Man-Made Static

What Causes Interference to Radio Receivers—Some Easy Methods of Locating the Cause of the Trouble—and How to Stop it

By A. F. VAN DYCK
Engineer, Technical Division, Radio Corporation of America

THE term "static" has been used, more and more commonly, to name the cause of many noises which are heard in radio receivers, and which sound like scratching, frying, clicking, or grinding. The word static is short for "static electricity." Real static electricity, or electrical charges deposited on the antenna, cause a very small part of the whole disturbance, and radio experts label all the causes of such interference as "atmospherics." However "static" seems to be a more usable and popular word, perhaps because it sounds so much like the short, sharp, vicious thing it stands for.

Now there is static and static—static caused by phenomena of nature, and that caused by electrical disturbances due to man's own agencies. It is the purpose of this article to point out and describe examples of one kind of interference which is very common in broadcast reception, and which is quite mysterious in many of its manifestations. This form is often called "inductive interference." There are a great many industrial and other applications of electricity in use, and everyone of them can, under certain conditions, become a radio transmitter in effect, and send out radio waves which will cause interference with the signals from radio broadcasting stations. Since the noise produced by such sources sounds very much like static, and yet is caused by human agencies, it is often called "man-made" static.

"What Is that Scratching Noise?"

Well, if you are morally certain it doesn't come from your receiver itself, you have every right to be suspicious of almost everything electrical about you which might possibly be out of order.

Mr. Van Dyck shows that in actual practise, the interference comes from a few sources and that, by the exercise of a little intelligence, the trouble may be eliminated, and all be made again serene on the radio horizon.

—THE EDITOR.

LITTLE BURSTS OF "STATIC"

Are often caused when the trolley of this surface car makes sparks in following the wire. "Static" of this sort is not particularly bothersome, because of its short duration

WHERE THE TROUBLE COMES FROM

IN MANY localities, man-made static causes far worse interference than does nature's own static. Fortunately, man-made static can always be eliminated, while nature's cannot by any means now known. The most difficult part of the process of elimination of man-made static is locating its source.

Some causes of "Man-made Static":

Class 1. Power Circuits
- (a) Lines
- (b) Insulators
- (c) Lightning arrestors (on power lines).
- (d) Transformers
- (e) Generators and motors

Class 2. Industrial Applications
- (a) Arc lights
- (b) Telephone and telegraph lines
- (c) Telephone ringers
- (d) Street cars and electric railroads
- (e) Factory motors
- (f) Store motors and barber shop appliances
- (g) Smoke and dust precipitators
- (h) Electric flashing signs

Class 3. Household Appliances
- (a) Door bells
- (b) Light switching
- (c) Sewing machines
- (d) Vacuum cleaners
- (e) Flat irons
- (f) Electric refrigerators
- (g) Dish washing machines
- (h) Kitchen mixers
- (i) Violet Ray outfits
- (j) Heater pads.

Class 4. Miscellaneous
- (a) X-Ray machines
- (b) Storage battery chargers
- (c) Electric elevators
- (d) Annunciator systems
- (e) Automobiles
- (f) Stationary gas engines
- (g) Tickers
- (h) Dentists' motors

PASSING ELECTRIC TRAINS

Often annoy the broadcast listener who blames radio in general for the resulting "scratchy" noise in his receiver. A faulty contact-shoe on one car of a train can cause considerable, although not serious, trouble

The list given above contains only devices which actually have been reported as causing interference. Many other similar ones, although not mentioned in this list, may cause interference in other cases. Of course, some of these causes are more frequent offenders than others. Certain ones in the list have been reported hundreds of times, others but a few times, and a few but once.

If all electrical circuits and devices were always kept in perfect order, radio receivers would have but little interference. The following devices are exceptions, that is, these devices cause interference even when they are in perfect order.

Class 1. Lightning arrestors on power lines.

Class 2. Telephone ringers
Street cars
Motors (of some types).
Smoke and Dust Precipitators

Class 3. Door bells
Light switching
Various motor driven devices
Violet Ray outfits

Class 4. X-Ray machines
Storage battery chargers
Electric elevators
Annunciator systems
Gas engines with electric ignition

The devices which appear in the first list and not in the second, cause interference only when they are not in perfect condition. It is therefore possible to eliminate the interference from such devices merely by putting them in perfect condition.

