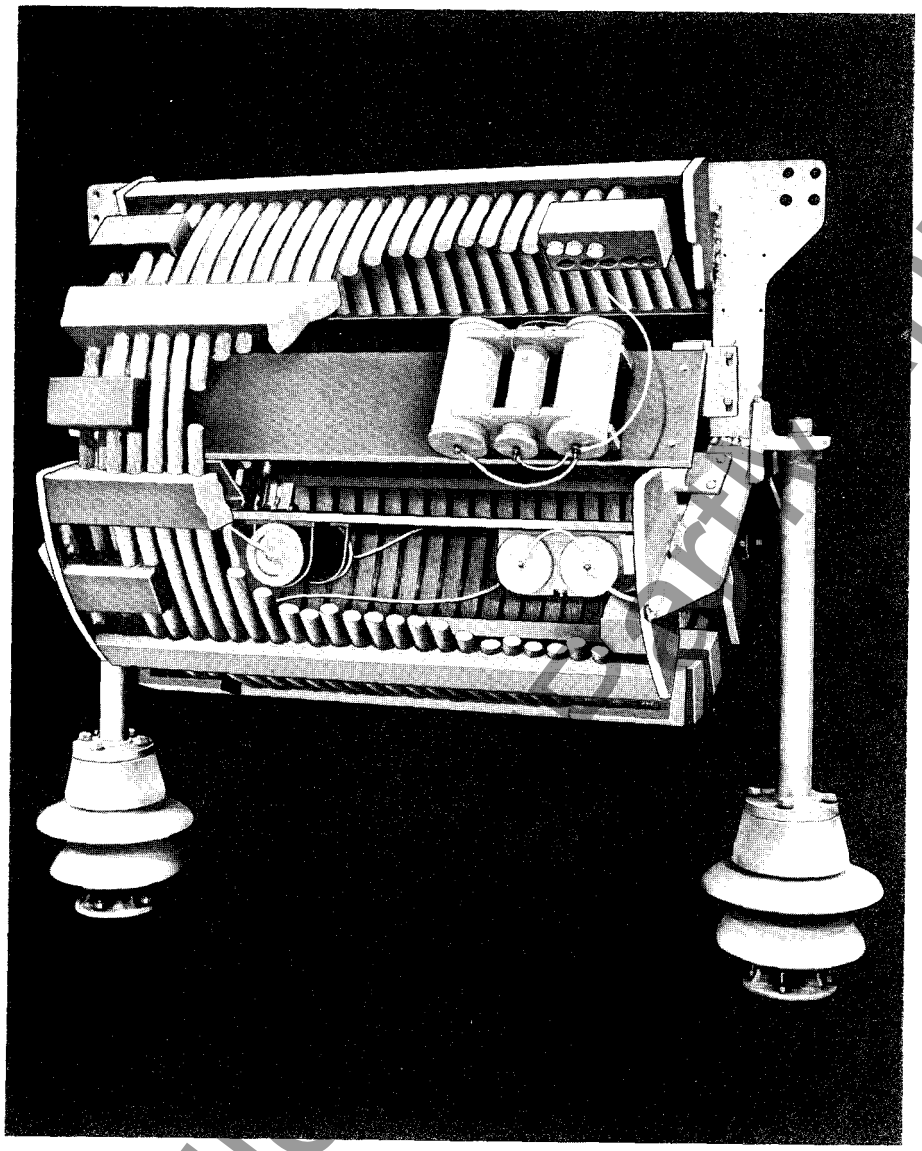
Westinghouse

Line Trap Tuners

.265 mh Type M Line Traps



Application

Line trap tuners resonate with the main coil of a line trap to produce the impedance characteristics of that line trap. Tuners consist of capacitors, resistors, and inductors. The circuitry and component values are dependent on the type of tuning, frequency range and impedance level necessary for each application.

Physically, tuning packs are located inside and at one end of the main line trap coil. Flexible leads and trimmer connectors are used for connections to the main coil.

