SUSS MJB 3 CONDENSED INSTRUCTIONS

Machine Start Up	Switch on compressed air, nitrogen, vacuum and check pressure at the manumeter box and the flow meter. Machine is switched off! → Ingite the exposure lamp. Switch on the machine. [POWER][1]
Set Up Procedure	Open maskholder clamping and pull out the maskholder. Put mask on the maskholder (bottom side). Depress [VACUUM MASK] and check mask clamping. Insert the maskholder and clamp it. Pull the transport slide to the right out of the alignment stage.
Loading The Substrate	Put the substrate (against the pins)[2] on the exposure chuck. Clamp the substrate (button at the transport slide[2]) and push the tranport slide back into the alignment stage.
Wedge Error Compensation	Load substrate. Move separation lever in contact position. Move contact lever to contact position. → [CONTACT][1]
Program Changes	**Program:** **Aktivated Keys:** Hardcontact [ST][1] Softcontact: [ST][1] + [Soft Contact][1] Vacuumcontact [HP] **Attention: Use proper exposure chucks!** **Negative Resist:** PURGE open (manometer box)[3] **Positive Resist:** PURGE close (Manometerbox).

---

[1]Button is illmitated

[2]Cannot be used with vacuum chucks

[3]Cooling IR-lamp if used with IR-machine

Exposure Without Alignment

Load mask and substrate.

Perform wedge error compensation: CONTACT [1]

Select exposure program, exposure time and timer or integrater mode.

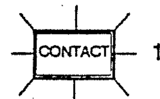
Press Exposure [1]. Substrate is exposed automatically.

Move contact lever to home position: CONTACT [4] + Separation [4]

Pull out the transport slide and change substrate.

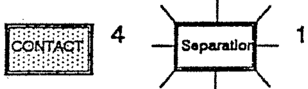
Exposure With Alignment

Load mask and substrate.

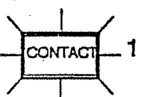
Perform wedge error compensation: 

[1]

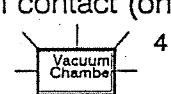
Select exposure program, exposure time and timer or integrater mode.

Move separation lever to separation positon: 

Use X-, Y- und Θ-micrometers to align the substrate to the mask.

Move separation lever to contact positon: 

[4]

For checking alignment in vacuum contact (only vacuum contact program) press: 

[4]

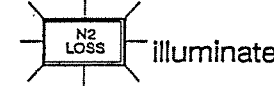
After satisfactory alignment press:

[4]
The substrate will be exposed.

Move contact lever to home position: CONTACT [4] Separation [4]

Pull out the transport slide and change the substrate.

Alarm

If you hear the alarm and 

illuminates, check nitrogen pressure at the manometer box and the flow at the flow meter.

If nitrogen pressure cannot be restored immediately, switch off the exposure lamp power supply to avoid risk of lamp explosion!

(**SUSS CIC 500** and **SUSS CIC 1000** are equipped with an interlock and will switch off the lamp automatically.)

[4] Illumination in the button is switched off.

SUSS MJB 3 CONDENSED INSTRUCTIONS

Machine Start Up	Switch on compressed air, nitrogen, vacuum and check pressure at the manumeter box and the flow meter. Machine is switched off! → Ingite the exposure lamp. Switch on the machine. [POWER][1]
Set Up Procedure	Open maskholder clamping and pull out the maskholder. Put mask on the maskholder (bottom side). Depress [VACUUM MASK] and check mask clamping. Insert the maskholder and clamp it. Pull the transport slide to the right out of the alignment stage.
Loading The Substrate	Put the substrate (against the pins)[2] on the exposure chuck. Clamp the substrate (button at the transport slide[2]) and push the tranport slide back into the alignment stage.
Wedge Error Compensation	Load substrate. Move separation lever in contact position. Move contact lever to contact position. → [CONTACT][1]

Program Changes

Program:	Aktivated Keys:
Hardcontact	[ST][1]
Softcontact:	[ST][1] + [Soft Contact][1]
Vacuumcontact	[HP]

Attention: Use proper exposure chucks!

Negative Resist:	PURGE	open (manometer box)[3]
Positive Resist:	PURGE	close (Manometerbox).

---

[1]Button is Illmitated

[2]Cannot be used with vacuum chucks

[3]Cooling IR-lamp if used with IR-machine

Exposure Without Alignment

Load mask and substrate.

Perform wedge error compensation:

Select exposure program, exposure time and timer or integrater mode.

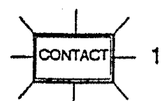
Press Exposure [1]. Substrate is exposed automatically.

Move contact lever to home position: CONTACT [4] + Separation [4]

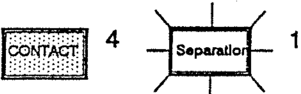
Pull out the transport slide and change substrate.

Exposure With Alignment

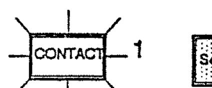
Load mask and substrate.

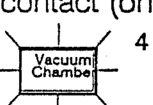
Perform wedge error compensation: 

Select exposure program, exposure time and timer or integrater mode.

Move separation lever to separation positon: 

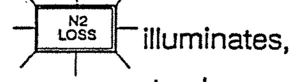
Use X-, Y- und Θ-micrometers to align the substrate to the mask.

Move separation lever to contact positon: 

For checking alignment in vacuum contact (only vacuum contact program) press: 

After satisfactory alignment press:

The substrate will be exposed.

Move contact lever to home position: 

Pull out the transport slide and change the substrate.

Alarm

If you hear the alarm and N2 LOSS illuminates,

check nitrogen pressure at the manometer box and the flow at the flow meter.

If nitrogen pressure cannot be restored immediately, switch off the exposure lamp power supply to avoid risk of lamp explosion!

(**SUSS CIC 500** and **SUSS CIC 1000** are equipped with an interlock and will switch off the lamp automatically.)

[4] Illumination in the button is switched off.

SUSS MJB 3

MASK ALIGNER

Operator's Reference Manual

1. GENERAL DESCRIPTION AND PRINCIPLES OF OPERATION
2. OPERATING PROCEDURES
3. WARNINGS AND SAFETY HAZARDS
4. QUALITY STANDARDS
5. MAINTENANCE
6. INSTALLATION
7. WARRANTY AND LIMITATIONS
8. APPENDIX

This Operator's Reference Manual is subject to review and/or revision.

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TABLE OF CONTENTS

SECTION		PAGE
1	**GENERAL DESCRIPTION AND PRINCIPLES OF OPERATION**	
1.1	The MJB 3 Series	1 - 1
1.1.1	MJB 3 Standard	1 - 1
1.1.2	MJB 3 HP/200W	1 - 1
1.1.3	MJB 3 HP/350W	1 - 2
1.2	Exposure Optics	1 - 2
1.3	Exposure Programs	1 - 2
1.4	A Brief Orientation	1 - 5
1.5	The Subassemblies of the MJB 3	1 - 6
1.5.1	Alignment Stage	1 - 6
1.5.2	Machine Base	1 - 6
1.5.3	Front Control Panel	1 - 6
1.5.4	Manometer Box	1 - 6
1.5.5	Microscope	1 - 6
1.5.6	Lamphouse and Mirrorhouse	1 - 8
1.6	Special Features	1 - 8
1.6.1	VACUUM CHAMBER Button	1 - 8
1.6.2	Vacuum Chamber Adjustment	1 - 8
1.6.3	Airing	1 - 9
1.6.4	Variable Thickness Adjustment	1 - 9
1.6.5	Nitrogen Loss Detector	1 - 9
1.6.6	Infrared Viewing System for Backside Alignment (Optional)	1 - 9
2	**OPERATING PROCEDURES**	
2.1	Machine Controls	2 - 1
2.1.1	Control Panel	2 - 1
2.1.2	Alignment Stage	2 - 5
2.1.3	Microscope Manipulator	2 - 6
2.1.4	Microscope	2 - 6
2.1.5	Manometer Box	2 - 7
2.2	Start Up Procedure	2 - 8
2.2.1	Pre-Operation Check List	2 - 8
2.2.2	Power Up	2 - 8
2.2.3	Exposure Lamp Ignition	2 - 8
2.3	Operation	2 - 8
2.3.1	Loading the Mask	2 - 8
2.3.2	Loading the Substrate	2 - 9
2.3.3	Aligning the Substrate to the Mask	2 - 9
2.3.4	Exposure	2-10
2.3.5	Unloading the Substrate	2-10

2.4 Exposure Mode Options 2-11
2.4.1 Vacuum Contact (High Precision) Mode 2-11
2.4.2 Standard (ST) Mode 2-11
2.4.2.1 Hard Contact 2-11
2.4.2.2 Soft Contact 2-12
2.4.2.3 Proximity Mode (Optional) 2-12
2.5 Adjustment Procedures 2-12
2.5.1 Vacuum Chamber Adjustment Procedure 2-12
2.5.2 Airing Feature Adjustment Procedure 2-13
2.5.3 Setting the Variable Thickness Adjustment 2-13

3 WARNINGS AND SAFETY HAZARDS

3.1 Electrical Precautions 3 - 1
3.2 High Pressure Lamps 3 - 1
3.2.1 Electrical Hazards 3 - 2
3.2.2 Lamp Explosion 3 - 2
3.2.3 Exhaust Requirements 3 - 2
3.2.4 Eye and Skin Safety 3 - 3
3.3 Broken Wafers 3 - 3
3.4 Moving Parts 3 - 3

4 QUALITY STANDARDS

4.1 Environment 4 - 1
4.2 Machine Checks and Adjustments 4 - 2
4.2.1 Light Intensity 4 - 2
4.2.2 Light Uniformity 4 - 2
4.2.3 Chucks and Maskholders 4 - 2

5 MAINTENANCE

5.1 General Maintenance 5 - 1
5.2 Replacement and Adjustment of Exposure Lamp: Standard and HP Models Only 5 - 1
5.2.1 Lamp Replacement: Standard and HP Models Only 5 - 2
5.2.2 Intensity and Uniformity Adjustments and Measurements: Standard and HP Models Only with 200W Lamphouse 5 - 3
5.2.2.1 Adjusting the Exposure Lamp 5 - 3
5.2.2.2 Intensity and Uniformity Measurements 5 - 4
5.2.3 Power Supply Calibration: Standard and HP Models Only 5 - 5
5.3 Replacement and Adjustment of Exposure Lamp in the 350W Lamphouse: Includes UV400, UV300, UV250, and UV200 Exposure Optics Only 5 - 5
5.3.1 Lamp Replacement: UV400, UV300, UV250, and UV200 5 - 6
5.3.2 Lamphouse Reassembly and Pneumatic Adjustments: UV400, UV300, UV250, and UV200 Exposure Optics Only 5 - 7

5.3.3 Intensity and Uniformity Adjustments and Measurements: UV400, UV300, UV250, and UV200 Exposure Optics Only 5 - 7
5.3.3.1 Adjusting the Exposure Lamp 5 - 8
5.3.3.2 Intensity and Uniformity Measurements 5 - 9
5.3.4 Power Supply Calibration: UV400, UV300, UV250, and UV200 Exposure Optics Only 5 - 9
5.4 Exposure Optical System: UV400, UV300, UV250, and UV200 Exposure Optics 5-10
5.4.1 Optical System Components 5-10
5.4.2 Optical Components by Model 5-11
5.4.2.1 UV400 Optical Components 5-11
5.4.2.2 UV300 Optical Components 5-12
5.4.2.3 UV250 Optical Components 5-12
5.4.2.4 UV200 Optical Components 5-12
5.4.3 Changing from One Wavelength Range to Another 5-13
5.5 Setting Contact Pressure and Separation Stroke Using Dial Indicator Kit 5-16

6 INSTALLATION

6.1 General 6 - 1
6.2 Receiving the Shipment 6 - 1
6.3 Installing the Equipment 6 - 1
6.4 Clearance Required for Crate 6 - 2
6.5 Environmental Requirements 6 - 2
6.6 Power Requirements 6 - 2
6.6.1 U.S. Market 6 - 2
6.6.2 International Market 6 - 2
6.7 Other Utility Requirements 6 - 3

7 WARRANTY AND LIMITATIONS

7.1 Scope 7 - 1
7.2 Exposure Lamp Explosions 7 - 2
7.3 Who Is Protected 7 - 2
7.4 How To Receive Warranty Service 7 - 2

8 APPENDIX

8.1 Discussion of Manual Alignment 8 - 1
8.2 Microscope Descriptions 8 - 2
8.2.1 SUSS Normalfield Microscope M400 8 - 2
8.2.1.1 Microscope Head and Eyepieces 8 - 2
8.2.1.2 Microscope Body 8 - 2
8.2.1.3 Objective Turret 8 - 2
8.2.1.4 Illuminator 8 - 3
8.2.1.5 Darkfield Illumination (if equipped) 8 - 3
8.2.1.6 Interference Contrast Illumination (if equipped) 8 - 3
8.2.1.7 Objectives 8 - 4

8.2.2 SUSS Splitfield Revolver Microscope: M200 - 200 Series 8 - 4
8.2.2.1 Microscope Head and Eyepieces 8 - 4
8.2.2.2 Microscope Body 8 - 4
8.2.2.3 Illuminators 8 - 5
8.2.2.4 Darkfield Illumination (if equipped) 8 - 5
8.2.2.5 Interference Contrast Illumination (if equipped) 8 - 5
8.2.2.6 Objectives 8 - 6
8.2.3 SUSS Splitfield Turret Microscope: M230 - 200 Series 8 - 6
8.2.3.1 Microscope Head and Eyepieces 8 - 6
8.2.3.2 Microscope Body 8 - 6
8.2.3.3 Objective Turrets 8 - 7
8.2.3.4 Illuminators 8 - 7
8.2.3.5 Objectives 8 - 7
8.3 Scanning Infrared Viewing System for Backside Alignment (optional) 8 - 7
8.3.1 Alignment Stage 8 - 8
8.3.2 Microscope Manipulator 8 - 9
8.3.3 Electronics Control 8 - 9
8.3.4 IR Mode Operation 8-10
8.3.5 Non-IR Operation 8-11

LIST OF FIGURES AND ILLUSTRATIONS

FIGURE		PAGE
1-1	SUSS MJB 3 Standard With Splitfield Microscope	1 - 3
1-2	SUSS MJB 3 HP/200W With Normalfield Microscope	1 - 4
1-3	SUSS MJB 3 Machine Subassemblies	1 - 7
2-1	Front Control Panel	2 - 3
2-2	Alignment Stage	2 - 4
5-1	Lamphouse (Standard and HP/200W)	5 - 17
5-2	Lamphouse (Standard and HP/200W) Showing Adjustments	5 - 18
5-3	Exposure Optical System (Standard and HP)	5 - 19
5-4	Lamphouse (350W)	5 - 20
5-5	Exposure Optical System (UV400/300/250/200)	5 - 21
5-6	Dial Indicator Assembled on Machine	5 - 22
5-7	Separation Stroke Adjustments	5 - 23
6-1	Checklist for Machine Installation (U.S. Market)	6 - 4
6-2	SUSS MJB 3 Footprint	6 - 5
8-1	Normalfield Microscope M400	8 - 12
8-2	Magnification and Optical Data, SUSS M400 Microscope	8 - 13
8-3	Splitfield Microscope M200	8 - 14
8-4	Magnification and Optical Data, SUSS M200 Microscope	8 - 15
8-5	Magnification and Optical Data, SUSS M204 Microscope	8 - 16
8-6	Splitfield Revolver Microscope M230	8 - 17
8-7	Magnification and Optical Data, SUSS M230 Splitfield Microscope	8 - 18
8-8	SUSS MJB 3 Scanning IR System	8 - 19

1 GENERAL DESCRIPTION AND PRINCIPLES OF OPERATION

The SUSS MJB 3 Mask Aligner is designed for high resolution photolithography in a laboratory, development or pilot production environment. The product line offers unsurpassed flexibility in the handling of irregularly shaped substrates and pieces of differing thicknesses, as well as standard size wafers up to 3" in diameter.

With the modular construction, the equipment lends itself to ease of service; functional groups are easily accessible and assemblies can be quickly modified or exchanged.

Various configurations can be ordered which are characterized by different light sources and alignment modes.

1.1 The MJB 3 Series

1.1.1 MJB 3 Standard

The MJB 3 Standard (Figure 1-1) is equipped with a 200W lamphouse containing a relatively simple but comparatively high resolution optical system. A 200W mercury short-arc lamp is used. Primary exposure wavelengths are 350-500nm (nanometers). The aligner performs exposures in hard contact mode (nitrogen pressure under the substrate) and soft contact mode (vacuum under the substrate). As an option, this model can also be equipped to perform proximity exposures. Line/space resolution of 1.5 microns and alignment accuracies of 0.2 micron can be obtained under optimum conditions.

1.1.2 MJB 3 HP/200W

The MJB 3 HP/200W (Figure 1-2) is equipped with the same optical system as the MJB 3 Standard, and can perform exposures in vacuum contact in addition to hard contact and soft contact, or in proximity (which is an option). It is equipped with a high precision alignment stage which allows alignment accuracies to 0.1 micron. Resolution of the MJB 3 HP/200W is 0.8 micron under optimum conditions.

1.1.3 MJB 3 HP/350W

The MJB 3 HP/350W has all the same features as the 200W version described in Section 1.1.2 except that it is equipped with a 350W lamphouse and diffraction reducing optics.

1.2 Exposure Optics

The exposure optics are divided into several wavelength regions:

UV 400 - The lamphouse is equipped with a 350W mercury high pressure lamp and diffraction optics. Usable wavelengths fall between 350 and 450nm. A resolution of 0.6 micron can be obtained under optimum conditions.

UV 300 - Using the same lamphouse as the UV 400 system and the 350W exposure lamp, the UV 300 is distinguished by optical filtering and a modified diffraction reducing lens plate. Usable wavelengths fall between 280 and 350 nm. A resolution of 0.4 micron can be obtained under optimum conditions.

UV 250 - The UV 250 system uses a 500W mercury xenon high pressure lamp as the light source. The diffraction reducing scheme is similar to that used in UV 400 and UV 300 systems but is optimized for wavelengths between 230 and 260 nm. A resolution of 0.3 micron can be obtained under optimum conditions.

UV 200 - A 350W cadmium xenon high pressure lamp functions as the light source in the UV 200 system. Diffraction reducing is very much like that used in the UV 250 but is optimized for wavelengths between 210 and 230nm. The highest resolution with considerable shorter exposure times, is obtained with an excimer laser as the light source. The laser source delivers 193 nm (ArF) or 248 nm (KrF) monochromatic light. A resolution of 0.2 micron can be obtained under optimum conditions.

1.3 Exposure Programs

The MJB 3 offers three exposure programs which can be selected with the HP (High Precision), ST (standard), and SOFT CONT. (soft contact) buttons. These buttons determine the sequence of events after the EXPOSURE button is pushed.

Vacuum Contact (HP) Mode - In the HP program, a vacuum is drawn between the mask and wafer prior to exposure. This mode allows the highest resolution since the gap between mask and wafer as a result of non-flatness, dust particles, etc. is minimized. Chucks equipped with vacuum gaskets must be used in this mode in order to obtain a vacuum between the substrate and the mask.

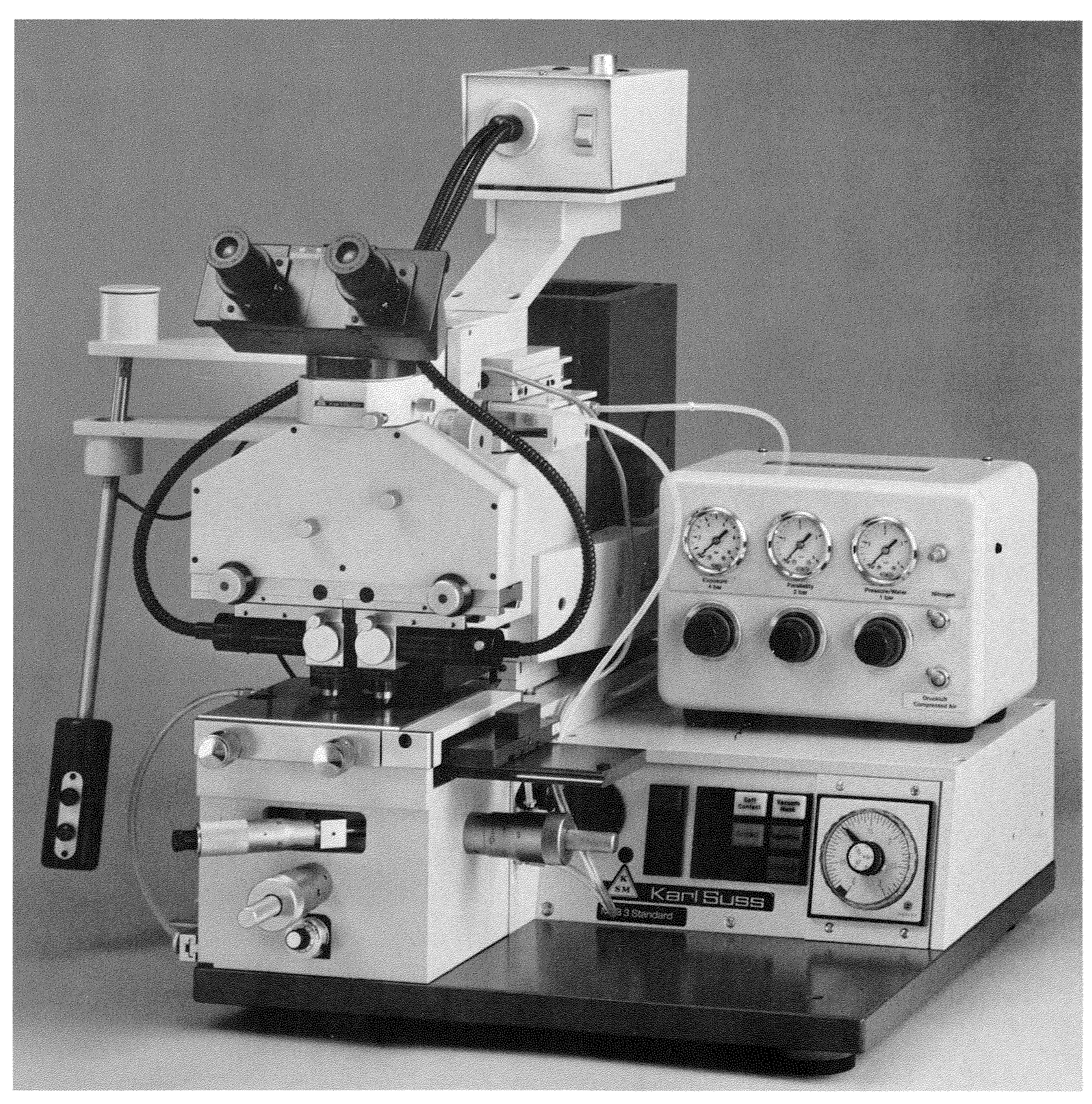


Figure 1 - 1 SUSS MJB 3 Standard with Splitfield Microscope

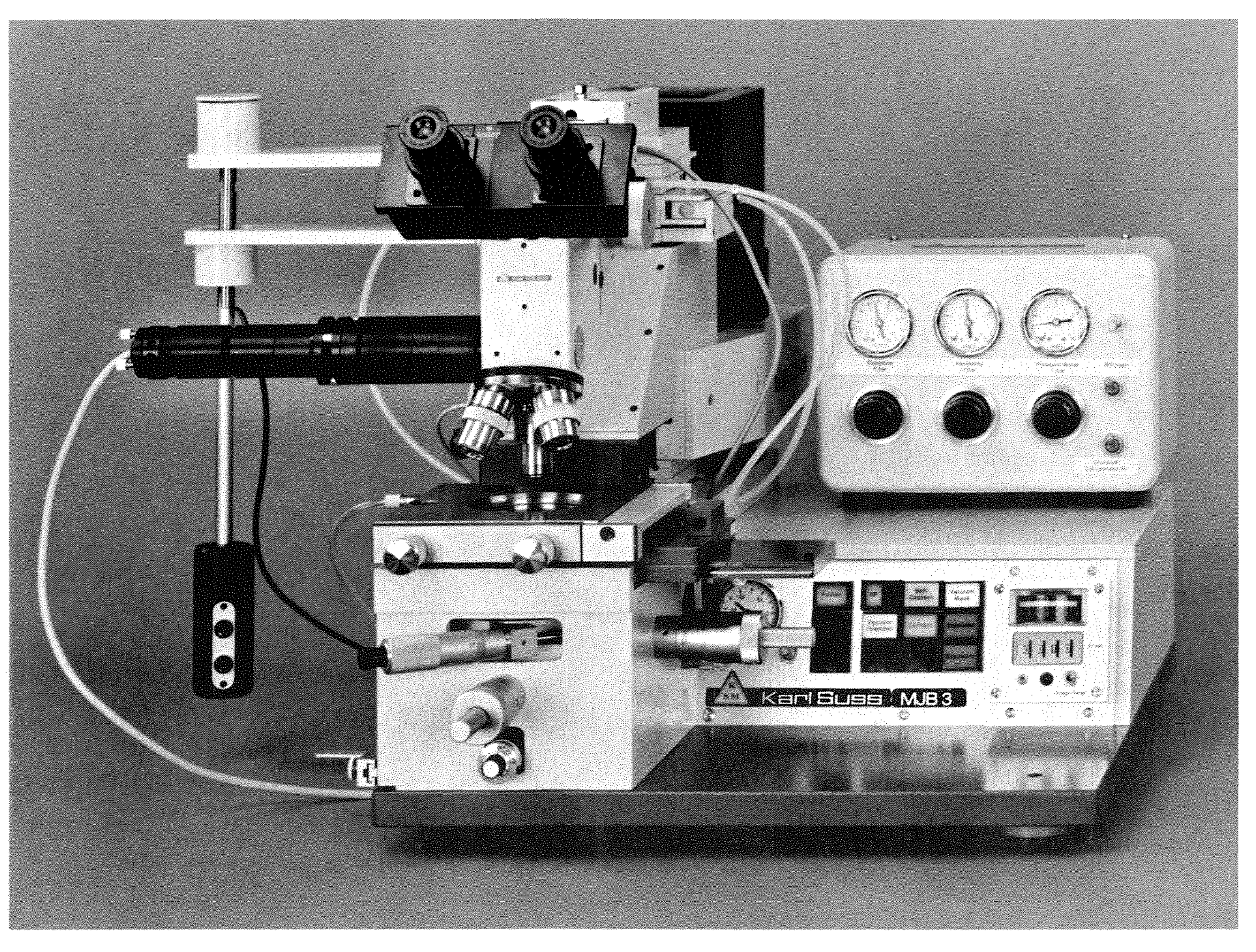


Figure 1 - 2 SUSS MJB 3 HP/200W with Normalfield Microscope

Standard (ST) Hard Contact Mode - During exposure, the vacuum holding the substrate to the chuck is switched off and positive nitrogen pressure is used to press the substrate against the mask.

Soft Contact Mode - When the ST and SOFT CONT. buttons are illuminated simultaneously, the soft contact mode is selected and the substrate is held to the mask just by the mechanical pressure of the chuck throughout the exposure. The vacuum holding the substrate to the chuck remains on.

Proximity (Optional) - If the machine is equipped with a button marked PROXIMITY, and the ST mode is selected, exposures may be made with a small gap between the mask and substrate. This proximity gap is determined by the position of the separation lever.

1.4 A Brief Orientation

The operation of the MJB 3 is straightforward and easy to learn. First, load a mask into the machine. Then place the substrate on the chuck and insert the chuck into the alignment stage.

At this point bring the substrate into contact with the mask by turning the contact lever counterclockwise. The CONTACT light on the front panel illuminates. This operation also accomplishes wedge error (parallelity) compensation (WEC) using a unique 3-point leveling approach.

By pulling the separation level towards the front of the machine, the operator obtains sufficient separation for alignment, and the CONTACT light will go out as the SEPARATION light illuminates. The substrate can now be aligned to the mask using the X, Y, and Theta micrometers. The operator can easily scan the microscope over the substrate in either the X or Y direction, or both simultaneously, by using the precision microscope manipulator.

When satisfactory alignment has been achieved, move the substrate back into contact with the mask by pushing the separation lever all the way to its rearmost position until the SEPARATION light goes out and the CONTACT light re-illuminates. The substrate is now ready for exposure.

To initiate exposure, set the exposure time on the timer and press the EXPOSURE button. In most models, the microscope will then elevate a sufficient distance to allow the objective to clear the maskholder (this lifting is not necessary in all cases). The mirrorhouse now moves forward over the mask. When the mirrorhouse reaches its foremost position, the shutter opens and exposure takes place for the specified amount of time. After exposure is complete, the shutter closes, the mirrorhouse retracts, and the microscope moves back down to its original position.

The substrate may now be unloaded. Rotate the contact lever fully towards the front of the machine, releasing the substrate from the mask. Pull the transport slide to the right and carefully remove the substrate from the chuck.

1.5 The Subassemblies of the MJB 3

The MJB 3 is made up of discrete subassemblies (Figure 1-3) as follows:

1.5.1 Alignment Stage

The alignment stage is the heart of the MJB 3, and consists of the pneumatics and mechanics for mask/substrate parallelity compensation and mask and substrate vacuum, maskholder (and maskholder clamping mechanism), Z-axis movement, alignment separation mechanism, X, Y, and Theta alignment micrometers, and variable thickness adjustment.

1.5.2 Machine Base

The base contains the relays, pneumatics, valves, and throttles which control the various machine functions.

1.5.3 Front Control Panel

The front control panel (Figure 2-1) contains the indicators and operating controls, including the CONTACT and SEPARATION indicator light, HP/ST exposure mode selection button (except MJB 3 Standard), SOFT CONTACT exposure mode button, VACUUM MASK button, optional PROXIMITY button, VACUUM CHAMBER button (except MJB 3 Standard) and the exposure timer. A vacuum gauge and throttle for adjusting the vacuum chamber vacuum are located at the left end of the front panel except on the MJB 3 Standard which has no vacuum chamber.

1.5.4 Manometer Box

The manometer box contains the gauges, regulators and throttles for adjustment of compressed air and nitrogen to the machine.

1.5.5 Microscope

The microscope assembly consists of the microscope adapter, microscope manipulator, and the microscope itself. Many microscope options are available, including normalfield, splitfield, and objective revolvers, as well as brightfield, darkfield, and interference contrast illumination.

The microscope manipulator is equipped with pneumatic brakes which are unlocked by pressing the buttons on the manipulator handle. Press just one button to select an X–only or Y–only scan. If both buttons are pressed simultaneously, the microscope can be scanned in any direction.

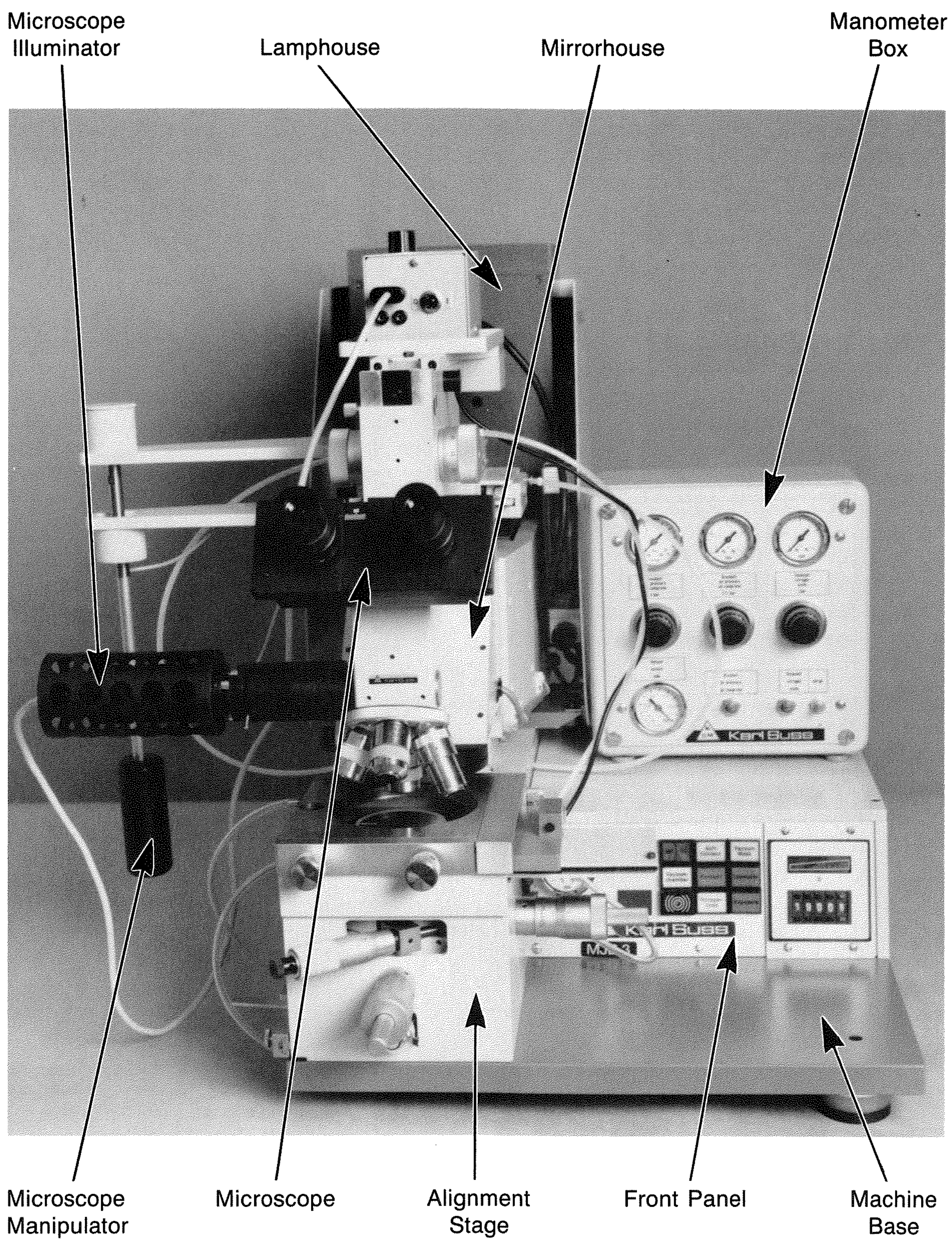


Figure 1 - 3 SUSS MJB 3 Machine Subassemblies

1.5.6 Lamphouse and Mirrorhouse

There are two types of lamphouse assemblies supplied with MJB 3 aligners. The MJB 3 Standard and MJB 3 HP/200W are equipped with a lamphouse containing a 200W mercury vapor exposure lamp, a spherical collecting mirror and a condenser lens assembly. Adjustment knobs for each of the components are located on the back of the lamphouse. After passing through the condenser lens assembly, the exposure light is reflected off a 45° surface mirror at the front of the mirrorhouse onto the mask and substrate.

The MJB 3HP/350W which uses the UV400, UV300, UV250, or UV200 exposure optics is equipped with a lamphouse containing an exposure lamp, an ellipsoidal collecting mirror, and a 45° cold light mirror. The type of exposure lamp (350W or 500W) depends on the optical range which is selected. The cold light mirror reflects the desired short-wavelength ultraviolet light through a fly's eye lens and transmits the longer wavelengths to a heat sink located in the bottom of the lamphouse. Adjustment knobs to move the lamp in X, Y, and Z are located on the front face of the lamphouse. The mirrorhouse and lamphouse contain a condenser lens, a diffraction reducing lens plate, a 45° surface mirror and a collimation lens. An extra frame is provided in the lamphouse tube for a filter (when required). The SUSS diffraction reducing exposure system provides very high resolution over the entire exposure area, resulting in steep resist edges and minimal diffraction effects.

1.6 Special Features

Several special features are incorporated into the MJB 3 to enhance flexibility and ease of operation.

1.6.1 VACUUM CHAMBER Button

All MJB 3 models are equipped with a VACUUM CHAMBER button, except for the MJB 3 Standard (which has no vacuum chamber). With this feature, it is possible to check the alignment prior to exposure with the mask and substrate in vacuum contact. This is particularly useful when using high magnification objectives with restricted depth of focus.

1.6.2 Vacuum Chamber Adjustment

The vacuum chamber is adjustable in all MJB 3 models except the MJB 3 Standard. Under certain circumstances, the operator may wish to expose substrates in vacuum contact mode with less than full vacuum in the vacuum chamber. For this purpose a vacuum gauge and adjustment throttle are provided on the left side of the front control panel. This adjustment does not affect the amount of vacuum under the substrate during alignment. Instructions for setting the vacuum level can be found in Section 2.5.1.

The vacuum gauge can also be used to detect vacuum leaks in the vacuum chamber caused by damaged chucks, vacuum gaskets, etc.

1.6.3 Airing

When using a chuck equipped with a vacuum gasket, a partial vacuum may be unintentionally pulled between the substrate and mask during alignment due to an imperfect seal between the substrate and the chuck; this causes the substrate and mask to stick together and make alignment difficult or impossible. The situation can occur if the back side of the substrate is unusually rough or scratched, or if scratches are present in the chuck surface.

