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RADIOTRONICS

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By the way—

Our cover this month shows two types of self-quenching Geiger-Muller tubes manufactured by Cintel. These are the GM-4, responsive to gamma particles and the GM-12, sensitive to beta radiation. Small stocks of both tubes are held, and technical data on the complete Cintel range will appear later.

The second part of the T.V. article on antennas and installation which appears this month is reprinted through the courtesy of the RCA Service Co. Inc., of Camden, New Jersey, U.S.A. In the October issue the basic circuit description of a commercial T.V. receiver will be dealt with. This step-by-step article will assist our readers to gain a clearer insight into the functioning of the various specialised video circuits.

We wish to complete our Head Office file of the "Proceedings of the Institute of Radio Engineers" (U.S.A.). Copies required are June to September, 1942, inclusive. If any reader can let us have one or more of these issues, we would be pleased to purchase them.

Information concerning new RCA releases published in Radiotronics is intended for information only, and present or future Australian availability is not implied.

Subscribers are reminded that all 1950 issues, as well as February to May, 1951, inclusive, are out of print.

CONTENTS

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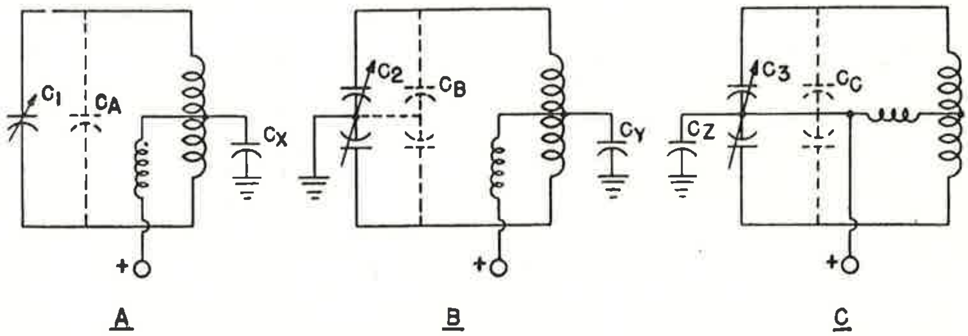
Proper Plate Tank Padding

There comes a time when practically every ham wants to take a high-frequency rig and make it work on a lower frequency. This involves wiring around frequency multiplier stages and winding new coils. It also involves worrying about the fact that the tuning condensers are of too low a capacitance to meet the requirements for a proper *Q*. The usual reaction to this problem is to parallel the old condensers with fixed capacitance of some sort, vacuum capacitors, discarded tuning condensers, or anything which will add the proper capacitance.

Unless proper procedures are followed in this padding stunt, it is very likely that a nice case of TVI will be developed, or perhaps a polite note from the authorities regarding harmonic emission. There is a right and a wrong way to add padding capacitance across a tuned circuit.

If the circuit considered is a single valve circuit with a single-ended plate tank, that is, one which has a single-section tuning condenser and a coil where the B plus voltage feeds in at the bottom, then no further worrying need be done. Padding capacitance may be added directly across the tuning condenser and the circuit will not be changed effectively by the added capacitance.

Fig. 1. Double-ended output tank circuits as discussed.



However, if the circuit is a single valve circuit with a double-ended plate tank, which is needed if the valve is neutralized, or if the circuit is a push-pull circuit, where again a double-ended plate tank is used, then we must watch out for gremlins. These gremlins take the shape of undesired harmonic signal output. Second harmonic, third harmonic and other harmonic signals will be present in the plate tank coil and thus be radiated if we allow these various harmonic currents to flow through the coil and induce their own voltages in the coil. To minimize the possibility of radiating these harmonics, it is necessary only to keep these harmonic currents from flowing through the final tank coil.

With reference to Fig. 1A, this circuit is one which is commonly used with either a single valve or a push-pull stage. C_1 is the tuning condenser and C_x the usual bypass condenser. When this circuit it tuned to resonance, it will have a very high impedance to current which comes from the valve and which is an r-f current at the fundamental frequency. However, current is also coming from the valve at radio frequencies which are harmonics of the fundamental frequency. These harmonic currents do not see the tank circuit as a resonant tank, but they merely see the tank circuit as a combination of inductance and capacitance, the inductance acting as a choke and the capacitance acting as a bypass condenser. These harmonic currents, like the fundamental current, are trying to find a path to ground. Naturally they will take the lowest impedance path. In Fig. 1A the only path for these harmonic currents is the path through the coil proper, through condenser C_x, and thence to ground.

If one valve is considered, then the path is through the top of the coil, whereas with a push-pull circuit, one valve sends its currents through the top of the coil and the other valve through the bottom of the coil. In any case, these harmonic currents are passing through the coil, and therefore they induce a harmonic voltage in the coil. Further, as higher and higher harmonics are considered the coil becomes a better and better choke, therefore the higher and higher a harmonic voltage will be induced. This means that the antenna link will pick up these voltages, send them on to the antenna, which will radiate these harmonics. Of course, many stunts are used in order to prevent the harmonic voltage from being coupled to the antenna, but we are interested here in preventing the harmonic voltage from existing.

How is this done? Refer to Fig. 1B. This is identical to Fig. 1A except that C_1 has been replaced with a split-stator condenser C_2. Now, when harmonic currents come from the valve, they are faced with the problem of whether to go through the coil (with its increasingly high impedance to higher and higher frequency harmonics), or whether to go through the split-stator condenser, C_2 (whose impedance is decreasing with frequency and which is becoming more and more effective as a bypass

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condenser as higher order harmonics are considered). Because of the difference in the impedance of these two paths, most of the harmonics current will take the path through C_2.

Before we start praising this circuit too greatly, however, let us examine it more closely. The two halves of the coil are coupled together and the centre-tap is rather firmly tied to ground through condenser C_y. If these two halves of the coil are overcoupled, as is usually the case, then the resonant curve for the entire coil may turn out to have a double hump. This is a nasty situation because it is then impossible to tune C_2 properly. If C_2 is set for the resonant frequency, then the impedance of the coil is not what it should be, and if C_2 is tuned so that the impedance is correct, then the circuit is not exactly at resonance.

This situation may be avoided by a few quick twists of a soldering iron, so that the circuit resembles that in Fig. 1C. Another equally correct circuit would be with C_z omitted and the centre of C_3 grounded, with the r-f choke disconnected from the centre of C_3, or any combination of the above. The important thing is to omit the bypass condenser which you occasionally find tied to the centre of the tank coil. The introduction of the r-f choke in the centre-tap lead of the coil in Fig. 1C and the omission of the bypass condenser at the centre-tap point practically guarantees that all of the harmonic will flow through C_3 to ground.

Now what about this padding that we started to discuss early in this article? In Fig. 1A, a padding condenser (C_A) would normally be added directly across C_1. Inasmuch as this circuit is already beyond hope, we are adding the last coffin nail by so doing. Ergo, don't add C_A as shown. If you insist on using that circuit, the least that can be done is to add two padding condensers in series across C_1. Then, if the junction of these two padding condensers is tied directly to ground, or bypassed to ground we have minimized harmonic radiation by providing a low impedance path to ground. Also, with these series padders in place, we can remove C_x and store it in the junk box. Now that that has been done, note that this circuit is now a brother of the circuit in Fig. 1C.

Fig. 1B is a circuit that it is best to stay away from, but if it were to be used, two padding condensers should be used, at C_B, one each across the two sections of the tuning condenser C_2. If at this point you can talk yourself into removing the bypass condenser, C_y, you will have made this circuit into another brother of the one in Fig. 1C. Referring to this latter circuit, padding capacitance should be added as indicated at C_c. If a single padding condenser were added directly across the whole tank coil then the harmonic currents could get to ground only through the original split-stator condenser C_3, which is now extremely small in capacitance compared to the rest of the circuit, and hence rather ineffectual. The current would divide, some going through this condenser, and the rest through the coil. This division of current would depend on the exact values of the capacitance and the inductance, but the point is that much current would be passing through the tank coil, and therefore producing harmonic voltages, which need not pass through if the padding capacitance were also made up in a split-stator arrangement.

Summing up all of the above, make sure that you have the proper circuit to start with. Then, when you add padding capacitance to this circuit to reach a lower frequency, make sure that you parallel both sections of the split-stator condenser with individual padding condensers. Your reward will be an improvement in valve efficiency and a silent muttered prayer from your neighbours.

T. V. Receiver *Installation* Techniques

Mechanical considerations

While to some extent, installation techniques may be kept standard, there is always the possibility that certain locations may present different installation problems. Also certain materials and accessories may be unobtainable. Thus, it may be necessary to improvise.

To enable the technician to make a suitable choice, a description of the many accessories that will provide adequate strength, electrical stability and neat appearance for television installation follows:

Masts and mast extension

The material providing a most dependable mast is a non-corrosive aluminium alloy commercially designated as 61ST. A standard-installation diameter of $1\frac{3}{8}''$ having a required tensile strength of 42,000 pounds per square inch. Other diameters are $1\frac{5}{8}''$ and $1\frac{7}{8}''$. Some masts, however, are made of steel tubing painted for protection.

To extend length of masts (generally taller than 12 ft.), $1\frac{3}{8}''$ tubing may be telescoped into $1\frac{5}{8}''$ tubing to a depth of 1 foot with the 1⅝″ section telescoped into 1⅞″ tubing at least 1 foot. The telescoping joint must be bolted at two points with the bolts at right angles to each other. The bolts should be ¼″ x 2⅜″ long and provided with nuts and lockwashers. They should be placed 6″ apart. See figure 55.

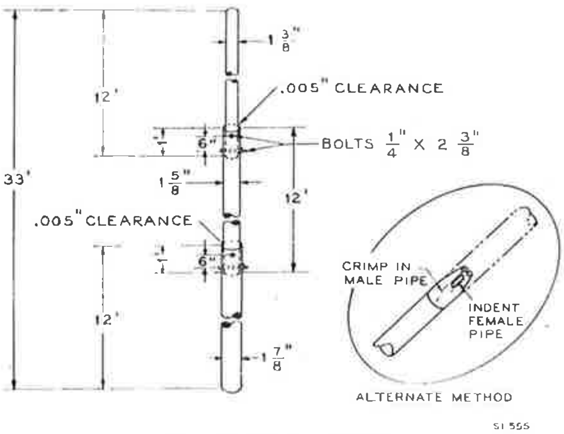


Fig. 55—Mast Extension

Some mast sections are made with one tapered end with crimped sides. These may be forced together using a wood block to prevent damage to tube ends. The crimped sides prevent turning within one another when the female end sides are depressed to form a lock. See figure 55 alternate method.

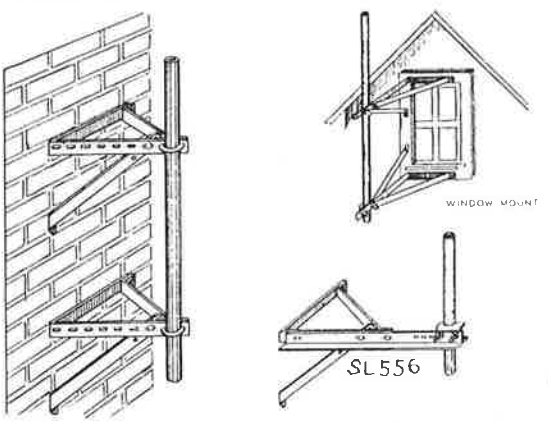


Fig. 56—Wall Bracket Mounting

Mast Brackets

The type bracket shown in figure 56 is a unit made up of separate parts which can be assembled in a number of different ways. Its flexibility makes it adaptable to many different types of installations. A 12″ clearance from a building wall is obtained. Perforated extension arms can be added to provide up to a 2 foot clearance. If mounting surface is stone or brick, lead anchors or expansion shields should be inserted after drilling holes with an appropriate-size star drill, then secure the bracket with lag bolts.