It is also possible to eliminate in part the interference caused by devices mentioned in the second list, but it is usually difficult and requires study by an expert, or someone who has had previous experiences with that form of interference.

THINGS WHICH MAY CAUSE INTERFERENCE IF OUT OF ORDER

LET us consider now those appliances which cause interference to radio because they are not in perfect order. First on the list are power lines, together with the insulators on the lines. It can be said, as a general proposition, that power lines are the cause of most "interference" in radio reception. This is not remarkable if one considers the great power of the energy which is transmitted over most electrical lines, and the very tiny power which

is required to operate sensitive radio receivers. An electric power line needs to radiate only a ridiculously small part of its power to create very strong interference with radio.

How does the electricity carried by power lines differ from that which operates radio receivers? An understanding of this difference is essential before one can intelligently try to locate any case of interference.

The power carried by electric transmission lines is either direct current, flowing always in the same direction around its circuit, or it is alternating current of low frequency, "alternating" in direction around its circuit twenty-five or sixty times each second (called 25 or 60 cycle power). Both of these two forms of electricity are harmless to radio, provided the antenna and receiver are at least fifteen or twenty feet away from the power wires, and provided the power lines and all of the electrical devices connected to the lines are in normal condition, and none of the devices are of Class 2, as listed above.

WHEN AND WHY A POWER LINE INTERFERES

TO OPERATE a radio receiver at a distance, we must have electrical alternations of *very high* frequency, thousands of cycles per second at least, because electricity operating at such frequencies sets up waves which can travel without wires. Therefore, to cause waves of the same nature as radio waves, and thereby cause interference with *real* radio signals, the electrical power on transmission lines at low frequency must be changed to high frequency. Here is how that happens.

Whenever an electric circuit makes a spark, either by a bad contact between any two parts of the circuit, or by the use of a voltage high enough to jump a gap between two parts (like the ignition spark plug), high frequency currents are generated. In fact, this method of generating high frequency currents (a spark caused by high voltage of the ordinary sort) was the one used in all the early radio transmitters, and is still used in some, although better ways are now known. So whenever any electric circuit causes a spark, radio waves are generated. The wavelength, or frequency, of these waves depends upon the electrical characteristics of the circuit. The wiring of the circuit forms an antenna and the distance over which the disturbance can be heard therefore depends upon the size and form of the wiring of the circuit.

A POOR CONNECTION

Inside the metal case of this lighting transformer could make broadcasting reception in this neighborhood very difficult. And if one of these power wires were scraping its insultation bare against a tree, or if there were a leaky insulator on this pole cross-arm, unpleasant local interference would also be set up

The electric power line itself does not produce interference with radio, unless in some part of it there develops a bad contact or other means of creating a spark. The spark may be so small as to be invisible to the eye, and yet create disturbance. And whenever there is interference from this source, it can be removed by locating the spark and either removing it, or in some way preventing the spark from sending out radio waves.

Sparking can develop on power lines in many ways. The most common way is through "leaky" insulators, that is, ones which do not give perfect insulation, and allow the power to creep off in tiny jumps. Troublesome radio interference is often due to power wires

LARGE MOTORS AND GENERATORS

Frequently set up interference for the broadcast listener. Sparking commutators on motors and collector rings on generators are responsible. This difficulty is not usually hard for the power house to remedy. The operator with the loop receiver is verifying the cause of the trouble

touching tree branches. Also many cases have been traced to the distributing transformers, which are usually mounted on poles in the center of the neighborhood they serve. These unfaithful transformers develop defective internal insulation, poor contact at their terminals, etc.

