



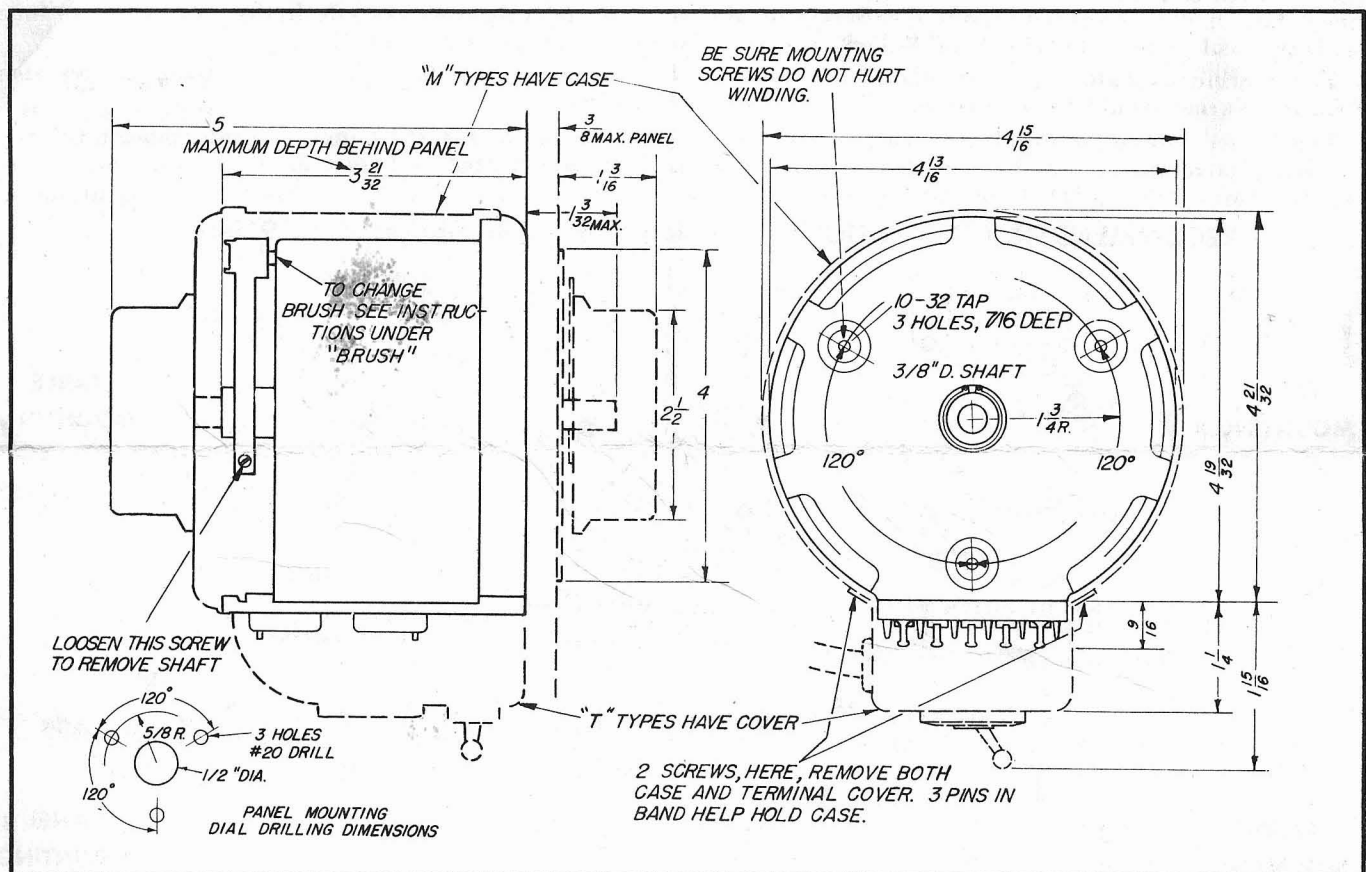
OPERATING INSTRUCTIONS

V-5 SERIES VARIAC[®]

Pronounced "VARY-ACKS". Trade Mark Registered, U.S. Pat. 2,009,013

Know your VARIAC! These instructions are to help you get better results with less trouble.

