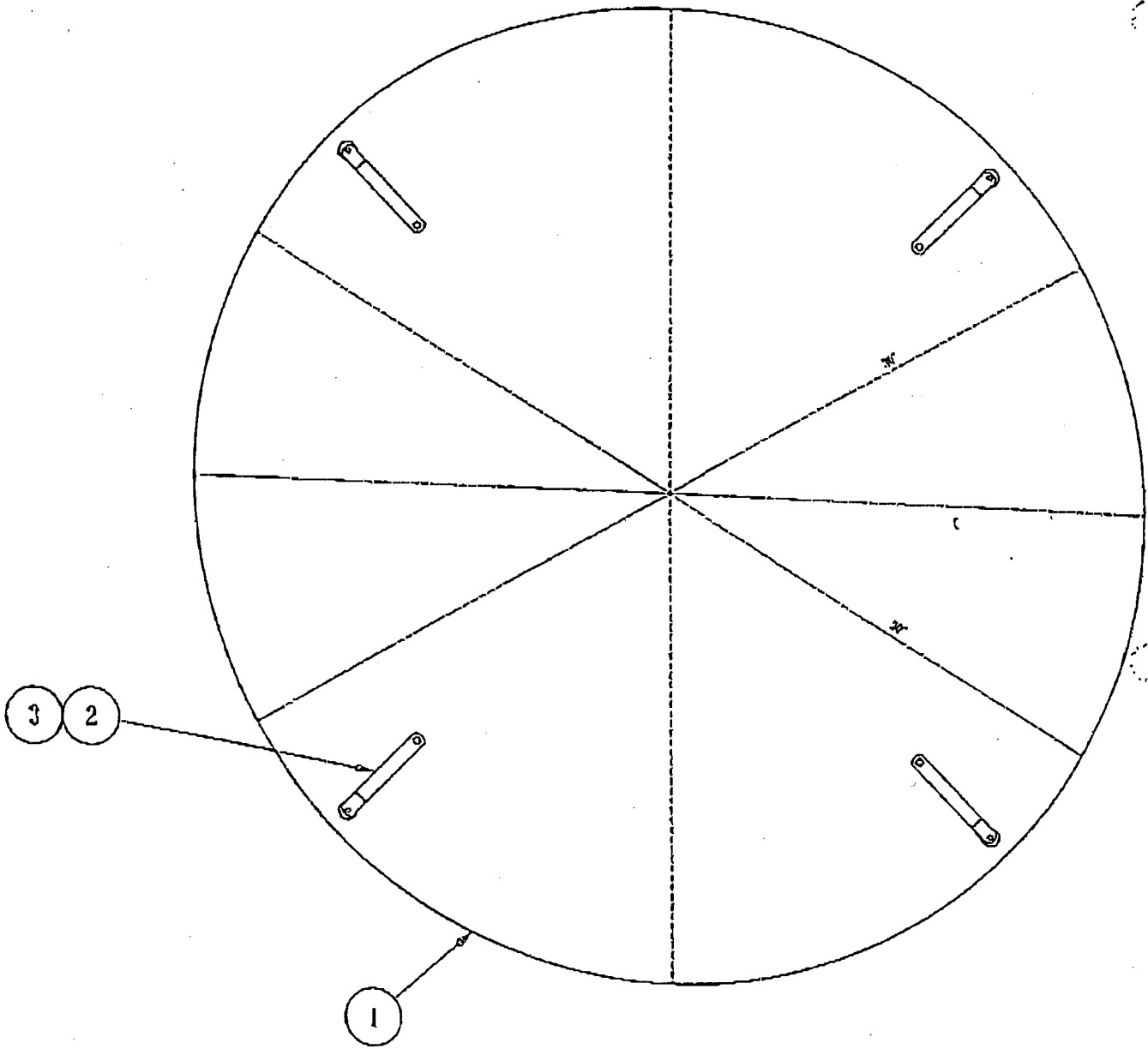
| QTY. | UNIT | PART NO. | DESCRIPTION |
|------|------|----------|------------------------------|
| 3 | 21 | 48 7352 | CABLE CLAMP |
| 1 | 20 | 48 5813 | SET SCREW 1-40 X 1/8 LG. |
| 1 | 19 | 22 2761 | COLLAR, SPINDLE |
| 1 | 18 | 48 6630 | WASHER |
| 1 | 17 | 48 6000 | WASHER |
| 4 | 18 | 48 6665 | SCREW, SHCS 8-32 X 1 1/4 LG. |
| 1 | 16 | 48 7665 | ANTI-BACKLASH NUT |
| 8 | 14 | 48 5623 | SCREW, SHCS 1-40 X 1/2 LG. |
| 2 | 13 | 48 5126 | SCREW, SHCS 8-32 X 1/2 LG. |
| 2 | 12 | 48 8044 | LIMIT SWITCH |
| 1 | 11 | 48 8077 | COUPLING |
| QTY. | UNIT | PART NO. | DESCRIPTION |

