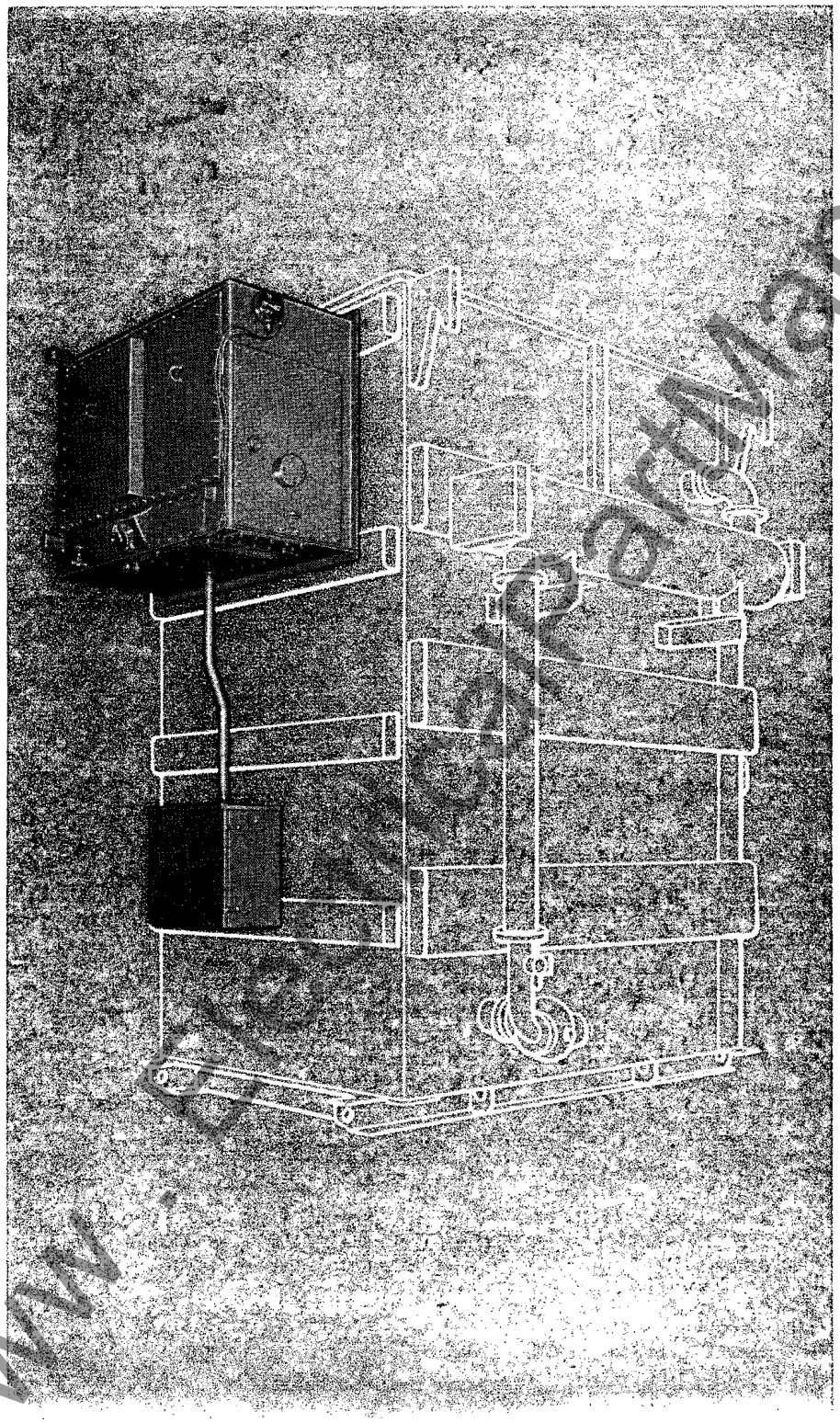
Westinghouse

UVT Vacutap™ Load Tap Changer

Through 350 Kv BIL



Application

The Westinghouse Type UVT Vacutap™ load tap changer is used in conjunction with power transformers or regulators to change taps under load; thereby controlling voltage magnitude or phase angle.

The Vacutap load tap changer utilizes the reactor switching principle and vacuum interrupter to accomplish the tap change.

The Vacutap load tap changer is designed for application where frequent operations are required. The rating of the tap changer is coordinated with the rating of the transformer or regulator so that all operating limits specified on the transformer or regulator nameplate are met. These limits are covered in AN Standard C57.12.30 and appendix C57.92 for transformers or AN Standard C57.15 and appendix C57.95 for regulators.

Advantages

Vacuum interrupters are used to interrupt the circuit within a half cycle. The interruption is contained in a high vacuum atmosphere instead of the usual arcing contacts under oil. Therefore, oil contamination with abrasive particles is eliminated. The result is greatly increased life for mechanical parts and less frequent need for cleaning surfaces and filtering oil.

All oil immersed components are in a single compartment resulting in a more compact design.

Contact life is increased up to 20 times that of conventional tap changers reducing maintenance and parts costs.

The 500,000 load operation warranty makes the Type UVT Vacutap load tap changer especially desirable for application requiring very frequent operations.

All mechanical parts are designed for heavy duty service. The extensive use of ball bearings and hardened shafts assures support of rotating parts for maximum mechanism life.

Contact wear of the vacuum interrupter can be visually determined through sight windows eliminating the need to remove unit from service, drain oil and unbolt the gasketed main tap changer cover plate for this inspection.

Ratings:

Current: 1000, 1500, or 2000 Amperes.
Voltage: All Voltages through 69 Kv (350 Kv BIL).
Frequency: 60 Hertz or 50 Hertz.
Phase: Three Phase.

