

# **ORIEL**

**VARIABLE FREQUENCY CHOPPER**

**MODEL 75157 (OPEN VERSION)  
MODEL 75155 (CLOSED VERSION)  
INCLUDING CONTROLLER**

## **Instruction Manual**

**ORIEL**  
CORPORATION

250 LONG BEACH BLVD., P.O. BOX 872, STRATFORD, CT. U.S.A. 06497 • TEL: (203) 377-8282 • TLX: 4750361 • FAX: (203) 378-2457



250 Long Beach Boulevard  
Stratford, CT 06497-0872  
Phone: (203) 377-8282  
Fax: (203) 378-2457

## VARIABLE FREQUENCY CHOPPER

**MODEL 75157 (OPEN VERSION)  
MODEL 75155 (CLOSED VERSION)  
INCLUDING CONTROLLER**

Please read these instructions completely before  
operating this equipment.

If there are any questions or problems regarding  
the use of this equipment, please contact:

**ORIEL CORPORATION**

- or -

**ORIEL S.A.R.L.**  
9 Avenue De Laponie  
Z.A. De Courtaboeuf  
91951 Les Ulis Cedex  
France  
Phone: 01-69-07-20-20  
Fax: 01-69-07-23-57

**ORIEL SCIENTIFIC, LTD.**  
1 Mole Business Park  
P.O. Box 31  
Leatherhead  
Surrey KT22 7AU  
England  
Phone: 0372-378822  
Fax: 0372-375-353

- or -

The representative from whom this equipment was purchased.

THIS IS NOT AN ORIEL PRODUCT

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UNLESS OTHERWISE SPECIFIED, THIS PART MUST BE MADE OF HEAVY GALVANIZED AND LITIGATION WAREHOUSE QUALITY STEEL AND MUST BE CAPABLE OF WITHSTANDING THE WEIGHT OF ALL PARTS WHICH ARE TO BE SUPPORTED THEREON. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.

SECTION I - INTRODUCTION

Optical systems often require the use of a chopper to modulate the light beam either because a detector, such as the pyroelectric detector, does not respond to continuous radiation or because the signal to noise ratio can be improved by modulation and filtering techniques. The Oriel Models 75155/75157 Variable Frequency Chopper with chopping rates of 3.2 Hz (with 2 aperture wheel) to 4000 Hz (with 40 aperture wheel) allows optimal modulation of the signal for both low and high speed detectors and permits the user to avoid high noise frequency regions. The chopper system offers great versatility with a variety of chopper wheels and convenient chopper mounting capabilities.

SECTION II - SAFETY CONSIDERATIONS

Hazard to Personnel

The 75155/75157 may be used with lasers and other light sources with potentially dangerous energy content. For safety,

THE PATH OF ANY REFLECTED BEAM MUST BE PROPERLY TERMINATED.  
PROTECTIVE EYEWEAR AND CLOTHING MUST BE WORN.

The chopper blade is capable of injuring fingers or hands if they come in contact with the blade while it is rotating. Therefore,

KEEP HANDS AND FINGERS CLEAR OF THE CHOPPER BLADE  
WHENEVER THE COPPER IS RUNNING!

The 75155/75157 has potentially lethal AC power line voltage inside the controller. Therefore,

ALWAYS DISCONNECT THE INPUT POWER  
BEFORE OPENING THE CONTROLLER ENCLOSURE AND DO  
NOT OPERATE THE CONTROLLER WITH THE ENCLOSURE OPEN.

SECTION III - SPECIFICATIONS

Physical dimensions : Chopper

<u>Model #</u>	<u>W</u>	<u>x</u>	<u>H</u>	<u>x</u>	<u>L</u>	<u>Weight</u>
75155	4-1/4	x	6	x	5-3/8	1.63 lbs.
75157	3-7/8	x	6	x	5-1/8	.75 lbs.

Controller

7-1/2 x 3-1/2 x 12 5.6 lbs.