To overcome the problem, a small flow of nitrogen can be introduced into the vacuum chamber whenever the substrate is separated from the mask. Instructions for adjusting the nitrogen flow can be found in Section 2.5.2.

1.6.4 Variable Thickness Adjustment

The MJB 3 is equipped with a device to maintain constant contact pressure when processing substrates of various thicknesses. Alternatively, this device may be used to vary the contact pressure for a given wafer thickness. When the equipment is installed, a reference mask and wafer are used to set the contact pressure between the mask and wafer. This setting may be varied using the thickness adjustment knob located on the front of the stage near the bottom of the machine (Figure 2-2). For a detailed description of how to set the contact pressure, refer to Section 2.5.3.

1.6.5 Nitrogen Loss Detector

In the MJB 3HP/350W, the exposure lamp is cooled by nitrogen. In the event of a nitrogen loss, the monitoring system causes the NITROGEN LOSS button to flash, and an audible alarm to sound. After approximately 3 minutes, the machine will automatically turn off the exposure lamp if the nitrogen supply has not been restored.

1.6.6 Infrared Viewing System for Backside Alignment (optional)

The MJB 3 may be equipped with a video camera, monitor, and special tooling to enable backside alignment and printing. For this application, special chucks are provided. An IR wand with a halogen light source is located below a filter plate to which the substrate is held by vacuum. The video camera is mounted on the alignment microscope using a trinocular microscope head. The image tube employed in the camera depends on the transmission characteristics of the substrate material.

For materials transparent to wavelengths below 1100nm (such as GaAs), a high quality camera having good response both in the short IR and the visible regions is used. For materials which are only transparent at longer IR wavelengths (such as InSb), a lead sulfide infrared tube is available. This tube has good response at the longer wavelengths but somewhat less resolution and more "lag" (persistence of previous image and delay in displaying a new image on the monitor). For the sake of economy, a true infrared tube is used only where absolutely necessary.

An aligner equipped with the infrared viewing system may also be used for conventional alignment by changing the chuck and other small mechanical components. This takes only a few minutes.

A more detailed description about the operation of the infrared viewing system can be found in the Appendix (Chapter 8).

2 OPERATING PROCEDURES

2.1 Machine Controls

All of the machine controls for the SUSS MJB 3 are described below.

2.1.1 Control Panel (Figure 2-1)

a. POWER button - Pressing the POWER button switches on the mask aligner. When the machine is powered or ON, the POWER button is illuminated.

b. CONTACT indicator - The CONTACT indicator is illuminated whenever both the contact lever and the separation lever are in the contact position. The substrate is then in contact with the mask. **Do not perform alignment when the contact indicator is lit.**

c. SEPARATION indicator - This indicator is illuminated when the contact lever is in the contact position and the separation lever is in the separation position. The substrate is then separated from the mask by a small distance to allow alignment to be performed. Exposure is not possible in this condition unless the aligner is equipped with a PROXIMITY button. (See Section 2.4.2.3)

d. EXPOSURE button - Pressing the EXPOSURE button initiates exposure and illuminates the button until exposure has been completed. The exposure time is determined by the setting on the exposure timer.

e. VACUUM MASK button - Pressing the VACUUM MASK button switches on the mask vacuum at the maskholder and illuminates the button.

f. VACUUM CHAMBER button - All MJB 3 machines are equipped with a VACUUM CHAMBER button except for the MJB 3 Standard which does not have a vacuum chamber. In the vacuum contact High Precision (HP) mode, the vacuum between mask and substrate is automatically pulled just before exposure. (Refer to Section 2.4.1 for a description of the HP mode.) However, it is possible to check the alignment with the mask and substrate in vacuum contact prior to making an exposure. This feature is particularly useful when using high magnification objectives with restricted depth of focus. Simply press the VACUUM CHAMBER button after moving the substrate to the contact position using the separation lever (CONTACT indicator illuminated), and the

vacuum will be pulled. The vacuum can be released by moving the separation lever to the separation position. If the EXPOSURE button is pressed while the VACUUM CHAMBER button is illuminated, the vacuum between mask and substrate is still preserved and exposure takes place in normal fashion.

g. HP/ST button - All MJB 3 models except the MJB 3 Standard are equipped with an HP/ST button which is used to select either vacuum chamber exposure mode (HP) or standard exposure mode (ST). The appropriate indicator light is illuminated to indicate the exposure mode selected. (Refer to Sections 2.4.1 and 2.4.2 for descriptions of the HP and ST exposure modes.)

h. SOFT CONTACT button - The SOFT CONTACT button is used to select the soft contact exposure mode. In this mode, the substrate is leveled against the mask, and the vacuum under the substrate remains on during exposure. To select soft contact exposure mode, the HP/ST button must be in the ST position.

i. PROXIMITY button (optional) - If the aligner is equipped with a button marked PROXIMITY on the front panel, exposures may be made with a small gap between the mask and the substrate. This proximity gap is determined by the position of the separation lever, and may be adjusted to a maximum distance of 50 microns, depending on the setting of the separation lever range. (A proximity gap of up to 150 microns can be achieved by ordering an optional lead screw when configuring the machine.) When the PROXIMITY button is pressed, it illuminates and defeats the interlock which normally prevents exposure unless the separation lever is in contact position. To select proximity exposure modes, the HP/ST button must be in the ST position.

> NOTE: Even when using the proximity exposure mode, two contacts will be made between mask and substrate: (1) prior to alignment in order to perform mask to substrate parallelity compensation, and (2) after exposure, when the parallelity compensation head brakes are switched off and the wedge head returns to its normal position.

j. Mechanical Exposure Timer - The exposure timer is located on the right side of the front panel. In order to set the timer, two controls are used: an inner knob marked "s", "10s", "m", "10m", "h", and "10h" (for seconds, minutes, and hours) which is used to set the multiplier, and an outer ring which is used to move the timer pointer. The scale for the timer pointer is graduated from 0 to 3. The exposure time is determined by multiplying the pointer setting by the multiplier set on the inner knob. The timer therefore has a range of 0.1 seconds to 30 hours. When the EXPOSURE button is pressed, the timer pointer rotates counterclockwise to 0 during exposure.

Example 1: To obtain an exposure time of 2 seconds, set the timer pointer at 2 and the multiplier to "s".

Example 2: To obtain an exposure time of 8 minutes, set the timer pointer to 0.8 and the multiplier to "10m".

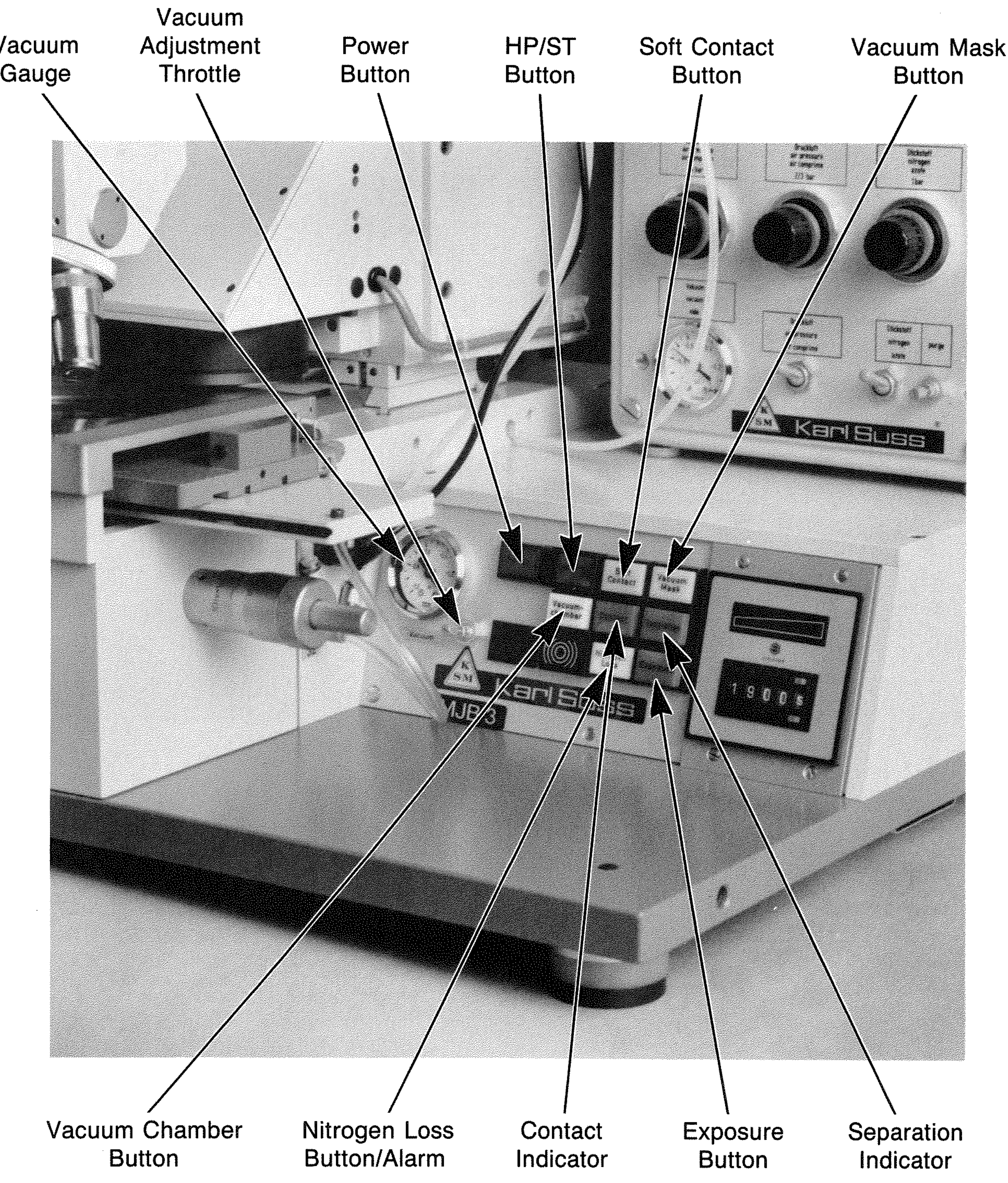


Figure 2 - 1 Front Control Panel

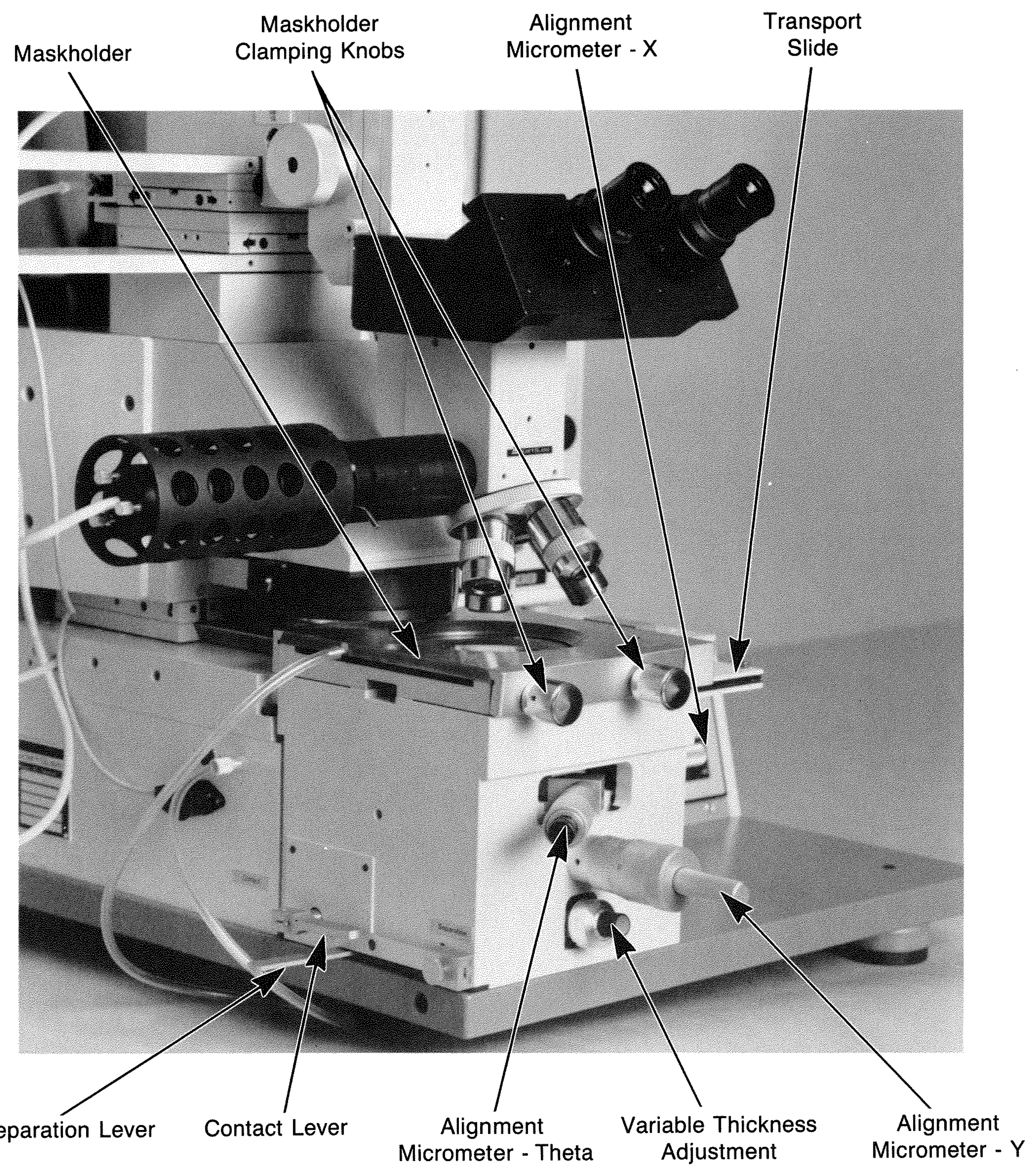


Figure 2 - 2 Alignment Stage

k. Electronic Exposure Timer - The MJB 3 may be equipped with an electronic rather than a mechanical exposure timer. If the machine has an electronic timer, set any exposure time from .01 seconds to 99 hours by pressing the red selector button on the right side of the timer to select "S" for seconds, "M" for minutes, and "H" for hours. Then use the digital switches located beneath the timer display to enter the desired exposure time.

l. Vacuum Gauge and Vacuum Adjustment Throttle - The vacuum gauge and the vacuum chamber adjustment throttles are located on the left end of the front panel for all MJB 3 models except the MJB 3 Standard where they are unnecessary. They are used to adjust the vacuum level in the vacuum chamber during exposure. This setting has no effect on the vacuum under the substrate during alignment. For instruction on setting the vacuum level, refer to Section 2.5.1.

m. NITROGEN LOSS button and alarm - The NITROGEN LOSS button and alarm are located at the lower center of the front panel on all MJB 3 models except the MJB 3 Standard or MJB 3HP/200W where they are unnecessary. The button is a latching type pushbutton that contains an indicator lamp; the alarm sounds a pulsating tone. The system monitors the flow of nitrogen used to cool the exposure lamp base. If the flow rate falls below a preset level, the system will be activated. If the NITROGEN LOSS button is in the "out" position, the button will flash and the alarm will be heard. If the NITROGEN LOSS button is in the depressed or "in" position, the button will flash, but the alarm will not sound. In either case, if nitrogen is not returned within approximately 3 minutes, the exposure lamp power supply will be automatically turned off, thereby significantly reducing the possibility of a lamp explosion due to overheating.

2.1.2 Alignment Stage (Figure 2-2)

a. Transport Slide - The transport slide is located near the top of the stage at the right hand side of the machine and is used to transport the chuck and substrate from the loading position into the stage.

b. Alignment Micrometers (X, Y, and Theta) - The Y and Theta alignment micrometers are located on the front of the alignment stage while the X micrometer is mounted on the right side. They are used during alignment to move the substrate in relation to the mask. The X and Y micrometers have both coarse and fine adjustment. The range of adjustment in X and Y is 6.0 mm and the pitch of the micrometer lead screws is 1.0 mm (coarse adjustment) and 0.05 mm (fine adjustment). The Theta (rotation) micrometer has a range of 30° with a pitch of 0.5 mm for the MJB Standard and 0.25 mm for the other models.

c. Contact Lever - The contact lever, which controls the Z-axis movement of the chuck, is located at the lower left side of the stage. After inserting a chuck and substrate into the stage using the transport slide, the contact lever is used to bring the substrate into contact with the mask for parallelity compensation.

d. Separation Lever - The separation lever is also located at the lower left side of the stage. This lever is used to move the substrate in and out of contact with the mask in order to perform alignment, once the contact lever has been engaged. Exposure can only be initiated when the separation lever is in the contact position (unless using the optional PROXIMITY program.)

e. The maskholder is securely clamped in the mask holder frame on the top of the stage using two knurled knobs. It is removed and reinserted into the maskholder frame from the left side of the stage.

f. Variable Thickness Adjustment - The variable thickness adjustment is located on the front of the stage immediately below the Y-micrometer. At the time of installation, the Z-travel of the stage is adjusted using a reference substrate and mask. If substrates or masks of different thicknesses are to be used, this thickness difference must be compensated for, using the variable thickness adjustment. This adjustment procedure is described in Section 2.5.3.

g. Nitrogen Purge - For work with negative resist, the stage is equipped with a purge which flushes the wafer and mask area with nitrogen to reduce the "oxygen effect". The nitrogen is introduced through a number of small holes in the back of the maskholder frame. The purge volume is adjusted using the throttle located on the lower right corner of the manometer box. (IR machines do not include this feature.)

2.1.3 Microscope Manipulator

The microscope manipulator, which controls the movement of the microscope over the alignment stage, is located on the left side of the machine. The manipulator rides on X–Y slides which are equipped with pneumatic brakes and mounted to the top of the mirrorhouse assembly. Two buttons located on the manipulator handle are used to unlock either or both brakes, thereby enabling the microscope to be scanned in either the X or Y directions exclusively, or in both directions simultaneously.

2.1.4 Microscope

The microscope is mounted on the MJB 3 by means of a microscope adapter which includes mechanical mounting parts, and a focusing rack. The focusing rack consists of a combined coarse/fine adjustment to allow rapid focusing of the microscope image. If the focus adjustment knob is turned in one direction only, the coarse focusing motion is in effect. The fine adjustment is automatically engaged as soon as the slightest turn is made in the opposite direction. The adjustment will switch back to the coarse focusing mode when the limits of fine adjustment are exceeded.

In addition, the microscope lift (if the microscope adapter is so equipped) raises the microscope to provide clearance between the objectives of the microscope and the maskholder. This lifting action will be automatically performed by the machine whenever the mirrorhouse travels to the front of the machine.

A number of microscope options are offered in both normalfield and splitfield types. The three basic configurations are described below. A more detailed description of the microscope supplied with your equipment may be found in the Appendix.

a. Splitfield Microscope - SUSS M200 - 200 Series (Figure 8-1)

The M200 microscope consists of the microscope head (either binocular or trinocular), eyepieces, microscope body, illuminator, and objectives. The choice of eyepieces and objectives depends upon the magnification desired. The objective separation distance is adjusted by using the two combination objective separation knobs which also adjust the fine focus. Two small knobs on the front of the body of the microscope are used to select either singlefield or splitfield operation.

b. Splitfield Revolver Microscope - SUSS M230 - 200 Series (Figure 8-2)

The M230 microscope is similar to the M200 except that it is supplied with three pairs of objectives. Locking screws located in the revolver mount dovetail allow the revolver to be rotated without changing the objective separation distance.

c. Normalfield Microscope - SUSS M400 (Figure 8-3)

The M400 microscope consists of the microscope head (either binocular or trinocular), eyepieces, microscope body, illuminator, objective turret, and objectives. It is offered in three versions: brightfield only, brightfield/darkfield, and an interference contrast combination of brightfield and darkfield. Interference contrast illumination is obtained, using an interference contrast objective, by inserting the analyzer and the polarizer into the illumination path. Darkfield illumination is achieved, using a darkfield objective, by inserting the darkfield stop into the light path.

2.1.5 Manometer Box

The manometer box contains the gauges and regulators used to control the machine pneumatics. There are three pressure gauges labelled Air Pressure (4 bar), Air Pressure (2 bar), and Nitrogen. These should be set at 4 bar (60 psi), 2 bar (30 psi), and 1 bar (15 psi) respectively, using the regulators located under each gauge. With the exception of parallelity compensation, the left Air Pressure Regulator located beneath the gauge labelled Air Pressure (4 bar) controls the pressure used for all machine functions controlled by air pressure (mirrorhouse movement, microscope lift and manipulator brakes, lamphouse heat sink cooling, etc.)

The Air Pressure Regulator which is located beneath the gauge labelled Air Pressure (2 bar) controls the pressure in the bladder ring located under the parallelity (wedge error) compensation plate.

The Nitrogen Regulator controls the nitrogen pressure to the machine. Nitrogen is used for lamp base cooling in the MJB 3/350W lamphouse, pressure under the wafer in standard exposure mode, the airing function, the nitrogen purge function, and to separate the wafer from the mask after exposure. Two pneumatic switches which control the compressed air and nitrogen supplies are located below the gauges and regulators, along with a throttle which is used to control the nitrogen purge to the wafer stage for work with negative resist. A gauge to show the vacuum supplied to the machine is situated at the bottom left of the manometer box.

2.2 Start Up Procedure

2.2.1 Pre-Operation Check List

Before starting the MJB 3, it is important to:

a. Switch on the nitrogen and compressed air (manometer box) and adjust the regulators to the proper settings (if necessary).

b. Switch on the vacuum to the machine.

2.2.2 Power Up

Assuming that the exposure lamp power supply is on and already in operation, turn on the MJB 3 by pressing the POWER button. The button will illuminate.

2.2.3 Exposure Lamp Ignition

If the exposure lamp power supply is not on, the MJB 3 main power should be off before switching on the power supply. The lamp ignition sequence is as follows:

a. Check that the machine is turned off.

b. Switch on the POWER to the exposure lamp power supply.

c. Press the lamp START button and release. If the lamp does not ignite after the firing sequence, press the button again.

d. For more detailed information about setup and operating procedures, refer to the Operator's Reference Manual for the Constant Intensity Controller (power supply).

2.3 Operation

2.3.1 Loading the Mask

NOTE: It is extremely important at all times to avoid scratching chucks and maskholders.

To load a mask into the machine, first loosen the two knurled knobs which clamp the maskholder onto the stage and withdraw the maskholder. Carefully place the maskholder on a flat surface, with the vacuum groove facing up.

Check that the MASK VACUUM button on the front panel is in the extended or off position. Place the mask on the maskholder with the patterned side up and then press the MASK VACUUM button. This will fix the mask to the maskholder by vacuum. Now invert the maskholder and reinsert it into the stage. Clamp the maskholder securely in place using the two knurled knobs.

2.3.2 Loading the Substrate

Place the substrate on the chuck, ensuring that it completely covers all the vacuum holes. Insert the chuck into the stage by carefully pushing the transport slide to the left until it reaches the stop. Bring the substrate into contact with the mask by rotating the contact lever 180° counterclockwise (toward the rear of the machine). The CONTACT indicator on the front panel will illuminate.

Where an MJB 3 is used in the standard exposure mode **with a standard chuck,** the operator may take advantage of the pre-vacuum feature when inserting the chuck into the stage. After the substrate is placed on the wafer chuck, squeeze the button on the front of the finger grip located at the right edge of the transport slide. This causes a vacuum to hold the wafer to the chuck during transport to the stage. Once the chuck is fully inserted into the stage, rotate the contact lever as above and release the pre-vacuum button.

> NOTE: The pre-vacuum feature will **only** function in the standard exposure (ST) mode with a standard chuck.

2.3.3 Aligning the Substrate to the Mask

First, select the exposure mode desired. Then focus the microscope on the mask and substrate using the focus adjustment knobs. If the microscope is equipped with an objective revolver, a low magnification objective should be used for coarse alignment and the magnification steadily increased until satisfactory alignment is obtained. In order to align the substrate, it must first be separated from the mask. Pull the separation lever toward the front of the machine until sufficient separation is obtained. The CONTACT indicator will go out and the SEPARATION indicator will illuminate. (The range of the separation stroke is adjustable and is set at the time of installation.) Now align the substrate to the mask using the X, Y, and Theta micrometers. The X and Y micrometers are equipped with both a coarse and fine adjustment.

If the aligner is equipped with a normalfield microscope, alignment is performed by scanning the microscope back and forth in either the X or the Y direction. The microscope manipulator is equipped with pneumatic brakes which are unlocked by pressing the buttons on the manipulator handle. Select either an X-only or Y-only scan by pressing just one button.

If the aligner is equipped with a splitfield microscope, the two objectives are aligned to two alignment features on opposite sides of the substrate using the microscope

manipulator and the objective separation controls. In this case, it is not necessary to scan the microscope across the mask during substrate alignment.

When satisfactory alignment is obtained, move the substrate back into contact with the mask by pushing the separation lever all the way to its rearmost position. The SEPARATION light will go out and the CONTACT light will illuminate.

When using high magnification, it is possible that the alignment position may be seen clearly only in the contact position because of depth of focus restrictions. If the alignment is unsatisfactory in contact position, repeat the alignment sequence until correct alignment is obtained.

For more detailed information, refer to the application note on alignment in the Appendix (Chapter 8).

2.3.4 Exposure

The substrate is now ready for exposure. (Exposure mode should be selected **before** alignment.) Set the exposure time on the timer located at the right end of the front panel. Sections 2.1.1.j or 2.1.1.k provide instructions on setting the timer.

Press the EXPOSURE button. (On some microscopes, the working distance of the high magnification objectives is so small that the objective extends into the maskholder opening when focused on the mask. In these cases, the microscope adapter on which the microscope is mounted is equipped with a lift mechanism.) When the EXPOSURE button is pressed, the microscope will first elevate an amount sufficient to allow the objective to clear the maskholder.

The mirrorhouse then moves forward into position over the mask. When the mirrorhouse reaches the foremost position, the exposure shutter opens and exposure takes place for the amount of time set on the exposure timer. After exposure, the shutter closes and the mirrorhouse automatically retracts. The microscope lift is then released and the microscope moves back down to its original position.

2.3.5 Unloading the Substrate

With exposure complete, the substrate may now be unloaded. Rotate the contact lever 180° clockwise (toward the front of the machine), which releases the substrate from the mask. Pull the transport slide to the right and carefully remove the substrate from the chuck.

2.4 Exposure Mode Options

2.4.1 Vacuum Contact (High Precision) Mode

In the HP mode, a vacuum is pulled between the mask and the substrate just before exposure. The highest possible resolution is obtained in this mode since the gap between substrate and mask (which is caused by flatness variations, dust particles, etc.) is as small as possible. Chucks fitted with vacuum gaskets must be used in this mode in order to obtain a vacuum between the substrate and the mask. Vacuum contact mode is not an option on the MJB 3 Standard model.

When printing in the vacuum contact mode, the following sequence of events occurs after the EXPOSURE button is pressed:

a. The vacuum under the substrate is switched off.

b. The vacuum between the substrate and the mask is switched on through the vacuum chamber hole located at the outer edge of the chuck.

c. The shutter opens, exposure takes place for the length of time set on the exposure timer, and the shutter closes, completing the exposure.

d. The vacuum between the substrate and the mask is switched off.

e. The vacuum under the substrate is switched on.

f. When the operator moves the contact lever to unload the substrate, a nitrogen burst is introduced through the vacuum chamber hole, breaking the vacuum between the substrate and the mask.

2.4.2 Standard (ST) Mode

In the ST mode, one of two (Standard or Soft Contact) exposure programs can be selected; this allows the greatest amount of flexibility in the use of the machine. Only chucks without vacuum gaskets should be used in the ST mode of operation.

2.4.2.1 Hard Contact

If the ST mode is illuminated, and both the SOFT CONTACT and PROXIMITY (if so equipped) buttons are not, exposure will be performed with nitrogen pressure pressing the substrate against the mask. The sequence of events after the EXPOSURE button is pushed is as follows:

a. The vacuum under the substrate is removed.

b. Nitrogen pressure is applied under the substrate. (This is adjustable by using throttle #18 located on the left side of the machine.)

> **CAUTION**: Too much nitrogen can cause the mask to bow.

c. The shutter opens, exposure takes place for the length of time selected on the exposure timer, and the shutter closes, completing the exposure.

d. The nitrogen pressure under the substrate is removed.

e. Vacuum is reapplied under the substrate.

2.4.2.2 Soft Contact

If the ST and SOFT CONTACT buttons are illuminated, then exposures will be performed with only mechanical pressure pressing the substrate against the mask. During exposure, the vacuum securing the substrate to the exposure chuck remains, and no nitrogen is applied.

2.4.2.3 Proximity Mode (Optional)

If the aligner is equipped with a button marked PROXIMITY (which is located on the front panel), exposures may be made with a small gap between the mask and the substrate. This proximity gap is determined by the position of the separation lever and may be adjusted to a maximum separation distance of 50 microns, depending on the setting of the separation lever range. (A separation gap of up to 150 microns can be achieved by ordering an optional lead screw when configuring the machine.)

When the PROXIMITY button is pressed, it defeats the interlock which normally prevents exposure unless the separation lever is in the contact position. The vacuum under the substrate remains on during exposure, which takes place in normal fashion.

> Note: Even when using the proximity exposure mode, two contacts will be made between mask and substrate: (1) prior to alignment in order to perform mask to substrate parallelity compensation, and (2) after exposure when the parallelity compensation head brakes are switched off and the wedge head returns to its normal position.

2.5 Adjustment Procedures

Certain features of the SUSS MJB 3 are user adjustable and are described in this section.

2.5.1 Vacuum Chamber Adjustment Procedure

The vacuum chamber is adjustable in all MJB 3 models except the MJB 3 Standard which has no vacuum chamber. Under certain circumstances, the operator may wish to expose substrates in vacuum contact mode with less than full vacuum in the vacuum chamber. If this is the case, a vacuum gauge and adjustment throttle are located at the left end of the control panel.

To set the vacuum level, bring a substrate to the contact position in vacuum chamber mode as outlined in Section 2.3.2, and press the VACUUM CHAMBER button. Use the throttle and vacuum gauge reading to adjust the vacuum as desired. Opening the throttle introduces a small leak into the vacuum chamber which offsets the vacuum from the vacuum source. Turn the throttle counterclockwise to decrease the vacuum, or clockwise to increase the vacuum.

Note: This adjustment does not affect the amount of vacuum under the substrate during alignment.

The vacuum gauge can also be used to detect vacuum leaks in the vacuum chamber due to damaged chucks, vacuum gaskets, etc.

2.5.2 Airing Feature Adjustment Procedure

When using a chuck equipped with a vacuum gasket, a partial vacuum may unintentionally develop during alignment between substrate and mask due to an imperfect seal between the substrate and the chuck. This can occur if the backside of the substrate is unusually rough or scratched, or if scratches are present in the chuck surface. This partial vacuum can cause the substrate and mask to stick together and make alignment difficult or impossible. To overcome this problem, a small flow of nitrogen is introduced into the vacuum chamber whenever the substrate is separated from the mask. This nitrogen flow is controlled by throttle #12 located towards the back left panel of the machine (Figure 2-10).

The throttle can be adjusted as follows:

a. Bring a substrate to the separation (alignment) position as outlined in Sections 2.3.1 through 2.3.3.

b. Turn throttle #12 counterclockwise until the substrate and mask do not stick together in separation position and the substrate moves freely in relation to the mask when the alignment micrometers are adjusted.

c. Using the separation lever, move the substrate into contact with the mask and back into separation again. Observe the substrate and mask through the microscope throughout this operation.

d. If the substrate shifts in relation to the mask during this procedure, turn the throttle clockwise until there is no further shifting.

2.5.3 Setting the Variable Thickness Adjustment

The MJB 3 is equipped with a device to process substrates of various thicknesses. The device can also be used to vary the contact pressure on a given wafer.

When the equipment is installed, a reference mask and wafer are used to set the contact pressure between the mask and wafer. This setting can be changed by using the thickness adjustment knob located on the front of the stage towards the bottom of the machine.

One revolution or turn of the thickness adjustment knob corresponds to a 150 micron variation of substrate thicknesses or contact pressure. Rotate the knob counterclockwise to increase the contact pressure (or subtract wafer thickness), or clockwise to decrease contact pressure (or add wafer thickness).

EXAMPLES: Assume that in each of the three cases a reference mask of 60 mil (1500 microns) thickness and a reference wafer of 20 mil (500 microns) thickness is used to set up the machine at installation. Also assume that a contact pressure of 500 microns is set which corresponds to a setting of 5.0 on the thickness adjustment knob.

Example #1:

Task - process 14 mil (350 micron) thick wafers.

Procedure - rotate the thickness adjustment knob counterclockwise to a setting of 6.0 (500 microns - 350 microns = 150 microns = 1 revolution).

Example #2:

Task - decrease contact pressure from 500 to 350 microns.

Procedure - rotate the thickness adjustment knob clockwise to a setting of 4.0 (150 microns = 1 revolution).

Example #3:

Task - use a 63 mil thick mask.

Procedure - rotate the thickness adjustment knob clockwise to a setting of 4.5 (63 mil - 60 mil = 3 mil = 75 microns = 0.5 revolution).

3 WARNINGS AND SAFETY HAZARDS

IMPORTANT: This section contains information that the operator must know and understand to minimize the risk of injuries.

KARL SUSS equipment is designed to protect the user against all possible hazards. After review by qualified safety personnel, the user should generate a specific safety procedure with regard to the particular application of the equipment and local codes and make certain that operators are familiar with the procedures. The safety procedures should be posted in a highly conspicuous location so that all operators of the equipment cannot fail to read them.

3.1 Electrical Precautions

When the covers are removed from the mask aligner, dangerous voltages may be exposed. When all of the covers are in place, there is no danger from these voltages.

Service of the electrical system should be performed only by qualified personnel, so it should never be necessary for the operator to have to open the cover of the electrical portion of the mask aligner. If any problems occur with the power supply, turn the machine off and notify maintenance immediately.

CAUTION: Never open the housing while the power line is connected.

3.2 High Pressure Lamps

The light source for the concentrated ultraviolet illumination required to expose the wafer is a high pressure lamp. Special precautions must be taken when working with these lamps.

3.2.1 Electrical Hazards

The voltage and current required to run a high pressure lamp constitute a lethal combination. Starting ignition voltages are 30 KV and open circuit potentials range up to 180 VDC at currents between 5 and 50 amps.

When performing any maintenance on the exposure lamp power supply, lamp housing, or the lamp itself, ensure that the power line to the power supply is disconnected.

3.2.2 Lamp Explosion

These exposure lamps operate at extremely high pressure (50 - 70 atm). Explosion is therefore a possibility if they are handled or operated wrongly. The lamps may fail as a result of improper cooling, improper setting of the power supply, usage outside the manufacturer's guidelines, etc. Additionally, some high pressure lamps, even when cold, are still above atmospheric pressure and should be handled with protective face shields and gloves.

> **NOTE:** Careful handling of the lamp and proper operation of the equipment will substantially reduce the possibility of lamp explosions.

The lamphouse is designed to minimize damage to the interior of the equipment and prevent possible injury to the operator should a lamp explosion occur. All assemblies and protective covers must be in place during operation of the machine.

Some of these lamps contain hazardous elements like mercury. If a lamp should break, avoid touching the fragments and/or breathing the vapor.

3.2.3 Exhaust Requirements

High pressure lamps produce ozone due to the interaction of the radiation emitted below a wavelength of 250 nm with oxygen. Ozone attacks the mucous membranes of the respiratory system, producing symptoms similar to pneumonia. The effects are cumulative. The smaller wattage lamps, cadmium-xenon to 200 watts and mercury to 500 watts, should be operated in a well ventilated area only. Larger wattage lamps, such as 350 watt Cd-Xe, 500 watt Hg-Xe, and 1000 watt Hg must be exhausted from the room.

3.2.4 Eye and Skin Safety

The ultraviolet light produced by these lamps can cause erythema of the skin (similar to sunburn) and conjunctivitis. In addition, the large infrared output can cause retinal burns resulting in blindness.

Every SUSS mask aligner is equipped with light guards, and the high pressure lamp and exposure path are enclosed. The mask aligner should not be operated unless all of these protective covers and devices are in place.

3.3 Broken Wafers

Since fragments of broken wafers and substrates can be very sharp, there is a risk of injury to the operator or to maintenance personnel when trying to remove them from the machine. Extra care should be taken and proper tools, i.e. tweezers, should be used to minimize this risk.

3.4 Moving Parts

The operator should be careful to keep loose clothing or long hair from getting caught in the machine.

4 QUALITY STANDARDS

This chapter briefly describes some of the quality standards which we recommend you follow to help you obtain the best possible results from your SUSS equipment. KARL SUSS manufactures precision instruments that cannot be expected to function properly unless they are correctly adjusted and maintained, and precautions are taken to ensure a clean environment.

We assume that you have a comprehensive quality control program which has been developed to suit your particular application. Our comments are intended only as a reminder that quality standards are an essential part of good business practices.

4.1 Environment

A mask aligner is intended for use in a well managed, professionally supervised clean room.