June, 1970
New Information
E, D, C/2091/DB

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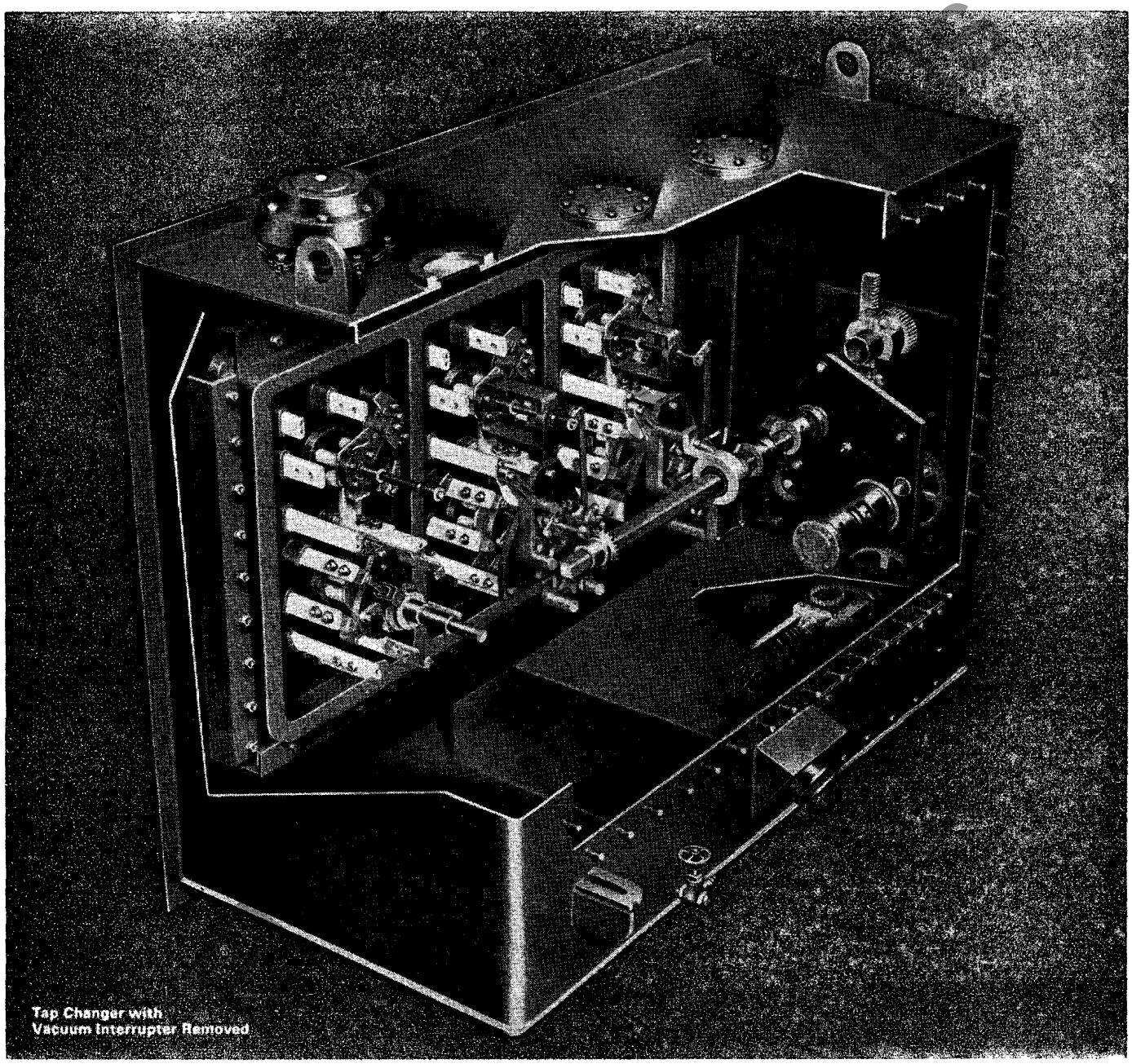

Tap Changer with Vacuum Interrupter Removed

Design Features

The Type UVT Vacutap load tap changer is mounted on one wall (usually an end wall) and near the cover of the main transformer or regulator tank. An opening in the main tank is provided for mounting the tap changer molded terminal board. Tap leads from the winding to be regulated are connected to the rear of the terminal board and the selector switch and reversing switch assembly is mounted on the front of the terminal board. The terminal board acts as a multiple bushing to seal off and insulate leads from the main tank into the tap changer housing.

The Type UVT Vacutap load tap changer consists of the following components:

- Molded terminal board (see page 4)
- Selector switches to select the tap connections, mounted on the molded terminal board (see page 4)
- Reversing switches to select the raise or lower connection of the tapped winding. It is also mounted on the molded terminal board and may be omitted for some application (see page 4)