LIST OF MATERIALS

33

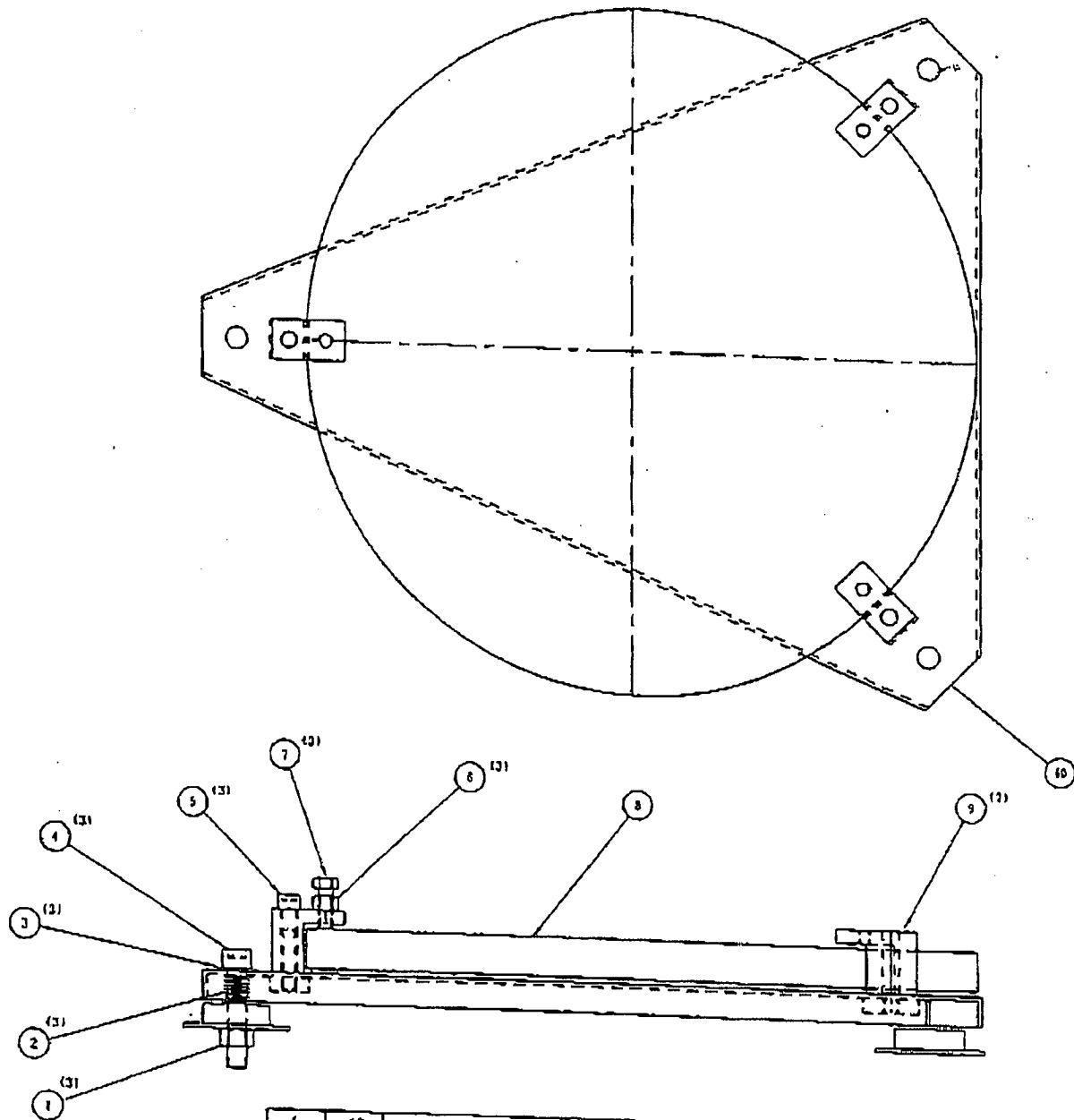


'X' Axis Motor Drive Assembly (12")



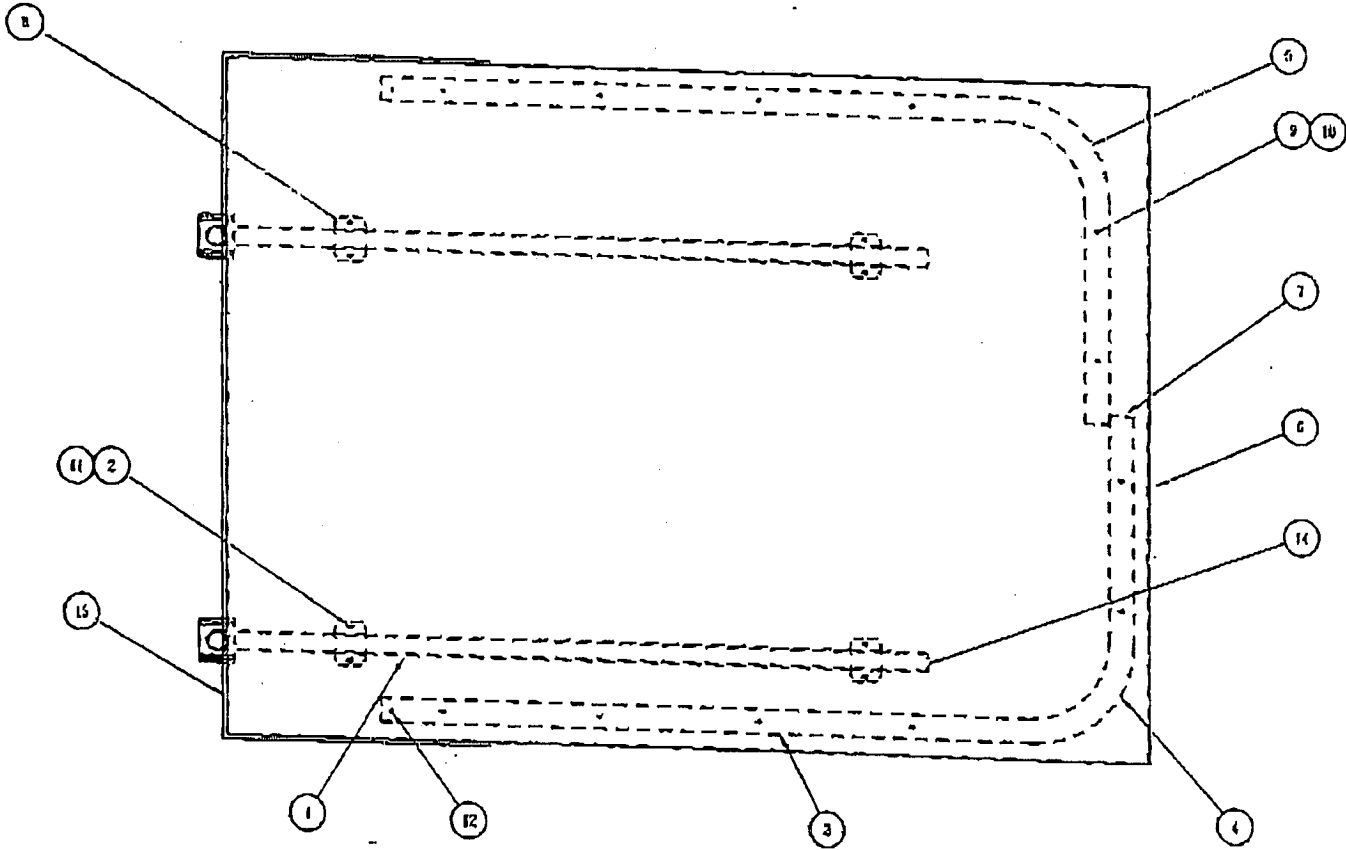
| | | | |
|------|------|--------------|---------------------------|
| 4 | 3 | 48 8149 | REPLACEMENT RUBBER BUMPER |
| 4 | 2 | 22 4111-00 | SCREEN CLIP ASSY. |
| 1 | 1 | 74 0432-2425 | 24" CLASS SCREEN |
| QTY. | ITEM | PART NO. | DESCRIPTION |

