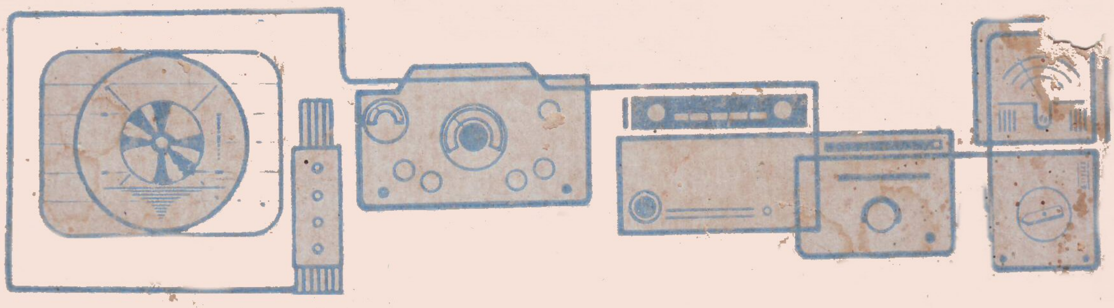
TELEVISION TRANSISTOR RADIO

PRACTICAL CIRCUITS & SERVICING



- Television Fundamentals with Practical Circuits.
- TV-Receiver Circuit Diagrams and Servicing.
- N. P. N. & P. N P. Transistor Radio Receiver Circuits.
- All World Hi-Fi and Band-Spread Radio Diagrams.
- Step by Step Fault Finding of TV–TR-Radios.
- Basic Practical Knowledge for Radio Novice.

TELEVISION
TRANSISTOR-RADIO
Practical Circuits
AND
Servicing

By
KRISHAN ARORA
PRINCIPAL
R. T. T. C. AGRA

RADIO TELEVISION TRAINING CENTRE
TECHNICAL PUBLICATIONS DIVISION AGRA-1 (INDIA)
Phone : 76083 **Price : Rs. 8-50**

PREFACE

This practical guide prepared by R. T. T. C. contains informations on servicing Radio, Transistor and Television receivers It presents a technical training course in Radio-Television for those radio servicemen who have an elementry knowledge of electronics fundamentals, and are interested to learn more by self study.

This is practical book because it was written from experience and not from pure theory. Twenty five years of valuable practical experience is given in this book.

In this edition a new television chapter has been added to make the book complete in this subject, for radio technicians.

A logical method of fault finding is essential for satisfactory repair of radio receiver in the service department. For this reason servicing techniques have been presented in every section and all material has been up dated to give you the latest informations. Both valves and transistor circuits are considered

The author feels that this edition of the book is the most comprehensive treatment on TV radio transistor servicing found in any one book.

Television receiver and NPN Transistor receiver circuit diagrams are also included in this edition for assembling and servicing.

I hope this book will enable you to make intelligent judgments in fault finding.

This book will be a stepping stone to a better and more prosperous future for everyone.

KRISHAN ARORA
Principal
Radio Television Training Centre
AGRA—282001

1st Jan. 1977

Printed at : **Sethi Packers, AGRA Phone : 62257**

CONTENTS

SECTION A

Television Theory and Servicing

1. Transmission of Vision Signal

The TV camera takes a moving picture of the programming at studio. The photosensitive plate insides the camera's picture tube is electrically altered by the light of the scene that is focused on it. An electron gun scans the photosensitive plate with a ray that has a 15625 cycle horizontal rate and a 50 cycle vertical rate produced by pulse generator.

The electron ray hits either light or dark spot according to the scene that is coming in through the lens. A wire comes out of the photosentive plate. If the ray hits a light spot on the plate, a small voltage is developed and small voltage will emerge through the wire. If the ray hits a dark spot a higher voltage is developed.

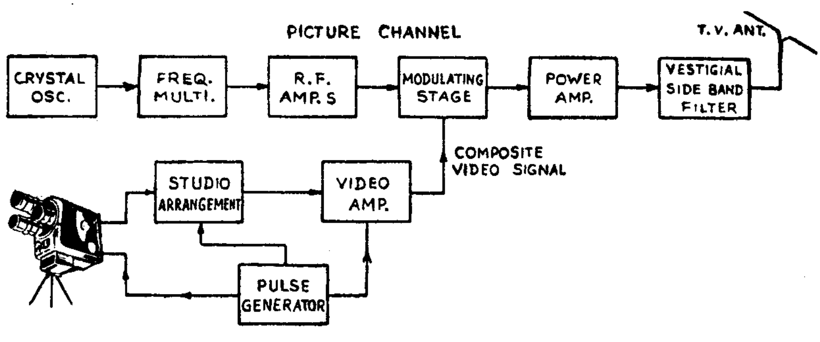


Fig. 1—Block Diagram of Vision Transmitter.

This signal voltage represents each picture in team of millions of tiny spots ranging from light to dark. The signal voltage is processed, beamed out on the air waves accepted by your TV and fed into the picture tube to make light and dark spots. Between the time the signal leaves the camera tube and is transmitted quite a bit has to be done to it.

Each TV station is known by its frequency. Each station has a different frequency. As you flip your channel selector you are tuning in different station each time. The station's designated frequency or carrier is developed by an oscillator set to run at that frequency in the transmitter. It is called the carrier the wave because the picture signal is impressed on it for transmission to your TV set.

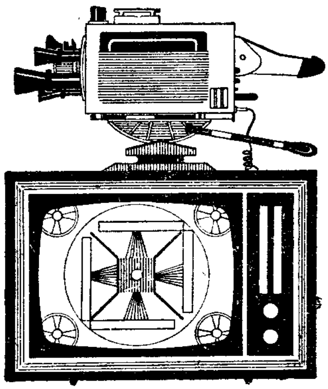


Fig. 2—Tv Set & Tv Camera.

There is a microphone near the camera. It picks up the sound of the scene. The sound is also impressed on the carrier wave, but in slightly different fashion.

While the picture signal affects the height or amplitude of the carrier, the sound affects the frequency.

The picture signal, on the other hand. is amplitude modulated (AM) because it affects the height or amplitude of the radio waves. The fact that picture and sound are respectively AM and FM helps keep them from intefering with each other.

One other important detail must be taken care of at the TV station. In your set the vertical oscillator runs free and automatically. That's not good enough. For unless your vertical oscillator draws the beam down at precisely the exact time as the camera at the TV studio, your TV picture will appear out of vertical sync. So at the end of every second picture, the studio inserts a vertical locking or vertical sync pulse. This transmitted vertical pulse, upon arrival at your TV, is seperated from the composite TV signal and sent to the vertical oscillator. At precisely the end of the picture information it is applied and locks the vertical sweep in to step, preventing flopping over.

The horizontal synch works like the vertical. In order for you to see a picture and not a distortion of any horizontal lines, the 625 lines must be drawn and whipped back precisely in time with the picture being scanned at the studio. So, at the end of every line of video information, a horizontal oscillator at precisely the end of each line of video. The pulse fires the oscillator and the yoke whips the electron beam back for the next line to begin.

In this way, picture, synch and sound, are loaded into the carrier and radiated from a transmitting antenna. Your TV aerial picks up some of the transmitted signal and channels it down into your set.

Let us now consider the basic block diagram of Television transmitter. The crystal oscillator and frequency multiplier stage generates the carrier frequency of vision signal The carrier frequency of vision signal of Delhi TV station is 62.25 Mc/s. The composite video signal having the synch pulses of 15625 Cps and 50 Cps is mixed with the carrier frequency in the modulating stage and then is sent to power amplifier stage for amplification. Finally the modulated vision signal after vestigial side band filter is sent to transmitting antenna for radiation. In vestigial system some of the sides bands on one side may be removed for reducing the band width occupied by the transmitter and this system is used in all present day TV transmissions.

2. *Television receiving system :*

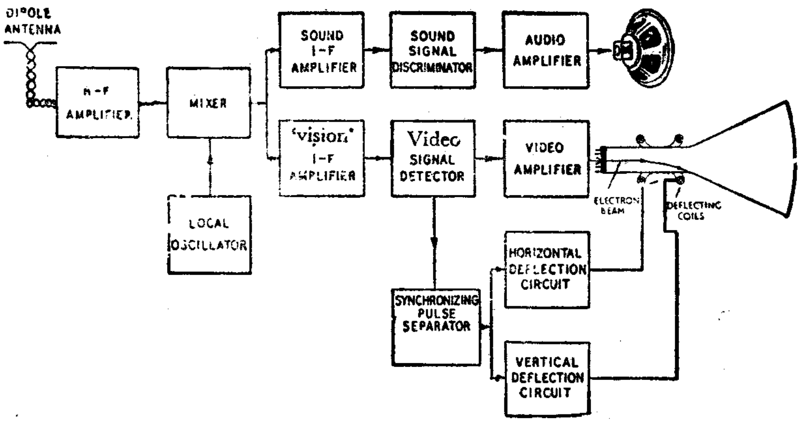


Fig. 3—Block Diagram of TV Receiver

Vision and sound carrier signals are picked up by the common receiving dipole antenna and are coupled to R F. voltage amplifier stage. The R.F. circuits are tuned to select the desire picture carrier. The tuning is sufficiently broad to pass the picture and sound signal.

The bandwidth is as high as 7 Mc/s. The bandwidth in normal radio receiver is only 10 Kc/s. These R.F. signals are amplified and then coupled to converter stage which consists of mixer and local oscillator.

The oscillator frequency voltage from oscillator stage and R.F. carriers signal are mixed in the mixer stage. This will give two I.F. Carriers, one corresponding to picture signal and the other corresponding to sound signal.

The separation between the two intermediate frequencies is same as difference between two carrier frequencies that is 5·5 Mc/s. Thus the mixer output will give two intermediate frequencies. The I. F. for sound is 33.4 Mc/s. and for picture signal is 38·9 Mc/s.

The R. F. ampiifier, the mixer and local oscillator grouped together and the whole unit is known as R.F. TUNER. The propcr coils for the tuning each circuits are switched by a turret mechanism on wafer switch. The seperation between the two I.F's one for sound and one for picture may be done immediately after the frequency changer or the separation is done after the first I.F. stage.

The Sound Channel I.F.'s bandwidth is about 150 to 200 Kc/s. and is narrower compared to the vision I.F. bandwidth.

The gain required for the sound I.F. stage is about the same as the picture I.F. stage but the bandwidth is narrow for the sound I.F. stage, the gain obtained per stage is much higher and so the number of stages will be less.

Vision I. F. Amplifer :

In this block diagram of televlsion receiver the vision I.F. signal is separated in the converter stage. The bandwidth characteristics must be sufficiently board enough to pass the full range of picture signal. As the gain per stage is low at least three stages are used to obtain the amplification needed for the video detector.

Video Signal Detector & Sound System :

The function of video detector is to separate the vision information frequencies from the carrier. The germanium diode can work as video detector. After this the signal contains all the information necessary for reproducing synchronizing blanking pulses but the sound signal is no more present. In modern television receiver the sound signal is separated from this video detector stage instead of converter stage. So there will be a hetrodying action between the vision I. F. and sound I. F. and a new sound signal I.F. is produced which is equal to the difference of two I.F.'s that is 38·9—33.4=5.5 Mc/s. In sound system, the sound I. F. signal is amplified by the sound I. F. amplifier stage and is then fed to discriminator stage for getting the audio output The audio output amplified by the power amplifier is sent to loud-speaker for reproduction of sound as shown in the block diagram.

Video Detector :

The video detector output provides a video signal voltage which contains all the information required and necessary for the reproduction of the pictures. This includes the synchronizing, blanking and desire picture information. This video amplifier usually a resistance capacity coupled stage is designed to amplify uniformly the picture or video signal.

The one video amplifier stage is quite enough for amplification of vision signal required for picture-tube operation. The range of frequencies is approximately 3.5 to 4 Mc/s.

When the video signal is sufficiently amplified, it is coupled to the cathode of the picture tube. This will cause the intensity of the beam current and the spot of light on the screen to vary so that the desire picture is reproduced.

Synchronizing Pulse Separator :

The function of this stage is to separate synchronizing pulses or information in the complete or composite video signal from this TV camera signal to provide an output consisting only of synch pulses.

This is necessary to keep the vertical and horizontal oscillator running in exact step with those at the transmitter of television station.

In this synchronizing separator stage the synch pulses for horizontal scanning and vertical synch pulses for vertical scanning are separated. The horizontal synch pulses are applied to horizontal time base oscillator, and vertical synch pulses are applied to the vertical line base oscillator.

Horizontal Deflection Circuit :

This is a time base oscillator which produces a sawtooth voltage or current wave, shape required for horizontal deflection on the screen of the picture tube. It is a type of oscillator whose operating frequency is adjusted to just a little lower than the frequency of the synchronizing signal pulses. The horizontal synch pulses operate the oscillator just before it would operate due to the characteristics of its own circuit and hence bring in time the synchronizing signals. The output is of sawtooth type so that the beam will move horizontally during active line and horizontal retrace between the lines. The output from the horizontal oscillator is amplified to the required level and applied to the deflecting coils in the yoke which are fitted on the neck of the picture tube.

Vertical Deflection Circuit :

This stage to similar to the horizontal deflection circuit and is designed to operate at a frequency of 50 cycle needed for vertical deflection of the beam of the picture tube. The output of the vertical sweep oscillator is amplified to the required level and applied to the vertical deflection coils in the yoke. These deflection circuits produce the required deflction signals and the scanning pattern with or without the synchronizing signal as the deflection generators are self oscillator and do not require any signal for operation. But the synchronizing signals are essential to maintain the TV receiver scanning exactly synchronized with the scanning at the transmitter in order to produce the image properly.

Power Supplies :

There are two types of power supplies are required in television receiver No. 1. Low voltage of about 250 volts D. C. for the anodes und screen grids of amplifiers, mixer & oscillators. This may be full wave rectifier using valve or silicon diode. No. 2. High voltage supply or about 16 to 18 Kilo volts is required for the final anode of the picture tube and this may be half wave reclifier getting the high a-c voltage in the horizontal output stage.

Cathode ray tube :

Electrons after emission from a cathode can be focused into a narrow beam. This electron beam can then be deflected by electric or magnetic field, and the utilization of this principle leads to the cathode ray tube or kinescope as it is called in television reception. It is used for display of radar information and also as laboratory tool to study the operation of electric circuits.

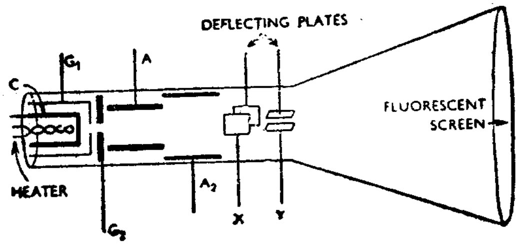


Fig. 4—Simple Cathode Ray Tube.

In the above picture C represents the cathode with heater shown inside the cathode G, serves as grid to control the spot brightness on the screen S. Anode No. A1 is known as the focusing anode since by variation of its potential the electron beam may be sharply focused on the screen. Anode A2 is the second or accelerating anode. X and Y. are two pairs of deflecting plates. S is a screen deposited zinc sulphide on the inner surface of the glass envelope, which gives off light when bombarded by high velocity electrons.

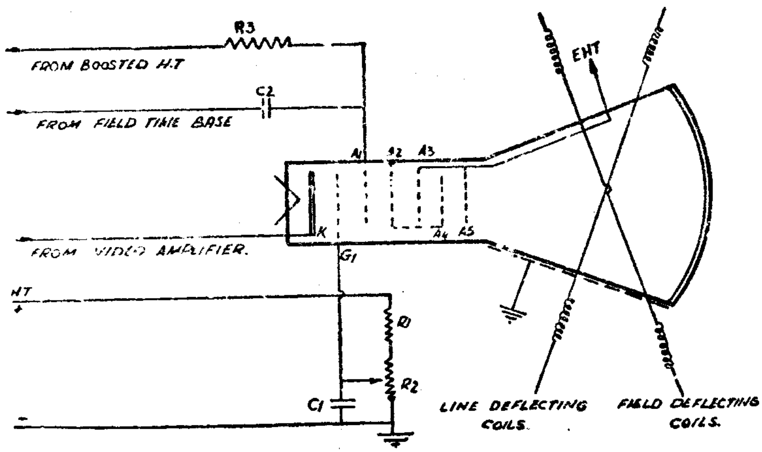


Fig. 5—Picture Tube & Deflecting coils.

If an AC voltage is applied between the pair of "Y" plates the electrons in the beam will be attracted towards the plate which is positive at the moment and repelled by one which is negative. The beam is therefore deflected up and down as the voltage varies and the luminious spot moves correspondingly on the screen. The other pair of X plates is arranged right angle to the first, any voltage across these plate will produce horizontal deflections to the left or right depending on polarity.

There is another type of C. R. T. in which deflection is produced by horizontal and vertical magnetic fields set up currents flowing in the deflecting coils x and y. This type of deflection control is better adopted to tubes using very high accelerating voltages and is commonly used in TV receivers

A variety of flourescent materials is available for the formation of screen. The colour of glow varies with the material and this may be a matter of some importance.

Iconoscope :

When the electron beam moves away from a particular spot on the screen the glow disappears but not instantaneously various fluroescent substances exhibit different rates of delay of brightness after the excitation is removed and the tubes are now available with either long persistance or short persistance sreens. Those with long persistance of yellow or orange. These screens are useful for study of extremely brief phenomena, such as radar information. The tube having short persistance of white glow is usually used in television receiver.

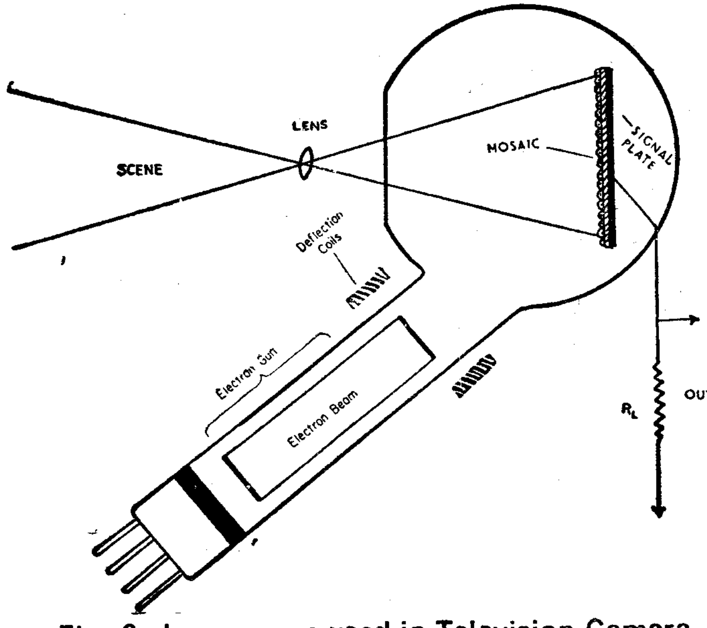


Fig. 6—Iconoscope used in Television Camera.

The iconoscope is a special type of tube used in some TV cameras having an electron gun and focused beam of electrons. The optical image is focused by a lens on to an image plate, consisting of a mosaic of tiny silver dots on a mica card backed by a metal plate. Each dot is photo electrically sensitized and gives up a number of electrons proportional to the light intensity striking it and thus assumes a positive potential charging the small capacitor formed between the tiny dot and the backing plate.

The electron beam, directed towards the mosaic is deflected horizontally across the picture by a pair of deflecting plates or by a controlled magnetic field. After each horizontal deflection or line the beam is deflected downward by the width of two lines and the horizontal deflection repeated. After all the old numbered lines are scanned the operation is repeated on the even numbered lines until the entire optical image has been covered. As the electron beam strikes each silver dot the capacity between dot and backing plate is discharged by addition of electrons to the dot and a current flows to the backing plate is proportional to the charge and thus to the light intensity on that particular dot. A picture consists of a composite of tiny dots scanned at a rate giving 25 complete pictures per second.

3. Television Raster :

The television picture that appears before your eyes is a result of split second timing between three operations. These electronic operations can be easily understood by comparing them to the functioning of a movie projection The projector lamp produce light on a screen just as the TV receiver produces light on a phosphor screen. The TV light is called a raster. In a movie projector the film produces a picture that appears in the light some what like the way a TV signal, intercepted by your TV set, produces a picture in the raster. The film feeding mechanism in the projector puts the film in front of the light in proper sequence similar to the way in which the TV receiver's signal path circuits lead to the TV signal to the picture tube.

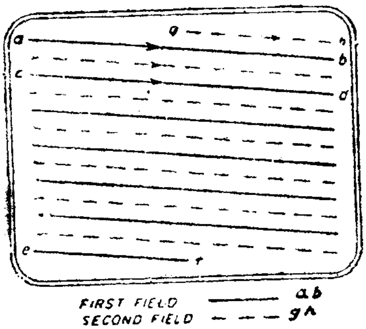


Fig. 7—Showing Interlaced Scanning on the Screen of picture tube.

In a movie projector the lamp shines through a rectangular opening into a screen. The rectangle is shaped so that for every four inches of width there is three inches height. A TV picture also has a aspect ratio of four to three. At this point however the similarity begins to end. A frame of movie film is shown on the screen all in one flash. A raster frame is shown on the screen in a meticulous composite of 1,50,000 pin points of light with no more than one pin points on the screen at any one instant.

The point of light appears on the phosphor because a cathode in an electron gun is emitting electrons in a signal fine ray. The phosphor glows when hit by the ray. Because the beam is narrow it produces only a tiny dot not more than a 32nd of an inch dead centre at the points at which it is aimed. Perhaps you have noticed that a pin point of light remains and gradually fades away when you turn off your TV set. This dot is produced by the rays, which has stopped moving, hitting the screen in one place.

The electron ray must be grabbed hold of f and swung back and forth and up and down. In actual practice it is started at the upper left-hand corner and traced across the screen: Then it snapped back in about one sixth the time it took to swing it across. Since this snap back or retrace is so much faster then the trace it is almost invisible. As soon as the retrace is completed the next line is begun. Line-by line the electron ray travels across he screen until it covers the complete viewing surface. You see only a full screen of light for this tiny dot travels many times faster than the human eye can follow.

A pair of electromagnets known as the yoke are placed around the picture tube neck. The ray must pass through them. The yoke, with its magnetic fields directing the stream of electrons, does the grabbing. By varying the magnetic fields set up by the yoke the ray can be traced retraced and pulled up and down. One part of the yoke, the horizontal section, pulls the ray back and forth. The other half of the yoke the vertical section, pulls the ray up and down.

There are 25 frames every second. If you multiply 625 by 25 it comes to 15625 lines per second. Remember this number. It is your horizontal frequency. The horizontal oscillator produces an alternating current of 15625 cycle per second.

4. *Installation of TV Antennas :*

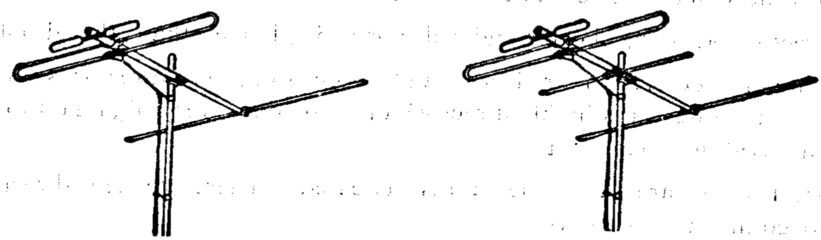


Fig-9 Folded Dipole TV Antennas.

The selection of the type of antenna to be installed will depend on many factors. The most important factor is the distance from the transmitting TV station.. A good outdoor antennas give the best possible picture at medium distance and make reception possible in fringe areas 100 to 150 miles away from TV transmitters.

Dipoles Antennas

The simple dipole antenna consists of two rods or tubes of steel or aluminum whose combined lengths are equal to the half of the transmitting wave length.

A folded dipole is a single hollow rod of aluminum bent back on it-self at each end. The impedence of o folded dipole is about 300 ohms The transmission line which connects to the ends of rod should have approximately the impedence as the antenna.

This folded dipole is easy to mount and works well over a wide range of frequeneies. For this folded dipole is widely used in television antenna system.

Delhi TV station is transmitting the signal on the 4th channel (61 to 68 Mc/s). The length of the dipole antenna also denpends on the frequencies of TV stations. Therefore the length of folded dipole for receiving the Delhi TV signal should be approximately 80 inches.

The spacing between the folded dipole elements is usually 2 to 3 inches for the low band.

Low band covers frequency range 54 Mc/s to 88 Mc/s.

High band covers frequency range 174 Mc/s to 216 Mc/s. Ultra High Frequency band covers frequency range 470 Mc/s to 890 Mc/s.

All dipole antennas are directional. This means that they respond best to signal arriving from certain direction. Rotating television antenna for best reception is necessary.

A metal rod of aluminum placed at a definite distance back of a folded dipole is known as reflector. The reflector rod absorbs signals that get past and reradiates them back to dipole and for this a stronger signal goes down to the transmission line of receiver. A reflector also serves to suppress unwanted signals coming from back side.

A metal rod placed ahead of dipole at a difinite distance is known as director. It also reradiates the signal to give addition of signals at the dipole.

The director rod is 5% shorter and reflector is 5% longer than the dipole element.

Any antenna having one reflector and more than one director is known as Yagi antenna. This Yagi antenna is highly directive and provides a very high gain for this reason it is eommonly used in fringe area.

As more directors are added the gain is increased. There are ten director elements can be employed in Yagi antennas.

All the television antennas, are basically combination of dipole, reflector and director elements. The different shapes and arrangement are used to give different compromises of three important antenna characterstics, gain, directivity and frequency response. With high gain antennas good reception is being obtained even out as for as 200 miles from TV station.

5. Cascade R. F. Amplifier in TV Receiver :

The first circuit in the tuner of television receiver is the R.F. amplifier. The R. F. amplifier takes the carrier signal of picture and sound and amplifies about fifty times, The R. F. amplifier must amplify the carrier only and reject any noise and static interference.

Pentodes and special types of triodes can be used in this stage. Pentodes have the advantages of giving high amplificaιion but tend to allow some snow to get into the picture

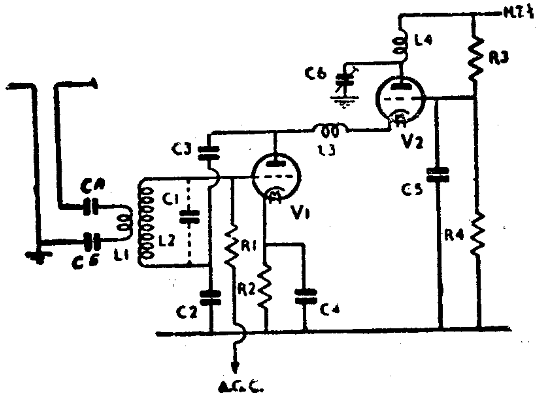


Fig. 9—Circuit Diagram of TV R.F. Stage

Triodes do not produce as much amplification but they are quite static free. For this reason like the 'Fig. 9' golden grid cascade r-f amplifiers are commonly used in TV receivers. This device combined the high amplification of the pentode with low noise characteristics of the triode. Two triodes with gold plated grids were placed into one tube envelope. The output of this stage will be fed to the mixer stage. Tuner troubles are more likely to occur in the r-f amplifier stage than in the following tuner circuits which are known as the mixer and local oscillator. The valve v1 and v2 are the triodes portions of valve ECC 88 combine in one envelope.

6. Frequency changer stage of TV Receiver

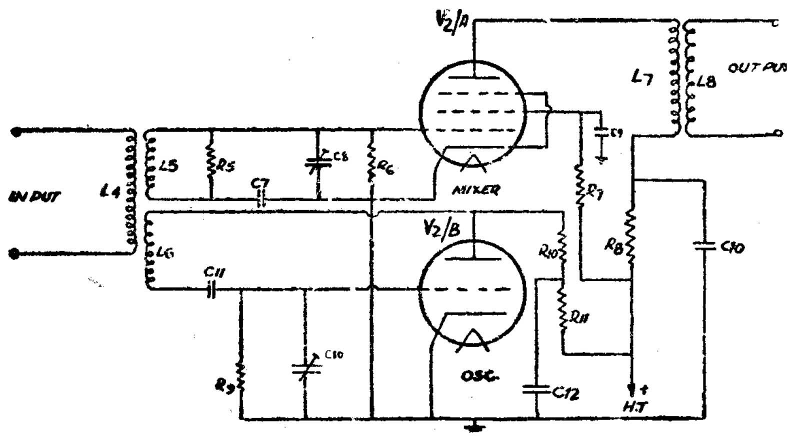


Fig. 10—Circuit Diagram of Converter Stage

Resistors :—

R5=6.8 M ohm   R6=0·25M ohm   R7=50K ohm
R8=1 K ohm   R9=22K ohm   R10=15K ohm

Capacitors :—

C7=50 Pfd   C8=2.5 Pfd (vari)   C9=1000 Pfd
C10=2·5 „ (vari)   C11=50 Pfd   C12=1000 Pfd

This 'Fig 11' is a converter stage. Triode valve ECF80 is used in this circuit. Triode portion V2/B of ECF 80 is working as Oscillator and V2/A is the pentode portion of this same valve working as mixer. The R f. signal of 2/B is fed to tuned circuit formed by the coil L5 and C8 and stray capacitance of the circuit. Resistor R5 is connected across the tuning coil L5 for broad tuning. This tuned circuit is designed to select the forth channel of Band 1 from 61 to 68 Mc/s.

In the oscillator circuit L6 and C10 forms a resonant circuit at 101·15 Mc/s.

The frequency of picture signal of Dehli TV station is 62·25 Mc/s and 67.75 Mc/s for sound. These both signals are mixed in the pentode valve with oscillator frequency of 101.15 Mc/s to form the I. F. 's of 33.4 Mc/s. and 38.9 Mc/s.

The I.F. of sound is 33.4 Mc/s and 38·9 Mc/s of picture. The variable capacitor C10 is known as fine tuning capacitor which is fitted on front panel of TV receiver. By varying the capacity of this capacitor you can select the desired signal of picture and sound The output of valve V2/A is fed to coil L8 which is input circuit of I. F. amplifier.

Trouble Shooting in R. F Tuner Circuit

(R. F. Amplifier, Mixer and Oscillator circuit)

Symptoms	Cures
1. No sound, good raster.	Replace R. F amplifier or Osc-mixer valve.
2. Snowy raster, snowy picture, no sound or weak sound.	Replace weak R. F. amplifier valve.
3. No reception on channel No. 4.	Replace Oscillator mixer valve.
4. Hum bars in pictures, distorted sound.	Replace faulty R. F. amplifier or Osc-mixer valve.
5. Ghosts in pictures that are affected by fine tuning control.	Replace faulty R. F. amplifier valve.
6. Sound and picture do not tune-together.	Replace Oscillator-mixer valve.

7. *Vision I. F. Amplifiers :*

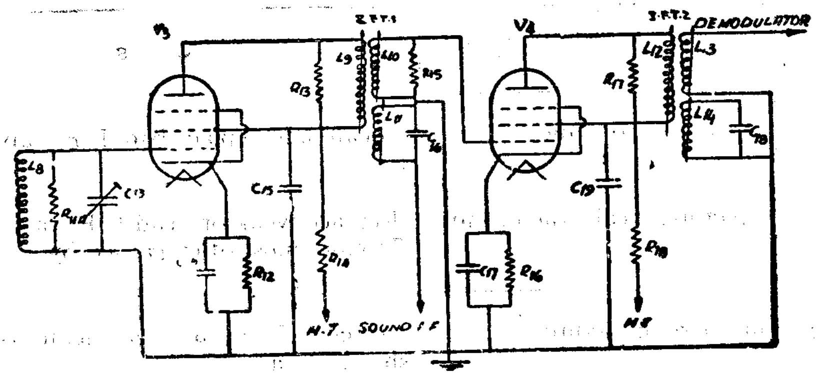


Fig. 12—Circuit Diagram of I. F. Stages.

Resistors.

R11,	=5 K ohm	R12	=300 ohm	R13, R15, R17=12 K ohm
R14, R18	=1 K ohm	R16	=150 ohm	

Capacitors.

C13,C16,C18=2·5 Pfd. C14,C15,C17,=·005 Mfd.

V3=EF 183 V4=EF184.

This is a schematic diagram of a typical two stage I. F. amplifier. The I. F. output of the mixer is mutually coupled to L8 This amplifier is also broadly tuned to handle a frequency range of 5 to 6 Mc/s. For this reason resitstor R11 is connected across the coil L8 for broad tuning. The gain of this amplifier is low so three or four I.F. stages are used in televison receiver. The tuning of each input and output circuit is sufficiently broad to pass the picture and sound signal. Vision I F. is 38·9 Mc/s and sound I. F. is 33·4 Mc/s.

In case of split sound TV receiver the sound I. F. is separated at secondary of I. F. T.1, but the modern TV receiver are based on Comite Consultatif International des Radio (C.C. I. R.) system, separation of sound is done after the first video amplifiers The required screen grids voltage are provided by R14 and R18. C15 and C16 are the by-pass capacitors. Resistor R12 and R16 are used to provide the grid bias voltage to valve V3 and V4 respectively. The output of 2nd I. F, amplifier V4 is coupled to pideo detector to extract the picture, sync, and blanking information from the modulated I. F. carrier.

Trouble Shooting in I. F. Section

Symptom	Cures
1. Raster only, no snow, no audio.	Locate and replace bad I F. valve.
2. Washed out picture, weak audio, no snow.	Replace weak or dead I. F. valve, Trouble most often caused by 1st. I.F. valve.
3. Fifty cycle hum bars in picture.	Defective I. F. valve has heater or cathode short, replace
4. Picture gets more and more contrast, slips vertically, buzz appears in sound	Replace I. F. valve. Trouble most often caused by the last I F. valve.
5. Jumpy picture, lines through picture. Condition not due to outside interference.	Clean all I. F. valve pins and base sockets

8. *Video-Detector.*

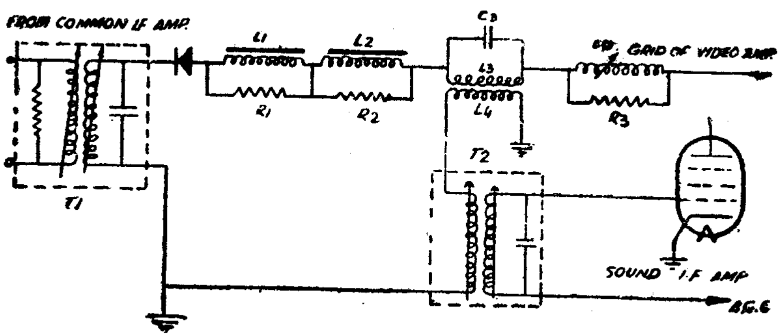


Fig 12—Diode working as Video-Detector

After the carrier leaves the I. F. section it is directed into a seperation stage known as video detector. At this point the audio and sync pulses are unloaded from the I. F. carrier and go their seperate ways to create sound and picture.

The function of the detector is to perform the unloading job and discard the I. F. carrier since the picture and sound elements of the TV signal are in the range of 5.5 maga cycles, the video detector is designed to pass frequencies no higher than thes upper limit. The 33 mega cycles I. F. carrier can not enter the detector and is eliminated.

The video detector can take one of two forms. It can either be a diode valve circuit or a germanium diode circuit as shown in Fig. 12.

9. Automatic Gain Control :

There is another circuit that operates as the sub-ordinate to the video amplifier. That circuit is known as the automatic gain control or AGC because of the function it performs.

In the television receiver the AGC is actually an automatic contrast control. The picture signal that comes through the air is constantly varying in strength. If permitted to appear on the TV screen that way would see a constantly changing picture. The AGC keeps the contrast at a level you see it. It does this by sampling the video signal strength through a tap from video amplifier. If the contrast goes too high the AGC circuit reduces the sensitivity of the tuner and I. F. amplifiers reducing the video signal. If the signal voltage goes to low the AGC increases the sensitivity of the receiver. The AGC performs this job instantly so that you have a constant picture that never varies in contrast.

The AGC circuit develops a small negative voltage that varies from about 0-5 volts to 5 volts. The stronger the signal becomes the more negative the AGC output voltage. The negative voltage if fed to the grids of tuner and I. F. amplifiers. In this way the signal strength is controlled and kept at a constant level.

10. Sound System In Television :

In modern television reciver the sound carrier signal travels with picture carrier signal through the r. f. amplifieri converter, I. f. amplifier, vision demodulator and video amplifier. In passing through the vision demodulator the sound and picture I. f. carriers mix with each other to produce a new sound i. f. signal of 5.5 Mc/s. The picture signal goes to the video amplifier and the sound i.f. carrier signal goes to through it own 5.5 Mc/s i.f. amplifier, discriminator, audio amplifier and loud speaker just as in an F.M. receiver This is known as intercarrier television sound system.

The frequency modulated sound signal from the last sound I.F. amplifier is applied to F. M. detector. The F. M. detector is also known as discriminator. There are two type of discriminator which are commonly used in the TV receiver. These are ratio-detector and Foster seelay discriminator. In this circuit Foster seelay discriminator is used for extracting the audio signal ftom I. F. signal.

The transformer T3 having the cenre tap in the secondary is used in the anode circuit of pentode valve and a single tuning capacitor C7 is used across the secondary winding.

Both the primary and secondary windings are tuned to resonate at the centre frequency of the I. F. signal. Regardless of the frequency variations of the I. F. signal, the signal

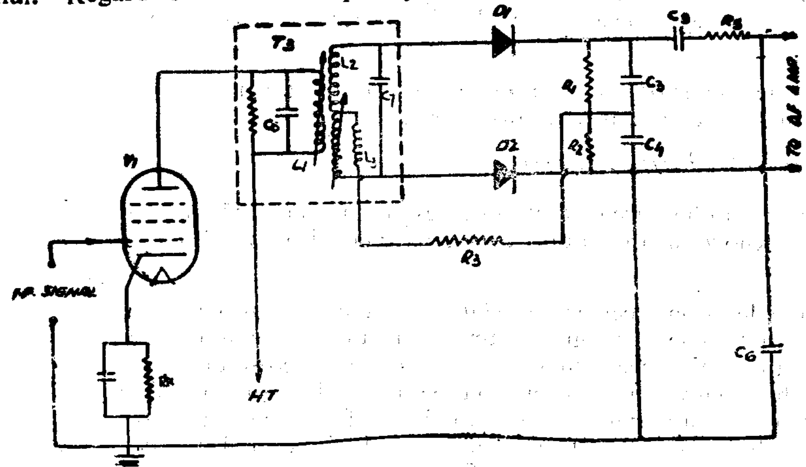


Fig 14—Foster Seelay Discriminator in TV. Set.

voltage developed across upper portion of L2 and lower portion of L2 is always equal. The sign l voltage developed across the primary coil of L1 is fed to the radio frequency; choke L3

The voltage across L3 adds both to the voltage across the upper portion of L2 and lower portion of L2. In this circuit the phase relationships between the voltages across L3, L2 (Upper) and L2 (Lower) will vary as the intermediate frequency deviates and an audio signal voltage is developed across the capacitor C6 which will be coupled to the first audio amplifier.

10. *Audio Section of Receiver :*

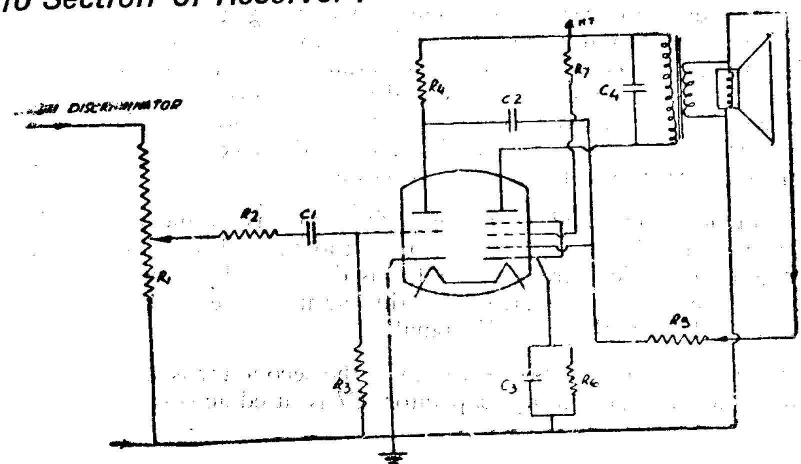


Fig. 15—Audio Amplifiers of TV Receiver

List of parts :— Value=ECL 82.

Resistors

R1=1M ohm	R2=10 K ohm	R3=22 M ohm	R4=220K ohm
R5=680 K ohm	R6=300 ohm	R7=500 ohm	

Capacitors

C1=10 Mfd.	C2=·01 Mfd	C3=50 Mfd.	C4=0.002 Mfd

The audio signal from the discriminator is fed to triode portion of ECL82 through R2 and C1. The resistor R1 works as volume control of audio amplifier. R2 is the r, f. stopper resistor to avoid unwanted r. f. disturbance in this stage. The output of this triode is coupled to the pentode portion of this valve through the coupling capacitor C2. This pentode portion works as the output stage of the audio amplifier. Resistor R6 and C3 are used in cathode circuit for providing the negative bias to the control grid of this pentode valve.

A small amount of output from the secondary of output transformer is fed back to control grid of pentode as a negative feed back for improving the quality of audio signal. In this audio amplifier stage the audio signal is increased until it is powerful enough to drive the loudspeaker. The power output of this amplifier is about three watts.

The servicing procedure of TV sound section is same as the audio section of radio receiver.

11. Video Amplifier and Picture Tube :

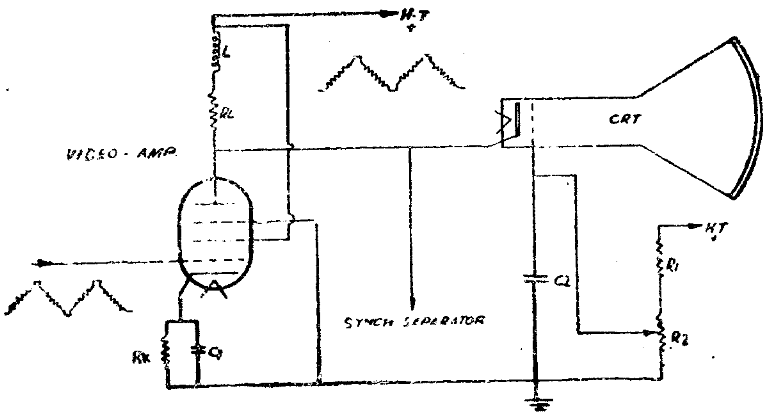


Fig. 16—Video Amplifier and Picture Tube.