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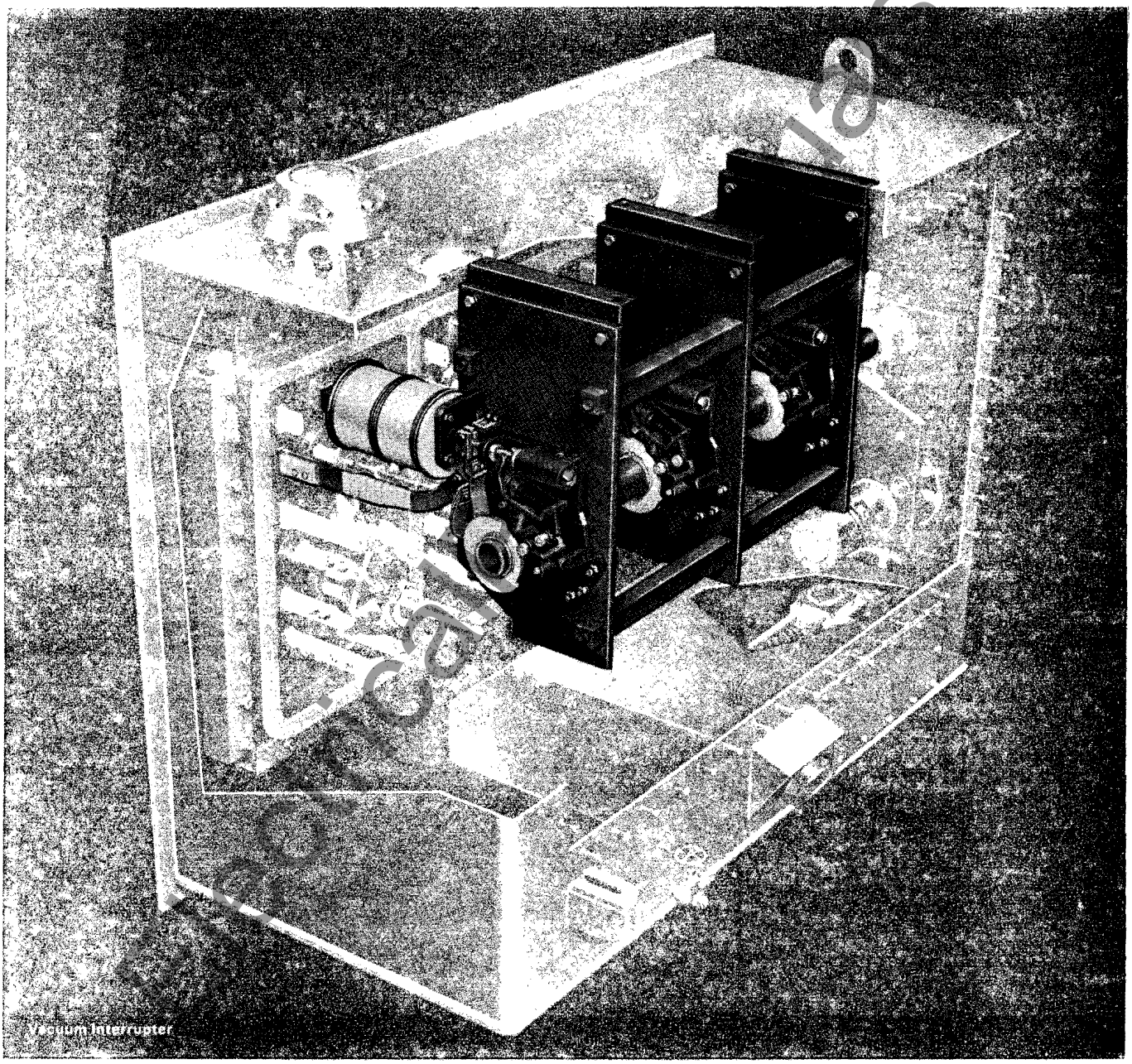

- Vacuum interrupter contact opens to break current flow during switching operations (see page 5)

- By-pass switches (on opposite side of barrier from interrupter) to shunt current flow around the vacuum interrupter except during interrupter operation (see page 5).

- Drive mechanism to provide coordinated movement for operating the selector switches, reversing switch, vacuum interrupter, and by-pass switch and to lock assemblies on position after tap change (see page 6).

- An air filled compartment at the bottom of the tap changer housing contains the control cam switch assembly (see page 7).

- Tap changer housing welded to main transformer or regulator tank and fitted with external position indicator, liquid level gauge, drain valve, pressure relief device and sight windows (see page 8).

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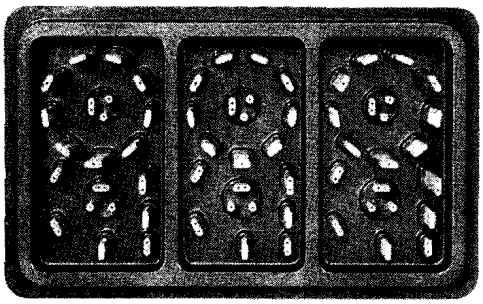
Molded Terminal Board



The taps from the regulated winding are brought from the main tank into the tap changer tank by means of bus bars cast into a one piece molded terminal board, the bus bars also serve as mounting posts for the selector and reversing switches.

Selector Switch

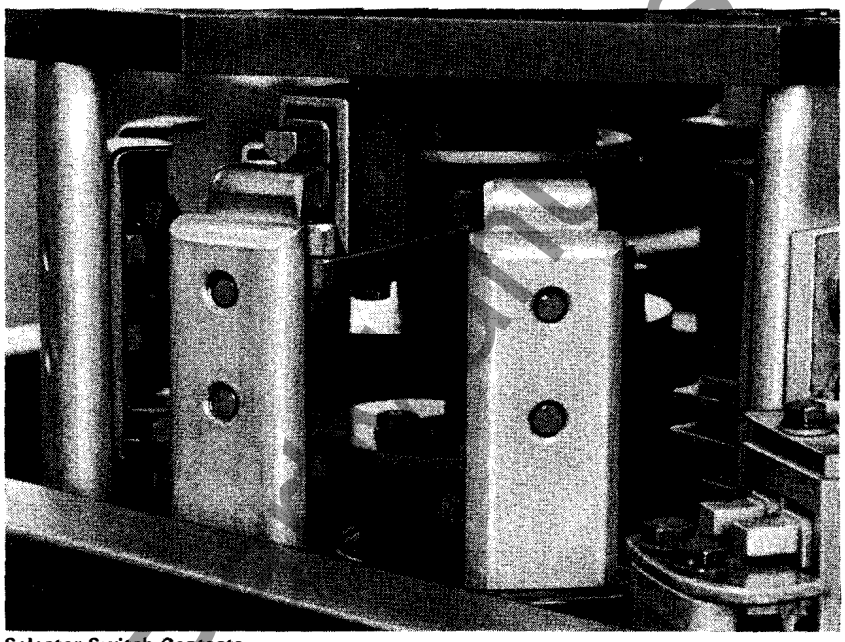
The selector switch consists of two contact arms driven alternately by two Geneva gear assemblies. Geneva gears provide positive indexing and the desired speed of movement for maximum contact life, slow break rapid movement between contacts and then reduced speed for engaging the next stationary contact. The Geneva gear mechanism also locks the contact on position between operations.

