

INSTRUCTIONS FOR KNOPP PHASE SEQUENCE INDICATOR MODELS K-3 and K-6 (K-7: See NOTE)

The Knopp Phase Sequence Indicator is of the rotating-disk type and is connected internally so that when the clips marked "A," "B," and "C" (red, white, and blue) are connected to the corresponding terminals of an AC generator where the markings "A," "B," and "C" are such that the voltage wave in each phase would reach its maximum positive value in that order, mechanical rotation of this Indicator will be clockwise, that is, in the direction of the arrow on its face.

VOLTAGE, FREQUENCY, AND OTHER CIRCUIT CHARACTERISTICS

The Model K-3 Knopp Phase Sequence Indicator can be used on three-phase, three-wire, 60-600 volt circuits, and on 25-60 cycle current. In addition, it is suitable for use on frequencies above 60 cycles provided the circuit voltages are equal to, or exceed, the following: 150 volts for 133 cycles, 200 volts for 180 cycles, 250 volts for 360 cycles, and 300 volts for 400 cycles.

This Model K-3 Knopp Indicator will operate satisfactorily on two-phase, three-wire systems. However, it should be noted that on such systems the voltage between the outers is 1.4 times the phase voltage. One should take this factor into consideration when using the indicator on higher voltage circuits, bearing in mind the voltage rating of the instrument. Knopp Indicators for two-phase, *four-wire* circuits are available on special order.

The Model K-6 Knopp Phase Sequence Indicator has been especially designed for operation on 400 cycle, 3-phase circuits and over a voltage range from 24 to 480 volts. In general construction and its manner of operation, it is the same as the Model K-3.

GENERAL OPERATION

For determining the phase sequence, connect the three clips "A," "B," and "C." Depress switch button momentarily and observe rotation of indicator disc. If rotation is the direction of the arrow, the sequence is "ABC." If the rotation is opposite to that of the arrow, the sequence is "ACB." By interchanging any two test clips the rotation of the disc can be reversed and the corresponding sequence determined.

Should your Knopp Phase Sequence Indicator not rotate when you think it should, we suggest you make sure of the following:

- (1) That all three legs of the 3-phase power supply circuit are actually energized; that there are no open circuits or blown fuses.
- (2) That the push button on the instrument is depressed all the way down so as to complete the circuit to all three coils in the indicator.

If your indicator is a Model K-6, be sure to use it on 400 cycles only. On 60 cycles it will not function properly, and the instrument could be damaged.

SOME METHODS OF APPLICATION

Phasing-in Circuits after Alterations

When using the Phase Sequence Indicator where changes in service, wiring, transformers, or switches are being made, proceed as follows:

Before beginning intended changes: With motors disconnected, attach the Indicator by means of the clips "A," "B," and "C" (red, white, and blue) to the three linewires at the switch or other convenient place on the load side of any changes that are being made. Depress the button, and if the rotation of the Indicator is not in the direction of the arrow, interchange any two of the clips until the Indicator rotates in the direction of the arrow on its face. If possible, leave the Indicator connected until the

changes have been made and service re-established. If this is not possible, mark the wires or switch blades "A," "B," and "C" according to the way the Indicator was last connected.

After service changes have been made: If the indicator has not been left connected, reconnect exactly as markings show on the wires or switch blades and depress the switch button on the face of the Indicator. If the Indicator rotates according to the arrow, the changes have been properly made and it is safe to place the motors in the circuit. If the Indicator does not rotate in the direction of the arrow, the changes have not been properly made and must be corrected before reconnecting the motors.

Use of the Indicator to determine that the sequence is the same after the alteration as before will avoid possibility of damage incident to reversing consumer's motors and machinery.

Connecting Motors and Generators

Use of the Knopp Phase Sequence Indicator when one connects three-phase motors and generators, protects apparatus and enhances service efficiency. By determining which terminals of a newly installed polyphase power circuit are to be connected to the sequence identified motor terminals, one eliminates the trial-and-error method and thus prevents damage and saves time.

Obviously the trial-and-error method is not permissible for direct-connected electric motors, which, because of the nature of the machines they drive, cannot be operated in reverse. Furthermore, reversal of the phase rotation of a generator when generators are being paralleled would result in a short circuit.

Suppose a 3-phase motor load is to be connected to a new set of 3-phase conductors. Before a change is made, original power sequence of the load is determined by attaching the Indicator to the line side of the open switch. With motor switch still open and with temporary new connections made, the new line ahead of motor switch is energized and the phase sequence checked. If original sequence is reversed, two of the new conductors can be interchanged to give the original sequence. As only minute power is required to operate the Knopp Indicator, there is no need to make tight connections until correct order has been established.

Motor and Generator Terminal Markings

The Indicator may be used to correlate definitely motor and generator conductor markings with the phase sequence of applied or generated voltage. Furthermore, if the terminals of a particular motor or generator are not marked for phase sequence, proper markings can be determined and made for the selected direction of rotation by applying the Indicator to the energized terminals of the motor or the output terminals of the generator.

Connections of Polyphase Power Factor Meters

Where instrument transformers are employed for power factor metering, mistakes are easily made in the connections. The phase sequence of the input current for the current coils should be checked for the correct order of attachment, as indicated by the manufacturer's diagram. The phase sequence of the voltage coils is determined by the Phase Sequence Indicator.

Reactive-Volt-Ampere Connections

When varmeters are being connected in polyphase circuits, it is necessary to use the correct phase order so as to assure correct meter indications. The Knopp Indicator furnishes direct and positive means of determining the proper sequence.

Active and Reactive Power Measurements

When connecting polyphase watt-hour meters for combination active and reactive power measurements, the correct order of phase rotation is essential. The Knopp Phase Sequence Indicator is of great value in seeing that the correct connections are made.

Six-Phase

The Indicator can be used to determine the phase order of six-phase circuits by arranging the six terminals into two groups of three, each group having equal voltage between all pairs of terminals and both groups having the same sequence. The two three-phase triangles should form a hexagon with equal voltage sides.

Polarity Identification of Wires of the Same Polyphase System

If more than three conductors are involved and it is desired to determine which are identified with the same 3-phase system, the conductors may be successively attached to the Indicator. Rotation indicates that the conductors are all of one system.

If six conductors are involved, all of which are of the same 3-phase system, select three conductors which give a phase sequence indication. Leaving two clips connected, remove third and attach it to remaining conductors successively until the same phase rotation is obtained. The conductor which produces the same rotation when connected to the third clip is of the same polarity as the conductor from which the clip was originally removed. Another clip is now manipulated in the same manner in order to determine which of the remaining conductors give the same sequence.

Continuity Indications

The presence of an open circuit in at least one phase of a 3-phase supply is indicated by non-rotation of the Sequence Indicator when the instrument is connected to the circuit and its push-button switch is depressed.

NOTE: K-7

The foregoing instructions, as they apply to the Model K-3, apply also, in all respects, to the Model K-7 with the exception that the color coding for the Model K-7 is "A" - Black, "B" - White, "C" - Red and the clips are marked "1," "2," and "3" in addition to "A," "B," and "C." (This type is available on order for the military only)

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