HOW TO FIND THE INTERFERENCE

IT IS often difficult to locate the exact spot of such power line interference, because the antenna formed by the lines is extensive and the interference therefore heard over a large area. To locate the trouble, that section where it is worst can be found by listening to it on ordinary receivers at various locations, and when the area has been localized to a particular section, a direction finding set with loop aerial must be employed. This set should not be too sensitive, as the increase in loudness as one gets nearer to the trouble (which is more apparent on an insensitive receiver), is also a useful indication, in addition to the direction. Power companies are usually glad to coöperate in removing such interference, particularly since it is an indication of a fault on their system which is wasting power, and which may grow worse until it finally results in interruption of the power service. The radio receiver, in fact, can be made use of by power companies as an effective method for locating line faults.

Generators and motors are somewhat different from power lines in that they may give interference while operating in a condition which is satisfactory from the mechanical and commercial point of view. Ordinarily, interference from machines is due to their commutators or slip rings, because sparks occur at these points. The sparks, just as described before, generate radio frequency currents, and the wiring to the machine acts as an antenna system radiating the waves. Obviously, the first step in eliminating this interference is to stop the sparking on the machine, or at least to reduce it as much as possible. It can not be stopped completely in all cases, as a certain small amount of sparking can not be avoided in most machines. However, the commutator should be clean and smooth, the brushes in good condition and properly set, and the machine not overloaded. In extreme cases with direct current machinery, and where the expense may be justified, the interference can be stopped by putting large "choke" coils in the wires connecting the machine with the power line. These must be put right at the machine terminals and must, of course, be capable of carrying the full current of the machine. The low voltage winding of a proper size transformer will often make a suitable "choke". In some cases, connecting large condensers (having a few microfarads capacity) directly across the terminals of the machine alleviates interference, but this method is not always effective. When condensers are thus used, they should be insulated to stand at least twice the voltage of the line. The use of choke coils has been successful in many cases of interference from small motors, such as dentists' motors, and those used in dictaphones, cash registers, household appliances, etc. With small motors, the choke coils may consist of "honeycomb" type coils. The size of coil must be chosen to suit the particular case, and is usually a size between 500 and 1500 turns. The larger the coil the better it is for reduction of interference, but if the supply line is

FARM CHARGING OUTFITS

Can make trouble for the broadcast listener. The usual cause is badly sparking brushes on the dynamo

alternating current, it can not be too large or it keeps too much line voltage away from the motor, thereby causing the motor to run slowly, or otherwise affecting its operation.

ONE CASE IN POINT

LOCATING interference of the sort which has been described above, becomes a good deal of a sporting proposition, with plenty of opportunity for clever detective work and systematic experimenting. In one instance which has been reported, a broadcast listener who had good reception conditions for over a year, returned from his summer vacation to find that reception was quite impossible on account of terrific "interference." This noise was continuous and appeared to be from a power line. Whenever an interference is on continuously day and night, it is fairly safe deduction that it is due to some power line itself, because devices fed from a line are switched off and on at least occasionally. So this listener concentrated on the power lines in his neighborhood, and first asked all his neighbors if any changes had been made during his absence. One neighbor recalled having seen linemen at work upon a certain transformer. Inasmuch as the interference was loudest near this transformer, it seemed logical to suspect this device. Inquiries to the power company revealed that the wood pole upon which the transformer was mounted, had needed replacement, and the transformer had therefore been taken from the old pole and mounted on the new one. This made the trail seem warmer, and the radio listener asked the power company to make examination of the transformer. The inspection was made, and in fact a second one, when it was found that one connection on the internal terminal block. of the transformer had not been soldered. As soon as this was soldered the interference ceased completely.

THE STRANGE CASE OF THE HEATING PAD

A RADIO dealer installed a very good radio receiver in a certain home, and it performed properly with satisfactory service for a period of several weeks. One day, however, the dealer received complaint of trouble. He investigated and found a bad case of interference which, after several days' observation, was noticed to be continuous except for an occasional short "silent" period. The quiet periods were erratic in time of occurrence although always in daytime, usually morning. The dealer