Electrically, the tuning packs are connected in parallel with the main coil. The trimmer connector provides a simple means for fine tuning the line trap. Loosening the connector and moving it on the main coil changes the inductance against which the tuner resonates. Protection against overvoltage is provided by a lightning arrester. The arrester sparkover characteristics are coordinated with the withstand voltage of the tuning packs and of the main coil. (See chart, Page 3.)

Benefits

Interchangeability

All tuning packs are interchangeable among current ratings with the exception of the 30-90 KHz 800 ampere rating and those used in the 400 ampere trap. This universal mounting reduces spare parts inventory and simplifies mounting procedures. These tuners are interchangeable with those in any type M line trap.

Simplified Mounting

Tuning packs are mounted so that they may easily be removed for periodic maintenance or for converting the line trap to a different tuning range. Simply loosen the captive nuts and remove the tuning pack from the mounting boards.

Simplified Tuning

Line trap tuning is simplified by using a trimmer connector on the main coil for fine tuning. Capacitor changes are made by changing flexible leads with bolt on connectors. The adjustable inductor used in double frequency and wide band line trap is adjusted by means of a moveable slug which is kept covered by a protective cap.

Hermetically Sealed Lightning Arrester

The lightning arrester which protects the tuning packs has a solder sealed porcelain housing. The solder sealing system provides a seal that is far superior to conventional gasket seals, which can age, compress, and permit entrance of moisture, resulting in eventual arrester failure.

All capacitors in Westinghouse line trap tuners use dry film as the dielectric. Capacitors made with this film have the following advantages over other type of capacitors:

No Oil

Because of their high dielectric strength, these capacitors need not be impregnated for additional strength. These dry-type capacitors are inherently more reliable than a capacitor with oil since failures due to oil leakage has been eliminated.

Higher Voltage Withstand

Due to the high dielectric strength of these capacitors, they have very high voltage withstand levels. Each capacitor in these tuning packs is designed to have a one minute 60 Hz withstand level at least three times as high as the voltage across the line trap under maximum short circuit conditions.

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Construction

Capacitor Sections

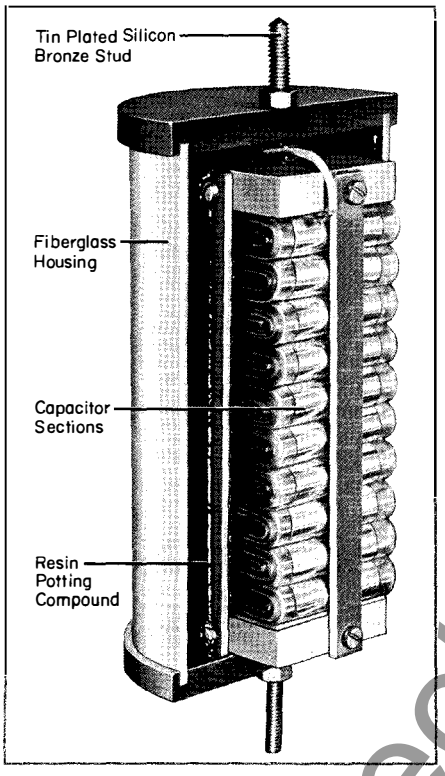
Each capacitor section is made by winding layers of film between sheets of electrical grade aluminum foil. These sections are then stacked in series for the proper capacitance and voltage withstand values. Connections between capacitor sections are made by winding an extra half turn of foil beyond the dielectric at each end of the section. In stacking the section then, this foil makes contact to the capacitor section next to it. A large surface area is thus used for the connection. Connecting the capacitor sections by foil-to-foil pressure rather than by a series of soldered connections results in more uniform, reliable connections.