Glass Screen Assembly

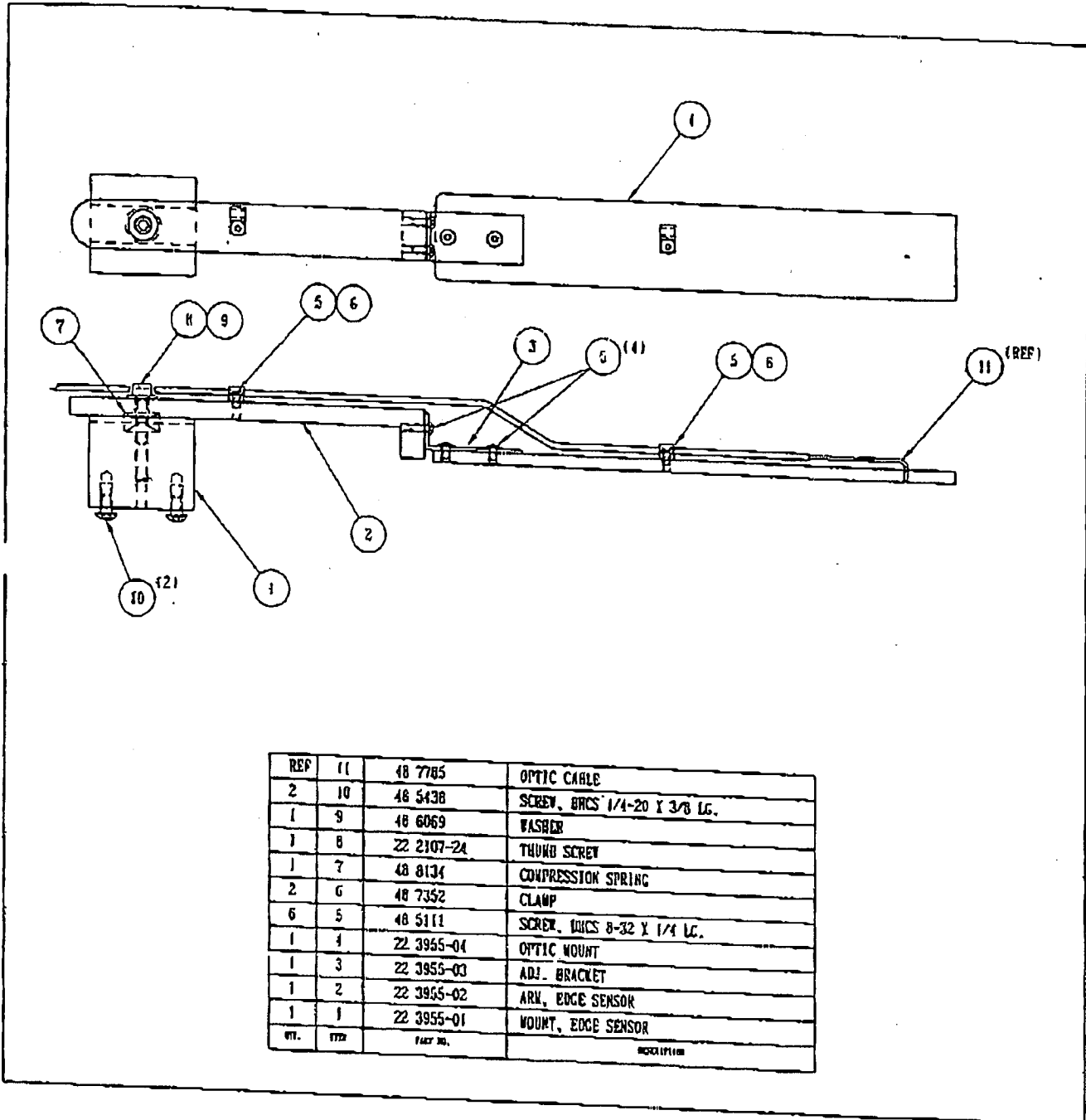


| QTY. | ITEM | PART NO. | DESCRIPTION |
|------|------|--------------|---------------------------------------|
| 1 | 10 | 22 3945-01 | MIRROR PLATEN |
| 3 | 9 | 22 3945-03 | MIRROR CLAMP |
| 1 | 8 | 22 0470 | MIRROR |
| 3 | 7 | 48 7941 | BOLT, HEX HD. NYLON 3/8-16 X 1.00 LG. |
| 3 | 6 | 48 5528 | HEX NUT 3/8-16 |
| 3 | 5 | 48 6221 | SCREW, SHCS 3/8-10 X 2.00 LG. |
| 3 | 4 | 48 8112 | SCREW, SHCS 1/2-20 X 2 1/2 LG. |
| 3 | 3 | 40 6035 | WASHER |
| 3 | 2 | 22 0474-0088 | COMP. SPRING |
| 3 | 1 | 48 5035 | HEX NUT 1/2-20 |

Mirror Mount Assembly



| | | | |
|------|-----|--------------|--------------------------------|
| 1 | 15 | 22 3954-01 | BACK CURTAIN |
| 2 | 14 | 48 7019-12 | ROLE PLUG |
| REF | 13 | 48 7768 | S-T LABEL |
| 50 | 12 | 48 5969 | CARRIERS |
| 8 | 11 | 48 6072 | HEX NUT 1/4-20 |
| 12 | 10 | 48 5605 | HEX NUT 6-32 |
| 12 | 9 | 48 5137 | SCREW, BHCS 6-32 X 1/4 LG. |