- Frequency range : 3.2-4000 Hz
- Motor speed : 1.6 - 100 rev/sec
- Chopper wheels : 2, 5, 30 and 40 apertures on  
(See Table 1) 3.375 inch diameter
- Frequency display : 4 digit LED; 1 Hz resolution
- Frequency stability\* : 0.2% / degree C; 0.2% / hour
- Frequency adjustment : 10 turn potentiometer or external  
DC voltage, 0-7 volts
- Phase jitter of blades : less than +/- 0.5 degrees
- Synchronization output : TTL compatible, BNC  
Open collector, mini-jack
- Line voltage : 95-132 VAC, 50-60 Hz, 1/2 Amp  
190-264 VAC, 50/60 Hz, 1/4 Amp  
Externally selectable  
IEC connector.

\* After half an hour warm-up.

TABLE 1  
CHOPPER WHEELS

Model No.	Blade Dia.	No. Apertures	Max Chopping Rate	Usable Aperture Inch (mm)
75162	5.035	2	200 Hz	1.29 (32.77)
75163	5.035	5	500 Hz	1.04 (26.5)
75164	5.035	30	3000 Hz	.177 (4.49)
75165	5.035	40	4000 Hz	.132 (3.36)

SECTION IV - SYSTEM DESCRIPTION

The Variable Speed Chopper is available in two versions:

Model 75157, Open Chopper, 115/220V (Figure B)

Model 75155, Closed Chopper, 115/220V (Figure A)

Since the closed version actually consists of an open chopper with a rectangular can and backplate, it is possible to do a field conversion from closed, to open chopper, configuration.

This is simply done by loosening (4) screws, item 11, Figure A, and remove the rectangular can.

Remove (4) screws, item 12, Figure A, and dis-assemble backplate, item 3, Figure A.

The variable speed chopper system consists of two major components.

- The chopper assembly (either open or closed).
- The chopper controller.

The Chopper Assembly

The chopper assembly consists of a small motor mounted on an angular frame. The motor shaft is provided with a mounting hub to accommodate one or two chopping blades. A photodetector is mounted on the frame to measure the actual chop frequency. A multiple pin connector is mounted next to the motor for connection to the controller.

All blades are 5.035 inch outside diameter with a .315 I.D. The number of apertures for standard blades are 2, 5, 30 and 40. See page III-2 for clear aperture size. Blades are available with a non reflecting black coating, and the closed version is supplied with a set of round apertures to match blade aperture.

The motor rotates at a maximum speed of 100 rev/sec depending on the number of apertures in the blade selected and the motor speed. The maximum frequency is defined as

$$100 \times n$$

where n equals the number of apertures in the blade. The value of n may be 5, 30 or 40, depending on the user's requirements. Using a 40 aperture blade, the maximum frequency can be 4000 Hz.



### Mounting Arrangements

The chopper assembly can be mounted on any Oriel table, both metric and inch, or other similar flat surface.

Another mounting alternative is to screw the chopper base onto an Oriel rod mount (see Volume I). This will enable the user to adjust the height as well as the angle of incidence. A 1/4-20 tapped insert is provided on top of the "can" to enable rod mounting with lower optical height. Item 9, Figure A, is temporarily inserted to prevent stray light entry.

### Assembly of Blade(s) (Figure B)

To assemble the blade(s), first dis-assemble screws #19, washer #4, and remove temporarily from the unit. Carefully insert the blade(s) between the phase detector, item #1, and assemble them onto the flanged hub of the motor assembly, item #3. Re-assemble washer #4 and (3) screws #19. To secure blade(s), insert a small pin or Allen wrench in the cross hole of the flanged hub and tighten screw #19 with Allen wrench.

When blades of the same model number are used, the duty cycle may be changed by off-setting the blades with respect to one another. Please be aware the "off-set" will reduce the aperture size.

### The Chopper Controller

The chopper controller provides an accurate DC voltage to the motor to maintain a constant operating speed. In conjunction with the photodetector mounted on the chopper, the actual chop frequency is measured and displayed and two different synchronization outputs are produced. The controls and connectors are defined below (reference Figure 1).