A peaked-roof bracket is shown in figure 57 with a mast-raising jig to facilitate the tough job

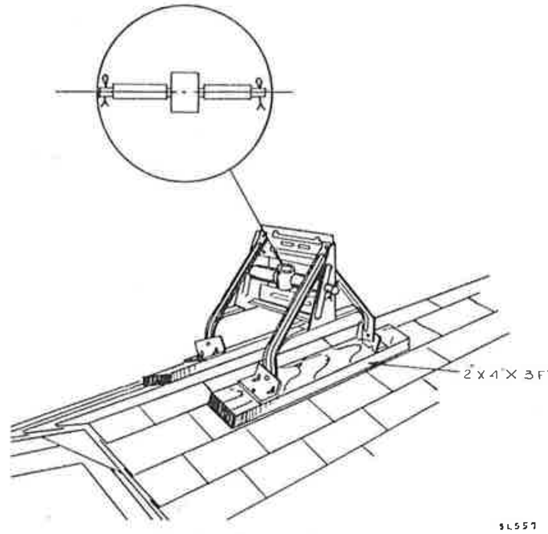


Fig. 57—Peaked-Roof Bracket

of raising a tall mast on a peaked roof. The bracket has an adjustable base structure to provide stable mounting either on the steepest roof encountered or on flat roofs.

The peaked-roof bracket should be mounted on two 3 foot lengths of 2″ x 4″ lumber fastened to the roof. The method of fastening supports, etc., to a roof is to employ long lag screws or bolts fastened to the roof rafters or supporting structure. Since this method of installation requires expert judgment and care, and requires sealing any puncture that might be made in the roofing materials, it should be resorted to only when there is no other satisfactory method.

Pipe Strap Mounting

The pipe strap mount can be used on any vertical surface where the mast does not have to clear an overhang greater than 2″. The number of straps and spacer blocks required depends on the mast height and the quality of the brick or other surface material used to anchor the lag screws. To insure a more permanent installation the spacer blocks should be weatherproofed with a good varnish. See installation sketch figure 58.

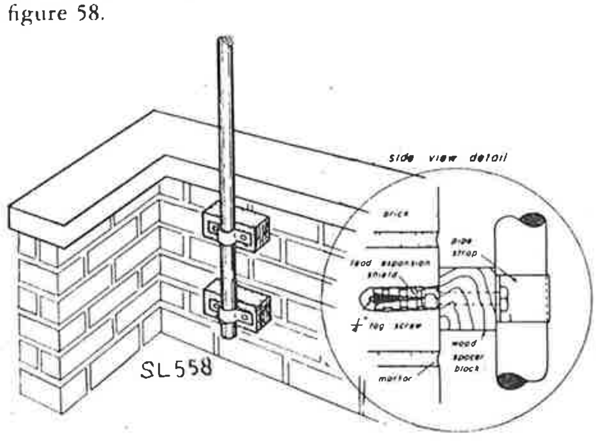


Fig. 58—Pipe Strap Mounting

Mast Bases

A base bracket bolted to a plywood or cypress wood base that has been weatherproofed with varnish may be used when making flat-roof installations. The base, usually 10″ x 10″ is serrated for water drainage and covers a wide enough area to be held in place by friction and the aid of guy wires. This eliminates the necessity of puncturing roofing material with lag screws.

If the roof has a slight slope that would tend to tilt the mast, a leveling shim of red cedar or fir, coated with weatherproof varnish, can be placed under one side of the mast bracket base. A mounting of this type is shown in figure 59.

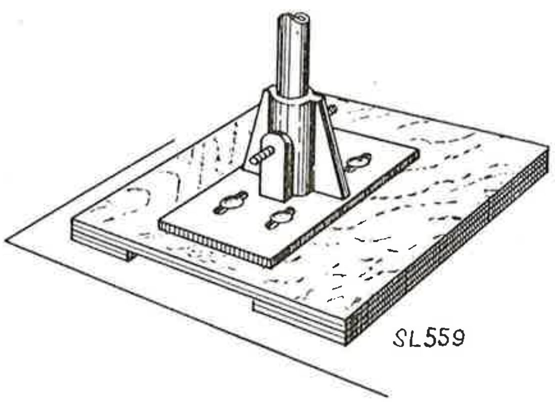


Fig. 59—Wood Base Mount

Chimney Strap Mount

The chimney strap mount shown in figure 60 is commonly used in RCA Service Company installations. This type mount is a time saver since no holes have to be drilled. Corner pieces add additional security. Strap mounts provided with either one or two straps are available on the market. The mast bracket is usually preassembled to the chimney strap.

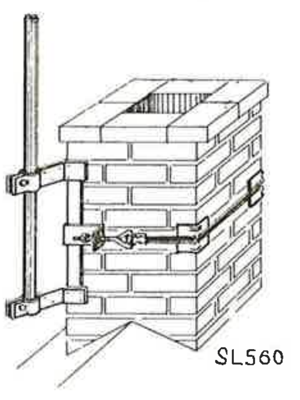


Fig. 60—One Strap Chimney Mount

Guying Methods

Antenna masts should be guyed if the locality is subject to violent weather, or if the mast is extremely tall.

If a mast is to be guyed, it should be done properly from a standpoint of materials and workmanship.

A typical guy wire is galvanized 42-strand wire made up of 7 units of 6 strands each on a rope core. Tensile strength is 600 lbs.

At the mast the guy wire is secured by a guy ring which slides over the top of the mast and rests on the larger diameter of a telescoped joint or a clamp around the mast. The guy ring must turn freely on the mast. Usually six holes are drilled in the guy ring to provide security for an adequate number of guy wires.

A study of figure 61 will reveal that thimbles are used at the guy ring and turnbuckle. These prevent fraying and breaking of wires. Cable clamps hold the wires together and prevent slippage with subsequent slackening of the wire.

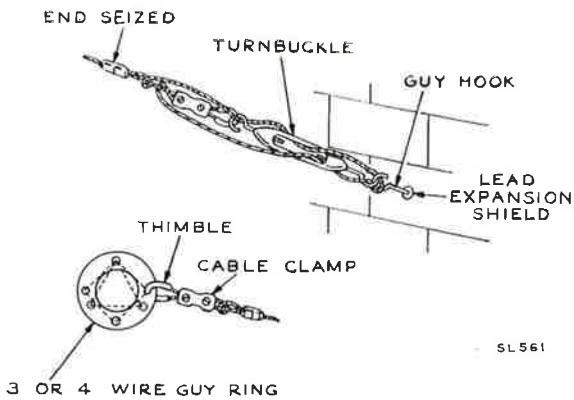


Fig. 61—Mast Guying Accessories

The guy hook used for securing the lower end of the turnbuckle may be screwed into a wooden structure. See figure 62 for methods. If the structure is

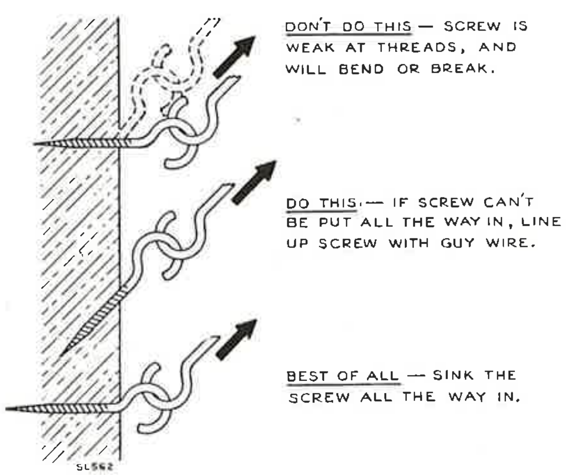


Fig. 62—Guy Hook Insertion

stone or brick, lead anchors or expansion shields should be inserted after drilling with a star drill.

Turnbuckles are used to adjust tension or slack in the guy wires. A pyramid or tripod arrangement properly spaced, usually provides even tension for guying the mast. (See figure 63.)

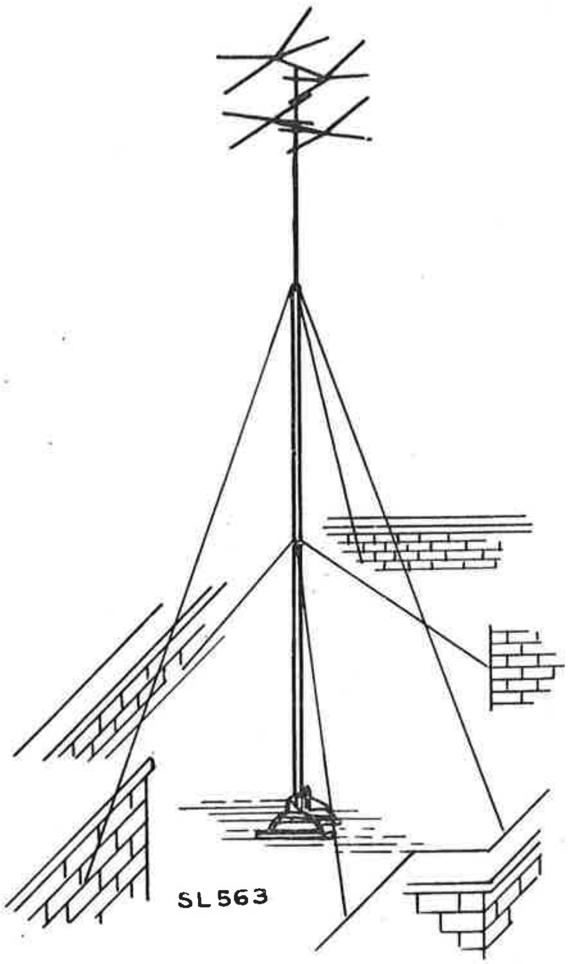


Fig. 63—Guying Mast

Antenna Terminal Connections

The frequencies involved in television makes a good connection to the antenna imperative. Lugs used by RCA Service Company provide a good electrical connection without the need of soldering. Only lugs designed for this purpose should be used for a solderless connection—otherwise soldering is recommended.

Stand-Off Insulators

There are many types of stand-off insulators. The transmission line, in order to be electrically stable and free from abrasion, should be properly secured along its entire run from the antenna terminals to the receiver terminals. The transmission line should not be allowed to flex at the antenna terminals. Mast-mounted stand-offs with clamps, are provided for security of the transmission line along the antenna cross-members and mast. To clear rain gutters, metal roofs and other objects, long screw-eye type stand-offs may be employed. For running the transmission line down or along a wall, many types of stand-offs may be used. Screw-eye type—porcelain—plastic, etc. If the walls are stone or brick, holes should be made with a star drill and lead anchors or expansion shields inserted. Various types of stand-offs are shown in figure 64.

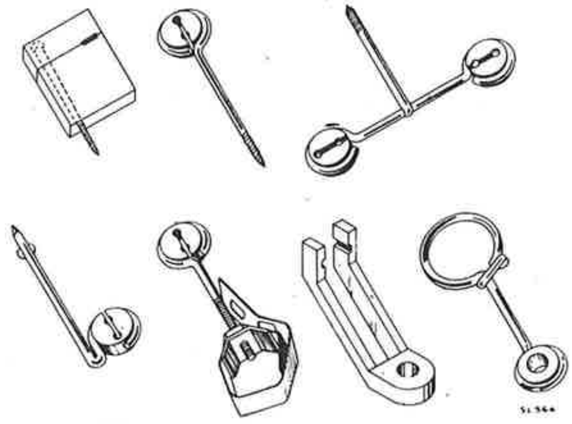


Fig. 64—Stand-Off Insulator Types

Feed-Through Insulators

If the transmission line is to be run across a basement, a hole should be drilled in the wall or window frame at a slight upward angle to prevent water from running in. Flexible plastic loom as shown in figure 67 may be used as a protective feed-through. Porcelain conduits with appropriate holes for flat ribbon line are also available for this purpose.

Basement Runs

The transmission line when run across a basement may be secured to walls, joists, ceilings, etc., by fibre head tacks, plastic or porcelain stand-offs or hook-eye type stand-offs.

Pre-Installation Preparations

Before actually going on an installation job, there are many important considerations—and the necessity of pre-installation preparation. These are "musts" if the job is to be carried out efficiently and profit is to be realized.

Probably the first consideration is, where is the installation going to be made? Then, what type or model receiver? Has the receiver been delivered? What channels will serve the area? Is the area normally one of adequate signal strength? What type structure is the building—peak roof—flat roof—chimney—stone walls—brick—wood siding—is there a basement? What are the local ordinance requirements? Are lightning arresters or grounded masts required according to local ordinances?

After these considerations, do you have the proper equipment and tools with which to do the job?

Before driving to the installation site it pays to check tires and gasoline supply. It is also convenient and profitable to know the shortest route and how to get there.

It pays to drive safely and show courtesy of the road—this becomes a business asset.