Mask dimensions are usually on the order of several microns, and frequently fall into the submicron range. At this level of precision, almost everything in a normal production environment would be judged too “dirty” to make semiconductor devices.

The cleanliness requirement is particularly stringent in the photomasking area. Not only are all of the critical dimensions produced here, but the frequent chemical operations present many opportunities for accidental contamination. Any type of contamination will affect fabrication yield and circuit reliability.

The exposure quality obtained from a mask aligner is a function of many variables in addition to clean room conditions. The quality of the mask used, wafer flatness, specifications and quality of the photoresist, and the condition of the resist spinner all play important roles.
To ensure the best possible results, the user must take appropriate steps to provide a clean environment and maintain consistent and effective quality standards for all aspects of the photomasking process.

4.2 Machine Checks and Adjustments

A mask aligner should be checked on a regular basis to ensure that the machine is still adjusted to optimum performance conditions.

4.2.1 Light Intensity

The light intensity measured at the wafer plane compared with the power input to the lamp gives an indication of any existing or pending failure of the exposure lamp. Towards the end of the lamp's life, the bulb begins to darken. This is an indication of an increased possibility of a lamp explosion.

You should record the power input to the exposure lamp on a daily basis. Do not exceed the limit specified by the manufacturer of the exposure lamp.

4.2.2 Light Uniformity

As part of your standard routine, you should measure the light intensity at different points of the wafer plane, for example at the 12, 3, 6, and 9 o'clock positions, and at the center.

By comparing these measurements, you can calculate and monitor the light uniformity. Please refer to the appropriate sections of Chapter 5 for details on intensity and uniformity adjustments.

4.2.3 Chucks and Maskholders

Chucks and maskholders are manufactured to very fine tolerances. Your normal routine as part of your attention to quality standards should include inspection of chucks and maskholders for cleanliness, mechanical integrity, and evidence of residues of any kind, including photoresist. The use of chucks or maskholders that have scratches or show signs of abuse will result in poor equipment performance.

A visual inspection is usually all that is required.

5 MAINTENANCE

Your SUSS Mask Aligner is carefully designed and solidly built to exacting standards in order to provide many years of reliable performance. In fact, there are SUSS aligners still in daily use after more than fifteen years of service. To ensure optimum performance and a long operating life, proper routine maintenance and care are absolutely essential.

This chapter will acquaint you with the general maintenance requirements and will outline the procedures for periodic maintenance and calibration such as lamp replacement, intensity and uniformity checks, and power supply calibration.

5.1 General Maintenance

The short time which you spend to accomplish these checks and tests will greatly improve the overall performance of the machine. Be alert at all times to any unusual machine noises, behavior, or changes in operation or results which may be symptomatic of problems which could damage the machine if left uncorrected.

It is most important to conduct a thorough visual check of the machine on a daily basis. Key areas include chucks, maskholders, and the alignment stage. These parts should be free of dust and residue, especially photoresist. Also inspect for scratches and other signs of wear since the use of scratched or damaged chucks and maskholders will result in poor equipment performance.

5.2 Replacement and Adjustment of Exposure Lamp: Standard and HP Models Only

The procedure for the replacement and adjustment of the exposure lamp for the MJB 3 Standard and the MJB 3 HP models is described below. Please refer to Section 5.3 for instructions regarding the MJB 3 UV400, UV300, UV250, and UV200 exposure optics.

> **CAUTION:** Under no circumstances should you touch the quartz bulb of the exposure lamp with your fingers. Immediately clean inadvertently touched spots with alcohol and a soft lint free cloth.

5.2.1 Lamp Replacement: Standard and HP Models Only

- Switch off the exposure lamp power supply and disconnect the main power cord: switch off the mask aligner.
- Do not attempt to open the lamphouse until the lamp has been switched off for al least 20 minutes. Then unscrew the screw securing the lamphouse and carefully swing it open on its hinges. (Refer to Figure 5–1.)

> **CAUTION:** Never touch the quartz bulb with your fingers! Handle the lamp only by its metal ends.

- Remove the knurled nut from the negative (non-engraved) terminal of the lamp and remove the lead wire.
- Take the new lamp from its box and remove the knurled nuts.
- Install the positive (engraved) terminal of the new lamp into the lamp socket by grasping the lamp at the negative (non-engraved) terminal and carefully screwing it in.
- Carefully secure the negative lead wire to the terminal using a new knurled nut.
- Check the exposure shutter for free movement. Switch on the mask aligner and turn the CONTACT lever to the contact position. Press the EXPOSURE button and check the shutter for correct operation. Return the CONTACT lever to the separation position and switch off the mask aligner.
- Close the lamphouse and secure it with the screw.
- Go to Section 5.2.2 and perform intensity and uniformity adjustments and measurements.

5.2.2 Intensity and Uniformity Adjustments and Measurements: Standard and HP Models Only With 200W Lamphouse

The exposure lamp must always be adjusted for intensity and uniformity after it has been changed in order to ensure uniform exposure across the entire exposure area. In addition, the intensity and uniformity should be checked whenever it is suspected that wafers are not being evenly exposed.

5.2.2.1 Adjusting the Exposure Lamp: Standard and HP Models Only

> **CAUTION:** The high intensity produced by exposure lamps can cause eye damage. Personnel working with this equipment should wear eye protection to block ultraviolet and infrared radiation. Karl Suss will not be responsible for injuries arising from incorrect or unprotected work with these systems.

All exposure lamp adjustments are done with the exposure lamp power supply in idle mode. To perform the adjustments, you will need an intensity meter and the appropriate optical probe (365 nm or 405 nm). Follow these instructions:

- Ensure that the mask aligner power button is in the OFF position.
- Switch on the nitrogen and compressed air sources (manometer box) and adjust the regulators to the proper settings.
- Switch on the exposure lamp power supply and ignite the exposure lamp by pressing the LAMP START button. Be certain that the power supply is set for idle mode. Allow the lamp to stabilize for 10 - 15 minutes.
- Switch ON the mask aligner.
- Turn the CONTACT lever to the contact position.
- Place a piece of black paper (approx. 100 mm x 100 mm, or 4" x 4") on the parallelity compensation plate to avoid scratching its surface. Place the optical probe on the paper.
- Set a long exposure time on the exposure timer and press the EXPOSE button.

The black knobs on the rear of the lamphouse are used to adjust the position of the exposure lamp, spherical mirror, and condenser lenses. Refer to Figures 5-2 and 5-3.

- Turn knob #1 clockwise to adjust the condenser lens assembly toward the lamp until the lamp electrode and its reflected image become visible on the paper.

- Move the electrode image to left or right center of the field by vertical adjustment (knob #2) and rotation (knob #3) of the lamp.

- Move the reflected electrode image to the other side of the center of the field using knob #4 and knob #5.

- Loosen the knurled screw (#6), and using knob #7, adjust the mirror in or out until the electrode image and its reflected image are of equal size. Clamp, using screw #6.

- Adjust the position of the electrode image and its reflected image until they are just touching in the center of the field, using knobs #2, 3, 4, and 5.

- Using knob #1, adjust the condenser lens assembly away from the lamp until the exposure beam uniformly illuminates the exposure area.

  NOTE: As the condenser lens assembly is moved away from the lamp, intensity is reduced. Within a range where acceptable uniformity is obtained, this adjustment may be used to vary intensity.

5.2.2.2 Intensity and Uniformity Measurements: Standard and HP Models Only

If the intensity and uniformity adjustments in Section 5.2.2.1 were performed properly, the light intensity will be uniform at this point.

In order to ensure that exposures will be satisfactory for uniform production results, it is important that the light intensity be within ± 10% tolerance.

With the optical probe, measure the light intensity at different point of the wafer plane, for example at the 12, 3, 6, and 9 o'clock positions, at the center, and at several points in between. Using the high and low readings (H and L), determine that the uniformity, as calculated by the formula:

$$\text{Uniformity} = [(H-L)/(H+L)] \times 100\%$$

is less than 10%.

Once the uniformity is within the prescribed tolerance, calibrate the power supply.

5.2.3 Power Supply Calibration: Standard and HP Models Only

Once the new exposure lamp has been installed and adjusted for intensity and uniformity, the exposure lamp power supply must be recalibrated, following the procedures outlined in the Operator's Reference Manual for the SUSS Constant Intensity Controller.

First, it is necessary to calibrate the supply to the measurement obtained on the power meter with the optical probe in the center of the exposure field. Next the power supply is adjusted to the desired intensity output. Once calibrated, the reading on the power meter should track the reading on the power supply.

The power supply idle wattage is set at the factory. The lamp should be replaced when it reaches the maximum allowable power setting to avoid the possibility of a lamp explosion.

Your mask aligner is supplied with a SUSS Model CIC 500 or Model CIC 1000 Constant Intensity Controller (power supply). You will find the manual for the power supply included with this manual.

5.3 Replacement and Adjustment of Exposure Lamp in the 350W Lamphouse: Includes UV400, UV300, UV250, and UV200 Exposure Optics Only

The procedure for the replacement and adjustment of the exposure lamp for the SUSS MJB 3 UV400, UV300, UV250, and UV200 exposure optics is described below. Refer to Section 5.2 for instructions regarding the MJB 3 Standard and HP models.

> **CAUTION**: Under no circumstances should you touch the quartz bulb of the exposure lamp with your fingers. Immediately clean inadvertently touched spots with alcohol and a soft lint free cloth.

If there are any questions, please feel free to contact KARL SUSS Customer Service, or your local SUSS service representative.

5.3.1 Lamp Replacement: UV400, UV300, UV250, and UV200 Exposure Optics Only

- Switch off the exposure lamp power supply and disconnect the main power cord.
- Switch off the mask aligner.
- Do not attempt to open the lamphouse until the lamp has been switched off for at least 20 minutes. Then unscrew the screw securing the lamphouse and carefully swing it open on its hinges. (Refer to Figure 5–4.)
- Examine the cold light mirror and clean it if necessary. To clean it properly, it must be removed from the lamphouse. HANDLE THE MIRROR WITH CARE! Clean under hot running water using a soft sponge and liquid soap. Rinse thoroughly, carefully blow off the mirror with nitrogen, and reinstall it in the lamphouse.

  The orientation of cold light mirrors 1 and 2 on the holder is not critical, since both sides of the mirror are coated. However, cold light mirrors 7, 8, and 11 are coated only on one side. This side is indicated by an arrow on one edge on the mirror. The mirror must be mounted on the holder so that the coated side faces the lamp.

> **CAUTION:** Never touch the quartz bulb with your fingers! Handle the lamp only by its metal ends.

- Remove the nut from the free end of the lamp and remove the lead wire. Keep the nut!
- Carefully unscrew the lamp from the socket. Should an adapter come out with the lamp, remove it and install it on the corresponding terminal of the new lamp.
- Take the new lamp from its box and remove the knurled nuts which are no longer needed.

  NOTE: The knurled nuts which come with replacement lamps must NOT be used!
- Install the new lamp, and adapter if necessary, in the lamphouse socket.

> **CAUTION:** The polarity of the Hg lamps is opposite that of the Cd/Xe and Hg/Xe lamps.

(1) When installing a Hg lamp, insert the negative terminal through the ellipsoid mirror and carefully screw it into the lamp socket.

(2) When installing a Cd/Xe or Hg/Xe lamp, insert the positive terminal through the ellipsoid mirror and carefully screw it into the lamp socket.

- Carefully secure the lead wire to the free end of the lamp with the hexagon nut. If the lead wire appears to be damaged or extremely blackened, replace it.
- Check the position of the cooling tube so that it is directed towards the metal base of the free end of the lamp.
- Continue with Section 5.3.2.

5.3.2 Lamphouse Reassembly and Pneumatic Adjustments: UV400, UV300, UV250, and UV200 Exposure Optics Only

- Close the lamphouse and secure it with its screw.
- Adjust the nitrogen flow for cooling of the lamp base using throttle #17 which is located on the rear of the machine. Close the throttle by turning it clockwise, then open counter clockwise about 1/2 to 1 turn.

> **CAUTION**: Throttle numbers may differ on some machines. Please verify the numbers with your pneumatic plan if in doubt.

- Adjust the air flow for cooling of the heat sink using throttle #16. The throttle should be open about 5 turns for an air input pressure of approximately 4 bar.
- Continue with Section 5.3.3 and perform the intensity and uniformity adjustments.

5.3.3 Intensity and Uniformity Adjustments and Measurements: UV400, UV300, UV250, and UV200 Exposure Optics Only

The exposure lamp must always be adjusted for intensity and uniformity after it has been changed in order to ensure uniform exposure across the entire exposure area. In addition, the intensity and uniformity should be checked whenever it is suspected that wafers are not being evenly exposed.

5.3.3.1 Adjusting the Exposure Lamp: UV400, UV300, UV250, and UV200 Exposure Optics Only

> **CAUTION**: The high intensity produced by exposure lamps can cause eye damage. Personnel working with this equipment should wear eye protection to block ultraviolet and infrared radiation. Karl Suss will not be responsible for injuries arising from incorrect or unprotected work with these systems.

All exposure lamp adjustments are done with the exposure lamp power supply in idle mode. To perform the adjustments, you will need an intensity meter and the appropriate optical probe (405 nm, 365 nm, 320 nm, 240 nm, or 220 nm). Follow these instructions:

- Switch on the nitrogen and compressed air sources which provide cooling for the lamphouse. Adjust the regulators to the proper settings.
- Ensure that the mask aligner is in the OFF position.
- Switch on the exposure lamp power supply and ignite the exposure lamp by pressing the LAMP START button. Be certain the power supply is set for idle mode. Allow the lamp to stabilize for 10 -15 minutes.
- Turn the CONTACT lever to the contact position.
- Place a piece of black paper (approx. 100 mm x 100 mm, or 4" x 4") on the parallelity compensation plate to avoid scratching its surface. Place the optical probe on the paper.
- Set a long exposure time on the exposure timer and press the EXPOSURE button.

The three knobs located on the lamphouse are used to adjust the position of the exposure lamp in the ellipsoidal mirror. The knob marked "Z" shifts the lamp vertically, and thus primarily controls intensity. The knob marked "Y" shifts the lamp in the Y direction, and the knob marked "X" shifts the lamp in the X direction. The primary purpose of the knobs is to adjust the uniformity of illumination.

- Maximize the reading on the power meter by first shifting the lamp vertically using the Z knob. Then do the same with the Y and X knobs.
- Alternately placing the probe at the front and rear edges of the illuminated area, use the Y knob to shift the lamp in the Y direction until the meter gives the same reading at both locations.

- Alternately placing the probe at the left and right hand edges of the illuminated area, use the X knob to shift the lamp in the X direction until the meter gives the same reading at both locations.
- Re-check the vertical adjustment (Z knob).

> **CAUTION**: The Z knob on the lamphouse must **only** be used to maximize the intensity of the exposure lamp. If you wish to adjust the intensity for process purposes, either adjust the power supply output or use proper filters. Using the Z knob to decrease the intensity will result in a build up of excess heat in the lamphouse which could lead to a lamp explosion.

5.3.3.2 Intensity and Uniformity Measurements: UV400, UV300, UV250, UV200 Exposure Optics Only

If the intensity and uniformity adjustments in Section 5.3.3.1 were performed properly, the light intensity will be uniform at this point.

In order to ensure that exposures will be satisfactory for uniform production results, it is important that the light intensity be within a ±5% tolerance.

With the optical probe, measure the light intensity at different points of the wafer plane, for example at the 12 3, 6, and 9 o'clock positions, at the center, and at several points in between. Using the high and low readings (H and L), determine that the uniformity, as calculated by the formula:

$$\text{Uniformity} = [(H-L)/(H+L)] \times 100\%$$

is less than ± 5%.

Once the uniformity is within the prescribed tolerance, calibrate the power supply.

5.3.4 Power Supply Calibration: UV400, UV300, UV250, and UV200 Exposure Optics Only

Once the new exposure lamp has been installed and adjusted for intensity and uniformity, the exposure lamp power supply must be recalibrated, following the procedures outlined in the Operator's Reference Manual for the SUSS Constant Intensity Controller.

First, it is necessary to calibrate the supply to the measurement obtained on the power meter with the optical probe in the center of the exposure field. Next, the power supply is adjusted to the desired intensity output. Once calibrated, the reading on the power meter should track the reading on the power supply.

The power supply idle wattage is set at the factory. The lamp should be replaced when it reaches the maximum allowable power setting to avoid the possibility of a lamp explosion.

Your mask aligner is supplied with a SUSS Model CIC 500 or Model CIC 1000 Constant Intensity Controller (power supply). You will find the manual for the power supply included with thie manual.

5.4 Exposure Optical System: UV400, UV300, UV250, and UV200 Exposure Optics

The UV400, UV300, UV250, and UV200 exposure optics are of similar design. They consist of an exposure lamp, ellipsoidal mirror, cold light mirror, fly's eye lens, condenser lens, diffraction reducing lens plate, turning mirror and front lens (refer to Figure 5-5).

A detailed description of the optical system is found in Section 5.4.1. Section 5.4.2 outlines the components which differ from one wavelength range to another, while Sections 5.4.3 and 5.4.4 detail the procedures for changing wavelength ranges.

5.4.1 Optical System Components

a. **Exposure Lamp** - In the case of UV400 and UV300, the exposure lamp is a 350W super pressure mercury short-arc lamp. The spectral lines emitted by the lamp which are of interest here are those at 436 nm, 405 nm, 365 nm, 335 nm, and 313 nm.

   In the case of UV250, the exposure lamp is a 500W Hg/Xe short-arc lamp which emits spectral lines in the 230-260 nm wavelength region, in addition to other lines at longer wavelengths.

   In the case of UV200, the exposure lamp is a 350W super pressure Cd/Xe short-arc lamp which emits spectral lines in the 210-230 nm region, in addition to other lines at longer wavelengths.

b. **Ellipsoidal Mirror** - The exposure lamp is mounted in an ellipsoidal collecting mirror, at one focus of the ellipsoid. This mirror (which is the same for all wavelength ranges) collects the radiation emitted by the lamp and focuses it at the second focus of the mirror.

c. **Cold Light Mirror** - The cold light mirror transmits the unwanted longer wavelength radiation to the heat sink located at the second focus of the ellipsoidal mirror under the cold light mirror, and reflects the shorter wavelength radiation (cold light) to the fly's eye lens. This mirror, unlike the ellipsoidal mirror, is specific to each wavelength range.

d. **Fly's Eye Lens** - The fly's eye lens disperses the light uniformly and directs it to the condenser lenses. The fly's eye lens is made of Herasil for the UV400 and UV300 and Suprasil (synthetic quartz) for the UV250 and UV200.

e. **Condenser Lens** - The condenser lens collimates the exposure light. The position of the condenser lens in the mirrorhouse tube affects intensity and uniformity. A scale is mounted on the right side of the mirrorhouse tube. The recommended position of the condenser lens is centered at 40 mm from the lamphouse, but it may be adjusted if necessary to obtain better uniformity. Like the fly's eye lens, the condenser lens is made of Herasil (for UV400 and UV300) and Suprasil or synthetic quartz (for UV250 and UV200).

f. **Filter Holder** - The filter holder is located between the condenser lens and the diffraction reducing lens plate. In the UV400 system, it may be used to mount filters of various types for work with negative resist or to reduce intensity (neutral density filters). In the UV300 system, a 365 nm interference filter is mounted in the holder. The position of the filter holder is not critical.

g. **Lens Plate** - The lens plate reduces diffraction effects in the printed image. The position of the lens plate, like that of the condenser lens, affects intensity and uniformity. The recommended position of the lens plate (which is adjusted by tightening the set screw) is approximately 85 mm on the reference scale. The lens plate is specific to each wavelength range.

h. **Turning Mirror** - The turning mirror, which is the same for all wavelength ranges, changes the direction of the exposure beam from horizontal to vertical. It is important that the metallized side of the mirror face the beam.

i. **Front Lens** - The front lens, which is specific for each wavelength range, provides final collimation and uniformity of the exposure beam.

5.4.2 Optical Components by Model

As already mentioned, the fly's eye lens and the condenser lens are both fabricated of Herasil for UV400 and UV300 exposure optics, and of Suprasil for UV250 and UV200 exposure optics. However, the Suprasil components can be used for all wavelength ranges, while the Herasil components may only be used for UV400 and UV300.

5.4.2.1 UV400 Optical Components

- **Exposure Lamp**: 350W Hg with adapter.

- **Cold Light Mirror**: #1 or #7. The number of the cold light mirror is marked on one corner. Cold light mirror #1 is specific to UV400, while cold light mirror #7 may be used for UV400 and UV300.

- **Lens Plate**: Two lens plates with 12 lenses each arranged in a triangle configuration, fabricated of Herasil.

- **Front Lens**: Transparent.

5.4.2.2 UV300 Optical Components

- **Exposure Lamp**: 350 Hg with adapter.

- **Cold Light Mirror**: #2 or #7. The number of the cold light mirror is marked on one corner. Cold light mirror #2 is specific to UV300, while cold light mirror #7 may be used for UV400 and UV300.

- **Interference Filter**: 60 mm diameter round filter (365 nm).

- **Lens Plate**: One lens plate with 12 single lenses arranged in a triangle configuration, fabricated of Herasil.

- **Front Lens**: Black.

5.4.2.3 UV250 Optical Components

- **Exposure Lamp**: 500W Hg/Xe.

- **Cold Light Mirror**: #11. The number of the cold light mirror is marked on one corner.

- **Lens Plate**: Two lens plates with 12 lenses each arranged in a triangular configuration, fabricated of Suprasil. The Suprasil lens plate may also be used for UV400.

- **Front Lens**: Transparent, fabricated of Suprasil.

5.4.2.4 UV200 Optical Components

- **Exposure Lamp**: 350W Cd/Xe with adapter.

- **Cold Light Mirror**: #8. The number of the cold light mirror is marked on one corner.

- **Lens Plate**: Two lens plates with 12 lens each arranged in a triangle configuration, fabricated of Suprasil. The Suprasil lens plate may also be used for UV400.

- **Front Lens**: Transparent, fabricated of Suprasil.

5.4.3 Changing from One Wavelength Range to Another

The procedure for converting from one exposure wavelength range to another is the same for all optics sets. Perform the following sequence using the components for the desired wavelength range as described in Section 5.4.2.

Switch off the exposure lamp power supply and disconnect it from the main power source. Allow at least 20 minutes for the lamp to cool.

Exposure Lamp

- Loosen the lamphouse retaining screw and swing open the lamphouse on its hinges.

  NOTE: If you are converting from UV400 to UV300, or from UV300 to UV400, the exposure lamp is the same for both optics set.

- Remove the existing lamp and adapter.
- Insert the correct lamp (See Section 5.3.1).

UV400 - 350W Hg with adapter	UV250 - 500W Hg/Xe
UV300 - 350W Hg with adapter	UV200 - 350 Cd/Xe with adapter

  NOTE: Install the Hg lamp with the negative terminal through the ellipsoid mirror. Install the Hg/Xe and Cd/Xe with the positive terminal through the ellipsoid mirror.

- Remove the power supply leads terminal cover on the back of the lamphouse.
- Check that polarity of power supply leads to lamphouse are correct. Reverse if necessary. Blue cable is positive - white cable is negative.
- Replace the power supply leads terminal cover.

Cold Light Mirror

NOTE: If you are converting from UV400 to UV300, or from UV300 to UV400, and a #7 cold light mirror is currently installed, you do not have to change the cold light mirror.

- Loosen the screws holding the cold light mirror retaining clips and remove the cold light mirror.

- Place the correct cold light mirror on the mount and tighten the retaining clips (see Section 5.3.1).

  UV400 - Cold Light Mirror #7 UV250 - Cold Light Mirror #11

  UV300 - Cold Light Mirror #7 UV200 - Cold Light Mirror #8

  CAUTION: Do not overtighten the retaining clips. The cold light mirror must have a small amount of free movement.

- Close the lamphouse and secure it with its screw.

Mirrorhouse

- Remove the mirrorhouse balance weights (if so equipped).

- Remove the cover on top of the mirrorhouse tube.

- Loosen the screws securing the condenser lens, filter holder, and the lens plate holder.

- Slide the components to the rear and remove the lens plate from its holder.

  NOTE: If you are converting from UV250 to UV200, or from UV200 to UV250, you do not need to change the lens plate.

- Insert the correct lens plate in the holder.

  UV400 - Two lens plates with 12 lenses each, fabricated of Herasil.

  UV300 - One lens plate with 12 single lenses, fabricated of Herasil.

  UV250 - Two lens plates with 12 lenses each, fabricated of Suprasil.

  UV200 - Two lens plates with 12 lenses each, fabricated of Suprasil.

- Slide the lens plate and holder forward to 85 mm from the lamphouse.

- If converting to UV300, insert the interference filter in the holder and slide it forward against the lens plate.

  If converting to UV400, UV250, or UV200 from UV300, remove the interference filter from its holder.

- Position the condenser lens centered at 40 mm from the lamphouse.

- Tighten the screws securing the condenser lens, filter holders, and the lens plate holder.
- Replace the mirrorhouse cover.
- Replace the mirrorhouse balance weights (if so equipped).

Front Lens

- Remove the front lens by grasping the small black knob and sliding it from the mirrorhouse.

  NOTE: If you are converting from UV250 to UV200, or UV200 to UV250, you do not need to exchange the front lens.

- Insert the proper front lens into the slide.

  UV400 - Transparent

  UV300 - Black

  UV250 - Transparent, fabricated of Suprasil

  UV200 - Transparent, fabricated of Suprasil

Intensity Sensor

- If the installed intensity sensor does not have a detector for the specific wavelength range you are converting to, it will be necessary to change the sensor so that the constant intensity controller will monitor the proper wavelength.
- The sensor is a dual channel system and may contain detectors for more than one wavelength.
- The type of sensor is marked on the plug connecting it to the power supply.

UV400 - 365 nm and 405 nm	UV250 - 240 nm
UV300 - 320 nm	UV200 - 220 nm

- If a sensor is installed that does not monitor the required wavelength, please contact SUSS Customer Service.

Reconnect the power supply to the main power source.

Refer to Section 5.3.3, Intensity and Uniformity Adjustments and Measurements, and recalibrate the power supply.

5.5 Setting Contact Pressure and Separation Stroke Using the Dial Indicator Kit

To set the contact pressure and separation stroke, please refer to Figure 5-6 and proceed as follows:

1. Move the machine out over the front of the bench to provide access to the separation stroke adjustment located under the stage.

2. Remove the microscope.

3. Place a wafer of known thickness on the chuck. If using a vacuum contact chuck, first remove the vacuum gasket.

4. Place a mask of known thickness on top of the wafer.

5. Assemble the dial indicator to the arms supplied and attached it using the fork behind the small plate located at the right front of the stage (Figure 5-6).

6. Place the steel bar supplied over the center of the chuck on the maskholder rails.

7. Position the dial indicated over the center of the bar and adjust it downward until the dial indicator arm contacts the bar and scale deflection is obtained. Rotate the outer ring of the dial indicator to obtain a reference needle reading of zero.

8. Rotate the contact lever 180° counterclockwise. The wafer and mask will contact the bar and move it upward.

9. The upward movement of the bar (measured from the zero reference) is the contact pressure. The amount of contact pressure is adjusted by rotating the variable thickness adjustment knob counterclockwise to increase it and clockwise to decrease it. One revolution of the knob corresponds to a 150 micron variation in contact pressure.

10. When the desired contact pressure has been set, record the wafer thickness, mask thickness, and the reading of the variable thickness adjustment knob. These values are used as the reference when varying substrate thickness or contact pressure without the use of the dial gauge (refer to Section 2.5.3).

11. Move the separation level to its rearmost position and observe the deflection on the dial indicator. This is the separation stroke. To adjust it, refer to Figure 5-7. Loosen the locking screw and slide the arm in to increase the separation stroke, or out to decrease it. Re-tighten the locking screw.

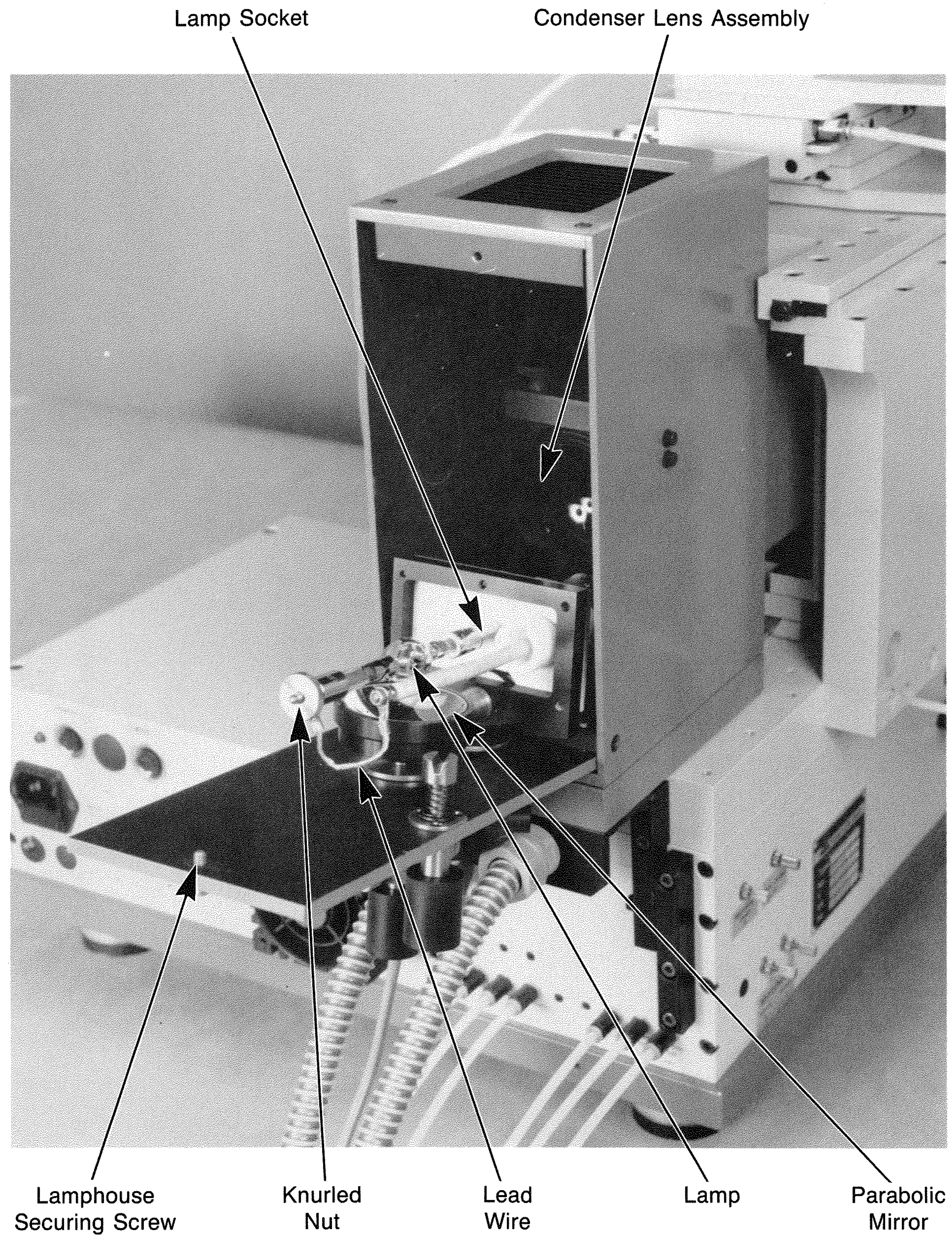


Figure 5 - 1 Lamphouse (Standard and HP/200W)

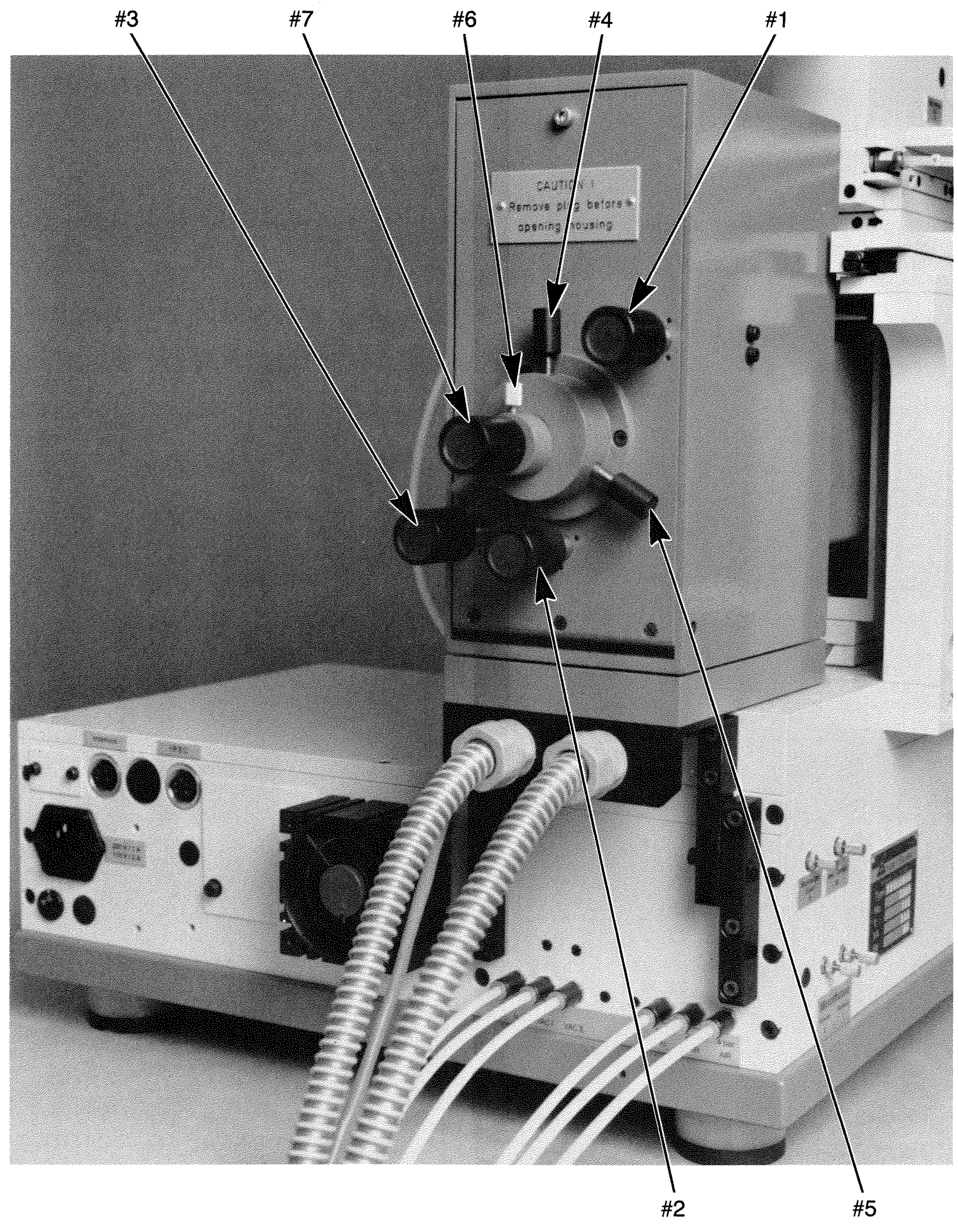


Figure 5 - 2 Lamphouse (Standard and HP/200W) Showing Adjustments

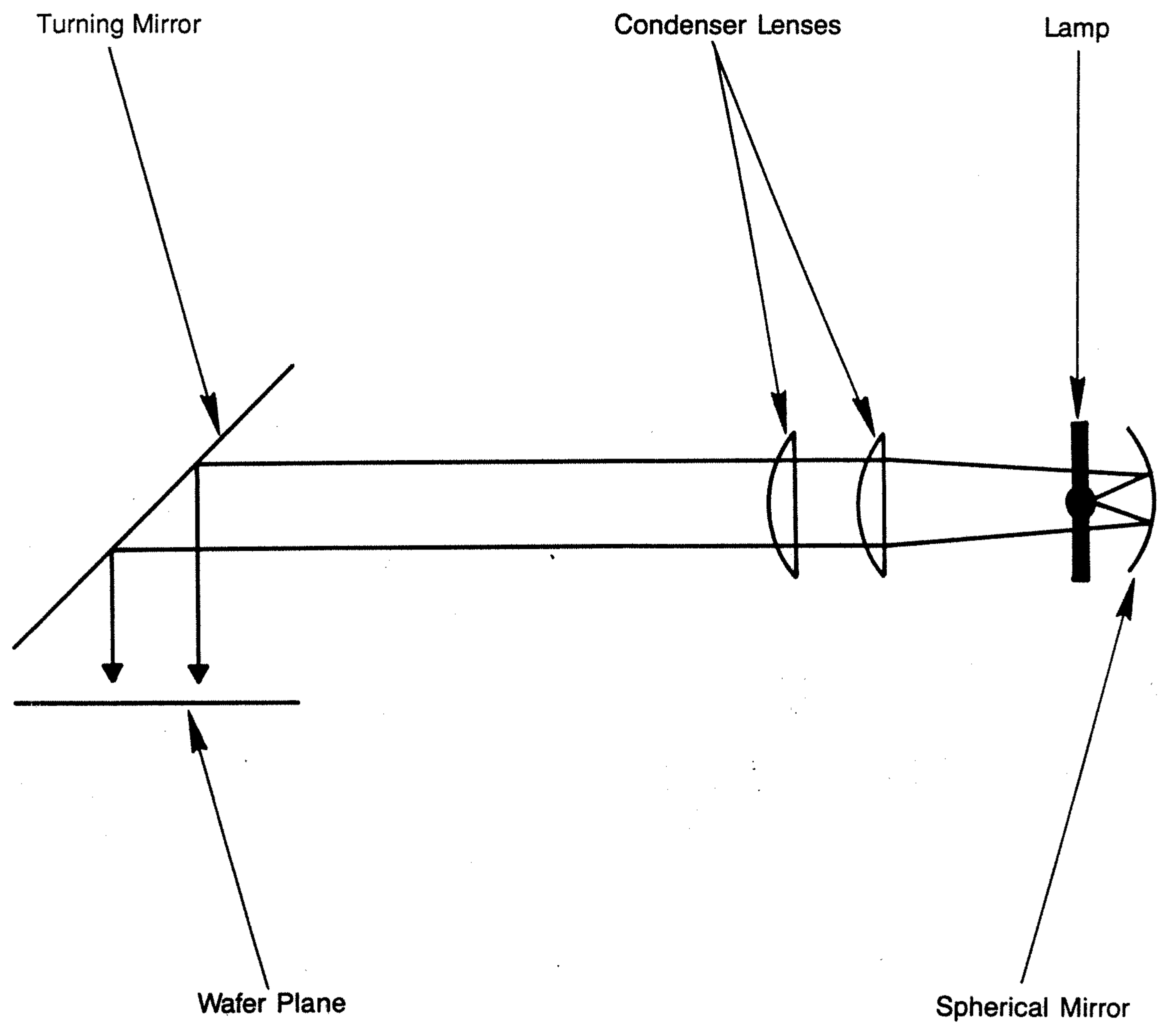


Figure 5 - 3 Exposure Optical System (Standard and HP)