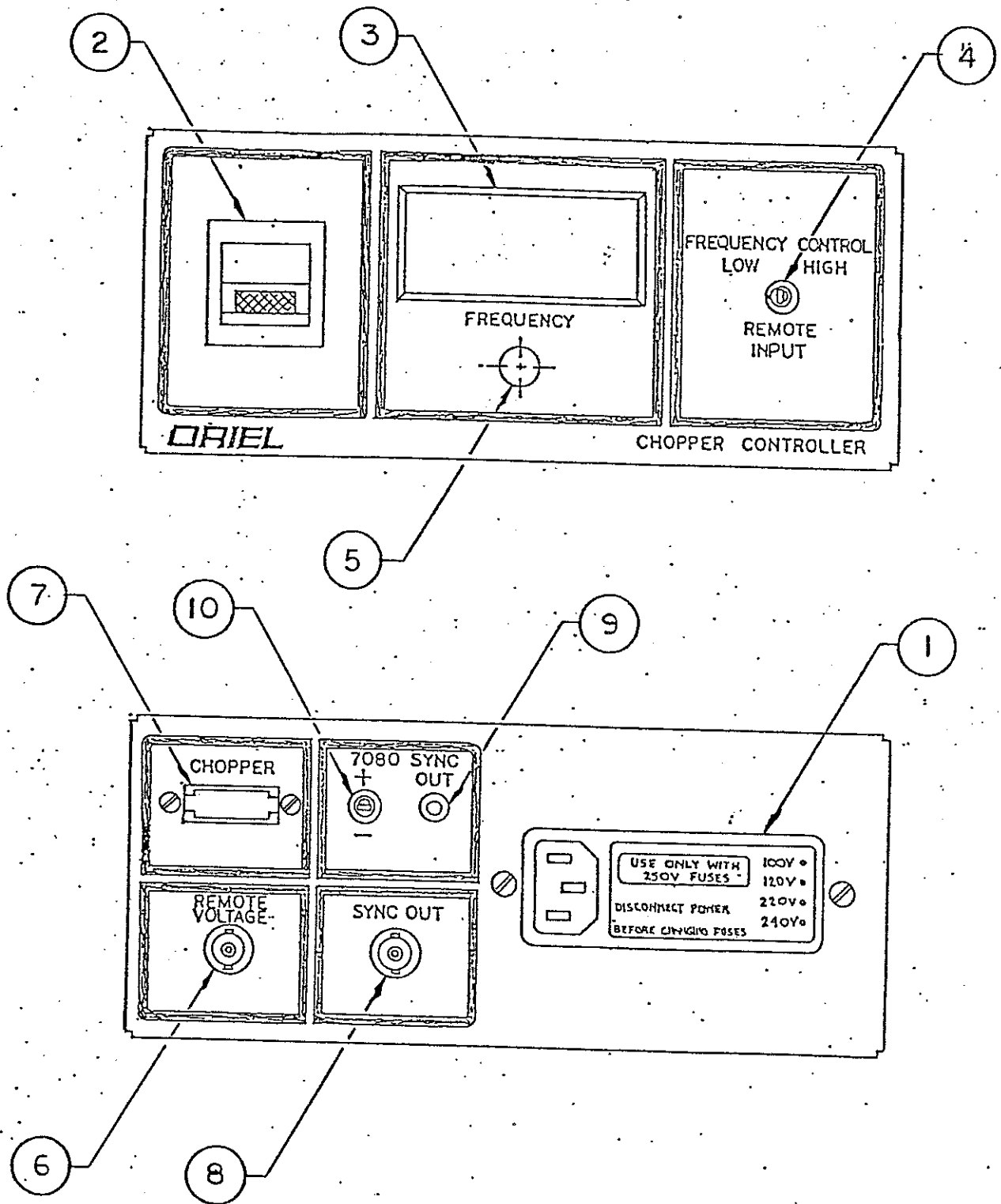


FIGURE 1 - CHOPPER CONTROLLER LAYOUT

## Item No.

1. Fuse block, AC connector, line voltage select.
2. Power switch, power on indicator.
3. Frequency readout, 4 digits (LED), 1 Hz resolution.
4. Frequency select. 3 position switch to select source of speed control and range of control for front panel potentiometer.
5. Frequency control. 10 turn potentiometer for adjusting the chop frequency while under front panel control.
6. Remote voltage input. BNC connector for application of a DC voltage (0-7 volts) for remote control of the chop frequency.
7. Chopper connector. Receptacle for the interconnect cable between the controller and the chopper. Motor drive voltage and synchronization signals are connected at this point.
8. Sync out. BNC connector with TTL synchronization signal.
9. 7080 out. Miniature phone jack providing open collector drive compatible with Oriel Model 7080.
10. 7080 Sync +/- . Two position switch for inverting the polarity of the 7080 synchronization signal.