Where parking is available on the customer's premises, ask permission to park as reasonably close to the scene of operations as possible.

If the customer rents, and the landlord's permission to make the installation has not been obtained, a form freeing you or your company from responsibility should be presented and signed by the customer *before* the installation is made.

Carry necessary tools and materials to be used to the house so as to avoid unnecessary trips.

Antenna Selection

The description of the area in which the installation is to be made should be of some help in selecting an antenna. Referring in this lecture to the subjects of "Television Antenna Principles" and "Antenna Types and Arrays", the technician will find information enabling him to make a suitable choice.

Antenna Location

The location of the antenna and selection of hardware and accessories should be determined by such factors as the building's structural facilities, stipulations specified by the owner of the building and local ordinances. From receiver operational standpoint—placing the antenna away from the street-side may counteract ignition noise pickup. Some particular spot on the building may provide more elevation. The transmission line run to the location of the receiver may influence antenna location. The necessity of installing a lightning arrester may influence the transmission line run.

Receiver Placement

The customer most likely has a preference for receiver location as indicated in figure 65. Unless operation of the receiver would be seriously hampered by the customer's choice of location, that's where it should be installed.

Some of the cases where the customer's choice of receiver placement should be diplomatically revised are listed below:

1. If the receiver location is close to a radiator or hot air register.
2. If there is a thermostat control directly above the receiver. (There have been cases where the rising heat from the television receiver has given the control a signal to shut off the heating system prematurely.)

Fig. 65—Deciding Receiver Placement

3. Where the receiver has been placed in an alcove that does not provide sufficient receiver ventilation.
4. Where a receiver has been placed too close to a wall, curtain, or draperies.
5. Where doors, or moving objects may come in contact with the cabinet, etc.
6. Where too much window light or other light source would destroy picture quality.
7. Where seating arrangement does not provide proper viewing.

Suggested Viewing Conditions

In placing the receiver, consideration should be given to viewing distance and room lighting.

The larger kinescopes have adequate brilliance to be viewed under normal room lighting. However, a lamp may be in such a position as to cause a glare on the kinescope. Kinescope viewing is more pleasant when some room light is present provided it doesn't fall directly on the face of the kinescope. A completely darkened room may cause glare and eye fatigue. A receiver placed where direct window light will fall upon the kinescope will not provide adequate contrast and brilliance. Thus, direct window lighting should be avoided and a place chosen where subdued lighting may be obtained.

The furniture may have to be arranged for proper-view seating or the receiver placed with this thought in mind.

The larger the kinescope, the more pronounced will be the scanning lines for a given distance. Thus, for a properly blended picture, points beyond where the scanning lines are not noticeable are best for viewing. Where rooms are small, a judicious choice of kinescope size should be made.

A Typical Installation

Beginning the actual installation—turn the receiver on. This will determine the receiver's apparent working condition. If preliminary operation is satisfactory, the receiver should remain turned on (with a reminder to the customer of the necessity) during the installation. This may reveal any possible defects and will make adjustments more accurate at the final steps of the installation due to the receiver having reached normal operating temperature.

If there is a basement, this should be checked for transmission line run. Also check for transmission line run outside the house.

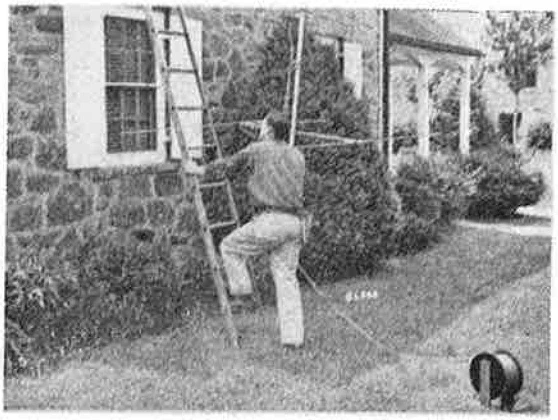
A ladder should be raised—but not handled directly in front of a window if such can be avoided. *Beware of overhead power lines!* Use care if resting the top of the ladder against a rain trough or other less rigid support and insure your own safety by anchoring the lower part of the ladder by digging ends into the ground or wedging if on a hard surface. A tie-line so the ladder won't blow down is an additional precaution. When necessity of scaling a peaked roof arises, a scaling ladder with hooked ends should be used.

While various methods of mounting the antenna have been shown, a typical method using a chimney strap with mast bracket prefastened to the strap, will be considered. This type is shown in figure 60.

First, the distance around the chimney should be measured to determine how much strap is needed. After the strap has been placed around the chimney, the corner pieces and strap should be neatly leveled and tightened into place.

The antenna is assembled on the ground. If the location requires a high-band antenna in addition to one for a low-band, the high-band antenna as a combination array should be mounted approximately 36″ from the low-band antenna, and orientation of the two sections judged approximately. Preassembly of high frequency antenna elements and interconnecting harness makes the job easier and faster.

Fig. 66—Use of Reel for Transmission Line



A transmission line reel mounted on a portable holder will allow the antenna to be carried to the roof top as the needed length of transmission line is reeled out. This technique is illustrated in figure 66.

The antenna is then set into the mast bracket and turned to the direction believed to provide best reception. Sufficient slack is left in the transmission line in case of re-orientation.

The transmission line run should be as direct as possible to the point of entry into the house and secured by suitable stand-offs. Ordinarily, transmission lines should not be run down the front of a house because of possible street noise interference pickup and poor appearance.

Twisting flat transmission line with about one twist per foot is recommended to reduce interference pickup from man-made noise such as automobile ignition radiation, etc.

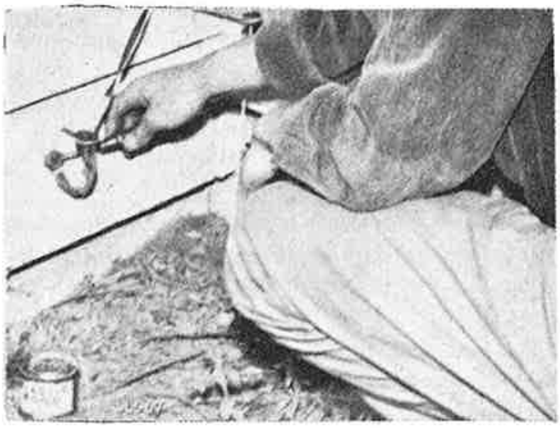


Fig. 67—Transmission Line Entrance

A hole is drilled through the wall or point where the transmission line is to enter. Then the transmission line is inserted through a suitable protective sleeve such as plastic loom or a porcelain feed-through inserted in the drilled hole, leaving a loop on the outer side so that water running down the line will not enter the hole. (See figure 67.) If the transmission line is to run across a basement ceiling, tack the line along joists, etc., using fiber head tacks, or as an alternate method, stand-off insulators may be used. Avoid paralleling transmission line close to water pipes or metal structures (this may tend to change the characteristic impedance of the line). Install the lightning arrester on a *water* pipe, making sure the pipe surface has been cleaned of corrosion or paint. Pass the transmission line across the recess provided in the arrester and clamp contacts securely to the line. See figure 68.

A fish wire dropped through a hole drilled in the floor near the receiver serves to pull the transmission line up to the receiver location. The line can then be connected to the receiver.

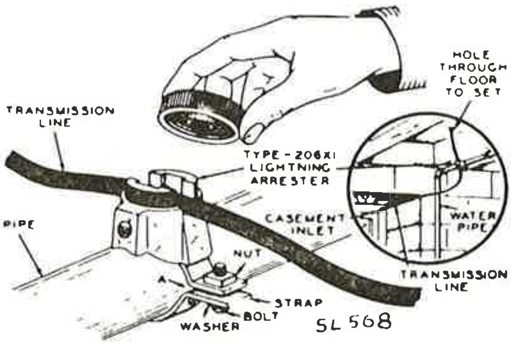


Fig. 68—RCA Interior Lightning Arrester Installation

Antenna Orientation

Basically, orientation means positioning the antenna so that it will intercept the desired signals at their greatest magnitude and discriminate against unwanted signals. The exception to wanting greatest signal strength is when the received signal is so great that it causes overloading in the receiver. Then, positioning the antenna for deliberate signal reduction may be in order.

To effect proper orientation it will be well to keep in mind certain information given earlier in this lecture. Of particular importance are the subjects "Antenna Directivity Patterns" and "Parasitic Elements."

The antenna's ability to intercept desired signals and exclude unwanted signals, depends greatly on the antenna's lobe arrangement at the particular frequencies involved.

The antenna should usually be positioned so that the radiated wave of the channel desired meets a major lobe "head-on". In some cases, however, it is desirable to sacrifice the full benefit of a major lobe in order to prevent a minor lobe from providing access to some unwanted signal, or to place the unwanted signal in line with an antenna null.

Under "VHF Peculiarities" it was pointed out that signals of VHF nature were bounced off tall objects, causing a deviation in their path so that they arrived at the receiving antenna at a time interval differing from the direct wave. See figure 69. The effect this

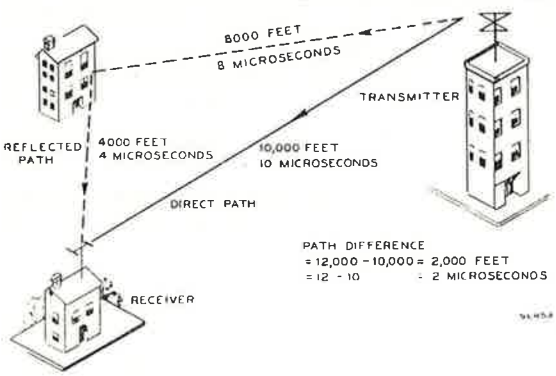


Fig. 69—Direct and Reflected Signal Time Relations

condition has on the kinescope screen is shown in the test pattern of figure 70.

Radio wave propagation velocity is 186,000 miles per second or 984 feet per microsecond. A round number of 1000 feet per microsecond is sufficiently accurate for convenient calculation.

Figure 69 shows a signal whose direct path from the transmitter to the receiving antenna is 10,000 feet, representing 10 microseconds in time. The signal can also travel toward the building shown along the path of the dashed line where it may be reflected much like a mirror reflects a beam of light. The receiving antenna's orientation is such that signal from both routes reaches the antenna. The reflected signal will travel a

Fig 70—Reflections (Ghosts)

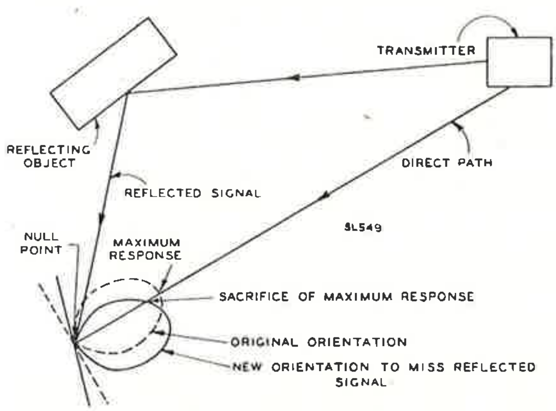


Fig. 71—Antenna Orientation

distance of 8000 + 4000 feet, or 12,000 feet, representing 12 microseconds in time. Thus, the reflected signal arrives at the receiving antenna 2 microseconds later than the direct signal. The reflected signal therefore will be displaced 2 microseconds apart from the direct-path signal on the kinescope screen.

To avoid the effects of a reflected signal, orienting the antenna to give minimum pickup from the reflecting source may be resorted to as shown in figure 71

Increasing or decreasing antenna height, re-locating the antenna or using a more directional array, may prove helpful.

There are cases where the only possible chance of receiving any signal whatsoever is to utilize a reflected signal. The necessity arises from the fact that the direct signal may be blocked by a mountain ridge or may be deflected after striking some large object in its path. See example, illustrated in figure 72.

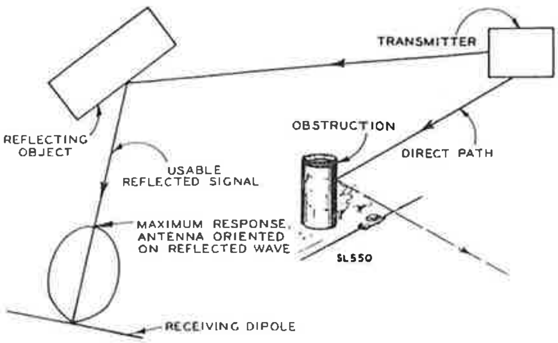


Fig. 72—Antenna Orientation Using Reflected Signal

Trees and thickly wooded sections create reflection problems that may be solved by taking advantage of a reflected signal approaching through a clearing, or more practical, by increasing the antenna height.