The stationary contact bus bars are cast into the molded terminal board and serve several functions. They act as conductors to connect from the contact to the winding tap lead. They provide support for the nine double blade stationary contacts. Three of the bus bars extend to provide support for the selector and reversing switch drive mechanism.

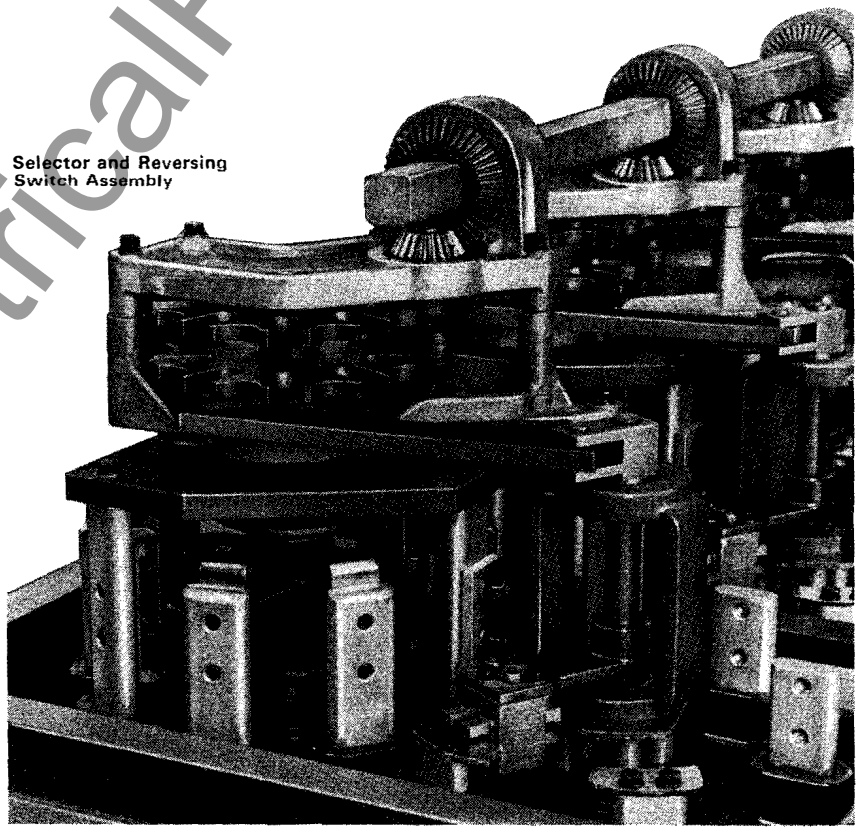
The moving contacts employ hard copper fingers with coin silver contact surfaces. The finger assemblies are spring loaded to provide contact pressure for normal load current and are equipped with steel yokes to provide strong magnetic clamping action during short circuit.

Reversing Switch

The stationary and moving contact assemblies of the reversing switch are mounted on bus bars cast into the molded terminal board adjacent to the selector assembly. The moving contact arm is operated by a drive mechanism coupled through an insulated arm to the selector Geneva gear drive shaft. The contacts of the reversing switch are of the same design as the selector switch contacts.



Selector Switch Contacts



Selector and Reversing Switch Assembly

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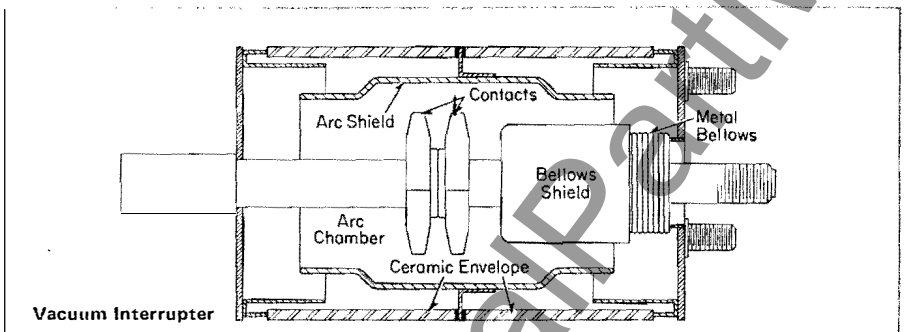
Vacuum Interrupter