## SECTION V - OPERATION

### Chopper Head Location

For best phase sensitive detection the chopper head should be positioned to chop only the desired radiative signal. If the chopper is placed close to the detector, then all radiation entering the detector will be chopped and "recognized" as signal. Ambient background will contribute to the measured result. It is better, in most cases, to place the chopper as close to the radiation source as possible so any ambient radiation from scattering or reflections between the source and detector is not modulated and, therefore, not recorded.

### System Interconnect

After the chopper is securely mounted, the cable connection between the chopper and the controller must be made.

The synchronization output must be connected from the controller to the signal processing system. The cable assembly for connection to the Oriel 7080 is provided.

AC power should be applied to the controller. Oriel products are normally configured for operation at 115 VAC. Products known to be destined for 220/240 VAC locations are set up for operation at the expected voltage and are tagged to indicate the change. If there is any doubt about the set up or a need to change the configuration, please see the section, "Line Voltage Selection".

### Chop Speed Setting

There are two methods of establishing the rotational speed of the motor. The front panel potentiometer in conjunction with the frequency select switch provides fine control of the chop frequency. An external control voltage applied via the BNC can provide the full range of motor speed (the more positive the voltage the faster the motor turns). It is possible to achieve motor speeds below 3.2 Hz or 4000 Hz, but the lower speeds may not be stable and the higher speeds will reduce motor life.

### Line Voltage Selection

The power entry module mounted on the rear panel provides an international IEC receptacle for power cord attachment. It has 120/240 VAC selection capability and the facility for North American and European fusing configurations.

This unit has been set up at the factory, based on destination, for either 120 VAC/North American fused operation or 240 VAC/European operation. Note that two European fuses are required. The configuration can be easily verified by noting the position of the white indication pin on the power module.

To change the selected voltage or fuse configuration, unplug the power cord from the unit and pry off the cover/fuse block assembly with a small bladed screwdriver or similar tool.

Use the indicator pin to pull the voltage selector card straight out of the housing. Orient the indicator pin so that it points in the opposite direction from the desired voltage, as indicated on the board. Reinsert the board with the voltage indication entering the module and the pin pointing out. When the cover is replaced verify that the pin indicates the correct voltage. Only the 120V and 240V selections are valid.

The fuses are mounted on the inside of the cover. The fuse(s) furthest into the housing are the active set. To change the fuse configuration, loosen the Phillips head screw which holds the fuse block, by two turns, lift the fuse block up at the screw end and then slide the block away from the screw. Invert the block and re-assemble, making sure that the end of the block opposite the screw is engaged before seating the block at the screw end and retightening the screw.

(For operation at 240 VAC, the alternative North American fusing arrangement may be used for polarized (non reversible) power socket/plug combinations. The fuse should be rated at one half the original 120V value.)

SECTION VI - TROUBLESHOOTING

The following information is provided to assist in troubleshooting system faults. For more detailed information on the controller itself, see the circuit description below.

System Faults

1. No power on indication/no digital display - check connection to AC line. Check fuse(s).
2. Chop frequency reads 000/motor does not turn - check connection between controller and chopper. Check that either
  - . front panel control is selected and potentiometer is not fully counter-clockwise, or
  - . external voltage control is selected and control voltage is not zero volt or below.
3. Chop frequency reads 000/motor is controllable - disconnect any connection to sync outputs. If the display now records frequency, the sync output is being loaded down externally. If the problem remains, set frequency control switch to external and disconnect any control voltage. Rotate chopper wheel by hand and measure voltage at BNC sync output. When the wheel blocks the light between the optical switch sensor and emitter, the voltage should be approximately 4 volts DC. When the light path is open, the voltage should drop to about zero volts. A constant voltage indicates a problem with the optical switch or the interconnect. If the voltage switches, the problem is in the controller.
4. No frequency control - check that correct mode is selected on frequency select switch.
5. Unstable chop speed - check secure mounting of wheel to motor. Check motor speed not below low limit. Check interconnect between controller and chopper.
6. Unstable signal measurement - check for unstable speed. Check that correct synchronizing output is being used.

