CUBICLE TYPE SWITCHGEAR

for

THE ALUMINUM COMPANY OF AMERICA

Cleveland, Ohio

G.O. PS-31008-Y - S.O. 76-Y-244

Instruction Book 5322-1091
February 27, 1942

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

UNPACKING THE SWITCHGEAR

CAUTION

KEEP THIS SWITCHGEAR COVERED

This switchgear has been carefully packed to protect the finish and the delicate glass enclosed instruments which are mounted on the panel. The equipment consists of apparatus which must be carefully protected from the weather and extreme changes in temperature.

If it is necessary to unpack the switchgear before final installation, it must be kept covered, dry and warm enough to prevent condensation, until placed in service.

Great care should be exercised in uncrating and handling to prevent damage to the instruments, and scratching the painted surface.

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DRAWING LIST

SUPPLEMENTARY INSTRUCTIONS

APPLICATION

These instructions apply to cubicle type switchgear supplied for the Aluminum Company of America, Cleveland, Ohio.

The equipment consists of a three section cubicle structure. The structure is fed from a 2300 volt 3 phase, 60 cycle incoming line connected directly to the bus. The synchronous motor circuits are controlled by 600 ampere, type "U" "De-ion" air circuit breakers.

The cubicles are numbered from left to right facing the front of the structure. Unit #1 provides facilities for connecting the 2300 volt, 3 phase, 60 cycle incoming line to the bus. Also included are a type JR operating transformer 460 to 230 to 115 volts, two potential transformers 2300 to 115 volts, and mounted on the hinged panel are the field rheostats for motors 1 and 2 and the exciter field rheostat.

Units #2 and #3 enclose the type U "De-ion" air circuit breakers, disconnect switches and the synchronous motor field relay control equipment. On the front hinged panel of units 2 and 3 are mounted the instruments, relays, control switches etc.

The type 25-U-25 "De-ion" circuit breakers are rectox solenoid operated from a 460 to 230 V. operating transformer. The breaker tripping is accomplished by means of a capacitor trip device connected to the potential transformer.

DESCRIPTION OF OPERATION

Procedure For Synchronous Motor Starting

Refer to schematic diagram shown on drawing 11-A-9202. By closing the knife switch on the breaker control relay panel the control bus is energized.

To start the motor turn the control switch to the close position and the following sequence of operation will occur.

(1) Breaker closing relay (42X) will pick up

(2) Energizing closing coil of breaker through a rectox unit.

(3) Breaker will close and

(4) Timing relay (48) will start timing.

(5) Short time contact (48S) will energize field contactor (41) and (48X) loading contactor.

(6) Field will be applied and loading solenoid will be energized.

(7) Timing relay will continue to run and if field is not applied after a definite time as indicated by 48L, the breaker will be tripped through contacts of 48L and of field failure relay (40). Also if the power factor is incorrect after time indicated by 48L the breaker will be tripped by contact of power factor relay (55).

In addition to means of tripping breaker and stopping the motor as described in #7 above, the following will also trip the breaker:

(1) Turning control switch to trip position.

(2) Overload as indicated by device 51

(3) Under voltage as indicated by device 27

(4) Overheating as indicated by device 49

(5) Low oil pressure under load as indicated by device OP.

Capacitor Trip Device

The capacitor trip device is fully described in Descriptive Data 33-130.

A two pole double throw knife switch is connected in the primary circuit of the capacitor trip device. With the switch making contact on the top studs, the capacitor trip device is ready

for service. With the switch making contact on the lower studs, the capacitor trip device is disconnected from the primary source and the condenser is discharged.

Relay Settings

Relays have been given a preliminary setting, before leaving the factory, based on data available. If it is found that they need a different setting under operating conditions, the settings may easily be adjusted after consulting the instruction leaflet included for that particular relay.

GENERAL DESCRIPTION OF CUBICLE TYPE SWITCHGEAR

Cubicle type switchgear is a type of switching equipment which is completely built and assembled at the factory. The cubicles are constructed of structural steel members and 1/8 inch thick, open hearth, steel sheets securely welded together to form a rigid structural unit that will not warp due to handling or changing temperature.