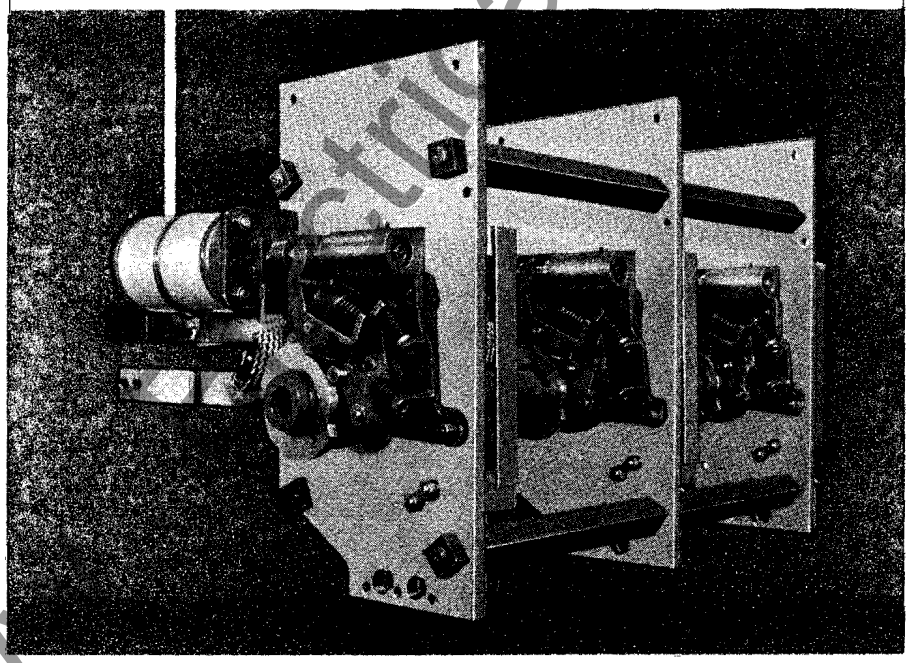
The vacuum interrupter assembly for each phase is mounted on one surface of a Micarta® board and the phases are positioned by means of insulating spacer rods. One drive shaft operates all phases simultaneously.

The vacuum interrupter drive assembly is a cam action spring driven mechanism. To open the interrupter, the spring driven mechanism impacts an operating rod connected to the moving contact of the interrupter. The velocity imparted to the moving contact is controlled through an oil dashpot. The interrupter is locked in the full open position while the selector switch changes taps. Upon completion of tap selection the interrupter mechanism is unlocked and the moving contact is closed by the pressure differential between the vacuum in the bottle and oil pressure in the compartment acting on the bellows seal connected to the contact shaft. Closing speed is also dashpot controlled.

The vacuum interrupter consists of a stationary and moving contact enclosed in a vacuum tight bottle. The moving contact rod is sealed through a flexible metal bellows protected from the arc by a shield. A metal envelope surrounds the contacts forming an arc chamber and condensing surface to collect vaporized contact material. The ceramic insulating envelope is connected to the metal part by vacuum tight seals.

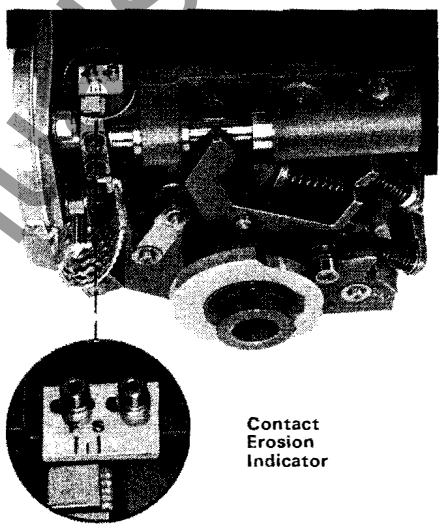


Vacuum Interrupter



Interrupter Mechanism

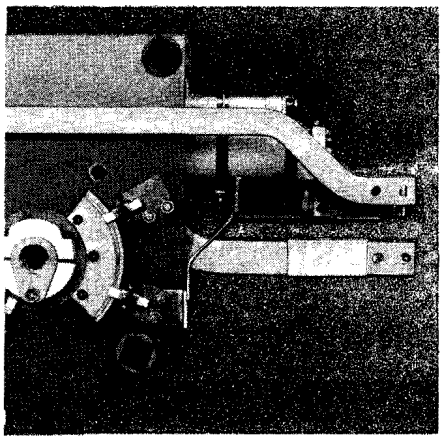
Wear Indicator



Contact Erosion Indicator

The rate of contact erosion can be observed through sight windows by observing scribe marks on the interrupter assembly. Marks "S" for start when new and "F" for finish cover the range of contact life.

By-Pass Switch



The by-pass switch is located on the opposite side of the Micarta board from the interrupter mechanism and is operated from the same main drive shaft. The by-pass switch moving contact is of blade type with chamfered leading edges. The by-pass switch normally bridges between the two stationary contacts thus by-passing the vacuum interrupter. During a switching operation the by-pass switch moving contact rotates so as to engage only one stationary contact and route the current through the interrupter just prior to its operation.