If the above checks have not resolved the problem, the Customer Service Department should be contacted to arrange service.

Circumstances may arise which require the customer to attempt on site repair. The following information is supplied to assist an experienced technician in this process.

< < < < W A R N I N G > > > >

POTENTIALLY LETHAL VOLTAGE LEVELS EXIST WITHIN THIS UNIT WHEN POWER IS APPLIED. EXTREME CARE SHOULD BE TAKEN WHEN WORKING IN OR NEAR THIS UNIT WHENEVER THE COVER IS NOT IN PLACE.

A visual inspection may be made by removing the top cover and looking for shorts, broken wires or obviously damaged components.

Repairs or internal adjustments to this equipment should only be attempted by an experienced electronic technician. Improper use of test equipment or tools can easily damage components within the unit or compound existing problems. If no problem is obvious, the information provided in the circuit description section should be sufficient to assist an accomplished technician in resolving most problems.

#### Circuit Description

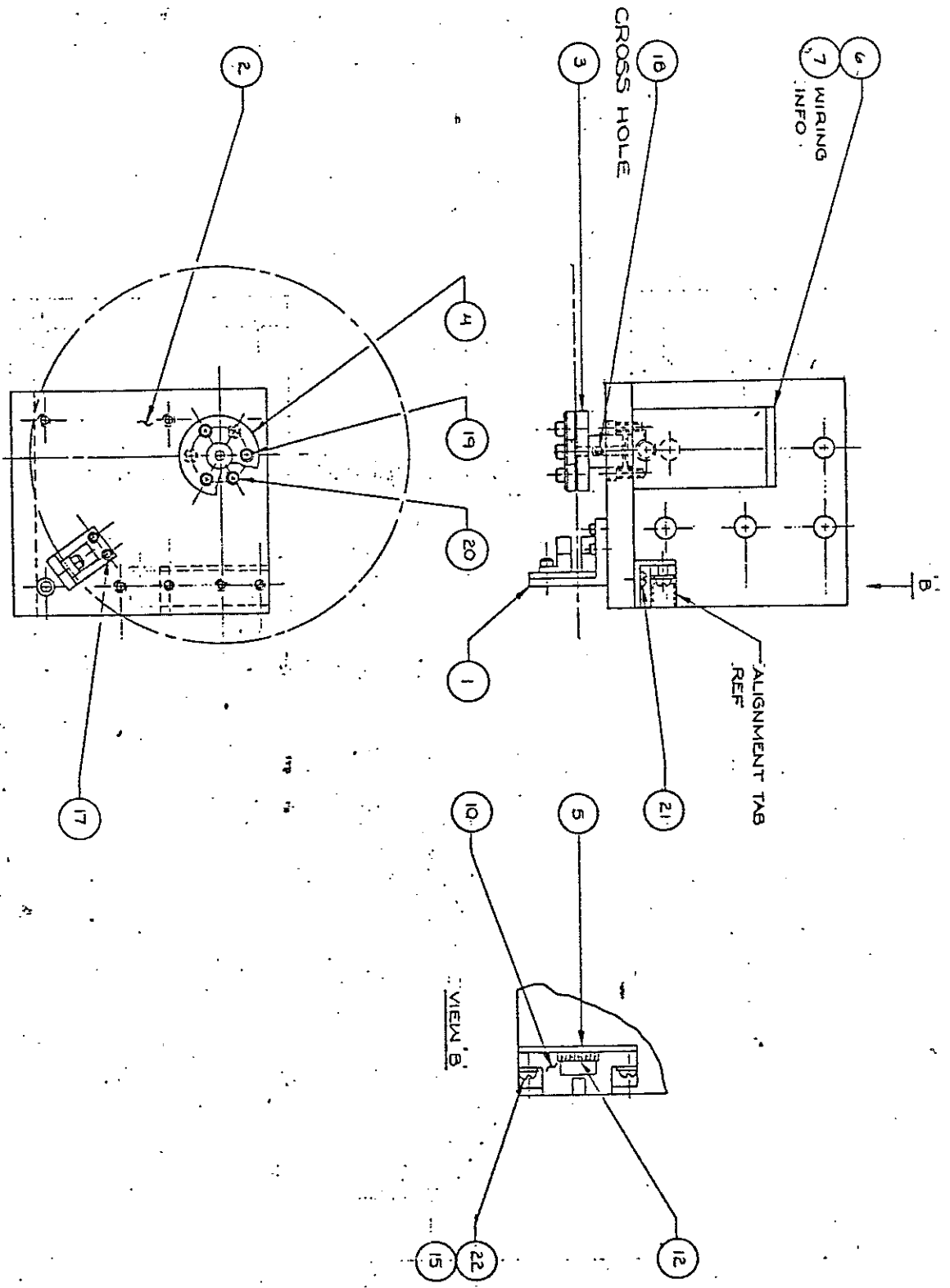
AC voltage is applied to the unit via switch S101 and fuse(s) F101 (and F102). The line voltage is stepped down by transformer T101. The 5 volt supply is generated from the center tapped secondary of T101 by CR102, CR105, C104 and VR102. The other secondary is rectified and filtered by CR101, C101 and C106 to produce the unregulated 40 volts for the motor. The 40 volts is regulated by VR102 to produce the stable voltage supply used in the control loop. R104 is used to trim this voltage to 26.5 volts.