Cubicle type switchgear combines in one unit, air circuit breakers, disconnecting switches, instrument transformers, bus bars, main copper connections, and swinging instrument panels on which are mounted relays and metering equipment and secondary wiring.

The lower section of the cubicle is divided by means of a sheet steel barrier into two compartments. The rear compartment houses the current transformers and the field control relays. The front compartment houses the air circuit breaker, operating mechanism and secondary wiring. Between the two compartments is a vertical steel barrier which separates the high tension equipment from the breaker mechanism and secondary wiring thus assuring perfect safety to attendants and maintenance men.

A hinged steel door in front of and a steel barrier below the circuit breaker isolate the breaker contacts and arc chambers from the secondary wiring and operating mechanism.

All equipment mounted on the front of the hinged instrument panel is covered so that no live parts are exposed, assuring a safety type, dead front equipment.

A copper ground bus, to which the circuit breaker frames and instrument transformer secondaries are grounded, runs continuously through the structure. A terminal is provided on this ground bus for making connection by means of a cable to the station ground.

Complete connections are furnished between the air circuit breaker, current transformers, disconnecting switches and the bus. The bus and connections are insulated with Micarta tubing and tape for 7500 volts. Joints are insulated by means of micarta compound boxes filled with insulating compound.

The disconnecting switches are interlocked with the circuit breaker to prevent operation of the switches unless the circuit breaker is in the "open" position. This is accomplished by having a rod (which is moved up by the circuit breaker operating mechanism) interfere with a sliding bar connected to the disconnecting switch shaft. The sliding bar cannot be moved from one position corresponding to the "open" position of the disconnecting switch to the "closed" position or vice versa, while the rod is up and the circuit breaker closed. It is possible to operate the circuit breaker with the disconnecting switches in either the "open" or "closed" position.

The disconnecting switches are gang operated, type LCG with multiple line contacts. The switches are operated by means of a removable operating handle which is inserted into a hole in a casting on the disconnecting switch shaft. When opening or closing the disconnecting switch, the operator should exercise care to make sure that the switch is in the fully open or fully closed position when the operating handle is removed. This care is necessary in order that proper contact may be secured between the silver surfaces of the switch and also that the breaker may be closed. If the switches are not in the fully "open" or "closed" position, the rod operated by the circuit breaker mechanism will not pass the sliding bar connected to the disconnecting switch shaft.

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PREPARATION OF STATION FOR CUBICLE TYPE SWITCHGEAR

FOUNDATION AND CONDUIT LAYOUT

The concrete floor upon which the cubicle type switchgear is to be erected must be designed for sufficient strength to withstand the weight of the structure plus the shock of the breakers opening under short-circuit. Provision must also be made in the floor for conduit for the control wiring and for the ground cable.

Conduit for control wiring and main leads should be installed in accordance with the conduit layout of the station. The ends of the conduit should extend approximately two inches above the finished floor and should be located in accordance with the cubicle floor plan. If more than one control conduit per cubicle is required, these should be in line in the space allotted for them.

SWITCHBOARD FOUNDATION

The preparation of the concrete floor is the only one important part of the installation of cubicle type switchgear, because simplicity of erection and easy and satisfactory operation depend directly upon the accuracy and trueness of the concrete floor on which the cubicles will be erected. The erector should note that time spent in assuring accurate, level and the true fitting of the concrete floor during the setting period, will be amply repaid in labor saved during the actual erection of the switchgear.

The entire concrete floor upon which the cubicles will be erected must be level and in no place vary more than 1/8" in three feet.

The foundation bolts for bolting the cubicles to the floor must be accurately plocated in accordance with the dimensions given on the foundation plan.

We refer the reader to the publication "Concrete Floors" by the Portland Cement Association for a complete discussion of the construction and finishing of concrete floors. Copies of this publication can be obtained from the Portland Cement Association Office in any large city.

