Introduction of Product

42,000 kVA TRANSFORMER FOR ELECTRIC FURNACE DELIVERED TO SHIN NIPPON CHISSO HIRYO K. K.

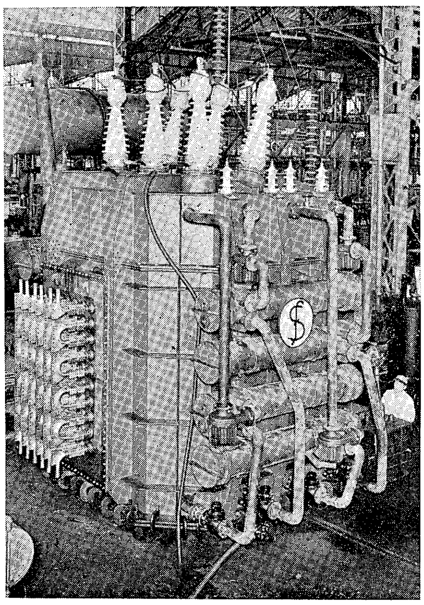

Fig. 1. 42,000 kVA Furnace Transformer

A 42,000 kVA transformer recently delivered to Shin Nippon Chisso Mizumata Factory for use with a carbide furnace is provided with new special features such as being able to directly step down the receiving voltage to furnace voltage, as being equipped with load-ratio adjuster, etc. The following is a short description of this transformer.

I. SPECIFICATION, WEIGHT, AND DIMENSIONS

Indoor, forced-oil, water-cooled type with on-load tap changer ;

3-Phase, frequency 50/60 c/s, Connections :
Primary △ or Y
Secondary Open △

	For 60 c/s	For 50 c/s
Output (kVA)	42,000	38,000
Primary Votage (V)	66,000	60,000
Secondary Rated Voltage (V)	242	220
Tap Voltage (V)		
Primary for △	308～176	280～160
Primary for Y	178～101.4	161.8～92.2
Number of Taps	25	25
Secondary Rated Current (A)	100,100	99,800

Gross weight	134 tons
Net weight	71 tons
Gross Volume of Oil	36,400 liters
Outline Dimensions	5,820×5,060×6,200 (Height) mm

II. CONSTRUCTION

The connection diagram being shown in Fig. 2, the equipment consists of a main transformer and a series transformer, both immersed in one oil tank. The voltage of the exciting coil of the series transformer is supplied from the tertiary winding of the main transformer to induce voltage in the series winding. With the load on, the induced voltage of the series winding is made to vary by changing the tap position and load-ratio adjustment of the secondary voltage is obtained. Since, ordinarily the construction of the conductors is too complicated to insert the series transformer into the secondary side in which a current of as much as several tens of thousand amperes flows, the load-ratio adjuster is sometimes connected to the primary side. However, in this case, the higher the receiving voltage, the more expensive the adjuster for higher voltage use results in. Also, the fact that the core of the main transformer requires a cross-sectional area corresponding to the maximum tap voltage, makes this arrangment extremely disadvantageous. We have by our special winding construction, worked out a very simple way for inserting the series transformer into the secondary side, as explained below :

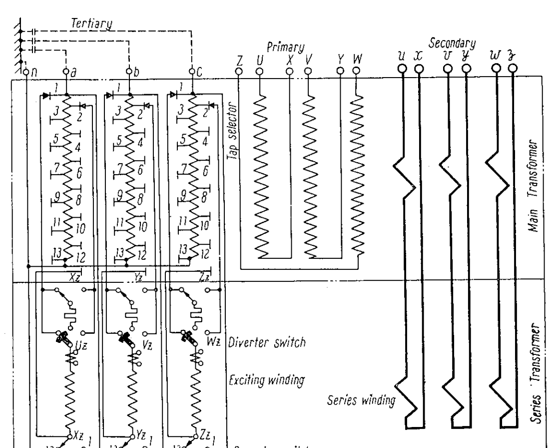

Fig. 2. Connection diagram

1. Core and Winding.

The Three-leg, core type iron core having a rectangular cross-section is used. The Silicon sheet steel for the core is karlite-insulation T_{95} (0.95 W/kg at 50 cycles, 10,000 gauss), and each piece of steel sheet was tested and selected by the Iron Loss Measuring Apparatus. Oil duct is provided in the core in the diredtion at right angles to the direction of the laminations of the steel sheets, in order to improve the cooling efficiency. The tightening bolts are made of nickel-chrome steel.