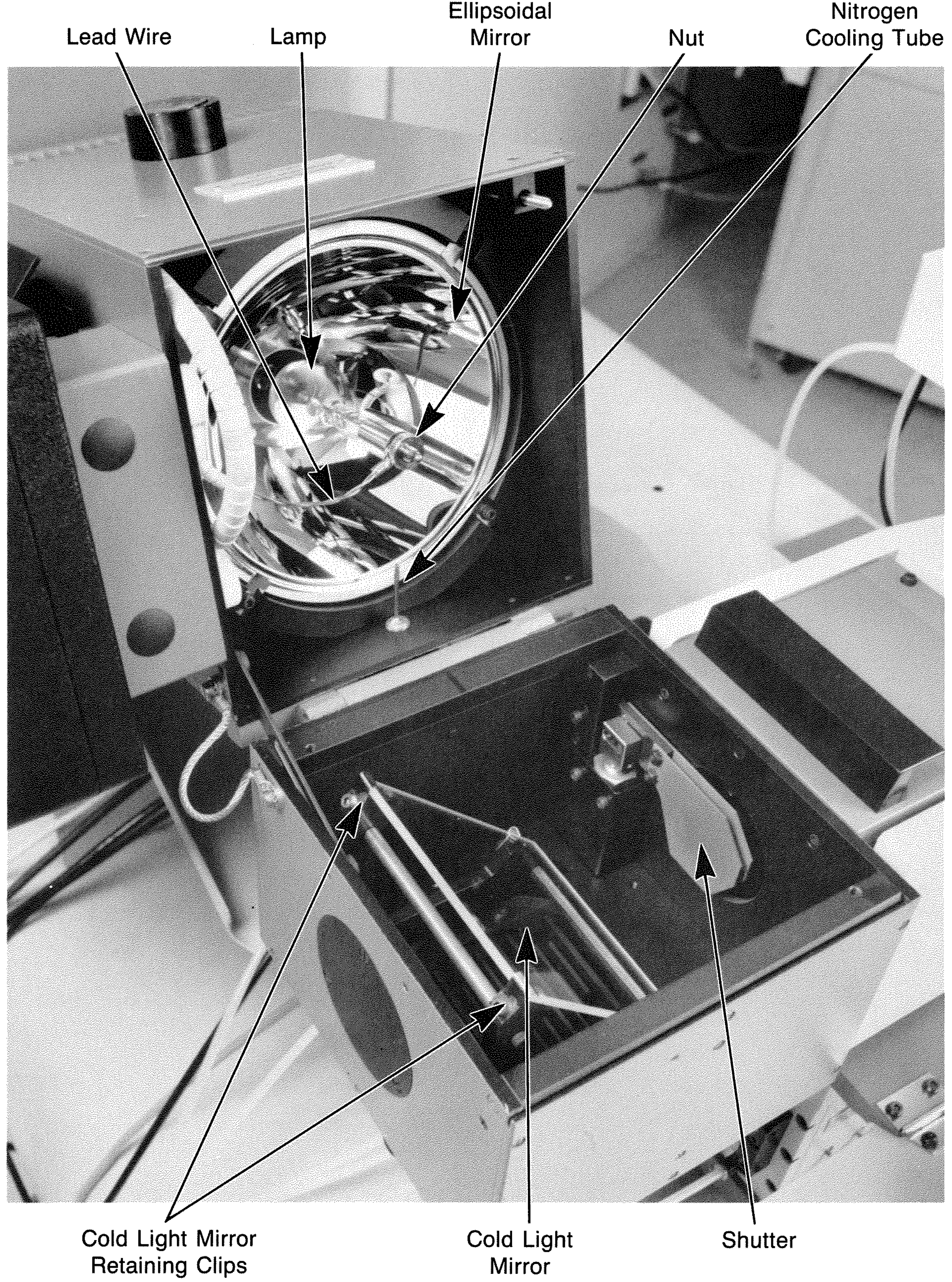
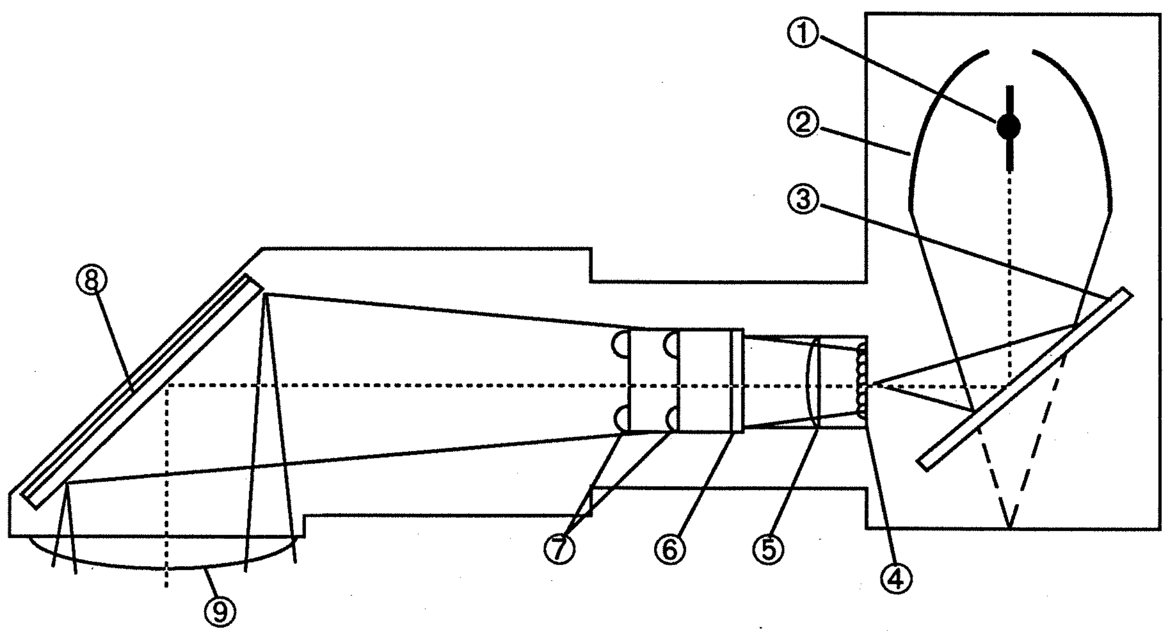


Figure 5 - 4 Lamphouse (350W)



① Lamp
② Ellipsoidal Mirror
③ Coldlight Mirror
④ Fly's Eye Lens
⑤ Condenser Lens
⑥ Frame for Filters
⑦ Diffraction Reducing Lens Plates
⑧ Turning Mirror
⑨ Front Lens

Figure 5 - 5 Exposure Optical System (UV400/300/250/200)

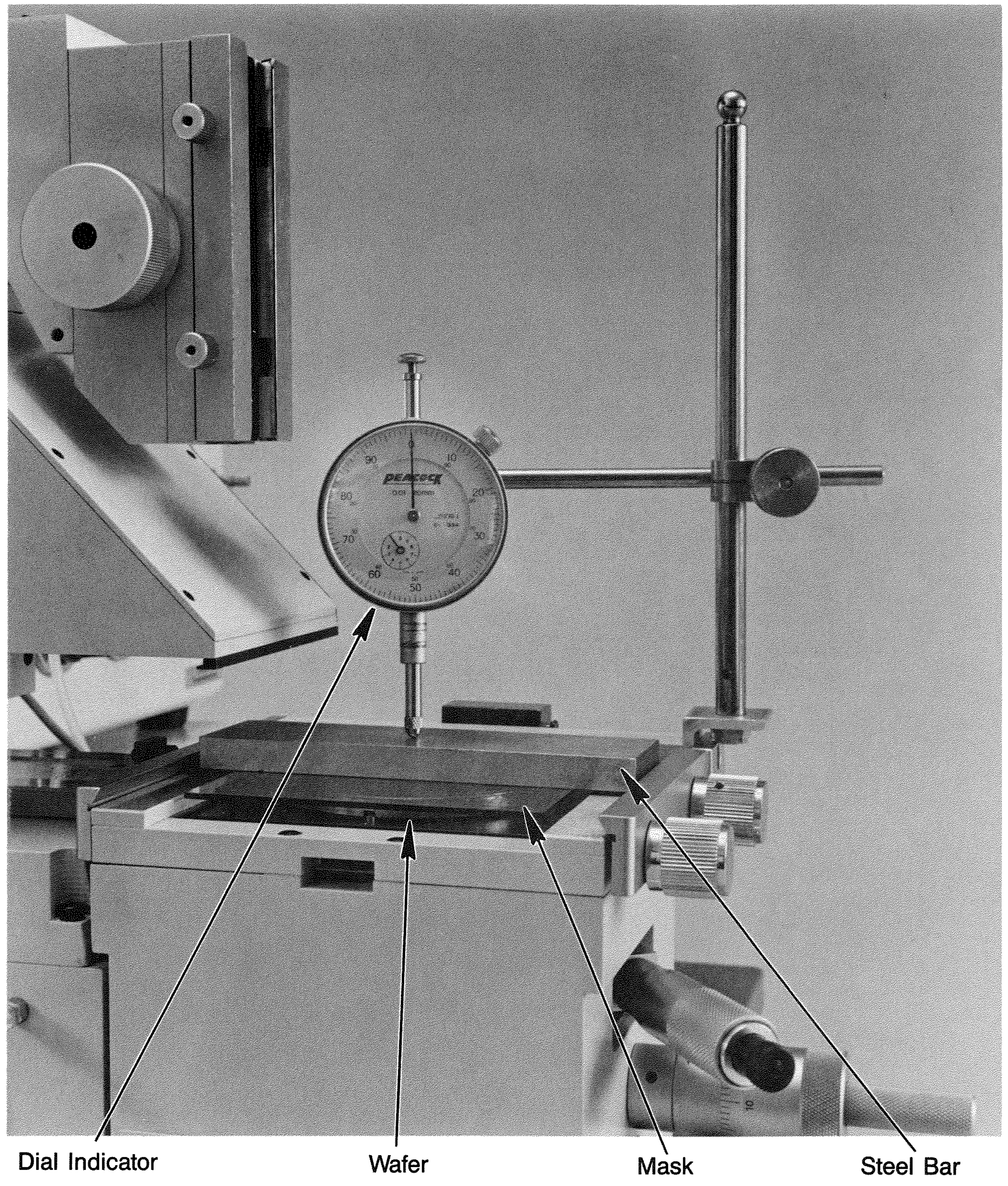


Figure 5 - 6 Dial Indicator Assembled on Machine

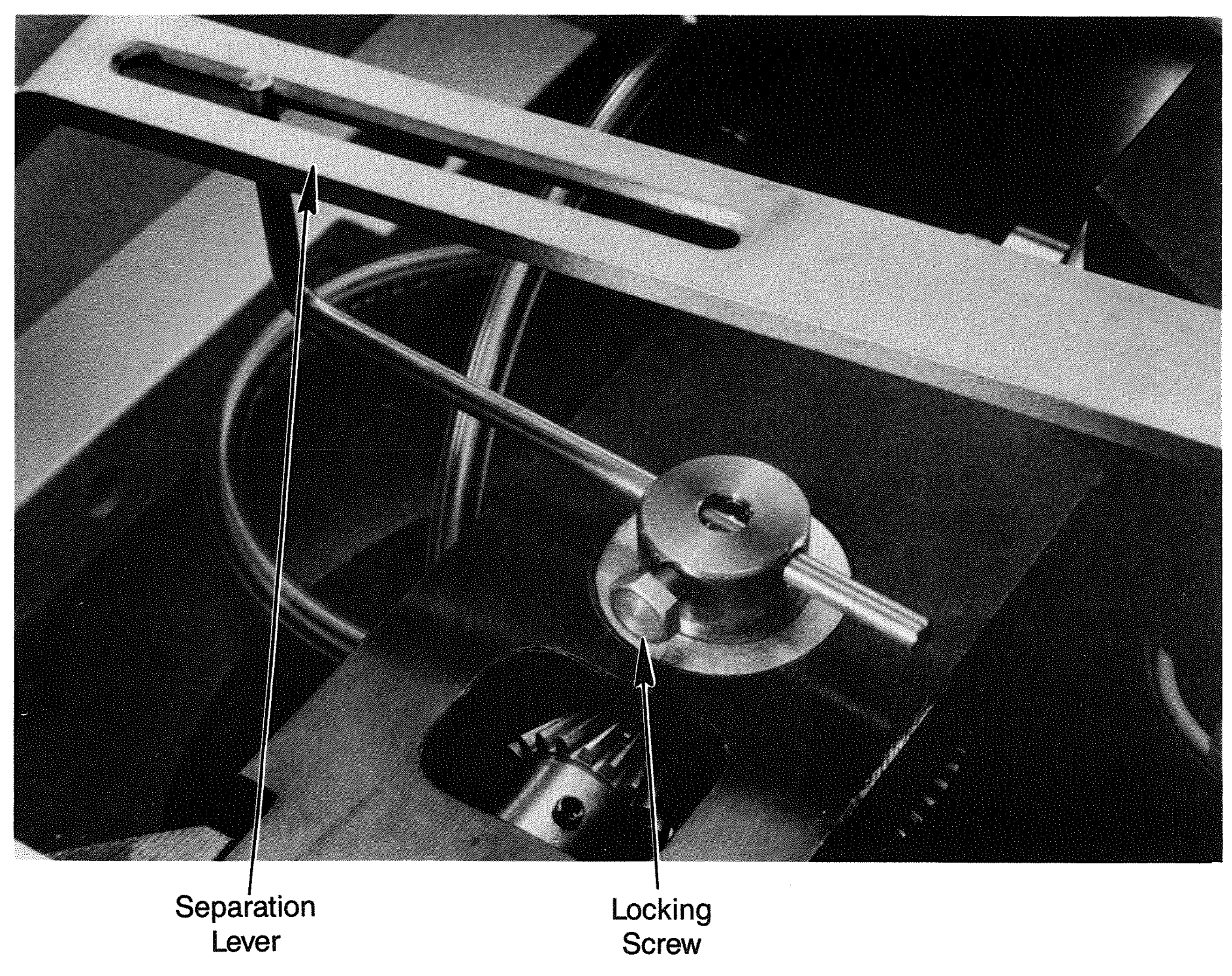


Figure 5 - 7 Separation Stroke Adjustments

6 INSTALLATION

6.1 General

A few weeks prior to shipment of your equipment, you should receive an installation package from KARL SUSS. Figure 6-1 is a checklist which should be used to ensure that installation of the equipment is smoothly accomplished. Figure 6-2 includes machine "footprints" which may be used to determine and allocate the space required.

6.2 Receiving the Shipment

KARL SUSS will give your company an estimated date of arrival before shipping the equipment to your facility. If there are any special requirements at your site concerning shipment and receipt of large, heavy containers, please get in touch with us immediately. Upon arrival of the shipment, the containers should be inspected for evidence of damage or mishandling. If any damage is apparent, notify the freight carrier and KARL SUSS at once.

6.3 Installing the Equipment

The mask aligner must be installed by a KARL SUSS field service representative. The various assemblies of the system, in their containers, may be transferred to the installation location if desired, but the containers should not be opened and unpacked until the service representative arrives. This is very important in order to avoid any questions regarding the equipment warranty.

6.4 Clearance Required for Crate

The machine and accessories are normally shipped in one crate fitted with skids to permit it to be moved with standard material handling equipment. The packed crate is approximately 940 mm (37 in) wide by 1245 mm (49 in) deep by 965 mm (38 in) high and weighs about 193 kg (425 lbs). The receiving doors should be wide enough to allow the crate to be moved inside the building for unpacking.

6.5 Environmental Requirements

The machine should be located in a vibration-free area that is also as free as possible from dust and acid fumes. The area must be maintained at a room temperature between 20°C (68°F) and 22°C (72°F) and at a relative humidity of 45 - 55% Since the equipment may be affected by static electricity from the operator, it should be installed where the floor covering does not generate a static charge.

The equipment must be installed at least 8 cm (3 in) from the wall to allow for ventilation. In addition, all utilities are connected to the back of the unit. Although the machine can usually be serviced in place, it may be necessary in some cases to move it 60 cm (24 in) from the wall for access.

6.6 Power Requirements

6.6.1 U.S. Market

The units require two grounded (3-pronged) 110V/60Hz outlets:

- one at 20 amps for the machine electronics
- one at 20 amps to power the isolation transformer which is connected to the lamp power supply.

6.2.2 International Market

The units require 220V/50Hz or 110V/60Hz AC.

- Power cord - grounded 3-wire cable; 1.5m (5 ft) for 220V.

6.7 Other Utility Requirements

Requirements for nitrogen, vacuum, and compressed air:

- Nitrogen: 30 - 45 psi or 2 - 3 bar; consumption - 17.5 scfh (0.5 m^3/h)
- Vacuum: more than 24" of Hg or less than 200 mbar absolute (less than -0.8 bar gauge); flow rate = insignificant
- Compressed air: 75 - 105 psi or 5 - 7 bar; consumption - 35 scfh (1.0 m^3/h)

Exhaust lamphouse cooling:

- Hose: 100 mm inside diameter
- No exhaust required for 200W and 350W lamp

It is important to use dry nitrogen and to eliminate any water, oil, or dust particles in the compressed air lines. All connections to a house vacuum system should be separate to avoid vacuum interference.

U.S. Market - Refer to Figure 6-1 for additional requirements.

International Market - The shipment includes hoses to connect vacuum, compressed air, and nitrogen to the machine. The customer is responsible for the connections to the back of the machine. KARL SUSS will equip each machine with the appropriate connector for 6 mm (1/4") hose.

CHECKLIST FOR MACHINE INSTALLATION

(U.S. Market)

NAME ______________________________

COMPANY ______________________________

MODEL ______________________________

SERIAL # ______________________________

EST. SHIP DATE ______________________________

SPECIAL NOTES ______________________________

____

Your organization will soon be receiving this high performance SUSS Mask Aligner. In order to ensure a smooth installation, the following need to be available prior to the arrival of the service engineer who will be setting up your machine:

1. Power meter to calibrate lamp and power supply. __________
2. Provided through 1/4" OD semi-rigid hose to machine location:

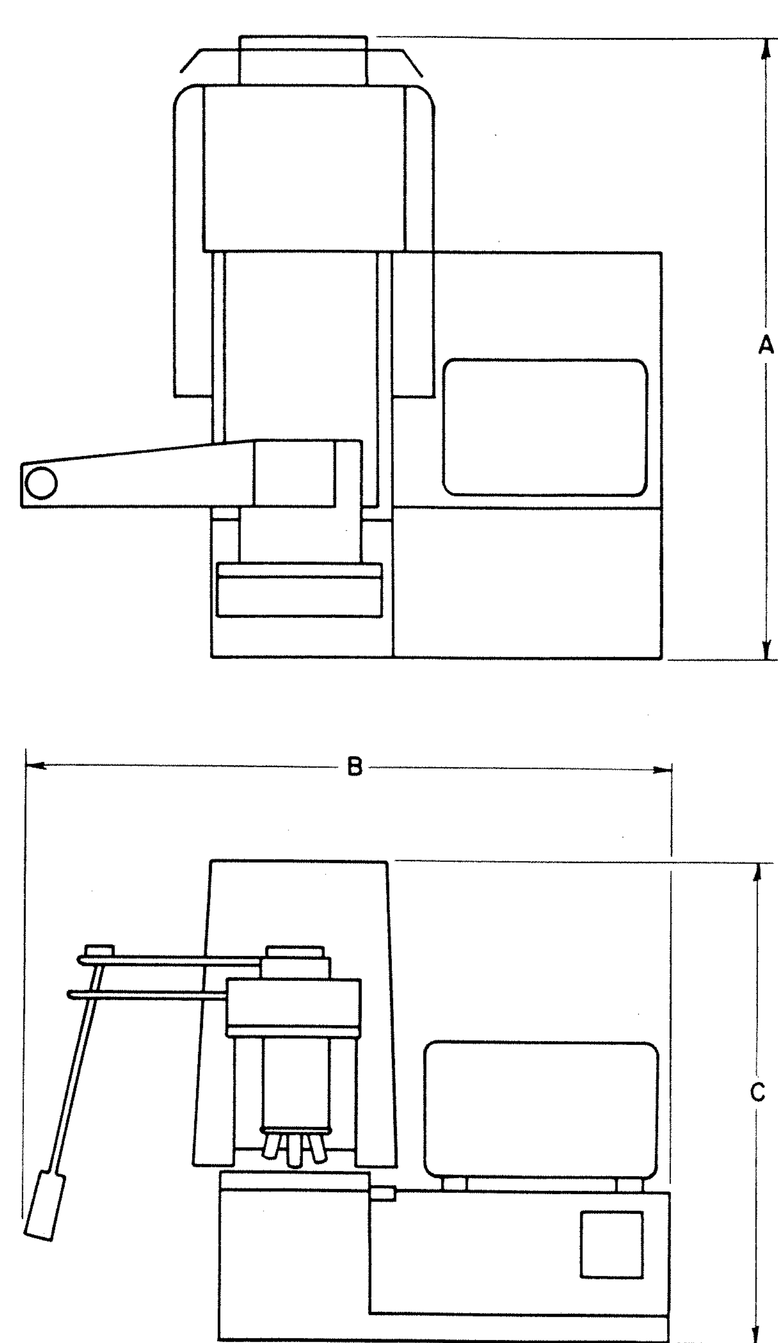
   a. 75 - 105 psi of filtered, dry air __________

   b. 30 - 45 psi of 99.9% grade dry nitrogen __________

   c. 24" Hg vacuum __________
3. Two tees for 1/4" OD hose. __________
4. Two 110 VAC/60Hz/20A grounded outlets within 6 feet of machine location. __________
5. Test masks and coated, dehydrated wafers for use in verifying machine operation. __________

At time of installation, the lab should be set up to a point that test prints can be made and evaluated.

Figure 6 - 1 Checklist for Machine Installation



DIMENSIONS

	DEPTH A	WIDTH B	HEIGHT C
MJB 3 Standard	700 mm (27.6")	625 mm (25")	550 mm (21.7")
MJB 3 HP/200W	700 mm (27.6")	625 mm (25")	550 mm (21.7")
MJB 3 HP/350W	760 mm (30")	625 mm (25")	550 mm (21.7")

Figure 6 - 2 Suss MJB 3 Footprint

7 WARRANTY AND LIMITATIONS

In most cases, KARL SUSS mask aligners carry a six month warranty covering labor, material, and workmanship. This warranty may vary for different areas around the world. Please consult the specific warranty terms outlined in your quotation for the particulars pertaining to your machine.

7.1 Scope

This warranty is limited to:

a. equipment unpacked and installed by KARL SUSS representatives.

b. equipment that is used and operated in accordance with the Operator's Reference Manual.

c. equipment that is properly maintained on a regular basis.

This warranty excludes:

a. damage during shipment. (Claims must be presented to the carrier or as determined by local practice.)

b. any items that are subject to wear during normal operation of the equipment, such as exposure lamps, maskholders, chucks, and the rubber lips for vacuum chucks.

All implied warranties, including warranties of merchantability and fitness for a particular purpose are limited in duration to the length of this warranty, unless otherwise provided by state law.

The liability of KARL SUSS is limited to the repair or replacement, at our option, of any defective product and shall in no event include incidental or consequential commercial damages of any kind.

7.2 Exposure Lamp Explosions

If an exposure lamp explosion should occur, please return the lamp socket and several of the glass fragments to KARL SUSS. We will contact the lamp manufacturer and try to determine the cause of the explosion. If the failure of the lamp is due to faulty workmanship or material, we will replace the lamp at no cost.

Consequential damage to the optics or lamphouse due to a lamp explosion is not covered by this warranty. It is important that you follow all lamp starting, adjustment, and cooling procedures, and that you do not exceed the recommended life of the lamp. We strongly suggest that you use only exposure lamps provided by KARL SUSS. Lamp explosions are nearly always caused by improper adjustment and/or operation of the exposure lamp.

7.3 Who Is Protected

This warranty is offered only to the original purchaser of the equipment.

7.4 How To Receive Warranty Service

U.S., Canada, and Mexico

1. Call Customer Service at 802-244-7884 during normal working hours, Eastern time.

2. Be prepared to furnish the following information (if available):

   a. Your company name, address, and telephone number with the name and telephone number or extension of the individual whom we may contact if necessary for further technical information regarding the problem.

   b. Model and serial number of the machine.

   c. A list of the peripheral equipment which may be associated with the machine and a description of the connections.

   d. A brief description of the problem.

3. Based on the information which you have provided, Customer Service will provide you with further instructions, and put you in touch with a SUSS field service representative.

International

The KARL SUSS office which processed your original order or currently handles your customer account can give you specific instructions about how to obtain warranty service.

8 APPENDIX

8.1 Discussion of Manual Alignment

Manual alignment is typically performed at an alignment gap which fully exploits the depth of focus of the microscope used. This ensures the least chance of damage to the mask or the substrate during alignment.

The depth of focus of a microscope is directly related to its magnification. For a typical alignment gap of about 20 microns (which is a reasonably safe distance between mask and wafer for most applications) the magnification is limited to about 180X which may not be sufficient to obtain the level of alignment accuracy required. However, increasing the magnification to 400X, for instance, drastically reduces the depth of focus to about 3 microns. For all practical purposes, it is impossible to perform alignments at such a small gap.

The line and space resolution of an alignment microscope of the maximum practical magnification (180X) is about 1.5 microns. Fortunately, it is not necessary to recognize submicron features in order to achieve submicron alignment accuracy. Instead, we use a different approach.

The human eye has a remarkable ability to recognize symmetry. The challenge in designing appropriate alignment marks therefore consists of finding schemes where some kind of symmetry is apparent using high contrast patterns. The simplest example is placing a small cross inside a large cross. The line width of the small cross is not significant if both sides of the cross can be seen without excessive eye movement. The distance between the edge of the smaller line and the larger line when both crosses are aligned is critical, however. This distance must be larger than the minimum feature size for the given line and space resolution of the microscope, but at the same time it has to be as small as possible.

The absolute minimum distance is about 2 microns, with typical values being between 3 and 5 microns, depending on contrast and edge quality. If the distance between the small line and the large line is 3 microns, a 0.5 micron misalignment will result in a 3.5/2.5 intensity ratio as read by the eye. This is a significant amount since the larger gap is 40% brighter than the smaller gap.

In proximity printing, the alignment gap and exposure gap are of the same order of magnitude, and so are usually handled with the same objective/eyepiece combination.

In contact printing, however, since the exposure gap is considerably smaller than the alignment gap, an objective/eyepiece combination with a small depth of focus can be used to verify the alignment at exposure position before the exposure takes place. A turret microscope using at least two different objectives is the ideal tool for this purpose.

In this case, a second adjustment key with smaller dimensions (for example, a 1 micron distance between the smaller and the larger lines) can be employed if desired to make checking the alignment in exposure position easier. For the highest alignment accuracy, it is likely that the operator will have to alternate repeatedly between the separation and contact positions, even if the aligner itself has no shift.

Regrettably, there is no simple way around the problem of performing alignment with insufficient magnification.

8.2 Microscope Descriptions

8.2.1 SUSS Normalfield Microscope M400

The SUSS M400 microscope (Figure 8-1) consists of the microscope head (either binocular or trinocular), eyepieces, microscope body, illuminator, objective turret and objectives. The microscope is equipped with a 4 objective turret. The SUSS M400 is offered in two versions: brightfield only and a brightfield/darkfield/interference contrast combination. Interference contrast and darkfield operation are only possible with certain objectives (Figure 8-2).

8.2.1.1 Microscope Head and Eyepieces

A binocular or trinocular head is available. The eyepieces may be exchanged by simply removing one set from the eyepiece tubes and replacing them with another set. An image is obtained in the trino-tube by pulling out the lever located on the left side of the head. The choice of eyepieces is dependent on the magnification desired (Figure 8-2).

8.2.1.2 Microscope Body

The microscope body contains a half mirror which reflects the microscope illumination onto the object and transmits the object image to the eyepiece image plane. In the brightfield/darkfield/interference contrast version, the microscope body also incorporates a slide containing the analyzer which is used for interference contrast illumination.

8.2.1.3 Objective Turret

There are detents for each objective position. The turret is rotated by grasping the turret (not the objectives!) and turning it to the detent.

8.2.1.4 Illuminator

The illuminator uses a 15W lamp which is powered from an adjustable transformer. Note that settings greater than "6" on the transformer should only be used for brief periods as this will drastically reduce the life of the lamp. An iris diaphragm is built into the body of the illuminator which can be used to obtain an optimum image.

In addition, on the brightfield/darkfield/interference contrast version, there are two slides built into the illuminator body. The first contains the polarizer plate which is used in conjunction with the analyzer to obtain interference contrast illumination. The polarizer may be rotated to obtain an optimum image using the lever. The second contains the darkfield stop which is inserted into the light path to obtain darkfield illumination.

To exchange the illumination lamp, slide the lamp socket out from the illuminator body. Exchange the lamp and re-insert the lamp socket. The three screws on the lamp socket may be used to center the lamp filament, and should be positioned so that approximately 5 mm of thread is exposed.

8.2.1.5 Darkfield Illumination (if equipped)

To obtain darkfield illumination, proceed as follows:

a. Rotate the turret to bring the darkfield objective (5.5x) to the observation position.

b. Insert the darkfield stop into the illuminator light path by pulling the slide toward the operator.

c. Ensure that the polarizer and analyzer are not in the light path (Refer to "Interference Contrast Illumination").

8.2.1.6 Interference Contrast Illumination (if equipped)

To obtain interference contrast illumination, proceed as follows:

a. Rotate the turret to bring an interference contrast objective (5xIC or 10xIC) to the observation position.

b. Insert the analyzer into the light path by pulling the analyzer slide out of the microscope body toward the operator.

c. Insert the polarizer into the illumination light path by pulling the polarizer slide toward the operator.

d. Ensure that the darkfield stop is not in the light path. (Refer to "Darkfield Illumination").

e. Rotate the polarizer using the lever to obtain an optimum image.

8.2.1.7 Objectives

Objectives may be of the brightfield, interference contrast or darkfield type. (Refer to Figure 8-2.) Objectives with higher magnification have a restricted depth of focus which allows observation of the mask and wafer only in contact position or at a small separation distance. Note that the positions of the interference contrast objectives or the darkfield objectives should not be exchanged in the turret.

8.2.2 SUSS Splitfield Revolver Microscope: M200 - 200 Series

NOTE: Some machines may incorporate the SUSS M204 Microscope. If so, please refer to Figure 8-5 for magnification and optical data.

The SUSS M200 Microscope (Figure 8-3) consists of the microscope head (either binocular or trinocular), eyepieces, microscope body, illuminator, and objectives. The choice of eyepieces and objectives depends on the magnification desired. The SUSS M200 is offered in three versions: brightfield only, brightfield/darkfield, and brightfield/ interference contrast. Darkfield and interference contrast operation are only possible with certain objectives. (Refer to Figure 8-4 for magnification and optical data on the SUSS M200, or Figure 8-5 for similar data on the SUSS M204.)

8.2.2.1 Microscope Head and Eyepieces

A binocular or trinocular head is available. The eyepieces may be exchanged by simply removing one set from the eyepiece tubes and replacing them with another set. An image is obtained in the trino-tube by pulling out the lever located on the left side of the head. The choice of eyepieces is dependent on the magnification desired. Rotation of the microscope may be performed by turning the knurled screw located under the microscope head.

8.2.2.2 Microscope Body

The microscope body contains prisms, optical shutters for selection of either singlefield or splitfield operation, and half mirrors which reflect the microscope illumination onto the object and transmit the object image to the eyepiece image plane. In the interference contrast version the microscope body also incorporates a slide containing the analyzer which is used for interference contrast illumination.

There are two small knurled knobs located on the front of the microscope body. Each light path of the microscope incorporates a shutter separately adjustable by these knobs. These permit selection of the image to be viewed:

a. Left hand half image and right hand half image (splitfield).

b. Full left hand image.

c. Full right hand image.

The distance between the objectives may be adjusted continuously between 26 mm and 100 mm using the two knurled knobs located on the bottom of the microscope body. In addition, a minimum distance of 14 mm or a maximum distance of 120 mm can be attained by two optional pivoting attachments. Both the sharpness of the microscope image and the scale of magnification are retained when changing the distance between the objectives. Fine adjustment of the image sharpness is effected by the same knobs.

8.2.2.3 Illuminators

Two types of illuminators are available. For brightfield operation only, two fiber-optic light guides connected to a lamphouse are normally used. For darkfield or interference contrast operation, two 15W direct illuminators are normally used. In both cases, the brightness is controlled by an adjustable transformer. Two iris diaphragms are built into the body of the illuminators which can be used to obtain a optimum image.

To exchange the illumination lamps of the direct illuminators, slide the lamp socket out from the illuminator body. Exchange the lamp and re-insert the lamp socket. The three screws on the lamp socket may be used to center the lamp filament, and should be positioned so that approximately 5 mm of thread is exposed.

The illumination lamp of the fiber optic illuminator is easily replaced by removing the lamphouse cover.

8.2.2.4 Darkfield Illumination (if equipped)

To obtain darkfield illumination, adapters with pivotable central stops are inserted into the illuminator light path. The normal objectives are replaced by brightfield/darkfield objectives (5.5X) with concentric condensers. Conversion from the brightfield to the darkfield mode and vice versa is effected by swinging the central stops in or out of the light path, respectively.

8.2.2.5 Interference Contrast Illumination (if equipped)

For interference contrast illumination, the unit is equipped with revolvable polarizers, objectives with Wollaston prisms, and an analyzer built into the microscope body. To obtain interference contrast illumination, proceed as follows:

a. Insert the analyzer into the light path by pulling the analyzer slide out of the microscope body towards the operator.

b. Insert the polarizers into the illuminator light path by pulling the polarizer slides toward the operator.

c. Rotate the polarizers using the levers to obtain an optimum image.

8.2.2.6 Objectives

Objectives may be of the brightfield, interference contrast, or darkfield type. (Refer to Figure 8-4 or Figure 8-5.) Note that each set of objectives is individually adjusted to the microscope. Therefore, their positions should not be exchanged. Replacement of a set of brightfield objectives with another set of higher magnification is possible, however, replacement with another set of lower magnification may result in some deterioration in image quality. In this case, the microscope should be returned to KARL SUSS for readjustment. Please call your KARL SUSS Customer Service representative for further instructions.

8.2.3 SUSS Splitfield Turret Microscope: M230 - 200 Series

The SUSS M230 Microscope (Figure 8-6) consists of the microscope head (either binocular or trinocular), eyepieces, microscope body, illuminator, two objective turrets, and six objectives. The eyepiece and objective combinations result in a range of magnification of 66-400X. (Refer to Figure 8-7.) The SUSS M230 is available in a brightfield version, or in a interference contrast type as an option.

8.2.3.1 Microscope Head and Eyepieces

A binocular or trinocular head is available. The eyepieces may be exchanged by simply removing one set from the eyepiece tubes and replacing them with another set. An image is obtained in the trino-tube by pulling out the lever located on the left side of the head. The choice of eyepieces is dependent on the magnification desired. Rotation of the microscope may be performed by turning the knurled screw located under the microscope head.