Capacitor Terminals

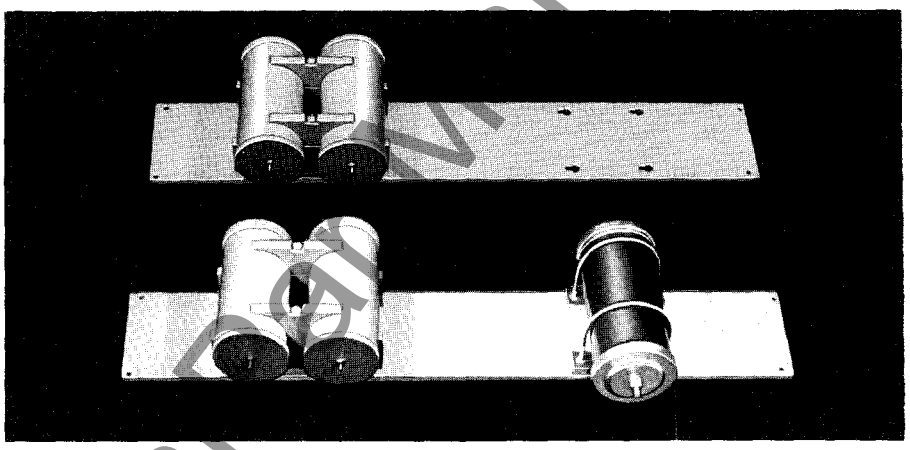
The external terminals of these capacitors are tin plated silicon bronze studs. The only soldered connections in a capacitor are those between the capacitor and external terminal.

Capacitor Packaging

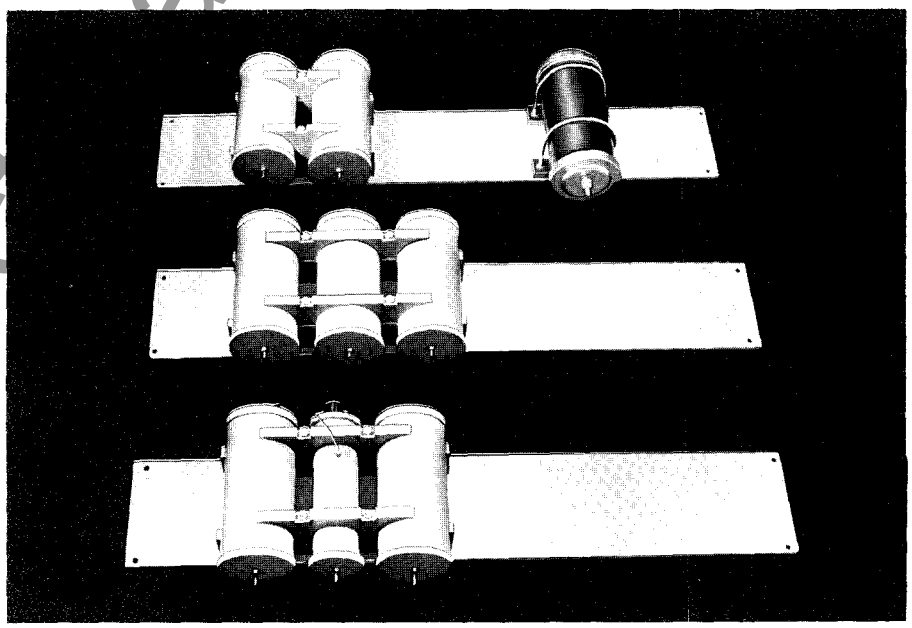
After the capacitor sections are assembled, they are placed in a spun fiberglass housing and potted. Both the fiberglass tube and resin potting compound serve to protect the capacitor from damage due to shipping, handling and weather. This resin has a high dielectric strength and very low water absorption rate. Many tests under extreme temperature and humidity conditions show this resin to be completely compatible with the film dielectric.