It was mentioned under the topic, "Polarization", that television transmission in this country is horizontally polarized, and, that receiving antennas, in order to receive the greatest amount of signal energy, are likewise horizontally polarized. In general, television receiving antennas should be mounted so that their elements are in a horizontal plane or parallel to the earth's surface. However, it may be noticed by experimentation that tilting the antenna or antenna elements to some angular plane will show improvement from a standpoint of increased signal pickup or may be a corrective measure in eliminating ghosts caused by reflections. The reason for this unusual corrective method of orientation is that the transmitted signal may have undergone a change in polarization in its path to the receiving antenna.

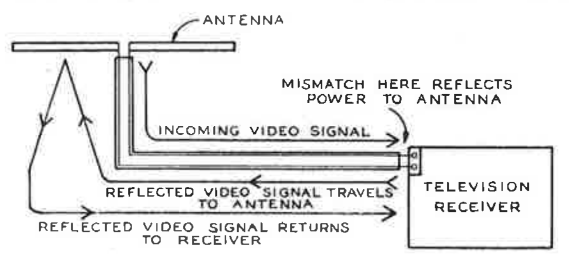
When more than one channel is involved, fixed orientation with a single antenna becomes a compromise.

A possible solution for obtaining the most signal on each channel is to incorporate an antenna rotator with which the antenna can be "pin-pointed" on the desired channel. Operation is by means of a control box and indicator located at the receiver.

Transmission Line Ghosts (Reflections)

The subject of "ghosts" (reflections) caused by physical objects in the path of the transmitted signal, was explained in Lecture Five and also mentioned in this lecture under "Orientation". There is another type of ghost which is often encountered, especially where transmission line runs are long and certain other conditions prevail. Suppose that neither the antenna nor the television receiver are matched to the transmission line on one particular channel. If it were desired to receive this channel, the possibility exists that a ghost would appear slightly to the right of the main image, and that antenna orientation would have little effect upon elimination of the ghost. This type of ghost displaced to the right is called a trailing ghost since its signal arrival follows the signal composing the main image.

In dealing with transmission lines, matching the television receiver to the line is most important. If this is neglected, reflected energy is returned from the receiver to the transmission line, in which case, the reflected energy travels back toward the antenna. If the antenna matches the transmission line, this reflected energy is absorbed at the antenna. However, the antenna seldom matches the transmission line except on one or two channels. Thus, when a mismatch is present at the antenna, the reflected energy from the receiver is again reflected into the line and again travels toward the receiver. This reflected energy then arrives at the television receiver terminals later than the main image because of the time required for the reflected power to make a complete trip. It is obvious that the longer the transmission line, the greater the time required for this reflected energy to travel back and forth. With longer transmission line runs, therefore, the ghost will be further displaced to the right of the main image. The time relations involved are shown in figure 73. In the equation shown in figure 73, the propagation factor must be considered. Effectively this means that the electrical length of the transmission line is greater than the physical length. The amount of displacement on the kinescope screen will vary with the width of the raster or kinescope size. If the transmission line is less than 50 feet long, any mismatch present will not result in a noticeable ghost. However, a loss of detail on the kinescope is evident. Where a sharp raster line structure exists but the



$$\text{REFLECTION TIME DELAY} = \frac{2\ell}{k} \times \frac{1}{984} \text{ MICROSECONDS}$$

ℓ = TRANSMISSION LINE LENGTH IN FEET

k = TRANSMISSION LINE PROPAGATION FACTOR

984 = SPEED OF RADIO WAVES IN FEET PER MICROSECOND

SL551

Fig. 73—Transmission Line Reflections (Ghosts)

fine detail of the picture seems lost, transmission line ghosts may be present.

Elimination of Transmission Line Ghosts

In general, corrections are applied at the receiver input terminals, since the reflected energy originates at the receiver. Three field methods of correction are possible. It should first be determined whether the R-F tuner is in proper alignment and whether the best possible balance for the transmission line has been achieved. After these considerations, if transmission line reflections are still present, matching transformers, stubs, or pads may be used.

Where the transmission line impedance differs widely from the receiver input impedance, as for example, a 300 ohm balanced line used with a receiver having a 72 ohm unbalanced input, the use of a matching transformer of the trifilar type is highly recommended. Very little attenuation is presented by the use of the transformer.

Stubs can be used, but have the disadvantage that they may affect other channels that are also being received, and a switching arrangement may be necessary. Generally, cut-and-try methods are used, and some experimentation is involved for the best results. The length of the stub depends on the length of line from the antenna terminals to the tuner and also upon the receiver input impedance.

The two methods above may be the only practical ones in weak signal areas. However, where strong signals are present, resistive pads can be used. Although a certain amount of attenuation is introduced, pads have the advantage of easy fabrication and low cost. They are also easily connected to the receiver. Detailed data on the construction of matching pads will be found in the Appendix of this lecture.

Direct Pickup Ghosts

Another type of ghost which may be encountered is known as a direct pickup ghost. This occurs because the transmission line is acting as an antenna and signals from the line arrive at the television receiver before the main signal from the antenna. This type of ghost appears at the left of the main image as a leading ghost.

A condition of this type can exist in strong signal areas and where long transmission lines are used. It can also occur when shielded transmission line is used. You would normally consider that the grounded shield of the line would eliminate this condition. However, the "pickup" can occur on the unshielded portion of transmission line between the receiver antenna connection terminals and the receiver input transformer or tuner.

Elimination of Direct Pickup Ghosts

Direct pickup can be checked by disconnecting the transmission line from the antenna, leaving the line connected to the receiver. If the ghost is eliminated, or reduced, it would indicate that the antenna is producing one signal while the line is producing the other.

The transmission line should be checked for any discontinuity since a break in one conductor of the line would also cause adverse conditions. A broken connection, or a line running close to metal surfaces, may prove troublesome. If so, these troubles should be corrected. If no improvements can be made by making simple changes in transmission line run, the use of shielded line may be necessary. The shield should be well grounded. In strong signal areas, if direct pickup exists when the transmission line is disconnected from the receiver, additional shielding of the chassis may be necessary. The use of shielded cable is generally sufficient to correct this condition, except in unusual situations.

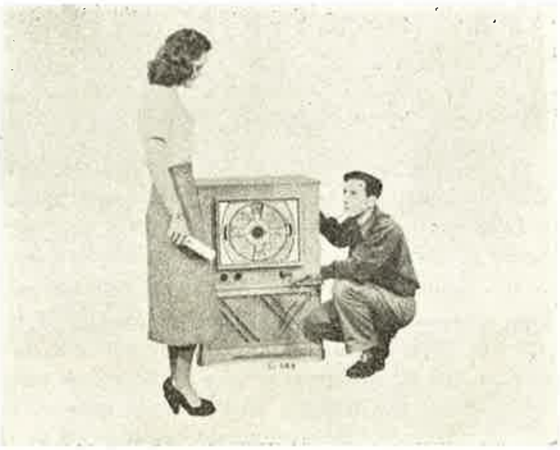


Fig. 74—Customer Instruction

Customer Instruction

Customer instruction immediately following the installation is of great importance and cannot be overemphasized. When the installation has been completed, customer instruction will serve to assure the customer's confidence in the receiver and dispell any inclination toward belief that the instrument is faulty. This also reduces call back service that ends with instruction where nothing was actually wrong with the receiver. The customer's "know-how" of tuning the receiver correctly will bring real satisfaction. The following helps are suggested:

1. Explain the function of each control and go through the routine of turning on and tuning the receiver several times.
2. Have the customer repeat the procedure often enough to become acquainted with the process of getting clear, bright pictures.
3. Polish cabinet and protecting glass.
4. If possible, leave an instruction book.