Parts list :—Valve Pentode portion of ECL84.

RK=47 ohm RL=6.8K ohm R1=100 K ohm R3=500K ohm (vari)

There are three exits out of the video detector one for audio which is already describe in the previous lesson, and the second one for sync and the third one video. The sync pulses are inclued in the composite r. f. signals transmitted by a TV broadcast station to prövide timing information required for synchronization of the transmitter and receiver scanning system.

The function of above video amplifier is to increase the pure picture signal so that it will be strong enough to create a picture on the TV tube. The video signal voltage is not constant in frequency. It covers a broad range of frequencies from zero to 4·5 Mc/s because it represents the millions of light and dark dots making up the TV picture. Video amplifiers must be carefully designed to cover the entire range of video frequencies.

The valves that have a low inter-electrode capacitance should be used for video amplifier. This is because large stray capacity will kill off the higher frequencies in the video signal.

The output of this video amplifier is applied to the cathode of the picture tube to intensity-modulate the electron beam during its vertical and horizontal scanning of the picture tube screen. The brightness control R2 adjusts the grid bias on the picture tube to assure that the blanking level occurs at the correct blank point, so it controls the intensity of illumination of screen of picture tube. The brightness adjusted when no picture signal is present on the screen, a point where the vertical retrace lines just disappear is the correct position.

12. *Synchronization Circuit*

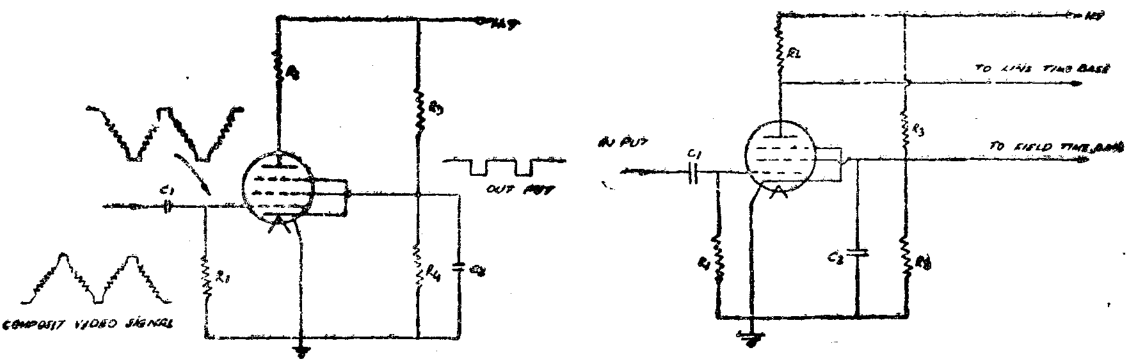


Fig 17—Synch Separator and Amplifier Circuits.

The sync section consists of four main parts, the sync separator, the integrator, the differentiator and the horizontal A.F.C. A portion of the signal voltage enters the sync separator stage after it leaves the video detector. The sync circuits are set up so that the sync pulses are clipped away nicely from the video and audio and the pulses alone are sent into the grid of sync separator valve. This work is done by a pentode valve as shown in the above circuit.

In the sync separator valve the vertical pulse is isolated from the horizontal pulse. The difference of time constant (R×C) duration of line and field sync pulse make it possible to sort them out. If output is taken from the resistor it is differentiator and if from the capacitor it is integrator. The vertical sync is applied to the vertical oscillator valve and locks the oscillator precisely in time with the way the studio camera is scanning each interlaced field. Your TV picture is thus locked in vertically.

The horizontal sync is applied to horizontal oscillator and locks the oscillator so it beats precisely in time with the way the studio camera is scanning each line of the frame. Your TV picture is thus locked in horizontally.

The simplest trouble to diagnose in a TV set is sync trouble. The picture just will not remain still. Sync trouble can be caused in the vertical oscillator or horizontal oscillator circuits.

Trouble No. 1 :—Picture Rolls and Slips.

A bad sync valve will not permit the sync pulses to get either the horizontal or vertical oscillators. If there is no sync pulse there is no synchronization. The second reason is that the vertical oscillator frequency is not exactly 50 cycles per sec. It is set a little below This is done so the addition of the sync pulse will raise the frequency to exactly 50 cycles. If the sync valve fail to process the verical syne pulse to the oscillator the oscillator will run free at slightly less than 50 cycles per second causing the picture to roll.

If the picture rolls and instead of locking slips either way according to the direction in which you will adjust the vertical hold control, the vertical sync pulse is not arriving at the vertical oscillator. This condition could be caused by a defective sync valve. If the picture locks in vertically but needs constant adjustment then this is also due to defective sync valve.

Trouble No. 2 :—Horizontal Drifting.

The horizontal sync processing is more complicated than the vertical as mentioned previously. Noise while it will not affect the 50 cycle per sec, vertical frequency, can be quite detrimental to 15625 c/s horizontal frequency.

Rather than take the horizontal pulse and inject it driectly into the horizontal oscillator grid as is done in the vertical oscillator, the pulse is sent into a special circuit known as the horizontal automatic frequency control. In this circuit the speed of the horizontal pulse is compared with the speed of the horizontal oscillator. As long as the two are running exactly neck and nack no votage is developed.

If one should begin to lead the other a DC correction voltage is developed and fed to the horizontal oscillator grid.

The voltage shifts the horizontal oscillator frequency so that it compares correctly with the frequency of the horizontal pulse. This DC correction voltage, a result of the comparison, actually controls the horizontal frequency automatically. If the sync pulse does not get past the sync circuits due to defective valves there will be no DC correction voltage and the picture will drift back and forth horizontally.

13. Horizontal Oscillator.

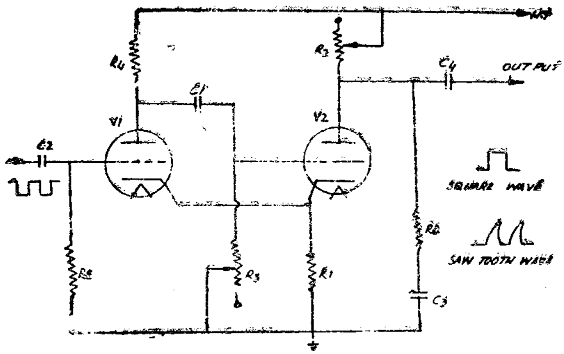


Fig. 18—Practical Time-Base Oscillator.

This is the cathode coupled time base oscillator circuit which is commonly used in television receiver, Here the two triode valves are coupled to each other by resistance capacity coupling and produces square waves. The grid leak resistor R3 is used as the hold control and brought out on the front panel of televison receiver. It determines the frequency of oscillations and thus it controls that picture does not slip up and down. The plate load resistor R2 is also a variable resistor which controls the size or height of the picture. This is kept at the back of the television receiver.

The main function of this stage is to produce an alternating current at the frequency of 15625 cycles per second exactly one pulse per every line drawn on the TV screen by the electron gun.

Some of the alternating current produced by the horizontal oscillator is used in making the very high voltage necessary to create light on the face of picture tube. This will study in the next lesson.

The first check in determining whether or not the oscillator is running is to listen for it. Most people can hear this high pitched if they try. To become acquainted with it do this while your TV set is turned on rotate the horizontal hold control R3. As you rotate the control you should hear an extremely high pithed while changing in frequency. If you do not hear this sound and there is no brightness on the TV screen, chances are the horizontal oscillator is not operating. Now check the horizontal oscillator valve.

The horizontal oscillator has specific frequency of 15625 cycles per second. It must run at exactly that speed not a cycle eitherway. This is the frequency the picture being taken or scanned at the studio. If your TV receiver is not exactly in step you will get a screen full of slanting lines instead of a picture. If the set has only a few lines on the screen, the horizontal oscillator frequency is close to 15625 though not exact. If the screen shows many slanting lines the frequency is far away from 15625. The first step towards curing the loss of horizontal synchronization to replace the horizontal oscillator tube. The second step is to try making adjustments. Adjustable resitors R_2 and R_3 are included in circuits to compensate for wear.

Turn the shaft of R_2 one way and the frequency goes up, turn it the other way and the frequency goes down. Adjust it to best position for getting 15625 cycle per second.

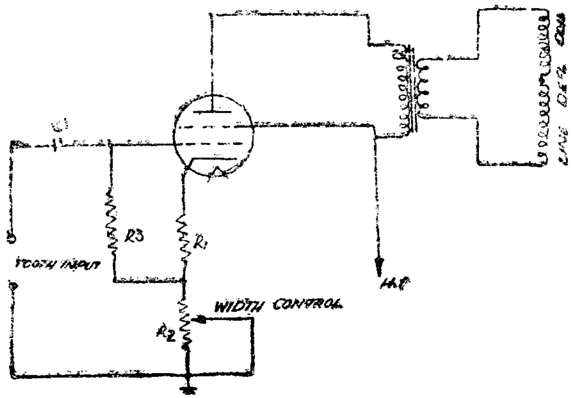


Fig. 19—Horizontal Output Stage.

When the horizontal pulse is first made in the horizontal oscillator it is too weak to be used. So it is passed from the oscillator into the next stage, the horizontal output amplifier. This circuit is also known as line time-base output stage. This circuit takes the 15625 cps pulses through capacitor C_1 and blows them up or amplifies them till they are large enough to work. From the anode of output valve the amplified pulse is sent to the yoke where it causes the electron ray to be swept back and forth across the picture tube face. Operation of the horizontal out-put tube is dependent upon the horizontal oscillator In fact it is so dependent that if the horizontal oscillator goes dead the lack of pulse on the grid of the horizontal output amplifier makes the tube run hotter than it should. Any such prolonged activity will burn out the output tube.

14. The Damper Valve.

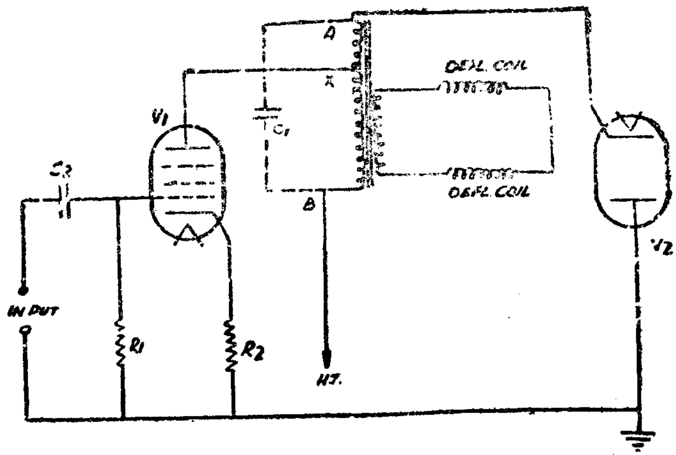


Fig. 20—Damper stage in TV receiver.

In the TV receiver a damper valve is used to dampening the vibrations or variation in the fly back system.

When we speak of fly back action we are talking about an electromagnetic phenomenon. The actual activity is this. The horizontal output amplifier feeds the horizontal pulse into yoke. The frequency is going off and on at 15625cps. While the frequency is at the height of its voltage a powerful magnetic field surrounds the yoke. During the next instant the frequency drops off to the depth of voltage. The magnetic field follows the voltage drop and collapses suddenly or flies back.

The sudden collapsing cause electricity of thousands of volts to appear for an instant in the yoke coil. The voltage is fed back into a small winding in the fly back transformer, The fly back activity causes many other, not quite as strong, frequencies voltage ractifier. The flp back activity causes many other, not quite as strong, frequencies to begin to develop. These transient voltage must be dampened. That is what the damper does It is a rectifier that changes these transient frequencies to direct current so. they are not frequencies any more.

As you known that the horizontal pulse produced in the horizontal oscillator and amplified in the horizontal output valve for the purpose of swinging the electron ray across the screen has an additional function of production of very high voltage needed to create brightness on the face of the picture tube.

15. *High Voltage Rectifier*

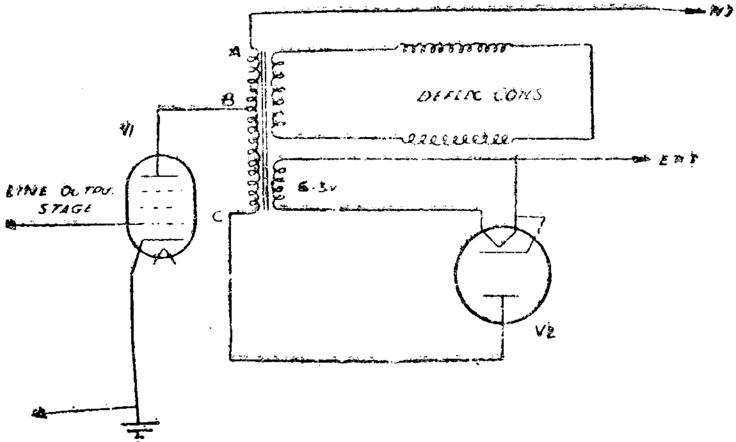


Fig. 21—Circuit Diagram of E. H. T. Supply.

In order for electron ray to reach tne phosphor face a high voltage of about 18000 volts must be applied to the picture tube,

By taking a sampling of the horizontal pulse and properly utilizing it the TV set can produce high voltage as a by product.

When the varying plate current of 15625 cycles will flow in the 'AB' upper-portion of transformer winding, a very high voltage will developed across the whole winding due to high rate of change of magnetic flux. From the terminal C the high AC voltage are given to the anode of V2 for rectification and we are getting the extra high d c. voltage from the cathode of this diode valve.

These high voltage are applied to the final anode of picture tube. The final anode is connected to the top cap of picture tube

If the sound is off and there is no brightness on the TV screen, then first check the high voltage recitifier valve.

If the electrical pressure is only a hundred volts there is vey little danger of leakage beacause the combination of plastic and air is plenty of insulation, However when the voltages rises to 18000 volts, the insulation problem becomes critical. Things like ageing of the wire, positioning of the wire and humidity in the air becomes important factors,

Your TV set can develop a mild leak or a serious one. The mild leaks are called corona discharge. There is a hissing noise and if you darken the room you will see at the trouble spot, a bluish ray emanating from high voltage system to a place on the chassis or high voltage cage. The cure is usually easy. Take a piece of plastic with high insulating qualities and position it in the path of the ray.

A serious leak is called arcing. It sounds miniature pistol shots and looks like a little lightning dlscharge from the high voltage system to a point on the chassis or a high voltage cage. To cure arcing use high voltage tape and reinsulate carefully the high voltage area.

16. Vertical Deflection Section

There is another important section of the television set is the vertical deflection circuit which consists of vertical time-base oscillator of 50 cps, amplifier and vertical output stage. The vertical time base oscillator works in a similar fashion to the horizontal oscillator execpt that the vertical deflection is at a relatively slow 50 cycles per second. This is exactly the right speed so that each horizontal line is pulled down beneath the other.

In multivibrator oscillator the sawtooth type oscillation takes place due to alternate conditions of the two triodes. The circuit may be free running and oscillate at its natural frequency but to synchronize the oscllator action with the signal from a TV transmitter, vertical synch pulses are injected for triggerting the oscillator.

Twenty five pictures of frames consisting of 625 lines are made per second on a TV screen. Each of these complete picture is broken up into two halves known as fields. The first field consisting of odd number lines is traced across the screen first. This is followed by interlacing in the second field which includes all the even numbered lines.

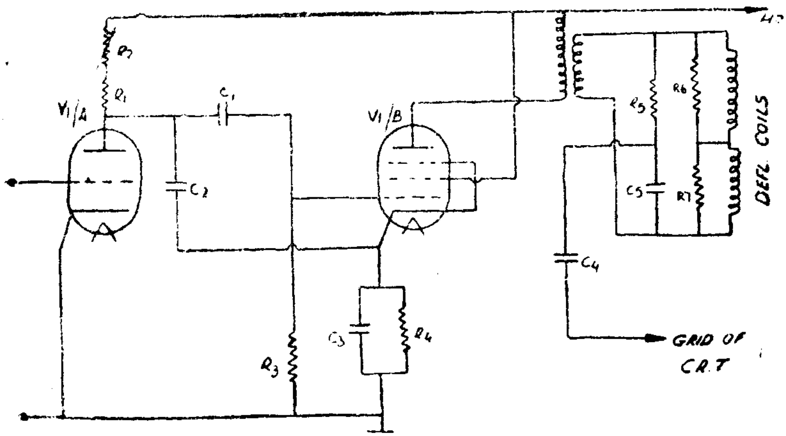


Fig. 22—Practical Circuit of Field Out-put Stage.

Since it takes two fields to make one complete picture and there are 25 complete pictures per second ir can be seen that the vertical oscillator must drive the electron ray through 50 complete field per second. This is the reason for the 50 cps output from the vertical oscillator. The flickering is avoided in this type of interlace scanning. In this circuit V^1A is the part of multi-vibrator oscillator and V^1B is the vertical output tube which takes the vertical pulses from the oscillator and amplifies them so they are large enough to drive the vertical deflection coils in the yoke.

If the vertical oscillator is not functioning then there will be no vertical sweeping and there will be only bright line across the centre of the screen and will burn and darken the phosphor of picture tube. In effect it will burn a line across the centre of the screen. If you come up with no vertical sweep turn the brightness control all the way down while you repair the set. The first step when your TV set develops this condition is to change the vertical oscillator valve.

If the picture rolls up and down then it means that you have lost vertical synchronization. Loss of vertical sync can happen due to weak vertical oscillator valve which throws the frequency either below or above the 50 cps. If the vertical hold control fails to correct this condition then replace vertical oscillator valve and adjust vertical hold control.

Under normal conditions the vertical hold control should lock in the picture in the middle, not at one extreme or the other. If this occurs the vertical oscillator is to be replaced.

If the vertical oscillator valve becomes weak the picture can shrink-in from top and bottom. Usually when this happens the shrinking is even or linear.

17. Power Supply of Television Receiver.

The circuit 'Fig 23' is the power supply of a television receiver. This is the only circuit in a TV set upon which all the rest depend. The remaining sections of a television set act in one way or another to help create picture and sound. If this power supply goes dead none of them will function.

When you turn on your TV receiver you close a circuit that permits 220 volts 50 cycle AC house current to enter the power supply. The AC line curreut is changed by the power-supply to the precise voltages needed to operate the remaining circuits.

Televison receiver valves need three separate voltage potentials in order to operate. The first is the heater voltage necessary to heat up the cathode and drive electrons off it. In this circuit there are two separate L.T. secondary windings of 6·3 volts for heating the heaters of all the tubes of a TV receiver. The second type of potential is the plate voltage necessary to attract electrons for the plates of the TV tubes. Since the plate voltage must be direct current, the power supply has the job of changing the alternating current from the line into direct current with the help of silicon diode D^1.

The third type of voltage used is grid voltage. Grid voltage is derived directly from the AGC circuit and the television signal itself. Since the power supply is called

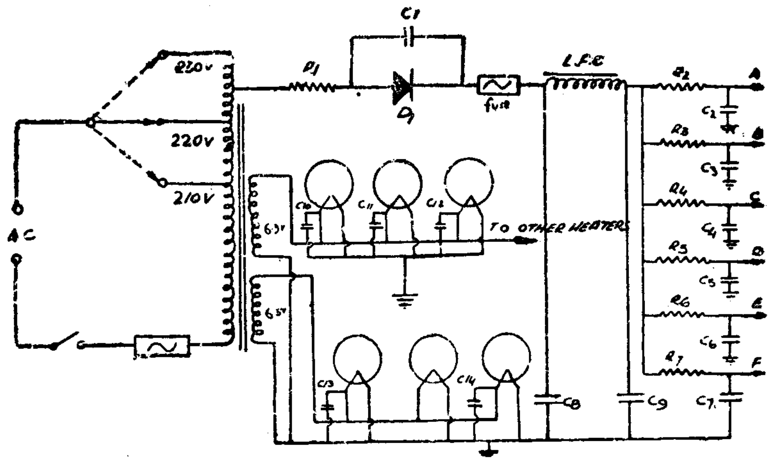


Fig. 22—Heater & Rectifier Circuit of AC/DC TV Reciver

upon to operate the AGC circuit and the tubes that process the TV signal, grid voltage also depends upon the power supply.

There are two main types of power supply, the transformer type is used in a/c TV receiver and transformerless type used in AC/DC TV receiver. In this transformer type heater voltages is furnished through the two step down windings in the transformer. The 220 volts 50 cycle AC current enters the primary of the transformer. There are two extra tapping of 210 volts and 230 volts in the primary winding. The 50/ dron windig feeds the windings in the transformer converts this to 6.3 volts. The secondary voltage feeds the heaters directly. The heaters of all the tubes are connected in parallel.

The silicon diode D^1 is working as a half wave recfifier. The pulsating DC voltage in the cathode is filtered to pure DC voltage with the help of low frequency choke and two electrolytic capacitor C^8 and C^9 and then delivers to different stages through their R. C. filters.

20. *M. W. Band Six Transistors Receiver.*

Parts list—

TR^1—Converter=AF 117	TR^2—Ist I. F. Amplifiar=AF 116
TR^3—2nd I. F. Amplifier=AF116	TR^4—Ist A. F. Amplifier=AC126
TR^5—Power Amplifier=AC128	TR^6—Power Amplifier=AC128
D —Detector =OA79.	

Resistors

R^1=10 KΩ	R^5=2.2 KΩ	R^3=1 KΩ	R^4=33 KΩ
R^5=680 KΩ	R^6=—	R^7=220Ω	R^8=150Ω
R^9=5 K Ω	R^{10}=4·7 KΩ	R^{11}=68 KΩ	R^{12}=1 ΩK
R^{13}=47 Ω	R^{14}=22Ω		

Capacitors

C^1=310 Pfd.	C^2=0·01 Mfd.	C^3=·01 Mfd.	C^4=0.05 Mfd.
C^5=10 Mfd.	C^6=0.05 Mfd.	C^7=·01 Mfd.	C^8=10 Mfd.
C^9=0.01 Mfd.	C^{10}=0.01 Mfd.	C^{11}=100 Mfd.	

Circuit Description—This is a typical circuit having only medium wave band. The ferrite rod inside the tuning coil T^1 works as the aerial. The Primary of T^1 and C^1 forms the resonant circuit for selecting the desire signal. The capacitor C^1 is the gang capacitor. This tuned circuit is coupled to the base of the converter transister TR^1 through the capacitor C^2. The forward bias is provided by R^1 and R^2. The oscillator tuned circuit is formed by the 2nd section of C^1 and T^2 The primary of T^2 is coupled to secondary winding for required feedback between collector and emitter. The emitter resistor R^3 acts as the emitter stabilzing resistor and for the additional bias to the transistor when circuit is oscillating.

The I. F. signal from TR^1 is picked out by the first I.F.T.[1] This tranaformer consists of two windings, one forming the resonant circuit with fixed ceramic capacitor, the other winding feeds the I. F. signal to the base of I. F. amplifier TR^2. The resultant forward biat to the base of TR^2 is provided by R^4, R^5, R^{10} and C^4. The I. F. amplifier TR^2 feeds the I. F. transformer I. F. T.[2] which is similar to I. F T,[1]. The bias is stabilized by the emitter resistor R^7 and C^6. The I. F, T.[2] feeds the signal to 2nd I. F. amplifier TR^3. The I.F. signal in the secondary of I F. T^3. is fed to the diode for detection. The a.g.c. voltage is fed through R^{10} to TR^2 only.

The volume control R^9 feeds the audio stage TR^4. The bias for TR^4 is provided by R^{11}. Transistor TR^4 feeds two output transistors through the push-pull transformer T^3 The power output transistors TR^5 and TR^6 ara operated in class B pushpul[and transformer T^4 is the L. F. output transformer feeding thc loudspeaker. The forward bias is provided to the bases of TR^5 and TR^6 by the rdsistor R^{12}. end R^{13}. Stabilization of the bias is by the resistor R^{14} which can not be by-passed because the transistor are operating class B. The capacitor C^{11} is in parallel with battery of three volts to reduce possible feedback due to the battery impedence.

M. W. BAND TRANSISTOR RADIO

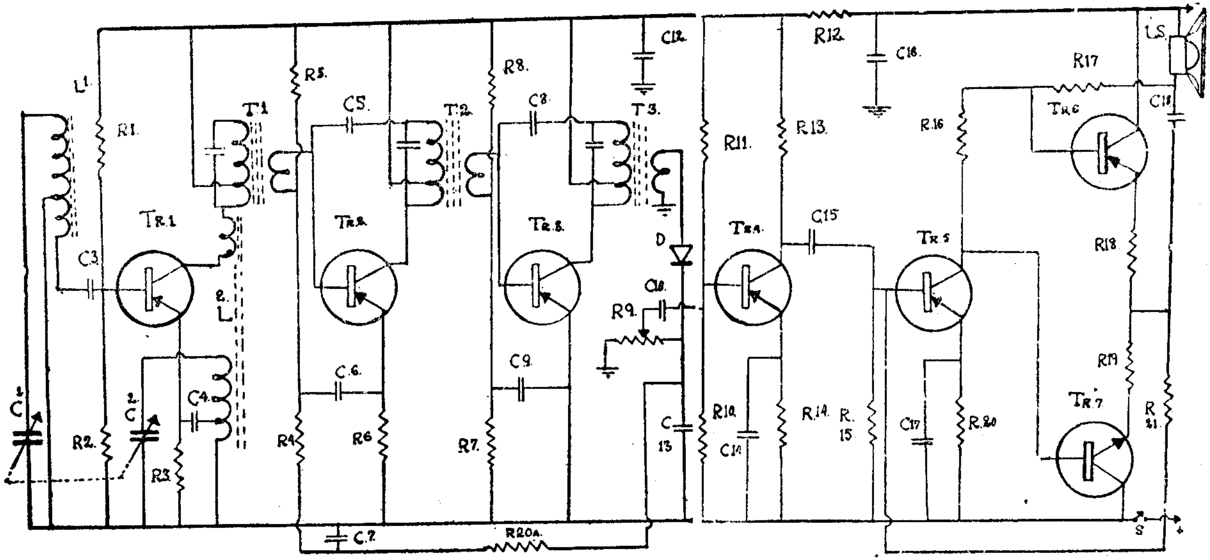


Fig. 25—Seven Transistors Radio Receiver

Capacitors :

C^1, C^2 = 300 Pfd.
C^3, C^{13} = 0.01 Mfd,
C^5, C^8 = 5 Pfd.

C^4 = 0.002 Mfd.
C^6, C^9 = 0.02 Mfd.
C^7 = 30 Mfd.

C^{10}, C^{15} = 10 Mfd.
C^{12}, C^{14}, C^{16} = 100 Mfd.
C^{17} C^{18} = 100 Mfd.

Resistors :

R^1 = 15 KΩ
R^2 = 5.6 KΩ
R^3 = 1.2 KΩ
R^4 = 56 KΩ
R^6 = 8.2 KΩ

R^6 = 1 KΩ
R^7 = 4.7 KΩ
R^8 = 22 KΩ
R^{10} = KΩ
R^{11} = 100 KΩ

R^{12} = 100 KΩ
R^{15} = 2.2 KΩ
R^{14} = 1 KΩ
R^{15} = 10 KΩ
R^{16} = 100 KΩ

R^{17} = 1 KΩ
R^{18} = 2.5Ω
R^{19} = 2.5Ω
R^{20} = 1 KΩ
R^{21} = 100 KΩ

Circuit Description. The incoming signal is tuned by capacitor C^1 and L^1 This signal is applied to a base through a capcitor C^3 of 0.01 mfd. The base bias is supplied by R^1 and R^2. The resistor R^3 in the emitter circuit is known as a stabilizing resistor. It reduces the sensitivity of the transistor to temperature changes and permits replacement by a transistor whose characteristics might be slightly different that the original transistor AF116. When signalvoltage applied to the base of TR^1 aids and opposes the bias on the base to emitter input circuit, this will vary the collector current. This varying current when passing through the primary coil of L^2 induces a voltage across the secondary which is then fed to the emitter of converter through a capacitor C^4 of ·002mfd. The oscillator coil L^2 is tapped to form a hartley oscillator. By mixing the incoming signal frequency and oscillator frequency, a third beat frequency is formed which is equal to 455 Kc/s. In the I.F amplifiers both the input and output circuits of the stages are tuned to the same intermediate frequency. The output of last I.F.T is fed to the diode for detection.

The transistor T^4 is the first audio amplifier. The input voltage from the volume control R^9 is applied to the base through C^{10} of 10mfd electrolytic capacitor. R^{10} and R^{11} is potential divider for providing the forward bias to the base. The resistor R^{14} is the stabilizing resistor which stabillized the collector current with the help of by-pass capacitor C^{14} The output voltage of resistor R^{13} is coupled to the base of TR^5 through a coupling capacitor C^{15}. Transistor TR^6 and TR^7 from the power amplifier used in complimentary symetrical output stage. The driver collector current through R^{14} provides the necessay bias for power stage and reduces cross over modulation. A small amount of negative feed-back is applied through R^{21}. The output impedence is 8 ohms. The circuit consumes very little current in the output stage. A speciality of this transformer-less output stage is that it has a very low distortion, better frequency response as in high fidelity receiver and less battery consumption.

Transistor TR^7 is N.P.N transistor and the other are P.N.P. transisto-s since the N.P.N. transistor are now easily available in the market, there is no difficulty in the assembling of this type of receiver.

22. Two Bands Transistor Radio Receiver

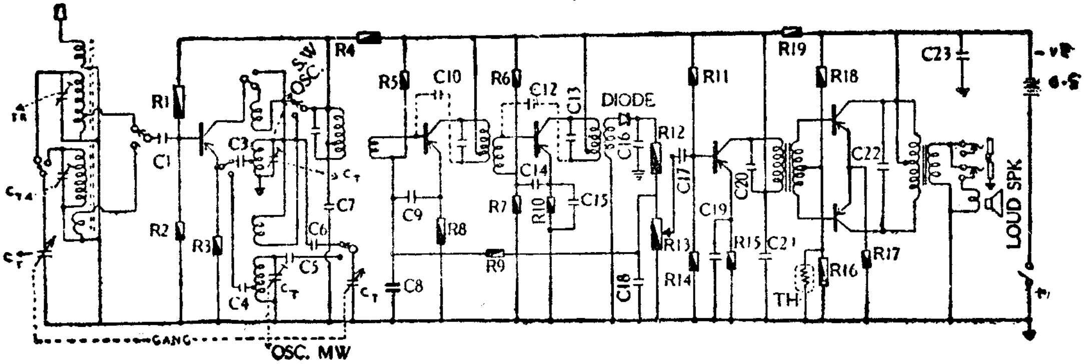


Fig. 26—Six Transistor Radio

1. Converter—AF114
2. Ist I.F. Amp.—AF117
3. 2nd I.F. Amp.—AF117
4. Ist A.F. Amp.—AC125
5. Power Amp —AC126
6. Power Amp —AC126

Resistors

R^1 =47K ohm	R^2. R^9=10K ohm	R^4 =200 ohm
R^5 =68K ,,	R^3, R^{12}=2.2K ,,	K^{16}=100 ,,
R^{10}=1K ,,	R^6. R^{11}=22K ,,	R^{16}=100 ,,
R^{14}=5.6K ,,	R^7. R^{18}=4.7K ,,	R^{17}=5 ,,
	R^8. R^{15}=680 ,,	

Capacitors

C^1 =0.01mfd	C^9. C^{14}=0 05mfd	C^5=500PF
C^4=0.001mfd	C^8, C^{17}=10mfd	C^6=600PF
C^7=0 05mfd	C^{20}, C^{22}=0.05mfd	C^3=300PF
C^{16}=0 04mfd	C^{15}, C^{19}=30mfd	C^{10}=5 PF
	C^{21}, C^{23}=100mfd	C^{12}=5 PF

Servicing Procedure of this Radio

Cause of no reception of the both bands—

This is one of the easiest trouble to remove but there are so many causes for no signal output in a transistor receiver.

The following is the complete list of causes. 1. Dead battery. 2. Bias resistor open in any transistor, R^{17}, etc 3. Open Coupling capacitor C^{17}. 4. Voice coil open. 5. Open or shorted jack for head phone 6 Open winding of L.F. transformers. 7. Shorted filtering capacitors C^{23}. 8. Open or shorted R^{13} volume contiol. 9. Open base winding of I.F.T. 10. Open or shorted collector winding of I F T. 11. Shorted in the circuit winding 12. Shorted gang-capacitor. 13. Open antenna loop. 14. Shorted by-pass capacitor C^{8} etc. 15. Inoperative oscillator section. 16. Open oscillator coil. 17. Defective diode. 18. Misalignment. 19. Open lead connection of the battery. 20. Defective Transistor.

It is a big and impressive list can be easily divide-up the radio receiver into two sections by feeding a signal from the signal injector across the volume-control. If you heard a response in the loud-speaker the audio section of the set is functioning normal.

If the sound does not come out, the fault is to be found out in the audio section There after one has to check the circuit stage by stage and locate the fault.

Oscillator mixer and I.F. amplifiers is the H.F. section of the receiver. The out-put from the converter, AF114 is fed to an I.F. Amplifier AF117. The majority of the receiver use two I.F. stages.

No output when modulated r. f. signal is fed at the antenna point would indicate a faulty H.F. section, assuming that A.F. section had already been tested and found satis-factory. Check the converter and I.F. stages and locate the fault.

SILICON TRANSISTORS RADIO

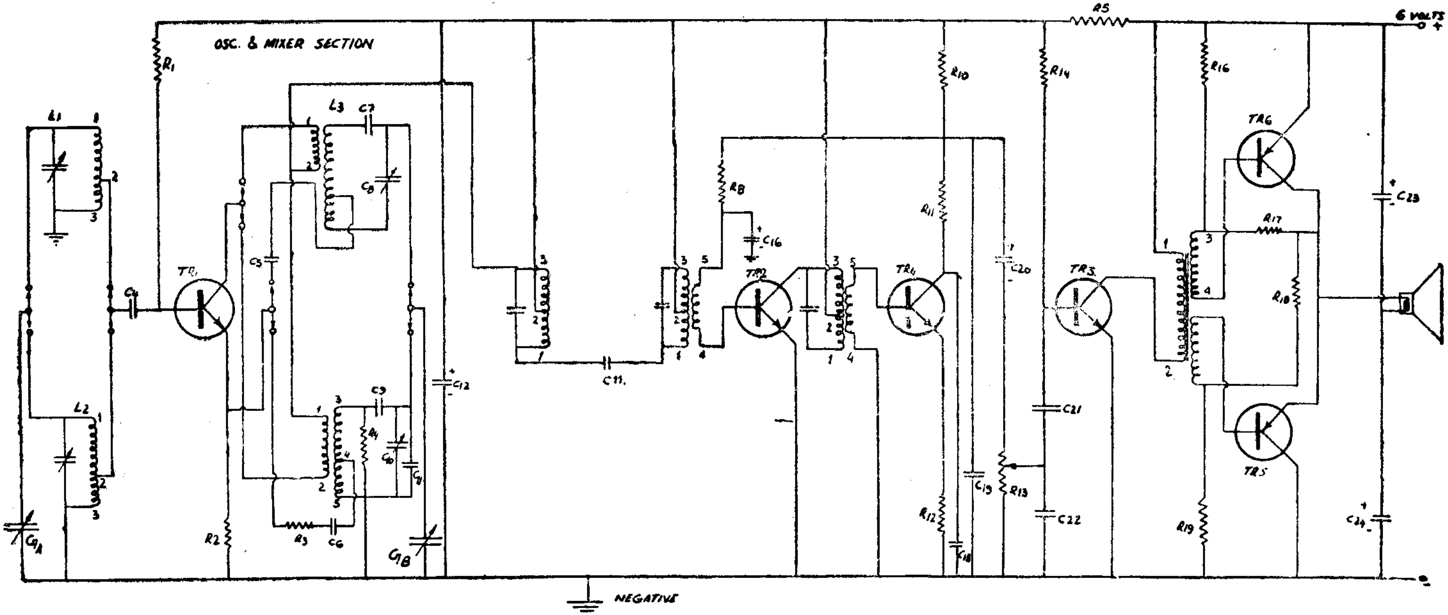


Fig. 27—Two Bands Silicon N.P.N. Transistor Receiver

Parts list :—

Tr^1=BF194B—Convertor	Tr^2=BF195C—I.F. Amplifier
Tr^4=BC147—Detector	Tr^3=BC147—A.F. Amplifier
Tr^5=AC128—Output stage	Tr^6=Output stage

23. *Silicon Transistor Radio Receiver*

Resistors :

R^1=330K Ω	R^2 =1KΩ	R^3=15 Ω	R^4=150K Ω
R^8=150 Ω	R^6=not used	R^7=not used	R^8=470K Ω
R^9=not used	R^{10}=8.2K Ω	R^{11}=820 Ω	R^{12}=10 Ω
R^{13}=10K Ω	R^{14}=200K Ω	R^{15}=not used	R^{16}=47 Ω
R^{17}=820 Ω	R^{18}=47 Ω	R^{19}=820 Ω	

Capacitors :

C^1A, C^1B=180Pfd—gang.
C^7=·04Mfd.
C^{11}=5Pfd.
C^{16}, C^{20}=4Mfd.

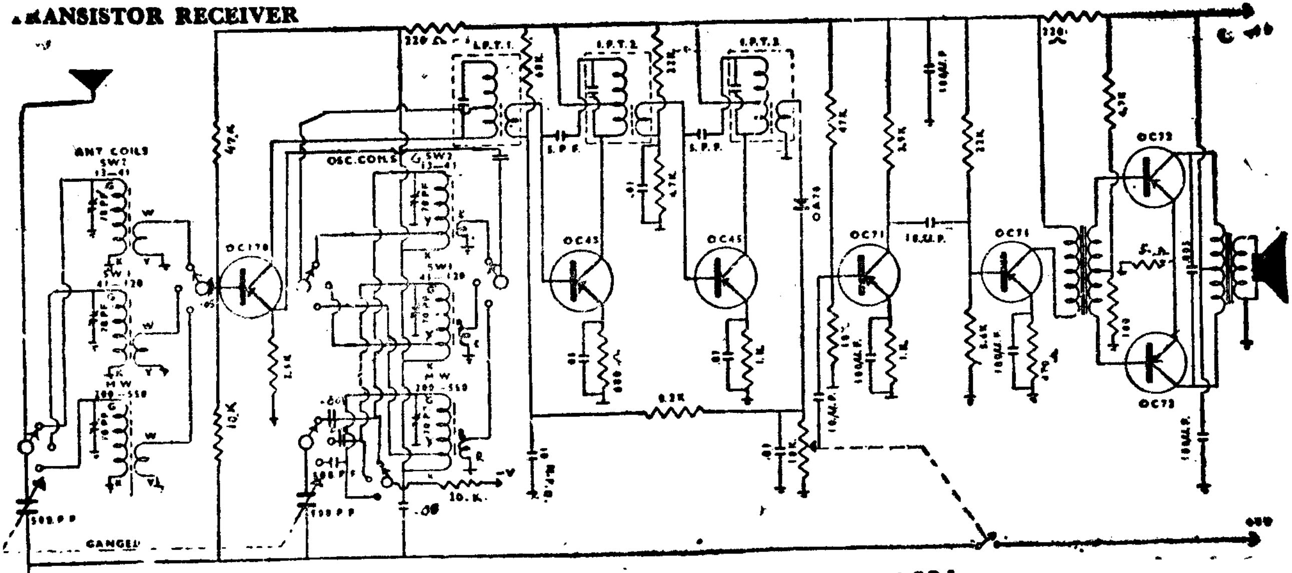
C^4. C^5, C^{19}. C^{22}=0.01 Mfd.
C^9=200 Pfd.
C^{12}, C^{23}, C^{24}=200Mfd.
C^{81}=10 Mfd.

REFERENCE CHART FOR TESTING P.N.P. TRANSISTORS

Test step	Base	Collector	Emitter	Ohm-Meter Reading
1.	Meter positive	Meter Negative	x	500K Ω
2.	Meter Negative	Meter Positive	x	300 ,,
3.	Meter Negative	x	Meter Positive	300 ,,
4.	Meter Positive	x	Meter Negative	500K ,,
5.	x	Meter Negative	Meter Positive	50K ,,
6.	x	Meter Positive	Meter Negative	500K ,,
7.	Meter Positive	Meter Negative	Meter Positive	500K ,,
8.	Meter Negative	Meter Negative	Meter Positive	275 ,,

Reverse the meter connections for testing N.P.N. transistor and reading will be approximately same. The silicon transistors are having high resistance between base and collector in comparison to germanium transisrors.

ALL WORLD TRANSISIOR RADIO



Designed By **RADIO TELEVISION TRAINING CENTRE. AGRA.**

Fig. 28—Seven PNP Transistors Receivar

Resistance of I.F. Transformer & L. F. Transformers.

Windings	I F T1	I.F T2	I.F.T3	T1	T2
Primary	4 8 Ω	4.8 Ω	4.4 Ω	1.2K Ω	30 Ω
Secondary	0.8 Ω	0.4 Ω	0.3 Ω	0.7 Ω	1 Ω

24 *Servicing of Transistor Radio Receiver*

First the batery voltage should be checked with the receiver switched on and the battery loaded, severe distortion, low sensitivity and reduced power output, may result from a low battery voltage If it is found that a owner has connected the cells in the reverse direction, the electrolytic capacitors in the circuit are as likely to be damaged as the transistors.

When the receiver is completely out of order and the battery is found to be serviceable then make a visual inspection to locate possible loose, dirty, or intermittent speaker connections It must be remembered, when testing transistors that a transistor should never de replaced before the surrounding components have been thorughly examined Since the transistor is the most reliable component in the receiver it should be the lass component to be suspected.

Now check the resistance across the receiver battery leads with ohm-meter, it is generally possible to observe whether the reading appears to be either very low indicating a short circuit or very high indicating an open circuit or similar fault. The resistance check will give information on D. C. fault only. Where the resistance check shows a normal value. the signal path is to be checked with the signal generator. The quick trouble shooting technique is to inject an appropriate signal into each transistor base going from loud-speaker to antenna.

Apply a signal of 400 cycle from the signal generator to the each base of power amplifier transistors, equal volume of 400 cycle note should be heard in the speaker from each transistor. Now connect the signal generator to the base of driver transistor OC71. If the audio note is heard, the driver stage is functioning normal. The signal generator lead may then be touched to the upper end of the volume-control to check the complete audio section of the receiver. The signal injector can be used for signal generator for checking these audio amplifier stages. If the audio section of the receiver is working properly the tests can proceed to detector OA70 and I.F. amplifiers OC45.