A WASHING MACHINE MOTOR

Such as the one shown here may produce enough "static" in radio receiver installed in the same house or very near by to spoil the incoming concerts. Remedy: clean the motor commutator and clean and adjust the motor brushes

looked for the source of the trouble and finally found it, but his success came only after a week of careful and logical work. The first tests, made with the coöperation of the power company, and by cutting off power in one section at a time, showed that the trouble originated in one certain small section. Further tests of the same sort showed that it came only when a certain transformer in this section was connected. Now it had been noticed every time the voltage was removed from the line during these tests that not only did the interference stop, but it did not start again until almost exactly ten minutes time after the power was turned on. It seemed quite reasonable to believe, therefore, as soon as the source had been narrowed down to one transformer, that this transformer became defective in some way after the power had been on long enough to heat it up to a certain temperature. So the power company went to the trouble of replacing the transformer with a new one. But, ten minutes after the new transformer was turned on, the interference came on as strong as ever. This was conclusive evidence that the trouble was not in the transformer but was somewhere on the lines going from the transformer, which as is usual, fed quite a number of houses in the neighborhood. When he tried a radio receiver with a loop antenna, he soon localized the trouble as coming from one particular house which was several hundred feet from the nearest radio receiver. When the main switch in this house was opened the interference stopped all over the section. Further systematic search in this house seemed to indicate that the porch light was the guilty device and so it was taken apart and examined—but the noise continued even when the porch light wiring was disconnected. Then a member of the household remembered that there was a baseboard outlet in a front room on the second floor which was probably connected to the porch light wiring. Examination of this outlet revealed that it was used practically continuously for an electric heater pad in the bed of an invalid. When this heater pad was disconnected, the noise stopped. Ten minutes after this heater was plugged in, the noise would start. A variable contact in the heater element of the pad partially opened the electric circuit and therefore caused sparking, when it became hot. It took ten minutes for the pad to heat up to the temperature which caused the sparking.

IT ISN'T HARD TO FIND THE TROUBLE

THE incident just given has been described in detail because it shows the sort of detective work which is usually necessary in order to locate inductive interference. Expert radio knowledge is an advantage, and familiarity with electrical practice a still greater benefit in "shooting trouble," but the chief requisites to successful locating of inductive interference are common sense and the ability to see what experiments are most likely to give useful information, and second, to interpret the results of the experiments.

A Power Company Cuts Out "Static"

One Lineman with a Loop Receiver Replaces Many Men and Saves Repair Costs, Current, and the Temper of the Broadcast Listener

By EARL C. McCAIN

ON THE 66,000 volt Arkansas Valley power transmission line of the Southern Colorado Power Company between Pueblo and La Junta, Colorado, there are 28,530 insulators. And each insulator has to be inspected frequently so that the high tension current will not stray from its copper path.

No doubt you are asking yourself what this has to do with radio. Well, it has just this to do with those who nightly listen to the voice of the broadcaster. Large power lines which "leak" current are certain to produce static in every radio receiver in the vicinity. The sound will almost always be continuous, and if the leak is bad enough, and your receiver is near enough the source of the trouble, you are going to have a pretty hard time of it. Distant stations simply can't be "pulled in" through the local artificial "static," and the more amplification you use, the louder it will come in.

Those who live in cities and those who don't, often encounter receiving trouble from this source. All that is necessary is for you to be

near a leaky power line.

The power companies don't like leaky lines any better than an irate broadcast listener does, for if the leak is sizeable, they are going to lose current, and in losing current, money.

George W. Hammill, superintendent of the Arkansas Valley transmission lines of the Southern Colorado Power Company, has had great success using a radio receiving set equipped with a loop antenna to detect faulty insulators and leaks of greater or less magnitude on the lines under his control.

A fairly sensitive loop receiver is quite directional, and the Power Company trouble shooters go out with their Ford and loop receiver, skim along the road and can note down each and every pole where there is trouble, without even leaving the car. It is perfectly possible for a lineman to inspect the line at a speed of sixty miles an hour, as far as the accuracy of the test is concerned. The loop receiving tester set has never shown a leakage without closer inspection revealing a broken insulator, and it has never passed a broken insulator without revealing it by sound. The officials of the Southern Colorado Power Company say they are very well satisfied with this method of testing and will use it on all their lines.