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Tap Change Sequence

On Tap Position to Bridging Position

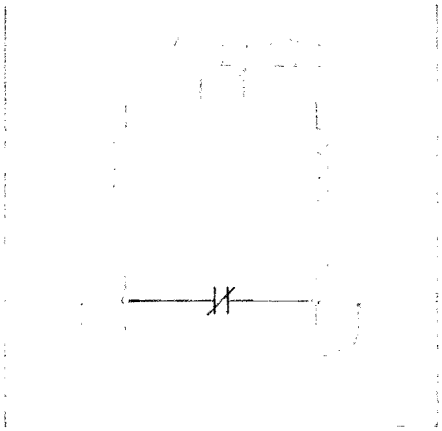


Fig. A. On One Tap
By-Pass Closed

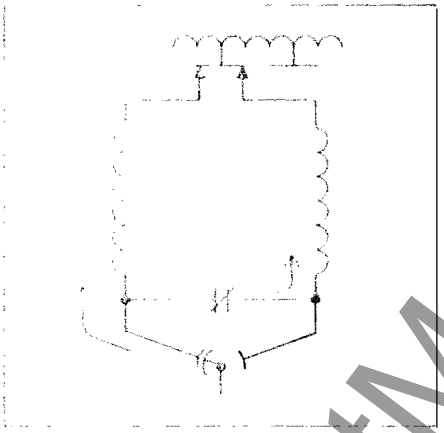


Fig. B. By-Pass Open Ready
For Interruption

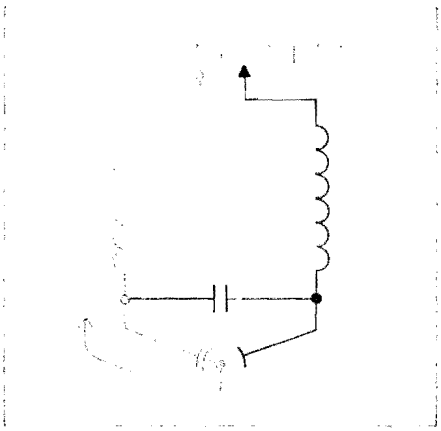


Fig. C. Vacuum Interrupter Open
Ready for Tap Selection

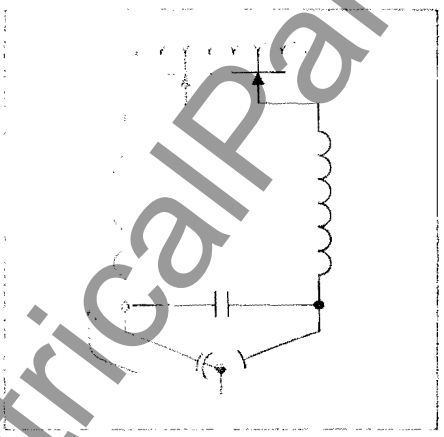


Fig. D. Tap Selection Made

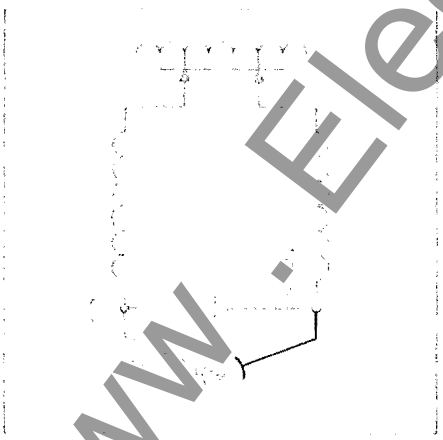


Fig. E. Interrupter Closes
Bridging Position Complete

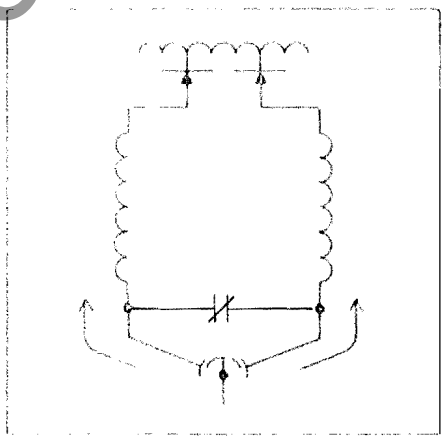
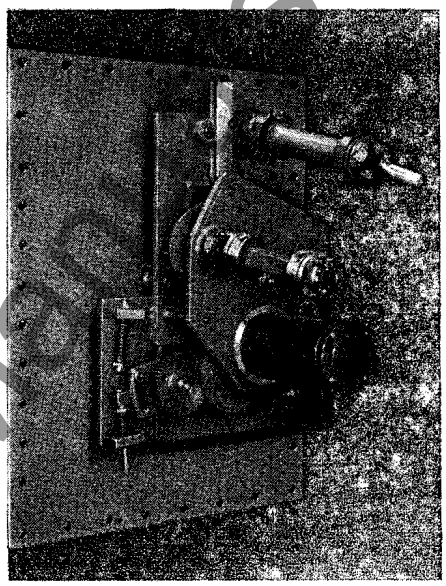
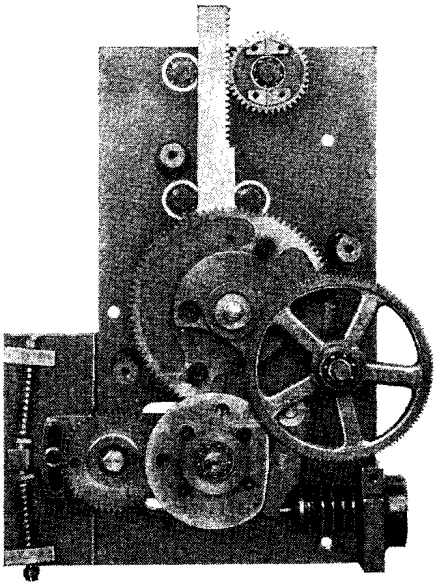


Fig. F. By-Pass Closed
Tap Change Completed

Drive Mechanism



The tap changer drive mechanism is powered by a 220 volt, single phase, oil immersed capacitor start, capacitor run motor. The lower shaft operates the selector and reversing switches and is driven through a Geneva gear action. The upper shaft operates the vacuum interrupter and by-pass switch through an oscillatory motion by means of a gear and pinion off a Scotch yoke mechanism.