Now apply a 455 Kc/s modulated signal from the signal generator to higher frequency section of the receiver. As soon as the signal is not passed by a stage of amplification, this stage should be checked. Care must be taken that the signal generator positive lead should have a series capacitor inorder not to change the bias condition in the circuit under test, or use a radiant loop with the signal generator for injecting the signal to the stages of transistor receiver.

ALL WORLD TRANSISTOR RADIO

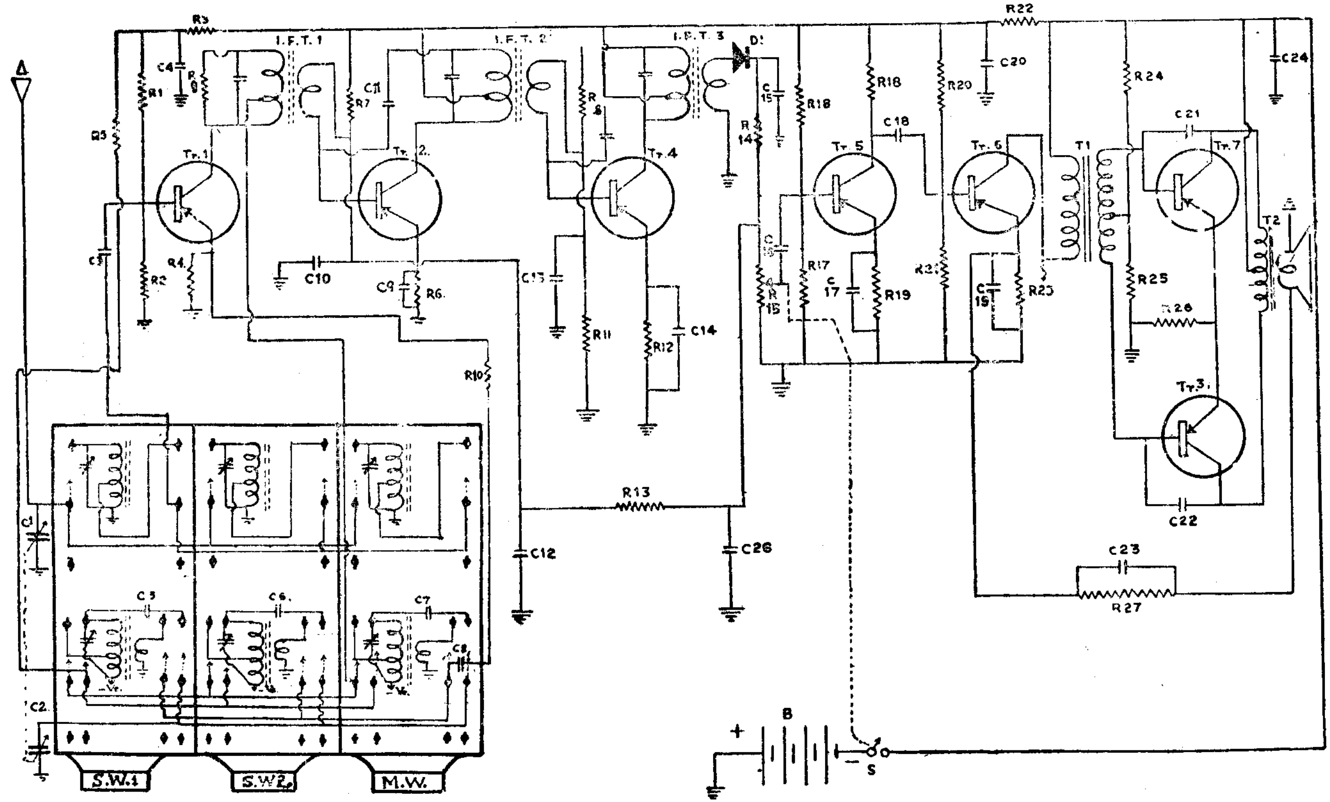


Fig. 29— Transistor Radio with PIANO Band-Switch

25. *Transistor Radio With Piano Switch.*

Parts List Transistors :

Tr. Number	Function	Tr. Number	Function
Tr^{1}—AF114	Mixer & Osc.	Tr^{6}=AC125	2nd A F. Amp.
Tr^{2}—AF117	1st I.F. Amp.	Tr^{7}=AC128	Power Amp.
Tr^{4}—AF117	2nd I.F. Amp.	Tr^{3}=AC128	Power Amp.
Tr^{6}—AC125	1st A.F. Amp.	D1 =OA79	Detector.

Resistors

R^{1} = 10 KΩ	R^{2} = 33 KΩ	R^{3} = 100Ω	R^{4} =2·5 K Ω
R^{6} = 10 K ,,	R^{6} = 1 K ,,	R^{7} = 68 K Ω	R^{8} =22 K ,,
R^{9} = 100 K ,,	R^{10}=33 ,,	R^{11}=4·7 K ,,	R^{12}=680 ,,
R^{13} = 10 K ,,	R^{14}=1 K ,,	R^{15}=5 K ,,	R^{16}=47 K ,,
R^{17}= 10 K ,,	R^{18}=3.9 K ,,	R^{19}=1 K ,,	R^{20}=22 K ,,
R^{21}=5·6 K ,,	R^{22}=100 ,,	R^{23}=510 ,,	R^{24}=4 7 ,,
R^{25}=100 ,,	R^{26}= 5 ,,	R^{27}=22 K ,,	

Capacitors

C^{1} =310 PF.	C^{2} =310PF.	C^{3} =0·005 Mfd.	C^{4} =0·05 Mfd.
C^{5} =0 01 Mfd.	C^{6} =0.005 Mfd.	C^{7}=0.002 Mfd.	C^{8} =0 002 Mfd.
C^{9} =0 05 Mfd.	C^{10}=0 01 Mfd.	C^{11}=5PF.	C^{12}=10 Mfd.
C^{13}=0.01 Mfd.	C^{14}=0 05 Mfd.	C^{15}=0·01 Mfd	C^{16}= 10 Mfd.
C^{17}=30 Mfd	C^{18}=10 Mfd.	C^{19}=30 Mfd.	C^{20}=100 Mfd.
C^{21}=0 005 Mfd	C^{22}=0 005 Mfd.	C^{23}=0·002 Mfd.	C^{24}=100 Mfd.

Connections With Piano and Switch.

There are 18 poles in this band switch. Each poles has two terminals The poles terminals are indicatd by the arrow mark Six poles are used for the upper three antenna coils, and twelve poles for lower oscillator coils.

Aerial and C^1 are connected to No. 1 pole and base of TR^1 is connected to pole No. 2 through capacitor C^3. Pole No. 1 is shorted to poles No. 3 and No. 5 Pole No. 2 is shorted to poles No. 4 and 6.

Battery negative voltage are coming to pole No. 8 through resistor R^3. The lower connection of osc. coil should be connected to this pole for getting negative voltage. Pole No. 8 is shorted to poles No. 12 and 16.

The collector of TR^1 is getting negative voltage through the lower parts of primary winding of I.F.T. 1. The centre tap of primary winding is connected to pole No. 15 for getting negative voltage, pole No. 15 is shorted to pole No. 11 and 7.

The tapped winding of Osc. coil is the primary winding and the other winding is the Sec. winding. The feed back voltages which are developed across sec. winding are applied to emitter of TR^1 through capacitor C^8. The capacitor C^8 is connected to pole No. 17 and this pole is shorted to pole No. 13 and 9. The extreme right pole No. 18 is shorted to poles No. 14 and 10. The osc. section fo gang capacitor C^2 is also connected to pole No. 18. Connect the others terminals of the coils and trimmers to the particular terminals as shown in the figure.

26. *All world Transistor Radio Receiver.*

Tr. Number	Function	Tr. Number	Function
Tr1—2SA234	Mixer	Tr5—2SB75	1st A. F. Amplifier
Tr2—2SA234	Oscillator	Tr6—2SB75	2nd A.F. Amplifier
Tr3—2SA12	1st I.F. Amplifier	Tr7—2SB77	Power Amplifier
Tr4—2SA12	2nd I.F. Amplifier	Tr8—2SB77	Power Amplifier

Resistors

R^1=33 K Ω	R^2=2·2 K Ω	R^3=100K Ω	R^4=3·3 K Ω
R^5= 1 K ,,	R^6= 1 K ,,	R^7=47K ,,	R^8=1.5 K ,,
R^9= 1 K ,,	R^{10}=22 K ,,	R^{11}=4.7K ,,	R^{12}=680 ,,
R^{13}=5·6K ,,	R^{14}= 1 K ,,	R^{15}= 5K ,,	R^{16}=47 K ,,
K^{17}=4.7K ,,	R^{18}=3.3 K ,,	R^{19}=680K ,,	R^{20}=22 K ,,
R^{21}=5·6K ,,	R^{22}=100 ,,	R^{23}=470 ,,	R^{24}=1.5 K ,,
R^{25}=50 ,,	R^{26}= 5 ,,	R^{27}=22 K ,,	D^1=OA79 Diode

Capacitors :

C^1 =310Pfd. C^2 =310Pfd. C^3 =0·04 Mfd. C^4 =0·05Mfd.
C^5 =100Pfd. C^6 =300Pfd. C^7 =300Pfd. C^8 =0.1Mfd.
C^9 =0·005mfd C^{10}=0·01mfd C^{11}=0·05mfd. C^{12}=10mfd.
C^{13}=0·01mfd. C^{14}=0 05 mfd. C^{15}=0·01mfd C^{16}=100mfd.
C^{17}=30mfd. C^{18}=10mfd. C^{19}=30mfd. C^{20}=100mfd.
C^{21}=0 005mfd C^{22}=0·005mfd. C^{22}=0·002mfd. C^{24}=100mfd.

Voltage Specifications

Transistor	2SA234 (Mix)	2AS234 (osc)	2AS12 (2nd IF)	2SA12 (2nd IF)	2SB75 (1st AF)	2SB75 (2nd AF)	2SB77 (out-put)
Collector	–5·1V	–4·2V	–5·1V	–5·1V	–3·8V	–4·6V	–6·0V
Base	–0·45V	–1V	–0 5V	–0·95V	–0·8V	–0·8V	–0·14V
Emitter	0·4V	–0·95V	–0·4V	–0·95	–0·75V	–0·75V	0 01 V

27. All Worlo Transistor Radio Using Silicon-Transistors.

Resistors :

R^1 =390 KΩ R^2 = 1·K Ω R^3 =470 Ω R^4 =220 K Ω
R^5 =100K ,, R^6 = 1 K ,, R^7 =220 ,, R^8 =220 ,,
K^9 =680 ,, R^{10}= 1 M ,, R^{11}=6·8K ,, R^{12}= 1 K ,,
R^{13}=220K ,, R^{14}=100 ,, R^{15}=100 ,, R^{16}=10 ,,
R^{17}=47 ,, R^{18}=820 ,, R^{19}=47 ,, R^{20}=820 ,,
V. C.–Volume Control =5K Ω

Capacitors

C^1 =0·01Mfd. C^2 =0·01Mfd. C^3 =100Mfd. C^4 =3·05Mfd.
C^5 =not used C^6 = 10Mfd, C^7 =0·05Mfd. C^8 =0·05Mfd.
C^9 =0·05Mfd. C^{19}=0·05Mfd. C^{11}=0 01Mfd. C^{12}=0·01Mfd.
C^{13}= 0·4Mfd. C^{14}=0·04Mfd. C^{15}=200Mfd. C^{16}=200Mfd

SILICON TRANSISTORS RADIO

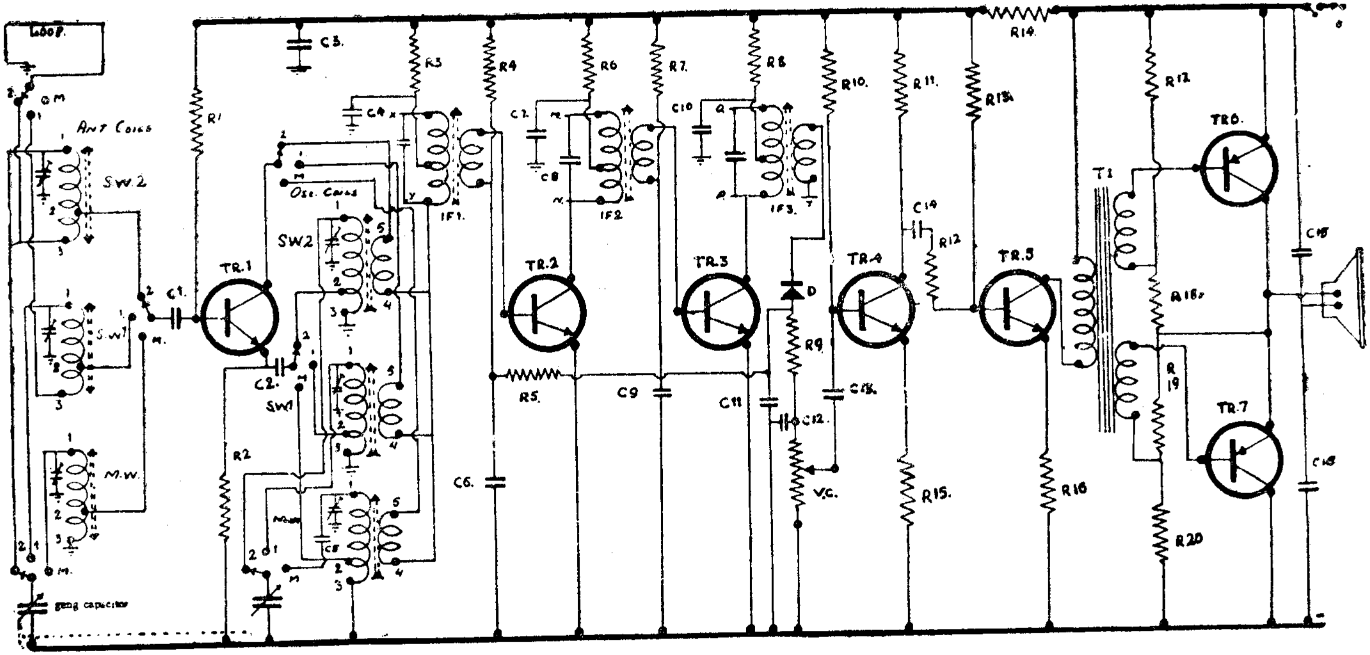


Fig. 30—High Gain Transistor RADIO

TR[1] = Converter = BF194B
TR[2] = 1st I. F. Amplifier = BF195 C
TR[3] = 2nd I. F.—Amplifier = BF195D
D[1] = Detector—OA79.

TR[4] = 1st L.F. Amplifier—BC148B
TR[5] = Driver Amplfier—BC148B
TR[6] = Power Amplifier—AC128
TR[7] = Power Amplifier—AC128

Capacity of each trimmer =30Pfd.
Capacity of each section of Gang=350 Pfd.
Battery voltage=6 Volts
Loudspeaker resistance=8 Ohms.
Transistor Leads Indentificafion (Bottom view)

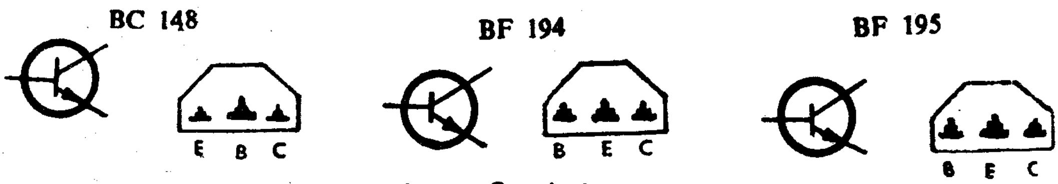


Fig. 31- Transistors Symbols and Pin Connecticns.

Antenna Coils Numbering.			Oscillator Coil.			I. F. Transformers.		
No.	1.	Start	No.	1.	Start of Sec.	No.	1.	Start of pri.
No.	2.	Tapping.	No.	2.	Tapping of Sec.	No.	2.	Tapping of pri.
No.	3.	Finish.	No.	3.	Finish.	No.	3.	Finish of pri.
			No.	4.	Start of pri	No.	4.	Start of sec.
			No.	5.	Finish of pri.	No.	5.	Finish of sec.

23. *All World P.N.P Transistor Radio Receiver.*

Resistors.

R^1 =100 Ω	R^2 =5 Ω	R^3 =3.3 K Ω	R^4 =100 Ω
R^5 =220 ,,	R^6 =22K ,,	R^7 =10 K ,,	R^8 =680 ,,
R^9 =2.2K ,,	R^{10}=33K ,,	R^{11}=10 K ,,	R^{12}=5 K ,,
R^{13}=1 K ,,	R^{14}=22K ,,	R^{15}=4.7 K ,,	R^{16}=680 ,,
R^{17}=10 K ,,	R^{18}=68K ,,	R^{19}=100 ,,	R^{20}=1.2 K ,,
R^{21}=33 K ,,	R^{22}=100 ,,	R^{23}=100	

Capacitors.

C^1 =100Mfd.	C^2 =100Mfd.	C^3 =100Mfd.	C^4 =10Mfd.
C^5 =100Mfd.	C^6 =10Mfd.	C^7 =0.01Mfd.	C^8 =0.05Mfd.
C^9 =0.01Mfd.	C^{10}=5Pfd.	C^{11}=5Pfd.	C^{12}=8·05Mfd.
C^{13}=30Mfd.	C^{14}=0·05Mfd.	C^{15}=0·005Mfd.	C^{16}=0·01Mfd.
C^{17}=0.00 Pfd.			

ALL WORLD TRANSISTOR RADIO

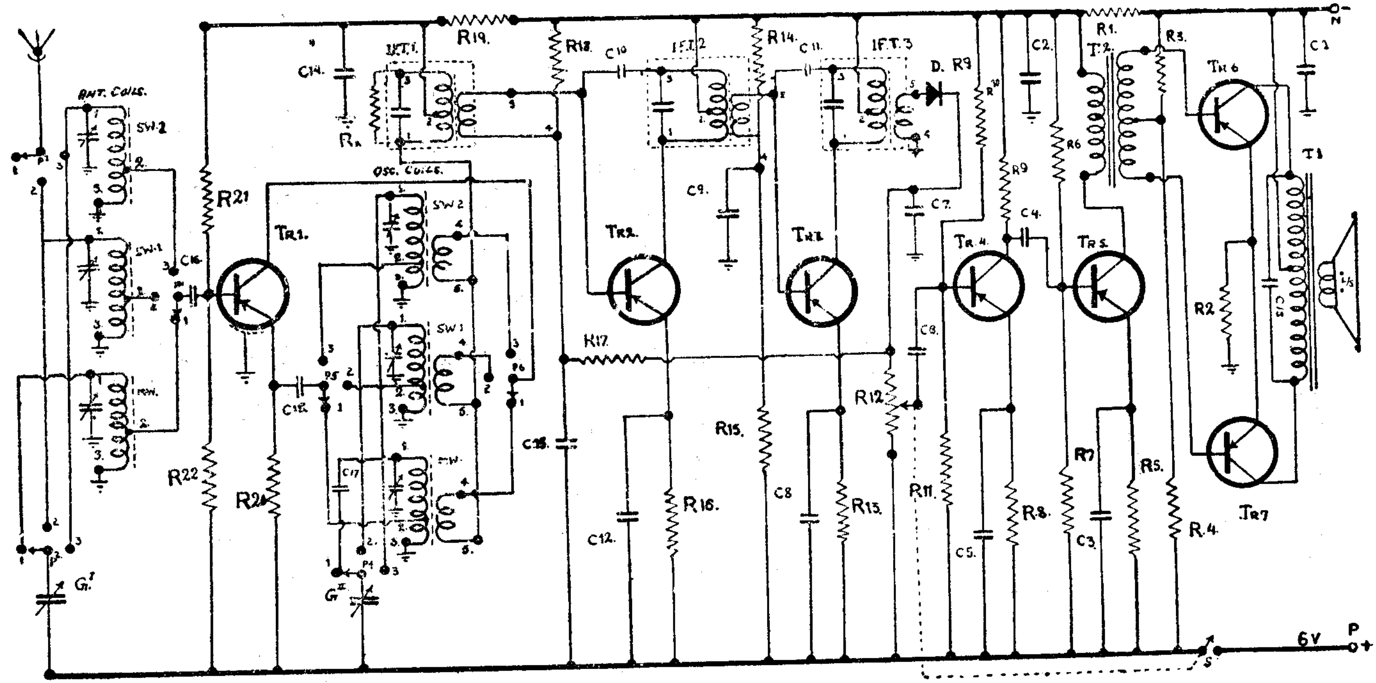


Fig. 32–Receiver using 7 P.N.P. Transistors

Parts List.

TR[1]=AF115—Converter stage
TR[2]=AF117—1st I.F. stage
TR[3]=AF117—2nd I.F. stage
TR[4]=AC126—1st A.F. stage
TR[5]=AC126—2nd L.F. stage
TR[6]=AC128—Output stage
TR[7]=AC128—Output stage
D =OA79—Detector

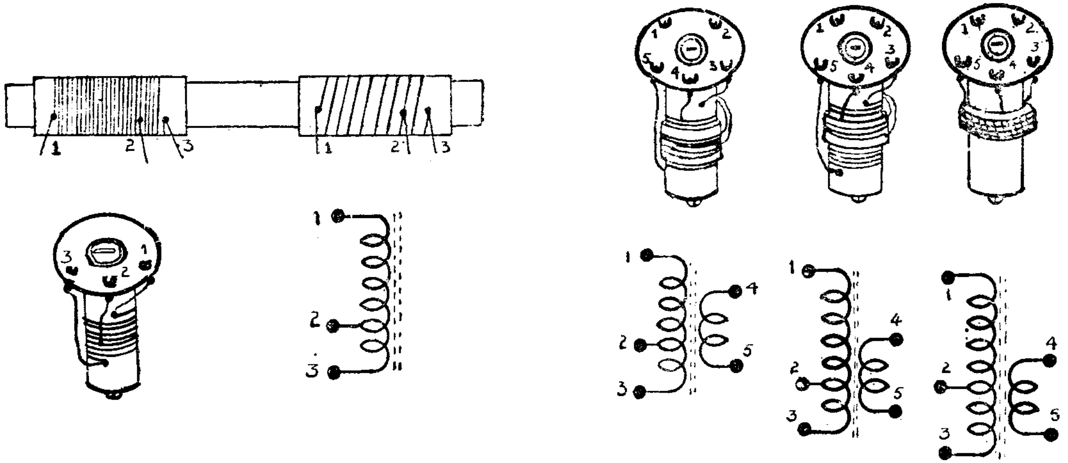


Fig 33. Antenna Coils & Symbols

Numbering Color Code & Connections of Coils

Ant. Coil.

No. 1—Start—white—Gang

No. 2—Tapping—green—Base of TR^1

No. 3—End—Black—Chassis

Oscillator Coil

No. 1—Sec. Start –green—Gang

No. 2–Sec Tap—yellow—Emitter

No 3—Sec. End Black—Chassis

No. 4—Pri. Start—whitc-Collector

No. 5–Pri. End–Red—1st. I.F T.

ASSEMBLING ANT. COILS SECTION

The pictorial view of antenna coil Section of all world transistor receiver is given in Fig. 34 M.W. and S.W.2 antenna coils are wound on ferrite rod, and third coil of S.W.^{2} having ferrite core is fitted on the chassis of the set. All these coils are designed as auto transformer having one winding only No. 1 is the 5 start of each coil, No. 2 is the tapping and No. 3 is the end of each coil which is to be connected to chassis. There are three trimmers fitted on the chassis near the coils. No 1 terminal of each coil is conneted to the respective trimmer and the rofor terminal of all the trimmers are connected to chassis.

Double wafer type have 6 Poles 3 positions band change switch is used in this transistor receiver. In the diagram only one wafer is shown which has 3 poles and nine terminals. Each pole has three terminals No. 1 for M.W. band, No 2 for S.W. 1 and No. 5 for SW² band.

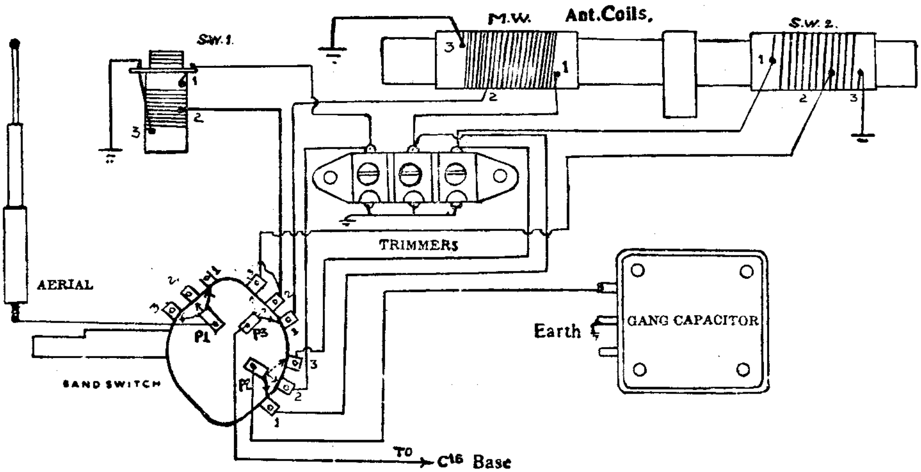


Fig. 34—Pictorial view of Antenna coil setion

Telescopic antenna is connected to pole No. 1, and the start end of SW² antenna coils are conneeted to No. 2 and No. 3 position terminals of this pole P¹ and No. 1 terminal remains unconnected. This No. 1 position is for medium wave band, it means that at M.W. position of the set the antenna remains disconnected to ant. coil of M. W. band. This antenna is not required at the time of M.W. band. The pole No. P² is conneeted to stator terminal of one section of gang capacitor which is fitted on the metal chassis. The middle terminals is rotor terminal of this capacitor which is to be connected to chassis. The three terminals of this pole P² are connected to the start No. 1 terminals of their respective coils. There is color marking on the coils, start No. 1 is white, tapping No. 2 is green and end terminal No. 3 is black. The pole No. P³ is connected to the one terminal of C¹⁶. This is a ceramic capacitor of 0.01 microfarad and the other end of this capacitor is to be connected to the base terminal of frequency changer transistor TR¹. The three terminals of this pole P³ are connected to the tapping terminal No. 2 of their respective coils. You must remember that in each coil, number of turns between No. 1 and 2 are more than between No. 2 and 3. In this way you can distinguish terminal one and three without any color marking. Always use copper tinned wire for this wiring of antenna coils.

ASSEMBLING OSCILLATOR COIL SECTION

The below figure is the pictorial view of oscillator section of all world transisjor receiver. Three ferrite core oscillator coils of each band are fitted on the chassis. Each coil has two winding and a tapping in the primary section. For identification No. 1, 2

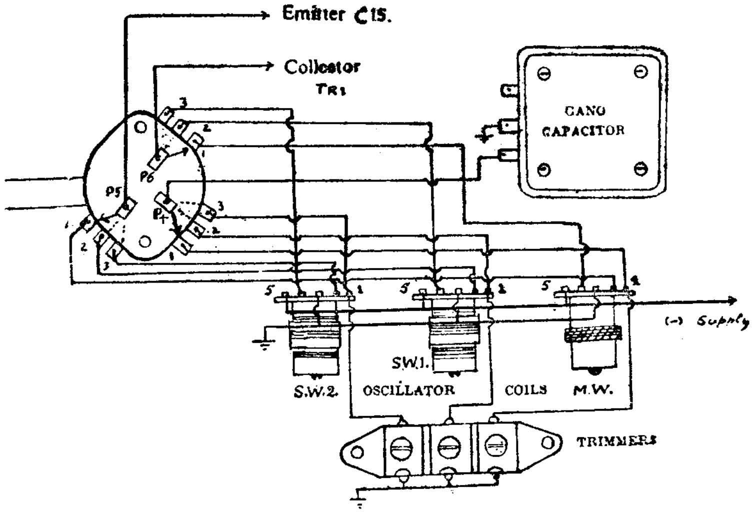


Fig. 35—Pictorial view of Oscillator coils section

and 3 is the primary and No. 4 and 5 is the secondary winding. A strip of three trimmers is also fitted on the chassis near these coils. Same gang capacitor is also shown in this figure. We will utilize the 2nd section of this capacitor for tuning the desire oscillator frequency. The band-change switch, which is shown in this figure is the 2nd wafer of the same band switch which is used for antenna coils. This wafer has also three poles and nine terminals as three for each pole.

Pole No. 6 is connected to the collector of transistor TR^1. (AF115), and this pole's terminals 1. 2 and 3 are connected to No. 4 terminal of primary winding of M.W, SW^1 and SW^2 oscillator coil respectively. In this wafer you have to observe the same sequence as you have adopted for antenna coils, this means that No. 1 for M.W. No. 2 for SW^1 and No. 3 for SW^2. Connect together the No. 5 terminal of each coil and connect one piece of wire from the No. 1 terminal of the primary winding of 1st. I.F.T. to the No. 5 terminal of any oscillator coil. In this way collector of TR^1 will get a reverse bias voltage (—) through the primary winding when connected in series with collector circuit. When the starting varying current flows in the primary a voltage will be set up in the secondary winding due to mutual indication. Trimmers are connected across the secondary windings of each coil. The rotor plate of each trimmer and No. 3 terminal of each coil are connected to chassis. The stator plates terminal of 2nd portion of gang capacitor is connected to pole No. P^4 and its three terminal are connected to No. 1 terminal of their respective coils. For generating oscillations feed back is essential. For this we will take the output from the tapping terminal of the secondary winding and feeds to the emitter of transistor TR^1 through the capacitor C^{15}, because the emitter is connected to pole terminal P^5 through this ceramic capacitor C^{15} having the capacitor of 0.005 micro farad. Capacitor C^{17} is the padding capacitor which is connected between the No. 1 terminal of MW antenna coil and No. 1 terminal of pole P^4. This C^{17} is fixed padder capacitor having the capacity of 500 picafarad. In this way you can assemble the oscillator section of transistor receiver. To avoide mistake use different color sleeve on the copper tinned wire for each band. Don't forget the emitter resistor R^2 (220 ohm) which is to be connected between emitter terminal of TR^1 and chassis. In this set chassis is connected to the positive terminal of six volt battery. After completing the wiring, check the each terminal and compare with circuit diagram. The remaining portion of transistor receiver has to be assembled on the printed board. For further guidance for assembling the remaining stages, you must study "SILICON TRANSISTOR ASSEMBLING."

I. F. ALIGNMENT OF TRASISTOR RADIO

1. Connect the A/C. voltmeter across the speaker voice coil terminals.
2. Connect the signal generator tuned to 455 Kc/s and modulated via 0.1 mfd. capacitor between Tr^1 base and chassis.
3. Attenuate the signal generator out-put to maintain 0.25 volt on the output meter to prevent over-loading of the reciver.
4. Set the gang condenser to the maximum capacity.
5. Set the volume control to maximum.
6. Adjust core of $I.F.T^3$ for maximum response.
7. Adjust core of $I.F.T.^2$ for maximam response.
8. Adjust core of $I.F.T^1$ for maximum output.
9. Repeat step No. 6, 7 and 8 seal the cores with wax.

R. F. ALIGNMENT

Signal-generator with 400 c/s modulated output and low output impedence.

1. Rotate tuning control to gang maximum.
2. Set the signal generator to 550 Kc/s and place the loop near aerial coil.
3. Adjust the core of M. W. Osc. coil for maximum response.
4. Rotate tuning control to gang minimum.
5. Reset signal generator to 1600 Kc/s.
6. Adjust the trimmer of M. W. Osc. coil for maximum response.
7. Repeat Step No. 1 to 6 as necessary, always finishing with No. 6.

8. Set signal generator at 600 Kc/s. Tune the receiver at this frequency and adjust the position of M. W Ant. coil on ferrite rod for maximum response.

9. Set the signal generator to 1500 Kc/s. Tune the receiver to this frequency and adjust the trimmer of M. W. Ant. coil for maximum response.

10. Repeat Step No. 8 to 10 until no further improvement is made.

Alignment of Short Wave Bands

11. Set the signal generator at 2.5 Mc/s. Tune the set to this frequency and adjust the core of S. W. 1. Osc. coil for maximum response.

12. Set the signal generator at 7.0 Mc/s. Tune the set to this frequency and adjust the trimmer of S.W. 1 Osc. coil for maximum response.

13. Set the signal generator to 3.5 Mc/s. Tune the set to this frequency and adjust the core of the S.W. 1 Ant. coil.

14. Set the signal generator to 6.5 Mc/s. Tune the set to this frequency and adjust the trimmer of S. W. 1 Ant. Coil.

15. Repeat Step No. 11 to 14 until no further-improvement is made.

Note :—Same R. F. alignment procedure for S. W.2 with appropriate signal frequencies according to dial setting.

TRANSISTOR RADIO SERVICING CHART (See Fig. 29)

Possible causes	Remedy
No Sound :—	
1. Battery rundown.	1. Check voltage, replace if low.
2. Open voice coil.	2. Check the continuity of voice coil.
3. Open pri. of driver transformer.	3. Check the winding with ohm-meter.
4. Open pri. of output transformer.	4. Check the winding with ohm-meter.
5. Defective on/off switch.	5. Check on/off switch.
6. Break in battery lead.	6. Check lead with ohm-meter.
7. Shorted filter capacitor.	7. Open one lead of C^{24}.

Causes	Remedy
Low sound :—	
1. Weak battery.	1. Check voltage of the battery on load.
2. Misalignment of I.F. transformer.	2. Check the I. F. alignment.
3. Defective transistor.	3. Check A. F. or I. F. transistor.
4. Leaky by-pass capacitors.	4. Check C^{14}, C^{17} or C^{19}.
5. Defective line filter capacitors.	5. Check C^{20} or C^{24}.
Noisy-reception :—	
1. Dry joint.	1 Check the stages visually.
2. Worn out volume control.	2. Check R^{15}. replace if scrachy.
3. Defective band-switch.	3. Wash the band switch with petrol.
4. Defective filter capacitor.	4. Check capacitor C^{20} or C^{24}.
5. Defective Power Transistor.	5. Check Tr^3 or Tr^7—2SB77.
6. Defective speaker.	6. Voice coil out of centre.
7. Leaky coupling capacitor.	7 Check capacitor C^{16} or C^{18}.
8. Defective A. F. stage.	8. Check transistor of A.F. stage.
9. Defective A G.C. filter capacitor.	9. Check capacitor C^{12}.
10. Mismatched output transformer.	10. Replace with a new transformer.
Motor-Boating :—	
1. Defective neutralizing capacitor.	1. Check the neutralizing capacitors.
2. Defective I.F. Transitor.	2. Check Tr^2 and Tr^4.
3. Defective by-pass capacitor.	3. Check all the by pass capacitors.
4 Weak battery.	4. Check battery voltage.
5. Dry solder joints.	5. Check the circuit visually.
6. Misalignment	6. Check alignment with Signal Generator
Fading :—	
1. Defective A.G.C. filter.	1. Check eesistor R^{13} and C^{12}.
2 Poor diode detector.	2. Check OA79 and replace it.
3. Misalingnment.	3. Check the receiver's alignment.
4. Open aerial connection.	4. Check antenna circuit.

29. Servicing Chart of Audio Section

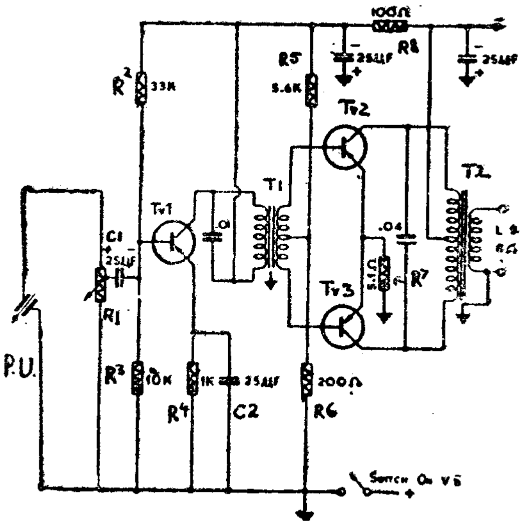


Fig. 36—Audio Amplifier Circuit Diagram

Quick check :—Feed an audio signal at pick-up terminals or across R^1 the volume control. Audio note should be heard in the speaker, or touch a damp finger on the base terminal of the transistor TR^1. A hum response should be heard in the speaker.

No Output Signal

Causes .—1. Battery completely run down. 2. Open voice coil of the speaker. 3. Faulty earphone jack. 4. Condenser across the primary winding of output transformer is shorted. 5. Open emitter resistor R^7. 6. Open pri. or sec. winding of driver transformer. 7. Shorted filter capacitors of 25 mfd. 8. Defective on/off switch. 9. Defective power amplifier transistor TR^2 or TR^3. 10. Defective 1st. A.F. transistor TR^1

Symptoms :—Distortion or Low Out-put.

Causes :—1. Weak battery. 2. Defective speaker. 3. Mismatch of L.F. output transformer. Mismatch of the power output transistors. 5. Change in the value of emitter resistors R^4 and R^7. 6. Change in the valve of base bias resistors. 7. Shorted emitter bypass capacitor C^2 in the 1st. A.F. stage. 8. Defective Driver transistor Tr^2. 9. Shorted turns in the primary of out-put transformer. 10. Leaky or reduced value of coupling capacitor C^1.

30. *Servicing Chart of Detector Stage*

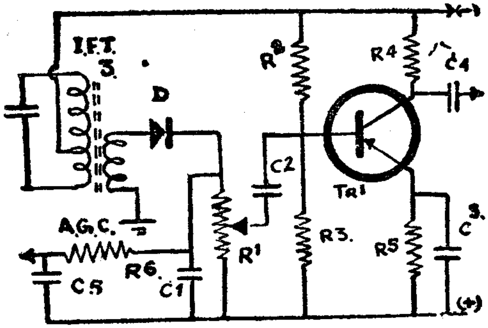


Fig. 37—Circuit Diagram of Detector and 1st. Audio Amplifier

Resistors :

$R^1 = 10K\Omega$	$R^2 = 47K\Omega$	$R^3 = 10K\Omega$
$R^4 = 5\ K\Omega$	$R^5 = 1\ K\Omega$	$R^6 = 10K\Omega$

Capacitors :

C^1=0 01 Mfd.	C^2=10 Mfd.	C^3=30 Mfd.
C^4=10 Mfd.	C^5=10 Mfd.	

Quick check :—Apply a modulated I. F. signal to the collector or the primary winding of I.F. transformer T^3. The modulation note should be heard in the speaker.

Symptom—Weak Signal.

Causes ;—1. Defective crystal diode D. 2. Defective R.F. by-pass capacitor C^1. 3. Open A.G.C. by-pass capacitor C^5 of 10Mfd. 4. Defective winding of I.F. transformer I.F.T^3. 5. Misalignment of I.F. transformer: 6. Open or shorted diode load R^1.

Symptom :—Distortion on Strong Signal.

Causes :—1. Shorted A.G.C. filter capacitor C^5. 2. Defective coupling capacitor C^2.

Testing of Diode :—

The average life of a crystal diode is more than 10,000 hours. These diodes rarely go bad. Measure the reverse and forward resistancc with an ohm-meter; the reverse resistance should be 1000 Kilo ohms or more and forward resistance should be 100 to 250 ohm only.

Note :—The detector stage is also providing the A.G.C. voltage to control the gain of I. F. amplifier stages.

31. *Servicing Chart of I.F. Stages.*

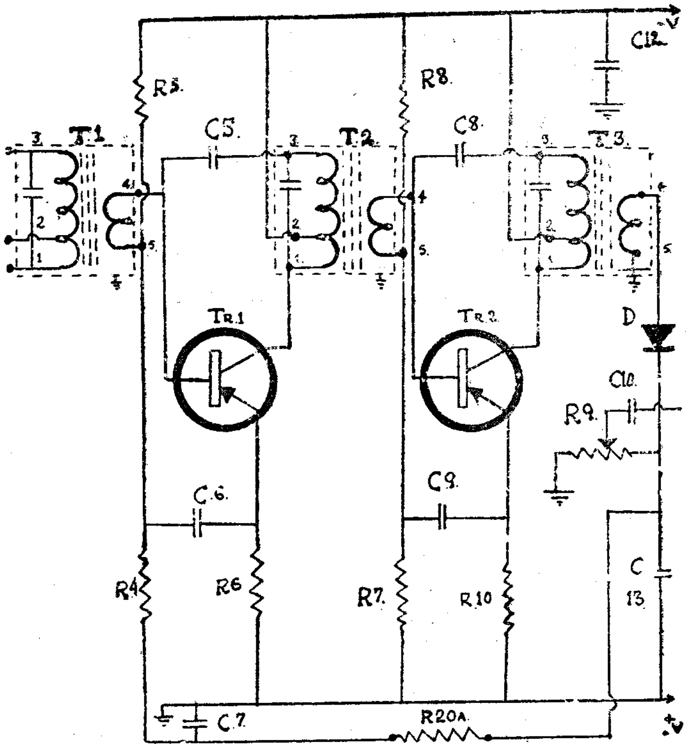


Fig. 36 Circuit Diagram of I. F. Amplifiers.

Quick check :—Apply a modulated I. F. signal from the signal generator to the base of 1st I.F. stage TR². The modulation notes should be heard in the speaker.

Symptom :—No output signal from the speaker.

Causes :—1. Defective Transistor TR¹ or TR². 2. Open emitter resistors R⁶. R¹⁰. 3. Open I. F. transformer coil. 4. Shorted base by-pass capacitor C,⁶ C⁹ 5. Short circuited the winding of I F.T. 6. Open base winding of I. F. T.¹ or I. F. T. ². 7. I.F. transformer completely misalignment.

For locating the defective stage for low gain, take a fixed capacitor of 0 05 mfd. touch the terminals of the condenser to base and collector of the transistor. When shorting a base and collector with this condenser. the volume will drop considerally if the stage is in order. In a defective stage there will be no change in the volume.

Now apply a modulated I. F. signal to collector of converter transistor If a 400 cycle response is heard in the speaker the I,F. stages are in working order,

Warning :—

Do not alter the alignment of the receiver in an attempt to improve the gain, many receivers are stagger tuned and although the gain can be improved by peaking the tuning, this will be accompanied by a loss of a response and an increase in distortion, if the alignment of the receiver is suspected always realign in accordance with the manufacturer's service manual.