Insulators are subject to damage or failure from three sources: mechanical stresses, such as being struck by bullets or stones; electrical stresses, such as lightning or other excess voltage surges, and atmospheric stresses, due to sudden variations in the temperature. Any of these causes break the insulators and permit leakage of current, often sufficient to interfere with service and compel a shutting off of the power until the fault can be repaired.

In most cases, this trouble occurs at the top of the insulator, where it cannot be seen even when a lineman has climbed the pole. The use of field glasses sometimes helps to detect insulator breaks, yet even the glasses often fail to show the smaller breaks. In such cases, the only solution is to determine the approximate location of the leak, install a relay contrivance to carry the current past a certain point, and carefully go over all the poles in that area.

E. F. Stone, superintendent of power lines for the Southern Colorado Power Company, says: "While many experiments have been made to determine means of locating insulator leakage, this is the most satisfactory of all. I believe this method is infallible, and power companies throughout the United States in the very near future will undoubtedly adopt this means of testing their lines."

Radio Clubs Can Help

We do not see why local radio clubs can't have a trouble squad equipped with a loop receiver to do electrical detective work on "power-line static" in the way described in this article.

By proper coöperation between the radio club amateurs, the broadcast listener, and the power companies, it would seem that radio life could be made more liveable for everybody.

—The Editor.

TESTING A TRANSFORMER

One lineman with this car and loop receiving set can inspect a 66,000 volt power line with 28,530 insulators where it took many linemen at a total cost of $6,000 for salaries and replacements under the old system

Man-Made Static

Definite Instructions on How to Eliminate Outside Local Interference with Radio Receivers

By A. F. Van DYCK
Engineer, Technical Division, Radio Corporation of America

PART II

IN THE preceding article a general discussion of "man-made static," or inductive interference, was given, including a list of such causes of this interference as are commonly reported. We will now take up these causes individually, to show how each originates and how each can be remedied.

Lightning arrestors used on power lines are not troublesome ordinarily, because they produce interference only when voltage is discharging through them, which is seldom, or when they are being "charged," which requires only a few seconds each day and is usually carried out at times other than broadcasting hours.

Arc lights are frequent and serious offenders. Arc light interference is very difficult, if not impossible, to eliminate. As somebody has said, the best way to eliminate this interference is to move one's home to a neighborhood where none of these lights exist. Arc light interference is particularly troublesome because the light itself has somewhat of the nature of a spark, which sets up interference as explained in the previous article. Consequently, it is often the case that arc light interference can be eliminated only with great difficulty and very special means. Very often, however, the major part of the trouble comes from faulty insulation of the power line, or the lamp itself, because the voltage used in arc light systems is quite high and the insulation must be very good. A number of cases of arc light interference have been cured by replacing defective insulators, etc. Therefore in studying a case of arc light interference, one should make certain that faulty insulation of the line is not responsible, and that the lamp burns steadily without flickering. When this sort of power line is "leaky," the noise produced in radio receivers sounds very much like the "rolling" of a snare drum.

The Dealer and the Radio Owner

Are asked and ask—often, how is my local electrical interference to be eliminated? Here are suggestions which will show the dealer how he can help his customers get greater satisfaction from their sets, and the owner of a receiver to know where the trouble comes from, when there is trouble.

Mr. Van Dyck has a simple remedy for every interference ill the broadcast listener will encounter.—The Editor.

Transformers on power lines are not troublesome very often, because they are inherently simple in design and construction, and are ruggedly and reliably built. A number of cases of loose connections on the terminal blocks of such transformers have been reported, however. That difficulty is simple to remedy.

TELEPHONE LINES AND RINGERS

TELEPHONE and telegraph lines do not often cause trouble because of faulty insulation, because they do not carry much voltage so that even if the insulation of the line becomes faulty no sparking is produced. However, if a telephone line or cable is so located that near-by power circuits induce considerable voltage in it, faulty insulation of the telephone line permits sparking of the voltage it receives from the power line. In one case of this sort, a telephone cable was located underground in a street which passed under an electric railroad. The heavy ground currents from the railroad set up electrolysis on the lead-sheathed telephone cable and finally ate through the lead and into the telephone wires. This action was possible whenever the cable became wet, as it did after every rainfall. For nearly one year, radio receivers in this neighborhood experienced bad inductive interference after every rain. The source was not found until the cable had been so badly damaged as to interrupt the telephone service, after which it was repaired by the telephone company, which of course eliminated the radio interference.