MECHANICAL SPECIFICATIONS



NET WEIGHTS

TYPE V-5	6 lbs., 12 oz.
TYPE V-5M	7 lbs., 0 oz.
TYPE V-5MT	7 lbs., 10 oz.
TYPE V-5H	6 lbs., 8 oz.
TYPE V-5HM	6 lbs., 12 oz.
TYPE V-5HMT	7 lbs., 6 oz.

DIALS

Dials are normally supplied for overvoltage operation, Figures 4, 6, 7, and 9. Dials for line voltage limit operation are available on special order. Dials are two-sided to permit either dial or pointer rotation, clockwise voltage increase being the rule in both cases. Pointers are provided, fastened to the under side of the dial, permitting fixed dial and moving pointer operation for panel mounting.

FOR BEST COOLING OPERATE PANEL-MOUNTED UNITS WITHOUT CASE!

ELECTRICAL SPECIFICATIONS

The current that may be drawn from a Variac depends, largely, on the use to which the Variac is put.

1. For general laboratory use, where the Variac is to be used to control a variety of loads under experimental conditions, it is safest to stay within *rated* current at all times and for all settings. If fuse protection is desired, fuse for rated current.

2. For particular applications, where the Variac is used with a fixed, known load, and where the overvoltage connection is omitted (Figures 5 and 8), maximum current may be drawn at line voltage. When the Variac is so connected, the current fall-off with decreasing output voltage will always keep the current within safe limits, except for incandescent lamp loads, which, for the Type V-5, should be limited to 6.5 amperes maximum.

3. For continuous 24-hour-per-day duty, rated current should not be exceeded. For ambient temperatures above 40°C., the Variac should be derated according to the curve of Figure 2.

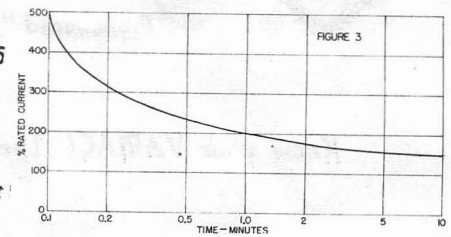
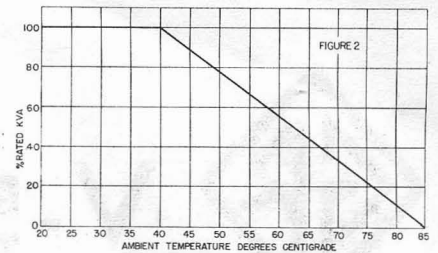
4. For services where an initial surge current may be expected (as in motor starting, incandescent lamp control, etc.), the Variac rated current may be exceeded on a time-current basis as depicted in Figure 3. At no time should more than five times (500%) rated current be drawn from the Variac.

V-5 TYPES

5	Rated Output Amperes	2	1	2
7.5	Max. Output Amperes	2.5	2.5	2.5
115	Input Volts	230	115	115
50, 60	Cycles Per Second	50,60	50,60	25*
0-135	Output Volts	0-270	0-270	0-135
9	No Load Watts	9	9	9
.86	KVA	.58	.29	.29

V-5H TYPES

*The V-5H may be used on 115 volts, 25 cycles. Connect as for 230 volts, 60 cycles.



RECOMMENDED CONNECTIONS are diagrammed in Figures 4 to 9 inclusive.

TABLE MOUNTING

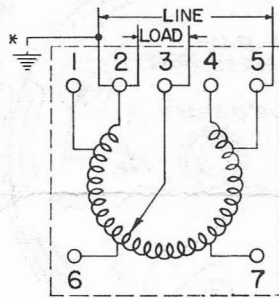


Figure 4

V-5 { LINE: 115 volts, 50 to 60 cycles
LOAD: 0-135 volts
V-5H { LINE: 230 volts, 50 to 60 cycles
LOAD: 0-270 volts

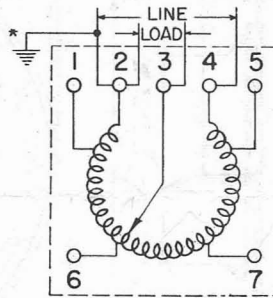


Figure 5

V-5 { LINE: 115 volts, 50 to 60 cycles
LOAD: 0-115 volts
V-5H { LINE: 230 volts, 50 to 60 cycles
LOAD: 0-230 volts