32. Servicing Chart of Converter Stage.

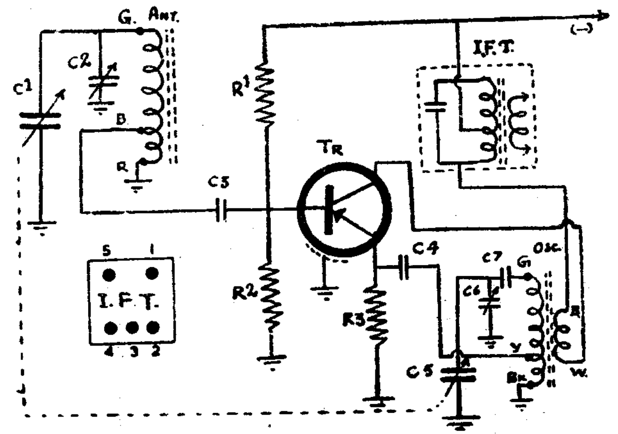


Fig. 39—Circuit Diagram of Converter Stage.

Quick Check :—Apply a modulated R. F. Signal at the antenna terminal. Tune the radio at this particularly frequency. The modulation note should be heard in the speaker.

In P.N.P. transistor, the base is usually negative with respect to emitter, but in this converter stage, the base is at positive potential with respect to emitter because the positive feed back from collector to emitter makes the base positive. This indicates that the oscillator is functioning.

Quick Check for Oscillator :—Measure the voltage across the emitter resistor R^3, and note the reading. Now take a small piece of wire and short the oscillator section of the gang capacitor C^5 and now take the voltage reading. If the meter pointer moves back, the oscillator is functioning, there will be slight decrease in voltage across the emitter resistor R^3.

Second Method of Checking Oscillator :—Switch on your transistor set, keep it near a good set which is in working condition. Tune the good set to high frequency end of the dial 1500 Kc/s. Tune your set, which you are testing at 1045 Kc/s. or near about If your set is working, a whistle will be heard in the speaker of good set. If no sound is heard, check all the components in this converter stage.

TRANSISTORIZED TUNER

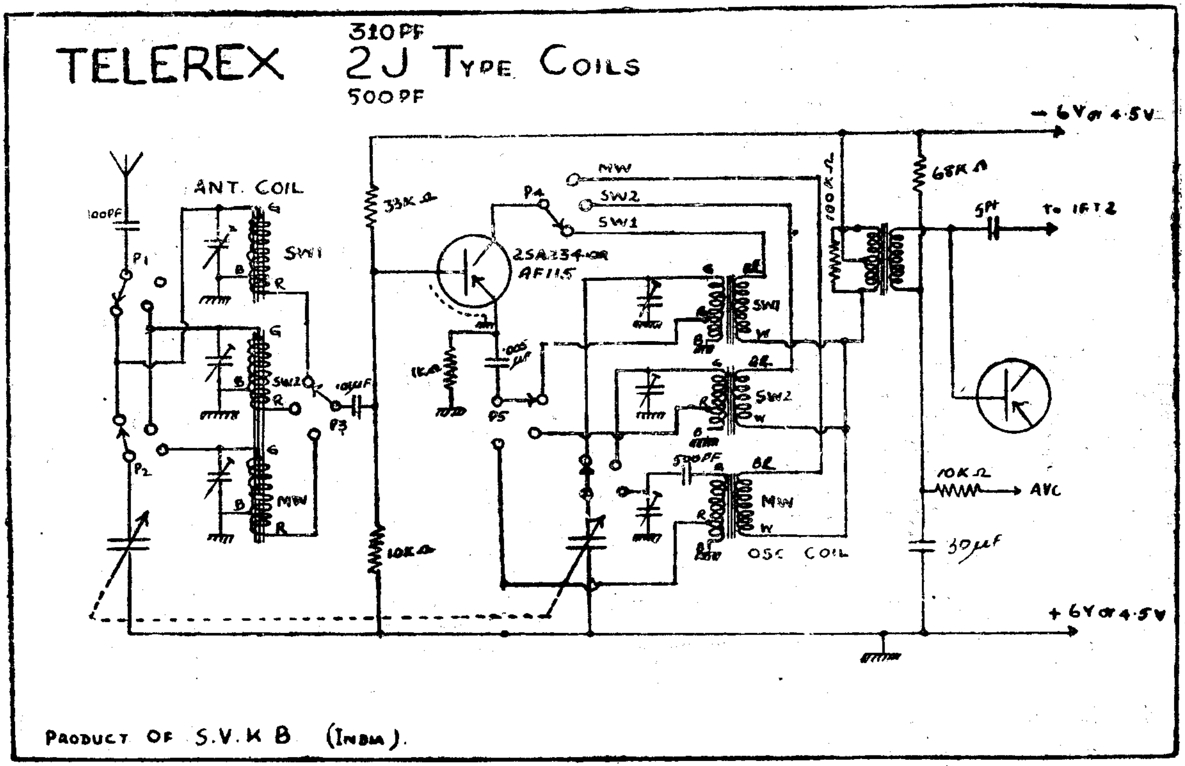


Fig. 40–Converter Stage of Three Band Transisfor Radio.

33. *R.F. Alignment Chart.*

Adjust Circuit		Step	Signal Generator output	Dial setting	Ajusting to maximum output
MW	OSC.	1	600 Kc/s	600 Kc/s	MW. OSC coil core
		2	1500 Kc/s	1500 Kc/s	MW. OSC. trlmmer
		3	600 Kc/s 1500 Kc/s	600 Kc/s 1500 Kc/s	Repeat three times steps (1) and (2)
	ANT.	4	600 Kc/s	600 Kc/s	MW. ANT. coil core
		5	1500 Kc/s	1500 Kc/s	MW. Ant. trimmer
		6	600 Kc/s 1500 Kc/s	600 Kc/s 1500 Kc/s	Repcat three times steps (4) and (5)
SW_1	OSC.	7	2.5 Mc/s	2 5 Mc/s	SW_1 OSC. coil core
		8	6.0 Mc/s	6.0 Mc/s	SW_1 OSC. trimmer (CT_5)
		9	2.5 Mc/s 6.0 Mc/s	2 5 Mc/s 6.0 Mc/s	Repeat three times steps (7) and (8)
	ANT.	10	2.5 Mc/s	2 5 Mc/s	SW_1 ANT. coil core
		11	6.0 Mc/s	6.0 Mc/s	SW_1 ANT. trimmer .
		12	2 5 Mc/s 6 0 Mc/s	2 5 Mc/s 6.0 Mc/s	Repeat three times steps (10) and (11)

Adjust Circuit		Step	Signal Generator output	Dial setting	Ajusting to maximum output
SW_2	OSC.	13	7.0 Mc/s	7.0 Mc/s	SW_2 OSC. coil core
		14	18.0 Mc/s	18.0 Mc/s	SW_2 OSC. trimmer
		15	7.0 Mc/s 18.0 Mc/s	7.0 Mc/s 18.0 Mc/s	Repeat three times steps ($_{13}$) and ($_{14}$)
	ANT.	16	7.0 Mc/s	7.0 Mc/s	SW_2 ANT. coil core
		17	18.0 Mc/s	18.0 Mc/s	SW_2 ANT. trimmer
		18	7.0 Mc/s 18.0 Mc/s	7.0 Mc/s 18.0 Mc/s	Repeat three times steps ($_{16}$) and ($_{17}$)

34. *Signal Injecter.*

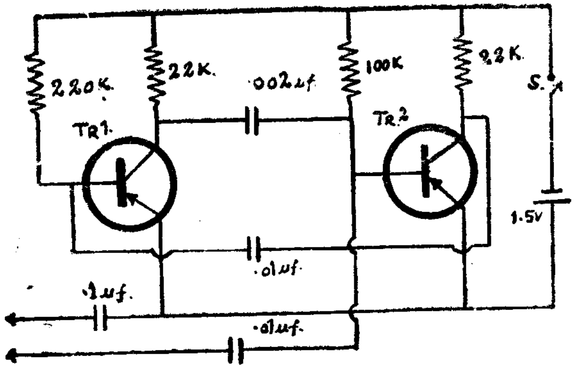


Fig. 41—Circuit Diagram of Signal Injector.

Principle and Operation :—

Its principle based on multivibrator oscillator, which is rich in harmonics The fundamental frequency of this signal generator is 1·5 Kc/s. TR^1 & TR^2 = OC71.

Now you can test any stage of transistor receiver by injecting the signal from this signal injector to the base of transistor. If the stage is working an audio signal will be heard from the loud-speaker.

Connect the emitter lead to the chassis of the transistor radio and signal output lead of TR^2 to the base of the transistor to be tested.

It is very useful testing equipment for locating the defective stage in a receiver.

35. *Circuit Diagram of Signal Tracer*

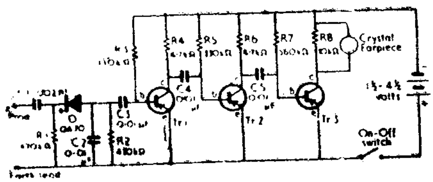


Fig. 42—Dircuit Diagram of Signal Tracer.

Parts List.

Resistors

R^1=470K ohm
R^2=470K ,,
R^3=330K ,,

R^4=4·7K ohm
R^5=330K ,,
R^6=4.7K ,,

R^7=330 K ohm.
R^8=10K ,,

Capacitors

C^1=0·002Mfd C^2=0.01Mfd C^3=0·01Mfd
C^4=0·01 ,,

Battery voltage=4·5 volts.

This signal tracer consists of a three-stage audio frequency amplifier. A. F. and R. F. signals are fed directly to the capacitors C^1 and chassis. The indicator consists of crystal headphone Suppose by touching the prods to the base of 1st. I.F. stage and chassis if you heard a response in the head-phone then, up to this stage set is functioning and if you are not getting the response in the head-phone, then the fault exists in the pre-stage and the signal is not coming to this stage.

36. *Light Blinker*

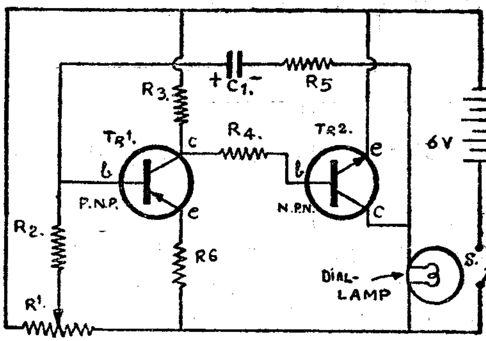


Fig. 43—Automatic Switching For Lighting a Bulb ON & OFF

Parts List.

Tr^1=AC128	R^1=10K Ω	R^3=1K Ω	R^5=1·8K Ω
Tr^2=AC127	R^2=6·8K ,,	R^4=270 ,,	R^6=5 ,,
C^1 =100Mfd.		Lamp=6 volt.. 0·15 Ampere.	

37. *Telephone Amplifier.*

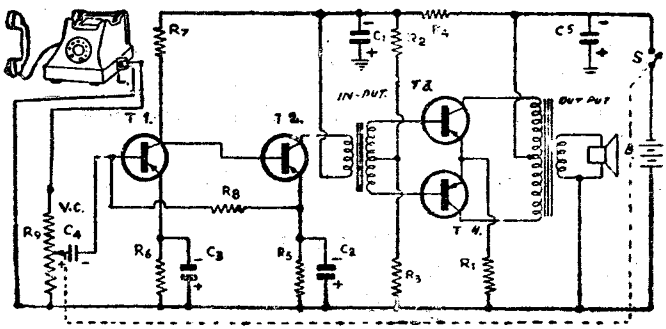


Fig. 44–Circuit Diagram of Telephone Amplifier.

Parts List.

TR^2=AC126	R^1= 5K Ω	R^5=470 Ω	R^9=10K Ω
TR^2=AC126	R^2= 1K ,,	R^6=2K ,,	C^1, C^5=100mfd.
TR^3=AC128	R^2= 33 ,,	R^7=6·8K ,,	C^2,C^3=30mfd.
TR^4=AC128	R^4= 220 ,,	R^8=10K ,,	C^4 =10mfd.

38. *Inter Communication set.*

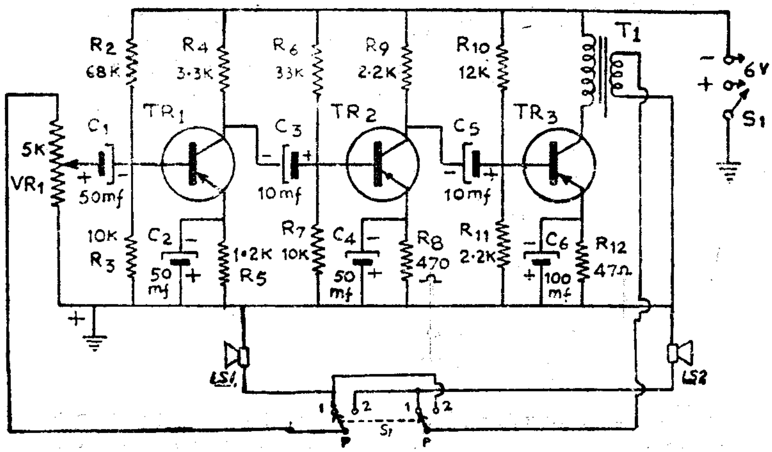


Fig. 46–Circuit Diagram of Inter-Com. Set.

This transistorized "intercom" set can be used to achieve reliable voice communications between two points in a normal size house. The master unit consits of audio amplifiers of three OC71 transistors. This Amplifier operates on 6 volts D.C. Speakers LS^1 and LS^2 are used for both talk and listen functions. The talk-listen switch S^1 at the master location establishes the talk or listen mode for the intercom station. The voice communication is initiated from the master unit. Now the switch S^1 is set to the talk position No. 1. and the audio voltage developed across the voice coil of LS^1 is coupled by the VR^1 and C^1 to the base of TR^1. With S^1 depressed to talk position No. 1. The LS^2 speaker is automatically connected to secondary of the audio amplifier output transformer (T^1) for listen mode operation and the initiator can now talk to the intercom station where this loud-speaker LS^2 is installed.

When the switch S^1 is in the listen position No. 2. The master unit speaker LS^1 is connected in the listen mode and the other speaker LS^2 is connected to the amplifier input. Now a reply from the remote unit LS^2 is communicated to the speaker LS^1 through the same audio amplifiers. The value of components are written in the circuit diagram.

36. Transistorized Power Supply.

DC 12 volts to 220 volts DC.

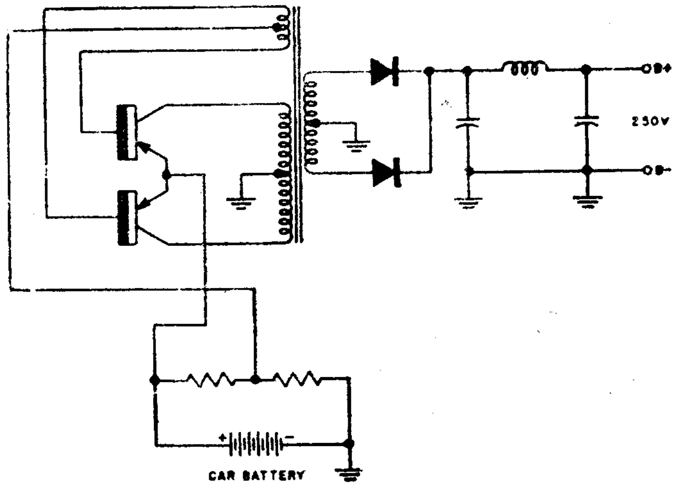


Fig. 46—Circuit Diagram of Converter 12 V to 220 V. DC

Resistors = 10 Ω & 300 Ω　　Capacitors = 0.01 Mfd. each

Diodes = BY-100　　Transistors = 2N2907

Circuit Description—

This transistorized power supply converts 12 volts DC. to 250 volts DC. in the car-radio. The circuit consists of a step-up transformer with the centre tap of the primary connected to chassis and chassis is connected to the battery negative. The two ends of primary winding are connected to the collectors of two switching transistors. The transistors are working as on-off switch, the time of switching being so controlled by the upper centre tap feed back winding of the transformer that they conduct alternately. The centre tap of feed back winding is connected to junction of two resistors which are connected across the battery. The value of resistor which is connected to negative end of the battery is 300 ohms and the other resistor which is connected to positive end having the value of 10 ohms.

The emitters are connected to the positive end of the battery. The battery voltage is thereby applied alternately across the two halves of the primary winding inducing a square wave voltage of about 1000 cycles per second which is then transfer to 250 volts across the secondary winding. This voltage is then rectified by the two silicon diodes. The diodes are working as full wave rectifier. The R.F. choke and two capactiors are used to filter the rectified voltage These filter D.C. voltage are used as high tension voltage for the anodes and screen grids of the valves used in the car radio.

40 *Battery Eliminator for Transistor Receiver.*

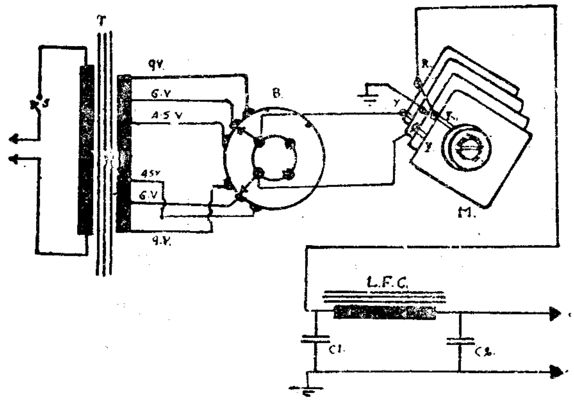


Fig. 47—Power Pack for Transistor Radio

Componens :—

1. T—Step down transformer having primary of 220 volts and secondary of 9V, 6V, 4.5V AC.
2. S—On/off switch in the primary winding.
3. B—Band change switch 4 poles, 3 positions. Only two po are being used for changing the voltage tapping.
4. M—Metal Rectifier Bridge Type. 100ma.

   Y=Yellow colour mark on the terminal for a.c. input.

   R=Black colour mark on the outer terminals for DC negative output are shorted together and centre terminal having Red colour is to be kept at chassis positive potential.
5. L.F.C.—Low frequency choke of 250 milli-henry.
6. C^1 & C^2—Filtering electrolytic capacitor of 100mfd.

Circuit Description :—

It is a full wave rectifier circuit For testing different types of transistor receivers one can set this supply 4·5 to 9 volt DC. Now the band change switch is set at 6 volts position. By switching the on/off switch at ON position, the current flows in the primary windiug of step down transformer and by mutual induction voltages are being induced in secondary winding. The a/c voltage are applied to the yellow terminals of metal rectifier through band change switch. Thus rectifier delivers d/c negative output from the red terminals which are connected together and a filter of one L.F. choke and two capacitor are used for filtering the pulsations. Always connect lower chassis terminal to the positive side of the transistor receiver terminal and L.F. choke terminal to the negtive side of the receiver.

41. *Transistors Equivalents.*

Converter	I.F. Amp.	Detector	A.F. Amp.	Power Amp.
AF114	AF117	OA78	AC125	AC128
BF194	BF195	OA79	BC147	AC127
OC170	OC45	A85	OC71	OC74
OC44	OC45	OA70	OC71	OC72
2SA234	2SA12	IN34	2SB75	2SB77
OC614	AF105	OA174	OC602	AC105
OC613	OC612	OA150	OC602	OC604
2SA58	2SA53	IS33	2SA54	2SB56
2SA10	2SA31	INA2	2SB32	2SB34
2SA102	2SA55	OA70	2SB171	2SB174
A115	OC45	OA91	OC81D	OC81
2SA93	2SA53	IN 60	2SB53	2SB56
2T201	2T76	IT23	2T64	2T86
2SA123	2SC76	OA70	2SD66	2SB51
2SA103	2SA101	,,	2SB175	2SB178
2SA70	5SA45	,,	2SA171	2SA174
2SA153	2SA155	IN38	2SB112	2SA163
AF116	AF117	OA79	AC123	AC128
2N370	2N139	IN34	2N109	2N270
2N1058	2N293	,,	T1582	2N1069
OC170	OC45	OA70	OC71	OC81
2N412	2N410	IN87	2N406	2N408
OC170	OC45	OA70	OC81D	OC81

SUPER-HETRODYNE RADIO

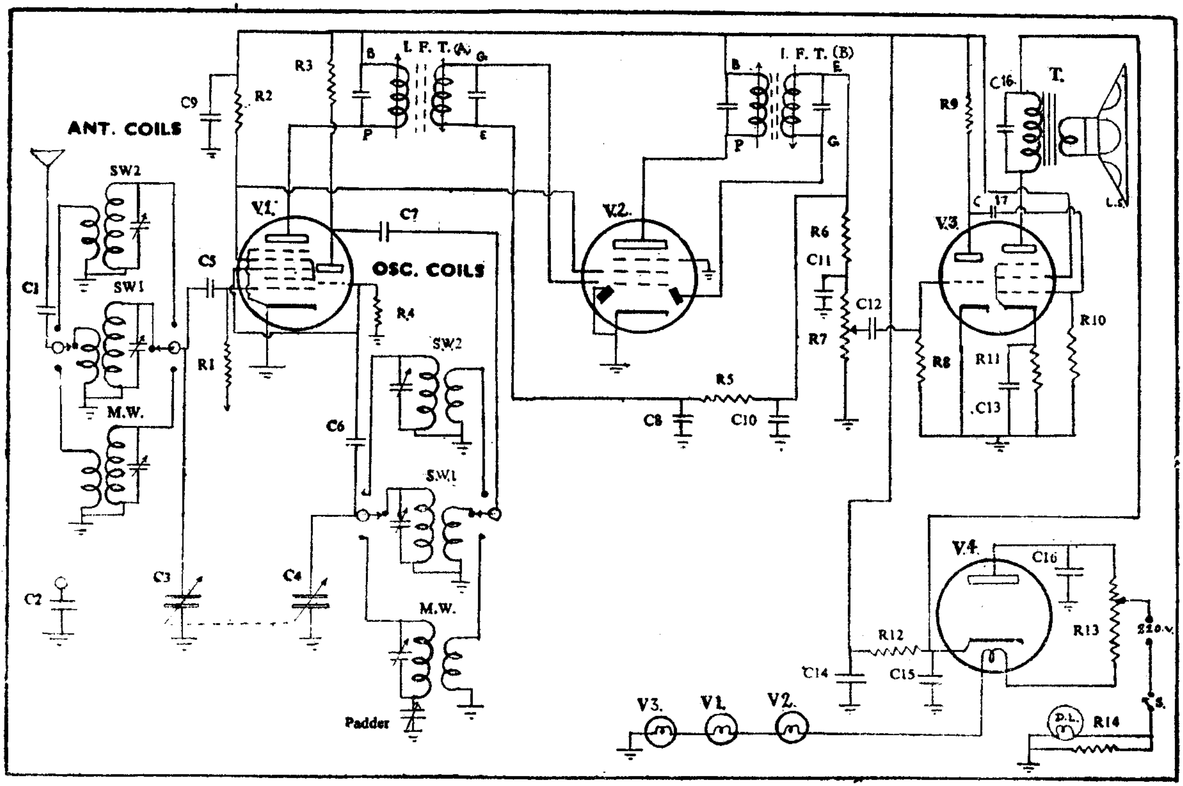


Fig. 48—Circuit Diagram of 4 Valves All World AC/DC Radio

SECTION C

Radio Practical Circuits

42. Four valves All World Radio (Fig. 48)

Parts List :—

Resistors		Capacitors	
R^1. R^{10}	=1 M ohm	C^1, C^5, C^6,	=100 Pfd—Ceramic
R^2. 1 watt	=27 K ,,	C^7. C^{10}, C^{11}	=100 ,, ,,
R^3, 1 watt	=22 K ,,	C^2, C^8, C^9	=0·5 Mfd-Paper
R^4, R^6	=47 K ,,	C^{12}, C^{17}	=·005 ,, ,,
R^5. 1/2 watt	=2 M ,,	C^{14}, C^{15}	=32 ,, Electrolytic
R^7, V.C.	=·5 M ,,	C^5, C^4	=500 Pfd Gang
R^8, 1/2 watt	=5 M ,,	C^{13}	=25 Mfd. Electrolytic
R^9 watt	=·22 M ,,	Miscellaneous :—	
R^{11}, 5 watt	=300 ,,	Padder=600 Pfd	
R^{12}, 10 ,,	=1000 ,,	Dial lamp=·15 ampere, 6 volts	
R^{13}, (vari)	=1000 ,,	Loudspeaker=3 ohm	
R^{14}, 5 watt	=100 ,,	Output transformer=L.F.T for UCL 82	
		I. F. transformer=I.F.T.A & I.F.T.B.	
		Band change switch=4 Poles, 3 Position.	

Pin Connections of the valves used in this circuits

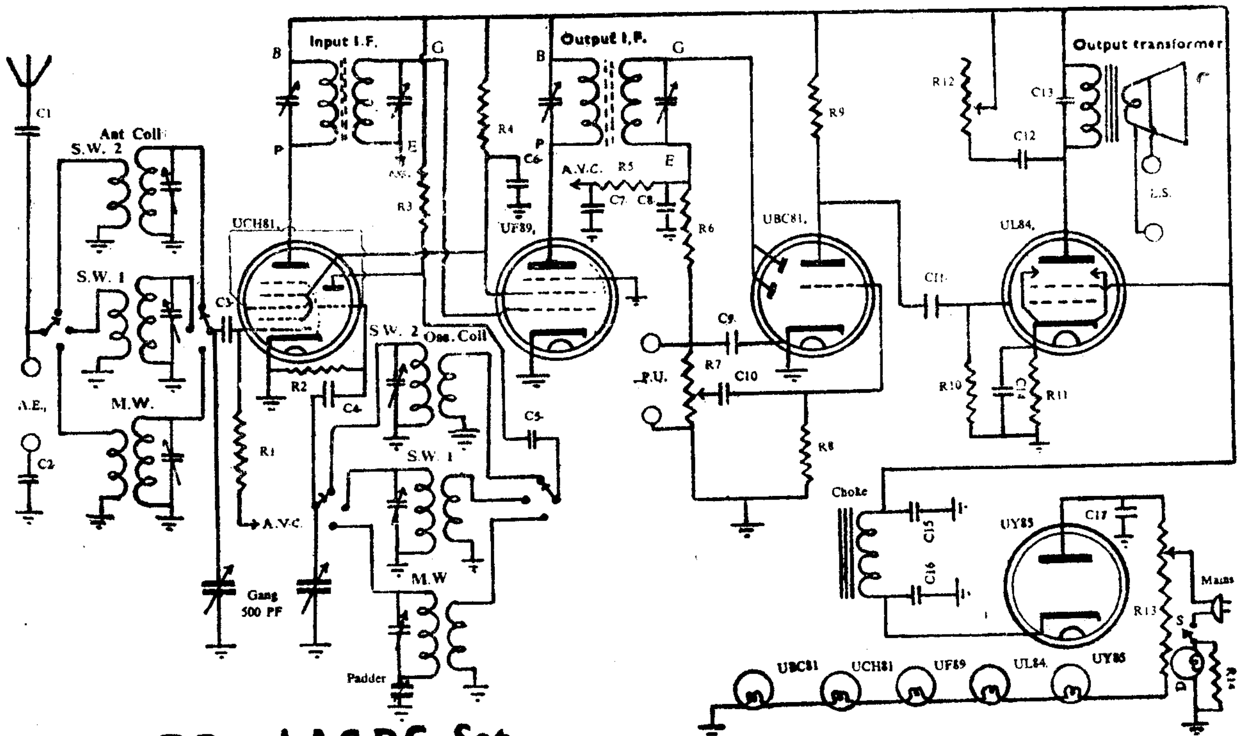
Valves No.	1	2	3	4	5	6	7	8	9	Function
V1=UCH 81	$g^{2'}$,g^4	g^1	k g^5	h	h	ah	g^3	at	g t	Conveter
V2=UBF 89	g^2	g^1	k		h	a	ad	ad″	g^3	Det. & I. F.
V3=UCL 82	gt	k g^2	g^1	h	h	a	g^2	kt	at	1st L.F. & Power Amp.
V4=UY 85	—	—	k	h	h	—	—	—	a	Rectifier

43. Five Valves Ac-Dc Superhetrodyne Radio. (Fig. 49)

Parts List—

Capacitors	Type	Resistors	Type
C1 =0·05Mfd	Paper	R1 = 1 M Ω	Carbon ½ Watt
C2 =0·01 ,,	,,	R2 = 47 K ,	,, ,,
C3 =100 Pfd	Ceramic	R3 = 22 K ,,	,, 1 Watt
C4 =100 ,,	,,	R4 = 15 K ,,	,, ,,
C5 =100 ,,	,,	R5 = 1 M ,,	,, ½ Watt
C6 =0·05Mfd	Paper	R6 = 47 K ,,	,, ,,
C7 =0·05Mfd	,	R7 = 0 5 M ,,	Volume Control
C8 =100Pfd	Ceramic	R8 = 10 M ,,	Carbon ½ Watt
C9 =100 ,,	,,	R9 =0.22 M ,,	,, ,,
C10=0 005Mfd	Paper	R10=0.47 M ,,	,, ,,
C11=0.01 ,,	,,	R11= 150 ,,	Wire Wound 5 Watt
C12=0·005 ,,	,,	R12= 500 K ,,	Tone Control
C13=0·005 ,,	,,	R13= 900 ,,	Wire Wound 10 Watt
C14=25Mfd. 25V	Electrolytic	R14= 150 ,,	,, 5 ,,
C15=32 ,, 350V	,,	Choke=5 Henry or	L.F. Choke
C16=32 ,, ,,	,,	Resistor of 1 K Ω	Wire Wound 10 Watt
C17=0·05, 450V	Paper		

ALL WORLD RADIO



3 Band AC.DC. Set.

Fig. 50—Five valves AC/DC Superhetrodyne Radio Circuit diagram.

Pin Connections of the Valves used in circuit.

Valve No.	1	2	3	4	5	6	7	8	9
UCH 81	g^2,g^4	g^1	k	h	h	ah	g^3	at	gt
UF 89	s	g^1	k	h	h	s	a	g^2	g^3
UBC 81	a	g^t	k	h	h	a'd	s	a"d	—
UL 84	—	g^1	kg^3	h	h	—	a	—	g^2
UY 85	—	—	k	h	h	—	—	—	a

44. *Five Valves Ac Superhetrodyne Radio (Fig 50)*

Parts List—

Resistors.

R^1 = 1M Ω　R^2 = 47 K Ω　R^3 = 22 K Ω　R^4 = 33 K Ω
R^5 = 1M ,,　R^6 = 47 K ,,　R^8 = 10 M ,,　R^9 = 0.2 M ,,
R^{10} = 0·5M ,,　R^{11} = 150 ,,　R^{12} = 0·5M ,,　R^{13} = 1 K ,,
Volume Control R^7 = 0·5M ,,　Tone Control R^{12} = 0·5 M ,,

Capacitors.

C^1 = 0 005Mfd　C^2 = 0.01Mfd.　C^3 = 100Pfd.　C^4 = 100Pfd.
C^5 = 100Pfd.　C^6 = 0·05Mfd.　C^7 = 0·05Mfd.　C^8 = 100Pfd.
C^9 = 100Pfd.　C^{10} = 0·05Mfd.　C^{11} = 0·01Mfd.　C^{12} = ·005Mfd.
C^{13} = 0·05Mfd.　C^{14} = 25Mfd.　C^{15} = 32Mfd.　C^{16} = 32Mfd.
Gang Capacitor—2 section = 500Pfd each.　Padder = 600Pfd.
Six Trimmers across secondary of each coil = 70Pfd.

Transformers.

Two—I.F. Transformers.
One—Power Transformer 80ma. → HT. 250 volts and LT. 6·3 volts.
Three Ant. R.F. Transformers.
One—L.F. Output Transformer
Three Osc. R.F. Transformers

ALL WORLD RADIO

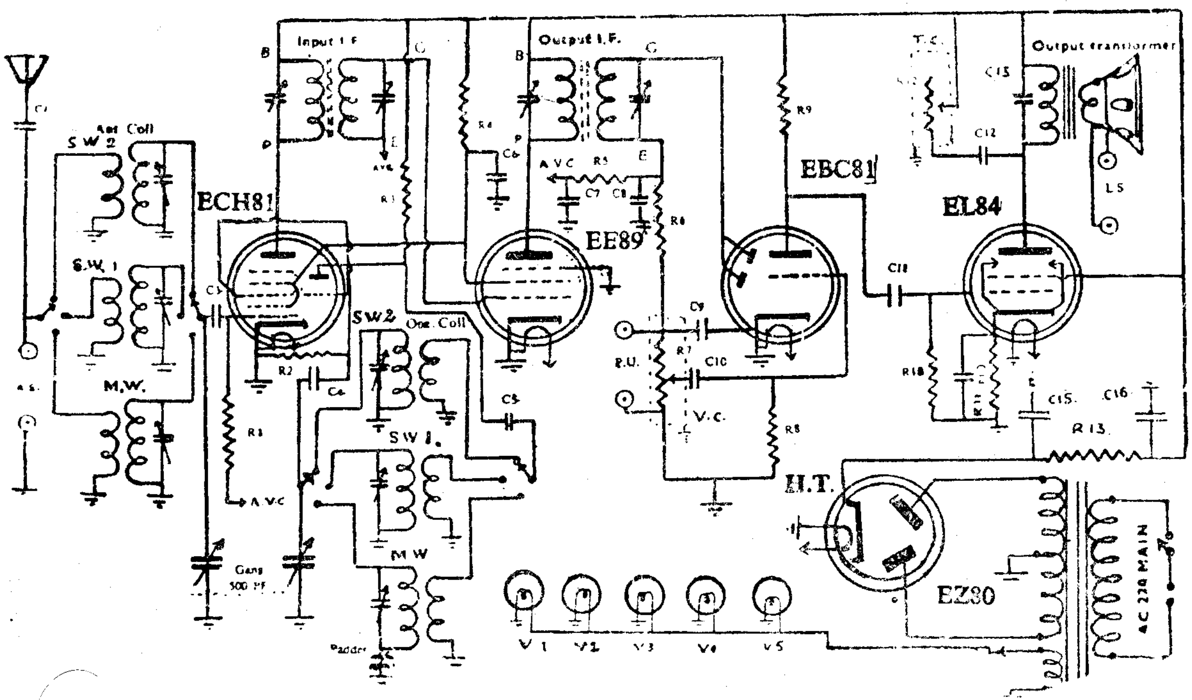


Fig. 50—Five Valves A/C Superhetrodyne Radio Circuit-diagram

Pin Connections of the Valves used in this circuit

Valve	1	2	3	4	5	6	7	8	9
EZ 80	a′	ic	k	h	h	ic	a″	ic	ic
EL 84	ic	g^1	k, g^3	h	h	ic	a	ic	g^3
EBC 81	a^t	g^t	k	h	h	ad′	s	ad″	ic
EF 89	s	g^1	k	h	h	s	a	g^3	g^3
ECH 81	g^2, g^4	g^1	k, g^5	h	h	ah	g^3	at	g^t

45 Six valves A/c Superhetrodyne Radio (Fig. 50)

Circuit Description

This basic six valves superhetrodyne radio receiver operates directly from an AC power line of 220 volts. AC power inputs are converted to DC Power by the EZ40 full wave rectifier circuit. The receiver uses a parallel heater arrangement. The on/off switch is connected in the primary of man's transformer. This power traosformer has three secondary windings. The middle secondary winding of five volts is not used in this circuit. One or two dial lamp can be connected across the 6.3 volts L.T. winding for dial light.

Now the band change switch is set at SW^2 band (7.5 to 22Mc/s) and tuning circuit selects the desire r.f. modulated signal of this band and couple this signal to the control grid of the ECH42 triode hexode converter valve. A local osciliator signal developed by the resonant circuit formed by the SW^2 oscillator coil and other section of gang capacitor is also applied to the mixer grid of this valve. The modulated r f and local oscillator signals are mixed in this valve to produce the 455Kc/s intermediate frequency used in this received Trimmer capacitors connected across the coils are adjusted to assure that the desire tracking relationship is maintained across the band.

A single I.F. stage which uses EF41 remote cut-off pentode provides the required amplification of intermediate frequency signals. This stage is made selective at 455Kc/s by the double tuned input and out-put I.F. transformers. The audio signal components are extracted from the I.F. signal by the 2nd detector circuit which consists of diode section of EBC41 tube and associated components.

The audio signal voltage across the volume control potentiometer is amplified by the triode section of EBC41 and is then used to drive the EL41 audio output stage The output stage develops the audio power required to produce an audible output from the speaker.

ALL WORLD RADIO

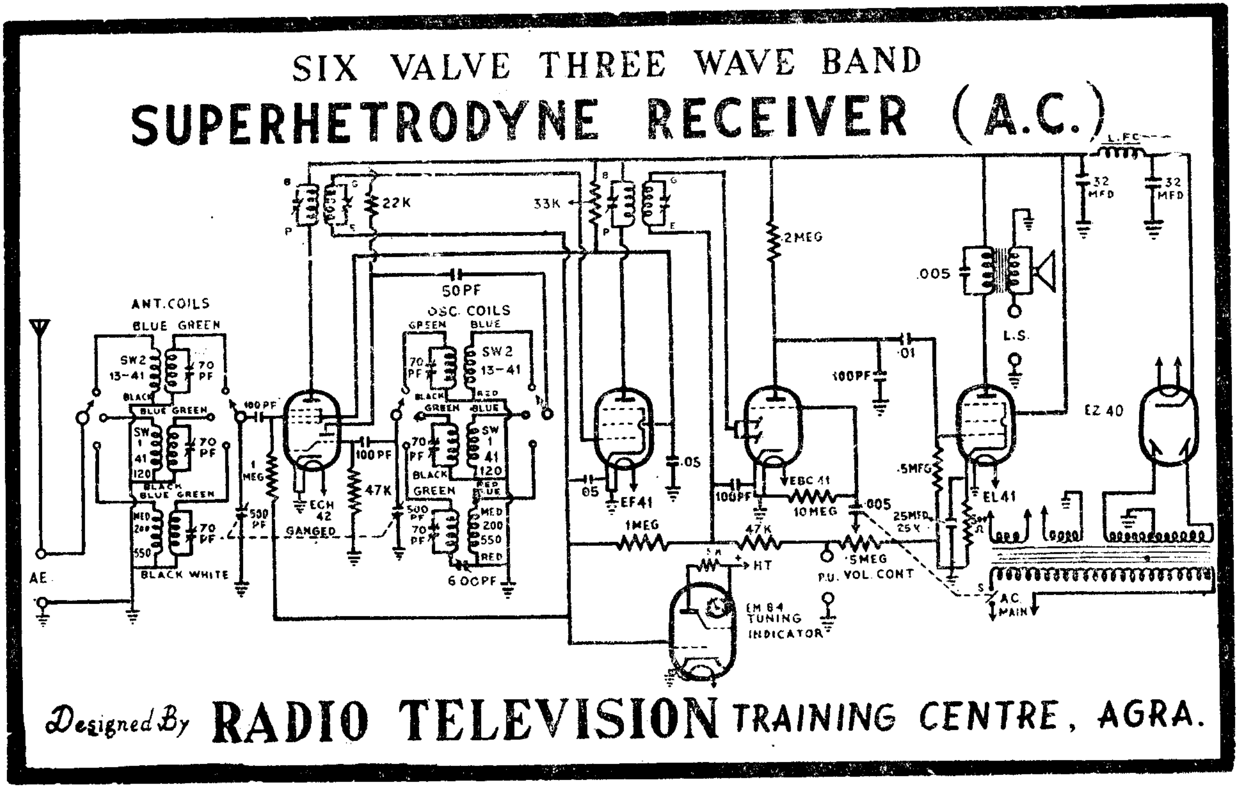


Fig. 51—Ciruit Digram of A/C Radio with Tuning Indicator.

Pin Connections of the Valves used in circuit.

Valve No.	1	2	3	4	5	6	7	8	9
ECH 42	h	a^h	a^t	g^t g^3	g^2,g^4	g^1	k	h	—
EF 41	h	a	—	—	g	g^1	k, g^3	h	—
EBC 41	h	a^t	g^t	s	a′d	a″d	k	h	—
EL 41	h	a	—	—	g^2	g^1	k, g^3	h	—
EZ 40	h	a′	—	—	—	a″	k	h	—
EM 84	g^t	ic	k	h	h	Ta	Def a	ic	a^t

46. *Six Valves High Fidelity Audio Amplifier. (Fig. 51)*

Circuit Description :-

This hi-fi. audio amplifier can deliver power output of 15 watt. The circuit operates from 220 volts AC and 6 volt battery. The vibrator is used to convert six volts DC to pulsating DC. The valve 6X5 is full wave rectifier which converts the AC input to DC output.

A high gain pentode voltage amplifier is used as tha input stage for the audio amplifier The R.C. coupling is used in the first and second valve. The output of this second stage 6N7 is coupled to the control grid of a triode split load type of phase inverter valve 6SC7. The outputs of each triode of 6SC7 which are equal in amplitude and opposite in phase are used to drive a pair of 6V6 beam power pentodes.

The pushpull output transformer couples the audio amplifier output to the speakers The taps on the secondary of this transformer match to the different number of speakers of 4 to 500 ohms.

General Instructions :—

1. The power transformer and rectifier stage should be placed near by the output end of the amplifier rather than near the input for the following reasons. If a slight hum is picked up by the first stage, it will be amplified by all the following stages and so become very objectionable The same volume of hum picked up by the power amplifier is not so amplified and therefore does no harm.

2. Keep the 220 volts A/C leads as short as possible. The main line cord should enter the chassis close to the power transformer and On/Off switch should be placed close to the main's transformer.