It was said above that telephone and telegraph lines do not often cause trouble because of faulty insulation. They do cause trouble often, however, because of the kind of currents used. It is reported very frequently that telephone ringing machines cause interference. Usually the ringers which inter-

fere are the hand operated type, which is common in small communities. This interference is readily recognized by its intermittent nature, and the use of call signals. When the ringing generator is motor driven and causes interference it is of course continuous, and not intermittent as is the case with hand operated ringing generators. It is particularly severe in the immediate neighborhood of the telephone exchange. Interference from telephone ringers can be eliminated usually, and always greatly reduced, by the use of a proper filter between the ringing keys and the machine. Such a device can be installed by any telephone electrician, and usually is arranged as shown in Fig. 1. This arrangement is effective in preventing interference, although it does not affect the low frequency currents used for ringing, because it prevents the high frequency currents, which also are generated by the ringing machine, from going out on the lines.

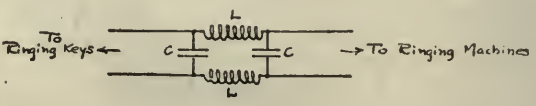


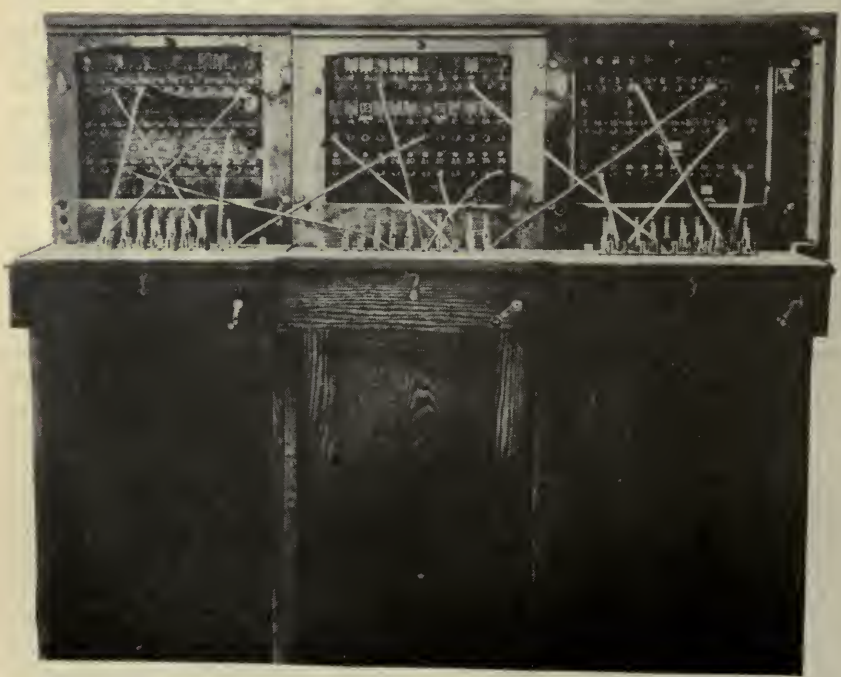
FIG. 1

How to connect a filter to prevent interference from telephone ringing systems. L is a " etard" coil (# 5AA Western Electric, or its equivalent) and C is a condenser of 8 mfd.

POWER COMPANIES COÖPERATE

IT IS interesting, and encouraging, to know that power companies are becoming interested in the interference problem to an increasing extent. Some companies are training men to locate faults causing radio interference. One company in the Middle West, has for several months past had a radio crew which is on duty nightly, and which responds to interference calls from any part of the city. This crew is equipped with a direction finding radio set mounted in an automobile, with which it is usually able to locate sources of interference quickly. A night spent on the job with this crew is an exciting experience, although if the night is one with the thermometer shrinking out of sight, the excitement is not unmixed with tingles of another sort.