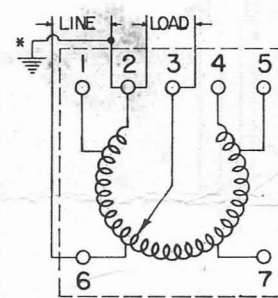


Figure 6

V-5H { LINE: 115 volts, 50 to 60 cycles
LOAD: 0-270 volts

TABLE MOUNTING

PANEL MOUNTING

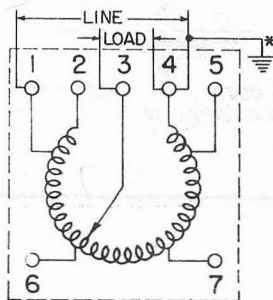


Figure 7

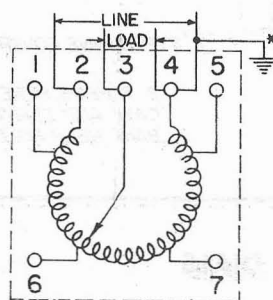


Figure 8

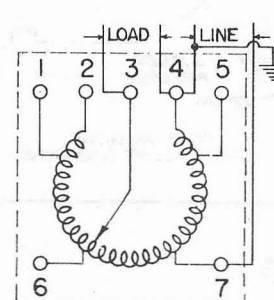


Figure 9

PANEL MOUNTING

*If ground is necessary, common line-load terminal must connect to ground side of line.

"T" MODEL CONNECTIONS are provided in the form of cord, plug, outlet and 2-pole switch. Figure 4 connections are normally supplied; Figure 5 connections may be obtained on special order. The marked plug prong connects to the wide slot in the outlet for polarizing purposes.

OPERATING AND SERVICE NOTES

1. Be sure voltage and frequency are correct before connecting Variac to line. The Variac is a transformer and will not operate on a d-c circuit.
2. When using overvoltage circuit (Figures 4, 6, 7, 9) be sure connected load will stand overvoltage.
3. Protective devices are cheaper than Variacs.

many cases on steady predictable loads, fuse protection will be entirely adequate. Where short-term overloads are to be handled (as in motor starting or lamp inrush) a time-current integrating breaker, such as the Heine-mann No. 0411TS, of the proper current rating is more effective.

4. Always set Variac to zero before switching to avoid surge damage. This is particularly important with lamp loads. The ratio of hot to cold resistance of modern incandescent lamps may be as great as 15:1. *Instantaneous brush current should never exceed 5 times rated current.*

5. Clean dirty brush tracks with crocus cloth (nothing coarser), remove loose particles with a fine brush, wash with carbon tetrachloride.

6. **BRUSH** V-5 types take the General Radio Company V-5 Brush; V-5H types, the General Radio Company V-5H Brush. Brushes may be removed by a simple rotation of the top plate to clear the retaining pins. Proper brush insertion is indicated by a slight click, or detent action, as the long axis of the top plate aligns with the retaining pins. Newly installed, or reinstalled, brushes must be seated for proper Variac operation. *With power off*, a few swings of the brush over the abrasive side of a piece of crocus cloth resting on the brush track will effectively mate brush and track. Remove the crocus cloth and blow or brush loose carbon from the brush track before applying power.

Brush extension is purposely limited to prevent contact between metal brush shell and Variac winding, avoiding short-circuits. Operation of a brush beyond its extension limit causes arcing and high resistance, indicated by high output voltage drop under load. Replace brushes before this limit is reached. Excessive load cur-

rent accelerates brush deterioration and damages windings. Rapid brush failure is a sure sign of overload.

7. When Variacs are operated for long periods at fixed brush setting near full load, the bare copper surface of the turns under the brush will oxidize unless kept clean. To prevent oxidation, clean as specified in section 5 when necessary, and in addition, apply a thin layer of heat-resistant, inert grease to the brush track. Dow-Corning D-C-44 Silicone Grease is excellent for this purpose.

8. Broken terminal strips may be removed and replaced with no other tool than a screw-driver. While every effort has been made to reduce terminal-strip breakage by the use of high impact strength material and a metal terminal cover, accidents will happen.