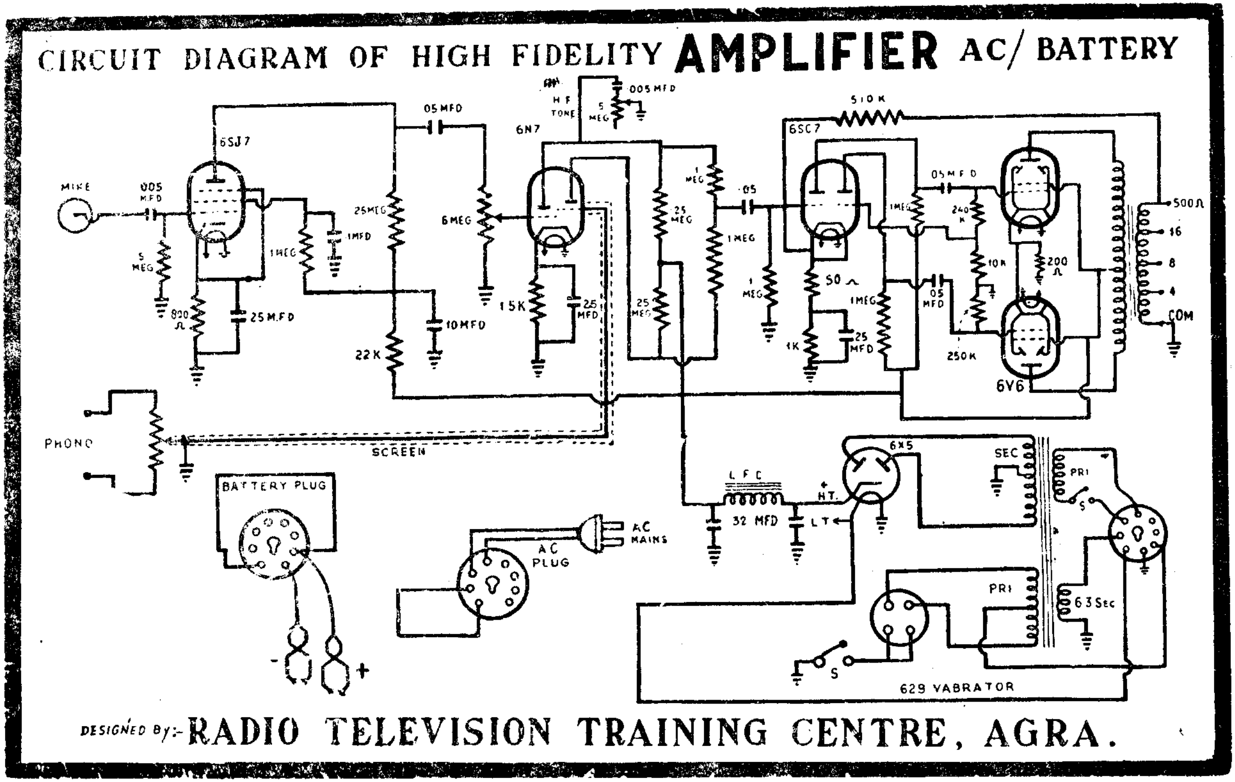


Fig. 50—Six Valves A/C and Battery Amplifier

3. Hum may be picked up from AC heater wiring. To avoid this trouble, the two leads should be twisted together as much as possible and kept as far from the control grid and plate leads as is convenient.

4. Motor boating is common trouble encountered in the construction of audio amplifier. This difficulty causes a noise in the loud speaker that resembles the exhaust of motor boat. The common cause of this difficulty is a lack of regulation of the voltage in the power supply.

5. Excessive plate or screen grid voltage will often cause howling poor quality.

6. The grid bias on all the valves should be high enough to prevent any of the grids from becoming positively charged. However, if the bias is unnessarily high it will result in lowered amplification.

7. When using only unit-speaker connect the leads across common and 16 ohms terminal.

8. For using two unit speaker in parallel, connect the leads across common and 8 ohms terminal.

9. For using four unit-speakars in parallel connect the leads across common and 4 ohms terminal.

10. When using matching transformer with the unit speaker, then connect the leads across common and 500 ohms terminals.

47. Superhetrodyne Radio with Piano Band switch

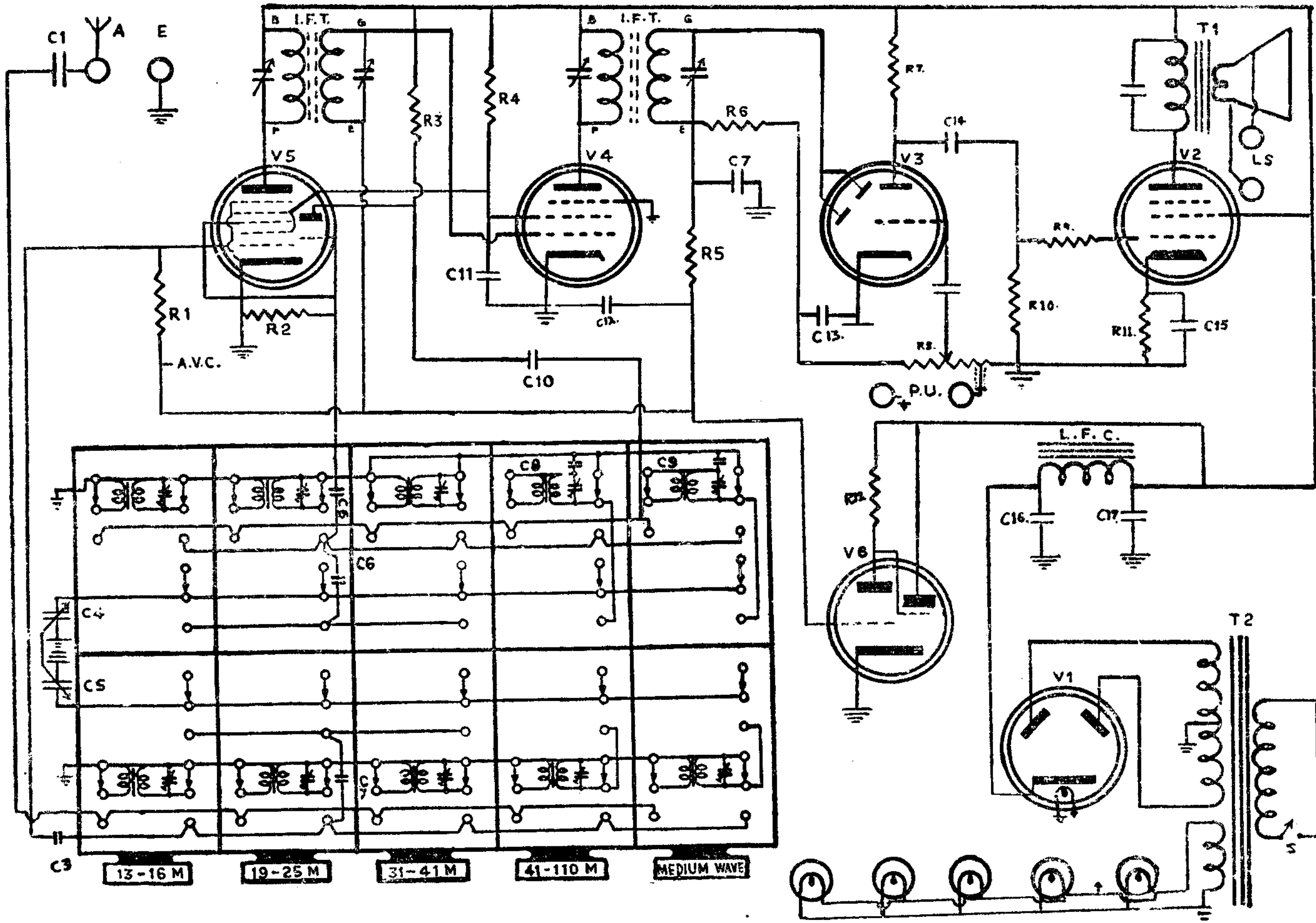
Circuit Description

All the lower coils are the antenna coils. The range in meters is written in front of each coil. Trimmers are connected across the secondary of each coil.

All the upper coils are the oscillators coils. The coil in front of each antenna coil is the oscillator coil of thet particular band. C8 and C9 are the padder capacitor of SW4 and MW. band.

All the windings of antenna and oscillator coils are being shorted with a moving strips of band switch which are indicated by the arrows.

By pressing the button of particular band change switch removes the shorting of the both primary and secondary winding of the antenna and oscillator coil of that band and the moving strips make the contacts with pole terminals and the set works on that band.



SIX VALVES FIVE BANDS SET.

USING PIANO BAND SWITCH

For selecting an other station on the next band press the button of that band. Mechanical device is being used which will release the shorts of the coil of new band and simultaneously short circuited the windings of the coils which is previously working

When you release all the buttons set will not work.

Poles Connections of Band Change Switch :—

Aerial capacitor C^1 is connected to the 1st pole terminal of the primary winding of the antenna coil. Grid capacitor C^3 is connected the 2nd pole terminal of the secondary winding of the antenna coil. Gang capacitor (Ant. section) C^5 is connected to the 3rd terminal of band change switch. Gang capacitor (Osc. section) C^4 is connected to the 4th pole terminal of the band change switch Osc. band spread capacitor C^6 is connected to the 5th pole terminal of the band change switch. Ant. band spread capacitor C^7 is connected to the 6th pole terminal of band change switch

Important Note—Connect one resistor of 10 MΩ in the control grid of valve V^3 and connect the other end of this resistor to chassis. This is the grid leak resisror which is not shown in the circuit.

Parts Lists

Resistors.

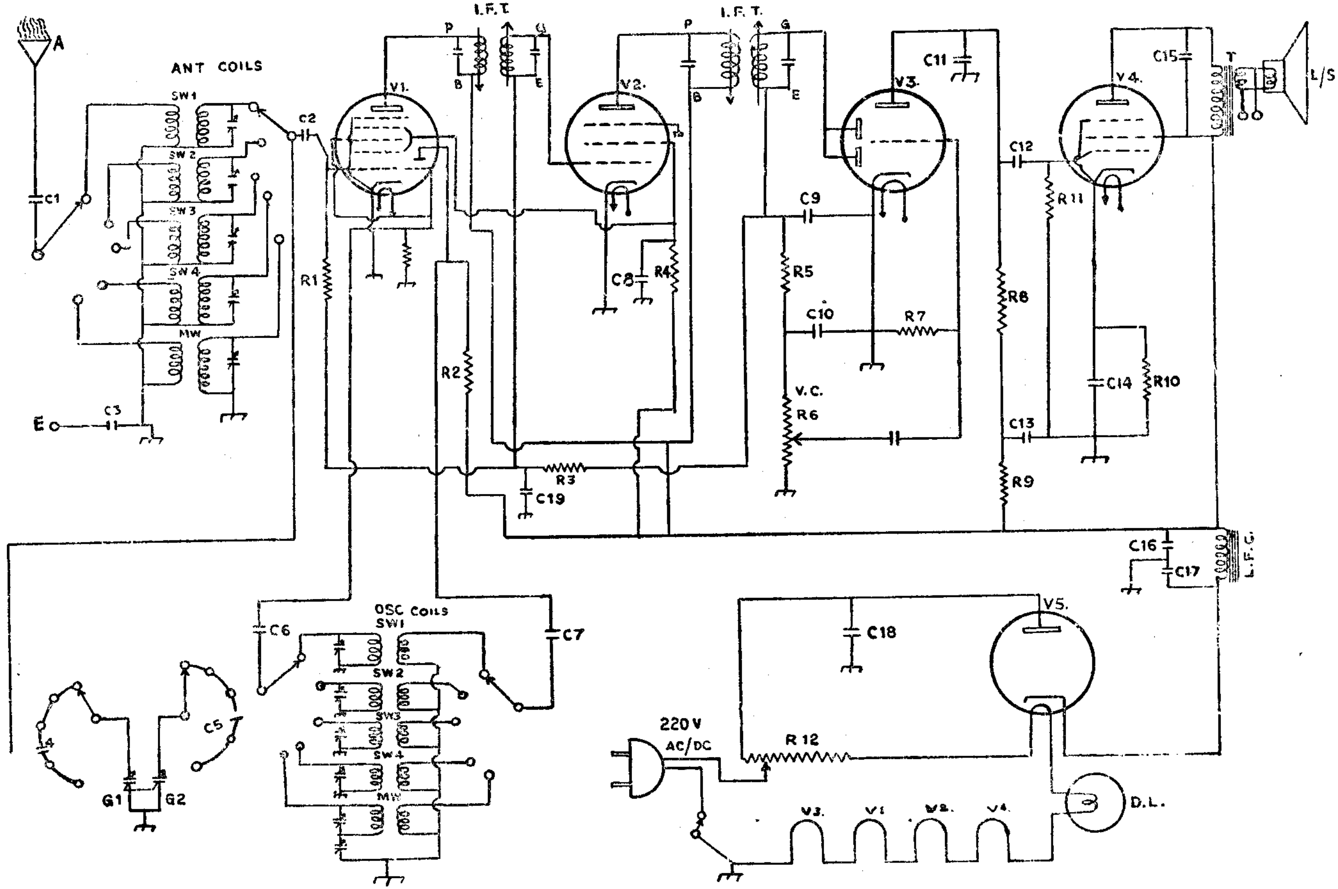
R^1=1 MΩ	R^2 =47 K Ω	R^3 =22 K Ω	R^4 =33 K Ω
R^5=1 M ,,	R^6 =47 K ,,	R^7 =0·2 M ,,	R^8 =0.5 M ,, VC
R^9=10K ,,	R^{10}=0·5M ,,	R^{11}=150 ,,	R^{12}=0·47M,,

Capacitors

C^1, C^{14}=·005 mfd	C^3, C^6, C^7, C^{10}, C^{13}=100 Pfd	C^4, C^5=Gang capacitor
C^8=5000Pfd	C^9=600Pfd	C^{11}, C^{12}=0.05mfd.
C^{15}=25mfd.	C^{16}, C^{17}=32 mfd.	

BAND SPREAD RADIO

5 VALVES — 5 BAND AC/DC.



48. Five Valves Band Spread Radio.

Value and function components.

Capacitors	Function	Resistors	Function
C1 = ·005Mfd	Aerial capacitor	R1 = 1M Ω	Grid leak resistor.
C2 = 100Pfd	Grid leak capacitor	R2 = 22K ,,	Osc. anode load resistor.
C3 = ·01Mfd	Earth capaciter	R3 = 2M ,,	AVC Filter resistor,
C4 = 100Pfd	Band spread capacitor	R4 = 15K ,,	Screen grid resistor
C5 = 100Pfd	Band spread ,,	R5 = 47K ,,	I.F filter resistor.
C6 = 100Pfd	Osc. grid capacitor	R6 = 0 5M ,	Volume control.
C7 = 100Pfd	Osc anode capacitor	R7 = 10M ,,	Grid leak resistor.
C8 = 0.05Mfd	Screen grid capacitor	R8 = 200K ,,	Anode load resistor.
C9 = 100Pfd	I.F. by-pass capacitor	R9 = 20K ,,	Anode decoupling resistor.
C10 = 100Pfd	I.F. by-pass ,,	R10 = 150 ,,	Cathode bias resistor.
C11 = 100Pfd	R.F. by-pass capacitor	R11 = 0.5M ,,	Grid leak input resistor.
C12 = 0·005Mfd	Coupling capacitor Paper	R12 = 900 ,,	Balast resistor.
C13 = 8Mfd	Decoupling capacitor	R = 47K ,,	Grid leak resistor of UCH81
C14 = 25Mfd	Cathode by-pass capacitor	R = 150 ,,	Anode resistor of V^5
C15 = ·005Mfd	Fixed Tone capacitor		Portion of R^1.
C16 = 32Mfd	Smoothing capacitor	**Valves**	
C17 = 32Mfd	Reservoir capacitor	V1 = UCH 81	Converter.
C18 = ·05Mfd	Anode by-pass capacitor	V2 = UF 8	I.F. Amp. lifier.
G1, G2 = 500Pfd	2 Section gang—capacitor	V3 = UBC 81	Det and L.F. Amp. lifier.
Trimmer = 70Pfd	Variable capacitor	V4 = UL 84	Power pentode.
		V5 = UY 85	Rectifier.

Note : (i) Connect the pole terminal of Sec. Ant. coil to the lower terminal of C4.

(ii) Connect the pole terminal of Pri. Osc. coil to the lower terminal of C5.

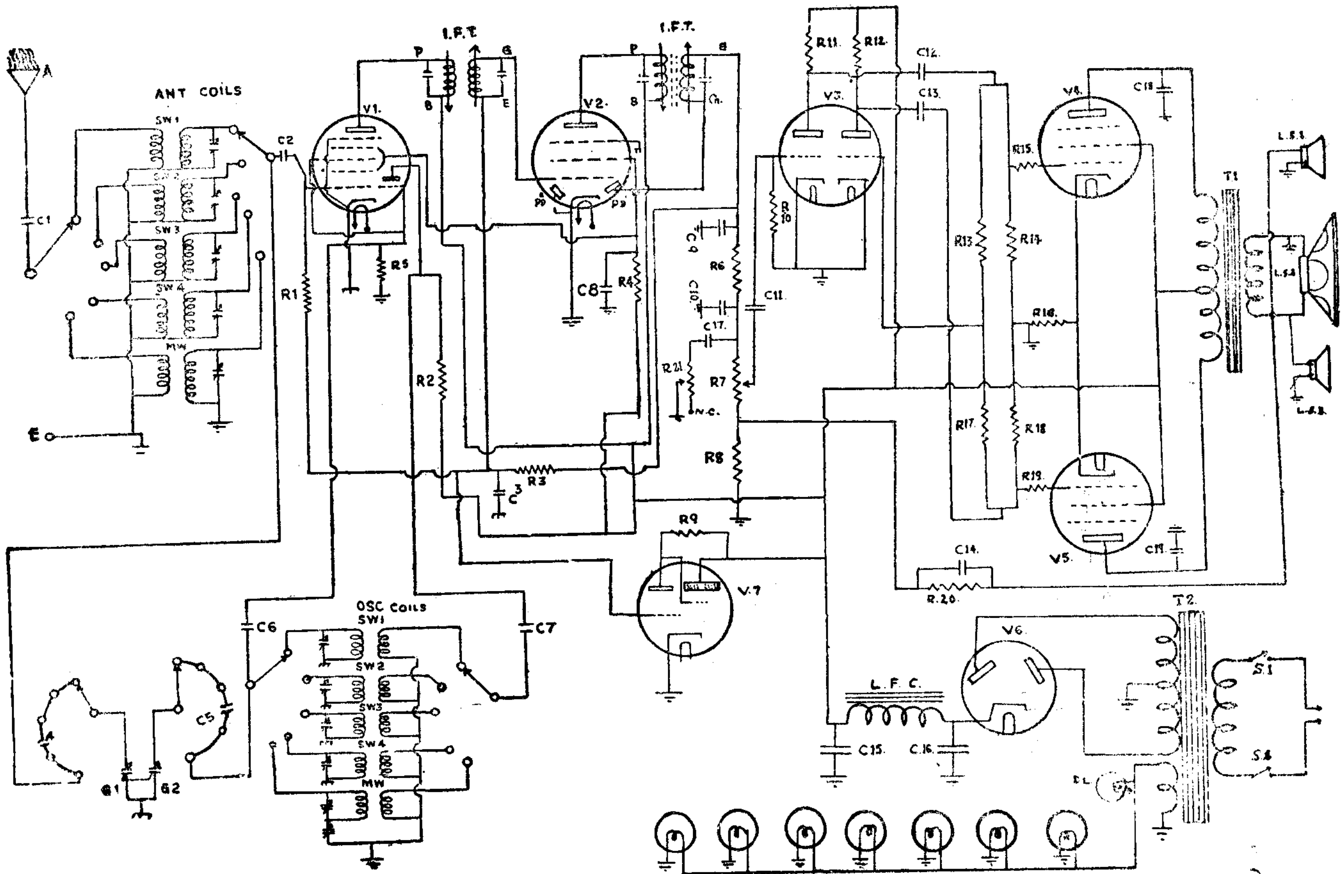


Fig. 55—Five Bands Seven Valves Hi-Fi Radio Receivers

49. Seven Valves High Fidelity Radio Receiver.

Parts List :—

Resistors

R^1=1 MΩ	R^6 =47 K Ω	R^{11}=47 K Ω	R^{16}=60 Ω
R^2=22K ,,	R^7 =0·5M ,,	R^{12}=47 K ,,	R^{17}=22 ,,
R^3=2·2 M,,	R^8 =5 ,,	R^{13}=22 K ,,	R^{18}=.68 M ,,
R^4=22 K ,,	R^9 =10K ,,	R^{14}=·68 M,,	R^{19}=10 K ,,
R^5=47 K ,,	R^{10}=1M ,,	R^{15}10 K ,,	R^{20}=47 K ,,

R^{21}=250 K Ω Tone control R^7=500 K Ω Volume control.

Capacitors

C6, C7, C9, C10=100Pfd	C2, C4, C5=100Pfd	C3, C8, C14=·05 Mfd
C11, C12, C13 = 01Mfd	C15, C16 =15Mfd.	C17 =·004Mfd
C1, C18, C19 =·005mfd.		

Special Features of this Circuit—

It is extremely difficult to design a receiver with single speaker to provide a full range of musical frequencies for good quality reproduction. For this in High-Fidelity receiver two are more speakers are used For reproducing the lower notes a large diaphragm is required and one or two small speakers for high notes.

The net work, R^{20} & C^{14}, is providing negative feed back, reproduction is thus more faithful than when the power pentodes are used without negative feed back, In this arrangement by feeding the voltage from the secondary of output transformer to the input V^3 reduces the amplitude of undesired harmonic and so obtain a marked improvement quality.

Detection is being done in the valve EBF 89. The diode PD' is functioning as 2nd detector. The second diode PD'' is kept at chassis potential

A.V C. voltage is provided to I. F. and converter stage through a filter consists of R^3 & C^3. To test the A.V.C connect a milli-ammeter in the anode circuit of V^2 or V^1, and tune the radio to a local or strong station. The tuning point should be passed one or two times and see the meter. If no change in the current take place in the meter, the A.V.C. system is not functioning then check the A.V.C. circuit R^3 and C^3.

The highest quality receivers usually employ a pushpull output stage. In push pull coupling 2nd harmonics distortion is completely cancelled. An increase in power output per valve is another one result of the pushpull circuit. Instead of pushpull input transformer, R C. coupling is used here, which causes less distortion than transformer coupling.

F. M. SUPERHETRODYNE RADIO

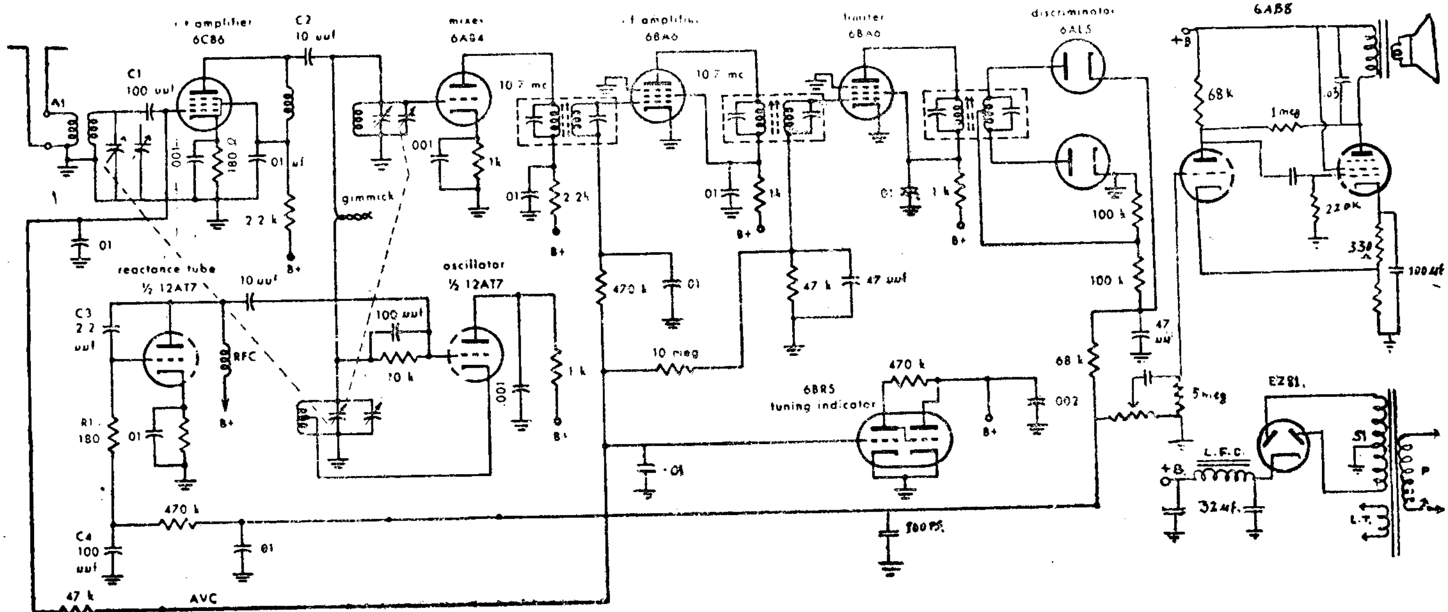


Fig. 56—Frequency Modulated Superhetrodyne Receiver Circuit Diagram.

Band spread circuits are used to obtain a tuning curve that should be wider one to receiver higher and lower notes. If high fidelity reception is to be attained all these frequencies must be received equally well. One section of gang condenser with a series capacitor C^4 and tuning coil of short wave form a band spread circuit.

6. *F.M. Superhetrodyne Radio Receiver.*

Principles of F. M. Receiver—

In frequency modulation system the frequency of the r. f. carrier is varied or deviated to a higher or lower number of cycle as per the frequency of the audio signal. In amplitude modulation system the amplitude of r. f. carrier is varied according to the audio-signal.

In Television sound receiver F. M. system is being used now a days. In F. M. receiver basically the r.f. and a.f stages are similar with A.M. receiver. Because of high frequencies there are some difference in the antenna r. f. and mixer circuit. The reactance tube is used to control the oscillator frequency of the oscillator. The major difference lies in the de-modulator, special type of circuit known as descriminator is required to demodulate the a.f. signal. The limiter valve 6BA6 acts as 2nd I. F. amplifier and clips offt he amplitude variations of the input signal, making its output more constant in amplitude. The output of limiter is fed to double diode vaive 6Al 5. This is Foster Seelay descriminator named after its inventor. This type of descriminator is com monly used in F.M. receiver and TV sound system. The descriminator output acros s the potentiometer, also serves double functions. It delivers a rectified signal voltage for A.F.C. to the reactance valve for stabilizing the frequency of oscillator 12AT7. The audio output is fed to the audio amplifier which is exactly similar as in AM receiver FM sets which are to be used to receive high fidelity radio signal, the audio stages must be capable of reproducing the wide range of audio frequencies.

The advantage of F.M. is that it provides excellent noise free reception of sound signal. Magic eye valve 6BR5 is also used in this receiver which provides tuning indication of desire incoming signai.

Pin Connections of the valves used in this circuits

Valves No.	Function	1	2	3	4	5	6	7	8	9	Base
1. 6CB6	R.F. Amplifier	g	k	h	h	a	g^2	g^3	—	—	7 Pin
2. 6AB4	Mixer	a	is	h	h	hc	g	k	—	—	7 Pin
3. 12AT7	Reactance-osc.	a	g	k	h	h	a′	g′	k′	h^{tap}	Noval
4. 6BA6	I F. & V^5 Limiter	g^1	k^3	h	h	a	g^2	k	—	—	7 Pin
5. 6A5	Discriminator	k	a′	h	h	k	s	a′	—	—	,,
6. 6AB8	Triode-PowerAmp.	at	g^t	k,s	h	h	a	g^3	g^2	g^1	Noval
7. 6BR5	Tuning Indicator	g	k,g	ic	h	h	ic	a	ic	t	,,
8. EZ81	Full wave Rectifier	a″	ic	k	h	h	ic	a′	ic	ic	,,

SECTION

D

Radio Servicing

51. Instructions for Installation Radio Antenna.

If programme is not clear in radio or if there is a lot of disturbance, then first of all check the aerial and the earth system. If aerial and earth are not fitted well, even good and perfectly all-right radio will not give good reception. While checking aerial and earth be careful about the following things.

1. There shouldn't be any joint in the lead-in-wire
2. Aerial's antenna shouldn't be in pararlel to the Main's wire,
3. Lead-in-wire shouldn't touch walls etc, while coming down.
4. Antenna should neither be more than nor less than 25 to 30 feet long.
5. If aerial poles are smaller, change them with longer ones. Higher the antenna more the signal voltage will it receive.
6. Always use plugs while fitting-in aerial and earth to the radio.
7. Use earth-wire nearer the radio so that lesser wire is consumed.
8. If earth wire is connected to the water pipe, do use C-clamp for proper connection
9. If there is no earth-connection with the radio, make a point to use one. This will reduce noise in the radio.
10. If antenna-wire is loose, fit it tightly. Loose antenna-wire causes fading.

VISUAL INSPECTION OF THE RECEIVER

Before repairing the radio, ascertain the cause of the trouble and for that reason inspect the set properly. Check mains cord and plug before repairing the set or opening cabinet of the radio.

Now take out the set from the cabinet and be sure that there is no dry-joint any where. If you find one, resolder it. If insulation of any wire is perished or is cracked either change that wire or put new sleeve over it And now look if any resistance is broken or has become blacky due to over-heating. Particulary check all wire-wound resistances with a meter. Check transformer and see, it is not over-heated Now capacitors must be checked. See if wax etc. does not seem oozing out due to over-heat, and if you find any capacitor like that, replace it. Now check gang capacitor and be sure that rotor and stator plates do not touch each-other. Revolve fully the gang and check it with an ohm-meter. Sometimes the plates get shorted due to dust particles. Check the valves and see that these are fitted in their proper sockets. Their sockets and valve-pins should be clean. Even if slightly dirty, clean them with petrol.

To wash Band-change switch is also a necessity because dirt etc. can result in bad contacts In this way the cause of the defect can be found by Visual Inspection.

Checking the Heater Circuit of A/C Radio

In A/C Radio, all the valves are connected parallel to 6 volt secondary winding of the power-transformer. In that radio, as such, even if one valve is fused, the other continue to glow. To test the heaters of the valve pull them out from sockets and check valves with an ohm-meter. If heater doesn't show continuity, the valve is bad and should be replaced. If, however, heaters of all the valves are O.K. and even then if a certain valve is not glowing then check the voltage across 6-volt winding of the power transformer using voltmeter in parallel to it. Also check the wire connecting heaters of all the valves. If voltages are not present in the winding, go for the checking of the power transformer.

Advantage of A/C Radio

1. Less filtering capacity is required in the filter circuit due to full wave rectification, and there is less electrical interference noises
2. Power consumption is less than AC/DC-radio.
3. More power output due to higher H. T. voltage produced in power transformer.
4. No danger of shock as chassis is always neutral.
5. Heat produced inside the receiver is less as compared to AC/DC Radio.

52. *Servicing Superhetrodyne Radio Receiver.*

First of all check the continuity at the plug terminals by putting the on/off switch at on position. If the meter does not show any continuity, the heater circuit of the valves is open circuited. A circuit which does not form a complete path for the flow of current

TELEVISION
TRANSISTOR-RADIO
Practical Circuits
AND
Servicing

By
KRISHAN ARORA
PRINCIPAL
R. T. T. C. AGRA

RADIO TELEVISION TRAINING CENTRE
TECHNICAL PUBLICATIONS DIVISION AGRA-1 (INDIA)
Phone : 76083 **Price : Rs. 8-50**

PREFACE

This practical guide prepared by R. T. T. C. contains informations on servicing Radio, Transistor and Television receivers It presents a technical training course in Radio-Television for those radio servicemen who have an elementry knowledge of electronics fundamentals, and are interested to learn more by self study.

This is practical book because it was written from experience and not from pure theory. Twenty five years of valuable practical experience is given in this book.

In this edition a new television chapter has been added to make the book complete in this subject, for radio technicians.

A logical method of fault finding is essential for satisfactory repair of radio receiver in the service department. For this reason servicing techniques have been presented in every section and all material has been up dated to give you the latest informations. Both valves and transistor circuits are considered

The author feels that this edition of the book is the most comprehensive treatment on TV radio transistor servicing found in any one book.

Television receiver and NPN Transistor receiver circuit diagrams are also included in this edition for assembling and servicing.

I hope this book will enable you to make intelligent judgments in fault finding.

This book will be a stepping stone to a better and more prosperous future for everyone.

KRISHAN ARORA
Principal
Radio Television Training Centre
AGRA—282001

1st Jan. 1977

Printed at : **Sethi Packers, AGRA Phone : 62257**

CONTENTS

SECTION A | Television Theory and Servicing

1. Transmission of Vision Signal

The TV camera takes a moving picture of the programming at studio. The photosensitive plate insides the camera's picture tube is electrically altered by the light of the scene that is focused on it. An electron gun scans the photosensitive plate with a ray that has a 15625 cycle horizontal rate and a 50 cycle vertical rate produced by pulse generator.

The electron ray hits either light or dark spot according to the scene that is coming in through the lens. A wire comes out of the photosentive plate. If the ray hits a light spot on the plate, a small voltage is developed and small voltage will emerge through the wire. If the ray hits a dark spot a higher voltage is developed.

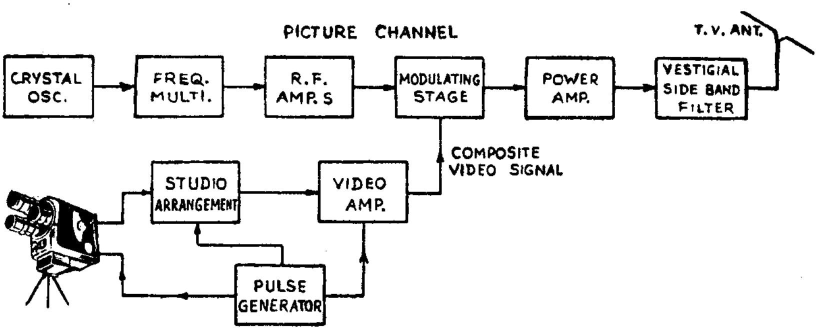


Fig. 1—Block Diagram of Vision Transmitter.

This signal voltage represents each picture in team of millions of tiny spots ranging from light to dark. The signal voltage is processed, beamed out on the air waves accepted by your TV and fed into the picture tube to make light and dark spots. Between the time the signal leaves the camera tube and is transmitted quite a bit has to be done to it.

Each TV station is known by its frequency. Each station has a different frequency. As you flip your channel selector you are tuning in different station each time. The station's designated frequency or carrier is developed by an oscillator set to run at that frequency in the transmitter. It is called the carrier the wave because the picture signal is impressed on it for transmission to your TV set.

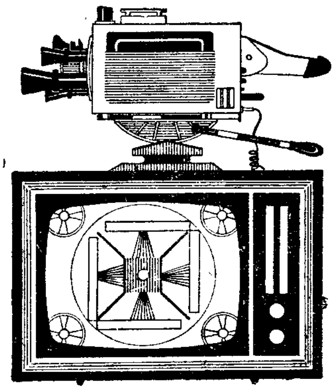


Fig. 2—Tv Set & Tv Camera.

There is a microphone near the camera. It picks up the sound of the scene. The sound is also impressed on the carrier wave, but in slightly different fashion.

While the picture signal affects the height or amplitude of the carrier, the sound affects the frequency.

The picture signal, on the other hand. is amplitude modulated (AM) because it affects the height or amplitude of the radio waves. The fact that picture and sound are respectively AM and FM helps keep them from intefering with each other.

One other important detail must be taken care of at the TV station. In your set the vertical oscillator runs free and automatically. That's not good enough. For unless your vertical oscillator draws the beam down at precisely the exact time as the camera at the TV studio, your TV picture will appear out of vertical sync. So at the end of every second picture, the studio inserts a vertical locking or vertical sync pulse. This transmitted vertical pulse, upon arrival at your TV, is seperated from the composite TV signal and sent to the vertical oscillator. At precisely the end of the picture information it is applied and locks the vertical sweep in to step, preventing flopping over.

The horizontal synch works like the vertical. In order for you to see a picture and not a distortion of any horizontal lines, the 625 lines must be drawn and whipped back precisely in time with the picture being scanned at the studio. So, at the end of every line of video information, a horizontal oscillator at precisely the end of each line of video. The pulse fires the oscillator and the yoke whips the electron beam back for the next line to begin.

In this way, picture, synch and sound, are loaded into the carrier and radiated from a transmitting antenna. Your TV aerial picks up some of the transmitted signal and channels it down into your set.

Let us now consider the basic block diagram of Television transmitter. The crystal oscillator and frequency multiplier stage generates the carrier frequency of vision signal The carrier frequency of vision signal of Delhi TV station is 62.25 Mc/s. The composite video signal having the synch pulses of 15625 Cps and 50 Cps is mixed with the carrier frequency in the modulating stage and then is sent to power amplifier stage for amplification. Finally the modulated vision signal after vestigial side band filter is sent to transmitting antenna for radiation. In vestigial system some of the sides bands on one side may be removed for reducing the band width occupied by the transmitter and this system is used in all present day TV transmissions.

2. *Television receiving system :*

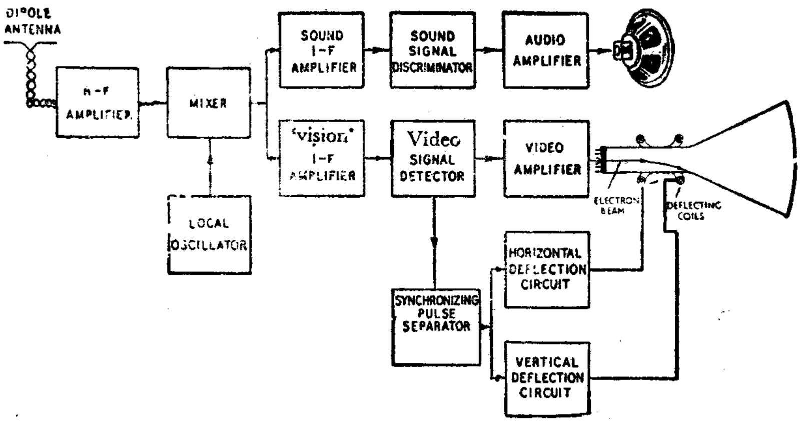


Fig. 3—Block Diagram of TV Receiver

Vision and sound carrier signals are picked up by the common receiving dipole antenna and are coupled to R F. voltage amplifier stage. The R.F. circuits are tuned to select the desire picture carrier. The tuning is sufficiently broad to pass the picture and sound signal.

The bandwidth is as high as 7 Mc/s. The bandwidth in normal radio receiver is only 10 Kc/s. These R.F. signals are amplified and then coupled to converter stage which consists of mixer and local oscillator.

The oscillator frequency voltage from oscillator stage and R.F. carriers signal are mixed in the mixer stage. This will give two I.F. Carriers, one corresponding to picture signal and the other corresponding to sound signal.

The separation between the two intermediate frequencies is same as difference between two carrier frequencies that is 5·5 Mc/s. Thus the mixer output will give two intermediate frequencies. The I. F. for sound is 33.4 Mc/s. and for picture signal is 38·9 Mc/s.

The R. F. ampiifier, the mixer and local oscillator grouped together and the whole unit is known as R.F. TUNER. The proper coils for the tuning each circuits are switched by a turret mechanism on wafer switch. The seperation between the two I.F's one for sound and one for picture may be done immediately after the frequency changer or the separation is done after the first I.F. stage.

The Sound Channel I.F.'s bandwidth is about 150 to 200 Kc/s. and is narrower compared to the vision I.F. bandwidth.

The gain required for the sound I.F. stage is about the same as the picture I.F. stage but the bandwidth is narrow for the sound I.F. stage, the gain obtained per stage is much higher and so the number of stages will be less.

Vision I. F. Amplifer :

In this block diagram of television receiver the vision I.F. signal is separated in the converter stage. The bandwidth characteristics must be sufficiently board enough to pass the full range of picture signal. As the gain per stage is low at least three stages are used to obtain the amplification needed for the video detector.

Video Signal Detector & Sound System :

The function of video detector is to separate the vision information frequencies from the carrier. The germanium diode can work as video detector. After this the signal contains all the information necessary for reproducing synchronizing blanking pulses but the sound signal is no more present. In modern television receiver the sound signal is separated from this video detector stage instead of converter stage. So there will be a hetrodying action between the vision I. F. and sound I. F. and a new sound signal I.F. is produced which is equal to the difference of two I.F.'s that is 38·9—33.4=5.5 Mc/s. In sound system, the sound I. F. signal is amplified by the sound I. F. amplifier stage and is then fed to discriminator stage for getting the audio output The audio output amplified by the power amplifier is sent to loud-speaker for reproduction of sound as shown in the block diagram.

Video Detector :

The video detector output provides a video signal voltage which contains all the information required and necessary for the reproduction of the pictures. This includes the synchronizing, blanking and desire picture information. This video amplifier usually a resistance capacity coupled stage is designed to amplify uniformly the picture or video signal.

The one video amplifier stage is quite enough for amplification of vision signal required for picture-tube operation. The range of frequencies is approximately 3.5 to 4 Mc/s.

When the video signal is sufficiently amplified, it is coupled to the cathode of the picture tube. This will cause the intensity of the beam current and the spot of light on the screen to vary so that the desire picture is reproduced.

Synchronizing Pulse Separator :

The function of this stage is to separate synchronizing pulses or information in the complete or composite video signal from this TV camera signal to provide an output consisting only of synch pulses.

This is necessary to keep the vertical and horizontal oscillator running in exact step with those at the transmitter of television station.

In this synchronizing separator stage the synch pulses for horizontal scanning and vertical synch pulses for vertical scanning are separated. The horizontal synch pulses are applied to horizontal time base oscillator, and vertical synch pulses are applied to the vertical line base oscillator.

Horizontal Deflection Circuit :

This is a time base oscillator which produces a sawtooth voltage or current wave, shape required for horizontal deflection on the screen of the picture tube. It is a type of oscillator whose operating frequency is adjusted to just a little lower than the frequency of the synchronizing signal pulses. The horizontal synch pulses operate the oscillator just before it would operate due to the characteristics of its own circuit and hence bring in time the synchronizing signals. The output is of sawtooth type so that the beam will move horizontally during active line and horizontal retrace between the lines. The output from the horizontal oscillator is amplified to the required level and applied to the deflecting coils in the yoke which are fitted on the neck of the picture tube.

Vertical Deflection Circuit :

This stage to similar to the horizontal deflection circuit and is designed to operate at a frequency of 50 cycle needed for vertical deflection of the beam of the picture tube. The output of the vertical sweep oscillator is amplified to the required level and applied to the vertical deflection coils in the yoke. These deflection circuits produce the required deflction signals and the scanning pattern with or without the synchronizing signal as the deflection generators are self oscillator and do not require any signal for operation. But the synchronizing signals are essential to maintain the TV receiver scanning exactly synchronized with the scanning at the transmitter in order to produce the image properly.

Power Supplies :

There are two types of power supplies are required in television receiver No. 1. Low voltage of about 250 volts D. C. for the anodes und screen grids of amplifiers, mixer & oscillators. This may be full wave rectifier using valve or silicon diode. No. 2. High voltage supply or about 16 to 18 Kilo volts is required for the final anode of the picture tube and this may be half wave reclifier getting the high a-c voltage in the horizontal output stage.

Cathode ray tube :

Electrons after emission from a cathode can be focused into a narrow beam. This electron beam can then be deflected by electric or magnetic field, and the utilization of this principle leads to the cathode ray tube or kinescope as it is called in television reception. It is used for display of radar information and also as laboratory tool to study the operation of electric circuits.