The control voltage is derived from the stable reference VR201 and the front panel potentiometer R206 (or applied externally to the rear panel BNC) and connected to pin 3 of U201. Pin 1 of U201 controls the base of transistor Q201 which drives the motor through the current sense resistor (parallel combination of R212, R213 and R214). The motor voltage and current are processed in the second section of U201, scaled and fed back to pin 2 of U201. Satisfying this loop keeps the motor running at constant speed. Q202 provides a current limit during start up. R208 is used to set maximum speed of rotation.

The LED of the optical switch, located on the chopper, is biased via J1-3 and J1-8 while the emitter of the associated NPN phototransistor drives the gate of Q302. U301 determines the chop frequency from the pulses out of the optical switch and drives the LEDs DS302-304. The signal at the drain of Q302 provides the sync output and, via Q303 and Q301, the 7080 sync output.



SIV	DESCRIPTION	DATE	BY

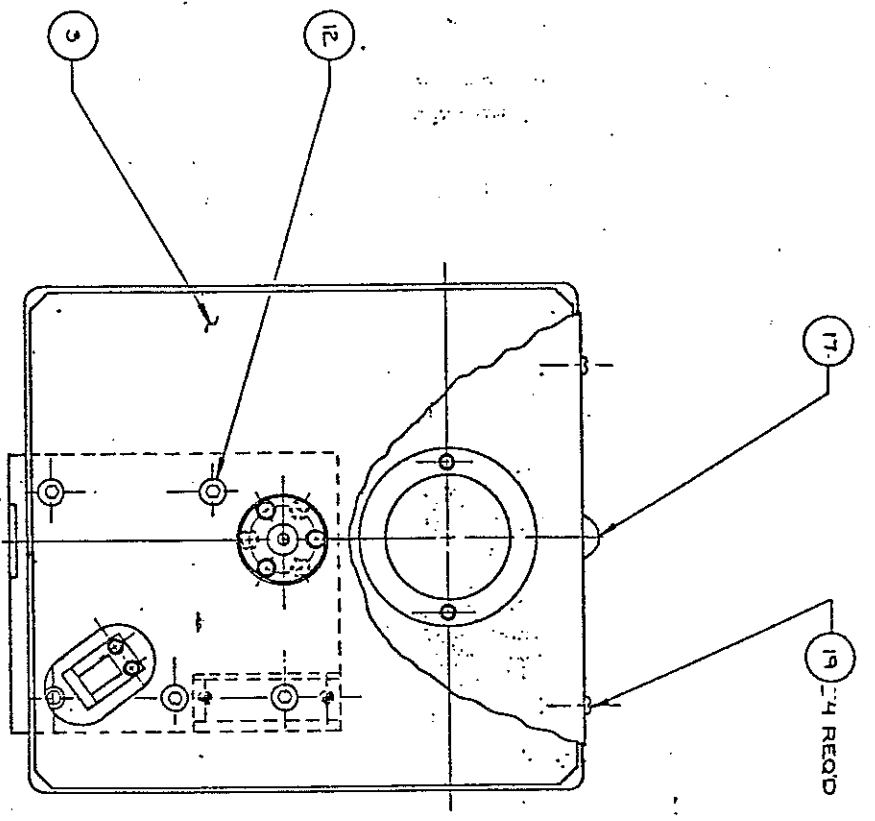