9. When returning Variacs for repair, or for any other reason, please request shipping instructions from our Service Department. Also please state type number of instrument and date of purchase. The type number of all V-5 Variacs appears at the top of the terminal strip and adjacent tabs of metal parts which register with terminal strip top.

10. If you feel that your Variac does not operate satisfactorily, write to our Service Department, explaining in detail the conditions of operation. Enclose a diagram of your circuit with input and output voltages and currents indicated, and specify type of load and rating.

ADDITIONAL INFORMATION ON VARIACS

Variacs have certain inherent characteristics, which, if known and used, greatly extend their usefulness under certain circuit conditions. A discussion of such circuit conditions and recommended practice is here furnished so that you may realize the full potentiality of your Variac.

1. **FIXED LOAD OPERATION** is the most commonly encountered Variac application. Under this condition full advantage may be taken of the *maximum current rating* obtained at line voltage. The optimum load may be determined from the formula:

$$\text{Min. load impedance} = \frac{\text{Line volts}}{\text{Maximum output amperes}}$$

For a load of this or greater impedance, load current will never exceed allowable current, if the Variac is connected to *omit the over-voltage feature*.

2. **LIMITED RANGE OPERATION**, either for low voltage circuits, or for line voltage regulation is another common Variac application. The Variac is, fundamentally, a wide range instrument, and its confinement to a limited range unnecessarily sacrifices this feature. The use of a supplementary transformer under such conditions offers many advantages. These are:

- (a) Increased current capacity in the ratio of line voltage to operating range.
- (b) Finer adjustment, since range is spread over whole Variac dial.
- (c) Improved Variac life as brush traverses entire winding to cover operating range, instead of repeatedly traversing a limited arc.

For simplicity, the discussion will be confined to Variacs operating from a nominal 115-volt line, but, it will

be understood that the same argument applies for 230-volt Variacs.

(1) Consider an output range of 0 to 10 volts. Since the ratio of line volts (115) to load volts (10) is 11.5, the increase in current from the use of a proper supplementary transformer is 11.5 to 1. The transformer should have a voltampere capacity equal to that of the Variac (Line voltage x maximum amperes) and should be connected as shown in Fig. (a).

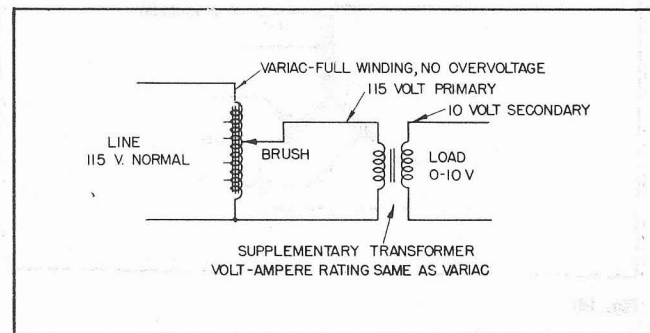


Fig. (a)

(2) Consider a line voltage range of 105 to 125 volts requiring adjustment to a nominal 115 volts. Line volt to load range is $\frac{115}{125-105} = 5.75$, indicating an increase in load current of 5.75 to 1. In this case the volt-ampere capacity of the supplementary transformer need only

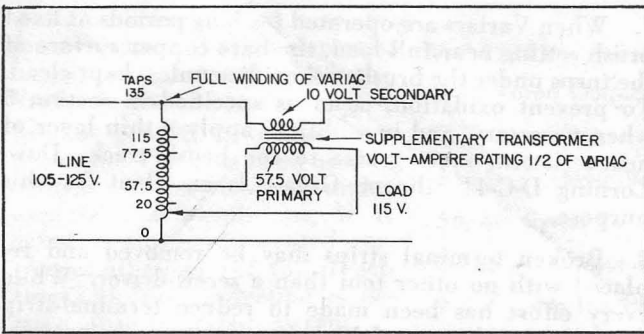


Fig. (b)

be one half that of the Variac, because of the plus and minus nature of the range. Fig. (b) shows the circuit. Other values, of course, may be employed, but the examples shown are typical. Note the enormous increase in current capacity, case (1) yielding 11.5 times, and case (2) 5.75 times the Variac rating. In addition, case (1) permits insulated isolation of the load.

3. HIGH VOLTAGE OPERATION above normal Variac ratings may be accomplished by ganging two standard Variacs in the circuit of Fig. (c).