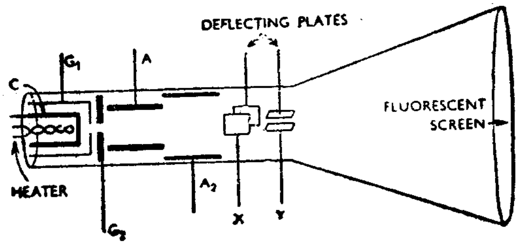


Fig. 4—Simple Cathode Ray Tube.

In the above picture C represents the cathode with heater shown inside the cathode G, serves as grid to control the spot brightness on the screen S. Anode No. A1 is known as the focusing anode since by variation of its potential the electron beam may be sharply focused on the screen. Anode A2 is the second or accelerating anode. X and Y. are two pairs of deflecting plates. S is a screen deposited zinc sulphide on the inner surface of the glass envelope, which gives off light when bombarded by high velocity electrons.

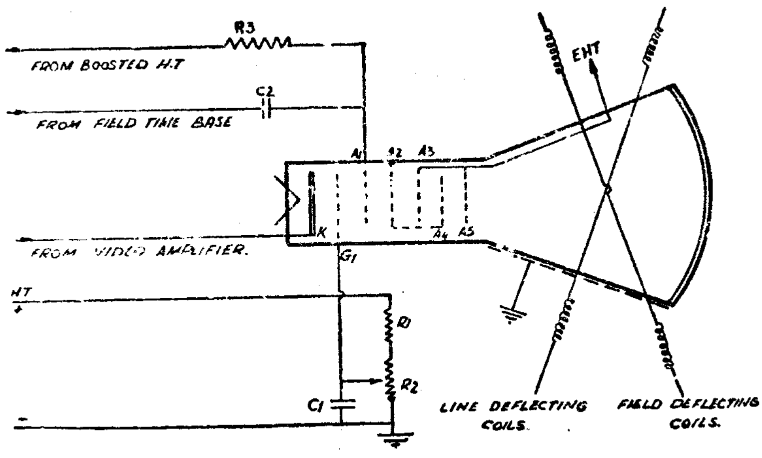


Fig. 5—Picture Tube & Deflecting coils.

If an AC voltage is applied between the pair of "Y" plates the electrons in the beam will be attracted towards the plate which is positive at the moment and repelled by one which is negative. The beam is therefore deflected up and down as the voltage varies and the luminious spot moves correspondingly on the screen. The other pair of X plates is arranged right angle to the first, any voltage across these plate will produce horizontal deflections to the left or right depending on polarity.

There is another type of C. R. T. in which deflection is produced by horizontal and vertical magnetic fields set up currents flowing in the deflecting coils x and y. This type of deflection control is better adopted to tubes using very high accelerating voltages and is commonly used in TV receivers

A variety of flourescent materials is available for the formation of screen. The colour of glow varies with the material and this may be a matter of some importance.

Iconoscope :

When the electron beam moves away from a particular spot on the screen the glow disappears but not instantaneously various fluroescent substances exhibit different rates of delay of brightness after the excitation is removed and the tubes are now available with either long persistance or short persistance sreens. Those with long persistance of yellow or orange. These screens are useful for study of extremely brief phenomena, such as radar information. The tube having short persistance of white glow is usually used in television receiver.

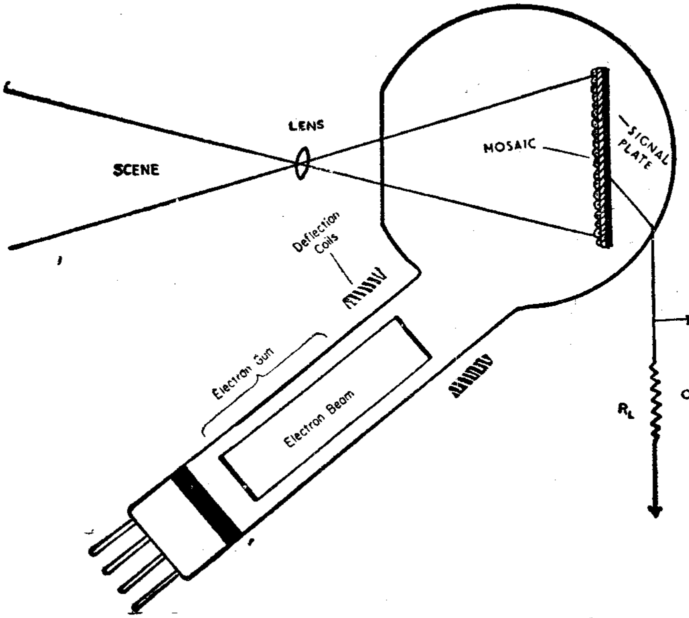


Fig. 6—Iconoscope used in Television Camera.

The iconoscope is a special type of tube used in some TV cameras having an electron gun and focused beam of electrons. The optical image is focused by a lens on to an image plate, consisting of a mosaic of tiny silver dots on a mica card backed by a metal plate. Each dot is photo electrically sensitized and gives up a number of electrons proportional to the light intensity striking it and thus assumes a positive potential charging the small capacitor formed between the tiny dot and the backing plate.

The electron beam, directed towards the mosaic is deflected horizontally across the picture by a pair of deflecting plates or by a controlled magnetic field. After each horizontal deflection or line the beam is deflected downward by the width of two lines and the horizontal deflection repeated. After all the old numbered lines are scanned the operation is repeated on the even numbered lines until the entire optical image has been covered. As the electron beam strikes each silver dot the capacity between dot and backing plate is discharged by addition of electrons to the dot and a current flows to the backing plate is proportional to the charge and thus to the light intensity on that particular dot. A picture consists of a composite of tiny dots scanned at a rate giving 25 complete pictures per second.

3. *Television Raster :*

The television picture that appears before your eyes is a result of split second timing between three operations. These electronic operations can be easily understood by comparing them to the functioning of a movie projection The projector lamp produce light on a screen just as the TV receiver produces light on a phosphor screen. The TV light is called a raster. In a movie projector the film produces a picture that appears in the light some what like the way a TV signal, intercepted by your TV set, produces a picture in the raster. The film feeding mechanism in the projector puts the film in front of the light in proper sequence similar to the way in which the TV receiver's signal path circuits lead to the TV signal to the picture tube.

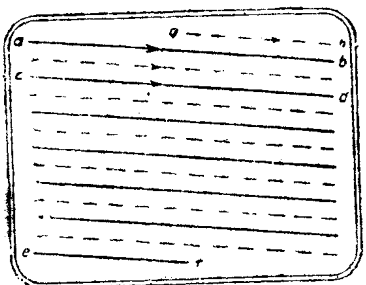


Fig. 7—Showing Interlaced Scanning on the Screen of picture tube.

In a movie projector the lamp shines through a rectangular opening into a screen. The rectangle is shaped so that for every four inches of width there is three inches height. A TV picture also has a aspect ratio of four to three. At this point however the similarity begins to end. A frame of movie film is shown on the screen all in one flash. A raster frame is shown on the screen in a meticulous composite of 1,50,000 pin points of light with no more than one pin points on the screen at any one instant.

The point of light appears on the phosphor because a cathode in an electron gun is emitting electrons in a signal fine ray. The phosphor glows when hit by the ray. Because the beam is narrow it produces only a tiny dot not more than a 32nd of an inch dead centre at the points at which it is aimed. Perhaps you have noticed that a pin point of light remains and gradually fades away when you turn off your TV set. This dot is produced by the rays, which has stopped moving, hitting the screen in one place.

The electron ray must be grabbed hold of f and swung back and forth and up and down. In actual practice it is started at the upper left-hand corner and traced across the screen. Then it snapped back in about one sixth the time it took to swing it across. Since this snap back or retrace is so much faster then the trace it is almost invisible. As soon as the retrace is completed the next line is begun. Line-by line the electron ray travels across he screen until it covers the complete viewing surface. You see only a full screen of light for this tiny dot travels many times faster than the human eye can follow.

A pair of electromagnets known as the yoke are placed around the picture tube neck. The ray must pass through them. The yoke, with its magnetic fields directing the stream of electrons, does the grabbing. By varying the magnetic fields set up by the yoke the ray can be traced retraced and pulled up and down. One part of the yoke, the horizontal section, pulls the ray back and forth. The other half of the yoke the vertical section, pulls the ray up and down.

There are 25 frames every second. If you multiply 625 by 25 it comes to 15625 lines per second. Remember this number. It is your horizontal frequency. The horizontal oscillator produces an alternating current of 15625 cycle per second.

4. *Installation of TV Antennas :*

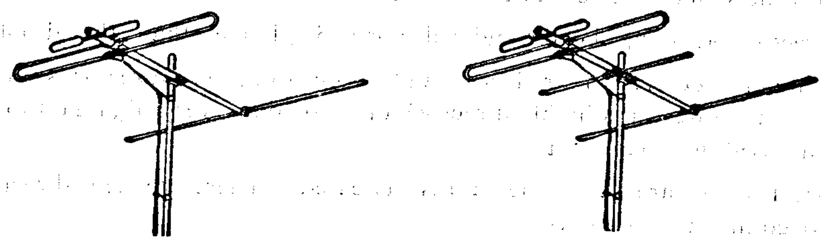


Fig-9 Folded Dipole TV Antennas.

The selection of the type of antenna to be installed will depend on many factors. The most important factor is the distance from the transmitting TV station. A good outdoor antennas give the best possible picture at medium distance and make reception possible in fringe areas 100 to 150 miles away from TV transmitters.

Dipoles Antennas

The simple dipole antenna consists of two rods or tubes of steel or aluminum whose combined lengths are equal to the half of the transmitting wave length.

A folded dipole is a single hollow rod of aluminum bent back on it-self at each end. The impedence of o folded dipole is about 300 ohms The transmission line which connects to the ends of rod should have approximately the impedence as the antenna.

This folded dipole is easy to mount and works well over a wide range of frequeneies. For this folded dipole is widely used in television antenna system.

Delhi TV station is transmitting the signal on the 4th channel (61 to 68 Mc/s). The length of the dipole antenna also denpends on the frequencies of TV stations. Therefore the length of folded dipole for receiving the Delhi TV signal should be approximately 80 inches.

The spacing between the folded dipole elements is usually 2 to 3 inches for the low band.

Low band covers frequency range 54 Mc/s to 88 Mc/s.

High band covers frequency range 174 Mc/s to 216 Mc/s. Ultra High Frequency band covers frequency range 470 Mc/s to 890 Mc/s.

All dipole antennas are directional. This means that they respond best to signal arriving from certain direction. Rotating television antenna for best reception is necessary.

A metal rod of aluminum placed at a definite distance back of a folded dipole is known as reflector. The reflector rod absorbs signals that get past and reradiates them back to dipole and for this a stronger signal goes down to the transmission line of receiver. A reflector also serves to suppress unwanted signals coming from back side.

A metal rod placed ahead of dipole at a difinite distance is known as director. It also reradiates the signal to give addition of signals at the dipole.

The director rod is 5% shorter and reflector is 5% longer than the dipole element.

Any antenna having one reflector and more than one director is known as Yagi antenna. This Yagi antenna is highly directive and provides a very high gain for this reason it is eommonly used in fringe area.

As more directors are added the gain is increased. There are ten director elements can be employed in Yagi antennas.

All the television antennas, are basically combination of dipole, reflector and director elements. The different shapes and arrangement are used to give different compromises of three important antenna characterstics, gain, directivity and frequency response. With high gain antennas good reception is being obtained even out as for as 200 miles from TV station.

5. Cascade R. F. Amplifier in TV Receiver :

The first circuit in the tuner of television receiver is the R.F. amplifier. The R. F. amplifier takes the carrier signal of picture and sound and amplifies about fifty times, The R. F. amplifier must amplify the carrier only and reject any noise and static interference.

Pentodes and special types of triodes can be used in this stage. Pentodes have the advantages of giving high amplification but tend to allow some snow to get into the picture

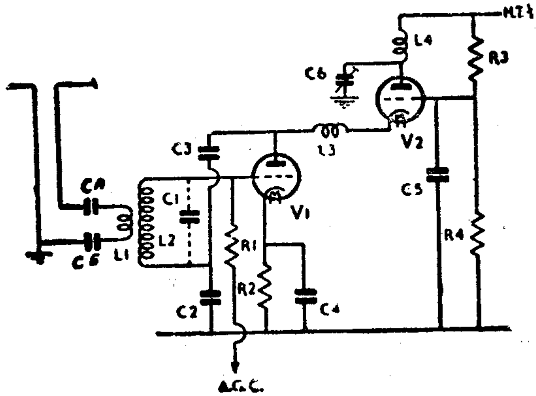


Fig. 9—Circuit Diagram of TV R.F. Stage

Triodes do not produce as much amplification but they are quite static free. For this reason like the 'Fig. 9' golden grid cascade r-f amplifiers are commonly used in TV receivers. This device combined the high amplification of the pentode with low noise characteristics of the triode. Two triodes with gold plated grids were placed into one tube envelope. The output of this stage will be fed to the mixer stage. Tuner troubles are more likely to occur in the r-f amplifier stage than in the following tuner circuits which are known as the mixer and local oscillator. The valve v1 and v2 are the triodes portions of valve ECC 88 combine in one envelope.

6. Frequency changer stage of TV Receiver

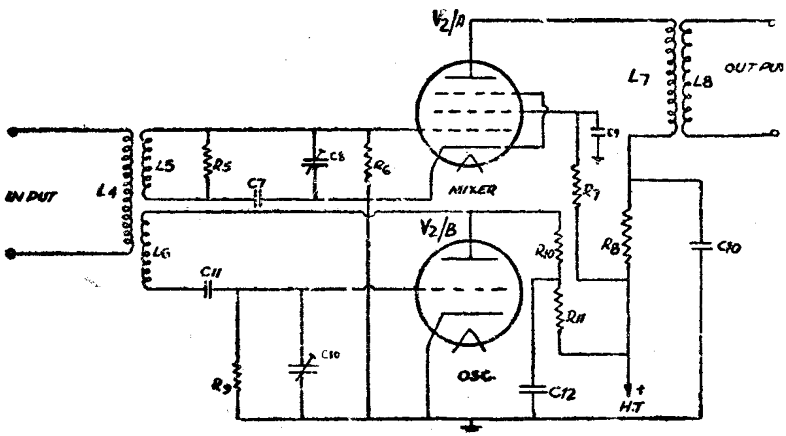


Fig. 10—Circuit Diagram of Converter Stage

Resistors :—

R5=6.8 M ohm	R6=0·25M ohm	R7=50K ohm
R8=1 K ohm	R9=22K ohm	R10=15K ohm

Capacitors :—

C7=50 Pfd	C8=2.5 Pfd (vari)	C9=1000 Pfd
C10=2·5 ,, (vari)	C11=50 Pfd	C12=1000 Pfd

This 'Fig 11' is a converter stage. Triode valve ECF80 is used in this circuit. Triode portion V2/B of ECF 80 is working as Oscillator and V2/A is the pentode portion of this same valve working as mixer. The R f. signal of 2/B is fed to tuned circuit formed by the coil L5 and C8 and stray capacitance of the circuit. Resistor R5 is connected across the tuning coil L5 for broad tuning. This tuned circuit is designed to select the forth channel of Band 1 from 61 to 68 Mc/s.

In the oscillator circuit L6 and C10 forms a resonant circuit at 101·15 Mc/s.

The frequency of picture signal of Dehli TV station is 62·25 Mc/s and 67.75 Mc/s for sound. These both signals are mixed in the pentode valve with oscillator frequency of 101.15 Mc/s to form the I. F. 's of 33.4 Mc/s. and 38.9 Mc/s.

The I.F. of sound is 33.4 Mc/s and 38·9 Mc/s of picture. The variable capacitor C10 is known as fine tuning capacitor which is fitted on front panel of TV receiver. By varying the capacity of this capacitor you can select the desired signal of picture and sound The output of valve V2/A is fed to coil L8 which is input circuit of I. F. amplifier.

Trouble Shooting in R. F Tuner Circuit
(R. F. Amplifier, Mixer and Oscillator circuit)

Symptoms	Cures
1. No sound, good raster.	Replace R. F amplifier or Osc-mixer valve.
2. Snowy raster, snowy picture, no sound or weak sound.	Replace weak R. F. amplifier valve.
3. No reception on channel No. 4.	Replace Oscillator mixer valve.
4. Hum bars in pictures, distorted sound.	Replace faulty R. F. amplifier or Osc-mixer valve.
5. Ghosts in pictures that are affected by fine tuning control.	Replace faulty R. F. amplifier valve.
6. Sound and picture do not tune-together.	Replace Oscillator-mixer valve.

7. *Vision I. F. Amplifiers :*

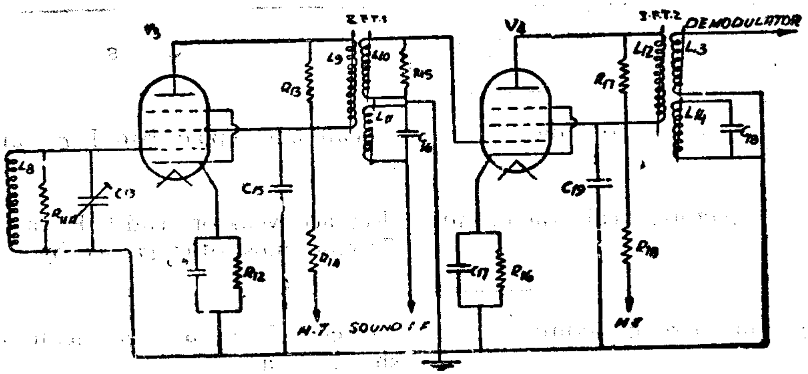


Fig. 12—Circuit Diagram of I. F. Stages.

Resistors.

R11,	=5 K ohm	R12	=300 ohm	R13, R15, R17=12 K ohm
R14, R18	=1 K ohm	R16	=150 ohm	

Capacitors.

C13,C16,C18=2·5 Pfd. C14,C15,C17,=·005 Mfd.

V3=EF 183 V4=EF184.

This is a schematic diagram of a typical two stage I. F. amplifier. The I. F. output of the mixer is mutually coupled to L8 This amplifier is also broadly tuned to handle a frequency range of 5 to 6 Mc/s. For this reason resitstor R11 is connected across the coil L8 for broad tuning. The gain of this amplifier is low so three or four I.F. stages are used in televison receiver. The tuning of each input and output circuit is sufficiently broad to pass the picture and sound signal. Vision I F. is 38·9 Mc/s and sound I. F. is 33·4 Mc/s.

In case of split sound TV receiver the sound I. F. is separated at secondary of I. F. T.1, but the modern TV receiver are based on Comite Consultatif International des Radio (C.C. I. R.) system, separation of sound is done after the first video amplifiers The required screen grids voltage are provided by R14 and R18. C15 and C16 are the by-pass capacitors. Resistor R12 and R16 are used to provide the grid bias voltage to valve V3 and V4 respectively. The output of 2nd I. F, amplifier V4 is coupled to pideo detector to extract the picture, sync, and blanking information from the modulated I. F. carrier.

Trouble Shooting in I. F. Section

Symptom	Cures
1. Raster only, no snow, no audio.	Locate and replace bad I F. valve.
2. Washed out picture, weak audio, no snow.	Replace weak or dead I. F. valve, Trouble most often caused by 1st. I.F. valve.
3. Fifty cycle hum bars in picture.	Defective I. F. valve has heater or cathode short, replace
4. Picture gets more and more contrast, slips vertically, buzz appears in sound	Replace I. F. valve. Trouble most often caused by the last I F. valve.
5. Jumpy picture, lines through picture. Condition not due to outside interference.	Clean all I. F. valve pins and base sockets

8. *Video-Detector.*

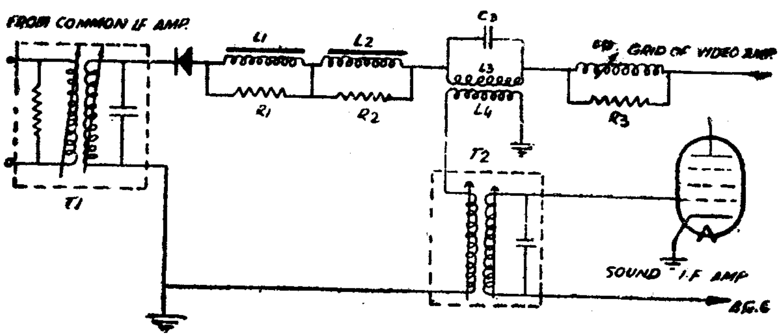


Fig 12—Diode working as Video-Detector

After the carrier leaves the I. F. section it is directed into a seperation stage known as video detector. At this point the audio and sync pulses are unloaded from the I. F. carrier and go their seperate ways to create sound and picture.

The function of the detector is to perform the unloading job and discard the I. F. carrier since the picture and sound elements of the TV signal are in the range of 5.5 maga cycles, the video detector is designed to pass frequencies no higher than thes upper limit. The 33 mega cycles I. F. carrier can not enter the detector and is eliminated.

The video detector can take one of two forms. It can either be a diode valve circuit or a germanium diode circuit as shown in Fig. 12.

9. Automatic Gain Control :

There is another circuit that operates as the sub-ordinate to the video amplifier. That circuit is known as the automatic gain control or AGC because of the function it performs.

In the television receiver the AGC is actually an automatic contrast control. The picture signal that comes through the air is constantly varying in strength. If permitted to appear on the TV screen that way would see a constantly changing picture. The AGC keeps the contrast at a level you see it. It does this by sampling the video signal strength through a tap from video amplifier. If the contrast goes too high the AGC circuit reduces the sensitivity of the tuner and I. F. amplifiers reducing the video signal. If the signal voltage goes to low the AGC increases the sensitivity of the receiver. The AGC performs this job instantly so that you have a constant picture that never varies in contrast.

The AGC circuit develops a small negative voltage that varies from about 0-5 volts to 5 volts. The stronger the signal becomes the more negative the AGC output voltage. The negative voltage if fed to the grids of tuner and I. F. amplifiers. In this way the signal strength is controlled and kept at a constant level.

10. Sound System In Television :

In modern television reciver the sound carrier signal travels with picture carrier signal through the r. f. amplifieri converter, I. f. amplifier, vision demodulator and video amplifier. In passing through the vision demodulator the sound and picture I. f. carriers mix with each other to produce a new sound i. f. signal of 5.5 Mc/s. The picture signal goes to the video amplifier and the sound i.f. carrier signal goes to through it own 5.5 Mc/s i.f. amplifier, discriminator, audio amplifier and loud speaker just as in an F.M. receiver This is known as intercarrier television sound system.

The frequency modulated sound signal from the last sound I.F. amplifier is applied to F. M. detector. The F. M. detector is also known as discriminator. There are two type of discriminator which are commonly used in the TV receiver. These are ratio-detector and Foster seelay discriminator. In this circuit Foster seelay discriminator is used for extracting the audio signal ftom I. F. signal.

The transformer T3 having the cenre tap in the secondary is used in the anode circuit of pentode valve and a single tuning capacitor C7 is used across the secondary winding.

Both the primary and secondary windings are tuned to resonate at the centre frequency of the I. F. signal. Regardless of the frequency variations of the I. F. signal, the signal

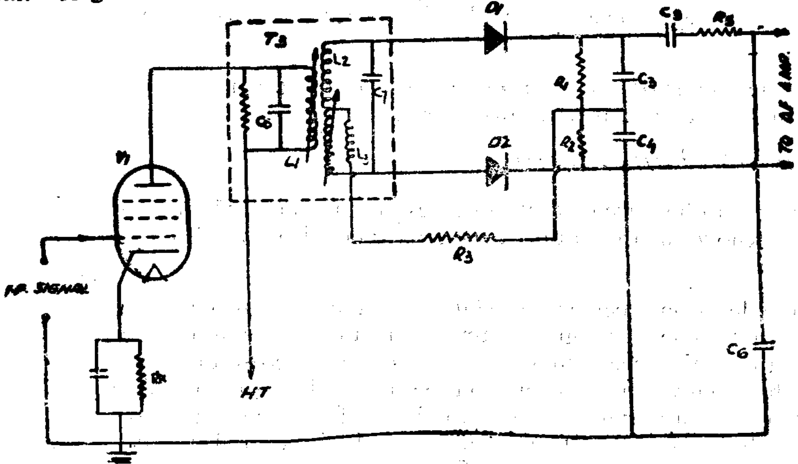


Fig 14—Foster Seelay Discriminator in TV. Set.

voltage developed across upper portion of L2 and lower portion of L2 is alwavs equal. The sign l voltage developed across the primary coil of L1 is fed to the radio frequency; choke L3

The voltage across L3 adds both to the voltage across the upper portion of L2 and lower portion of L2. In this circuit the phase relationships between the voltages across L3, L2 (Upper) and L2 (Lower) will vary as the intermediate frequency deviates and an audio signal voltage is developed across the capacitor C6 which will be coupled to the first audio amplifier.

10. *Audio Section of Receiver :*

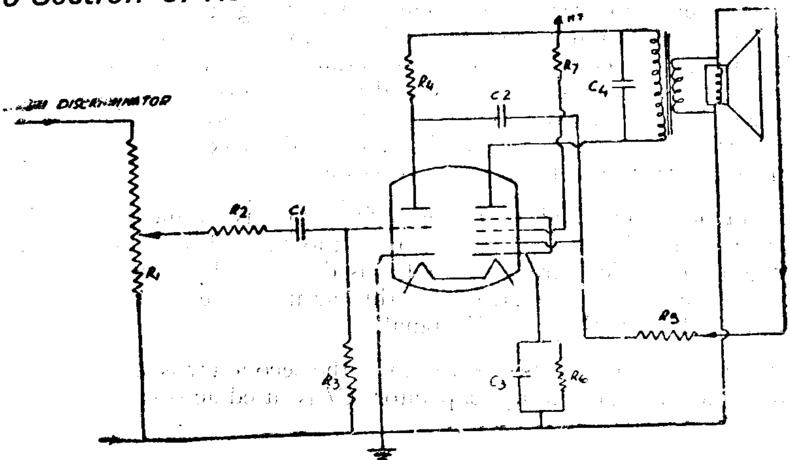


Fig. 15—Audio Amplifiers of TV Receiver

List of parts :— Value=ECL 82.

Resistors

R1=1M ohm	R2=10 K ohm	R3=22 M ohm	R4=220K ohm
R5=680 K ohm	R6=300 ohm	R7=500 ohm	

Capacitors

C1=10 Mfd.	C2=·01 Mfd	C3=50 Mfd.	C4=0.002 Mfd

The audio signal from the discriminator is fed to triode portion of ECL82 through R2 and C1. The resistor R1 works as volume control of audio amplifier. R2 is the r, f. stopper resistor to avoid unwanted r. f. disturbance in this stage. The output of this triode is coupled to the pentode portion of this valve through the coupling capacitor C2. This pentode portion works as the output stage of the audio amplifier. Resistor R6 and C3 are used in cathode circuit for providing the negative bias to the control grid of this pentode valve.

A small amount of output from the secondary of output transformer is fed back to control grid of pentode as a negative feed back for improving the quality of audio signal. In this audio amplifier stage the audio signal is increased until it is powerful enough to drive the loudspeaker. The power output of this amplifier is about three watts.

The servicing procedure of TV sound section is same as the audio section of radio receiver.

11. Video Amplifier and Picture Tube :

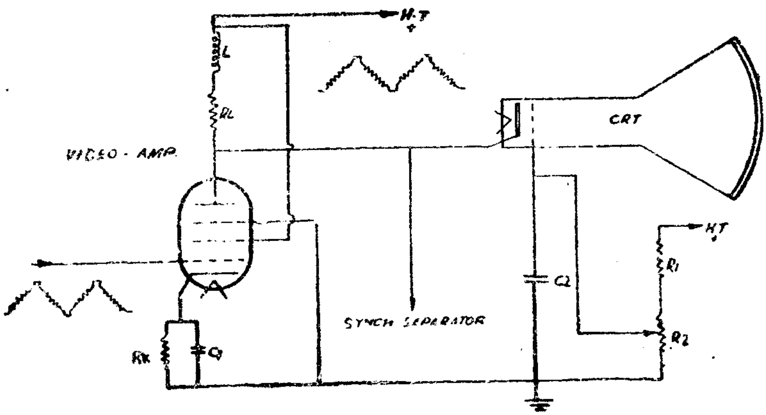


Fig. 16—Video Amplifier and Picture Tube.

Parts list :—Valve Pentode portion of ECL84.

RK=47 ohm   RL=6.8K ohm   R1=100 K ohm   R3=500K ohm (vari)

There are three exits out of the video detector one for audio which is already describe in the previous lesson, and the second one for sync and the third one video. The sync pulses are inclued in the composite r. f. signals transmitted by a TV broadcast station to provide timing information required for synchronization of the transmitter and receiver scanning system.

The function of above video amplifier is to increase the pure picture signal so that it will be strong enough to create a picture on the TV tube. The video signal voltage is not constant in frequency. It covers a broad range of frequencies from zero to 4·5 Mc/s because it represents the millions of light and dark dots making up the TV picture. Video amplifiers must be carefully designed to cover the entire range of video frequencies.

The valves that have a low inter-electrode capacitance should be used for video amplifier. This is because large stray capacity will kill off the higher frequencies in the video signal.

The output of this video amplifier is applied to the cathode of the picture tube to intensity-modulate the electron beam during its vertical and horizontal scanning of the picture tube screen. The brightness control R2 adjusts the grid bias on the picture tube to assure that the blanking level occurs at the correct blank point, so it controls the intensity of illumination of screen of picture tube. The brightness adjusted when no picture signal is present on the screen, a point where the vertical retrace lines just disappear is the correct position.

12. *Synchronization Circuit*

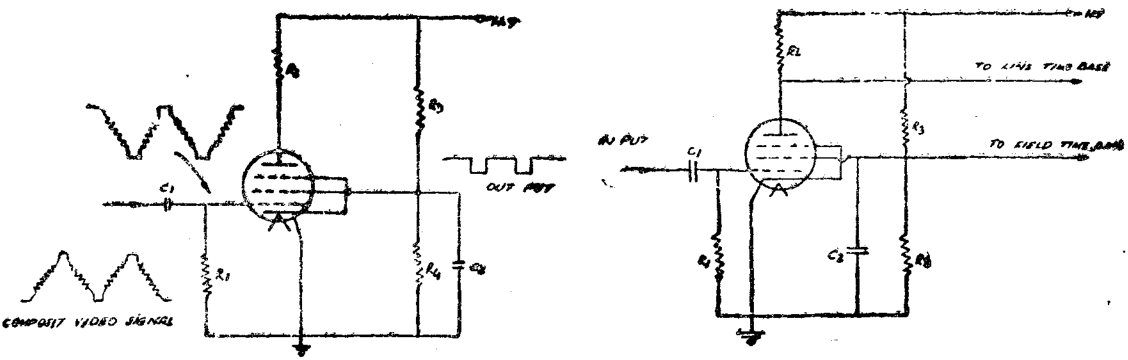


Fig 17—Synch Separator and Amplifier Circuits.

The sync section consists of four main parts, the sync separator, the integrator, the differentiator and the horizontal A.F.C. A portion of the signal voltage enters the sync separator stage after it leaves the video detector. The sync circuits are set up so that the sync pulses are clipped away nicely from the video and audio and the pulses alone are sent into the grid of sync separator valve. This work is done by a pentode valve as shown in the above circuit.

In the sync separator valve the vertical pulse is isolated from the horizontal pulse. The difference of time constant (RxC) duration of line and field sync pulse make it possible to sort them out. If output is taken from the resistor it is differentiator and if from the capacitor it is integrator. The vertical sync is applied to the vertical oscillator valve and locks the oscillator precisely in time with the way the studio camera is scanning each interlaced field. Your TV picture is thus locked in vertically.

The horizontal sync is applied to horizontal oscillator and locks the oscillator so it beats precisely in time with the way the studio camera is scanning each line of the frame. Your TV picture is thus locked in horizontally.

The simplest trouble to diagnose in a TV set is sync trouble. The picture just will not remain still. Sync trouble can be caused in the vertical oscillator or horizontal oscillator circuits.

Trouble No. 1 :—Picture Rolls and Slips.

A bad sync valve will not permit the sync pulses to get either the horizontal or vertical oscillators. If there is no sync pulse there is no synchronization. The second reason is that the vertical oscillator frequency is not exactly 50 cycles per sec. It is set a little below This is done so the addition of the sync pulse will raise the frequency to exactly 50 cycles. If the sync valve fail to process the verical syne pulse to the oscillator the oscillator will run free at slightly less than 50 cycles per second causing the picture to roll.

If the picture rolls and instead of locking slips either way according to the direction in which you will adjust the vertical hold control, the vertical sync pulse is not arriving at the vertical oscillator. This condition could be caused by a defective sync valve. If the picture locks in vertically but needs constant adjustment then this is also due to defective sync valve.

Trouble No. 2 :—Horizontal Drifting.

The horizontal sync processing is more complicated than the vertical as mentioned previously. Noise while it will not affect the 50 cycle per sec, vertical frequency, can be quite detrimental to 15625 c/s horizontal frequency.

Rather than take the horizontal pulse and inject it driectly into the horizontal oscillator grid as is done in the vertical oscillator, the pulse is sent into a special circuit known as the horizontal automatic frequency control. In this circuit the speed of the horizontal pulse is compared with the speed of the horizontal oscillator. As long as the two are running exactly neck and nack no votage is developed.

If one should begin to lead the other a DC correction voltage is developed and fed to the horizontal oscillator grid.

The voltage shifts the horizontal oscillator frequency so that it compares correctly with the frequency of the horizontal pulse. This DC correction voltage, a result of the comparison, actually controls the horizontal frequency automatically. If the sync pulse does not get past the sync circuits due to defective valves there will be no DC correction voltage and the picture will drift back and forth horizontally.

13. *Horizontal Oscillator.*

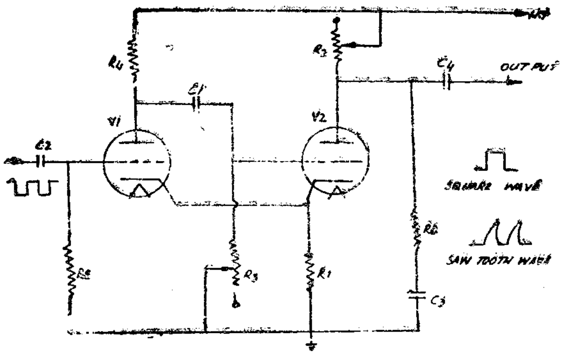


Fig. 18—Practical Time-Base Oscillator.

This is the cathode coupled time base oscillator circuit which is commonly used in television receiver, Here the two triode valves are coupled to each other by resistance capacity coupling and produces square waves. The grid leak resistor R3 is used as the hold control and brought out on the front panel of televison receiver. It determines the frequency of oscillations and thus it controls that picture does not slip up and down. The plate load resistor R2 is also a variable resistor which controls the size or height of the picture. This is kept at the back of the television receiver.

The main function of this stage is to produce an alternating current at the frequency of 15625 cycles per second exactly one pulse per every line drawn on the TV screen by the electron gun.

Some of the alternating current produced by the horizontal oscillator is used in making the very high voltage necessary to create light on the face of picture tube. This will study in the next lesson.

The first check in determining whether or not the oscillator is running is to listen for it. Most people can hear this high pitched if they try. To become acquainted with it do this while your TV set is turned on rotate the horizontal hold control R3. As you rotate the control you should hear an extremely high pithed while changing in frequency. If you do not hear this sound and there is no brightness on the TV screen, chances are the horizontal oscillator is not operating. Now check the horizontal oscillator valve.

The horizontal oscillator has specific frequency of 15625 cycles per second. It must run at exactly that speed not a cycle eitherway. This is the frequency the picture being taken or scanned at the studio. If your TV receiver is not exactly in step you will get a screen full of slanting lines instead of a picture. If the set has only a few lines on the screen, the horizontal oscillator frequency is close to 15625 though not exact. If the screen shows many slanting lines the frequency is far away from 15625. The first step towards curing the loss of horizontal synchronization to replace the horizontal oscillator tube. The second step is to try making adjustments. Adjustable resitors R_2 and R_3 are included in circuits to compensate for wear.

Turn the shaft of R_2 one way and the frequency goes up, turn it the other way and the frequency goes down. Adjust it to best position for getting 15625 cycle per second.

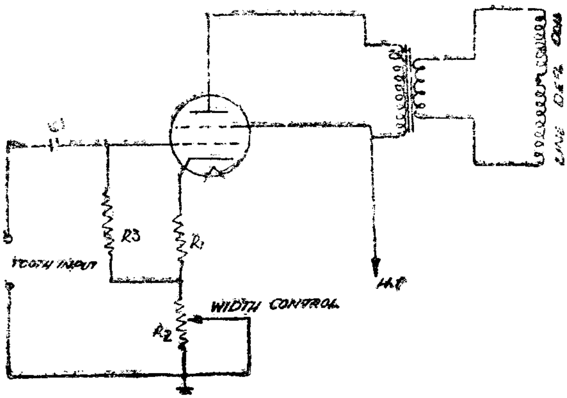


Fig. 19—Horizontal Output Stage.

When the horizontal pulse is first made in the horizontal oscillator it is too weak to be used. So it is passed from the oscillator into the next stage, the horizontal output amplifier. This circuit is also known as line time-base output stage. This circuit takes the 15625 cps pulses through capacitor C_1 and blows them up or amplifies them till they are large enough to work. From the anode of output valve the amplified pulse is sent to the yoke where it causes the electron ray to be swept back and forth across the picture tube face. Operation of the horizontal out-put tube is dependent upon the horizontal oscillator In fact it is so dependent that if the horizontal oscillator goes dead the lack of pulse on the grid of the horizontal output amplifier makes the tube run hotter than it should. Any such prolonged activity will burn out the output tube.

14. The Damper Valve.

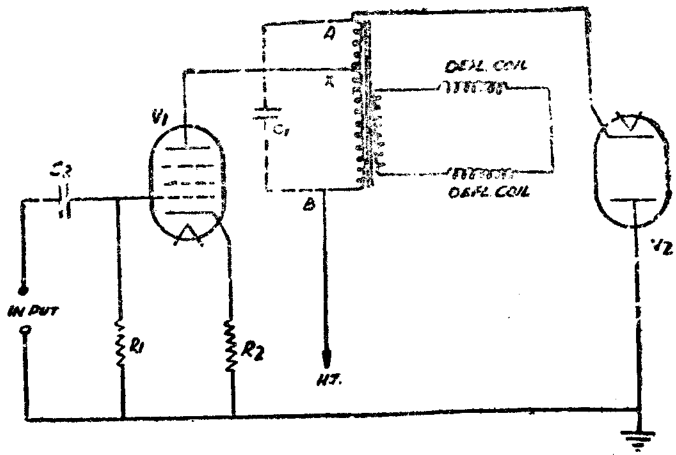


Fig. 20—Damper stage in TV receiver.

In the TV receiver a damper valve is used to dampening the vibrations or variation in the fly back system.

When we speak of fly back action we are talking about an electromagnetic phenomenon. The actual activity is this. The horizontal output amplifier feeds the horizontal pulse into yoke. The frequency is going off and on at 15625cps. While the frequency is at the height of its voltage a powerful magnetic field surrounds the yoke. During the next instant the frequency drops off to the depth of voltage. The magnetic field follows the voltage drop and collapses suddenly or flies back.

The sudden collapsing cause electricity of thousands of volts to appear for an instant in the yoke coil. The voltage is fed back into a small winding in the fly back transformer, The fly back activity causes many other, not quite as strong, frequencies voltage ractifier. The flp back activity causes many other, not quite as strong, frequencies to begin to develop. These transient voltage must be dampened. That is what the damper does It is a rectifier that changes these transient frequencies to direct current so. they are not frequencies any more.

As you known that the horizontal pulse produced in the horizontal oscillator and amplified in the horizontal output valve for the purpose of swinging the electron ray across the screen has an additional function of production of very high voltage needed to create brightness on the face of the picture tube.

15. *High Voltage Rectifier*

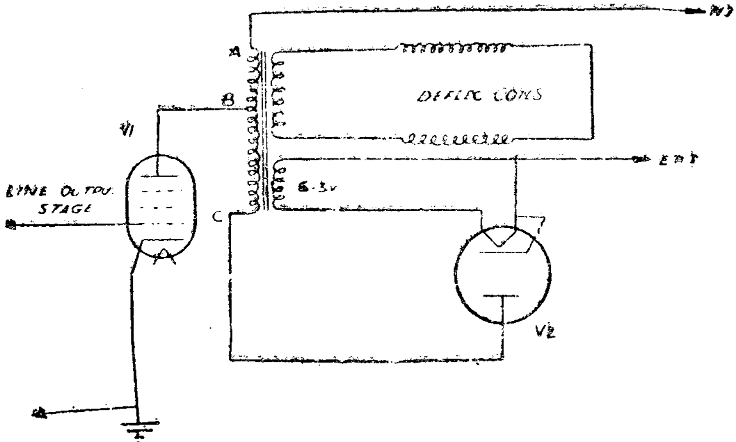


Fig. 21—Circuit Diagram of E. H. T. Supply.

In order for electron ray to reach tne phosphor face a high voltage of about 18000 volts must be applied to the picture tube,

By taking a sampling of the horizontal pulse and properly utilizing it the TV set can produce high voltage as a by product.

When the varying plate current of 15625 cycles will flow in the 'AB' upper-portion of transformer winding, a very high voltage will developed across the whole winding due to high rate of change of magnetic flux. From the terminal C the high AC voltage are given to the anode of V2 for rectification and we are getting the extra high d c. voltage from the cathode of this diode valve.

These high voltage are applied to the final anode of picture tube. The final anode is connected to the top cap of picture tube

If the sound is off and there is no brightness on the TV screen, then first check the high voltage rectifier valve.

If the electrical pressure is only a hundred volts there is vey little danger of leakage beacause the combination of plastic and air is plenty of insulation, However when the voltages rises to 18000 volts, the insulation problem becomes critical. Things like ageing of the wire, positioning of the wire and humidity in the air becomes important factors,

Your TV set can develop a mild leak or a serious one. The mild leaks are called corona discharge. There is a hissing noise and if you darken the room you will see at the trouble spot, a bluish ray emanating from high voltage system to a place on the chassis or high voltage cage. The cure is usually easy. Take a piece of plastic with high insulating qualities and position it in the path of the ray.

A serious leak is called arcing. It sounds miniature pistol shots and looks like a little lightning dlscharge from the high voltage system to a point on the chassis or a high voltage cage. To cure arcing use high voltage tape and reinsulate carefully the high voltage area.