**FIG. B**

UNLESS OTHERWISE SPECIFIED, THE PART MUST BE FREE OF HEAVY MACHINING AND STRIPPING MARKS, CHUCK MARKS AND OTHER DEFECTS. ALL DIMENSIONS MUST BE TO THE CENTER OF THE PART UNLESS OTHERWISE SPECIFIED.

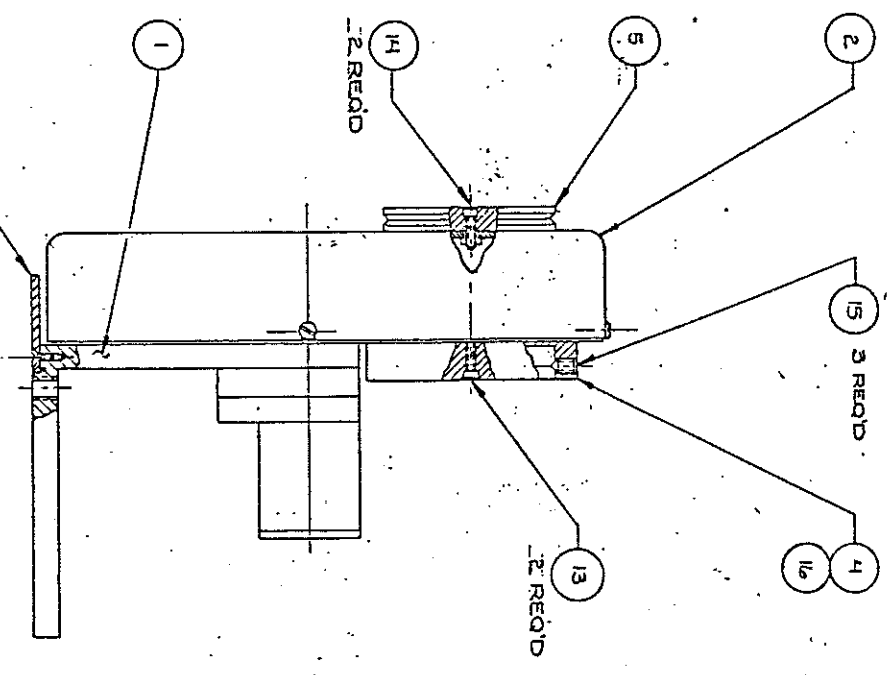
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PARTS TO BE USED: UNLESS OTHERWISE SPECIFIED FINISHES: 1. POLISH 2. PLATE 3. ANNEAL		TITLE: <b>CHOPPER, SMALL</b> OPEN	

REV	DESCRIPTION	DATE	BY



PARTIAL SECTION OF COVER,  
ITEM ② IN FRONT VIEW  
FOR CLARITY

FIG. A



UNLESS OTHERWISE SPECIFIED, THE PARTS SHALL BE MADE OF STEEL UNLESS OTHERWISE SPECIFIED. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED. ALL DIMENSIONS ARE TO BE TAKEN TO THE CENTER UNLESS OTHERWISE SPECIFIED. ALL DIMENSIONS ARE TO BE TAKEN TO THE CENTER UNLESS OTHERWISE SPECIFIED. ALL DIMENSIONS ARE TO BE TAKEN TO THE CENTER UNLESS OTHERWISE SPECIFIED.

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<b>ORIEL CORPORATION</b> STRATFORD, CONNECTICUT <b>CHOPPER, SMALL</b> <b>CLOSED</b> PARTS LIST NO. P7B155-3-1000			