Those power companies which are most progressive in keeping their lines free from interference radiation are those which have realized that the wide-spread use of radio has helped their business materially, and as a result, they are doing what they can to help radio, knowing that the better radio reception conditions are in the territory they serve, the greater the electrical energy they are likely to sell. It has been observed that a neighborhood consumes markedly more electrical energy as soon as radio receivers become common in it. This is readily explained by the fact that the members of households equipped with radio sets stay more at home in the evenings, and also stay up later. There is many a home where the "midnight electricity" has burned nearly every night since radio entered in. Likewise the use of power to charge storage batteries has been a considerable item. Since this extra power is used at a time when other demands are light, it is a most desirable sort of load, and power companies which have appreciated this new factor are actively coöperating in reducing interference with radio reception.



A SMALL TELEPHONE EXCHANGE

Showing the hand ringers which may intermittently set up interference to radio listeners

ELECTRIC PRECIPITATORS

MANY cases of interference have been caused by an electric device, the precipitator, although these installations are not very common. The electric precipitator is used to prevent smoke or noxious fumes or material from leaving chimneys. It operates by establishing a highly charged electric field inside the chimney, of such

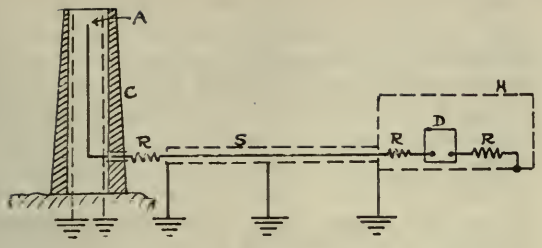


FIG. 2

How to eliminate interference from an electric precipitator. A, grounded wire which must extend above the central high tension wires; C, the chimney; R, resistances of 2,000 to 5,000 ohms; S, screen around high tension wires; D, rectifier; H, screen around rectifier, transformer, etc.

a nature and direction that particles going up the chimney are charged and driven against the walls where they stick. After a sufficient deposit has been created, it is removed in some suitable manner.

Precipitators have been used in concrete manufacturing plants, chemical plants, incinerating plants, as well as in ordinary factories where coal smoke created a nuisance. In many cases, the precipitator does valuable work in preventing actual damage to surrounding vegetable and animal life.

Precipitators cause interference for the reason that the high voltage used in their operation is obtained from an electrical device called a rectifier, which may generate high frequency alternating currents as well as the direct current which the precipitators need. The high frequency currents are not useful to the precipitator and may be eliminated without affecting its operation. If the design of the precipitator is so arranged that the distance between the rectifier and the chimney is only a few feet, there is usually no trouble. But if the rectifier is separated from the chimney, the wire which joins them forms a good antenna which will radiate waves. This wire also runs up the chimney, but here it usually can not radiate, because there are other wires or metal surfaces surrounding it and connected to the ground. Radiation from the precipitator system and consequent interference with radio reception can be eliminated by placing a grounded mesh screen around the rectifier and the wire to the chimney. If screening of the various parts is impracticable, damping resistances can be inserted which will prevent the high frequency currents from getting to parts of the circuit from which they can radiate seriously. A little experimentation may be necessary, but it should always be possible to make interference from a precipitator negligible at distances greater than a few score yards from the installation. The diagram given (Fig. 2) shows proper connections for an installation of the worst sort, that is, one where the rectifier and the chimney are separated by a considerable distance.

Electric signs of the flashing kind are not troublesome often, partly because they are not common in residential neighborhoods. Interference from this source can be minimized by keeping the switching contacts in good condition and by connecting resistances of the proper size across the contacts. It can be eliminated entirely by putting choke coils in *every* wire going into the switch, including the main power lines. The choke coils must be capable of carrying the current which will pass through them.

HOUSEHOLD APPLIANCES

MOST household appliances are used only intermittently and for short periods. Interference is often experienced in the same house where the appliances are used, but rarely extends farther, if the appliances are in good condition. Devices involving small motors may need to have the motor brushes and commutators cleaned and cared for. Bad contacts in plugs, sockets, switches, etc., are much more apt to give trouble, particularly in flatirons and other heating devices. In heating appliances the current used is relatively large and the service conditions are more severe due to the heat, so that bad contacts are quite likely to develop.