16. Vertical Deflection Section

There is another important section of the television set is the vertical deflection circuit which consists of vertical time-base oscillator of 50 cps, amplifier and vertical output stage. The vertical time base oscillator works in a similar fashion to the horizontal oscillator execpt that the vertical deflection is at a relatively slow 50 cycles per second. This is exactly the right speed so that each horizontal line is pulled down beneath the other.

In multivibrator oscillator the sawtooth type oscillation takes place due to alternate conditions of the two triodes. The circuit may be free running and oscillate at its natural freq uency but to synchronize the osclllator action with the signal from a TV transmitter, vertical synch pulses are injected for triggerting the oscillator.

Twenty five pictures of frames consisting of 625 lines are made per second on a TV screen. Each of these complete picture is broken up into two halves known as fields. The first field consisting of odd number lines is traced across the screen first. This is followed by interlacing in the second field which includes all the even numbered lines.

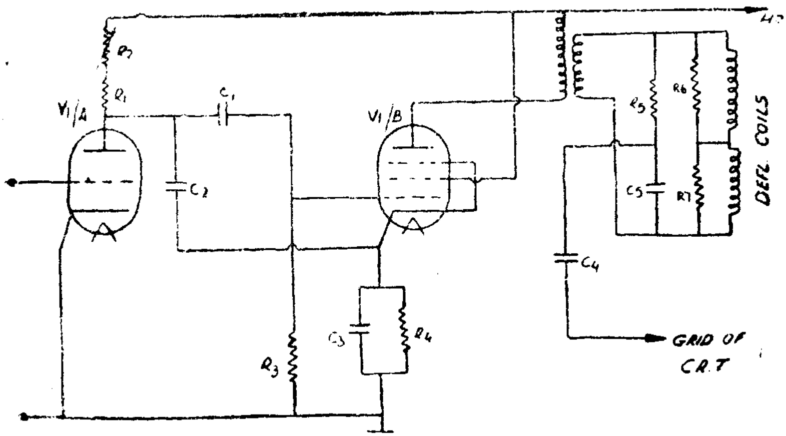


Fig. 22—Practical Circuit of Field Out-put Stage.

Since it takes two fields to make one complete picture and there are 25 complete pictures per second ir can be seen that the vertical oscillator must drive the electron ray through 50 complete field per second. This is the reason for the 50 cps output from the vertical oscillator. The flickering is avoided in this type of interlace scanning. In this circuit V^1A is the part of multi-vibrator oscillator and V^1B is the vertical output tube which takes the vertical pulses from the oscillator and amplifies them so they are large enough to drive the vertical deflection coils in the yoke.

If the vertical oscillator is not functioning then there will be no vertical sweeping and there will be only bright line across the centre of the screen and will burn and darken the phosphor of picture tube. In effect it will burn a line across the centre of the screen. If you come up with no vertical sweep turn the brightness control all the way down while you repair the set. The first step when your TV set develops this condition is to change the vertical oscillator valve.

If the picture rolls up and down then it means that you have lost vertical synchronization. Loss of vertical sync can happen duc to weak vertical oscillator valve which throws the frequency either below or above the 50 cps. If the vertical hold control fails to correct this condition then replace vertical oscillator valve and adjust vertical hold control.

Under normal conditions the vertical hold control should lock in the picture in the middle, not at one extreme or the other. If this occurs the vertical oscillator is to be replaced.

If the vertical oscillator valve becomes weak the picture can shrink-in from top and bottom. Usually when th⁴s happens the shrinking is even or linear.

17. Power Supply of Television Receiver.

The circuit 'Fig 23' is the power supply of a television receiver. This is the only circuit in a TV set upon which all the rest depend The remaining sections of a television set act in one way or another to help create picture and sound. If this power supply goes dead none of them will function.

When you turn on your TV receiver you close a circuit that permits 220 volts 50 cycle AC house current to enter the power supply. The AC line curreut is changed by the powcr-supply to the precise voltages needed to operate the remaining circuits.

Televison receiver valves need three separate voltage potentials in order to operate. The first is the heater voltage necessary to heat up the cathode and drive electrons off it. In this circuit there are two separate L.T. secondary windings of 6·3 volts for hcating the heaters of all the tubes of a TV receiver. The second type of potential is the plate voltage necessary to attract electrons for the plates of the TV tubes. Since the plate voltage must be direct current, the power supply has the job of changing the alternating current from the line into direct current with the help of silicon diode D[1].

The third type of voltage used is grid voltage. Grid voltage is derived directly from the AGC circuit and the television signal itself. Since the power supply is called

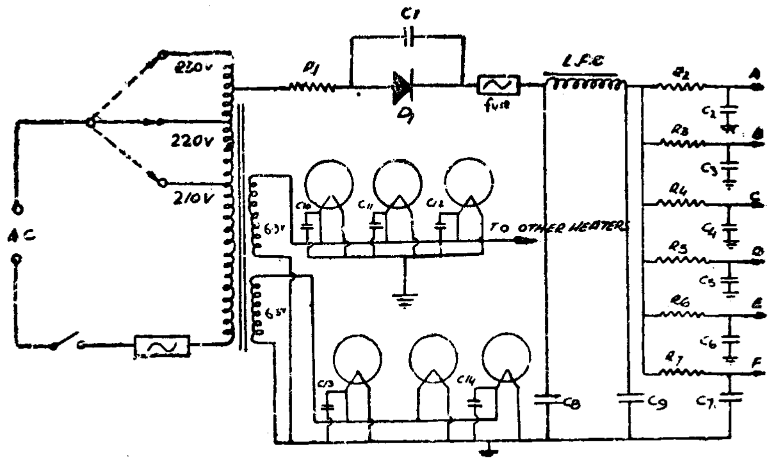


Fig. 22—Heater & Rectifier Circuit of AC/DC TV Reciver

upon to operate the AGC circuit and the tubes that process the TV signal, grid voltage also depends upon the power supply.

There are two main types of power supply, the transformer type is used in a/c TV receiver and transformerless type used in AC/DC TV receiver. In this transformer type heater voltages is furnished through the two step down windings in the transformer. The 220 volts 50 cycle AC current enters the primary of the transformer. There are two extra tapping of 210 volts and 230 volts in the primary winding. The 50/ dron windig feeds the windings in the transformer converts this to 6.3 volts. The secondary voltage feeds the heaters directly. The heaters of all the tubes are connected in parallel.

The silicon diode D[1] is working as a half wave recfifier. The pulsating DC voltage in the cathode is filtered to pure DC voltage with the help of low frequency choke and two electrolytic capacitor C^8 and C^9 and then delivers to different stages through their R. C. filters.

20. *M. W. Band Six Transistors Receiver.*

Parts list—

TR^1—Converter=AF 117	TR^2—Ist I. F. Amplifiar=AF 116
TR^3—2nd I. F. Amplifier=AF116	TR^4—Ist A. F. Amplifier=AC126
TR^5—Power Amplifier=AC128	TR^6—Power Amplifier=AC128
D —Detector =OA79.	

Resistors

R^1=10 KΩ	R^5=2.2 KΩ	R^3=1 KΩ	R^4=33 KΩ
R^5=680 KΩ	R^6=—	R^7=220Ω	R^8=150Ω
R^9=5 K Ω	R^{10}=4·7 KΩ	R^{11}=68 KΩ	R^{12}=1 ΩK
R^{13}=47 Ω	R^{14}=22Ω		

Capacitors

C^1=310 Pfd.	C^2=0·01 Mfd.	C^3=·01 Mfd.	C^4=0.05 Mfd.
C^5=10 Mfd.	C^6=0.05 Mfd.	C^7=·01 Mfd.	C^8=10 Mfd.
C^9=0.01 Mfd.	C^{10}=0.01 Mfd.	C^{11}=100 Mfd.	

Circuit Description—This is a typical circuit having only medium wave band. The ferrite rod inside the tuning coil T^1 works as the aerial. The Primary of T^1 and C^1 forms the resonant circuit for selecting the desire signal. The capacitor C^1 is the gang capacitor. This tuned circuit is coupled to the base of the converter transister TR^1 through the capacitor C^2. The forward bias is provided by R^1 and R^2. The oscillator tuned circuit is formed by the 2nd section of C^1 and T^2 The primary of T^2 is coupled to secondary winding for required feedback between collector and emitter. The emitter resistor R^3 acts as the emitter stabilzing resistor and for the additional bias to the transistor when circuit is oscillating.

The I. F. signal from TR^1 is picked out by the first I.F.T.^{1} This tranaformer consists of two windings, one forming the resonant circuit with fixed ceramic capacitor, the other winding feeds the I. F. signal to the base of I. F. amplifier TR^2. The resultant forward biat to the base of TR^2 is provided by R^4, R^5, R^{10} and C^4. The I. F. amplifier TR^2 feeds the I. F. transformer I. F. T.^{2} which is similar to I. F T,^{1}. The bias is stabilized by the emitter resistor R^7 and C^6. The I. F, T.^{2} feeds the signal to 2nd I. F. amplifier TR^3. The I.F. signal in the secondary of I F. T^3. is fed to the diode for detection. The a.g.c. voltage is fed through R^{10} to TR^2 only.

The volume control R^9 feeds the audio stage TR^4. The bias for TR^4 is provided by R^{11}. Transistor TR^4 feeds two output transistors through the push-pull transformer T^3 The power output transistors TR^5 and TR^6 ara operated in class B pushpul[and transformer T^4 is the L. F. output transformer feeding thc loudspeaker. The forward bias is provided to the bases of TR^5 and TR^6 by the rdsistor R^{12}. end R^{13}. Stabilization of the bias is by the resistor R^{14} which can not be by-passed because the transistor are operating class B. The capacitor C^{11} is in parallel with battery of three volts to reduce possible feedback due to the battery impedence.

M. W. BAND TRANSISTOR RADIO

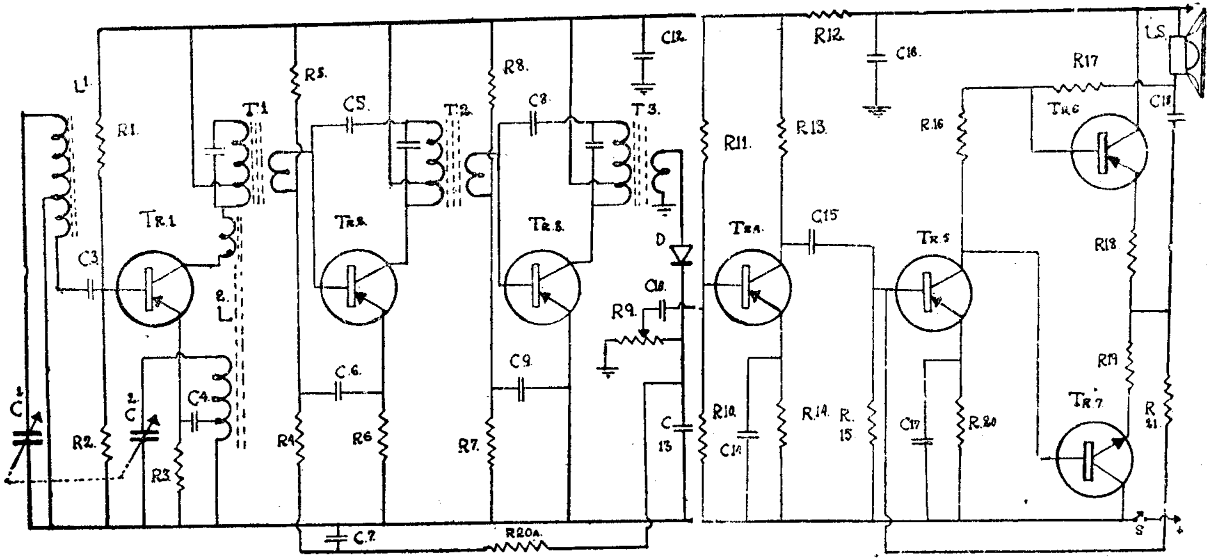


Fig. 25—Seven Transistors Radio Receiver

Capacitors :

C^{1}, C^{2} = 300 Pfd.
C^{3}, C^{13} = 0.01 Mfd,
C^{5}, C^{8} = 5 Pfd.

C^{4} = 0.002 Mfd.
C^{6}, C^{9} = 0.02 Mfd.
C^{7} = 30 Mfd.

C^{10}, C^{15} = 10 Mfd.
C^{12}, C^{14}, C^{16} = 100 Mfd.
C^{17} C^{18} = 100 Mfd.

Resistors :

R^{1} = 15 KΩ
R^{2} = 5.6 KΩ
R^{3} = 1.2 KΩ
R^{4} = 56 KΩ
R^{6} = 8.2 KΩ

R^{6} = 1 KΩ
R^{7} = 4.7 KΩ
R^{8} = 22 KΩ
R^{10} = KΩ
R^{11} = 100 KΩ

R^{12} = 100 KΩ
R^{15} = 2.2 KΩ
R^{14} = 1 KΩ
R^{15} = 10 KΩ
R^{16} = 100 KΩ

R^{17} = 1 KΩ
R^{18} = 2.5Ω
R^{19} = 2.5Ω
R^{20} = 1 KΩ
R^{21} = 100 KΩ

Circuit Description. The incoming signal is tuned by capacitor C^1 and L^1 This signal is applied to a base through a capcitor C^3 of 0.01 mfd. The base bias is supplied by R^1 and R^2. The resistor R^3 in the emitter circuit is known as a stabilizing resistor. It reduces the sensitivity of the transistor to temperature changes and permits replacement by a transistor whose characteristics might be slightly different that the original transistor AF116. When signalvoltage applied to the base of TR^1 aids and opposes the bias on the base to emitter input circuit, this will vary the collector current. This varying current when passing through the primary coil of L^2 induces a voltage across the secondary which is then fed to the emitter of converter through a capacitor C^4 of ·002mfd. The oscillator coil L^2 is tapped to form a hartley oscillator. By mixing the incoming signal frequency and oscillator frequency, a third beat frequency is formed which is equal to 455 Kc/s. In the I.F amplifiers both the input and output circuits of the stages are tuned to the same intermediate frequency. The output of last I.F.T is fed to the diode for detection.

The transistor T^4 is the first audio amplifier. The input voltage from the volume control R^9 is applied to the base through C^{10} of 10mfd electrolytic capacitor. R^{10} and R^{11} is potential divider for providing the forward bias to the base. The resistor R^{14} is the stabilizing resistor which stabillized the collector current with the help of by-pass capacitor C^{14} The output voltage of resistor R^{13} is coupled to the base of TR^5 through a coupling capacitor C^{15}. Transistor TR^6 and TR^7 from the power amplifier used in complimentary symetrical output stage. The driver collector current through R^{14} provides the necessay bias for power stage and reduces cross over modulation. A small amount of negative feed-back is applied through R^{21}. The output impedence is 8 ohms. The circuit consumes very little current in the output stage. A speciality of this transformer-less output stage is that it has a very low distortion, better frequency response as in high fidelity receiver and less battery consumption.

Transistor TR^7 is N.P.N transistor and the other are P.N.P. transisto-s since the N.P.N. transistor are now easily available in the market, there is no difficulty in the assembling of this type of receiver.

22. Two Bands Transistor Radio Receiver

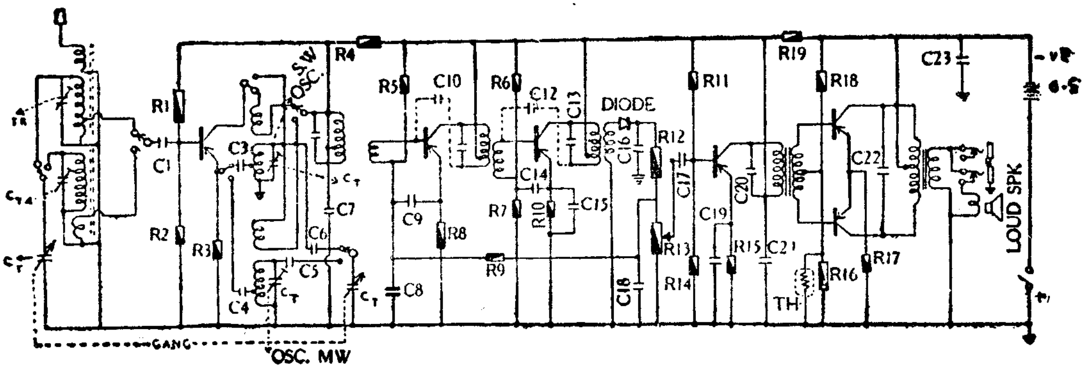


Fig. 26—Six Transistor Radio

1. Converter—AF114	4. Ist A.F. Amp.—AC125
2. Ist I.F. Amp.—AF117	5. Power Amp —AC126
3. 2nd I.F. Amp —AF117	6. Power Amp —AC126

Resistors

R^1 =47K ohm	R^2. R^9=10K ohm	R^4 =200 ohm
R^5 =68K ,,	R^3, R^{12}=2.2K ,,	K^{16}=100 ,,
R^{10}=1K ,,	R^6. R^{11}=22K ,,	R^{16}=100 ,,
R^{14}=5.6K ,,	R^7. R^{18}=4.7K ,,	R^{17}=5 ,,
	R^8. R^{15}=680 ,,	

Capacitors

C^1 =0.01mfd	C^9. C^{14}=0 05mfd	C^5=500PF
C^4=0.001mfd	C^8, C^{17}=10mfd	C^6=600PF
C^7=0 05mfd	C^{20}, C^{22}=0.05mfd	C^3=300PF
C^{16}=0 04mfd	C^{15}, C^{19}=30mfd	C^{10}=5 PF
	C^{21}, C^{23}=100mfd	C^{12}=5 PF

Servicing Procedure of this Radio

Cause of no reception of the both bands—

This is one of the easiest trouble to remove but there are so many causes for no signal output in a transistor receiver.

The following is the complete list of causes. 1. Dead battery. 2. Bias resistor open in any transistor, R^{17}, etc 3. Open Coupling capacitor C^{17}. 4. Voice coil open. 5. Open or shorted jack for head phone 6 Open winding of L.F. transformers. 7. Shorted filtering capacitors C^{23}. 8. Open or shorted R^{13} volume contiol. 9. Open base winding of I.F.T. 10. Open or shorted collector winding of I F T. 11. Shorted in the circuit winding 12. Shorted gang-capacitor. 13. Open antenna loop. 14. Shorted by-pass capacitor C^{8} etc. 15. Inoperative oscillator section. 16. Open oscillator coil. 17. Defective diode. 18. Misalignment. 19. Open lead connection of the battery. 20. Defective Transistor.

It is a big and impressive list can be easily divide-up the radio receiver into two sections by feeding a signal from the signal injector across the volume-control. If you heard a response in the loud-speaker the audio section of the set is functioning normal.

If the sound does not come out, the fault is to be found out in the audio section There after one has to check the circuit stage by stage and locate the fault.

Oscillator mixer and I.F. amplifiers is the H.F. section of the receiver. The output from the converter, AF114 is fed to an I.F. Amplifier AF117. The majority of the receiver use two I.F. stages.

No output when modulated r. f. signal is fed at the antenna point would indicate a faulty H.F. section, assuming that A.F. section had already been tested and found satisfactory. Check the converter and I.F. stages and locate the fault.

SILICON TRANSISTORS RADIO

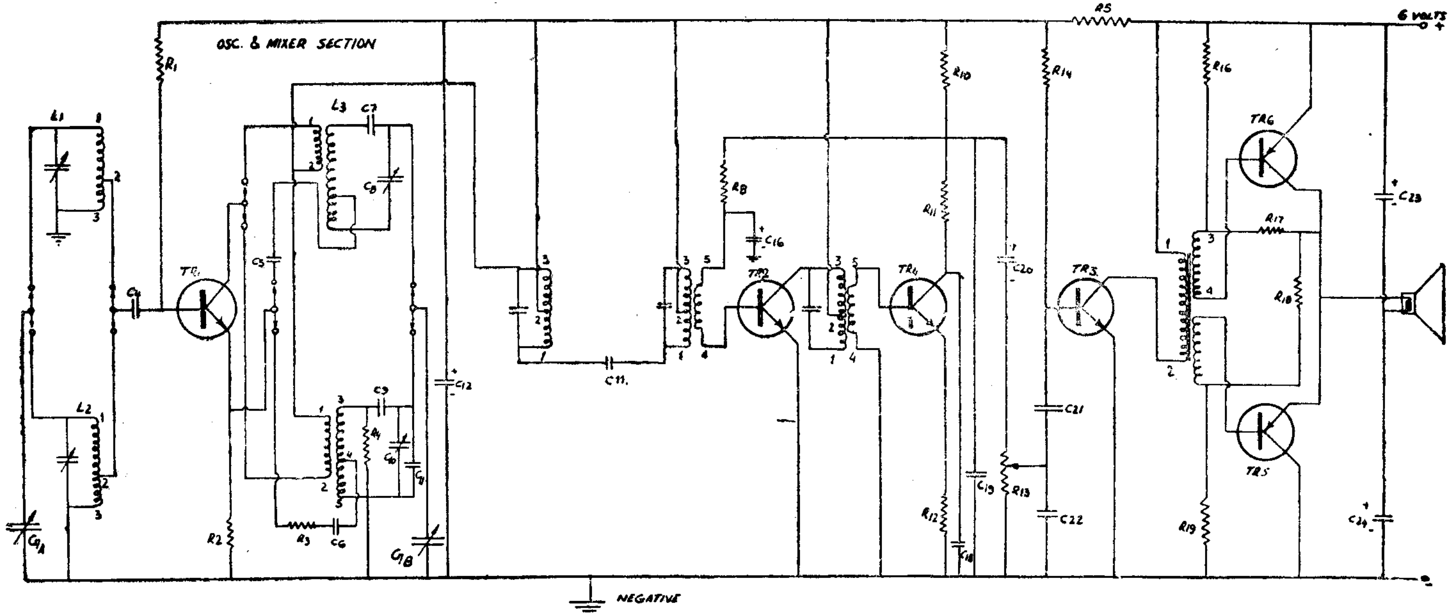


Fig. 27—Two Bands Silicon N.P.N. Transistor Receiver

Parts list :—

- Tr^1=BF194B—Convertor
- Tr^4=BC147—Detector
- Tr^5=AC128—Output stage
- Tr^2=BF195C—I.F. Amplifier
- Tr^3=BC147—A.F. Amplifier
- Tr^6=Output stage

23. Silicon Transistor Radio Receiver

Resistors :

R^{1}=330K Ω	R^{2} =1K Ω	R^{3}=15 Ω	R^{4}=150K Ω
R^{8}=150 Ω	R^{6}=not used	R^{7}=not used	R^{8}=470K Ω
R^{9}=not used	R^{10}=8.2K Ω	R^{11}=820 Ω	R^{12}=10 Ω
R^{13}=10K Ω	R^{14}=200K Ω	R^{15}=not used	R^{16}=47 Ω
R^{17}=820 Ω	R^{18}=47 Ω	R^{19}=820 Ω	

Capacitors :

C^{1}A, C^{1}B=180Pfd—gang.

C^{7}=·04Mfd.

C^{11}=5Pfd.

C^{16}, C^{20}=4Mfd.

C^{4}. C^{5}, C^{19}. C^{22}=0.01 Mfd.

C^{9}=200Pfd.

C^{12}, C^{23}, C^{24}=200Mfd.

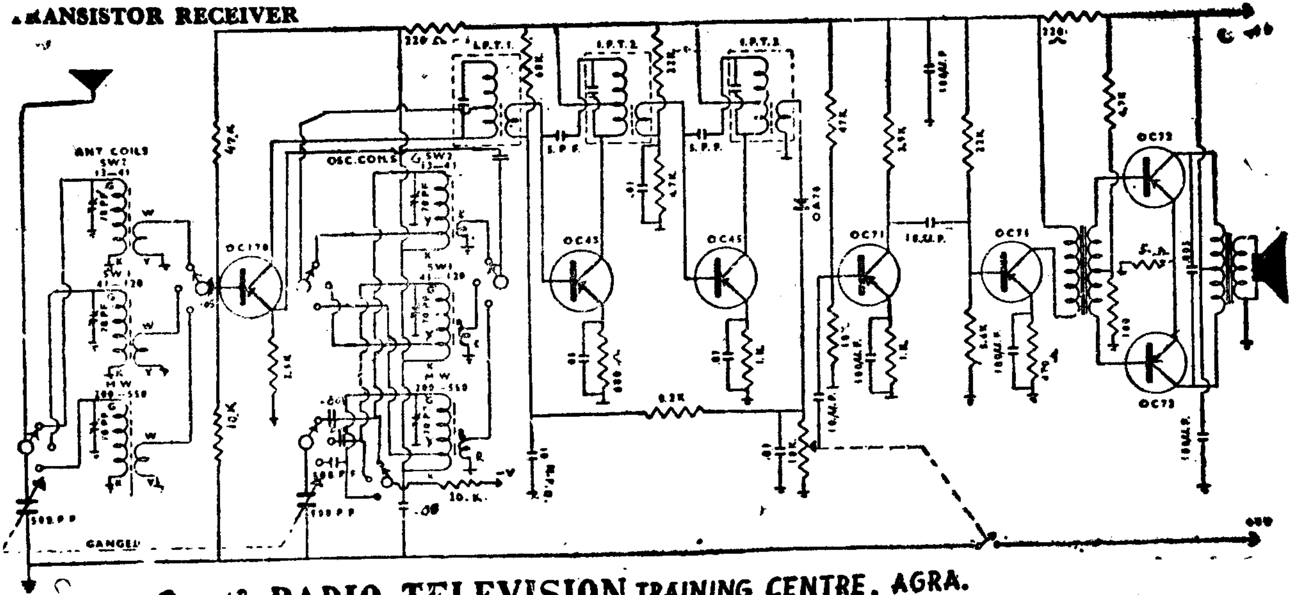
C^{81}=10 Mfd.

REFERENCE CHART FOR TESTING P.N.P. TRANSISTORS

Test step	Base	Collector	Emitter	Ohm-Meter Reading
1.	Meter positive	Meter Negative	x	500K Ω
2.	Meter Negative	Meter Positive	x	300 ,,
3.	Meter Negative	x	Meter Positive	300 ,,
4.	Meter Positive	x	Meter Negative	500K ,,
5.	x	Meter Negative	Meter Positive	50K ,,
6.	x	Meter Positive	Meter Negative	500K ,,
7.	Meter Positive	Meter Negative	Meter Positive	500K ,,
8.	Meter Negative	Meter Negative	Meter Positive	275 ,,

Reverse the meter connections for testing N.P.N. transistor and reading will be approximately same. The silicon transistors are having high resistance between base and collector in comparison to germanium transisrors.

ALL WORLD TRANSISIOR RADIO



Designed By **RADIO TELEVISION TRAINING CENTRE. AGRA.**

Fig. 28—Seven PNP Transistors Receiver

Resistance of I.F. Transformer & L. F. Transformers.

Windings	I F T1	I.F T2	I.F.T3	T1	T2
Primary	4 8 Ω	4.8 Ω	4.4 Ω	1.2K Ω	30 Ω
Secondary	0.8 Ω	0.4 Ω	0.3 Ω	0.7 Ω	1 Ω

24 *Servicing of Transistor Radio Receiver*

First the batery voltage should be checked with the receiver switched on and the battery loaded, severe distortion, low sensitivity and reduced power output, may result from a low battery voltage If it is found that a owner has connected the cells in the reverse direction, the electrolytic capacitors in the circuit are as likely to be damaged as the transistors.

When the receiver is completely out of order and the battery is found to be serviceable then make a visual inspection to locate possible loose, dirty, or intermittent speaker connections It must be remembered, when testing transistors that a transistor should never de replaced before the surrounding components have been thorughly examined Since the transistor is the most reliable component in the receiver it should be the lass component to be suspected.

Now check the resistance across the receiver battery leads with ohm-meter, it is generally possible to observe whether the reading appears to be either very low indicating a short circuit or very high indicating an open circuit or similar fault. The resistance check will give information on D. C. fault only. Where the resistance check shows a normal value. the signal path is to be checked with the signal generator. The quick trouble shooting technique is to inject an appropriate signal into each transistor base going from loud-speaker to antenna.

Apply a signal of 400 cycle from the signal generator to the each base of power amplifier transistors, equal volume of 400 cycle note should be heard in the speaker from each transistor. Now connect the signal generator to the base of driver transistor OC71. If the audio note is heard, the driver stage is functioning normal. The signal generator lead may then be touched to the upper end of the volume-control to check the complete audio section of the receiver. The signal injector can be used for signal generator for checking these audio amplifier stages. If the audio section of the receiver is working properly the tests can proceed to detector OA70 and I.F. amplifiers OC45.

Now apply a 455 Kc/s modulated signal from the signal generator to higher frequency section of the receiver. As soon as the signal is not passed by a stage of amplification, this stage should be checked. Care must be taken that the signal generator positive lead should have a series capacitor inorder not to change the bias condition in the circuit under test, or use a radiant loop with the signal generator for injecting the signal to the stages of transistor receiver.

ALL WORLD TRANSISTOR RADIO

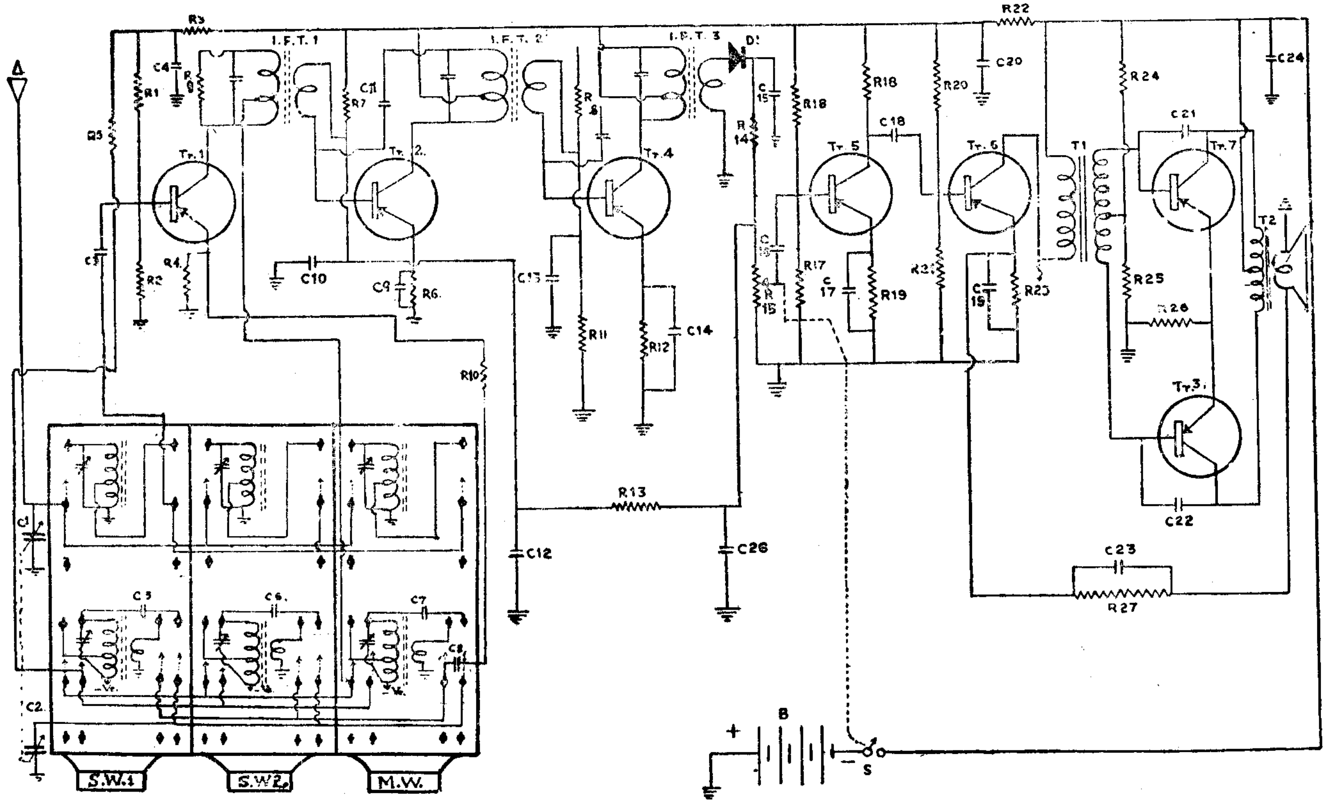


Fig. 29— Transistor Radio with PIANO Band-Switch

25. *Transistor Radio With Piano Switch.*

Parts List Transistors :

Tr. Number	Function	Tr. Number	Function
Tr^1—AF114	Mixer & Osc.	Tr^6=AC125	2nd A F. Amp.
Tr^2—AF117	1st I.F. Amp.	Tr^7=AC128	Power Amp.
Tr^4—AF117	2nd I.F. Amp.	Tr^3=AC128	Power Amp.
Tr^6—AC125	1st A.F. Amp.	D1 =OA79	Detector.

Resistors

R^1 = 10 KΩ	R^2 = 33 KΩ	R^3 = 100Ω	R^4 =2·5 K Ω
R^6 = 10 K ,,	R^6 = 1 K ,,	R^7 = 68 K Ω	R^8 =22 K ,,
R^9 =100 K ,,	R^{10}=33 ,,	R^{11}=4·7 K ,,	R^{12}=680 ,,
R^{13} = 10 K ,,	R^{14}=1 K ,,	R^{15}=5 K ,,	R^{16}=47 K ,,
R^{17}= 10 K ,,	R^{18}=3.9 K ,,	R^{19}=1 K ,,	R^{20}=22 K ,,
R^{21}=5·6 K ,,	R^{22}=100 ,,	R^{23}=510 ,,	R^{24}=4 7 ,,
R^{25}=100 ,,	R^{26}= 5 ,,	R^{27}=22 K ,,	

Capacitors

C^1 =310 PF.	C^2 =310PF.	C^3 =0·005 Mfd.	C^4 =0·05 Mfd.
C^5 =0 01 Mfd.	C^6 =0.005 Mfd.	C^7=0.002 Mfd.	C^8 =0 002 Mfd.
C^9 =0 05 Mfd.	C^{10}=0 01 Mfd.	C^{11}=5PF.	C^{12}=10 Mfd.
C^{13}=0.01 Mfd.	C^{14}=0 05 Mfd.	C^{15}=0·01 Mfd	C^{16}=10 Mfd.
C^{17}=30 Mfd	C^{18}=10 Mfd.	C^{19}=30 Mfd.	C^{20}=100 Mfd.
C^{21}=0 005 Mfd	C^{22}=0 005 Mfd.	C^{23}=0·002 Mfd.	C^{24}=100 Mfd.

Connections With Piano and Switch.

There are 18 poles in this band switch. Each poles has two terminals The poles terminals are indicatd by the arrow mark Six poles are used for the upper three antenna coils, and twelve poles for lower oscillator coils.

Aerial and C^1 are connected to No. 1 pole and base of TR^1 is connected to pole No. 2 through capacitor C^3. Pole No. 1 is shorted to poles No. 3 and No. 5 Pole No. 2 is shorted to poles No. 4 and 6.

Battery negative voltage are coming to pole No. 8 through resistor R^3. The lower connection of osc. coil should be connected to this pole for getting negative voltage. Pole No. 8 is shorted to poles No. 12 and 16.

The collector of TR^1 is getting negative voltage through the lower parts of primary winding of I.F.T. 1. The centre tap of primary winding is connected to pole No. 15 for getting negative voltage, pole No. 15 is shorted to pole No. 11 and 7.

The tapped winding of Osc. coil is the primary winding and the other winding is the Sec. winding. The feed back voltages which are developed across sec. winding are applied to emitter of TR^1 through capacitor C^8. The capacitor C^8 is connected to pole No. 17 and this pole is shorted to pole No. 13 and 9. The extreme right pole No. 18 is shorted to poles No. 14 and 10. The osc. section fo gang capacitor C^2 is also connected to pole No. 18. Connect the others terminals of the coils and trimmers to the particular terminals as shown in the figure.

26. All world Transistor Radio Receiver.

Tr. Number	Function	Tr. Number	Function
Tr1—2SA234	Mixer	Tr5—2SB75	1st A. F. Amplifier
Tr2—2SA234	Oscillator	Tr6—2SB75	2nd A.F. Amplifier
Tr3—2SA12	1st I.F. Amplifier	Tr7—2SB77	Power Amplifier
Tr4—2SA12	2nd I.F. Amplifier	Tr8—2SB77	Power Amplifier

Resistors

R^1=33 K Ω	R^2=2·2 K Ω	R^3=100K Ω	R^4=3·3 K Ω
R^5= 1 K ,,	R^6= 1 K ,,	R^7=47K ,,	R^8=1.5 K ,,
R^9= 1 K ,,	R^{10}=22 K ,,	R^{11}=4.7K ,,	R^{12}=680 ,,
R^{13}=5·6K ,,	R^{14}= 1 K ,,	R^{15}= 5K ,,	R^{16}=47 K ,,
K^{17}=4.7K ,,	R^{18}=3.3 K ,,	R^{19}=680K ,,	R^{20}=22 K ,,
R^{21}=5·6K ,,	R^{22}=100 ,,	R^{23}=470 ,,	R^{24}=1.5 K ,,
R^{25}=50 ,,	R^{26}= 5 ,,	R^{27}=22 K ,,	D^1=OA79 Diode

Capacitors :

C^1 =310Pfd.	C^2 =310Pfd.	C^3 =0·04 Mfd.	C^4 =0·05Mfd.
C^5 =100Pfd.	C^6 =300Pfd.	C^7 =300Pfd.	C^8 =0.1Mfd.
C^9 =0·005mfd	C^{10}=0·01mfd	C^{11}=0·05mfd.	C^{12}=10mfd.
C^{13}=0·01mfd.	C^{14}=0 05 mfd.	C^{15}=0·01mfd	C^{16}=100mfd.
C^{17}=30mfd.	C^{18}=10mfd.	C^{19}=30mfd.	C^{20}=100mfd.
C^{21}=0 005mfd	C^{22}=0·005mfd.	C^{22}=0·002mfd.	C^{24}=100mfd.

Voltage Specifications

Transistor	2SA234 (Mix)	2AS234 (osc)	2AS12 (2nd IF)	2SA12 (2nd IF)	2SB75 (1st AF)	2SB75 (2nd AF)	2SB77 (out-put)
Collector	—5·1V	—4·2V	—5·1V	—5·1V	—3·8V	—4·6V	—6·0V
Base	—0·45V	—1V	—0 5V	—0·95V	—0·8V	—0·8V	—0·14V
Emitter	0·4V	—0·95V	—0·4V	—0·95	—0·75V	—0·75V	0 01 V

27. *All World Transistor Radio Using Silicon-Transistors.*

Resistors :

R^1 =390 KΩ	R^2 = 1·K Ω	R^3 =470 Ω	R^4 =220 K Ω
R^5 =100K ,,	R^6 = 1 K ,,	R^7 =220 ,,	R^8 =220 ,,
K^9 =680 ,,	R^{10}= 1 M ,,	R^{11}=6·8K ,,	R^{12}= 1 K ,,
R^{13}=220K ,,	R^{14}=100 ,,	R^{15}=100 ,,	R^{16}=10 ,,
R^{17}=47 ,,	R^{18}=820 ,,	R^{19}=47 ,,	R^{20}=820 ,,

V. C.—Volume Control =5K Ω

Capacitors

C^1 =0·01Mfd.	C^2 =0·01Mfd.	C^3 =100Mfd.	C^4 =3·05Mfd.
C^5 =not used	C^6 = 10Mfd,	C^7 =0·05Mfd.	C^8 =0·05Mfd.
C^9 =0·05Mfd.	C^{19}=0·05Mfd.	C^{11}=0 01Mfd.	C^{12}=0·01Mfd.
C^{13}= 0·4Mfd.	C^{14}=0·04Mfd.	C^{15}=200Mfd.	C^{16}=200Mfd

SILICON TRANSISTORS RADIO

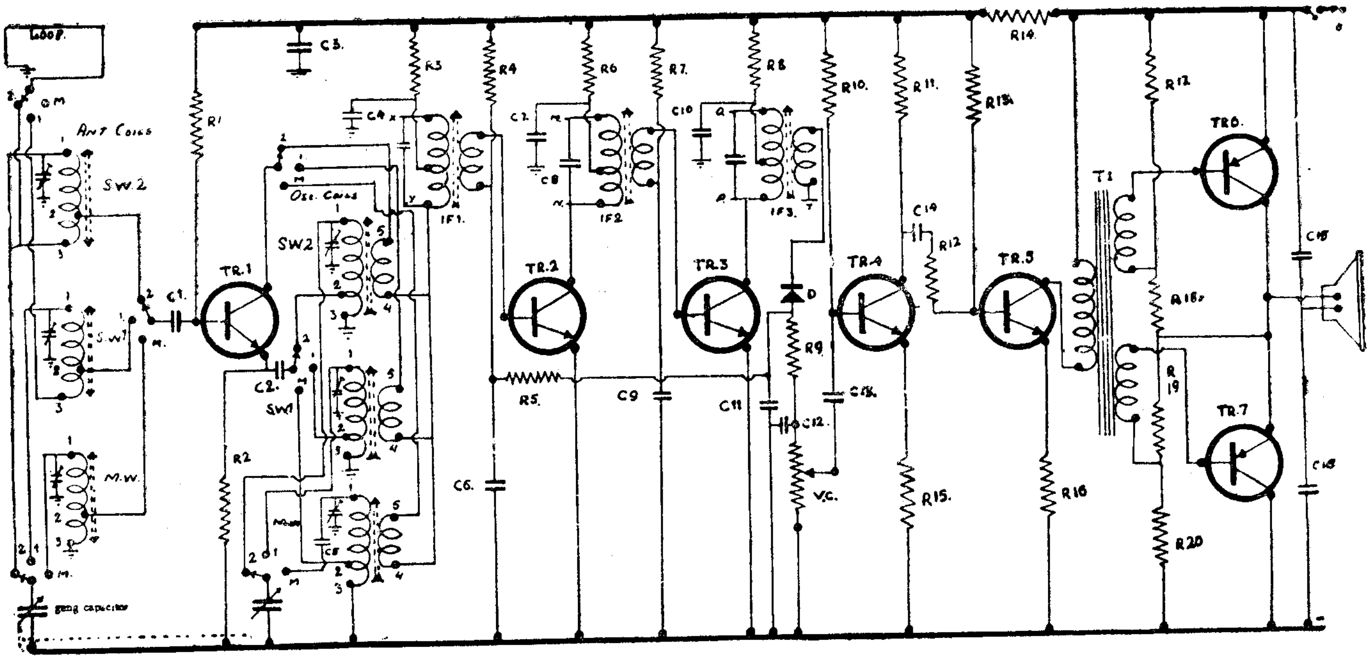


Fig. 30—High Gain Transistor RADIO

TR¹=Converter=BF194B
TR²=1st I. F. Amplifier=BF195 C
TR³=2nd I. F.—Amplifier=BF195D
D¹ =Detector—OA79.
TR⁴=1st L.F. Amplifier—BC148B
TR⁵=Driver Amplfier—BC148B
TR⁶=Power Amplifier—AC128
TR⁷=Power Amplifier—AC128

Capacity of each trimmer = 30Pfd.
Capacity of each section of Gang = 350 Pfd.
Battery voltage = 6 Volts
Loudspeaker resistance = 8 Ohms.
Transistor Leads Indentificafion (Bottom view)

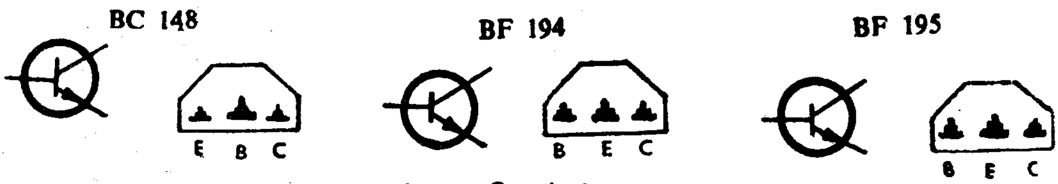


Fig. 31- Transistors Symbols and Pin Connecticns.