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HANDLING OF THE CUBICLE-TYPE SWITCHGEAR BEFORE ERECTION

The steel cubicles are shipped in complete individual units placed side by side on a flat car, secured together by a wooden framework and covered with a housing for protection from the weather. Care should be taken in removing the crating and bracing to prevent damage to any part of the cubicle. If the cubicles are placed in storage prior to erection, they should be stored in a dry place and on a fairly level surface to prevent unnecessary strains.

Lifting angles for the top of each cubicle are provided for use in moving the cubicles where a crane is available. If a crane is not available it will be necessary to skid the cubicles into place on rollers which may be made from pieces of pipe or conduit, placed under the wood skids on which the cubicles are shipped.

INSTALLATION OF CUBICLES

The instructions in the foregoing paragraphs have described the preparation of the foundation and the concrete floor upon which a cubicle type switchboard can be erected in a satisfactory manner without difficulty.

The erection of the structure should start preferably with an end housing, which may be selected by its number as shown on the general assembly drawing. Remove all cratings and foreign material, except skids, from the housing and move it into position either by crane or by pipe rollers. The rollers should be high enough to allow the cubicle to pass over the foundation bolts and conduits protruding above the floor. When in the correct location, remove the rollers and place the cubicle in position. The shipping angle bolted across the cubicle foundation angles at the rear of cubicle should not be removed until the cubicles are bolted down.

With a surveyor's level, or an accurate machinist's level, check the cubicle foundation angles for levelness, both laterally and longitudinally. These level checks should be made at points just inside the front and rear doors. Elevation should be corrected by inserting shims under the foundation angle. These shims should always be placed around the holding down bolts.

Establish a base line a few inches in front of the cubicle. This line should be parallel to the desired front of the structure. Measure the distance from the front of the housing to the base line and equalize the dimensions by forcing the housing in the correct position, thus making the face of the cubicle parallel to the base line. Bolt the foundation angles down securely to the floor.

Check the plumbness of the housing by dropping a plumb line from the center or the horizontal steel member running across the front of the housing at the top of the upper door. Place a steel bar across from one foundation angle to the other just inside the door and on it mark the exact center of the cubicle. If the point of the plumb bob registers with the mark made on the bar of steel, the cubicle is plumbed satisfactorily. If the point of the plumb bob fails to register with the mark at the center of the housing, the cause may be due to insufficient accuracy in levelling the foundation angles, or to distortion of the housing frame due to rough handling in shipment. In the first place the trouble may be remedied by checking and shimming. If the frame is distorted it will be evident as the frame members will be bent. The bent members may be brought into shape again by bumping with a hard timber.

The rear of the cubicles should be plumbed in a manner similar to the front.

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INSTALLATION OF CUBICLES - Continued

The necessity for accurate setting of the first cubicle cannot be stressed too strongly, as the appearance and correct alignment of the entire group is determined by the setting of this first cubicle.

Remove the crating and inspect the second cubicle of the group, and remove the tie bolts from the left hand side. Plac the cubicle in correct position adjacent to the erected cubicle and level the foundation angles, shimming where necessary and align with the base line as described for the first cubicle. Bolt the foundation angle securely to the foundation angle of the first cubicle and also to the floor. Check the plumbness of the cubicle with the plumb bob as described for the first cubicle and correct if necessary; insert the remaining bolts and bolt the two cubicles together. Continue in this manner until the entire group is erected, and the appearance and workmanship checked and approved.

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GROUND BUS CONNECTIONS

It is recommended that the ground bus connection should have a cross-section of 500,000 c.m. or greater if the soil in which it is buried is of such character as to cause appreciable corrosion. This is especially true where electrolysis from stray circuits or contact with dissimilar metals exists. The resistance of the soil surrounding a station ground depends on the condition of the soil as well as its chemical content. Dry, loose, sandy or frozen soils will have a high resistance as compared with moist soils, or soils containing ashes, cinders or salt solution.

The ground bus on the housings should be permanently connected to the station ground by a cable or bus of cross section not smaller than that of the housing ground bus. This cable or bus should make as direct a connection as possible between the structure and the ground and should not be run in metal conduit.