8.2.3.2 Microscope Body

The microscope body contains prisms, optical shutters for selection of either singlefield or splitfield operation, and half mirrors which reflect the microscope illumination onto the object and transmit the object image to the eyepiece image plane.

There are two small knurled knobs located on the front of the microscope body. Each light path of the microscope incorporates a shutter separately adjustable by these knobs. These permit selection of the image to be viewed:

a. Left hand half image and right hand half image (splitfield)

b. Full left hand image

c. Full right hand image

8.2.3.3 Objective Turrets

Each turret incorporates detents for each objective position. The turret is rotated by grasping the turret (not the objectives!) and turning it to the detent.

8.2.3.4 Illuminators

Two fiber optic light guides connected to a lamphouse are used. The brightness is controlled by an adjustable transformer. Two iris diaphragms are built into the body of the illuminators which can be used to obtain an optimum image.

The illumination lamp is easily replaced by removing the lamphouse cover.

8.2.3.5 Objectives

Three pairs of objectives are normally supplied: 3.5X, 10X, and 25X. The 25X objectives have a restricted depth of focus which allows observation of the mask and wafer only in contact position. Therefore the 3.5X and 10X objectives should be used for alignment and the 25X objective for checking alignment. Note that each objective is individually adjusted to the microscope. To retain parfocality of the objectives, they should not be removed from the turret. (Refer to Figure 8-7.)

8.3 Scanning Infrared Viewing System for Backside Alignment (Optional)

Each SUSS MJB 3 is equipped with a video camera, monitor, and special tooling enabling the printing of features on one side of wafers aligned to features on the other. The Infrared (IR) mode or normal operating mode may be selected with a minimum of conversion time.

In the IR mode, a special chuck transparent to the IR spectrum is used (refer to Figure 8-8). The lamp under this chuck has a high output in the IR range. This IR radiation is transmitted through the chuck and the wafer to the microscope and camera.

Since the infrared source is always directly below the microscope objective, any point within the scan field, which is slightly less than two inches in diameter, can be viewed with the same infrared intensity. In addition, alignment errors due to refraction (parallax errors) are eliminated since the light source is always centered beneath the objective.

Components other than those described in the SUSS MJB 3 Operator's Reference Manual have been supplied with your machine. Please familiarize yourself with the Operator's Manual for the conventional MJB 3 so that you may better understand the description of the IR system.

The differences between the conventional machine and the IR system are explained and grouped under the following subassemblies:

- Alignment Stage
- Microscope Manipulator
- Electric Control
- Operation

8.3.1 Alignment Stage

The maskholder is removed and inserted from the front of the alignment stage with the securing knobs on the left side. The mask is held by vacuum as described in the Operator's Manual.

The transport slide has two clear hoses attached to it from the machine base. The larger diameter hose supplies the vacuum for the pre-vacuum feature. The smaller diameter hose is attached to a throttle at the base of the stage on the right side and provides the vacuum to secure the wafer to the IR exposure chuck and is attached to the left side of the pre-vacuum switch block. When the IR chuck is used, the other end of this hose attaches to the chuck and supplies the vacuum to secure the wafer to the chuck. It also supplies the nitrogen for the hard contact exposure mode. When the MJB 3 is used with non-IR chucks, an adapter ring is fitted into the wafer transport. This ring accommodates normal MJB 3 chucks, and the hose fastens to the right side of the ring. In this mode, pre-vacuum is supplied only to standard chucks.

A small diameter clear hose is located at the chuck mounting plate which is the smooth metal plate at the center of the alignment stage. This is used with the IR chuck adapter to supply cooling nitrogen to the IR lamp. It is controlled by the throttle marked "Purge" on the manometer box.

Two types of exposure chucks are available - each type has special adapters that adapt the chucks to the machine.

The IR chucks are constructed of a material transparent to the IR Wavelength range. The IR chuck is placed in the transport slide, and the small clear hose is attached to its right side. A special adapter is then placed on the chuck mounting plate. This adapter has a semicircular cutout in the top to allow the IR lamp to travel, and has locating pins in the bottom to properly position it on the chuck mounting plate. A small clear hose attaches to the right side of the adapter to provide cooling for the IR lamp. When the adapter is properly positioned on the chuck mounting plate, the cutout will be on the left side. The IR chucks allow exposure in either the hard contact, soft contract, or proximity modes, as described for a conventional MJB 3.

To operate the MJB 3 without the IR mode, any normal MJB 3 exposure chuck may be used. A ring adapter is placed in the transport slide, and the clear hose is attached to

its right side. The exposure chuck is then simply placed into this adapter ring. Additionally a second adapter is used for non-IR exposure chucks. It is cylindrical, and is placed in the center of the chuck mounting plate. This adapter supplies the vacuum to the exposure chuck. In this mode there is the option of any of the four exposure modes which are described for the conventional system, depending on the type of exposure chuck and model of machine.

8.3.2 Microscope Manipulator

The microscope manipulator has an assembly attached to the left side that supports the IR lamp. The lamp may be inserted or retracted from under the exposure chuck. When the lamp is inserted, it is located directly under the microscope viewing objective, as the microscope and lamp are scanned. During exposure, the lamp automatically retracts before the mirrorhouse comes forward. In the non-IR mode, the lamp remains in the retracted position. The lamp is a 12 V, 20W, halogen type and is readily available under P/N 61000256 from KARL SUSS.

8.3.3 Electronics Control

The SUSS MJB 3 IR System has an electronics control module that should be placed to the left of the machine. The controls and connections are described below:

Rocker - The rocker type power switch is located on the rear panel, next to the power cord connection.

Fuse - The main power fuse is a 1 amp fast blow type. To replace, insert a small screwdriver in the notch on the fuse folder and pry it out. The fuse snaps into this holder. After the fuse has been replaced, press the fuse holder back into its frame.

> **CAUTION**: Disconnect the main power from the unit before replacing the fuse.

NOTE: If the replacement fuse blows immediately when power is applied, turn the unit off and contact qualified service personnel.

Electrical Connections - There are five electrical connections on the rear panel of the electronics control module: the power cable, and four screw-on plugs. The plugs include:

2-pin plug - foot switch
3-pin plug - microscope illumination
5-pin plug - connection of electronics control module to the MJB 3 base
7-pin plug - IR lamp assembly

Microscope Illumination - This front panel knob controls the intensity of the microscope illumination. Turning it clockwise will increase the illumination.

IR Illumination - This front panel knob adjusts the intensity of the IR illumination when the foot switch is pressed. Turning the knob clockwise will increase the illumination.

Power Lamp - This indicator will be illuminated when the main power is supplied to the unit.

Scanner Switch - This switch has two positions. To use the IR mode, place the switch in the Automatic position. This will cause the IR lamp to be inserted under the exposure chuck for alignment, and also cause it to be retracted for exposure. If the IR mode is not wanted, place the switch in the manual position. The lamp will be retracted from under the exposure chuck and will remain in that position.

Foot Switch - The foot switch is connected to the rear panel of the electronics control module. While it is depressed, power will be supplied to the IR lamp.

Operation - Operation of the MJB 3 is as described in Section 2.3 for the conventional system. Below are the steps necessary to set the machine up for either IR or non-IR operation.

8.3.4 IR Mode Operation

1. Switch on the camera, monitor, and electronics control module.

2. Place the IR chuck adapter on the chuck mounting plate. Connect the cooling hose to the fitting and open the purge throttle on the manometer box one and one half turns.

3. Place the IR chuck in the transport plate and connect the clear hose to the right side of the chuck.

4. Open completely the vacuum control throttle at the lower right rear corner of the alignment stage.

5. Push the HP/ST button on the MJB 3 control panel to the ST position.

   NOTE: Whenever an IR chuck is used, the ST mode must be selected.

6. Place the scanner switch on the electronics control module in the automatic position.

7. Place the wafer on the chuck with the wafer features down. The wafer may be mounted on an IR transparent carrier, i.e. quartz, glass, or Al_2O_3.

8. Insert the wafer and chuck into the stage and bring the wafer to the separation position for alignment (refer to Sections 2.3.2 and 2.3.3).

9. Press the foot switch. Observe the image on the video monitor and rotate the microscope focus adjustment to obtain the clearest image. Depending on application, it may be helpful to use the normal microscope illumination to illuminate the mask. Also adjust the illumination level of the IR lamp to obtain the best image. Under normal circumstances, a 5x or 10x objective will provide the best combination of resolution and depth of focus.

10. Perform the alignment in the usual way (refer to Section 2.3.3), using the image on the video monitor.

11. When satisfactory alignment has been obtained, continue as outlined in Sections 2.3.4 (Exposure) and 2.3.5 (Unloading the Substrate).

8.3.5 Non-IR Operation

1. Place the scanner switch on the electronics control module in the Manual position.

2. Place the cylindrical adapter on the chuck mounting plate.

3. Place the adapter ring in the transport slide and connect the clear hose to its right side.

4. Place the exposure chuck into the adapter ring.

5. Close completely the vacuum control throttle at the lower rear corner of the alignment stage.

6. Close the purge throttle on the manometer box.

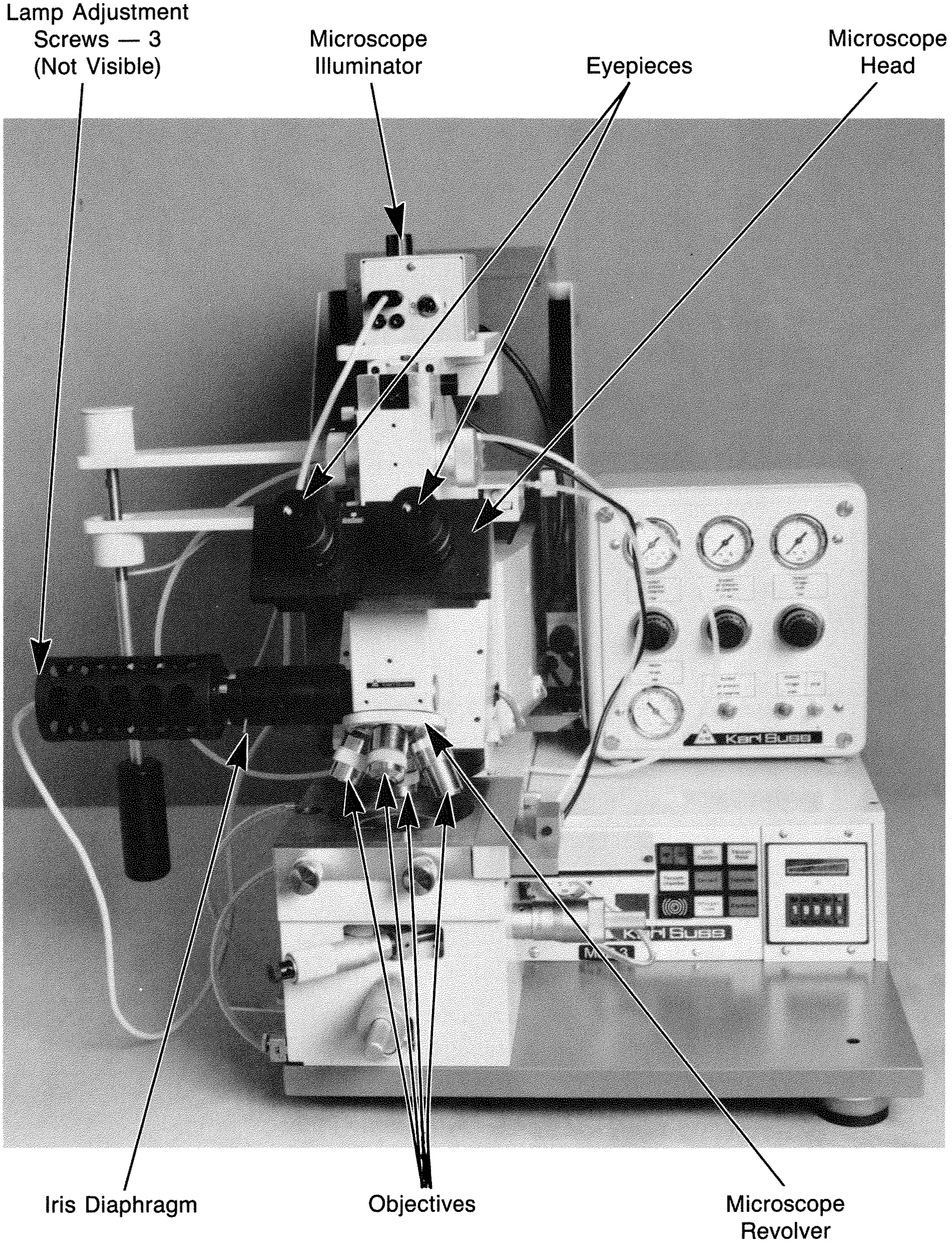


Figure 8 - 1 Normalfield Microscope M400

SUSS M400 Normalfield Microscope

OBJECTIVE	PL 3.2X		NPL 5X		5.5X EPI		NPL 10X		PL 25X		H 32X	
NUMERICAL APERTURE	0.06		0.09		0.15		0.20		0.40		0.6	
EYEPIECE (X)	6.3	10	6.3	10	6.3	10	6.3	10	6.3	10	6.3	10
FIELD OF VIEW (mm)	5.6	5.6	3.6	3.6	2.0	2.0	1.8	1.8	0.7	0.7	0.5	0.5
TOTAL MAGNIFICATION	20	32	31	50	56	90	63	100	160	250	200	320
DEPTH OF FOCUS (µm)	120	80	100	70	40	25	25	20	8	8	3.5	2.0
AT MAXIMUM RESOLUTION (µm)	5.0	3.5	4.0	2.5	2.0	1.25	1.6	1.0	1.2	0.8	0.8	0.5
WORKING DISTANCE (mm)	12		12		13		BF -17 IC -12		11		10	
ILLUMINATION TYPE	BF		BF and BF/IC		BF, DF		BF and BF/IC		BF		BF	

BF = Brightfield DF = Darkfield IC = Interference Contrast

Figure 8 - 2 Magnification and Optical Data SUSS M400 Microscope

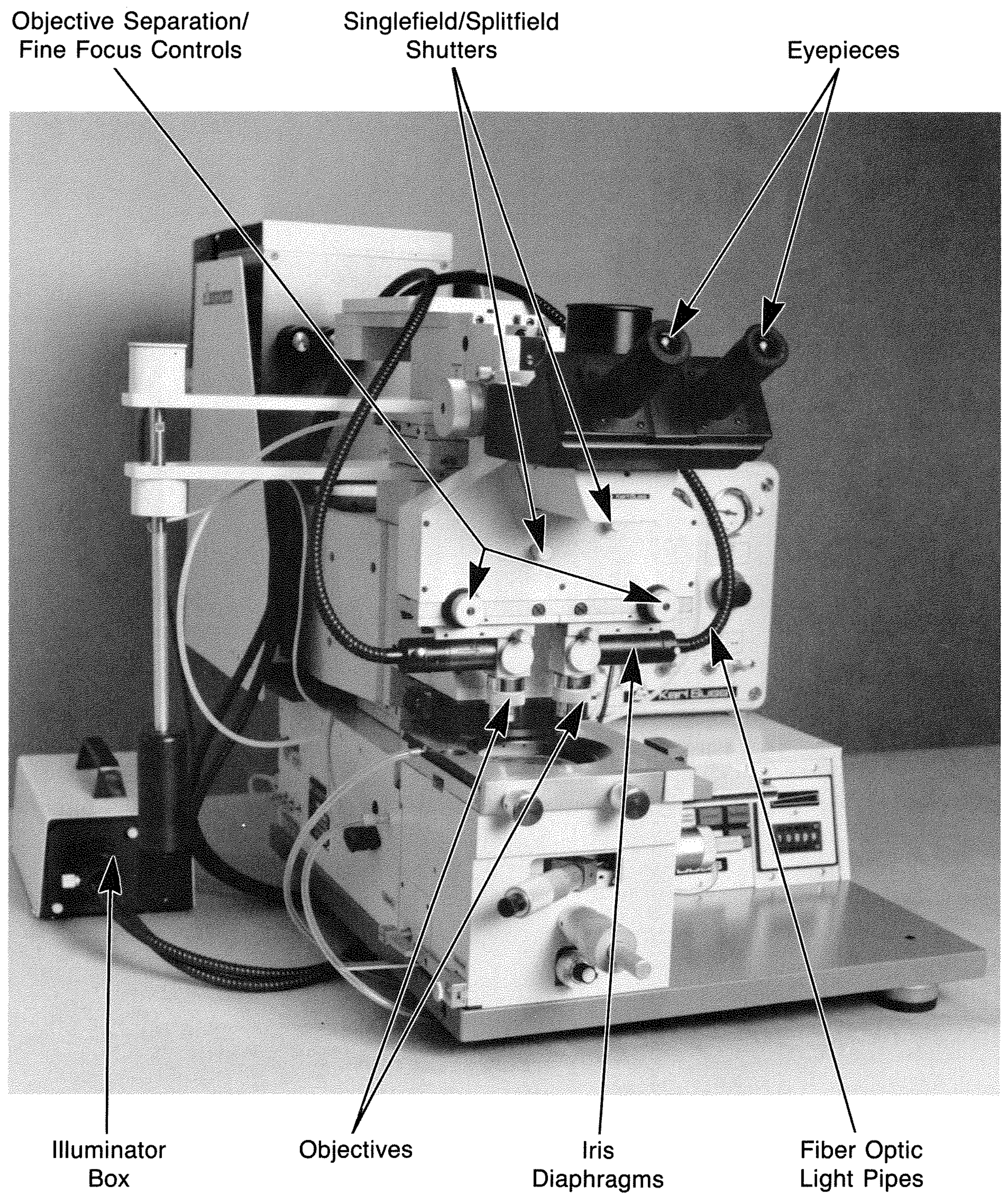


Figure 8 - 3 Splitfield Microscope M200

SUSS M200 Splitfield Microscope

OBJECTIVE	PL3.5X (1)			NPL 5X IC			5.5X EPI (2)			NPL 10X			PL25X					
NUMERICAL APERTURE	0.08			0.09			0.15			0.20			0.40					
EYEPIECE (X)	6.3	10		6.3	10	12.5	6.3	10		6.3	10	12.5	6.3	10				
FIELD OF VIEW (mm)	1.5	1.5		1.9	1.9	1.9	1.25	1.25		0.95	0.95	0.95	0.42	0.42				
TOTAL MAGNIFICATION	75	115		50	90	110	90	140		120	180	230	270	430				
DEPTH OF FOCUS (µm)	80	50		80	60	60	30	20		25	20	15	3	3				
AT MAXIMUM RESOLUTION (µm)	3.2	2.0		5.0	3.0	3.0	2.0	1.2		2.0	1.0	1.0	1.0	1.0				
WORKING DISTANCE (mm)	13.5			15.0			14.5			17.5			9					
ILLUMINATION TYPE	BF			BF/ IC			BF/ DF			BF or BF/IC			BF					

BF = Brightfield DF = Darkfield IC = Interference Contrast

(1) corresponds to magnification 8 x ∞ in SUSS M200 Microscope (2) corresponds to magnification 9 x ∞ in SUSS M200 Microscope

Figure 8 - 4 Magnification and Optical Data SUSS M200 Microscope

SUSS M204 Splitfield Microscope

OBJECTIVE	PL3.2X			NPL 5X			NPL 10X			LL 20X IC			PL25X					
NUMERICAL APERTURE	0.06			0.09			BF - 0.20 IC - 0.22			0.40			0.40					
EYEPIECE (X)	6.3	10	12.5	6.3	10		6.3	10	12.5	6.3	10	12.5	6.3	10	12.5			
FIELD OF VIEW (mm)	4.6	4.6	4.6	3.0	3.0		1.5	1.5	1.5	0.75	0.75	0.75	0.6	0.6	0.6			
TOTAL MAGNIFICATION	25	38	48	31	50		75	120	150	150	240	300	190	300	375			
DEPTH OF FOCUS (μm)	100	80	80	80	60		25	20	20	8	4	4	5	3	3			
AT MAXIMUM RESOLUTION (μm)	5.0	3.5	3.5	4.0	2.5		1.6	1.25	1.25	1.2	1.0	1.0	1.2	0.8	0.8			
WORKING DISTANCE (mm)	12			12			BF - 17 IC - 12			10			11					
ILLUMINATION TYPE	BF			BF and BF/ IC			BF and BF/ IC			IC			BF					

BF = Brightfield DF = Darkfield IC = Interference Contrast

Tube factor = 1.2X

(1) Total Magnification: Objective x Eyepiece x Tube Factor (1.2)

Figure 8 - 5 Magnification and Optical Data SUSS M204 Microscope

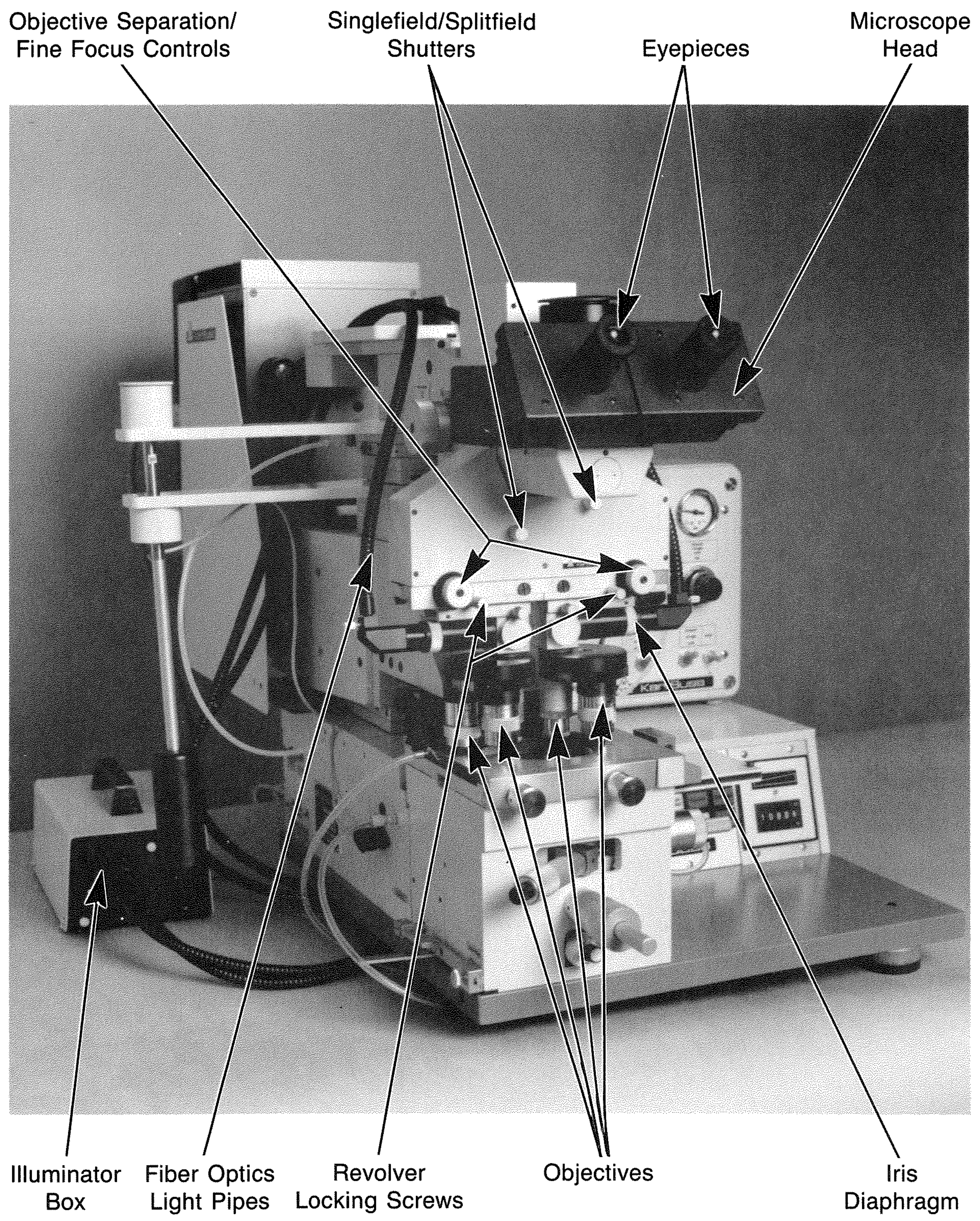


Figure 8 - 6 Splitfield Revolver Microscope M230

	SUSS M230 Splitfield Turret Microscope									SUSS M230 Interference Contrast Splitfield Turret Microscope								
OBJECTIVE	PL 3.5X [1]			NPL 10X			PL 25X			NPL 5X IC			NPL 10X IC					
NUMERICAL APERTURE	0.08			0.20			0.40			0.09			0.20					
EYEPIECE (X)	6.3	10		6.3	10		6.3	10		6.3	10		6.3	10				
FIELD OF VIEW (mm)	1.3	1.3		0.85	0.85		0.42	0.42		2.0	2.0		0.85	0.85				
TOTAL MAGNIFICATION	80	130		130	200		270	430		55	90		130	200				
DEPTH OF FOCUS (µm)	60	40		20	15		3	3		90	70		20	15				
AT MAXIMUM RESOLUTION (µm)	3.2	2.0		2.0	1.2		1.0	1.0		4.0	2.5		2.5	1.5				
WORKING DISTANCE (mm)	12			17.5			9			13			13					
ILLUMINATION TYPE	BF			BF			BF			BF/IC			BF/IC					

BF = Brightfield DF = Darkfield IC = Interference Contrast

(1) corresponds to magnification 8 x ∞ in SUSS M200 Microscope

Figure 8 - 7 Magnification and Optical Data SUSS M230 Microscope

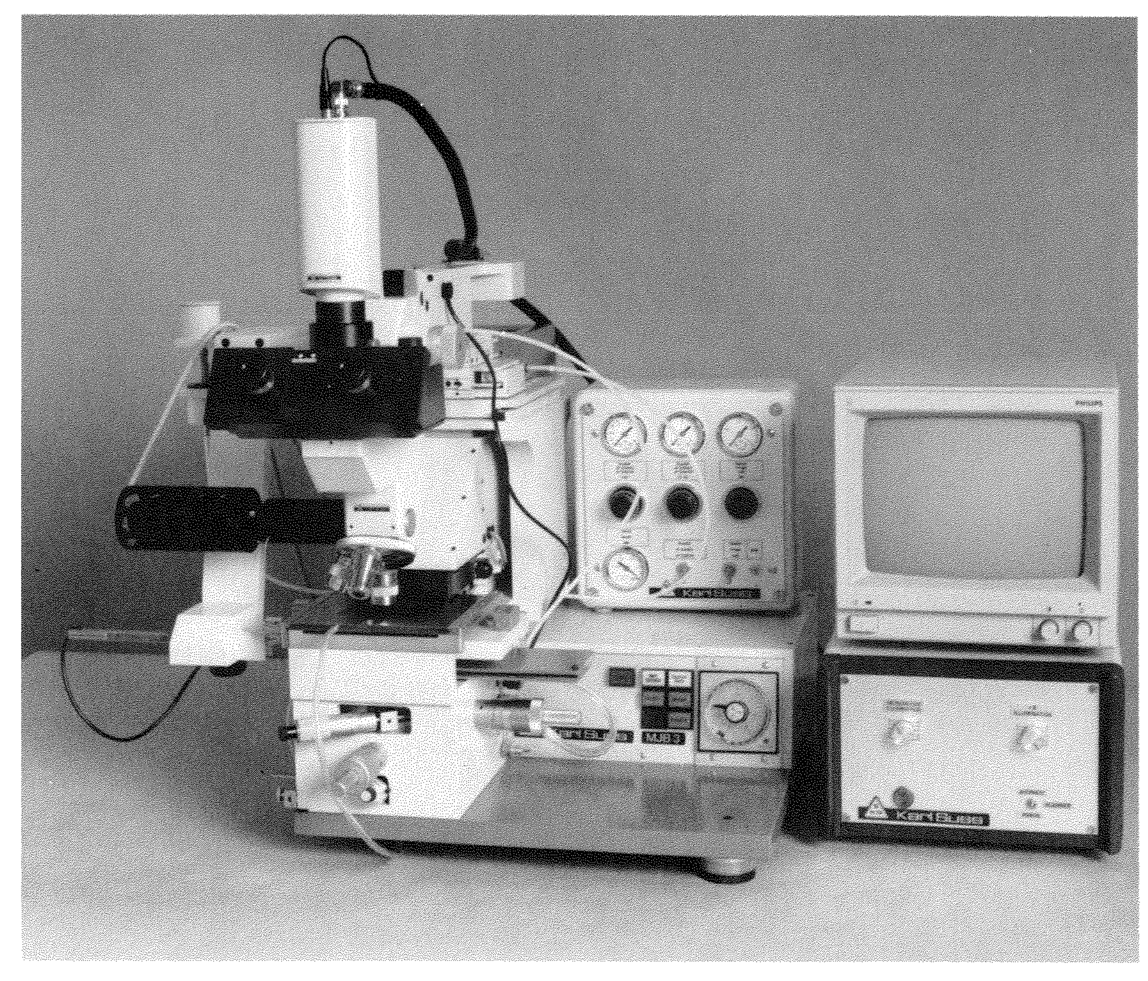


Figure 8 - 8   SUSS MJB 3 Scanning IR System

K
SM
Karl Suss

SUSS MJB 3

MASK ALIGNER

Parts Identification Manual

SECTION	ASSEMBLY
1.0	MANIPULATOR
2.0	STAGE
3.0	FRONT PANELS
4.0	DAMPER SLIDE
5.0	MOUNTING PLATE
6.0	MIRRORHOUSE PISTON
7.0	LAMPHOUSE ASSEMBLY
8.0	LAMPHOUSE TOP

This Manual is subject to review and/or revision without notice.

P/N 080AA002
1087

LIST OF REVISIONS

REVISION #	CHANGE	DATE
	ORIGINAL DOCUMENT	11/87

RECOMMENDED REPLACEMENT PARTS
FOR MJB 3 MASK ALIGNER

Fuses:

PN: 61008796	0.5 Amp
PN: 61004464	1.6 Amp
PN: 61004405	2.5 Amp
PN: 61004499	6.3 Amp
PN: 61004448	1.0 Amp

Use only OEM fuses; check fuse holder for proper size.

Mechanical Relay:

PN: 61001902

Pneumatic Valves:	**# on Valve**
PN: 61501409	K 65.115
PN: 61501417	K 65.111
PN: 61500356	K 65.127

The pneumatic valves on the MJB 3 have a valve number on the side of the valve. Match this number to the appropriate part number to order the correct valve.

Lamps:

PN: 61000094	200 Watt Hg Lamp
PN: 61000078	350 Watt Hg Lamp
PN: 610L0003	500 Watt HgXe Lamp
PN: 610L0001	350 Watt CdXe Lamp

Microscope Lamps:

PN: 61007064	6V 5 Watt (Plugs into MJB 3)
or	or
PN: 61000264	6V 15 Watt (Has separate Illumination Control Box)

Microscope Lamp, Splitfield and Turret:

PN: 61000256	20 Watt
PN: 61028908	85 Watt

IR Illumination Lamp:

PN: 61000256

Lamphouse:

PN: 26001055	Cathode Shielded Cable, 350 Watt
PN: 260WI001	Anode Wire, 350 Watt
PN: 26001101	Lamp Wire, 200 Watt

HOW TO ORDER REPLACEMENT PARTS

If you wish to place an order for replacement parts, we suggest that you follow this procedure to ensure that the proper parts are shipped to you.

1. Call Customer Service during normal working hours at the location nearest to you:

   East Coast (Vermont) 802-244-7884

   West Coast (California)

2. Be prepared to furnish the following information as appropriate:

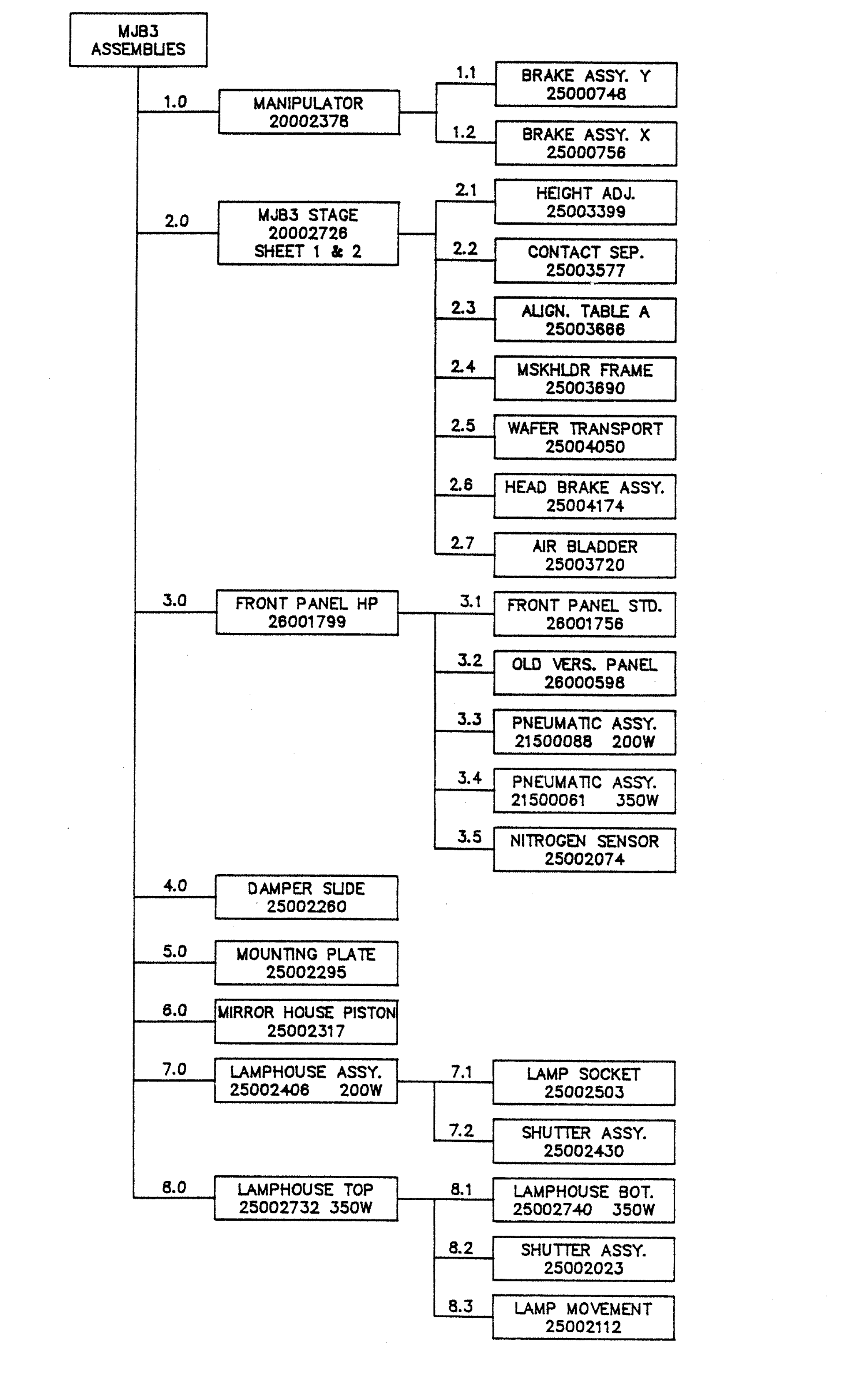
   a. Model/type and serial number of the machine.

   b. Item number, description, and part number. It will be helpful if you supply the page number (in this manual) and the assembly number when placing your order.