APPENDIX

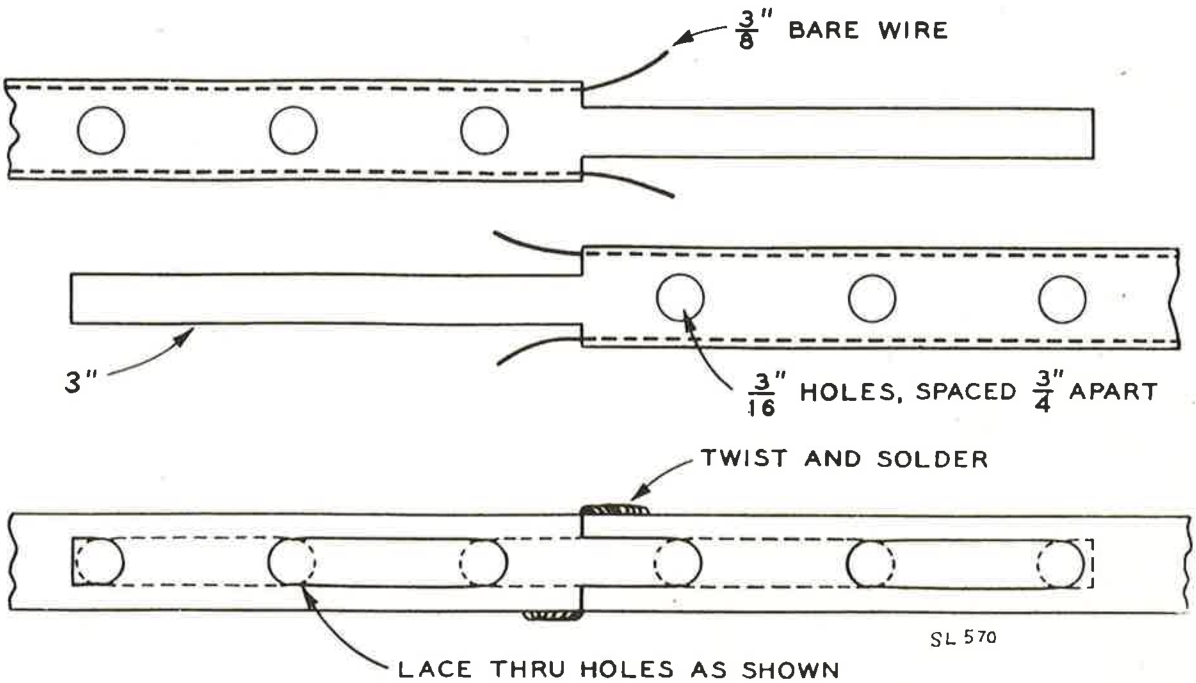


Fig. 1—Method of Splicing 300 Ohm Line

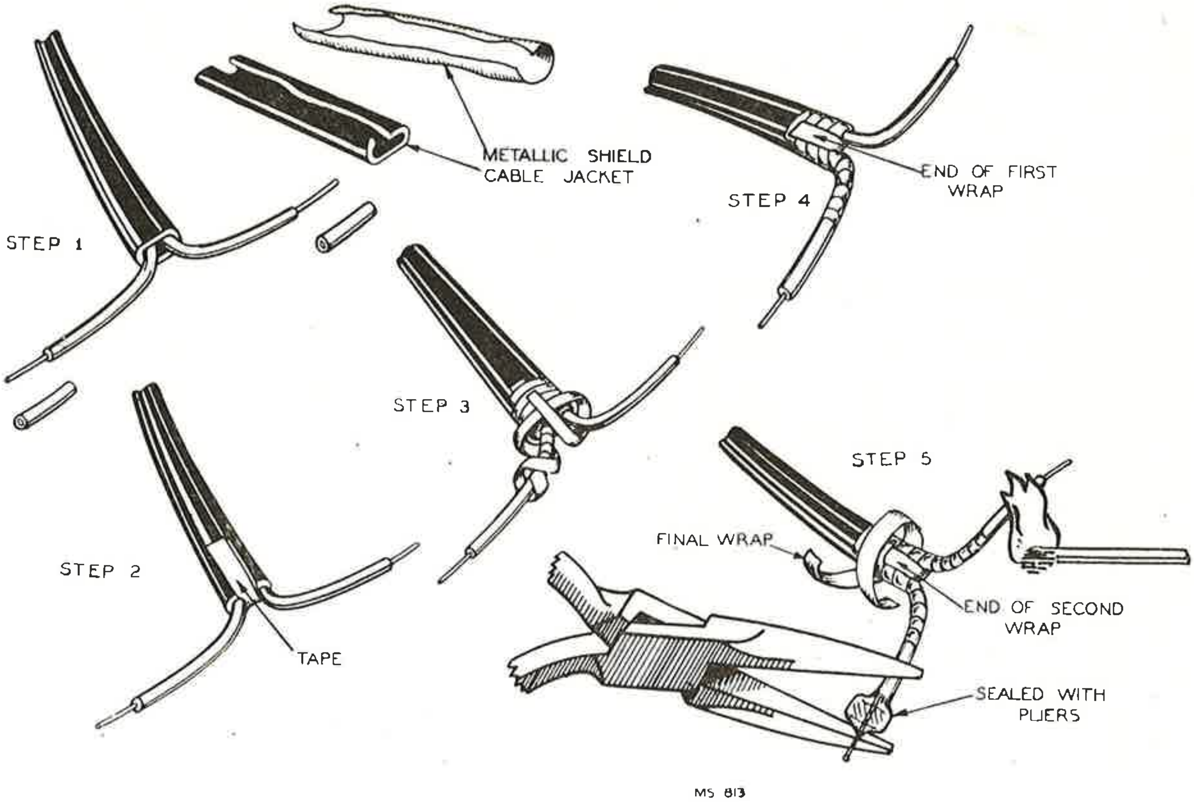


Fig. 2—Method of Sealing Balanced Shielded Line

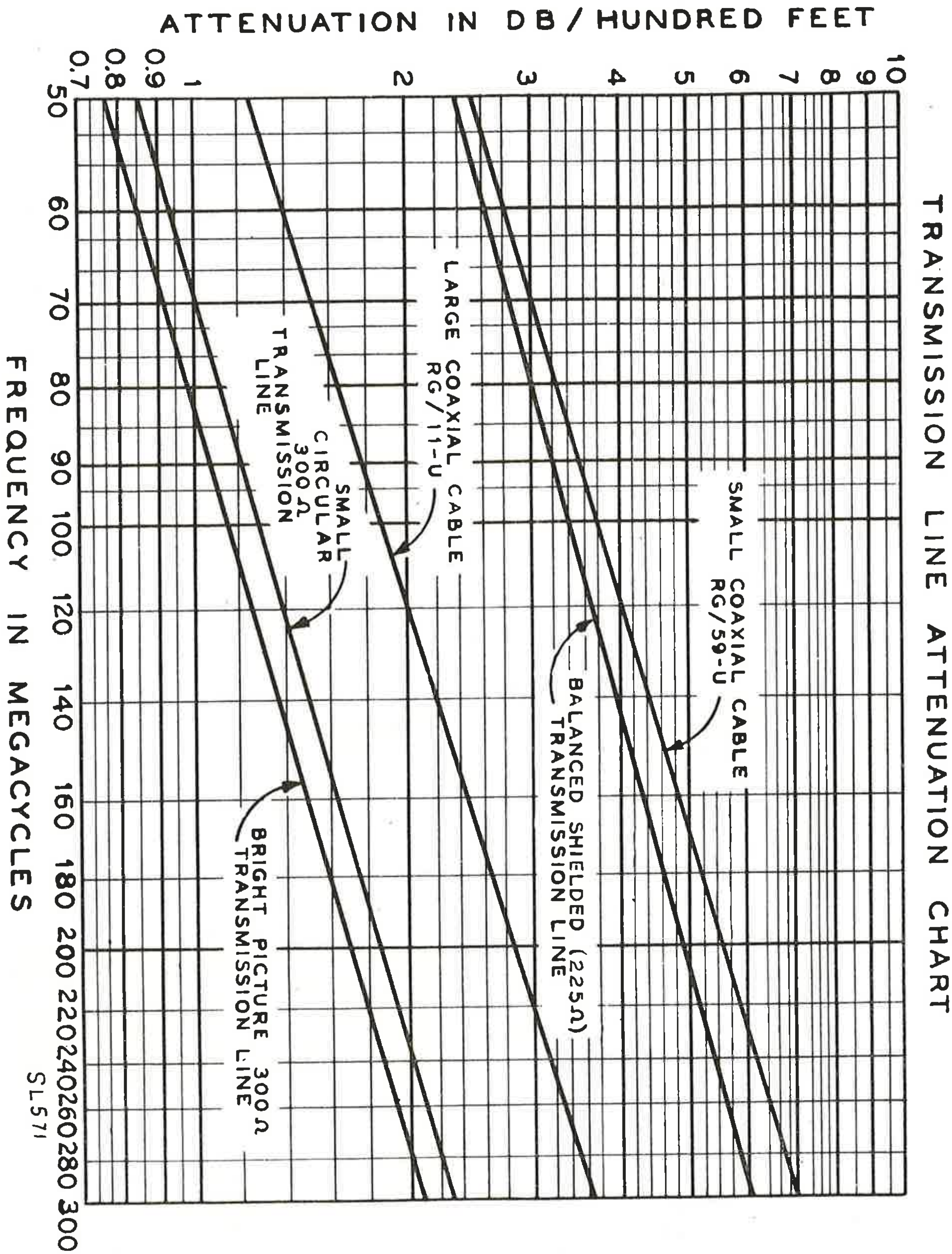


Fig. 3—Transmission Line Attenuation Chart

MATCHING AND ATTENUATING PADS

Pads are simply resistive networks which are used for either attenuating a signal which is too strong and overloads the receiver, or for matching impedances to prevent undesirable reflections arising from mismatched transmission lines. There is a minimum amount of attenuation associated with matching pads which becomes greater as the ratio of the two impedances increase. This value of attenuation is generally between 10 db and 35 db. In cases where the available signal voltage is low, the use of a trifilar matching transformer may be preferred.

Matching Pads

A table of balanced and unbalanced matching pads is shown in figure 4. These pads are useful for eliminating ghosts due to transmission line reflections. This often occurs when the receiver is used with transmission line impedances other than its design value. RCA Victor receivers can be used with either 72 ohm unbalanced coaxial line or 200-300 ohm balanced line by making appropriate wiring changes in the antenna plug at the elevator transformer. Models previous to the 8T241 have 300 ohm balanced inputs only.

Attenuating Pads

Attenuating pads are often used in metropolitan areas where signal strengths are excessive and a limited contrast range results. The use of AGC circuits in receivers has greatly alleviated this condition however. Attenuating pads are also useful where it is desired to provide additional isolation between nearby receivers, or receivers which are used with a common antenna. The values shown in figures 5 and 6 are sufficient for most common applications. Installation of a typical attenuator pad is shown in figure 7.

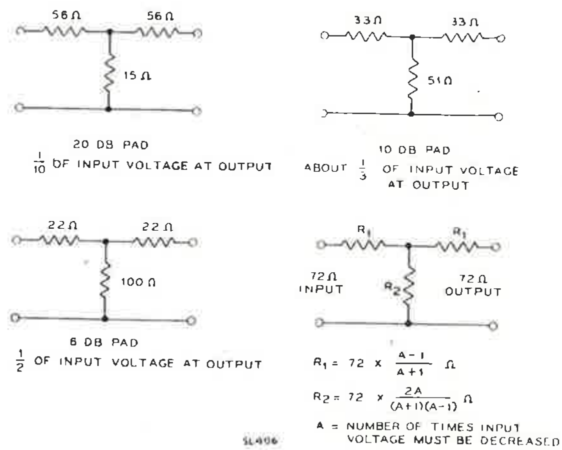


Fig. 5—72 Ohm Pads, Unbalanced

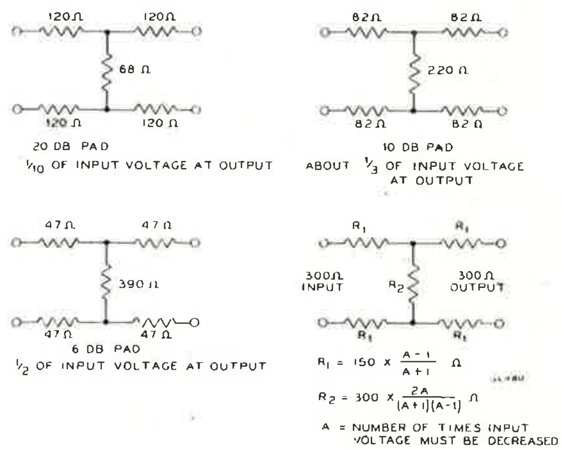
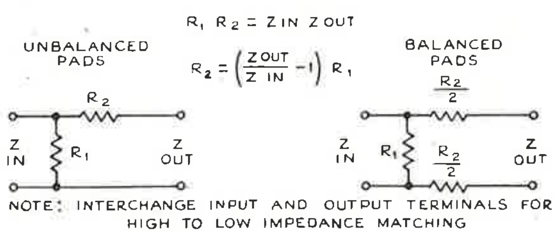


Fig. 6—300 Ohm Pads, Balanced



Z_{IN} Ω	Z_{OUT} Ω	R_1 Ω	R_2 Ω
50	300	56	270
75	300	82	240
150	300	220	220

Z_{IN} Ω	Z_{OUT} Ω	R_1 Ω	$\frac{R_2}{2}$ Ω
50	300	56	150
75	300	82	120
150	300	220	100