A variety of methods is available for providing the ground, two of which will be described. The best ground is obtained by using a copper or brass plate from 10 to 25 square feet area, depending on a station capacity, and 1/2" thick. Drill a number of 1/2" holes in this sheet. Place the sheet in a pit of sufficient depth to insure its being surrounded by permanently moist earth, on a bed of crushed charcoal, two feet thick. A connection of at least 500,000 c.m. stranded cable should be made to the plate by fanning three feet of the strands over the surface and soldering them securely. Cover the plate with a two-foot layer of charcoal and fill the pit with earth, settling it with a salt solution.

A satisfactory ground can be made from ten pieces of 1-1/2" galvanized iron pipe of sufficient length to reach moist earth (not less than 12 feet). Drive these pipes into the earth placing them symmetrically over an area at least 25 feet square. Connect all the pipes together by a 500,000 c.m. cable, and clamp pipe connections. Bury the cable a sufficient distance below the surface to prevent mechanical injury.

Taping Instructions

THE FOLLOWING INSTRUCTIONS SHOULD BE FOLLOWED IN TAPING ALL MAIN CONNECTIONS AS REQUIRED ON METAL ENCLOSED SWITCHGEAR. SEE EQUIPMENT INSTRUCTION BOOK FOR REQUIRED TAPING. FOR MAXIMUM SAFETY OF THE EQUIPMENT DO NOT FAIL TO COMPLETE TAPING BEFORE PUTTING IN SERVICE.

LAYERS OF HALF-LAPPED V.C. TAPE (SEE TABLE)

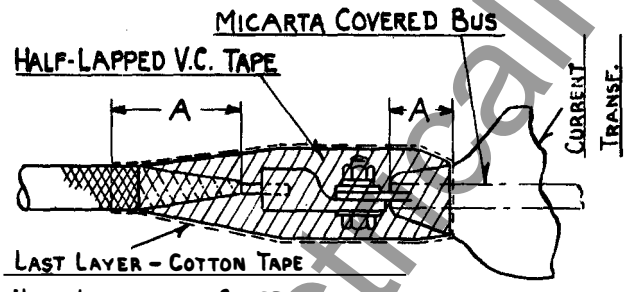
FINISHING LAYER HALF-LAPPED COTTON TAPE

CORD OR SEW ENDS OF TAPING FOR PERMANENT FASTENING. TAPE WITH FRICTION TAPE FOR TEMPORARY FASTENING.

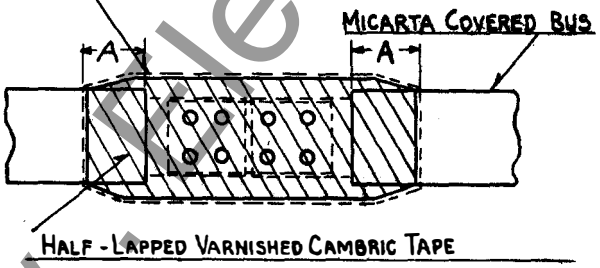
FIG. 1

SERVICE VOLTAGE	LAYERS OF V.C. TAPE	"A" CREEPAGE
750	3	1
2500	4	1
4000	5	1
4500	6	1½
6600	7	1½
7500	8	1½
13200	12	1½ TO 2
15000	13	1½ TO 2
25000	18	ENGINEERS
37000	28	INSTRUCTIONS

WRAP WITH HALF-LAPPED LAYERS OF .010 VARNISHED CAMBRIC TAPE (W.E. & M. CO. NO. 1266 TAN TREATED CLOTH.) APPLYING AS MANY LAYERS AS GIVEN IN THE ABOVE TABLE. APPLY A COAT OF #3395 INSULATING VARNISH BETWEEN LAYERS.
TAPE OVER THE CAMBRIC WITH ONE LAYER OF .007 COTTON TAPE AND WRAP THE ENDS WITH CORD TO KEEP THEM IN PLACE. FINISH WITH 1 COAT OF BLACK SHELLAC M-1133 AND 1 COAT OF BLACK INSULATING VARNISH M-1736.



CABLE CONNECTION FIG. 2



BUS SPLICE FIG. 3

Taping Instructions - Dwg. 823949-12