Typical tuner capacitor



S tuner on mounting board with and without lightning arrester



S tuner and lightning arrester, D2 tuner and D1 tuner

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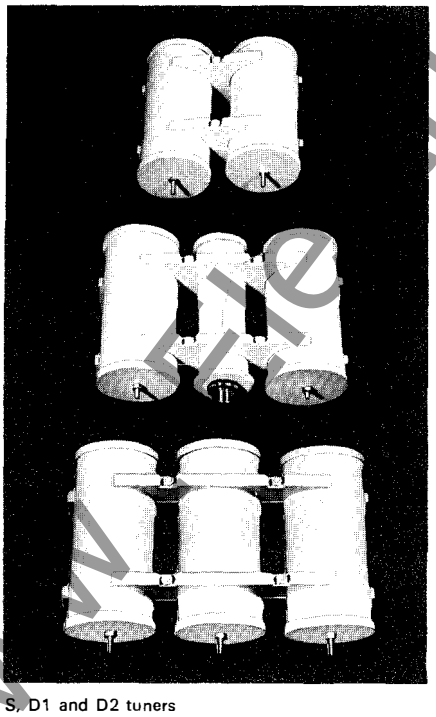
Adjustable Inductor
Double frequency and wide band line trap tuners have an adjustable inductor as part of the tuning pack circuitry. This inductor is made by winding layers of PVC insulated wire on a hollow tube. Inside this tube is a movable slug used to adjust the inductor. This assembly is then placed in a spun fiberglass housing, potted and sealed.

Resistors
Non-inductive, vitrious enamel resistors are used in the line trap tuners. When used they are mounted separately from the capacitor units.

Lightning Arrester
Protection against overvoltage is provided by a solder sealed lightning arrester. The exclusive Westinghouse hermetical solder seal process of soldering the end caps to both ends of the porcelain housing completely and permanently protects all of the arrester's operating elements from moisture.

Mounting
Complete tuning packs are mounted inside the line trap on a mounting board. The mounting boards are drilled and slotted (See page 2) to simplify installation of the tuning packs. Retaining nuts which hold the tuning pack on the mounting board are held captive to prevent their being dropped during installation.



S, D1 and D2 tuners

Design Tests
Line traps are connected in series with the high voltage transmission line. The continuous voltage applied to the tuners then is the voltage developed across the line trap due to power current flowing through the main line trap coil. In addition, line trap tuners are subjected to high voltages as a result of traveling waves due to lightning or switching surges on the high voltage line.

Tuning pack components are protected from these overvoltages with a lightning arrester. The coordination must be such that the tuning packs are not shorted out while the line trap is carrying full rated short circuit current, but there must be a margin of safety between the sparkover level of the arrester and the withstand values of the tuning pack components.

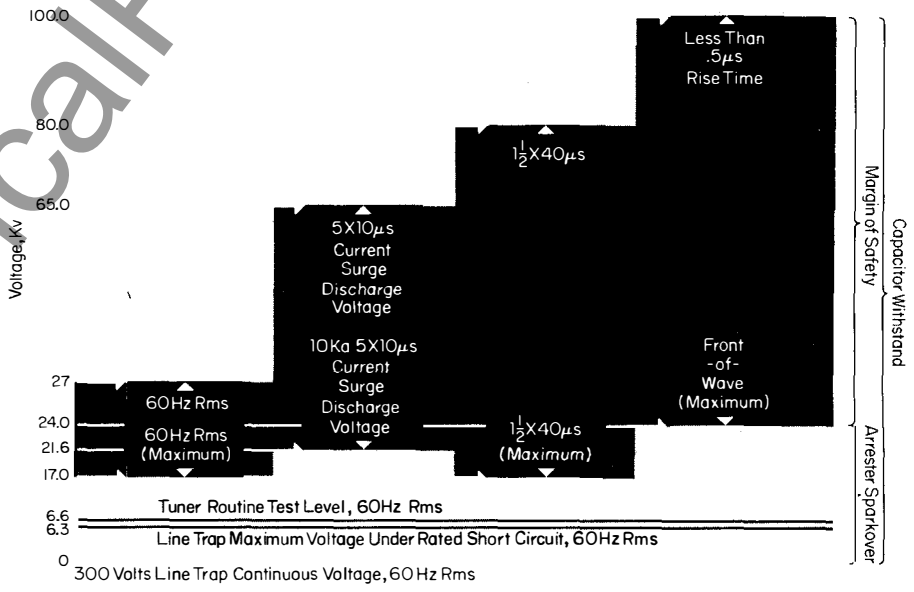
Westinghouse dry type tuning packs and lightning arresters exceed all applicable NEMA standards. The following design tests have been made on the tuning pack components:

60 Hertz Withstand
These dry type capacitors have passed 60 Hz over potential tests of 27 KV for one minute without failure. This is 3 times the voltage developed across the line trap under maximum short circuit conditions.