R_1 AND R_2 ARE PRACTICAL VALUES SL497

Fig. 4—Matching Pads

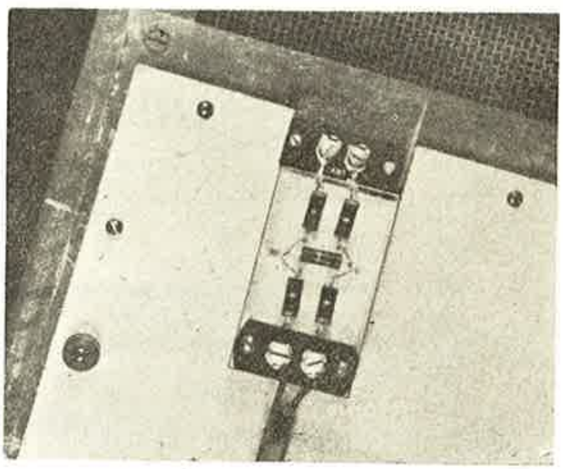


Fig. 7—Attenuator Pad

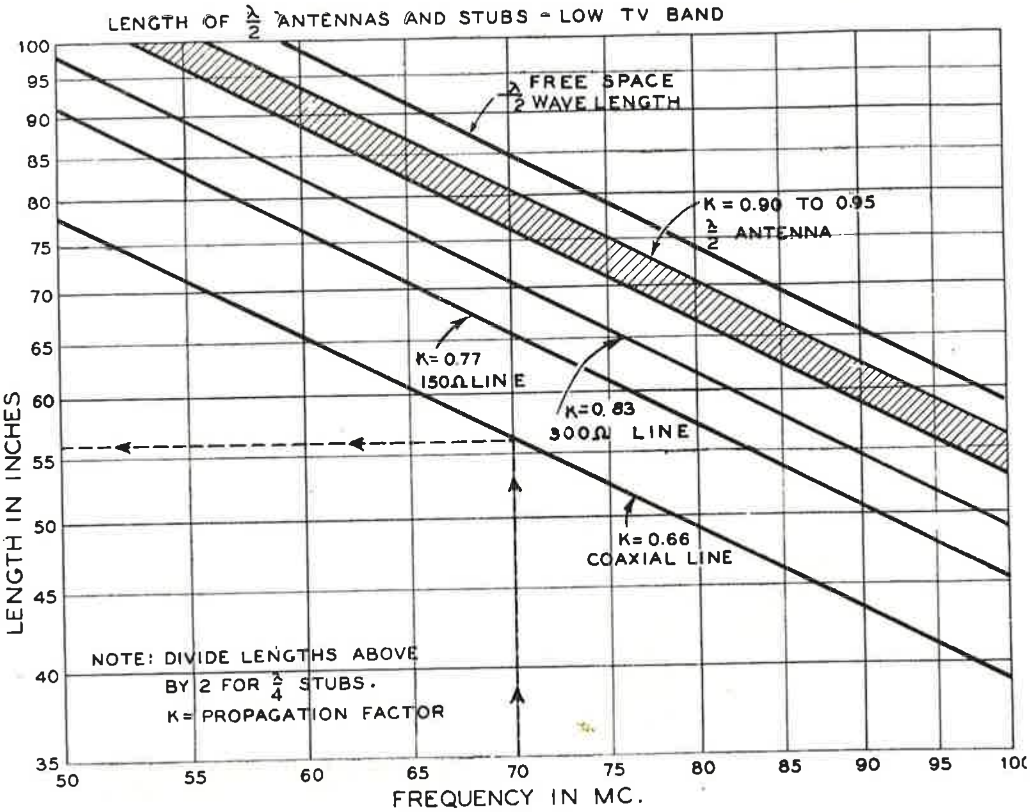


Fig. 8—Length of Half Wave Antennas and Stubs for Low TV Band

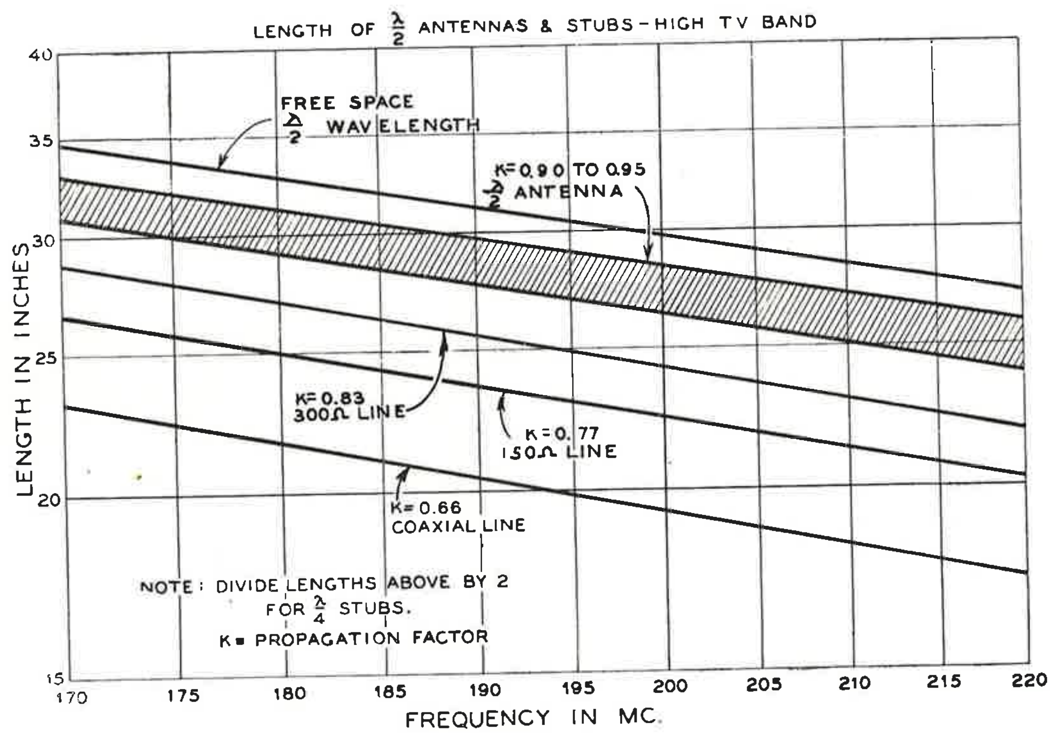


Fig 9—Length of Half Wave Antennas and Stubs for High TV Band

INSTRUCTIONS FOR MAKING INDOOR FOLDED DIPOLE ANTENNAS

Some of the folded dipole installations that are possible are shown in figure 35. These installations are often capable of giving satisfactory performance in strong signal areas. For best results, the dipole should be resonant on the weakest low channel station to be received, and a location should be chosen so that it is broadside to the direction of the station. The folded dipole can be made from RCA Bright Picture wire (300 ohm transmission line). Generally, a strip of Bright Picture wire one half wavelength long, as determined from the appendix tables, (Figures 8 and 9), is cut from the spool and shorted at each end. One conductor is cut at the center of the strip and bared so that the transmission line can be spliced into these two new leads. The transmission line can then be run to the television receiver, concealing it in the most practical manner for a particular installation. In some cases a particular length of transmission line will give improved results.

Where the maximum performance is desired from an indoor folded dipole made of 300 ohm line, the propagation constant of the line must be considered. This is usually accomplished by connecting a capacitor in series with the conductor opposite the feed line. The value of the capacitor is approximately 70 mmf per meter at the resonant frequency. Thus, if an antenna is to be resonant at 77 mc., or roughly 4 meters, a value of 4 x 70 mmf, or 280 mmf, is indicated. For practical use, a 270 mmf capacitor should be satisfactory.

Another method that can be used for compensation is shorting the folded dipole about 85% of the distance from the center. The ends can remain shorted as before. The construction is shown in "Appendix" figure 10.

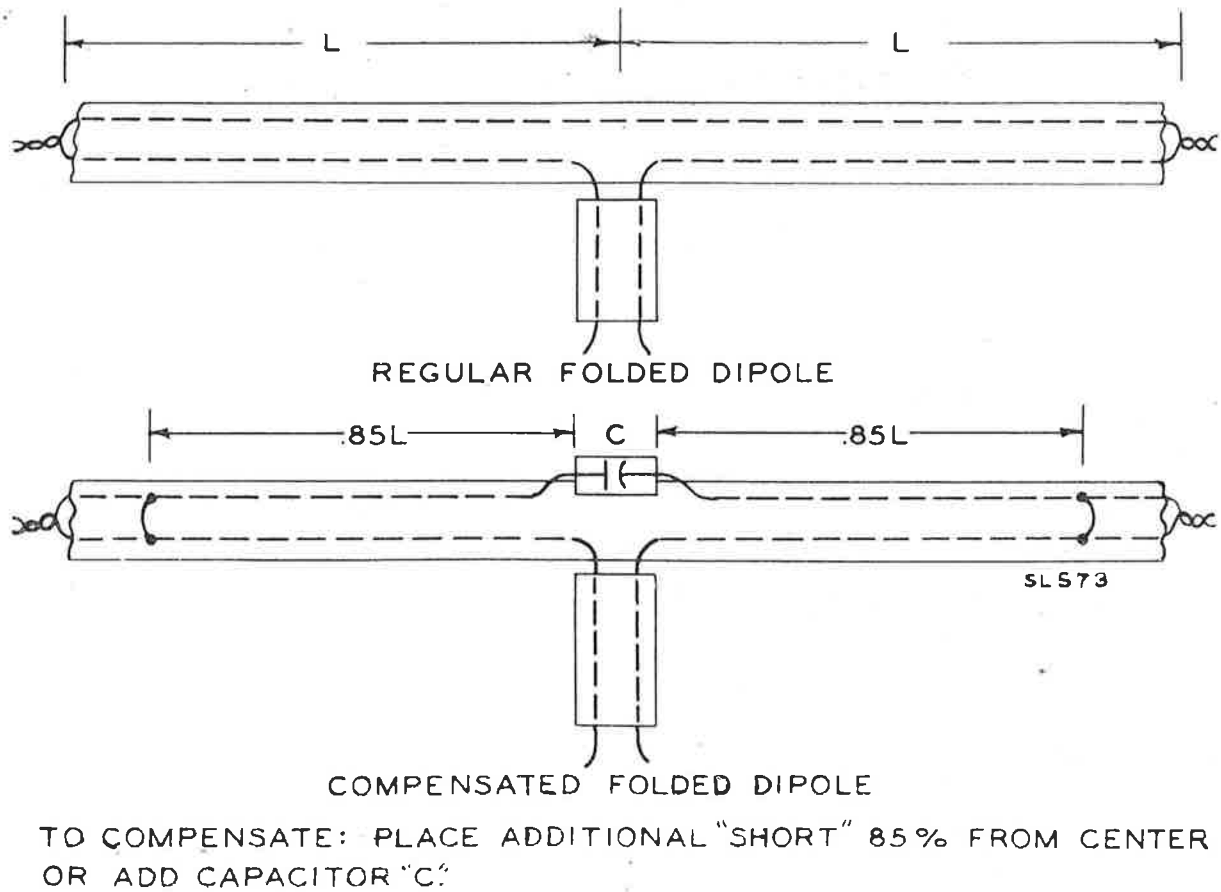


Fig. 10—Making Folded Dipole From 300 Ohm Line

SUMMARY OF DESIRABLE INSTALLATION PRACTICES

1. All masts should preferably be grounded, with a #6 to #14 aluminum or copper conductor, run in as straight a line as possible from the mast to the earth, cold water pipe, or steel structure of the building. The ground wire should be locked under one of the nuts of the supporting bracket or pipe strap used in securing the mast.

2. The lightning arrester should be UL approved, and placed indoors or outdoors as near the point of entry as possible. It should be grounded on cold water pipe, separately driven rod in the earth, or steel structure of the building. Where weather may have adverse effects on the operation of the arresters, mounting indoors is preferred. Arresters should not be installed near gas meters or inflammable material. Both conductors of a balanced line should be protected.

3. All antennas should be located on rear or remote side of the building away from the street whenever possible. They should not be attached to, or in, any soil pipe, vent pipe or other plumbing appurtenance. Where it is necessary to install the antenna directly above the street, or where failure might result in damage to person or property, a safety wire should be attached to the cross arm at the mast, to keep it from falling until repairs can be made.

4. The transmission line and ground wire from the mast should be installed so there is at least 6″ clearance between existing 'phone, power, or other signal wires, where reasonable rigidity is assured. Outdoors where cross over is necessary, with maximum slack and swing, this distance should not be less than 10″.

5. On flat roofs, the minimum distance of the cross arm and elements is 7′ above the roof, except on private residences where 6′ masts may be acceptable unless the local codes specify otherwise.

6. The masts, guy wires, or lead-in, should not obstruct fire escapes, doorways, or other passageways on the roof where hazard to personnel at night would result.

7. Transmission line supports should preferably be placed every 10′ in running the line around or down the building, and spaced at least 3″ from the building. Doors, shutters, screens, etc., must not be obstructed.

8. Where it is necessary to run the line across inaccessible areas or down the building where supports are not accessible for a distance of 35′ or more, the line should be suspended from a messenger cable. The line should not obstruct alleyways, streets, or other emergency exits or passageways.

9. Turnbuckles should be protected against turning by threading the guy wire through the turnbuckles. Cable clamps and thimbles should be used with turnbuckles.

10. All anchor bolts and expansion shields should be secured in solid brick—not the mortar between the brick. Rawl plugs should also be used in brick, and when used for transmission line supports, spans should not exceed 35′.

11. Fire escapes should not be used for grounding or supporting the antenna or transmission line.

12. Existing 'phone line or power line supports should not be used as a convenience for transmission line supports, and the ground wire from the television mast should not come nearer than 6″ to any existing 'phone or power wiring.

13. At all times good judgment should be exercised in the mechanics of the installation to conform with national as well as local building and electrical codes. Always consider the customer's property, safety, and durability of the installation.

New RCA Release

Radiotron 5ZP16 is a new and improved, five-inch cathode-ray tube for use as the flying-spot scanner in a high-quality, video-signal generator. It has a resolution capability of better than 1000 lines at the centre of the reproduced picture. This new tube supersedes the 5WP15 for new equipment design.

Featured in the 5ZP16 is a new metal-backed phosphor — P16 — which has not only extremely short persistence to provide a good signal-to-noise ratio but also a stable decay characteristic for which equalization can be easily supplied; radiation in the violet and near-violet region only and no long-persistent radiation to be filtered out as heretofore required; relatively little change in radiation output with focusing adjustment; and remarkable freedom from grain.

Other features of the 5ZP16 include a high-resolution gun of the electrostatic-focus type; a 40°-deflection defocusing and provide high corner resolution; a non-darkening faceplate; an external conductive coating on the neck which, when grounded, prevents corona between yoke and neck; a built-in capacitance between interior and exterior neck coatings to serve as a supplementary filter capacitor for the high-voltage power supply; and an external insulating coating on the bulb cone to minimize sparking over the surface of the glass bulb under conditions of high humidity.

COUNTERS

By SERGE A. KORFF

The devices that detect the ionising radiations of the atom were invented some 40 years ago. Now they have become basic tools of the atomic age.