Interference from door bells and elevator calls can be prevented by connecting a large condenser (2 mfd. capacitance) across the device, or by connect-

HIGH TENSION WIRES

Like these cause frequent disturbance to the near by broadcast listener. Radio antennas at right angles to power wires such as these will pick up the least interference

ing a "honeycomb" coil in series with each wire to it. In some cases, both condenser and coils may be necessary. In every case, the condenser or coil must be placed as close to the bell as possible.

Violet ray outfits are serious disturbers of the peace, particularly since it seems to be popular practice among owners to use them just before going to their beds, which is about the middle of the evening in the schedule of the radio fan. Neighborly requests to utilize the machines in non-broadcasting hours are usually effective. If not, the interference can be stopped by inserting choke coils in the power lines to the machine, one in each line. These may be made by winding three layers of No. 18 bell wire on a three inch tube with winding about six inches long. Then two condensers each having 1 mfd. capacity should be connected across the terminals of the machine and the mid-point connection grounded. This has been effective in several installations.

It should be understood that the method of inserting choke coils in the lines, which has been mentioned several times, requires the use of parts properly approved by the Board of Fire Underwriters as with all devices connected to the power lines in a house.

HOW TO FIX MISCELLANEOUS INTERFERENCE

AMONG the miscellaneous interference sources listed in last month's article, the X-ray machine is the worst. They are not very common, however. These machines radiate quite powerfully, and the radiations are sent out chiefly from the power lines from which is taken the power to run them. To prevent interference from X-ray machines, the method described for violet ray machines should be used. The size of wire used in the choke coils must be quite large enough to carry the current which the X-ray machine draws. Also additional condensers of the same size and method of connection may be placed across the power lines where they enter the two choke coils. If it is desired to have a radio receiver close to an X-ray outfit, it will also be necessary, probably to enclose the X-ray apparatus in a grounded metal cabinet.

Gas engines with electric ignition often give interference. The farm lighting plant is a common example of this. Part of this interference comes from the high tension leads and sparks at the spark plugs, and part comes from the contactor in the low voltage circuit. The radiation is usually at very short waves and is highly damped in character. Both of these factors make it difficult for the ordinary receiver to tune out the interference. The remedy is to replace *all* the ignition wiring with lead covered cable, the lead coverings being well grounded at frequent intervals and particularly at its ends. Of course if lead covered cable is used for the high tension wires, the insulation between the lead and the wire must be very good to stand the voltage. Sometimes heavy rubber insulated cable, wrapped with tin foil which is grounded, can be used. Occasionally it will be necessary to insert choke coils in the spark plug leads, right at the spark plugs. Such coils may be made with about 200 turns of No. 36 double silk covered wire wound on a two-inch tube. These coils may have to be enclosed in a grounded metal box.

The ignition system of automobiles radiates short waves in the same manner as that of the stationary gas engines described above. These can be heard only a short distance ordinarily, such as when the automobile is almost directly under an outdoor antenna.

Every broadcast listener should assist as much as he can, to locate and eliminate unnecessary inductive interference. Every listener should realize that broadcasting is only one of the many electric applications upon which we have come to depend. It is also the latest, and as such it must do its share in accommodating itself to the others. It is quite unreasonable to expect that every power line, every motor, every electric device, shall operate at all times so as not to produce interference with the weak radio voltage received from some relatively small station hundreds of miles away. The broadcast listener must do his share by working with signals which are strong enough to dominate a reasonable strength of waves from other sources. The romance of reaching out to great distances of reception is apt to cause any one to forget that motors and other things must continue to operate. As broadcasting continues to develop, it will be found that several features will be improved, including better ratios of signal strength to strength of unavoidable interferences. It may be necessary once in a while to have an "Inductive Interference Clean-up Week," but we can reasonably expect that interference troubles will decrease to a satisfactory degree, as radio takes, and is accorded, its proper place among the electrical services of mankind.