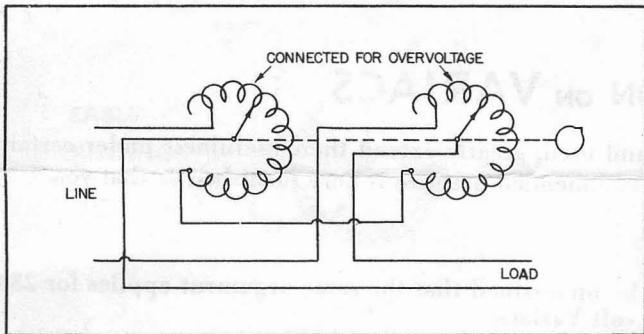


Fig. (c)

This circuit shown permits doubling of standard voltage ratings with current ratings unchanged. Thus 230-

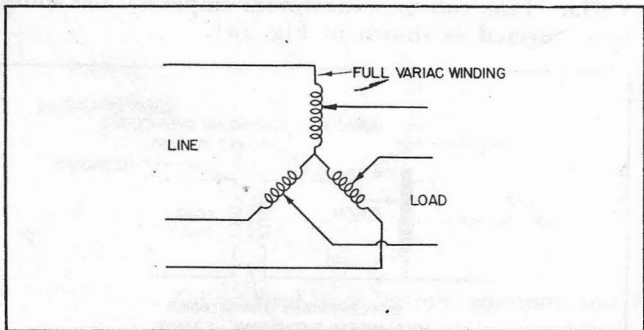


Fig. (d)

volt models may be used at 460 volts, 115-volt models at 230 volts. **CAUTION:** Load must not be grounded.

4. THREE-PHASE OPERATION of Variacs again introduces an inherent advantage in the "Y" connection illustrated in Fig. (e). Because of the overvoltage winding of Variacs, a 3-gang "Y" assembly will operate at twice nominal line voltage. Thus standard 0 — 135-volt units can operate at 230 volts; 0 — 270-volt units operate at 460 volts. This actually means that the KVA rating for a 3-phase "Y" is 3.52 times the single phase rating of an individual Variac of the type ganged, instead of 3 times.

Open "Δ" connections, however, while not yielding a rating gain, permit overvoltage as shown in Fig. (e), or may be operated to line voltage only.

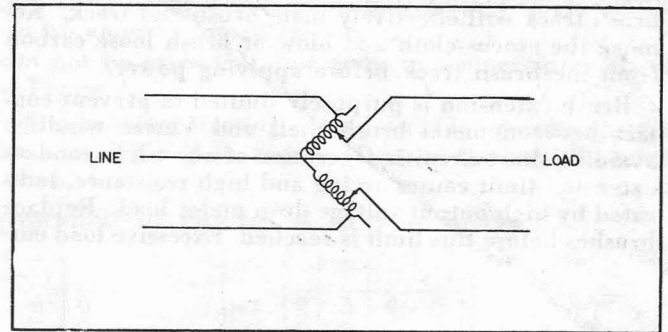


Fig. (e)

5. PARALLEL OPERATION OF VARIACS is not recommended, except in the case of the largest units, as it is better to use a single unit of the next larger size. When units are connected in parallel, it is essential that a choke be connected as shown in Fig. (f), to limit circulatory currents and unbalance. In many 230-volt applications the connection of two 115-volt units as

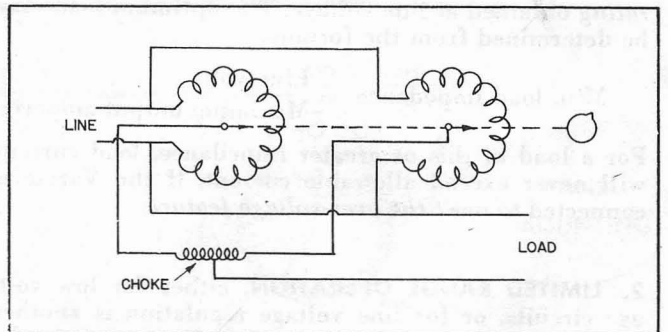


Fig. (f)

shown under "3." (High-Voltage Operation) is better than parallel operation and will, in most cases, yield more power.

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