Impulse Withstand
Each tuning pack component has successfully passed a 1½ x 40 microsecond voltage wave of 80 KV.

Discharge Voltage
A discharge voltage is developed across a lightning arrester when it sparks over due to current flowing through the valve blocks. Since this voltage may exceed the sparkover voltage of the arrester, its coordination with the withstand voltage of the capacitors is important. The components in these tuning packs have passed, without failure, the voltage developed across the lightning arrester with a 5 x 10 microseconds, current surge through the arrester. Under these conditions, the voltage developed was 65 KV.

Coordination Chart



This chart shows the margin of safety between the capacitor withstand voltage levels and the lightning arrester sparkover levels.

This example is for a 3000 ampere line trap but is applicable to all line traps rated 1200 through 3000 amperes as they use the same tuning packs and lightning arresters. For the lower rated line traps the voltage across the line trap under continuous and short circuit conditions will be less.

Both the 400 and 800 ampere line traps use a 3 KV arrester which has a minimum sparkover of 5 KV, 60 Hz. rms.

The capacitors in the 400 ampere line trap tuner and in the 800 ampere 30-90 KHz frequency range tuner are designed for a 25 KV, 60 Hz. rms short-time withstand.

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Design Test (Cont.)

Capacitance Change With Temperature
A stable capacitance is a prerequisite for line trap tuners. If the capacitance changes, the line trap tuning will be affected. Although this would be most noticeable with resonant tuned single or double frequency line traps it can also occur with wide band line traps. These capacitors have excellent capacitance vs. temperature characteristics, substantially better than NEMA requirements of less than 2% change from −40°C to +40°C over the frequency range of 30 to 200 KHz.

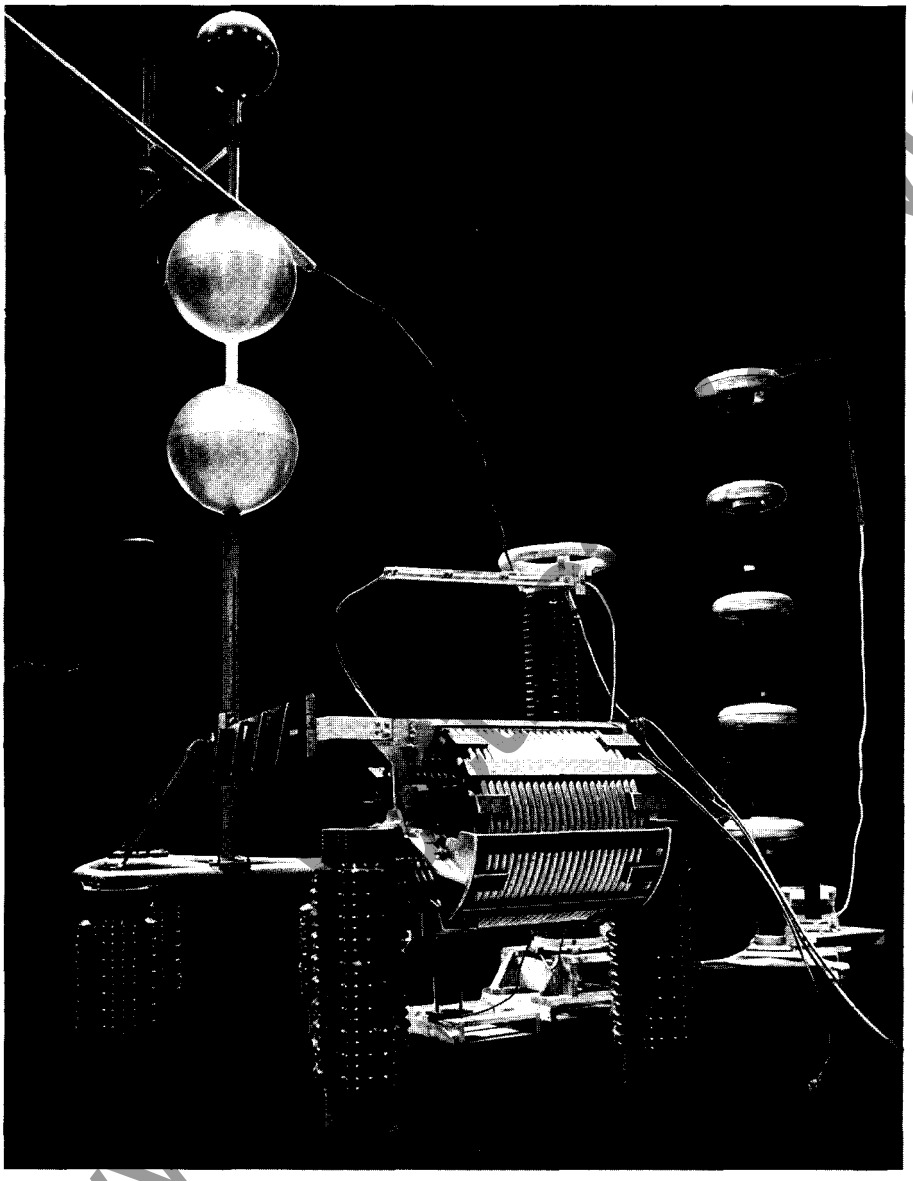
Lightning Arrester Design Tests
The lightning arrester is used to protect the tuning pack from overvoltages due to line faults or traveling waves. As such, its sparkover voltage level *must be coordinated* with the voltage withstand level of the tuning components, and it must not interrupt the carrier signal during rated short current circuits. In addition, the arrester must have the same level of reliability as the tuning pack components. The following design tests have been made on this arrester:

1. Impulse and Switching Surge Sparkover
Inpulse and switching surge tests were done in accordance with USAS C62.1, 1967. These arresters have a maximum switching surge and 1.2 x 50 microsecond impulse sparkover of 17 KV for the 6 KV arrester and 8 KV for the 3 KV arrester.

2. ASA Front of Wave Impulse Sparkover
These arresters were tested for front of wave sparkover by subjecting them to a voltage wave rising at a nominal rate of 100 KV per microsecond per 12 KV of arrester rating. The maximum sparkover was 12 KV for the 3 KV arrester and 24 KV for the 6 KV arrester.

3. Duty Cycle Test
As a design test, these arresters withstood a 30 shot duty cycle test. This test consists of energizing the arrester at rated voltage and then applying a 5,000 ampere lightning surge. This is repeated 20 times with one minute between shots.

4. Discharge Voltage
This arrester was treated with a 5 x 10 microsecond current surge of 10,000 ampere magnitude. The discharge voltage under these conditions was never greater than 11 KV for the 3 KV arrester and 21.6 KV for the 6 KV arrester.



Line trap being tested for fast front surge withstand. This test was designed to simulate the type of fast front voltage surges which can occur on EHV systems. A circuit was developed to produce a voltage wave which would rise to 200 KV in 0.03 microseconds and decay to 6 KV in 1 microsecond. The line trap with tuning packs and lightning arresters was tested with this waveform; no failures or flashing occured during this test.

Routine Tests
A number of routine tests are performed on each component in the tuning pack to insure that the line trap tuner will meet the design standards.

The following routine tests are performed on each tuner:

1. Prior to potting, the capacitance of each capacitor is measured, a 25 KV DC voltage is applied to the capacitor, and the capacitance is again measured.
2. After potting, a DC over potential test is applied to each capacitor; the capacitance is then measured and recorded.
3. The resistance of each resistor is measured and recorded.
4. The inductance of the adjustable inductor is measured and recorded.

The following routine tests are made on each lightning arrester:

1. Radio influence voltage.
2. Leakage current at rated voltage, 60 Hz.
3. 60 Hz sparkover.
4. Leak test under pressure.

Further Information
Description: DB 39-711
Prices: PL 39-710

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