The windings of both the main and the series transformers are constructed such that the secondary winding is on the outside of the concentric layers of windings. A special attention is paid to this secondary winding, that is, the two transformers are placed side by side with bare electric copper plate covering the outside of high tension winding of each transformer. This bare copper plate is made into a ∞ — shaped cylindrical coil having two continous turns. Fig. 3 shows the inserting operation of this coil and illustrates the secondary windings of the main and the series transformers constructed as a single coil without any connecting points. Thus, neat and perfect coupling of the two transformers is obtained electrically as well as mechanically.

The beginning and the end of the copper plate coil are directly connected to the water-cooled pipe terminals and made to pass throgh the tank wall to the electric furnace conductors as illustrated in Fig. 1. Therefore, this construction in which the connection from the coil to the electric furnace is made as short as possible, gives advantage in effecting savings in copper material and making the transformers into a compact unit. The primary and the tertiary windings of the main transformer are placed concentrically within and adjacent to the secondary winding in the order the primary and tertiary. Simple shields are provided at the ends of the 60 kV primary winding to suppress the potential oscillations in the winding produced by surge voltage and at the same time to ease the field intensity. The neutral point of 10 kV tertiary winding is grounded to take care of the transfer voltage of the surges entering from the primary side. In addition, the three terminals are grounded by surge absorbers for assuring further safety in construction. The tertiary winding consists of several copper wires wound in parallel, and since each tap coil is a parallel wound cylindrical tap winding and wound up to the entire height of the winding, the electro-magnetic force in the direction of the axis of the winding becomes very small even when the taps are idle. This fact, together with the fact that there are no taps in the primary coil, gives sufficient and highly reliable mechanical strength to the windings against short-circuits.

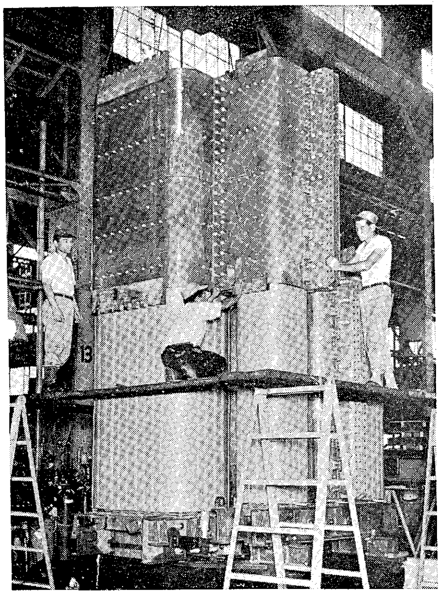

Fig. 3. Secondary Coil

2. On-Load Tap Changer

The on-load tap changer, consisting of a tap selector and a change-over switch, is assembled in a switch-case attached to the side wall of the oil tank opposite to the wall on which the secondary terminals are fitted and is coupled to the Motor-Drive by means of a driving shaft penetrating the side wall. Since the tap selector is operated without electric current, no arcs are produced, permitting it to be placed in the same clean oil that the transformer is immersed in. However, the change-over switch is placed in the oil in an isolated switch-case, because arc is produced each time a change-over is made and causes soot formation in the oil.

The tap selector is provided with 14 tap contacts per phase and a polarity changer attached to its side. By reversing the polarity of the exciter coil, either positive or negative voltage can be induced in the series winding, thus doubling the adjusting range.

The change-over switch is a Jansen-Schalter, and it is proved by the operation test that it withstands, through the whole life of the transformer, change-over operation of 20,000 to 30,000 times per year without replacing the contacts. Thus, it is anticipated that the tap-changer will give perfect performance and will withstand the frequent control necessary in electric furnace operation.

3. Accessaries

Eight water-cooled unit coolers having a large rate of haet exchange are attached to the side walls of the oil tank together with the oil feed pumps. A nitrogen-sealed oil conservator is furnished to prevent deterioration of the insulation oil.

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