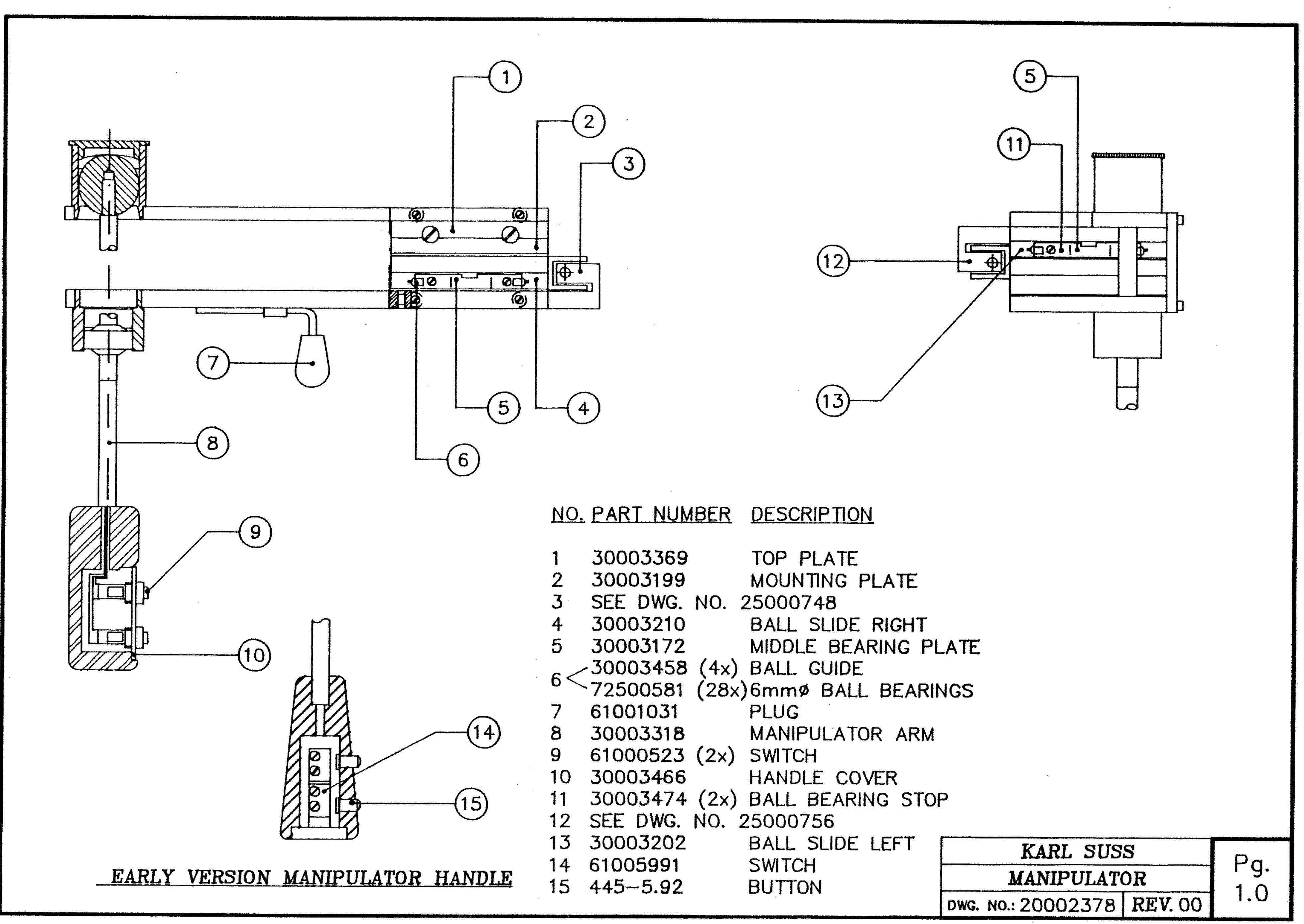
   c. Whether lamphouse is 200W or 350W.

   d. Purchase order number.

   e. Name and telephone number or extension of the individual whom we may contact if necessary for technical information regarding the part(s).

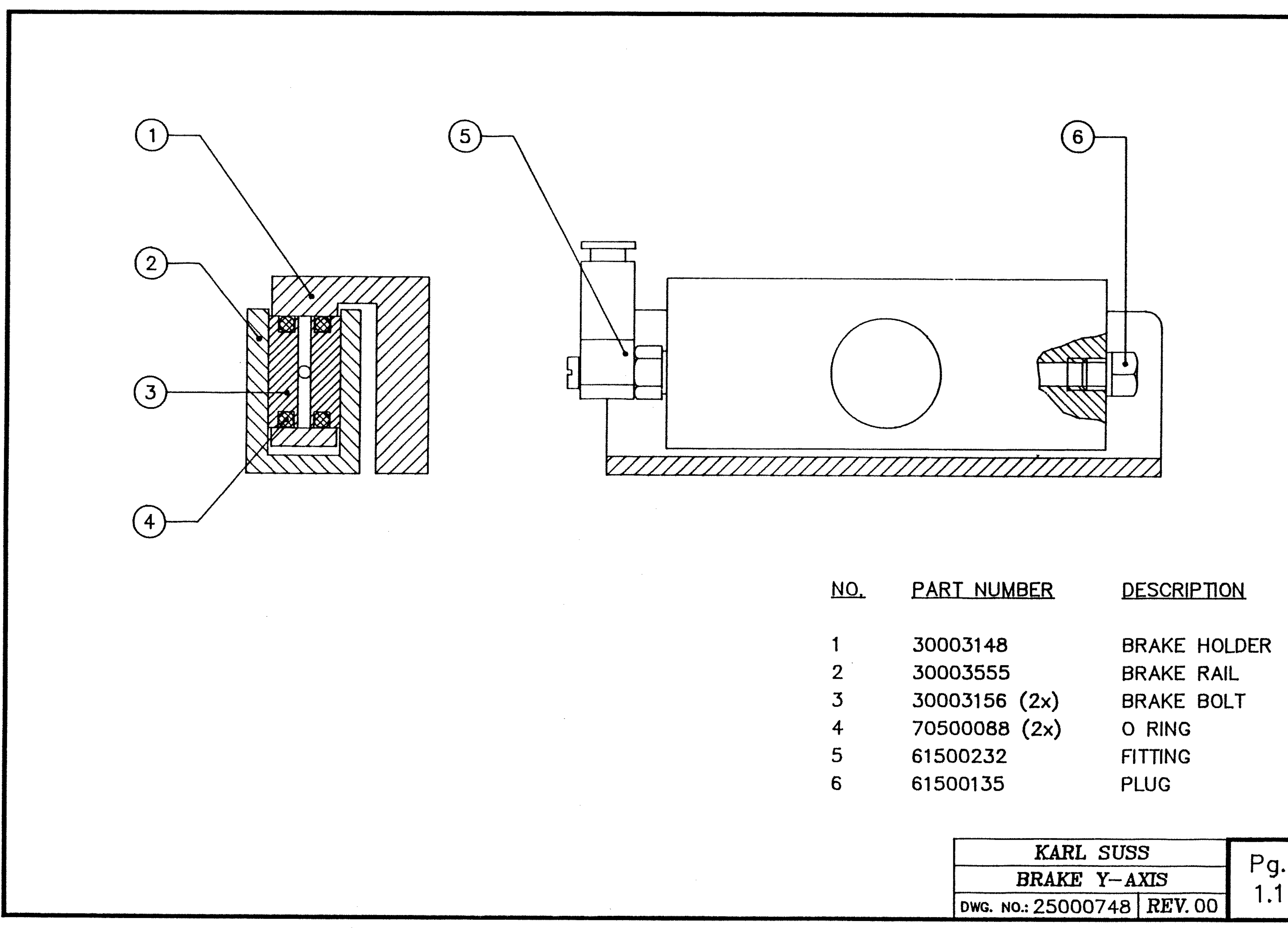


MJB3 ASSEMBLIES
1.0
MANIPULATOR 20002378
1.1
BRAKE ASSY. Y 25000748
1.2
BRAKE ASSY. X 25000756
2.0
MJB3 STAGE 20002726 SHEET 1 & 2
2.1
HEIGHT ADJ. 25003399
2.2
CONTACT SEP. 25003577
2.3
ALIGN. TABLE A 25003666
2.4
MSKHLDR FRAME 25003690
2.5
WAFER TRANSPORT 25004050
2.6
HEAD BRAKE ASSY. 25004174
2.7
AIR BLADDER 25003720
3.0
FRONT PANEL HP 26001799
3.1
FRONT PANEL STD. 26001756
3.2
OLD VERS. PANEL 26000598
3.3
PNEUMATIC ASSY. 21500088 200W
3.4
PNEUMATIC ASSY. 21500061 350W
3.5
NITROGEN SENSOR 25002074
4.0
DAMPER SLIDE 25002260
5.0
MOUNTING PLATE 25002295
6.0
MIRROR HOUSE PISTON 25002317
7.0
LAMPHOUSE ASSY. 25002406 200W
7.1
LAMP SOCKET 25002503
7.2
SHUTTER ASSY. 25002430
8.0
LAMPHOUSE TOP 25002732 350W
8.1
LAMPHOUSE BOT. 25002740 350W
8.2
SHUTTER ASSY. 25002023
8.3
LAMP MOVEMENT 25002112



NO.	PART NUMBER	DESCRIPTION
1	30003369	TOP PLATE
2	30003199	MOUNTING PLATE
3	SEE DWG. NO. 25000748	
4	30003210	BALL SLIDE RIGHT
5	30003172	MIDDLE BEARING PLATE
6	30003458 (4x)	BALL GUIDE
	72500581 (28x)	6mmø BALL BEARINGS
7	61001031	PLUG
8	30003318	MANIPULATOR ARM
9	61000523 (2x)	SWITCH
10	30003466	HANDLE COVER
11	30003474 (2x)	BALL BEARING STOP
12	SEE DWG. NO. 25000756	
13	30003202	BALL SLIDE LEFT
14	61005991	SWITCH
15	445–5.92	BUTTON

KARL SUSS		Pg. 1.0
MANIPULATOR		
DWG. NO.: 20002378	REV. 00	



NO.	PART NUMBER	DESCRIPTION
1	30003148	BRAKE HOLDER
2	30003555	BRAKE RAIL
3	30003156 (2x)	BRAKE BOLT
4	70500088 (2x)	O RING
5	61500232	FITTING
6	61500135	PLUG

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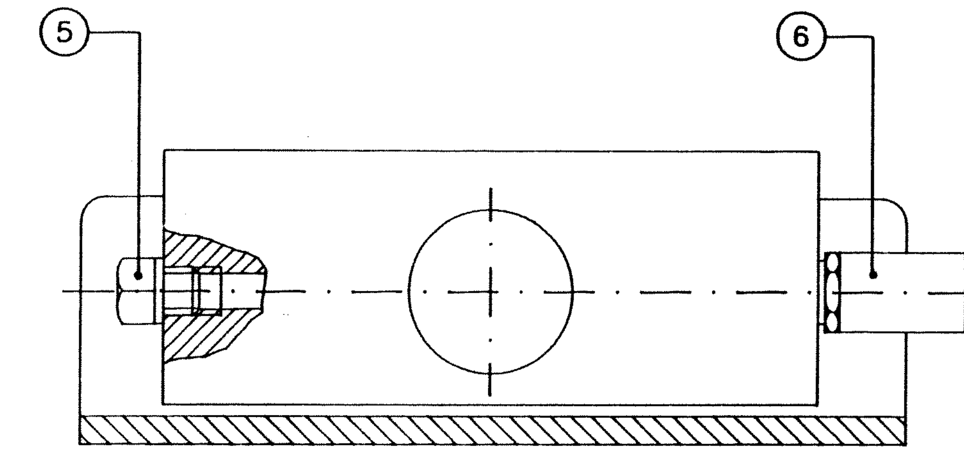
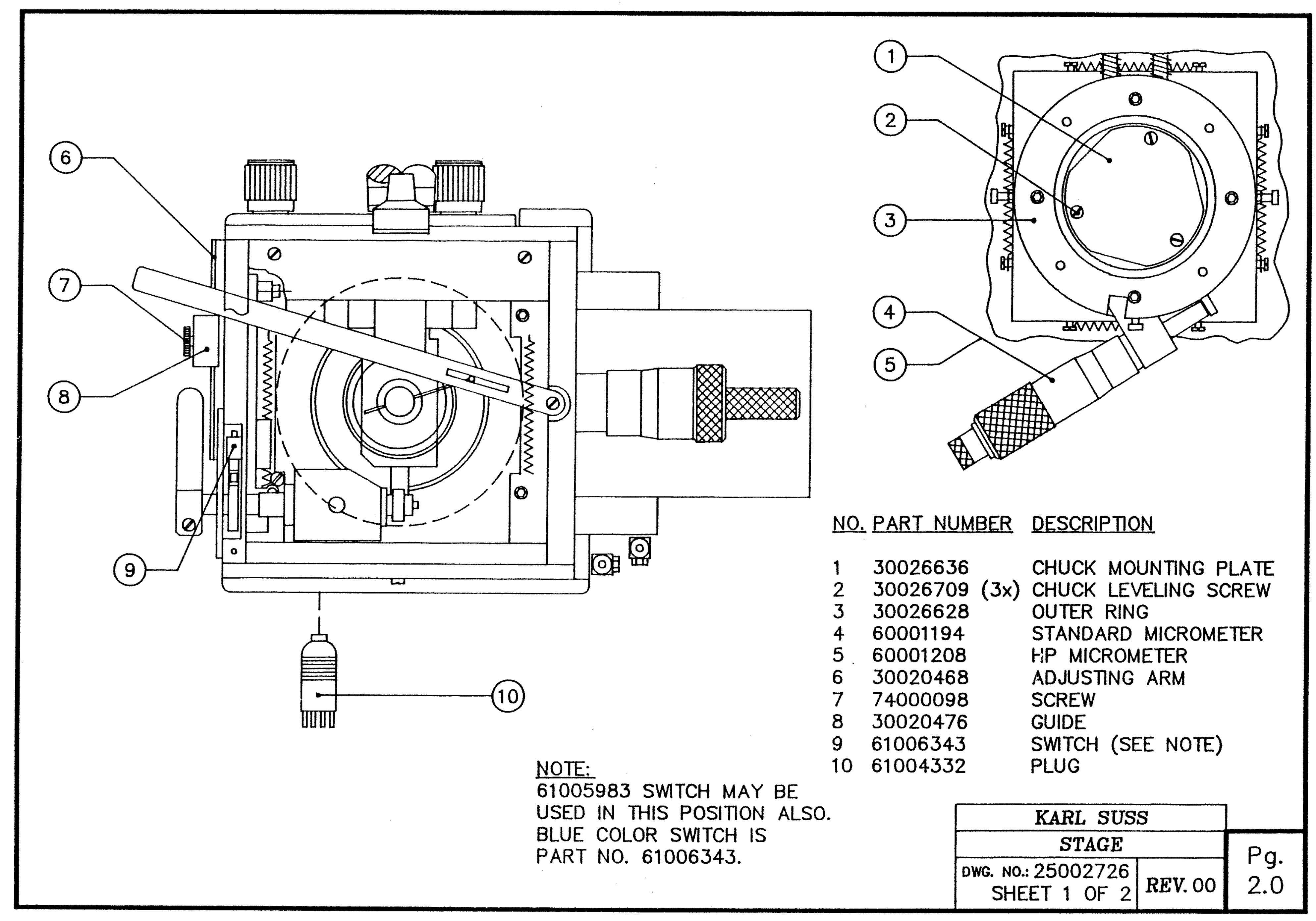
BRAKE Y-AXIS

DWG. NO.: 25000748 REV. 00



NO.	PART NUMBER	DESCRIPTION
1	30003148	BRAKE HOLDER
2	30003555	BRAKE RAIL
3	30003156 (2x)	BRAKE BOLT
4	70500088 (2x)	O RING
5	61500135	PLUG
6	61500372	ST. FITTING

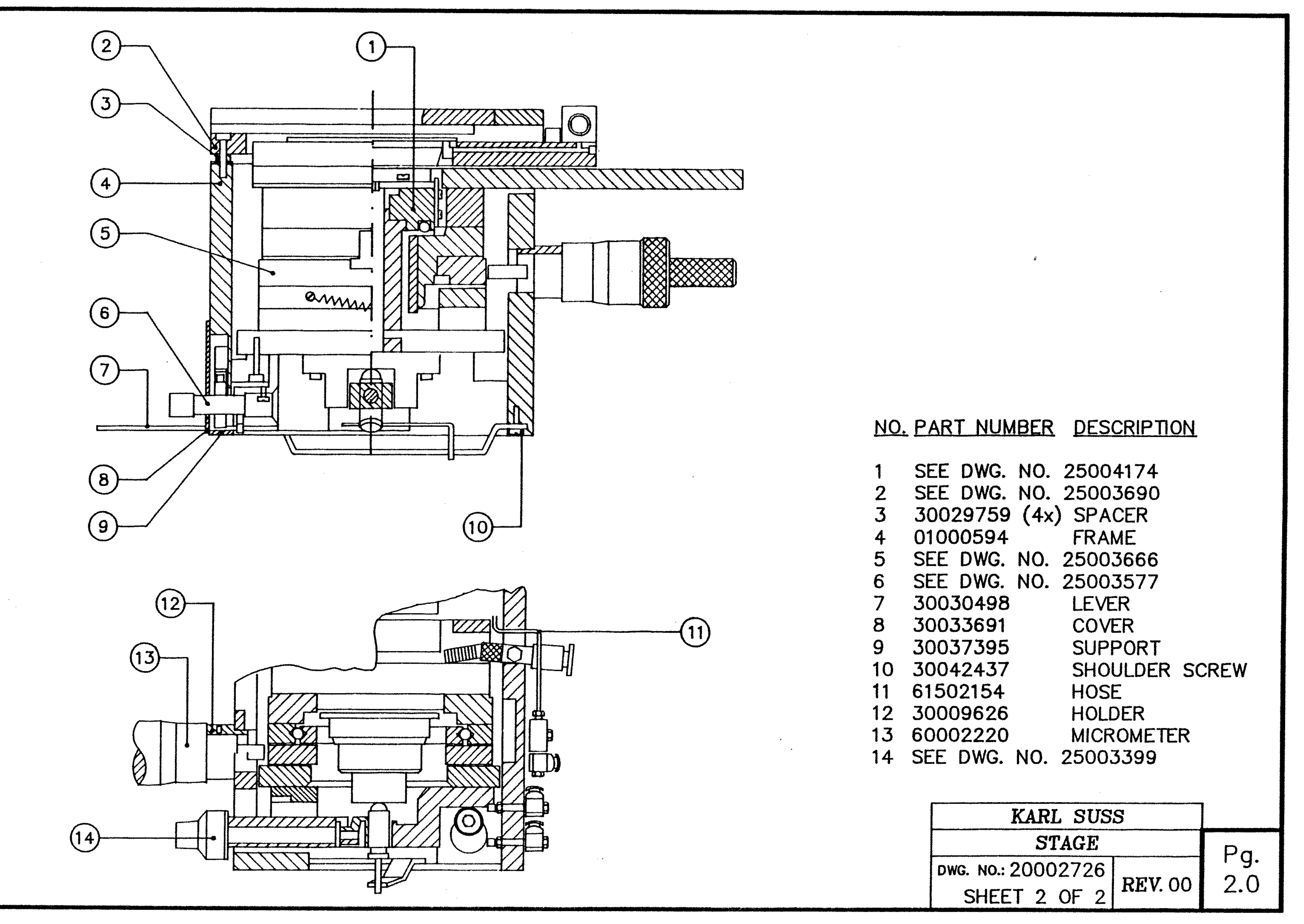
KARL SUSS		Pg. 1.2
BRAKE X–AXIS		
DWG. NO.: 25000756	REV. 00	



NO.	PART NUMBER		DESCRIPTION
1	30026636		CHUCK MOUNTING PLATE
2	30026709	(3x)	CHUCK LEVELING SCREW
3	30026628		OUTER RING
4	60001194		STANDARD MICROMETER
5	60001208		HP MICROMETER
6	30020468		ADJUSTING ARM
7	74000098		SCREW
8	30020476		GUIDE
9	61006343		SWITCH (SEE NOTE)
10	61004332		PLUG

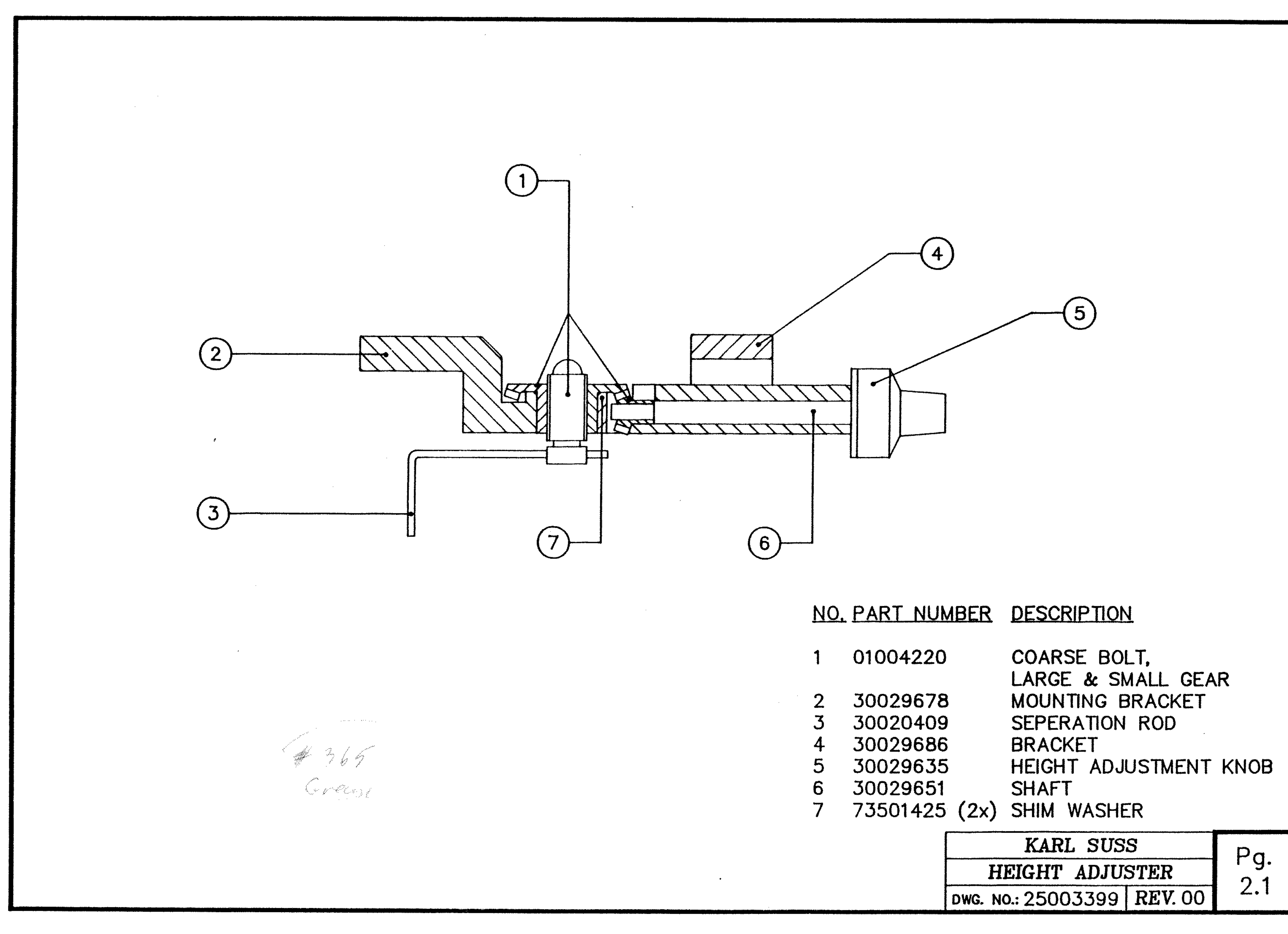
NOTE:
61005983 SWITCH MAY BE USED IN THIS POSITION ALSO. BLUE COLOR SWITCH IS PART NO. 61006343.

KARL SUSS		Pg. 2.0
STAGE		
DWG. NO.: 25002726 SHEET 1 OF 2	REV. 00	



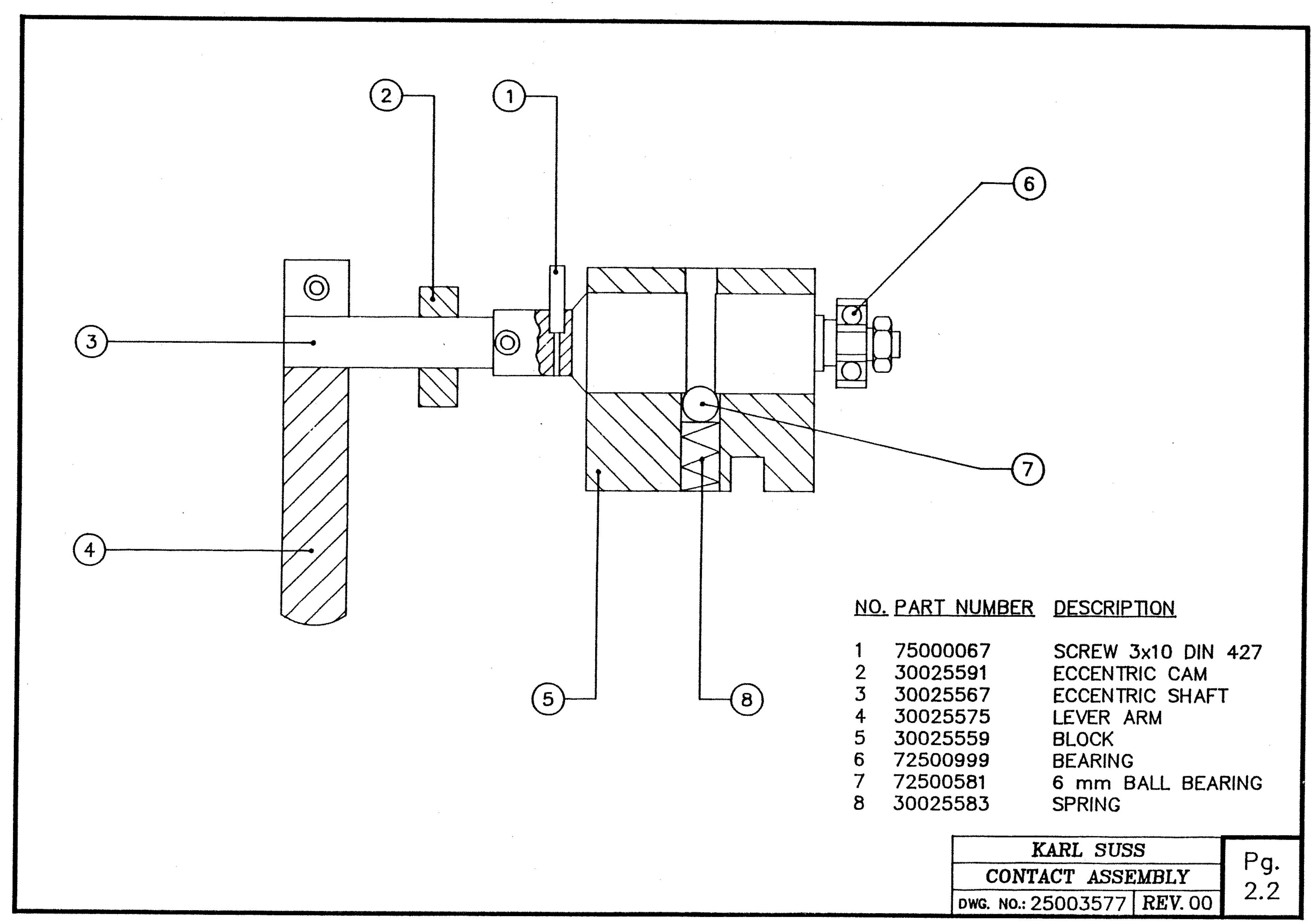
NO.	PART NUMBER	DESCRIPTION
1	SEE DWG. NO. 25004174	
2	SEE DWG. NO. 25003690	
3	30029759 (4x)	SPACER
4	01000594	FRAME
5	SEE DWG. NO. 25003666	
6	SEE DWG. NO. 25003577	
7	30030498	LEVER
8	30033691	COVER
9	30037395	SUPPORT
10	30042437	SHOULDER SCREW
11	61502154	HOSE
12	30009626	HOLDER
13	60002220	MICROMETER
14	SEE DWG. NO. 25003399	

KARL SUSS		
STAGE		
DWG. NO.: 20002726 SHEET 2 OF 2	REV. 00	Pg. 2.0



NO.	PART NUMBER	DESCRIPTION
1	01004220	COARSE BOLT, LARGE & SMALL GEAR
2	30029678	MOUNTING BRACKET
3	30020409	SEPERATION ROD
4	30029686	BRACKET
5	30029635	HEIGHT ADJUSTMENT KNOB
6	30029651	SHAFT
7	73501425 (2x)	SHIM WASHER

KARL SUSS		Pg. 2.1
HEIGHT ADJUSTER		
DWG. NO.: 25003399	REV. 00	



NO.	PART NUMBER	DESCRIPTION
1	75000067	SCREW 3x10 DIN 427
2	30025591	ECCENTRIC CAM
3	30025567	ECCENTRIC SHAFT
4	30025575	LEVER ARM
5	30025559	BLOCK
6	72500999	BEARING
7	72500581	6 mm BALL BEARING
8	30025583	SPRING

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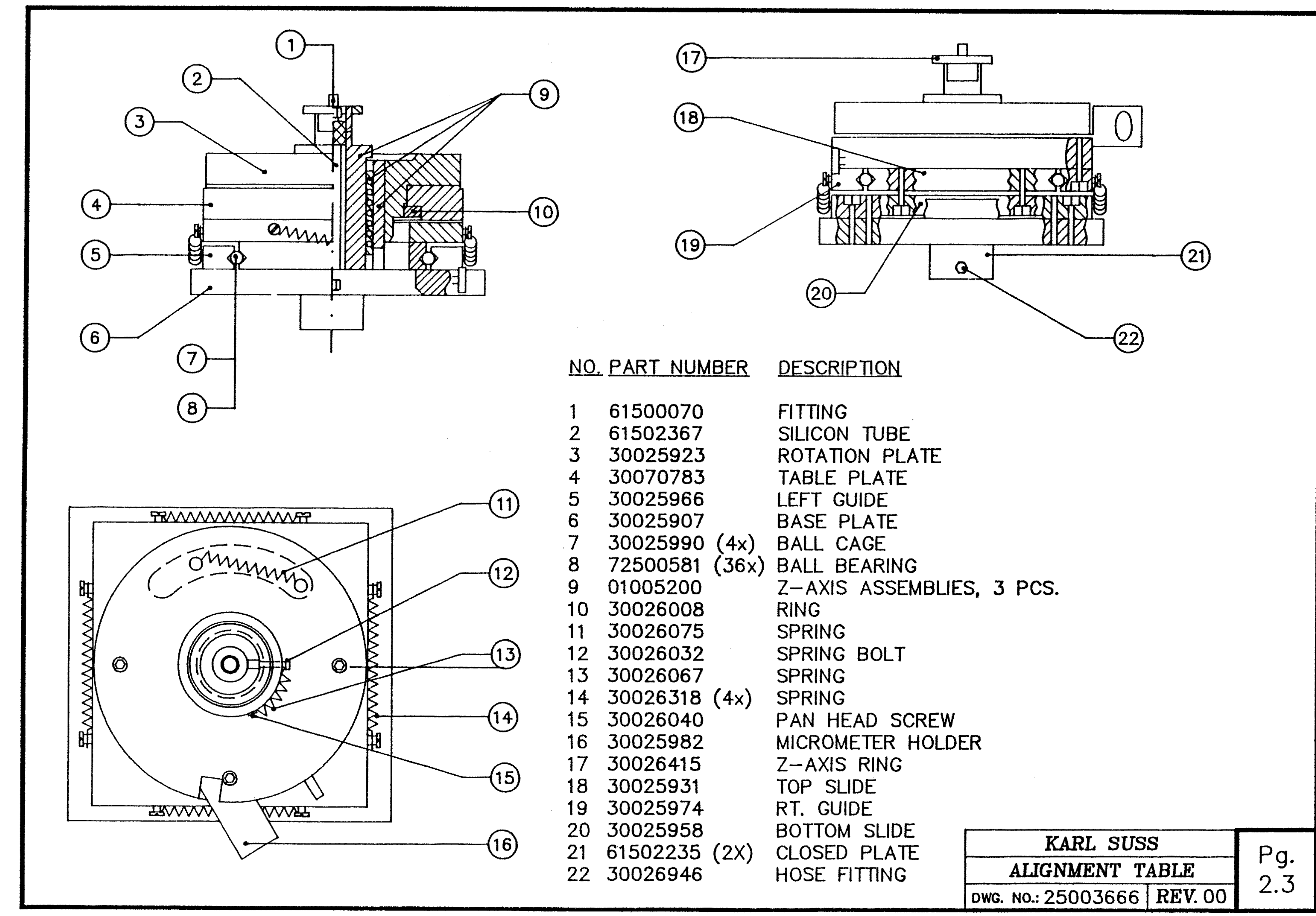
CONTACT ASSEMBLY

DWG. NO.: 25003577 REV. 00



NO.	PART NUMBER		DESCRIPTION
1	61500070		FITTING
2	61502367		SILICON TUBE
3	30025923		ROTATION PLATE
4	30070783		TABLE PLATE
5	30025966		LEFT GUIDE
6	30025907		BASE PLATE
7	30025990	(4x)	BALL CAGE
8	72500581	(36x)	BALL BEARING
9	01005200		Z-AXIS ASSEMBLIES, 3 PCS.
10	30026008		RING
11	30026075		SPRING
12	30026032		SPRING BOLT
13	30026067		SPRING
14	30026318	(4x)	SPRING
15	30026040		PAN HEAD SCREW
16	30025982		MICROMETER HOLDER
17	30026415		Z-AXIS RING
18	30025931		TOP SLIDE
19	30025974		RT. GUIDE
20	30025958		BOTTOM SLIDE
21	61502235	(2X)	CLOSED PLATE
22	30026946		HOSE FITTING

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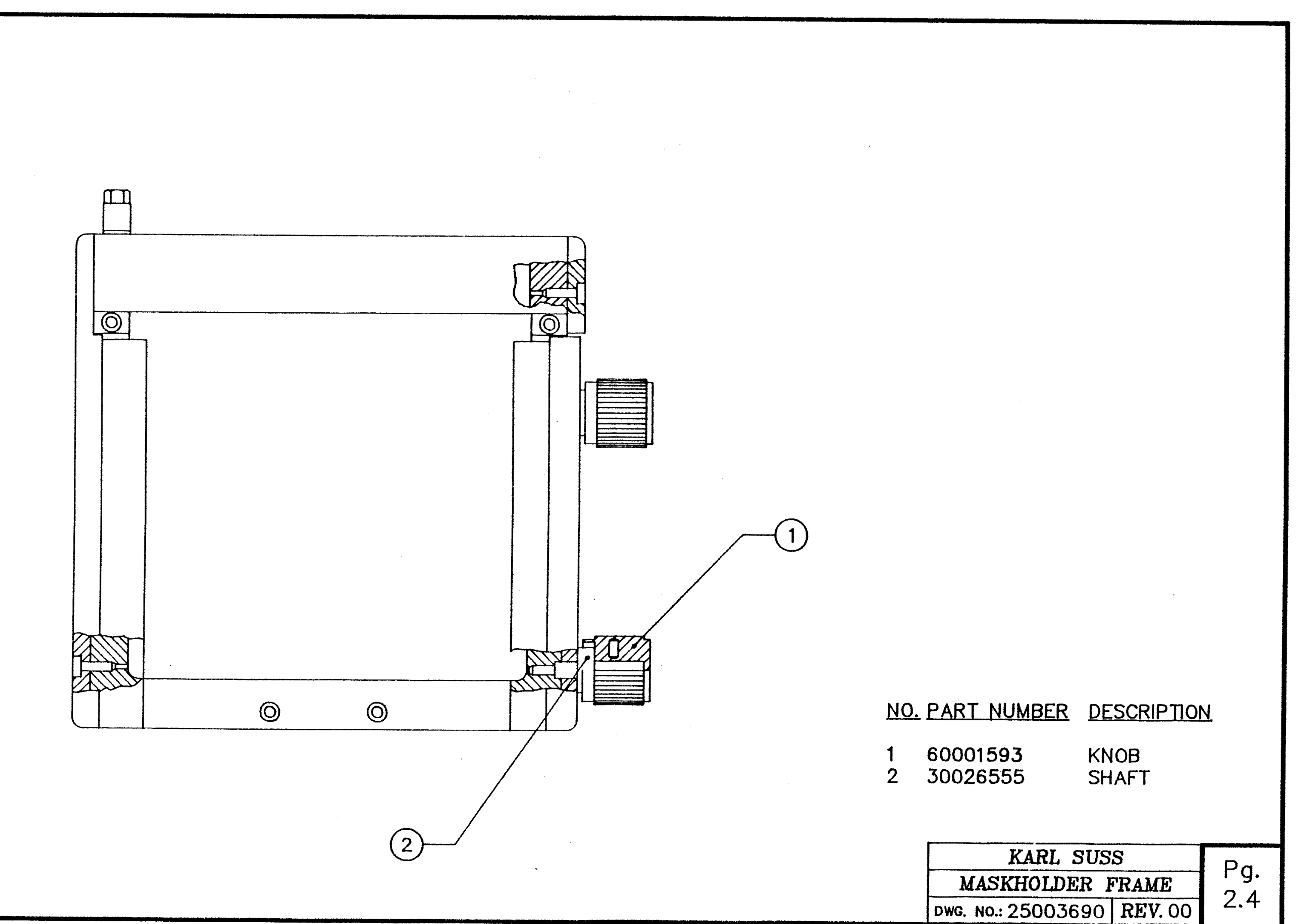
ALIGNMENT TABLE