Drive Mechanism with Motor and
Geneva Gear Plate Removed

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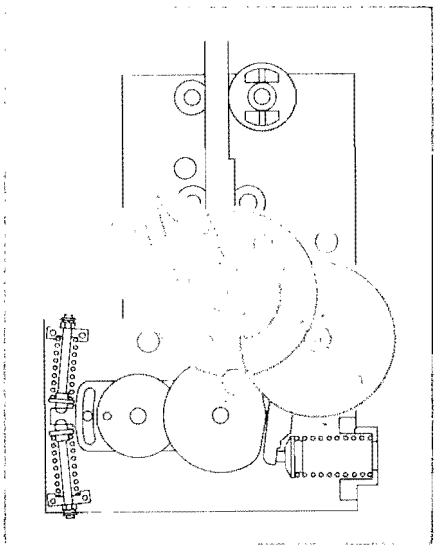
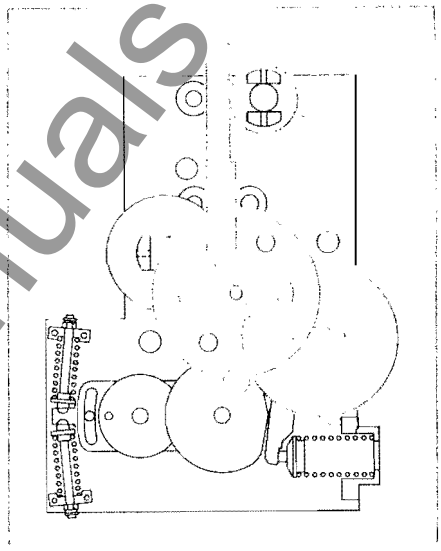


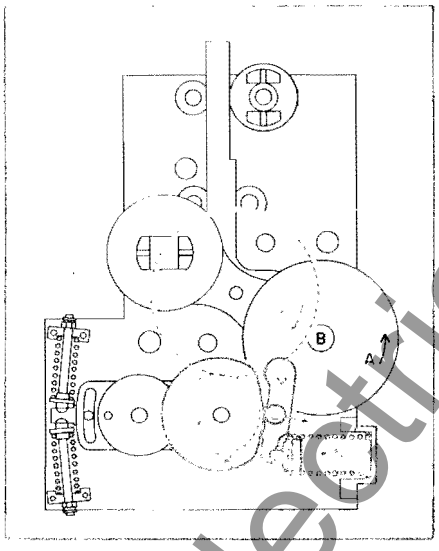
◀ Selector and Reversing Switch Drive

Gear "Z" attached to drive motor rotates large gear "A". Gear "B" attached to gear "A" rotates gear "C". Lock segment "D" and pin "E" operate Geneva gear "F". Shaft from Geneva gear "F" operates the three ganged selector and reversing switch mechanisms.



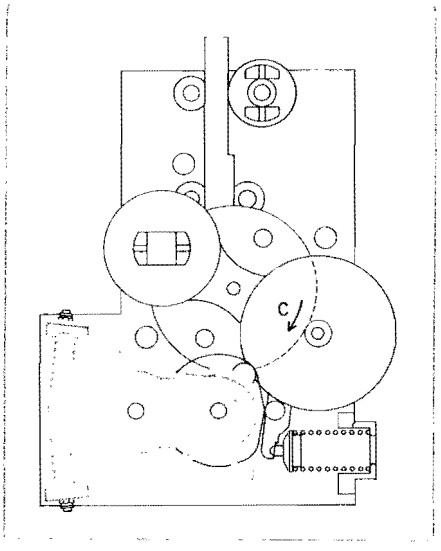
Interrupter and By-pass Switch Drive ▶

Gear "Z" attached to drive motor rotates large gear "A". Gear "B" attached to gear "A" rotates gear "C". Pin "G" fixed to gear "C" drives gear rack "H" rotating gear "I". Shaft from gear "I" operates the vacuum interrupter and by-pass switch.



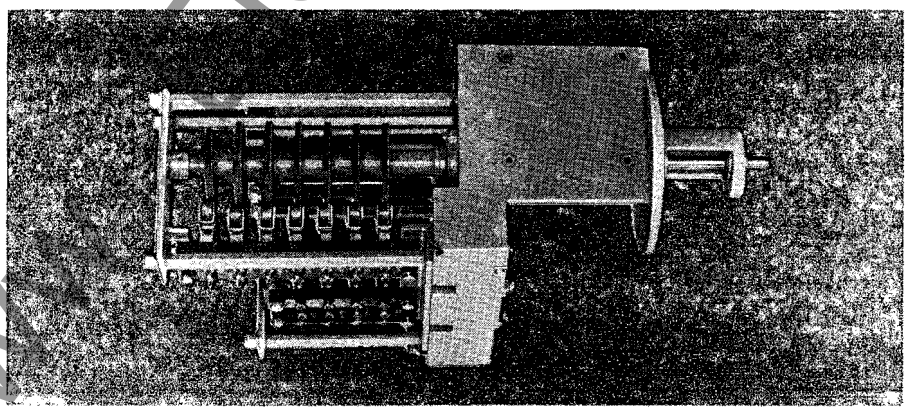
◀ Braking Cam

Gear "C" is driven as described previously and drives gear "J". Cam "K" fixed to gear "J" moves roller "L" which is attached to arm "M". Arm "M" depresses spring "N". Energy stored in spring "N" returns cam "K" and the remainder of the drive to the desired position between tap changes after drive motor power is switched off and provides braking action to hold the drive in the desired position for the next tap change.



Mechanical Stop ▶

Gear "C" is driven as described previously and drives gear "J". Gear "J" drives gear "P" and having one more tooth than gear "P" it advances pin "Q" which is fixed to gear "P", partially each revolution. Pin "Q" advances during each tap change until the end of the range. If the electrical limit switch fails or if tap change is being hand cranked and tries to go beyond the normal range then pin "Q" strikes plate "O" jamming arm "S" against spring "T" preventing any further rotation beyond the end of the range.



◀ Cam Switches

The control cam switches are housed in the air compartment at the bottom of the main tap changer compartment. The cam shaft extends into the drive mechanism compartment and is gear driven from the main drive mechanism. A secondary shaft drive from the cam shaft operates the external tap position indicator. Transmitting devices for remote tap position indication can also be attached to the cam shaft.