With the advent of atomic energy, many devices of physics which long labored unostentatiously in laboratories have emerged as words on the front pages of newspapers. Among these are Geiger counters. One is led to believe that they were only recently invented, and that they were first constructed by scientists working on the atomic energy programme in the U.S. Some nervous politicos have gone so far as to suggest that we have given the "secrets" of the construction of Geiger counters to other nations.

Actually the first experiment in which such counters were used was performed in 1909 at the Cavendish Laboratory of Cambridge University. The authors of the report describing them were Ernest Rutherford and H. Geiger. About 15 years later Geiger and W. Müller, a colleague assisting him in his studies of radioactivity in Germany, had occasion to make much larger counters than had been used before. Their designs were widely copied by other investigators and became known as Geiger-Müller counters. Present-day counters differ only in trivial details from those models. So the basic principle of this type of detecting device is at least 41 years old, and the instrument has been in general use by physicists on both sides of the Atlantic for nearly a quarter of a century.

For brevity's sake the devices are now referred to simply as counters. Their function is to detect and count atomic particles and radiations, or "rays." The word ray is a loosely used term that embraces all types of radiations, whether streams of charged particles, such as cathode rays and alpha rays, or beams of electromagnetic energy, such as visible light and X-rays. A counter does not record these radiations directly: it is in effect a track-examining device, like a hunting dog, which detects the presence of the quarry by its spoor.

Almost every type of radiation causes matter through which it passes to become "ionized," which means that the normal balance of positive and negative charges possessed by the atoms is disturbed. The positively-charged nucleus loses some of its neutralizing retinue of negatively-charged electrons and becomes a positive ion. The freed electrons may attach themselves to neutral atoms and thus produce negative ions. It is the amount of ionization produced that serves as the footprint and the measure of the responsible radiation.

There are several ways of recording this ionization; for example, a stream of alpha particles falling on a photographic plate will leave a developable trace in the emulsion; or, passing through a cloud chamber, it will leave enough ionization to cause cloud condensation when the chamber is expanded. In a Geiger counter the ions are made to initiate an electrical impulse which is translated into an easy-to-read visible or audible signal.

Suppose we have a glass tube containing a gas (any gas will do, but some gases such as argon and neon do better) and two metallic electrodes by means of which a voltage can be applied to the gas. If the voltage is high enough there will be a glow discharge in the gas—a phenomenon that has been made familiar to everyone by the neon sign. Now suppose that the voltage applied to the tube is almost but not quite high enough to cause a glow discharge. If an appreciable number of ions is suddenly created in the gas, a glow discharge may appear. This is the principle of the Geiger counter. It is an arrangement of electrodes in a gas, with an applied voltage almost sufficient to initiate a self-sustaining discharge in the gas, and some provision for "quenching" the discharge caused by ionization once it starts.

The two electrodes usually are in the form of (1) a cylinder and (2) a fine wire running through the centre of the cylinder. The particles to be detected may be shot in through one end of the cylinder, through an aperture in the cylinder wall, or, if they are sufficiently penetrating (*e.g.,* X-rays), through the cylinder wall itself. As a particle passes through the gas inside the cylinder, it produces ionization. Any positive ion thus produced starts to drift, under the attractive force of the electrical field, toward the cylinder wall. The electron, or negative ion, similarly starts to drift toward the central wire. Since the field is very intense just around the central wire, the electron experiences a large acceleration when it reaches this region. It may gain enough energy to produce additional ionization by collision with other gas molecules. Each molecule thus ionized contributes more electrons, and each new electron may in turn produce further ionization. When the built-up "avalanche" of electrons finally arrives at the central wire, it produces an electrical impulse. This signal, amplified by vacuum tubes, is the counter's recording of the detected particle; it can be measured, or simply counted, or stored for a cumulative record.

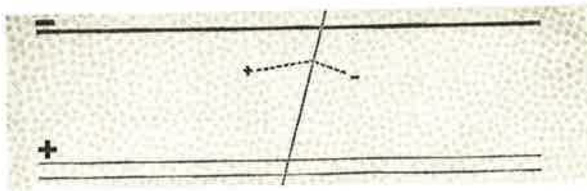
With acknowledgments to Scientific American, July, 1950.

Meanwhile the positive ions formed in the discharge of the electrons drift out to the cylinder, and when they arrive there they are neutralized. The counter is then ready for the next count. It is the travel time of the positive ions that determines the "resolving time" of the counter, or the fastest rate at which the counter will count particles passing through it. In most counters this travel time is between 100 and 200 micro-seconds, so that the counter can count between 5,000 to 10,000 particles per second.

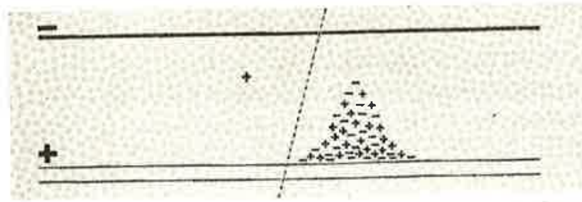
Each kind of atomic particle has its own "specific ionization," *i.e.,* it produces a certain number of ions per centimetre of path in a given gas at a given pressure. The number of ions produced also depends on the energy of the particle. This fortunate circumstance makes it possible to identify a particle as well as detect it. For example, a million-volt alpha particle will produce some 30,000 pairs of positive ions and negative electrons per centimetre of air at normal pressure; a deuteron of similar energy produces perhaps 10,000, a proton about 5,000, and an electron only 30 or 40. In order to distinguish between kinds of particles, the counter must be operated at a fairly low voltage. The size of the electron avalanche, *i.e.,* the size of the pulse, is then proportional to the number of ion-pairs produced by the particle, and the counter in this case is called a proportional counter. It is easy to design electronic circuits that will accept only pulses of a specified range of sizes. Thus the electronic circuits connected to a counter can be set to count the number of pulses produced by particles of any predetermined kind. A counter can be connected to two or more such circuits at once, so one circuit can count alpha particles while the second simultaneously counts beta particles entering the counter.

The reason the counter cannot differentiate particles at higher voltages is that the voltage produces a saturation of charge inside the counter, and the discharge pulse is the same whether it is triggered by one electron or 30,000. If we are interested only in counting the number of particles passing through the counter, without distinguishing the particles, operation of the counter in this voltage region serves perfectly well. In practice most counters are used in this way, because no pulse-size discriminating equipment or high-gain amplifier is required and the electronic circuitry is therefore simpler.

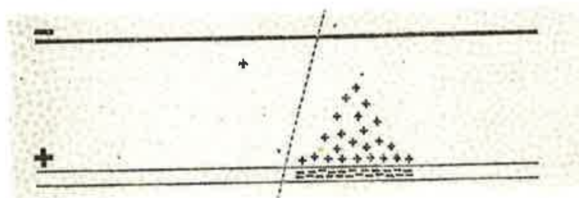
How does a counter detect X-rays? These rays do not ionize atoms as particles do. But we have seen that all that is needed to start the pulse-producing process is to set free at least one electron within the cylinder of the counter. There are two mechanisms by which X-rays can produce electrons: they can knock secondary electrons from the walls of the cylinder or other solid parts of the counter, and they can scatter electrons in the gas by the recoil process known as the Compton effect. Gamma rays produce electrons by the same mechanisms, so they too can be detected. Similarly ultraviolet light ejects electrons from the cylinder walls or gas atoms by the photoelectric effect; in this case the counter becomes a



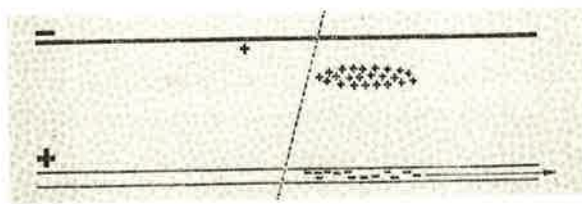
ELEMENTS of a counter in a highly schematic cross section are cylinder (*top*) and wire (*bottom*). A ray passing between them mutilates a gas atom.



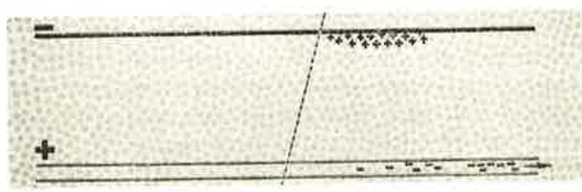
ELECTRON removed from gas atom by ray moves toward positive wire, colliding with other gas atoms. Result is an avalanche of electrons.



POSITIVE IONS are left behind as electrons collect in the wire. The positive ions move more slowly than the electrons because they are more massive.



ION CLOUD drifts toward the negatively charged cylinder. Electrons, still held in place by attraction of positive ions, begin to move along the wire.



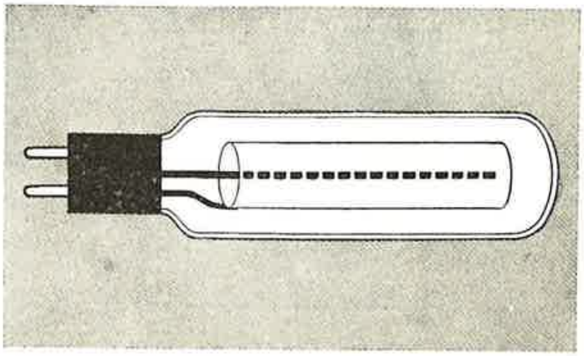
IMPULSE moves along wire as electrons are freed of attraction of positive ions. The positive ions are neutralized at the negatively-charged cylinder.

photoelectric cell and records a count each time a light-quantum produces a photoelectron. A counter can even be made to record the low-energy radiation of visible light. Visible light will produce no photoelectrons in the gas, but if the counter's cylinder is coated with a photo-sensitive substance, the light will knock photoelectrons from this surface, and the counter will therefore detect the light-flux falling upon it.

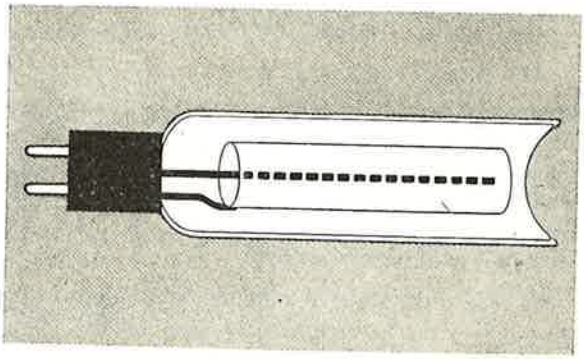
Designing a counter that will count neutrons is a little more difficult. Since neutrons are uncharged, they will not themselves produce ionization or electrons. Neutrons can, however, produce ionization indirectly by colliding with charged particles and causing them to ionize; in other words, a neutron is detected, loosely speaking, not from its own footprints but from the track of the charged particle to which it gives a push. The simplest situation of this kind occurs when high-energy neutrons knock electrons or nuclear particles out of the walls or gas molecules in an ordinary counter. But this is a very inefficient method of counting neutrons; at best the counter registers only one out of 50,000 of the fast neutrons that pass through it, and it does not record slow neutrons at all, for the impact of a neutron with less than 30 electron volts of energy is generally insufficient to separate an electron from its atom. For counting neutrons, therefore, the counter is modified by providing a material in which slow neutrons can cause a nuclear reaction. The most effective substance for this purpose is boron; another good one is lithium. When a neutron is captured by a boron atom, the result is the ejection of an alpha particle, which produces abundant ionization. The event can therefore be detected and recognized by a proportional counter. The probability of this capture reaction increases as the neutron energy decreases, so that very slow neutrons are the most easily counted. The probability for detection of neutrons by the boron nuclear reaction is more than a thousand times greater than by simple collision and recoil. The boron in the counter can be provided either as a lining for the walls or as a gas. Most neutron counters used to-day are simply conventional counters filled with boron trifluoride gas.

There now exist a remarkable variety of counters, in many sizes and shapes and for many special purposes. They range in size from tiny models about two millimetres in diameter and a few millimetres long to giant tubes eight inches in diameter and six feet long. Some have envelopes of glass, others of metal. Some have very thin windows to permit low-energy particles or ultraviolet light to enter; others are built so that the radioactive material to be counted can be placed inside the counter itself. For example, radioactive carbon 14, which gives off very weak radiation, is usually put inside the counter, either in the form of a gas such as methane (CH_4) made with the radio-carbon, or in a rod or plate. Some counters have jackets into which radioactive liquids can be poured. There are counters in the form of needles that can be inserted into biological specimens.