DWG. NO.: 25003666 REV. 00



NO.	PART NUMBER	DESCRIPTION
1	60001593	KNOB
2	30026555	SHAFT

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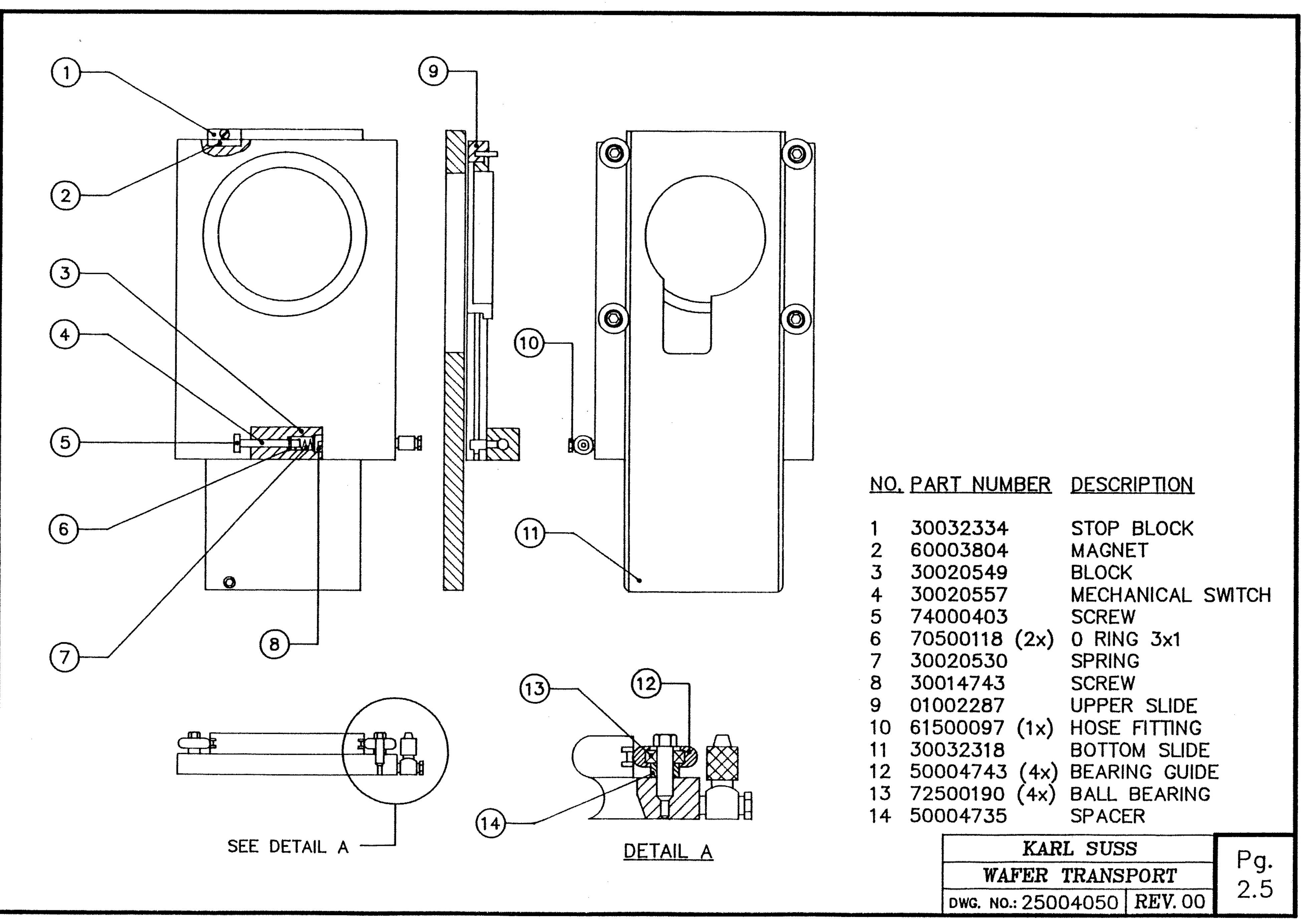
MASKHOLDER FRAME	
DWG. NO.: 25003690	REV. 00



NO.	PART NUMBER	DESCRIPTION
1	30032334	STOP BLOCK
2	60003804	MAGNET
3	30020549	BLOCK
4	30020557	MECHANICAL SWITCH
5	74000403	SCREW
6	70500118 (2x)	0 RING 3x1
7	30020530	SPRING
8	30014743	SCREW
9	01002287	UPPER SLIDE
10	61500097 (1x)	HOSE FITTING
11	30032318	BOTTOM SLIDE
12	50004743 (4x)	BEARING GUIDE
13	72500190 (4x)	BALL BEARING
14	50004735	SPACER

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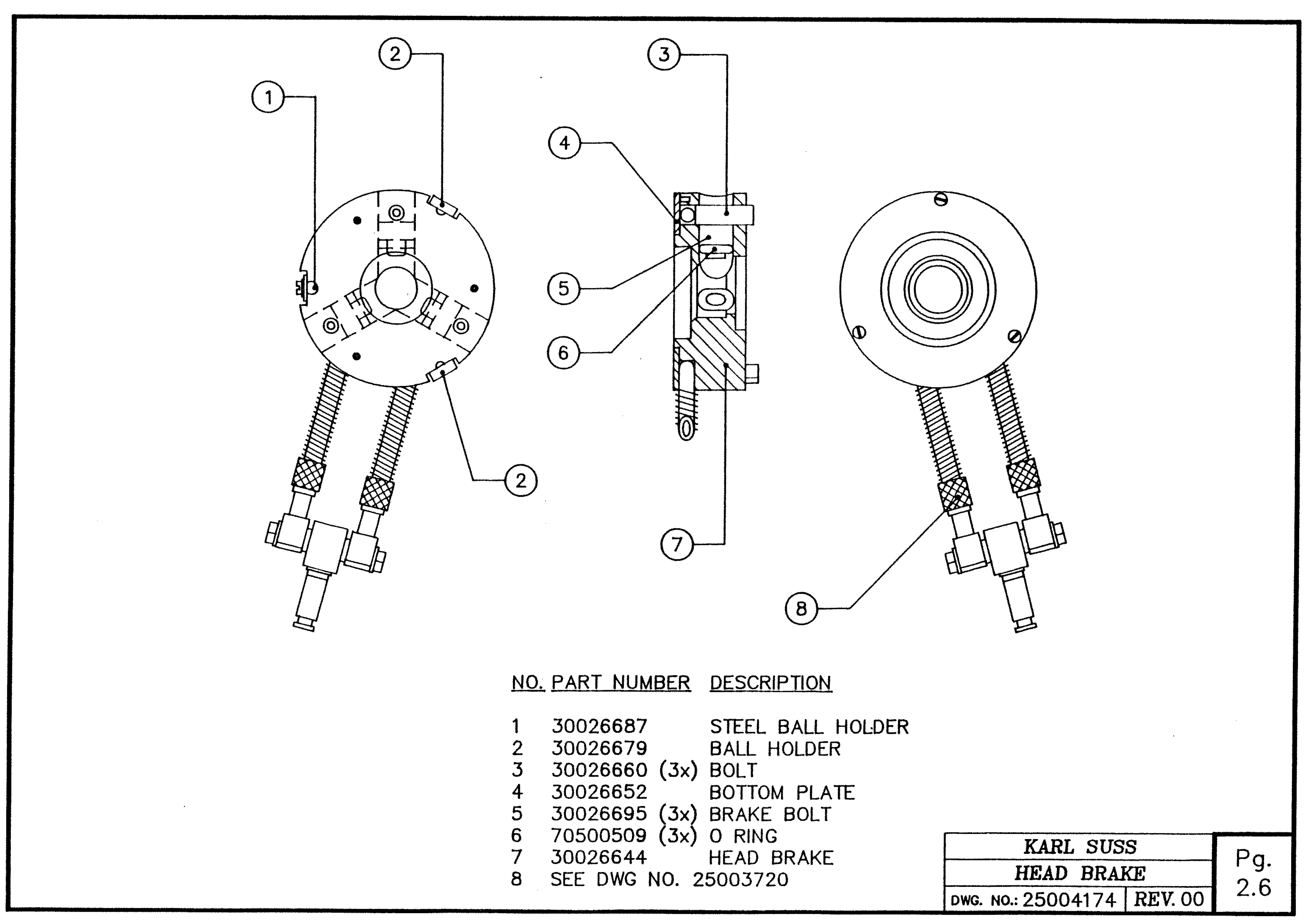
WAFER TRANSPORT

DWG. NO.: 25004050 REV. 00



NO.	PART NUMBER		DESCRIPTION
1	30026687		STEEL BALL HOLDER
2	30026679		BALL HOLDER
3	30026660	(3x)	BOLT
4	30026652		BOTTOM PLATE
5	30026695	(3x)	BRAKE BOLT
6	70500509	(3x)	O RING
7	30026644		HEAD BRAKE
8	SEE DWG NO. 25003720		

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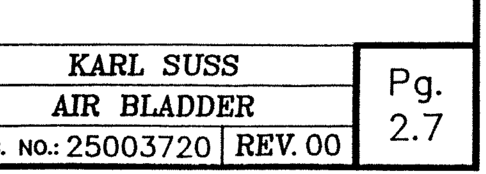
HEAD BRAKE

DWG. NO.: 25004174 | REV. 00

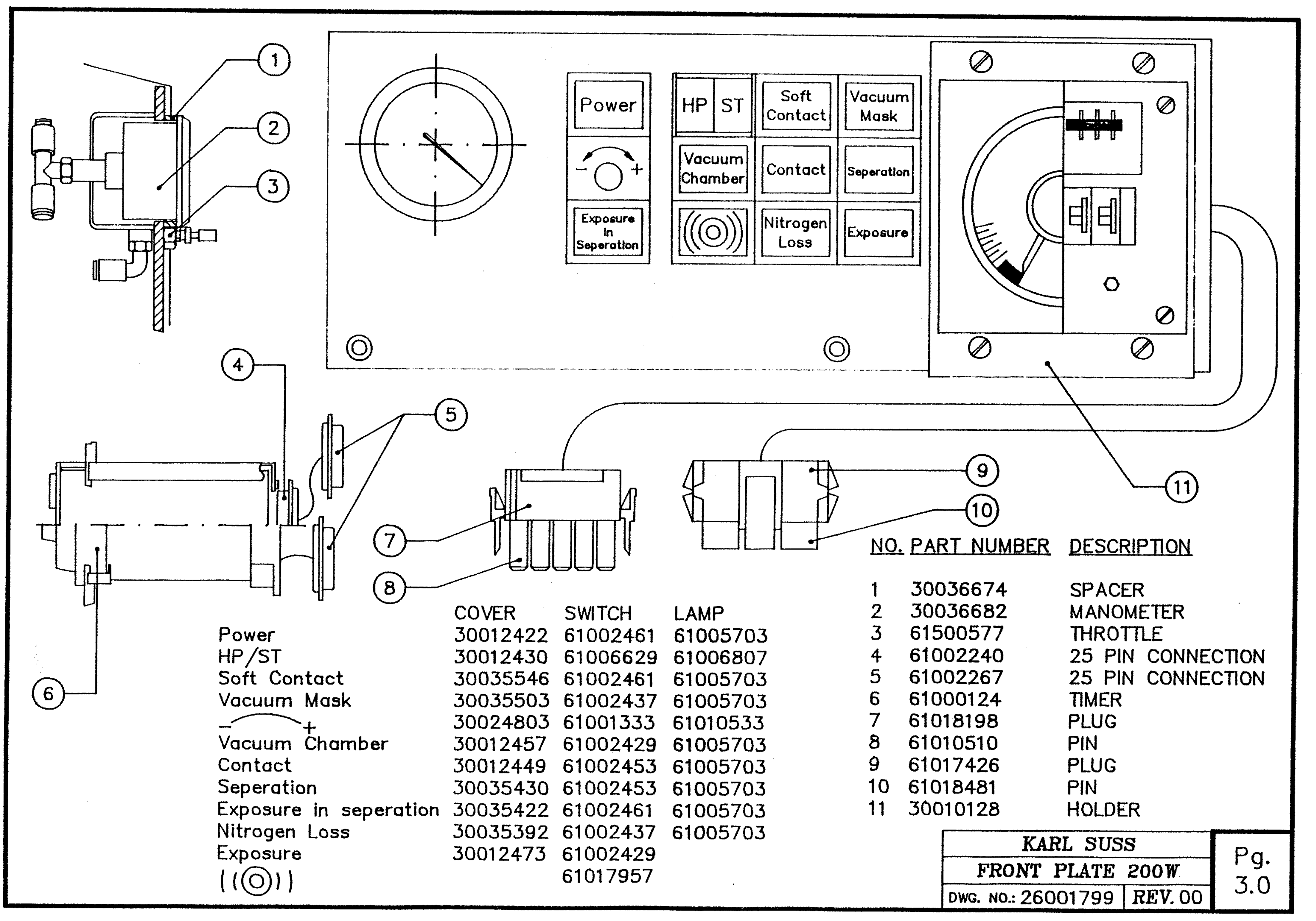
NO.	PART NUMBER		DESCRIPTION
1	61500097	(2x)	ELBOW
2	61502367		SILICON TUBE
3	30026725	(2x)	SPRING
4			SOLDER JOINT
5	30026717	(2x)	NUT
6	61500453		T FITTING
7	61500372		STRAIGHT FITTING



KARL SUSS

AIR BLADDER

DWG. NO.: 25003720 REV. 00



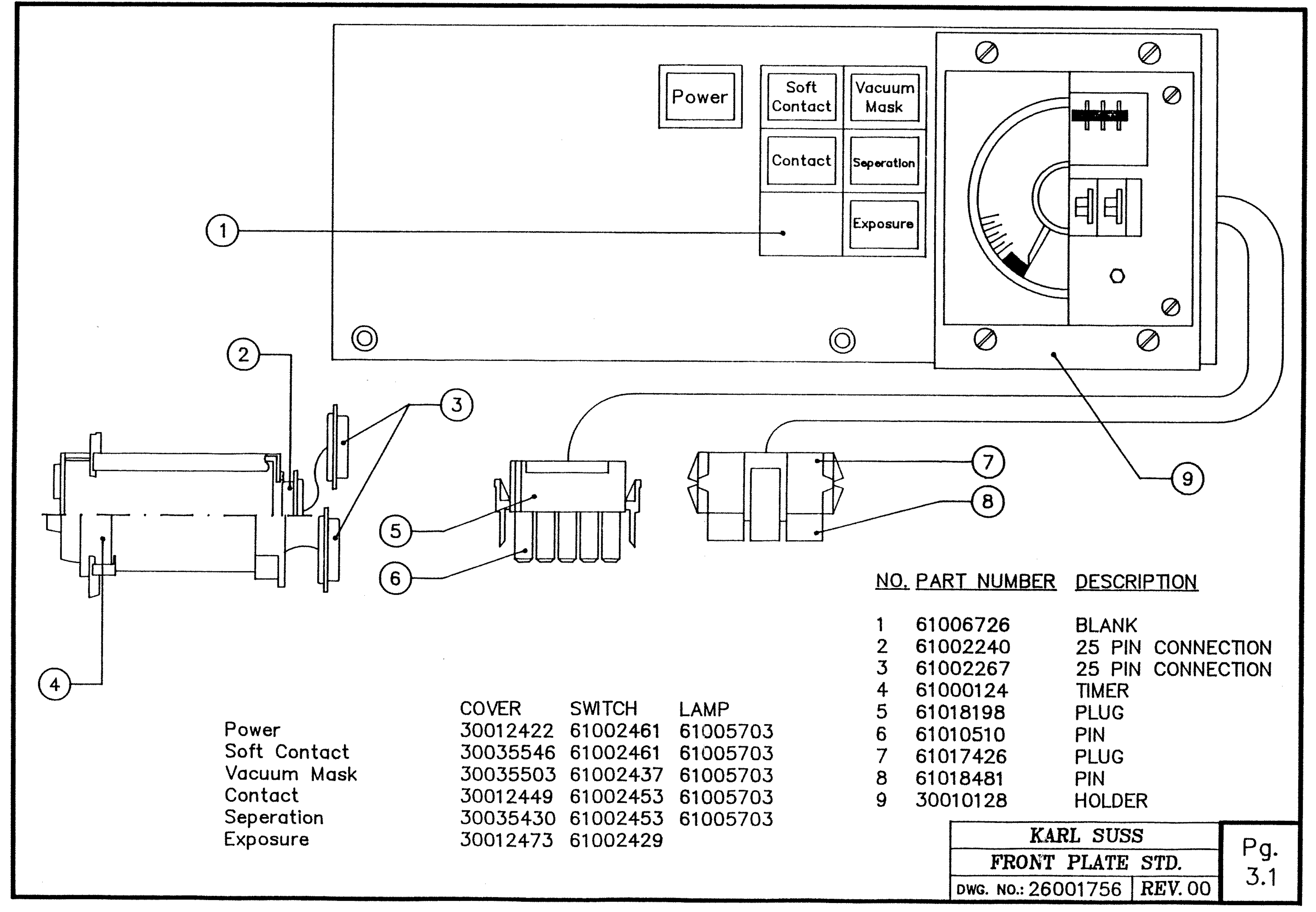
	COVER	SWITCH	LAMP
Power	30012422	61002461	61005703
HP/ST	30012430	61006629	61006807
Soft Contact	30035546	61002461	61005703
Vacuum Mask	30035503	61002437	61005703
– ⌒ +	30024803	61001333	61010533
Vacuum Chamber	30012457	61002429	61005703
Contact	30012449	61002453	61005703
Seperation	30035430	61002453	61005703
Exposure in seperation	30035422	61002461	61005703
Nitrogen Loss	30035392	61002437	61005703
Exposure	30012473	61002429	
((◎))		61017957	

NO.	PART NUMBER	DESCRIPTION
1	30036674	SPACER
2	30036682	MANOMETER
3	61500577	THROTTLE
4	61002240	25 PIN CONNECTION
5	61002267	25 PIN CONNECTION
6	61000124	TIMER
7	61018198	PLUG
8	61010510	PIN
9	61017426	PLUG
10	61018481	PIN
11	30010128	HOLDER

KARL SUSS

FRONT PLATE 200W

DWG. NO.: 26001799 REV. 00



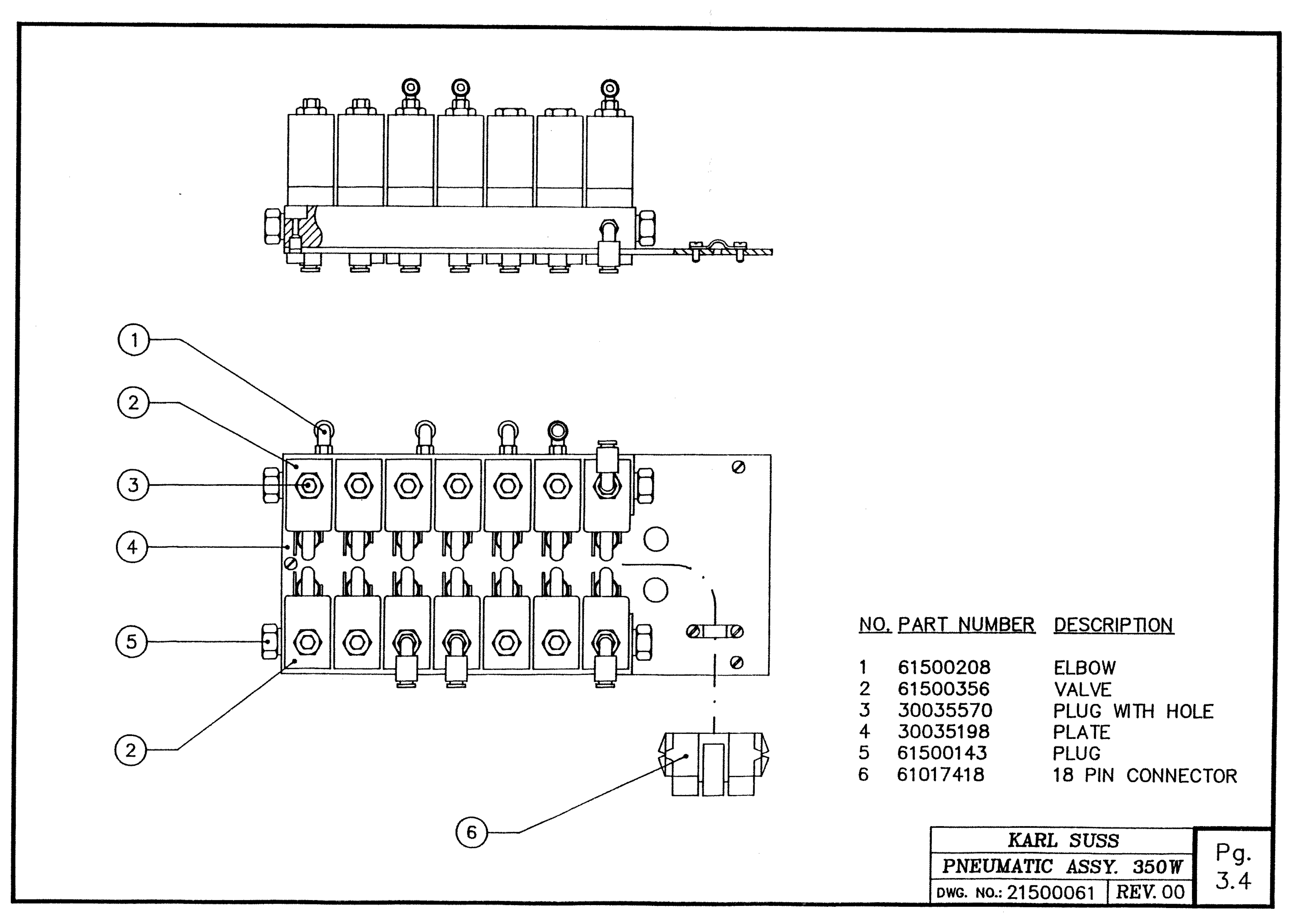
	COVER	SWITCH	LAMP
Power	30012422	61002461	61005703
Soft Contact	30035546	61002461	61005703
Vacuum Mask	30035503	61002437	61005703
Contact	30012449	61002453	61005703
Seperation	30035430	61002453	61005703
Exposure	30012473	61002429	

NO.	PART NUMBER	DESCRIPTION
1	61006726	BLANK
2	61002240	25 PIN CONNECTION
3	61002267	25 PIN CONNECTION
4	61000124	TIMER
5	61018198	PLUG
6	61010510	PIN
7	61017426	PLUG
8	61018481	PIN
9	30010128	HOLDER

KARL SUSS

FRONT PLATE STD.

DWG. NO.: 26001756 REV. 00

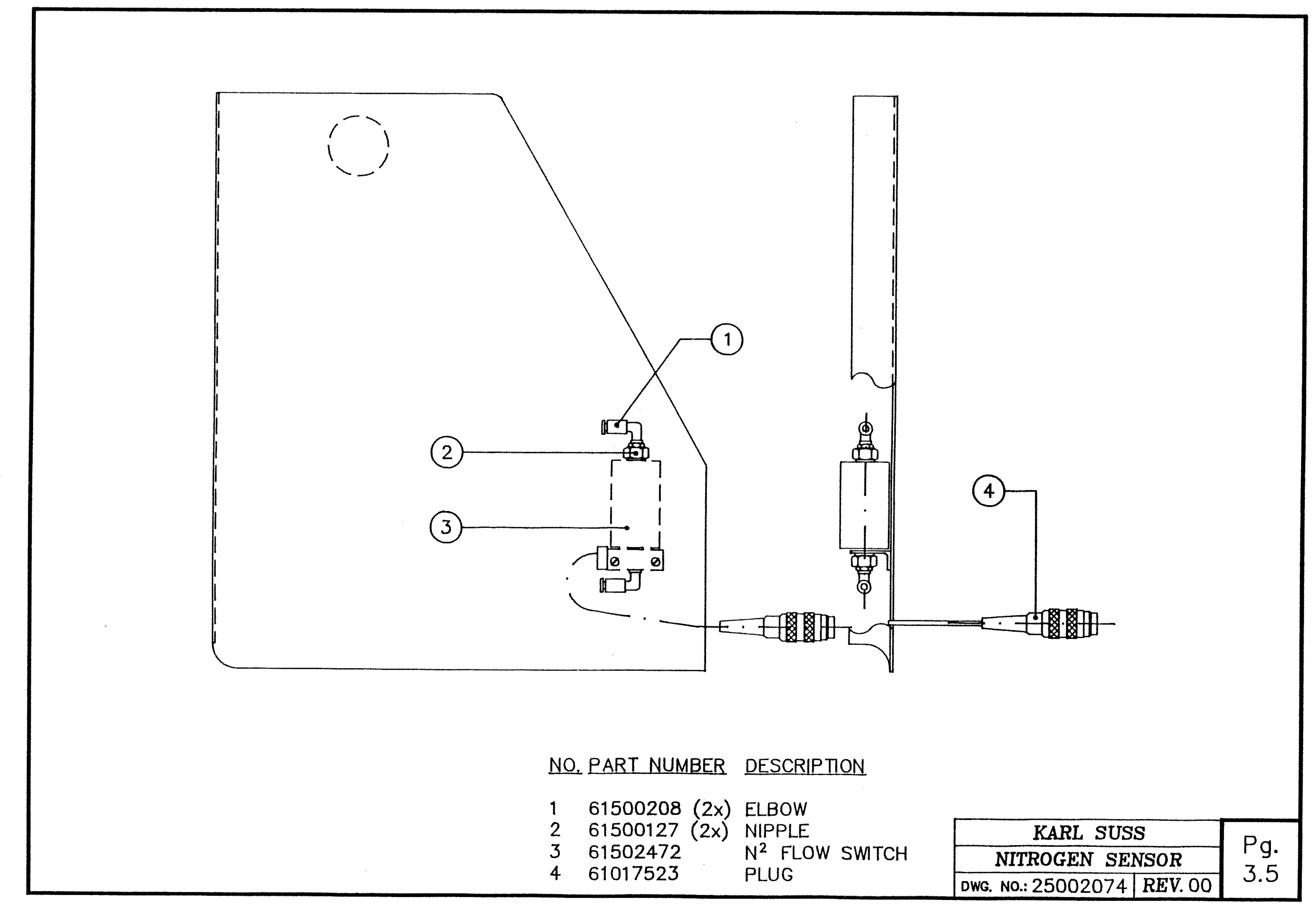


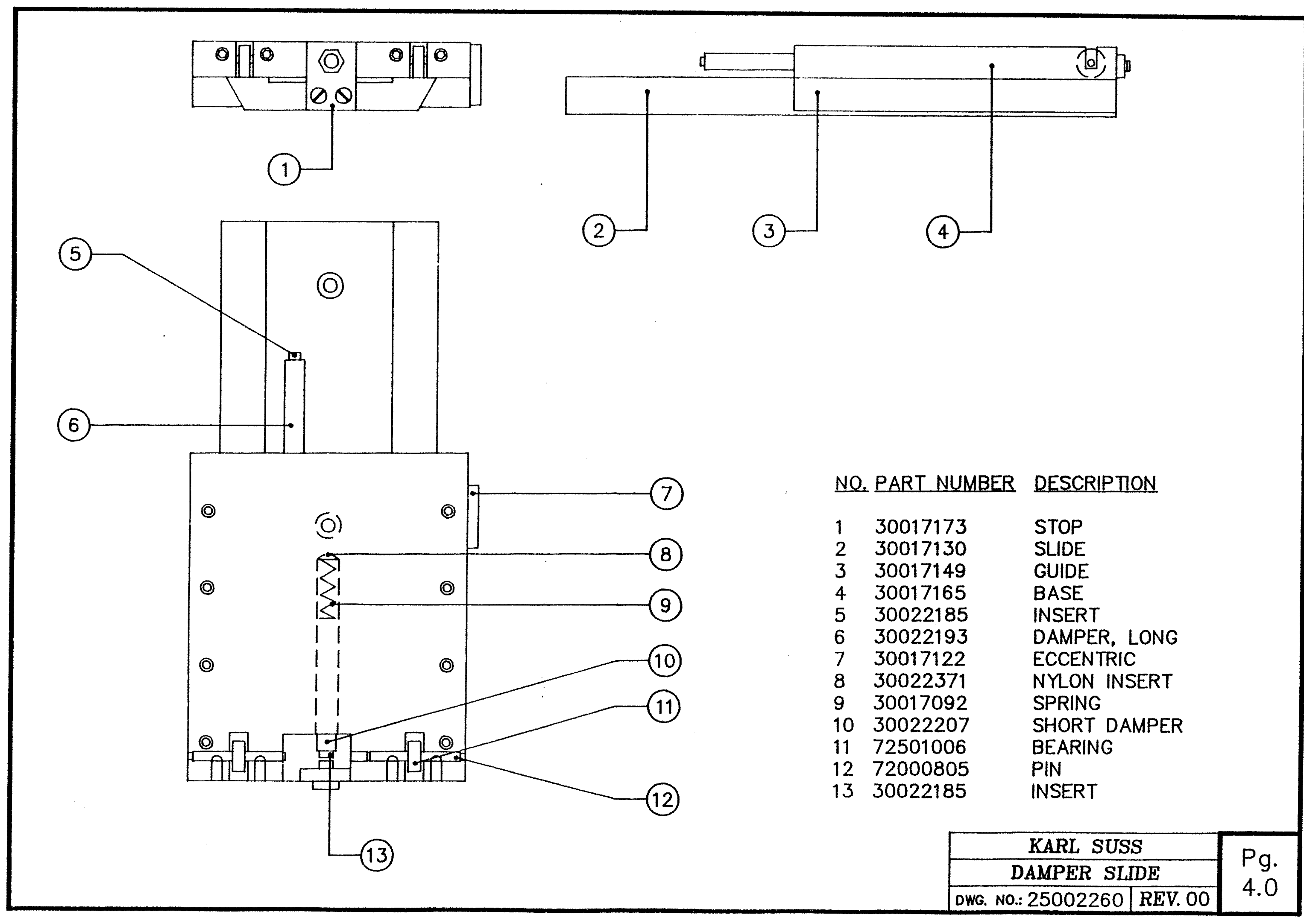
NO.	PART NUMBER	DESCRIPTION
1	61500208	ELBOW
2	61500356	VALVE
3	30035570	PLUG WITH HOLE
4	30035198	PLATE
5	61500143	PLUG
6	61017418	18 PIN CONNECTOR

KARL SUSS

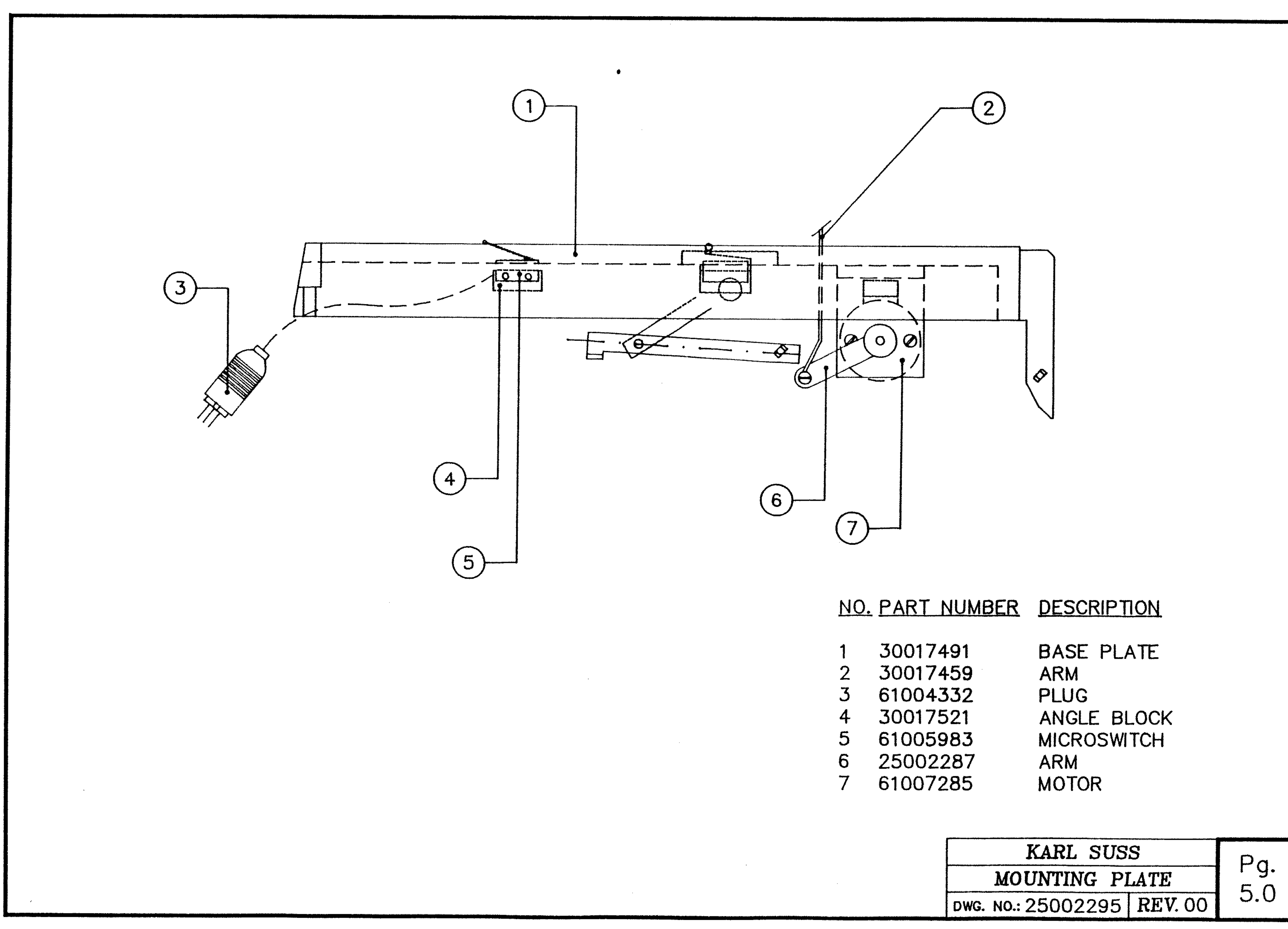
PNEUMATIC ASSY. 350W

DWG. NO.: 21500061 REV. 00


1
2
3
4
NO. PART NUMBER DESCRIPTION
1 61500208 (2x) ELBOW
2 61500127 (2x) NIPPLE
3 61502472 N² FLOW SWITCH
4 61017523 PLUG
KARL SUSS
NITROGEN SENSOR
DWG. NO.: 25002074
REV. 00
Pg. 3.5