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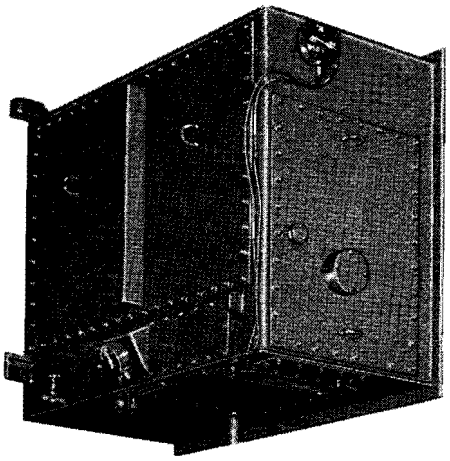
Tank and Fittings



The enclosure for the tap changer assembly is welded to the main transformer or regulator tank at a location convenient to the connection to the winding tap leads.

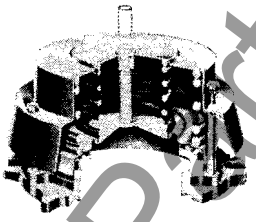
A large cover plate provides sufficient area for access to the selector switches and terminal board and interrupter/by-pass switches. The cover plate is bolted and gasketed, and provided with support hinges to swing clear when unbolted. Access plates are also provided for the air compartment.

The tap changer tank is equipped with a one inch drain valve with ⅜" sampler and a filling/vent plug at the top. Three sight windows with protective covers are located so as to view the contact wear indicators without taking the unit out of service and unsealing the oil filled compartment.

An opening is provided for insertion of the hand crank for manual operation and is covered by a metal plate.

The following gauges and indicators are provided:

Mechanical Relief Device

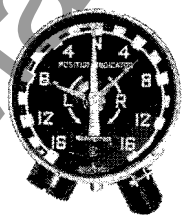


Relieves abnormally high internal pressure. Factory calibrated to operate at 10 psi. Easily visible operation semaphore. After operation, positively reseals and continues to give protection against the elements.

Magnetic Liquid Level Gauge

Float position transmitted magnetically through tank wall to gauge pointer preserving tank seal.

Tap Position Indicator



A tap position indicator is mounted at the bottom of the compartment and at an angle to facilitate reading from ground level.

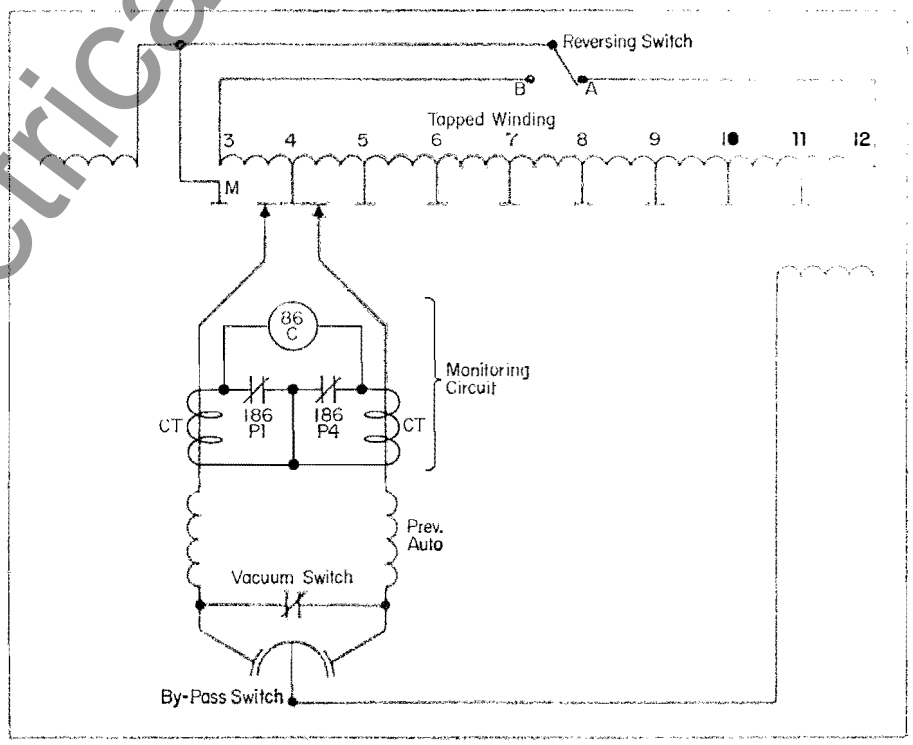
Tap Changer Control

Standard control arrangements as described for the transformer or voltage regulator such as automatic or remote manual can be provided.

CT Monitoring Circuit

A CT monitoring circuit is utilized to protect the tap changer in case the vacuum interrupter fails to interrupt and transfer the load current during a tap change. A pair of cam operated switches 186P1 and 186P4 in conjunction with relay 86C are used to sense a presence of current in the selector switch moving contact during its no-load movement. The 186P1 switch is timed to open after the vacuum interrupter transfers the load current and before the selector switch P1 opens and closes after P1 recloses. The 186P4 switch is timed to open after the vacuum interrupter transfers the load current and before the selector switch P4 opens and closes after P4 recloses.

When the tap changer is on position or the selector switch contact is carrying load current during a tap change, the CT is shorted by a 186 switch. Therefore, if current is flowing thru a CT when the selector contact is involved in a switching operation, the opening of the 186 contact will operate relay coil 86C and prevent further tap changes.



UVT Schematic Diagram

Westinghouse Electric Corporation
Power Transformer Division, Sharon, Pa. 16146
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