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I. & M. REQUIREMENTS SPECIFICATION
BELL TELEPHONE LABORATORIES, INC.
SYSTEMS DEVELOPMENT DEPT., NEW YORK

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DESCRIPTION AND OPERATION

OF

TWO AND THREE PHASE INDUCTION MOTORS

PER KS-5007, KS-5123 AND KS-5137

SECTION 1 - GENERAL

1.1 Two and three phase induction motors for use in telephone and telegraph power plants are a squirrel-cage type of motor and are used for direct connection to charging and ringing generators. Installation and Maintenance requirements for these motors will be found in specification X-72057-01.

1.2 Section 2 of this specification describes these motors and will be called "Description".

1.3 Section 3 of this specification describes the operation of these machines and will be called "Operation".

1.4 Section 4 of this specification describes various conditions which may interfere with the proper operation of the motors and will be called "General Troubles".

SECTION 2 - DESCRIPTION

2.1 The two and three phase induction motors used in telephone power plants, have two windings, one stationary and the other revolving. The stationary winding, or stator consits of coils of insulated wire properly spaced and rigidly fastened into the slots of laminated punchings forming the motor field. The revolving winding, or rotor consists of a number of bars parallel to the rotor shaft, short-circuited by rings at both ends and mounted in a core. The core is mounted on a spider fastened to the rotor shaft and rotates within the stator. Fins are attached to the spider to circulate air through the windings for cooling purposes.

Motors for use with "M" type charging generators are supplied with a special "telephone finish", black and glossy in appearance to match the finish of the "M" generators. Motors used with the commercial type generators are provided with a commercial type finish which is dark blue gray with a semi-gloss finish.

2.2 The bearings on the motors driving charging and ringing machines have steel backed babbit bearings. These bearings are lubricated by means of oil rings which rest on the shaft in slots cut through the bearing and lining. The rings dip into the oil in the oil chamber and as they rotate carry the oil up to the shaft where it passes along grooves cut into the bearing lining thus lubricating the entire bearing surface.

The bearings on the fractional horsepower motors driving telegraph and repeater sets are made of bronze and are lubricated by means of oil soaked waste packed around the bearing. Provision is made for oiling these bearingsfrom above through a hole in the bearing cap.

2.3 Motors under 5 HP rating require no starting compensators and may be connected directly across the line. Motors above 12.5 HP rating require starting compensators to limit the starting current inrush.

Motors between 5 and 12.5 HP rating may require compensators or may be connected directly across the line depending upon their construction and on local requirements. Motors in this range which have a high rotor reactance at the instant of starting may in most instances be connected directly across the line while those having a low rotor reactance at the moment of starting require starting compensators. The motors having a high rotor reactance secure this reactance by the shape and position of the squirrel-cage bars in the rotor. The reactance decreases as the motor speeds up due to the decrease in rotor frequency so that at rated speed the rotor impedance becomes approximately equal to the rotor impedance of the same sized motor with a low starting reactance.

2.4 The compensators used with these motors are of the auto-transformer type having a "Start", "Off", and "Run" position. The desired starting voltage is obtained by connecting the motor to one of four taps on the transformer winding. It is necessary to hold the starting lever arm in the "Start" position manually but in the "Run" position the lever arm is held by a catch controlled by an undervoltage coil. Any interruption of the power service releases this catch and the lever arm is returned to the "Off" position by means of a spring. A mechanical interlock prevents the operator from throwing the lever arm to the "Run" position until after it has been thrown to the "Start" position and the lever can then be thrown only with a rapid unhesitating movement. On compensators for motors of commercial type sets there is also a thermal overload relay which opens the circuit of the undervoltage coil in case the motor becomes overloaded. This relay is reset by pushing the "Stop" button on the front of the compensator.

SECTION 3 - OPERATION

3.1 Preparation for Starting - Before starting these motors a general inspection should be made to see that nothing is in or on the set which will interfere with its starting.

The height of the oil in the oil wells on machines provided with gauges should be noted and oil added if necessary.

3.2 Starting - Motors without compensators should be started by closing the associated motor line switch connecting the motor directly across the service lines. Motors provided with compensators should be started by first throwing the compensator lever to the "Start" position, holding it there until the motor approaches full rated speed as indicated by the sound of the motor, then throwing the compensator lever rapidly through the "Off" to the "Run" position. This will connect the motor directly across the service lines.

3.3 Running - After starting, the oil rings should be inspected to see that they are turning on their shaft and delivering oil to the shaft and bearing. On waste packed bearings no examination is required.

3.4 Stopping - To stop the motors without compensators, it is necessary only to open the motor line switch. To stop the motors having compensators press the "Stop" button in the front of the compensator or on the power board which will release the catch holding the switch in the running position and allow the compensator switch to return to the "Off" position.

SECTION 4 - GENERAL TROUBLES

4.1 Failure to Start

Cause	Action
Fuses open	Replace
No voltage on one or more phases of the power service	Notify supervisor
Rotor blocked	Remove obstruction
Defective motor winding	Repair or replace motor

4.2 Failure to Come Up to Speed

Cause	Action
Low Voltage or frequency or both	Notify supervisor
Open phase	Notify supervisor

4.3 Motor Stops

Cause	Action
Overload relay on compensator operated	Reset and start again avoiding overload
No voltage on one or more phases of the power service	Notify supervisor
Fuses blown	Replace

4.4 Overheating of Bearings

Cause	Action
Oil rings not functioning	Adjust or replace
Bent shaft	Replace rotor and shaft
Rough bearing surface	Smooth or replace bearing
Improper alignment	Realign
Insufficient oil	Add oil
Improper grade of oil	Clean out bearing and lubricate with proper oil
Dirt or grit in oil	Clean out bearing and lubricate with fresh oil
Too much end thrust	Replace bearing

NOTE In case a hot bearing develops, the load should be taken off the associated generator; the bearing should then be flushed with dynamo oil until cool. The motor should in no case be stopped unless the rotor is striking the stator windings. Stopping the motor might result in the shaft adhering to the bearing lining and make the replacement of the bearing more difficult. After cooling the bearing, the set should be stopped and an inspection made to determine the cause of the heating, and the condition corrected before again starting the set and placing load on the generator.

4.5 Overheating of Windings

Cause	Action
Overload	Adjust load
No voltage on one phase of power service	Remove load and notify supervisor
Open phase or short circuited winding in motor	Repair or replace motor
Low service voltage	Notify supervisor

4.6 Excessive Noise and Vibration

Cause	Action
Set not level	Level set
Improper alignment	Realign set
Loose bolts and nuts	Tighten

Excessive Noise and Vibration (Con't.)

Cause	Action
Loose rotor bars	Repair or replace rotor
Worn bearings	Replace
Bent Shaft	Replace rotor and shaft
Troubles in stator windings	Repair or replace motor
Open phase	Remove load and notify supervisor

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