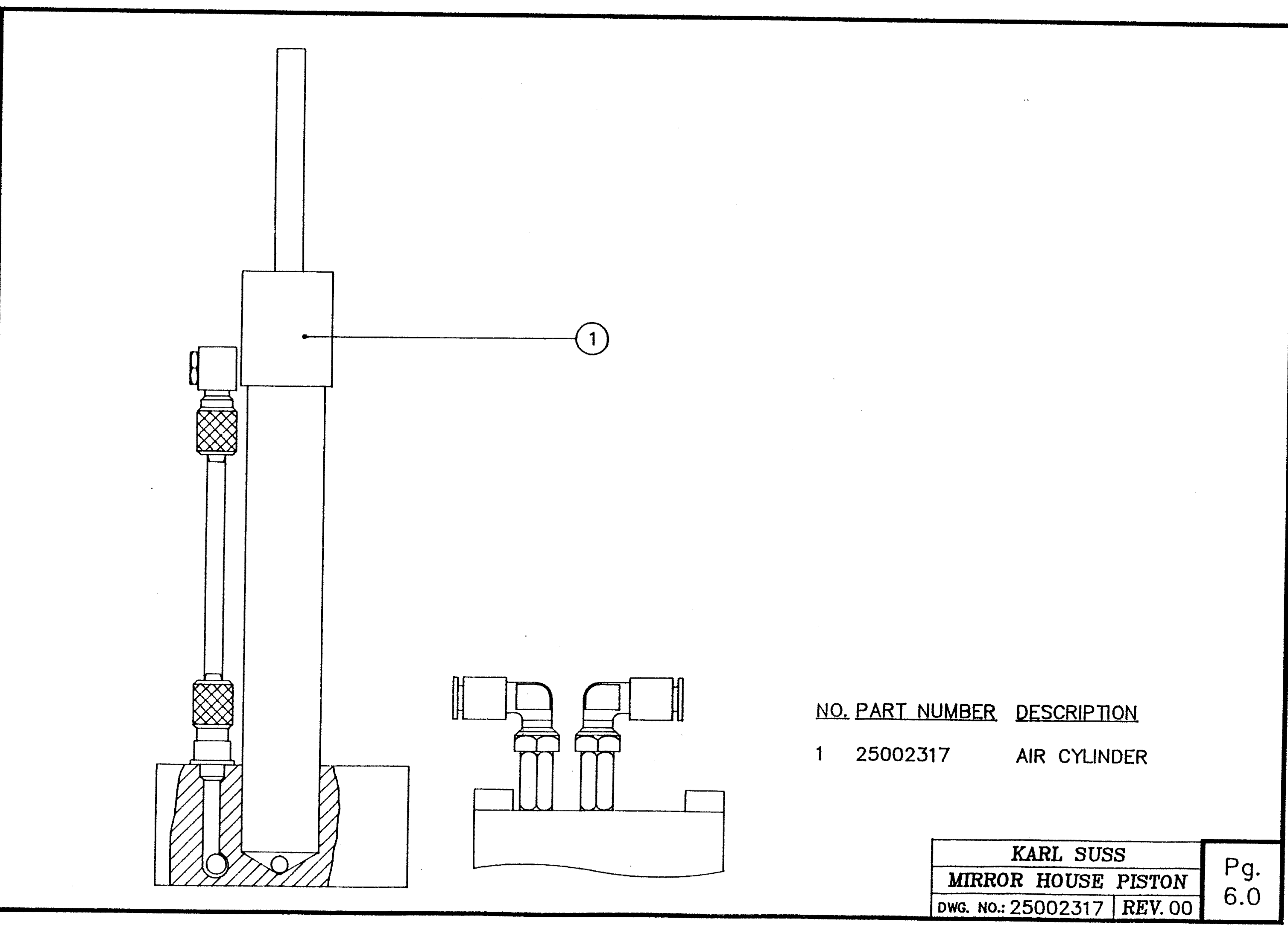


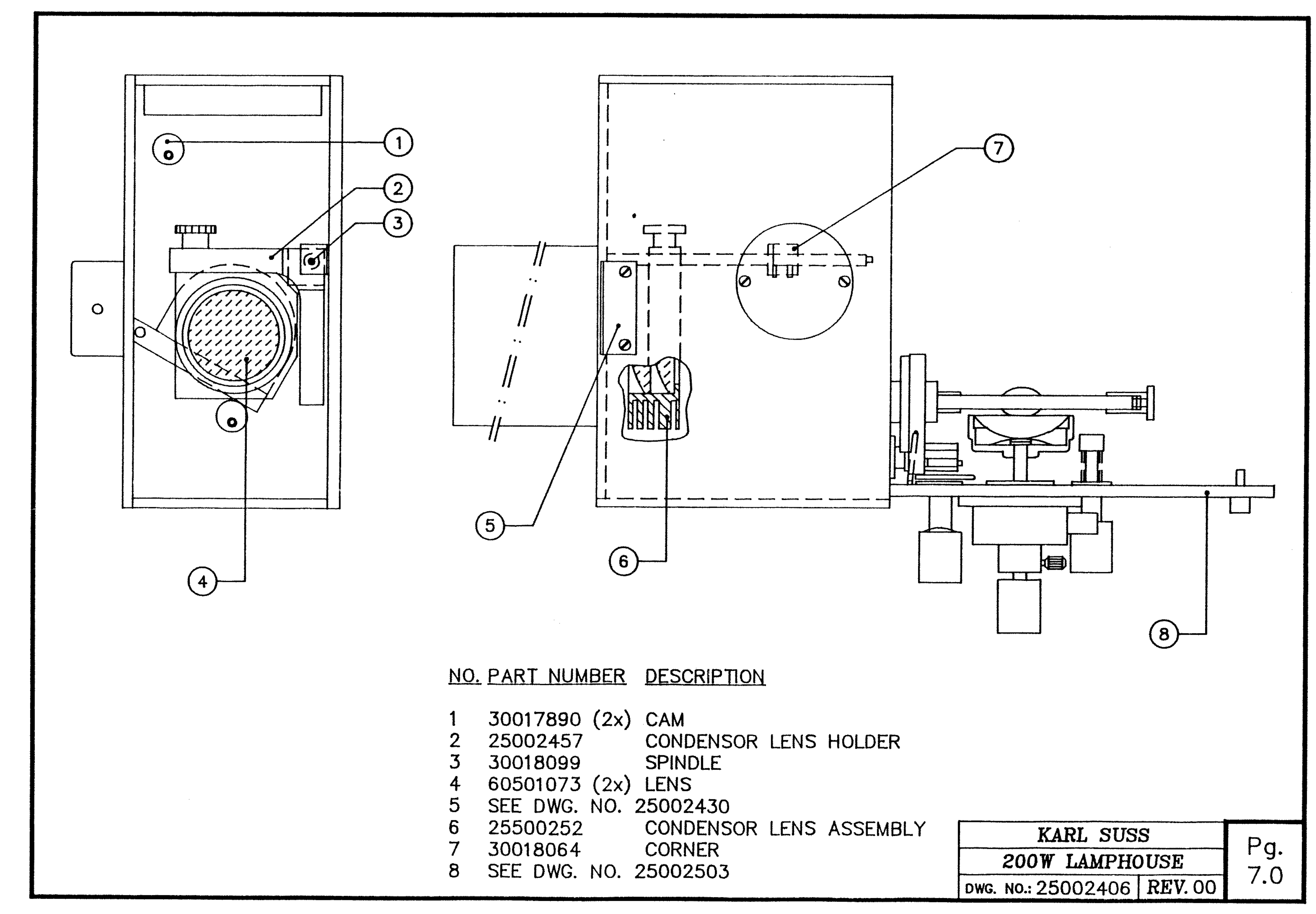
NO.	PART NUMBER	DESCRIPTION
1	30017173	STOP
2	30017130	SLIDE
3	30017149	GUIDE
4	30017165	BASE
5	30022185	INSERT
6	30022193	DAMPER, LONG
7	30017122	ECCENTRIC
8	30022371	NYLON INSERT
9	30017092	SPRING
10	30022207	SHORT DAMPER
11	72501006	BEARING
12	72000805	PIN
13	30022185	INSERT

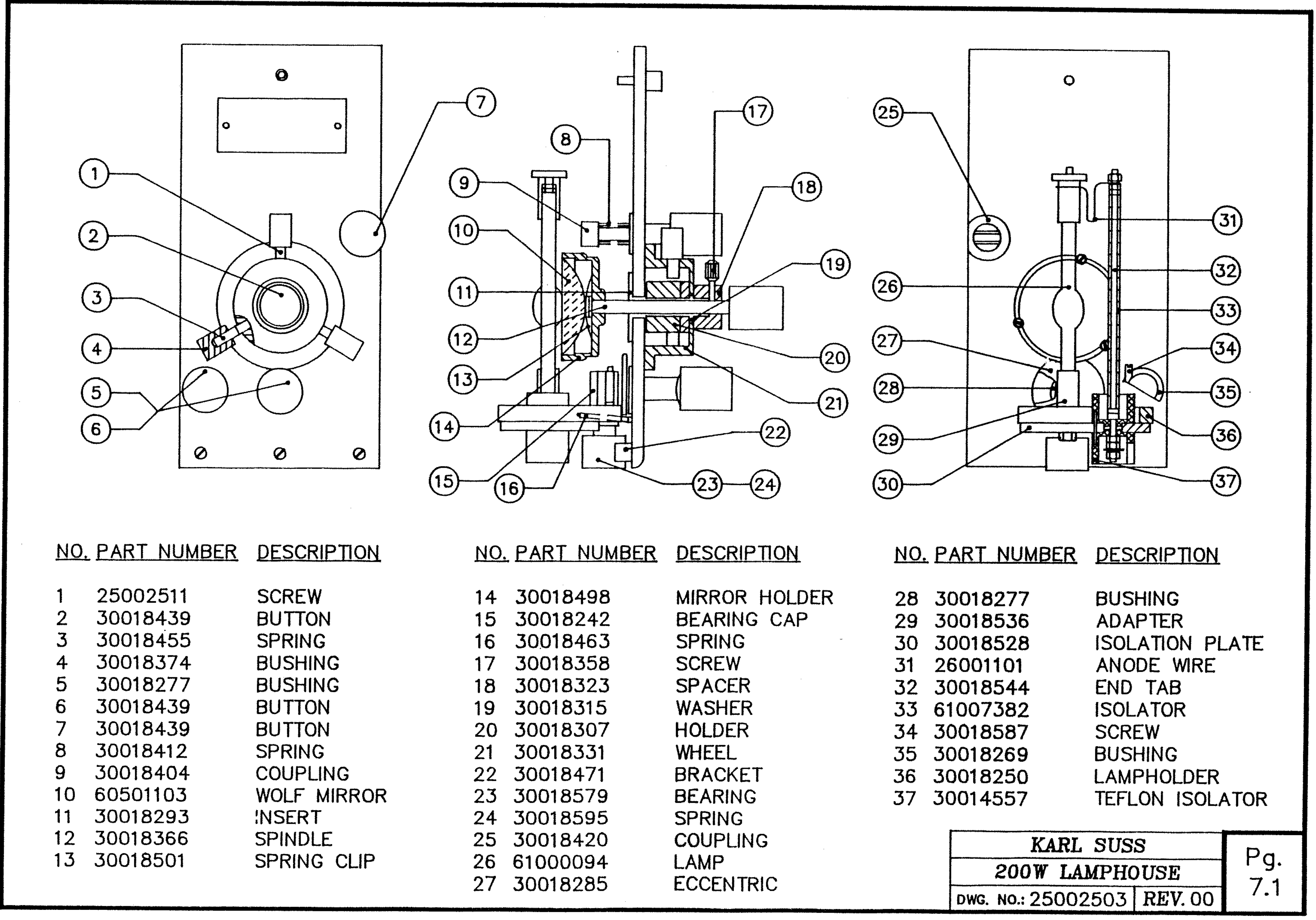


NO.	PART NUMBER	DESCRIPTION
1	30017491	BASE PLATE
2	30017459	ARM
3	61004332	PLUG
4	30017521	ANGLE BLOCK
5	61005983	MICROSWITCH
6	25002287	ARM
7	61007285	MOTOR

KARL SUSS		Pg. 5.0
MOUNTING PLATE		
DWG. NO.: 25002295	REV. 00	


1
NO. PART NUMBER DESCRIPTION
1 25002317 AIR CYLINDER
KARL SUSS
MIRROR HOUSE PISTON
DWG. NO.: 25002317
REV. 00
Pg. 6.0


1
2
3
4
5
6
7
8
NO. PART NUMBER DESCRIPTION
1 30017890 (2x) CAM
2 25002457 CONDENSOR LENS HOLDER
3 30018099 SPINDLE
4 60501073 (2x) LENS
5 SEE DWG. NO. 25002430
6 25500252 CONDENSOR LENS ASSEMBLY
7 30018064 CORNER
8 SEE DWG. NO. 25002503
KARL SUSS
200W LAMPHOUSE
DWG. NO.: 25002406
REV. 00
Pg. 7.0



NO.	PART NUMBER	DESCRIPTION
1	25002511	SCREW
2	30018439	BUTTON
3	30018455	SPRING
4	30018374	BUSHING
5	30018277	BUSHING
6	30018439	BUTTON
7	30018439	BUTTON
8	30018412	SPRING
9	30018404	COUPLING
10	60501103	WOLF MIRROR
11	30018293	!NSERT
12	30018366	SPINDLE
13	30018501	SPRING CLIP
14	30018498	MIRROR HOLDER
15	30018242	BEARING CAP
16	30018463	SPRING
17	30018358	SCREW
18	30018323	SPACER
19	30018315	WASHER
20	30018307	HOLDER
21	30018331	WHEEL
22	30018471	BRACKET
23	30018579	BEARING
24	30018595	SPRING
25	30018420	COUPLING
26	61000094	LAMP
27	30018285	ECCENTRIC
28	30018277	BUSHING
29	30018536	ADAPTER
30	30018528	ISOLATION PLATE
31	26001101	ANODE WIRE
32	30018544	END TAB
33	61007382	ISOLATOR
34	30018587	SCREW
35	30018269	BUSHING
36	30018250	LAMPHOLDER
37	30014557	TEFLON ISOLATOR

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200W LAMPHOUSE

DWG. NO.: 25002503 REV. 00

1

NO.	PART NUMBER	DESCRIPTION
1	25002430	SHUTTER ASSEMBLY

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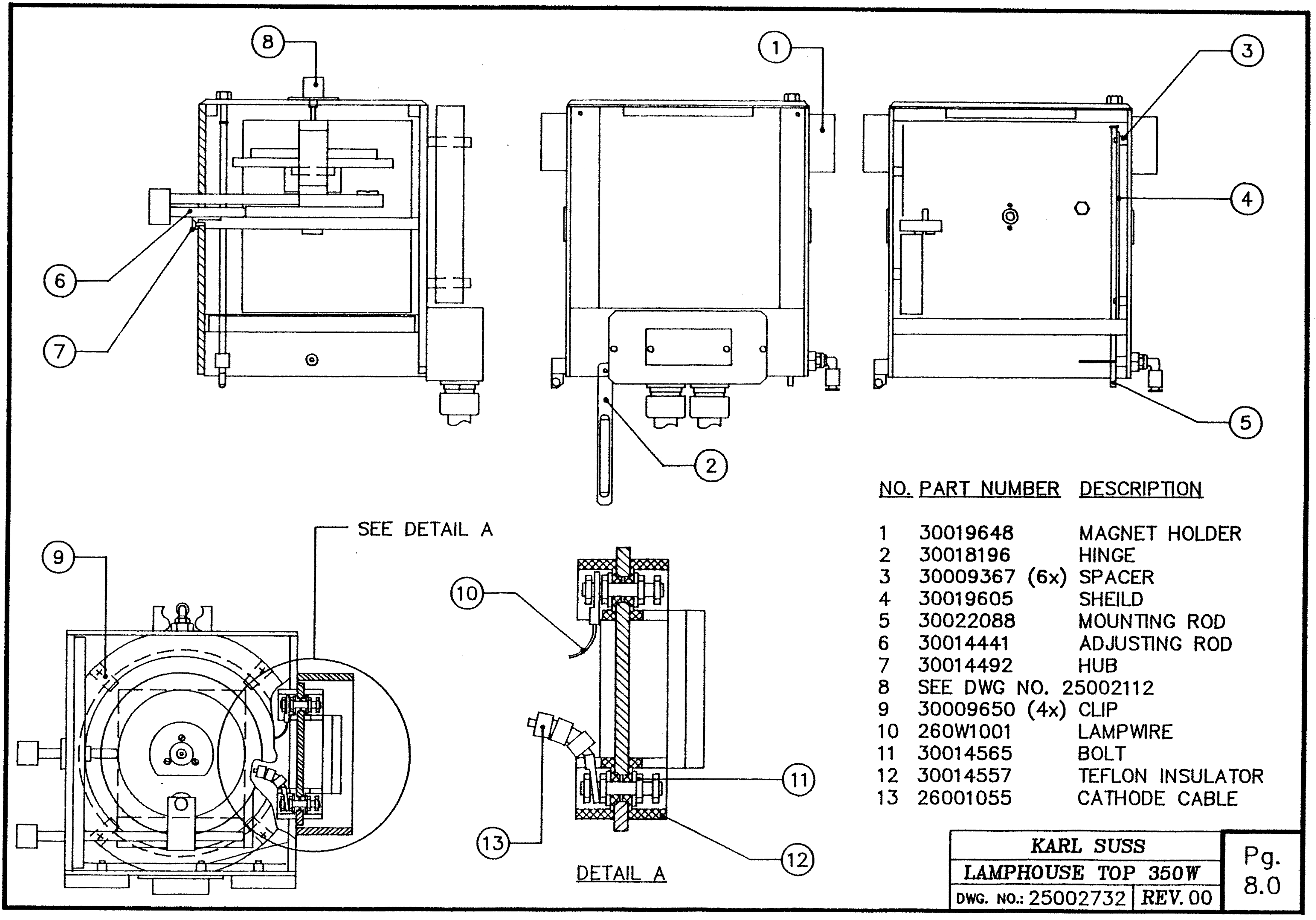
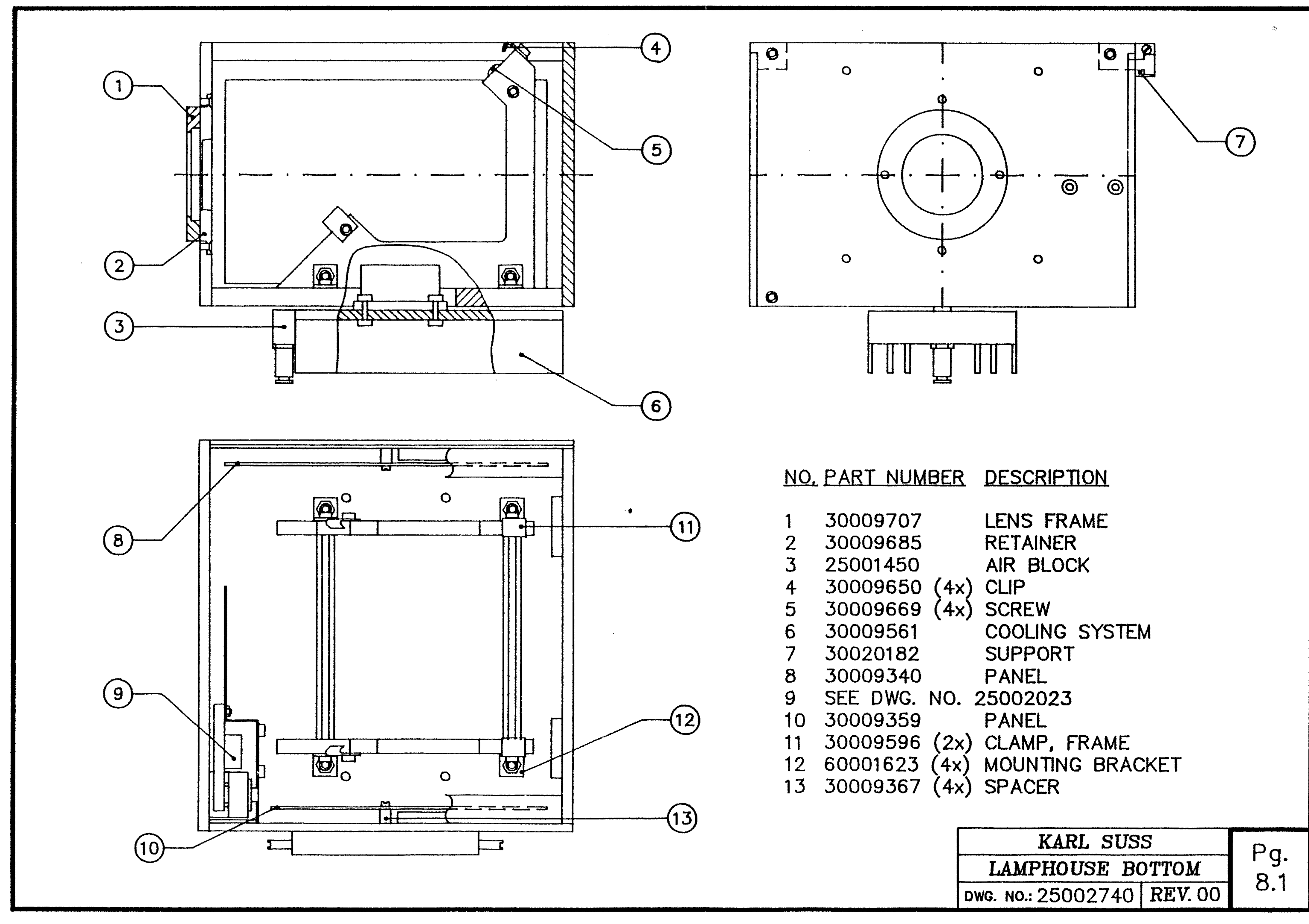
SHUTTER ASSY. 200W	
DWG. NO.: 25002430	REV. 00



NO.	PART NUMBER	DESCRIPTION
1	30019648	MAGNET HOLDER
2	30018196	HINGE
3	30009367 (6x)	SPACER
4	30019605	SHEILD
5	30022088	MOUNTING ROD
6	30014441	ADJUSTING ROD
7	30014492	HUB
8	SEE DWG NO. 25002112	
9	30009650 (4x)	CLIP
10	260W1001	LAMPWIRE
11	30014565	BOLT
12	30014557	TEFLON INSULATOR
13	26001055	CATHODE CABLE



NO.	PART NUMBER		DESCRIPTION
1	30009707		LENS FRAME
2	30009685		RETAINER
3	25001450		AIR BLOCK
4	30009650	(4x)	CLIP
5	30009669	(4x)	SCREW
6	30009561		COOLING SYSTEM
7	30020182		SUPPORT
8	30009340		PANEL
9	SEE DWG. NO. 25002023		
10	30009359		PANEL
11	30009596	(2x)	CLAMP, FRAME
12	60001623	(4x)	MOUNTING BRACKET
13	30009367	(4x)	SPACER

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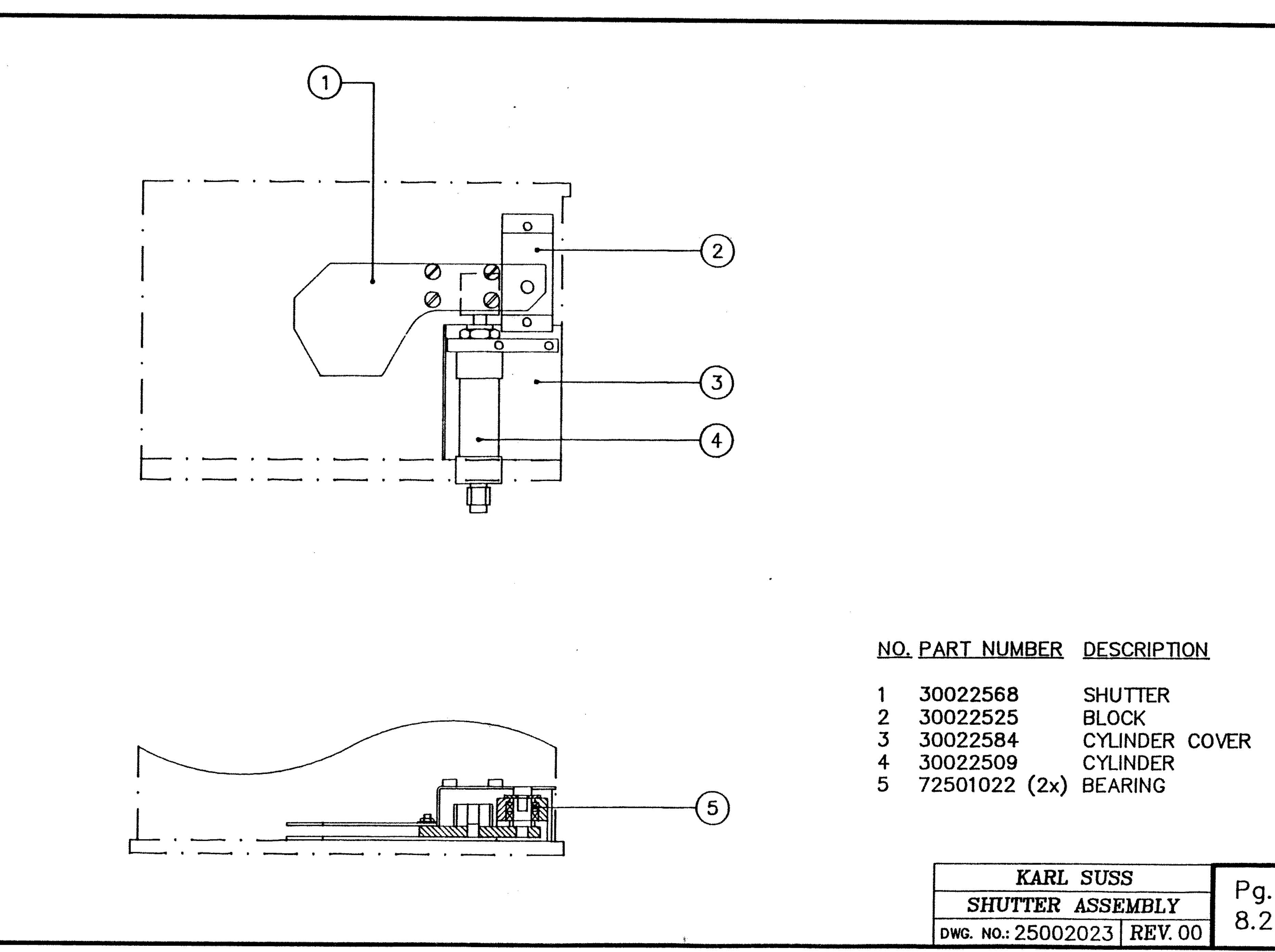
LAMPHOUSE BOTTOM

DWG. NO.: 25002740 REV. 00



NO.	PART NUMBER	DESCRIPTION
1	30022568	SHUTTER
2	30022525	BLOCK
3	30022584	CYLINDER COVER
4	30022509	CYLINDER
5	72501022 (2x)	BEARING

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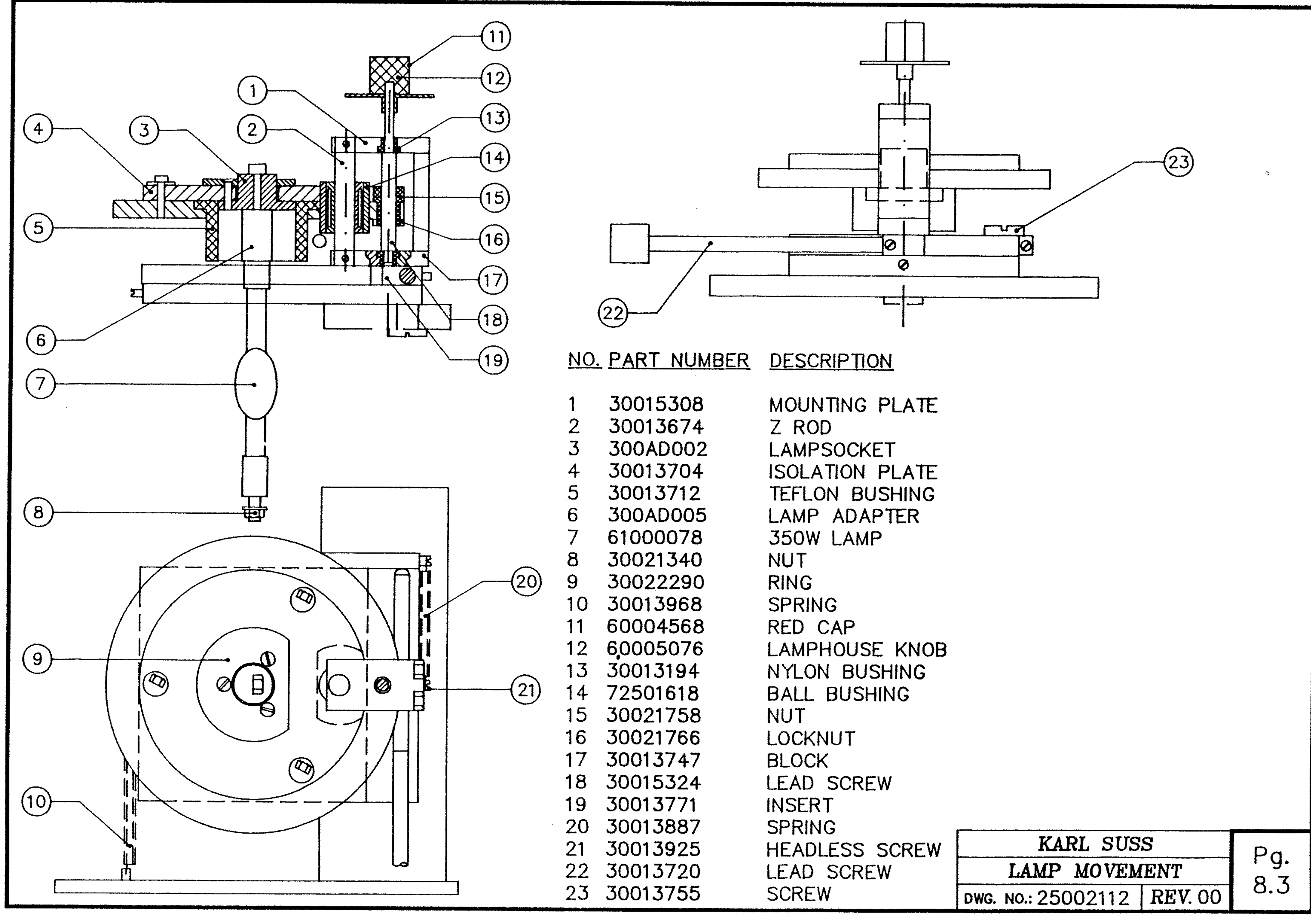
SHUTTER ASSEMBLY

DWG. NO.: 25002023 REV. 00



NO.	PART NUMBER	DESCRIPTION
1	30015308	MOUNTING PLATE
2	30013674	Z ROD
3	300AD002	LAMPSOCKET
4	30013704	ISOLATION PLATE
5	30013712	TEFLON BUSHING
6	300AD005	LAMP ADAPTER
7	61000078	350W LAMP
8	30021340	NUT
9	30022290	RING
10	30013968	SPRING
11	60004568	RED CAP
12	60005076	LAMPHOUSE KNOB
13	30013194	NYLON BUSHING
14	72501618	BALL BUSHING
15	30021758	NUT
16	30021766	LOCKNUT
17	30013747	BLOCK
18	30015324	LEAD SCREW
19	30013771	INSERT
20	30013887	SPRING
21	30013925	HEADLESS SCREW
22	30013720	LEAD SCREW
23	30013755	SCREW

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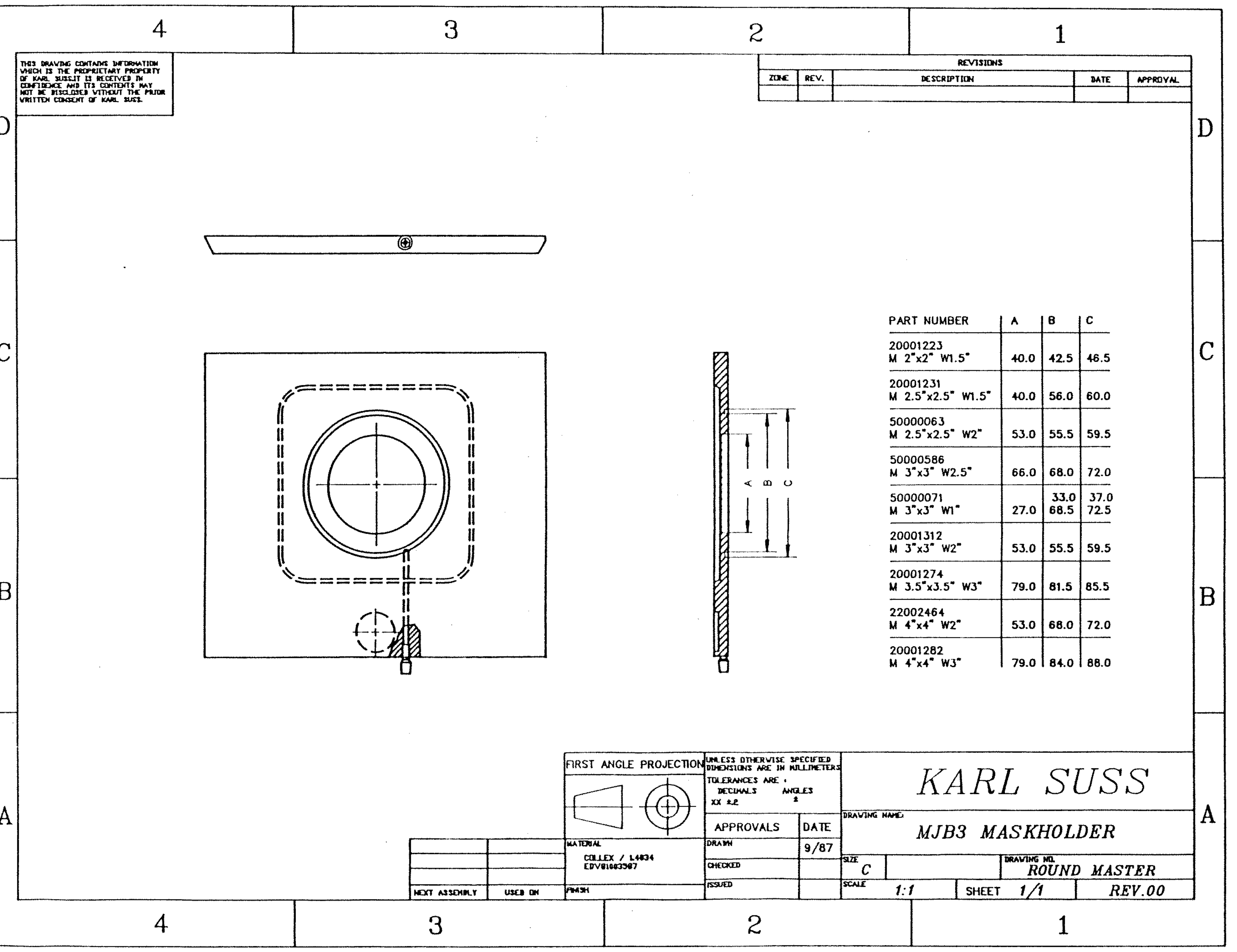
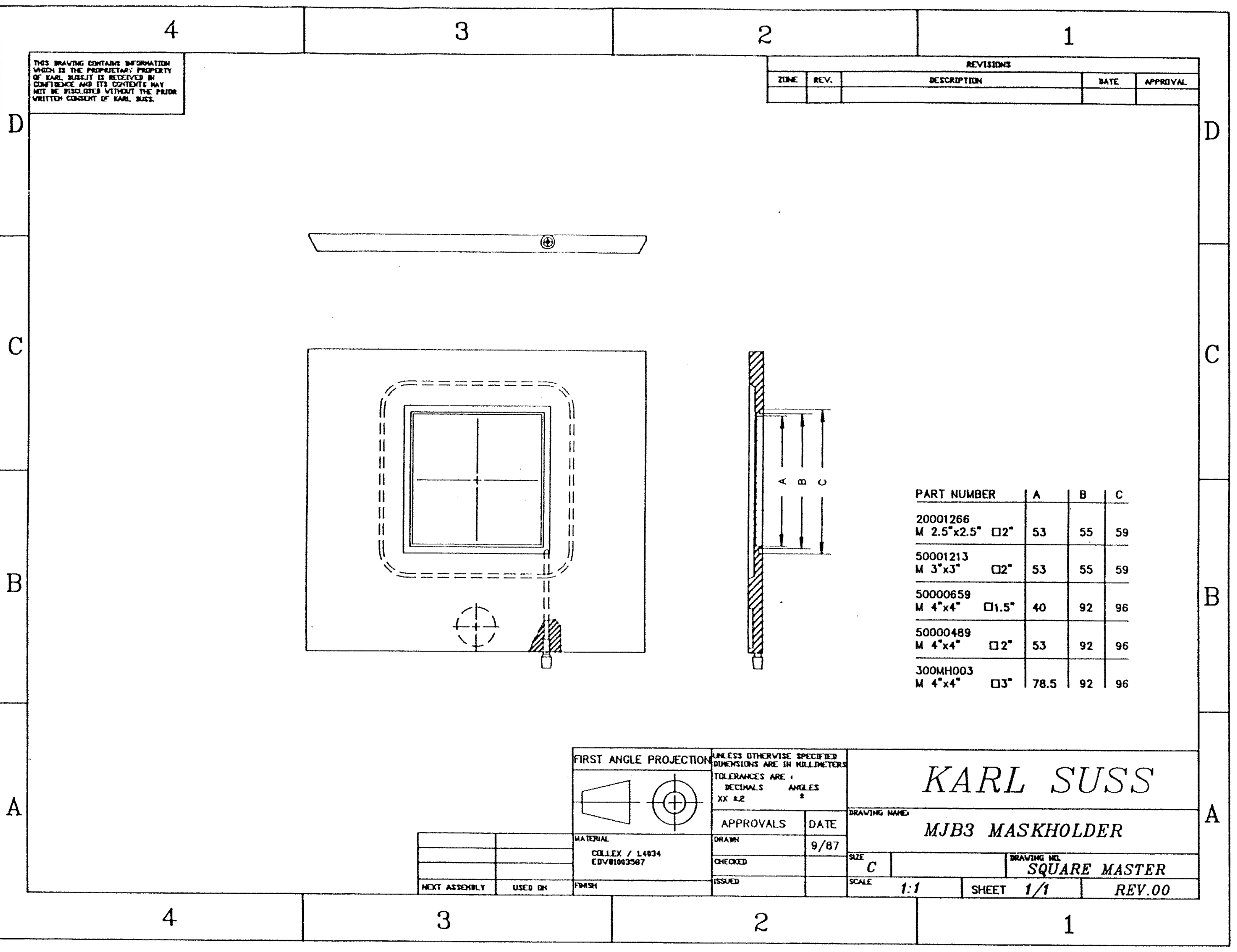
LAMP MOVEMENT

DWG. NO.: 25002112 | REV. 00



PART NUMBER	A	B	C
20001223 M 2"x2" W1.5"	40.0	42.5	46.5
20001231 M 2.5"x2.5" W1.5"	40.0	56.0	60.0
50000063 M 2.5"x2.5" W2"	53.0	55.5	59.5
50000586 M 3"x3" W2.5"	66.0	68.0	72.0
50000071 M 3"x3" W1"	27.0	33.0 68.5	37.0 72.5
20001312 M 3"x3" W2"	53.0	55.5	59.5
20001274 M 3.5"x3.5" W3"	79.0	81.5	85.5
22002464 M 4"x4" W2"	53.0	68.0	72.0
20001282 M 4"x4" W3"	79.0	84.0	88.0



PART NUMBER	A	B	C
20001266 M 2.5"x2.5" □2"	53	55	59
50001213 M 3"x3" □2"	53	55	59
50000659 M 4"x4" □1.5"	40	92	96
50000489 M 4"x4" □2"	53	92	96
300MH003 M 4"x4" □3"	78.5	92	96

K
SM
Karl Suss