| 8 | 8 | 48 8120 | STAUFF CLAMP |
| 4 | 7 | 48 5968 | END CAPS |
| 1 | 6 | 22 3939-15 | CANOPY TOP |
| 1 | 5 | 22 0452-0088 | RIGHT HAND TRACK |
| 1 | 4 | 22 0453-0008 | 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 3939-17 | CANOPY POST |
| QTY. | TRK | PART NO. | DESCRIPTION |



| | | | |
|-----|------|------------|------------------------------|
| REF | 11 | 48 7785 | OPTIC CABLE |
| 2 | 10 | 48 5438 | SCREW, BRCS 1/4-20 X 3/8 LG. |
| 1 | 9 | 48 6069 | WASHER |
| 1 | 8 | 22 2107-24 | THUMB SCREW |
| 1 | 7 | 48 8134 | COMPRESSION SPRING |
| 2 | 6 | 48 7352 | CLAMP |
| 6 | 5 | 48 5111 | SCREW, UNCS 8-32 X 1/4 LG. |
| 1 | 4 | 22 3955-04 | OPTIC MOUNT |
| 1 | 3 | 22 3955-03 | ADJ. BRACKET |
| 1 | 2 | 22 3955-02 | ARM, EDGE SENSOR |
| 1 | 1 | 22 3955-01 | MOUNT, EDGE SENSOR |
| WT. | 1772 | FACT NO. | NO. OF PARTS |

NOTES

Lined area for notes, consisting of approximately 25 horizontal lines.