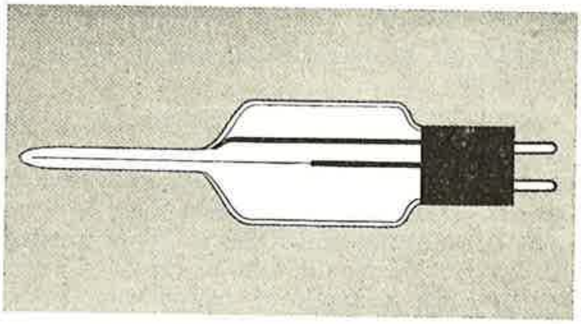
Counters can be arranged to give a great deal of information about radiations besides merely counting the particles. For example, several counters can be connected in such a way that a discharge is counted only when all the counters discharge simultaneously. This is called "coincidence counting." One obvious use for such an arrangement is to show the direction from which a stream of radiation is coming: when five counters are arranged in a straight line, the direction of any particle that discharges all five is clearly determined. Another use is to measure the effect of radiation-absorbing materials. Absorbers of various thicknesses are placed between the counters, and the change in the counting rate indicates the amount of absorption of the radiation by the material. In this way we not only can study the absorbing ability of various materials at various thicknesses, but when the properties of the absorber are known we can identify the kind of radiation or measure the energy of the particles. Coincidence counters are widely used, especially in research on high-energy particles. Very complicated combinations of coincidence and anti-coincidence counters have



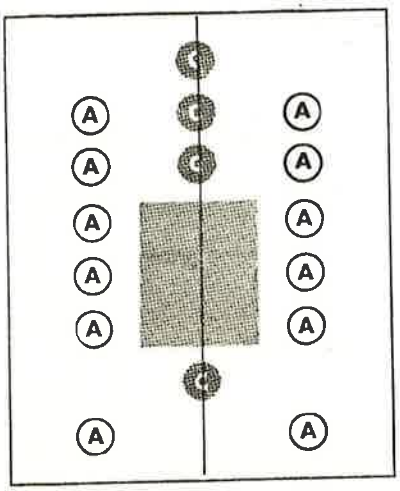
Standard counter tube is basically a positively-charged wire surrounded by a negatively-charged cylinder. These parts are enclosed in a gas-filled glass envelope which may be mounted upon a standard tube base.



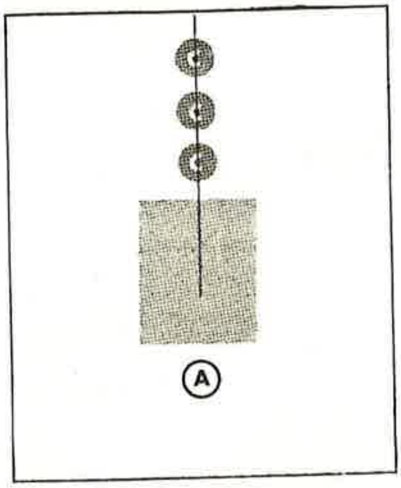
Thin-window counter tube has a thin glass window at one end to admit those particles which cannot penetrate the glass envelope of the standard tube. Sometimes the radioactive material is placed within the counter.



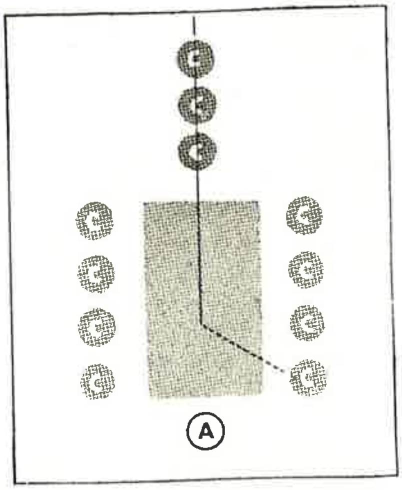
Thin-walled counter tube is constructed with a needlelike end for insertion into radioactive liquids or tumours. Here cylinder is replaced by a thin metal coating that is deposited on the interior of the glass envelope.



Penetrating cosmic-ray particles are counted to the exclusion of showers of particles by a special "anti-coincidence" arrangement of counters. Penetrating particle passing only through counters labelled C is counted; shower, passing also through counters labelled A, is not.



Non-penetrating cosmic-ray particles are counted by another anti-coincidence arrangement. Here the anti-coincidence counter is placed beneath the absorbing material. A particle passing through counters labelled C is counted; particle passing through four counters is not.



Decaying cosmic-ray particles such as mesons might be counted by an arrangement of 12 counters, one of them an anti-coincidence counter. The counters are connected in such a way that they will count only a particle that fires the three counters at the top and one of side counters.

been employed in studying cosmic-ray phenomena. An anti-coincidence counter is operated in such a manner that a pulse is recorded only when the counter does *not* count; if a particle enters this counter and is detected by it, the circuit is desensitized and there is no pulse.

To reduce the labor of counting, a counter can be operated so that it records only every second pulse, or every tenth; the actual count is then determined by multiplying the reading by the scaling factor. Some counters have electronic circuits that store the counts and present the total arriving in a unit of time; such circuits are called counting-rate meters. They are frequently used in portable counters employed for radioactive survey work, such as geological prospecting for radioactive ores or exploration of areas contaminated by accidental spilling of radioactive compounds.

Aside from their many well-known uses in the atomic energy programme and in laboratory research, counters are finding more and more applications in industry, medicine and other fields. They have become a remarkably useful tool in oil prospecting. For this purpose there is a special cylindrical device that has a piece of radium at one end and a counter at the other, with a lead shield between. When the device is lowered into a well, radiation from the radium, prevented by the lead shield from reaching the counter directly, is scattered back to the counter by the geological formation. The nature of this scattering depends on the kind of formation, and with a little experience in interpreting the record the prospector can identify the formation and thereby determine whether it is of a type likely to contain oil. A variation of this technique uses a neutron counter with a source of neutrons (radium and beryllium) at the other end. Since neutrons are preferentially scattered by hydrocarbons, this method can readily detect hydrocarbon-bearing formations.

Another commercial use of counters is as a particularly sensitive thickness-gauge. A source of radiation is placed over a table and a Geiger counter below it. As the material to be measured (*e.g.*, a sheet of metal) slides across the table, the response of the counter, controlled by the amount of particle absorption in the sheet, accurately measures its thickness. Other counters are used to monitor large X-ray machines or radioactive wastes for safety or to locate lost tubes of radium. In industrial and medical research counters are now in common use to follow radioactive tracers. Such tracers are employed to study the uptake of chemicals or fertilizers by plants, the effects of insect sprays, the migration of particular elements in melts of steel and a great number of other phenomena. In each case a Geiger counter is essential to tell where the radioactive compound has gone, and how much has gone there.

In an age of increasing interest in radioactivity, natural and artificial, it is clear that counters are destined to become one of mankind's most useful tools.

"THE WIRELESS AND ELECTRICAL TRADER YEAR BOOK"* 1951. 22nd Edition. Published by Trader Publishing Co. Ltd., London. 292 pages.

Since THE WIRELESS & ELECTRICAL TRADER YEAR BOOK was first published in 1925 it has become firmly established as the retailers' invaluable reference book to the radio and electrical industries.

In the latest edition — for 1951 — considerable space has been devoted to television data designed to meet the needs of English dealers in the areas in U.K. where the new television stations are to be opened later this year. This includes condensed specifications of current commercial television receivers (with such valuable facts as valves used, I.F. values, etc.) and information on valve and cathode-ray tube base connections, with over 200 valve base diagrams. These alone are invaluable to radio and TV service engineers.

Other time-saving data ranges from specifications of current radio receivers, legal information and a directory of trade associations to a new section on TV test equipment and notes on licencing requirements as they affect the retailer.

Each year sees great changes in the names, addresses, telephone numbers and products of the firms engaged in the radio and electrical industries. These revisions have been incorporated in the directory sections, and the lists of names and addresses of firms therefore make the YEAR BOOK an invaluable and time-saving desk companion for overseas firms seeking contact with British suppliers.

Directory sections are printed on distinctively tinted papers for ease of reference. The main sections are:

Legal and general information — Television Information and Data — Valve Base Connections — Valve Base Diagrams — Radio & TV Receiver Specifications — Trade & Wholesalers' Addresses — Proprietary Names Directory — Classified Buyers Guide — Directory of principal Trade Organisations.

"RADIO CIRCUITS,"* by W. E. Miller, 3rd Edition. Published by Trader Publishing Co., Ltd., London. 120 pages.

Frequently one is called upon to recommend a suitable book for beginners in radio. "Radio Circuits" provides an excellent answer to such inquiries.

Stage by stage, from aerial to loudspeaker, the workings of a typical receiver are clearly and simply explained.

The author has avoided the use of mathematics and involved discussions while covering the operation of each section in considerable detail. Very little previous knowledge of radio on the reader's part is assumed.

In this latest edition a new chapter has been added describing recent receiver developments. Contents include:

Preface. Superhet Principles. Aerial Input Circuits. Tuned Input Stage. Band-Pass Coupling. R.F. Amplifier Stage. Frequency-Changing. Oscillator Arrangements. Early F.C. Circuits. Modern F.C. Valves. Oscillator Tracking. I.F. Amplifiers. Variable Selectivity. Demodulation Circuits. A.V.C. Principles. Delayed A.V.C. A.V.C. Circuit Variations. A.F. Amplification. Practical A.F. Circuits. Second A.F. Stages. Push-Pull R.C. Stages. Transformer Coupling. Q.P.P. A.F. Coupling. Class B.A.F. Coupling. Loudspeaker Arrangements. A.C. Power Supplies. A.C./D.C. Power Supplies. Tone Control Circuits. Negative Feedback. Tuning Indicators. Gramophone Reproduction. Recent Developments. Conclusion. Index.

*Our copy received with the compliments of: Trader Publishing Co. Ltd., Dorset House, Stamford Street, London, S.E.1, England.

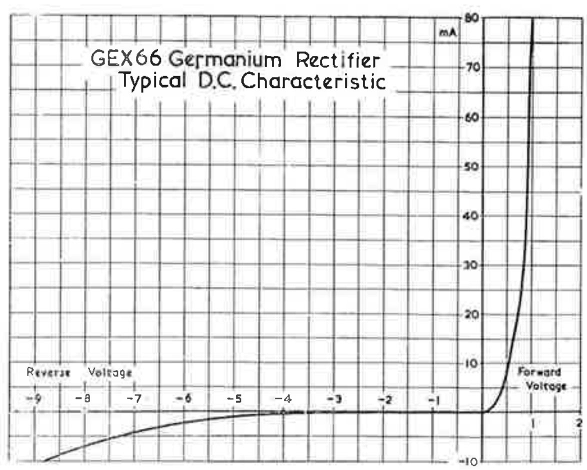
GEX66 Germanium Crystal Rectifier

(Tentative Data)

The GEX 66* is a germanium point contact rectifier which has been specially processed to attain a very low resistance in the forward direction. The average current at + 1 volt is 80 mA, while the slope resistance at this current is about 6 ohms.

In the negative direction the average current at — 1 volt is about 15 μA, the maximum current being about 30 μA.

A typical current voltage characteristic is shown in the figure.



The rectifier has been developed for use in applications where it is necessary to have a low forward resistance at applied voltages of the order of 1 volt or less. Examples of such applications are:— telephone modulators, instrument rectifiers and high frequency mixers.

*Similar to American type 1N72.

The efficiency of rectification of the standard high back voltage germanium rectifier falls with frequency by an amount which depends on the maximum peak inverse (or turnover) voltage. In the GEX 66 the turnover voltage has been reduced to about 10 volts, and as a result the efficiency of rectification remains high up to frequencies of the order of 1000 Mc/s. It is therefore very suitable for use as a detector or mixer on the v.h.f. band.

Typical characteristics

Colour code:	Red/Blue/Blue	
Forward current at + 1 volt	— 80 mA	average
„ „ „ + ½ „	— 8 mA	„
Reverse current at — 1 „	— 15 μA	„
Turnover voltage	10 volts	
Shunt Capacitance	0.8 μμF approx.	

Germanium Crystal Rectifier Graphs

Supplementing the information in Radiotronics No. 145, we publish herewith graphs showing turnover voltage and rectification efficiency for germanium crystal rectifiers GEX 33, GEX 44 and GEX 55.