Antenna Coils Numbering.			Oscillator Coil.			I. F. Transformers.		
No.	1.	Start	No.	1.	Start of Sec.	No.	1.	Start of pri.
No.	2.	Tapping.	No.	2.	Tapping of Sec.	No.	2.	Tapping of pri.
No.	3.	Finish.	No.	3.	Finish.	No.	3.	Finish of pri.
			No.	4.	Start of pri	No.	4.	Start of sec.
			No.	5.	Finish of pri.	No.	5.	Finish of sec.

23. *All World P.N.P Transistor Radio Receiver.*

Resistors.

R^1 = 100 Ω	R^2 = 5 Ω	R^3 = 3.3 K Ω	R^4 = 100 Ω
R^5 = 220 ,,	R^6 = 22K ,,	R^7 = 10 K ,,	R^8 = 680 ,,
R^9 = 2.2K ,,	R^{10} = 33K ,,	R^{11} = 10 K ,,	R^{12} = 5 K ,,
R^{13} = 1 K ,,	R^{14} = 22K ,,	R^{15} = 4.7 K ,,	R^{16} = 680 ,,
R^{17} = 10 K ,,	R^{18} = 68K ,,	R^{19} = 100 ,,	R^{20} = 1.2 K ,,
R^{21} = 33 K ,,	R^{22} = 100 ,,	R^{23} = 100	

Capacitors.

C^1 = 100Mfd.	C^2 = 100Mfd.	C^3 = 100Mfd.	C^4 = 10Mfd.
C^5 = 100Mfd.	C^6 = 10Mfd.	C^7 = 0.01Mfd.	C^8 = 0.05Mfd.
C^9 = 0.01Mfd.	C^{10} = 5Pfd.	C^{11} = 5Pfd.	C^{12} = 8·05Mfd.
C^{13} = 30Mfd.	C^{14} = 0·05Mfd.	C^{15} = 0·005Mfd.	C^{16} = 0·01Mfd.
C^{17} = 0.00 Pfd.			

ALL WORLD TRANSISTOR RADIO

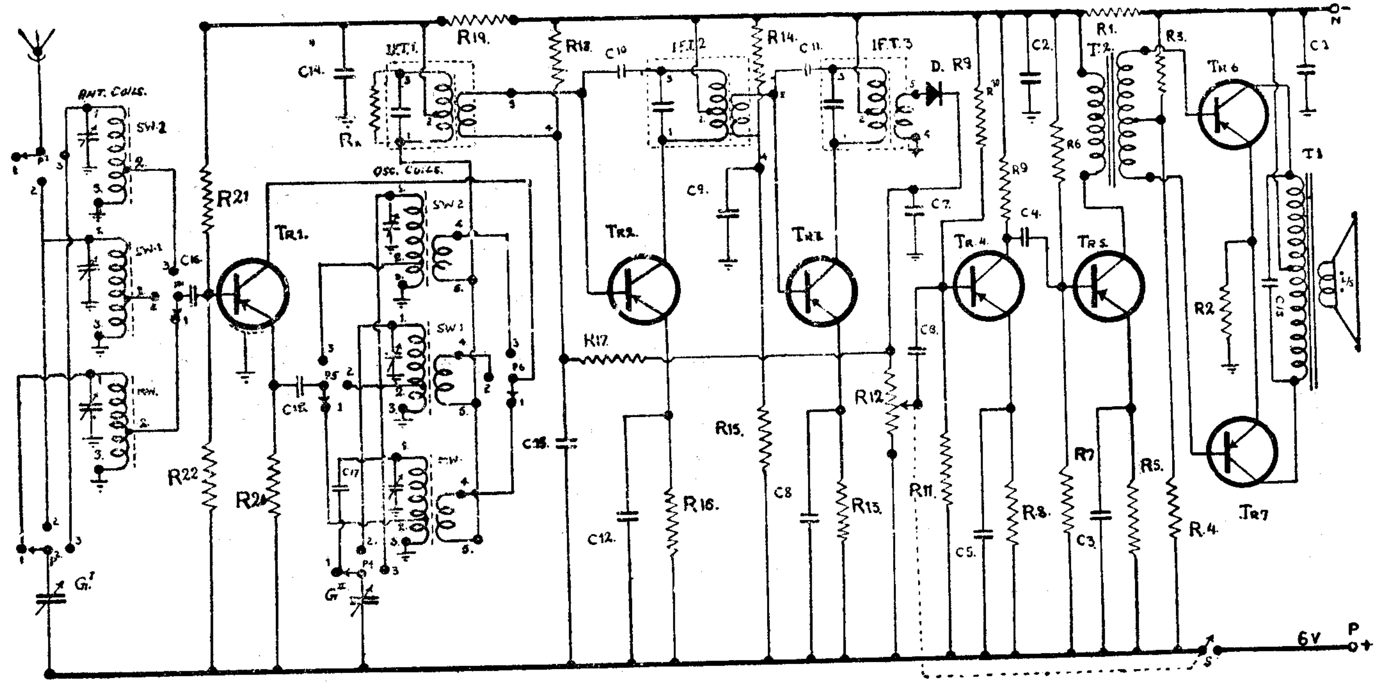


Fig. 32–Receiver using 7 P.N.P. Transistors

Parts List.

TR^1 = AF115—Converter stage

TR^2 = AF117—1st I.F. stage

TR^3 = AF117—2nd I.F. stage

TR^4 = AC126—1st A.F. stage

TR^5 = AC126—2nd L.F. stage

TR^6 = AC128—Output stage

TR^7 = AC128—Output stage

D = OA79—Detector

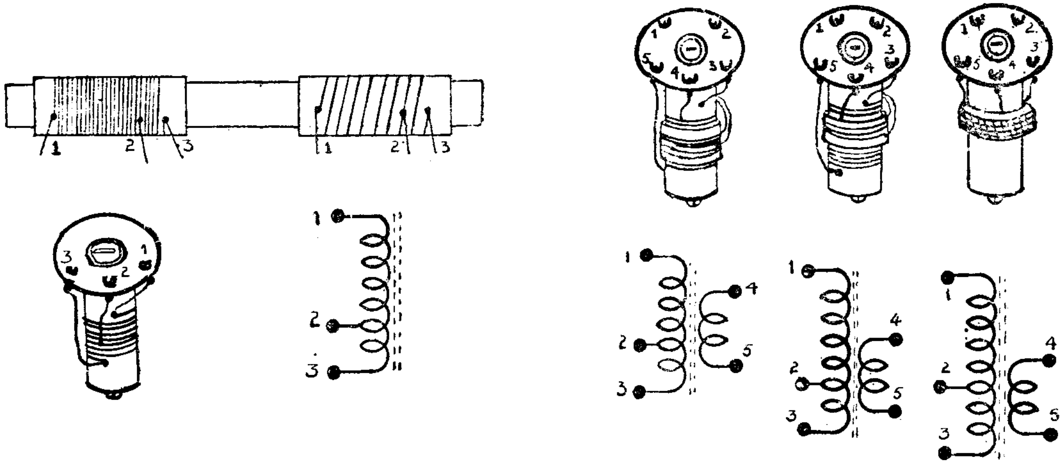


Fig 33. Antenna Coils & Symbols

Numbering Color Code & Connections of Coils

Ant. Coil.

No. 1—Start—white—Gang

No. 2—Tapping—green—Base of TR[1]

No. 3—End—Black—Chassis

Oscillator Coil

No. 1—Sec. Start –green—Gang

No. 2—Sec Tap—yellow—Emitter

No 3—Sec. End Black—Chassis

No. 4—Pri. Start—whitc-Collector

No. 5—Pri. End—Red—1st. I.F T.

ASSEMBLING ANT. COILS SECTION

The pictorial view of antenna coil Section of all world transistor receiver is given in Fig. 34 M.W. and S.W.2 antenna coils are wound on ferrite rod, and third coil of S.W.[2] having ferrite core is fitted on the chassis of the set. All these coils are designed as auto transformer having one winding only No. 1 is the 5 start of each coil, No. 2 is the tapping and No. 3 is the end of each coil which is to be connected to chassis. There are three trimmers fitted on the chassis near the coils. No 1 terminal of each coil is conneted to the respective trimmer and the rofor terminal of all the trimmers are connected to chassis.

Double wafer type have 6 Poles 3 positions band change switch is used in this transistor receiver. In the diagram only one wafer is shown which has 3 poles and nine terminals. Each pole has three terminals No. 1 for M.W. band, No 2 for S.W. 1 and No. 5 for SW² band.

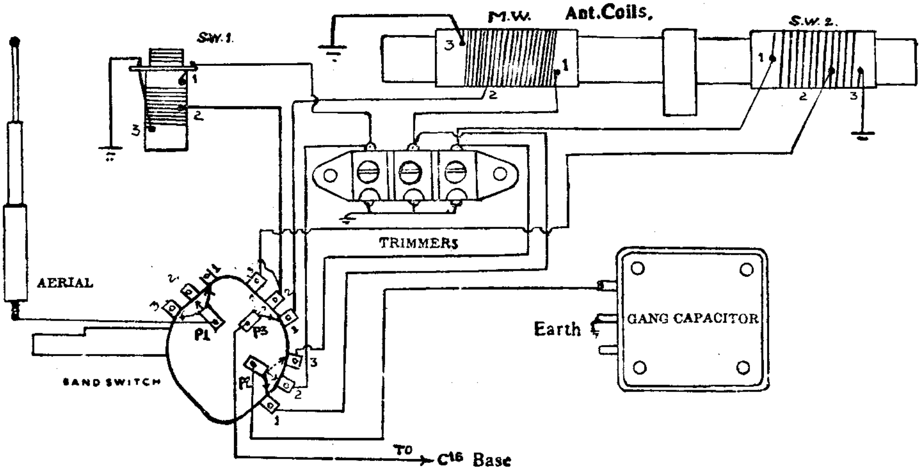


Fig. 34—Pictorial view of Antenna coil setion

Telescopic antenna is connected to pole No. 1, and the start end of SW² antenna coils are conneeted to No. 2 and No. 3 position terminals of this pole P¹ and No. 1 terminal remains unconnected. This No. 1 position is for medium wave band, it means that at M.W. position of the set the antenna remains disconnected to ant. coil of M. W. band. This antenna is not required at the time of M.W. band. The pole No. P² is conneeted to stator terminal of one section of gang capacitor which is fitted on the metal chassis. The middle terminals is rotor terminal of this capacitor which is to be connected to chassis. The three terminals of this pole P² are connected to the start No. 1 terminals of their respective coils. There is color marking on the coils, start No. 1 is white, tapping No. 2 is green and end terminal No. 3 is black. The pole No. P³ is connected to the one terminal of C¹⁶. This is a ceramic capacitor of 0.01 microfarad and the other end of this capacitor is to be connected to the base terminal of frequency changer transistor TR¹. The three terminals of this pole P³ are connected to the tapping terminal No. 2 of their respective coils. You must remember that in each coil, number of turns between No. 1 and 2 are more than between No. 2 and 3. In this way you can distinguish terminal one and three without any color marking. Always use copper tinned wire for this wiring of antenna coils.

ASSEMBLING OSCILLATOR COIL SECTION

The below figure is the pictorial view of oscillator section of all world transistor receiver. Three ferrite core oscillator coils of each band are fitted on the chassis. Each coil has two winding and a tapping in the primary section. For identification No. 1, 2

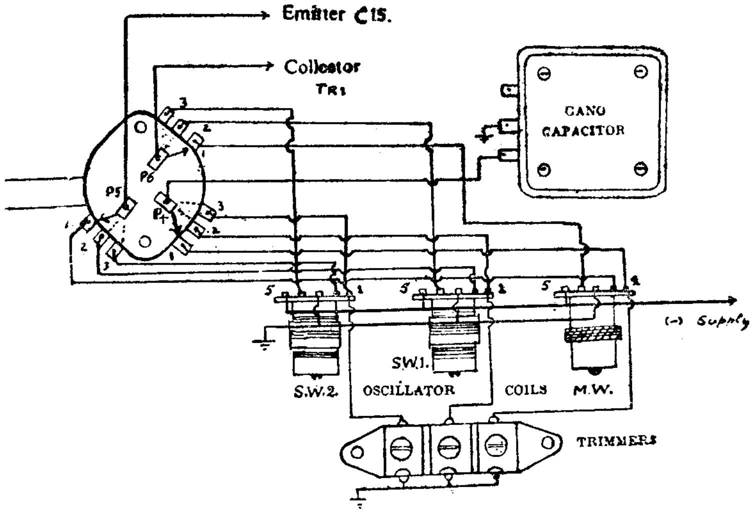


Fig. 35—Pictorial view of Oscillator coils section

and 3 is the primary and No. 4 and 5 is the secondary winding. A strip of three trimmers is also fitted on the chassis near these coils. Same gang capacitor is also shown in this figure. We will utilize the 2nd section of this capacitor for tuning the desire oscillator frequency. The band-change switch, which is shown in this figure is the 2nd wafer of the same band switch which is used for antenna coils. This wafer has also three poles and nine terminals as three for each pole.

Pole No. 6 is connected to the collector of transistor TR^1. (AF115), and this pole's terminals 1. 2 and 3 are connected to No. 4 terminal of primary winding of M.W, SW^1 and SW^2 oscillator coil respectively. In this wafer you have to observe the same sequence as you have adopted for antenna coils, this means that No. 1 for M.W. No. 2 for SW^1 and No. 3 for SW^2. Connect together the No. 5 terminal of each coil and connect one piece of wire from the No. 1 terminal of the primary winding of 1st. I.F.T. to the No. 5 terminal of any oscillator coil. In this way collector of TR^1 will get a reverse bias voltage (—) through the primary winding when connected in series with collector circuit. When the starting varying current flows in the primary a voltage will be set up in the secondary winding due to mutual indication. Trimmers are connected across the secondary windings of each coil. The rotor plate of each trimmer and No. 3 terminal of each coil are connected to chassis. The stator plates terminal of 2nd portion of gang capacitor is connected to pole No. P^4 and its three terminal are connected to No. 1 terminal of their respective coils. For generating oscillations feed back is essential. For this we will take the output from the tapping terminal of the secondary winding and feeds to the emitter of transistor TR^1 through the capacitor C^{15}, because the emitter is connected to pole terminalP^5 through this ceramic capacitor C^{15} having the capacitor of 0.005 micro farad. Capacitor C^{17} is the padding capacitor which is connected between the No. 1 terminal of MW antenna coil and No. 1 terminal of pole P^4. This C^{17} is fixed padder capacitor having the capacity of 500 picafarad. In this way you can assemble the oscillator section of transistor receiver. To avoide mistake use different color sleeve on the copper tinned wire for each band. Don't forget the emitter resistor R^2 (220 ohm) which is to be connected between emitter terminal of TR^1 and chassis. In this set chassis is connected to the positive terminal of six volt battery. After completing the wiring, check the each terminal and compare with circuit diagram. The remaining portion of transistor receiver has to be assembled on the printed board. For further guidance for assembling the remaining stages, you must study "SILICON TRANSISTOR ASSEMBLING."

I. F. ALIGNMENT OF TRASISTOR RADIO

1. Connect the A/C. voltmeter across the speaker voice coil terminals.
2. Connect the signal generator tuned to 455 Kc/s and modulated via 0.1 mfd. capacitor between Tr^1 base and chassis.
3. Attenuate the signal generator out-put to maintain 0.25 volt on the output meter to prevent over-loading of the reciver.
4. Set the gang condenser to the maximum capacity.
5. Set the volume control to maximum.
6. Adjust core of I.F.T^3 for maximum response.
7. Adjust core of I.F.T.^{2} for maximam response.
8. Adjust core of I.F.T^1 for maximum output.
9. Repeat step No. 6, 7 and 8 seal the cores with wax.

R. F. ALIGNMENT

Signal-generator with 400 c/s modulated output and low output impedence.

1. Rotate tuning control to gang maximum.
2. Set the signal generator to 550 Kc/s and place the loop near aerial coil.
3. Adjust the core of M. W. Osc. coil for maximum response.
4. Rotate tuning control to gang minimum.
5. Reset signal generator to 1600 Kc/s.
6. Adjust the trimmer of M. W. Osc. coil for maximum response.
7. Repeat Step No. 1 to 6 as necessary, always finishing with No. 6.
8. Set signal generator at 600 Kc/s. Tune the receiver at this frequency and adjust the position of M. W Ant. coil on ferrite rod for maximum response.
9. Set the signal generator to 1500 Kc/s. Tune the receiver to this frequency and adjust the trimmer of M. W. Ant. coil for maximum response.
10. Repeat Step No. 8 to 10 until no further improvement is made.

Alignment of Short Wave Bands

11. Set the signal generator at 2.5 Mc/s. Tune the set to this frequency and adjust the core of S. W. 1. Osc. coil for maximum response.
12. Set the signal generator at 7.0 Mc/s. Tune the set to this frequency and adjust the trimmer of S.W. 1 Osc. coil for maximum response.
13. Set the signal generator to 3.5 Mc/s. Tune the set to this frequency and adjust the core of the S.W. 1 Ant. coil.
14. Set the signal generator to 6.5 Mc/s. Tune the set to this frequency and adjust the trimmer of S. W. 1 Ant. Coil.
15. Repeat Step No. 11 to 14 until no further-improvement is made.

Note :—Same R. F. alignment procedure for S. W.2 with appropriate signal frequencies according to dial setting.

TRANSISTOR RADIO SERVICING CHART (See Fig. 29)

Possible causes	Remedy
No Sound :—	
1. Battery rundown.	1. Check voltage, replace if low.
2. Open voice coil.	2. Check the continuity of voice coil.
3. Open pri. of driver transformer.	3. Check the winding with ohm-meter.
4. Open pri. of output transformer.	4. Check the winding with ohm-meter.
5. Defective on/off switch.	5. Check on/off switch.
6. Break in battery lead.	6. Check lead with ohm-meter.
7. Shorted filter capacitor.	7. Open one lead of C^{24}.

Causes	Remedy
Low sound :—	
1. Weak battery.	1. Check voltage of the battery on load.
2. Misalignment of I.F. transformer.	2. Check the I. F. alignment.
3. Defective transistor.	3. Check A. F. or I. F. transistor.
4. Leaky by-pass capacitors.	4. Check C^{14}, C^{17} or C^{19}.
5. Defective line filter capacitors.	5. Check C^{20} or C^{24}.
Noisy-reception :—	
1. Dry joint.	1 Check the stages visually.
2. Worn out volume control.	2. Check R^{15}. replace if scrachy.
3. Defective band-switch.	3. Wash the band switch with petrol.
4. Defective filter capacitor.	4. Check capacitor C^{20} or C^{24}.
5. Defective Power Transistor.	5. Check Tr^{3} or Tr^{7}—2SB77.
6. Defective speaker.	6. Voice coil out of centre.
7. Leaky coupling capacitor.	7 Check capacitor C^{16} or C^{18}.
8. Defective A. F. stage.	8. Check transistor of A.F. stage.
9. Defective A G.C. filter capacitor.	9. Check capacitor C^{12}.
10. Mismatched output transformer.	10. Replace with a new transformer.
Motor-Boating :—	
1. Defective neutralizing capacitor.	1. Check the neutralizing capacitors.
2. Defective I.F. Transitor.	2. Check Tr^{2} and Tr^{4}.
3. Defective by-pass capacitor.	3. Check all the by pass capacitors.
4 Weak battery.	4. Check battery voltage.
5. Dry solder joints.	5. Check the circuit visually.
6. Misalignment	6. Check alignment with Signal Generator
Fading :—	
1. Defective A.G.C. filter.	1. Check eesistor R^{13} and C^{12}.
2 Poor diode detector.	2. Check OA79 and replace it.
3. Misalingnment.	3. Check the receiver's alignment.
4. Open aerial connection.	4. Check antenna circuit.

29. Servicing Chart of Audio Section

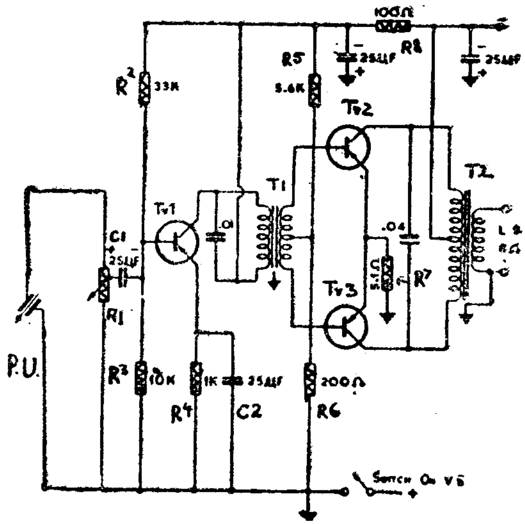


Fig. 36—Audio Amplifier Circuit Diagram

Quick check :—Feed an audio signal at pick-up terminals or across R^1 the volume control. Audio note should be heard in the speaker, or touch a damp finger on the base terminal of the transistor TR^1. A hum response should be heard in the speaker.

No Output Signal

Causes .—1. Battery completely run down. 2. Open voice coil of the speaker. 3. Faulty earphone jack. 4. Condenser across the primary winding of output transformer is shorted. 5. Open emitter resistor R^7. 6. Open pri. or sec. winding of driver transformer. 7. Shorted filter capacitors of 25 mfd. 8. Defective on/off switch. 9. Defective power amplifier transistor TR^2 or TR^3. 10. Defective 1st. A.F. transistor TR^1

Symptoms :—Distortion or Low Out-put.

Causes :—1. Weak battery. 2. Defective speaker. 3. Mismatch of L.F. output transformer. Mismatch of the power output transistors. 5. Change in the value of emitter resistors R^4 and R^7. 6. Change in the valve of base bias resistors. 7. Shorted emitter bypass capacitor C^2 in the 1st. A.F. stage. 8. Defective Driver transistor Tr^2. 9. Shorted turns in the primary of out-put transformer. 10. Leaky or reduced value of coupling capacitor C^1.

30. *Servicing Chart of Detector Stage*

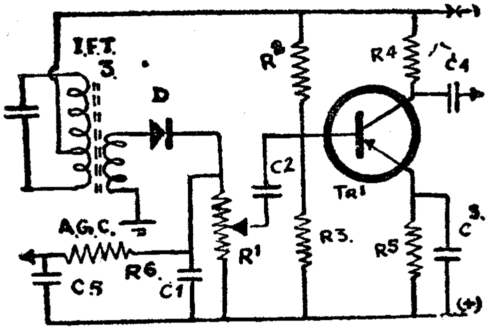


Fig. 37—Circuit Diagram of Detector and 1st. Audio Amplifier

Resistors :

R^1=10K Ω	R^2=47K Ω	R^3=10K Ω
R^4=5 K Ω	R^5=1 K Ω	R^6=10K Ω

Capacitors :

C^1=0 01 Mfd.	C^2=10 Mfd.	C^3=30 Mfd.
C^4=10 Mfd.	C^5=10 Mfd.	

Quick check :—Apply a modulated I. F. signal to the collector or the primary winding of I.F. transformer T^3. The modulation note should be heard in the speaker.

Symptom—Weak Signal.

Causes ;—1. Defective crystal diode D. 2. Defective R.F. by-pass capacitor C^1. 3. Open A.G.C. by-pass capacitor C^5 of 10Mfd. 4. Defective winding of I.F. transformer I.F.T^3. 5. Misalignment of I.F. transformer: 6. Open or shorted diode load R^1.

Symptom :—Distortion on Strong Signal.

Causes :—1. Shorted A.G.C. filter capacitor C^5. 2. Defective coupling capacitor C^2.

Testing of Diode :—

The average life of a crystal diode is more than 10,000 hours. These diodes rarely go bad. Measure the reverse and forward resistance with an ohm-meter, the reverse resistance should be 1000 Kilo ohms or more and forward resistance should be 100 to 250 ohm only.

Note :—The detector stage is also providing the A.G.C. voltage to control the gain of I. F. amplifier stages.

31. *Servicing Chart of I.F. Stages.*

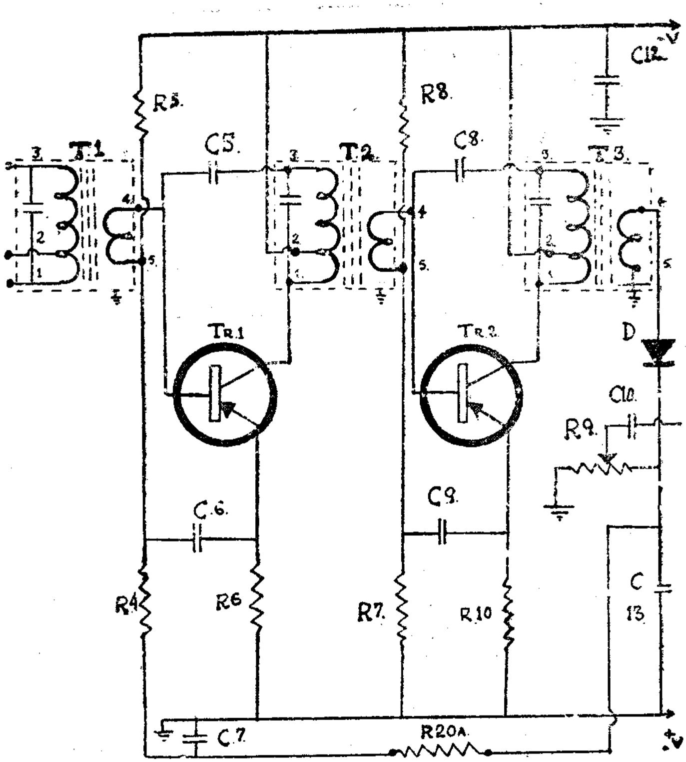


Fig. 36 Circuit Diagram of I. F. Amplifiers.

Quick check :—Apply a modulated I. F. signal from the signal generator to the base of Ist I.F. stage TR^2. The modulation notes should be heard in the speaker.

Symptom :—No output signal from the speaker.

Causes :—1. Defective Transistor TR^1 or TR^2. 2. Open emitter resistors R^6. R^{10}. 3. Open I. F. transformer coil. 4. Shorted base by-pass capacitor $C,^6$ C^9 5. Short circuited the winding of I F.T. 6. Open base winding of I. F. $T.^1$ or I. F. T. ^{2}. 7. I.F. transformer completely misalignment.

For locating the defective stage for low gain, take a fixed capacitor of 0 05 mfd. touch the terminals of the condenser to base and collector of the transistor. When shorting a base and collector with this condenser. the volume will drop considerally if the stage is in order. In a defective stage there will be no change in the volume.

Now apply a modulated I. F. signal to collector of converter transistor If a 400 cycle response is heard in the speaker the I,F. stages are in working order,

Warning :—

Do not alter the alignment of the receiver in an attempt to improve the gain, many receivers are stagger tuned and although the gain can be improved by peaking the tuning, this will be accompanied by a loss of a response and an increase in distortion, if the alignment of the receiver is suspected always realign in accordance with the manufacturer's service manual.

32. Servicing Chart of Converter Stage.

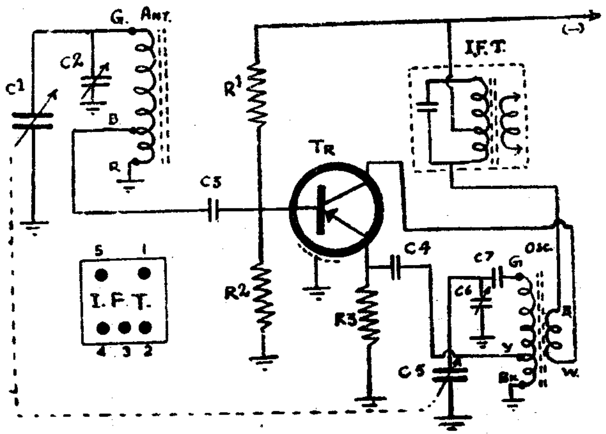


Fig. 39—Circuit Diagram of Converter Stage.

Quick Check :—Apply a modulated R. F. Signal at the antenna terminal. Tune the radio at this particularly frequency. The modulation note should be heard in the speaker.

In P.N.P. transistor, the base is usually negative with respect to emitter, but in this converter stage, the base is at positive potential with respect to emitter because the positive feed back from collector to emitter makes the base positive. This indicates that the oscillator is functioning.

Quick Check for Oscillator :—Measure the voltage across the emitter resistor R^3, and note the reading. Now take a small piece of wire and short the oscillator section of the gang capacitor C^5 and now take the voltage reading. If the meter pointer moves back, the oscillator is functioning, there will be slight decrease in voltage across the emitter resistor R^3.

Second Method of Checking Oscillator :—Switch on your transistor set, keep it near a good set which is in working condition. Tune the good set to high frequency end of the dial 1500 Kc/s. Tune your set, which you are testing at 1045 Kc/s. or near about If your set is working, a whistle will be heard in the speaker of good set. If no sound is heard, check all the components in this converter stage.

TRANSISTORIZED TUNER

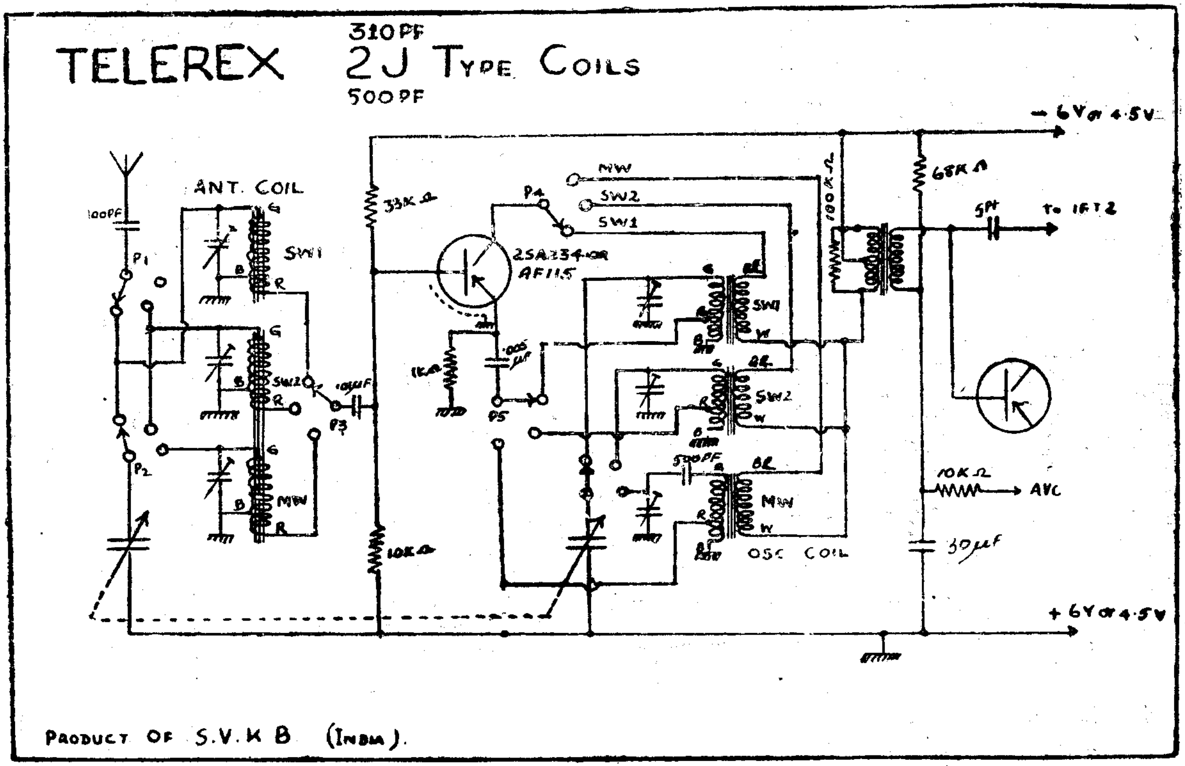


Fig. 40–Converter Stage of Three Band Transisfor Radio.

33. *R.F. Alignment Chart.*

Adjust Circuit		Step	Signal Generator output	Dial setting	Ajusting to maximum output
MW	OSC.	1	600 Kc/s	600 Kc/s	MW. OSC coil core
		2	1500 Kc/s	1500 Kc/s	MW. OSC. trlmmer
		3	600 Kc/s 1500 Kc/s	600 Kc/s 1500 Kc/s	Repeat three times steps (1) and (2)
	ANT.	4	600 Kc/s	600 Kc/s	MW. ANT. coil core
		5	1500 Kc/s	1500 Kc/s	MW. Ant. t rimmer
		6	600 Kc/s 1500 Kc/s	600 Kc/s 1500 Kc/s	Repcat three times steps (4) and (5)
SW_1	OSC.	7	2.5 Mc/s	2 5 Mc/s	SW_1 OSC. coil core
		8	6.0 Mc/s	6.0 Mc/s	SW_1 OSC. trimmer (CT_5)
		9	2.5 Mc/s 6.0 Mc/s	2 5 Mc/s 6.0 Mc/s	Repeat three times steps (7) and (8)
	ANT.	10	2.5 Mc/s	2 5 Mc/s	SW_1 ANT. coil core
		11	6.0 Mc/s	6.0 Mc/s	SW_1 ANT. trimmer
		12	2 5 Mc/s 6 0 Mc/s	2 5 Mc/s 6.0 Mc/s	Repeat three times steps (10) and (11)

Adjust Circuit		Step	Signal Generator output	Dial setting	Ajusting to maximum output
SW_2	OSC.	13	7.0 Mc/s	7 0 Mc/s	SW_2 OSC. coil core
		14	18.0 Mc/s	18.0 Mc/s	SW_2 OSC. trlmmer
		15	7.0 Mc/s 18.0 Mc/s	7.0 Mc/s 18 0 Mc/s	Repeat three times steps (13) and (14)
	ANT.	16	7.0 Mc/s	7.0 Mc/s	SW_2 ANT. coil core
		17	18.0 Mc/s	18.0 Mc/s	SW_2 ANT. trimmer
		18	7.0 Mc/s 18.0 Mc/s	7.0 Mc/s 18.0 Mc/s	Repeat three times steps (16) and (17)

34. *Signal Injecter.*

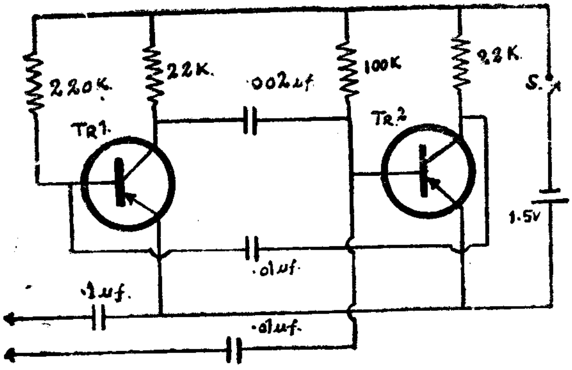


Fig. 41—Circuit Diagram of Signal Injector.

Principle and Operation :—

Its principle based on multivibrator oscillator, which is rich in harmonics The fundamental frequency of this signal generator is 1·5 Kc/s. TR^1 & TR^2 = OC71.

Now you can test any stage of transistor receiver by injecting the signal from this signal injector to the base of transistor. If the stage is working an audio signal will be heard from the loud-speaker.

Connect the emitter lead to the chassis of the transistor radio and signal output lead of TR^2 to the base of the transistor to be tested.

It is very useful testing equipment for locating the defective stage in a receiver.

35. *Circuit Diagram of Signal Tracer*

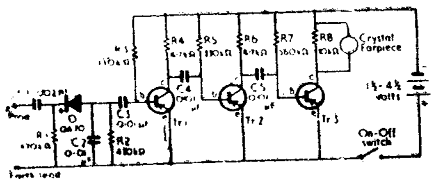


Fig. 42—Dircuit Diagram of Signal Tracer.

Parts List.

Resistors

R^1=470K ohm	R^4=4·7K ohm	R^7=330 K ohm.
R^2=470K ,,	R^5=330K ,,	R^8=10K ,,
R^3=330K ,,	R^6=4.7K ,,	

Capacitors

C^1=0·002Mfd C^2=0.01Mfd C^3=0·01Mfd
C^4=0·01 „

Battery voltage=4·5 volts.

This signal tracer consists of a three-stage audio frequency amplifier. A. F. and R. F. signals are fed directly to the capacitors C^1 and chassis. The indicator consists of crystal headphone Suppose by touching the prods to the base of Ist. I.F. stage and chassis if you heard a response in the head-phone then, up to this stage set is functioning and if you are not getting the response in the head-phone, then the fault exists in the pre-stage and the signal is not coming to this stage.

36. *Light Blinker*

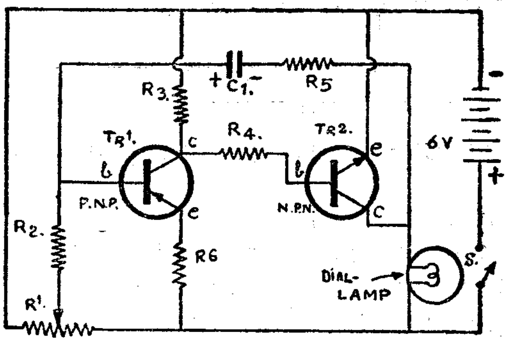


Fig. 43—Automatic Switching For Lighting a Bulb ON & OFF

Parts List.

Tr^1=AC128 R^1=10K Ω R^3=1K Ω R^5=1·8K Ω
Tr^2=AC127 R^2=6·8K „ R^4=270 „ R^6=5 „
C^1 =100Mfd. Lamp=6 volt.. 0·15 Ampere.

37. *Telephone Amplifier.*

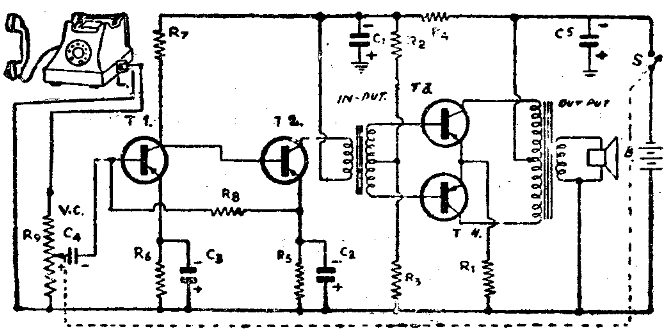


Fig. 44–Circuit Diagram of Telephone Amplifier.

Parts List.

TR^2=AC126	R^1= 5K Ω	R^5=470 Ω	R^9=10K Ω
TR^2=AC126	R^2= 1K ,,	R^6=2K ,,	C^1, C^5=100mfd.
TR^3=AC128	R^2= 33 ,,	R^7=6·8K ,,	C^2,C^3=30mfd.
TR^4=AC128	R^4= 220 ,,	R^8=10K ,.	C^4 =10mfd.

38. *Inter Communication set.*

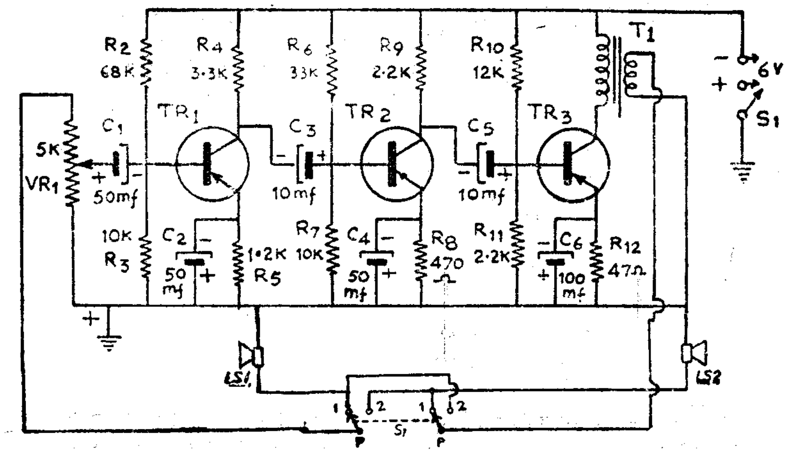


Fig. 46–Circuit Diagram of Inter-Com. Set.

This transistorized "intercom" set can be used to achieve reliable voice communications between two points in a normal size house. The master unit consits of audio amplifiers of three OC71 transistors. This Amplifier operates on 6 volts D.C. Speakers LS^1 and LS^2 are used for both talk and listen functions. The talk-listen switch S^1 at the master location establishes the talk or listen mode for the intercom station. The voice communication is initiated from the master unit. Now the switch S^1 is set to the talk position No. 1. and the audio voltage developed across the voice coil of LS^1 is coupled by the VR^1 and C^1 to the base of TR^1. With S^1 depressed to talk position No. 1. The LS^2 speaker is automatically connected to secondary of the audio amplifier output transformer (T^1) for listen mode operation and the initiator can now talk to the intercom station where this loud-speaker LS^2 is installed.

When the switch S^1 is in the listen position No. 2. The master unit speaker LS^1 is connected in the listen mode and the other speaker LS^2 is connected to the amplifier input. Now a reply from the remote unit LS^2 is communicated to the speaker LS^1 through the same audio amplifiers. The value of components are written in the circuit diagram.

36. *Transistorized Power Supply.*

DC 12 volts to 220 volts DC.

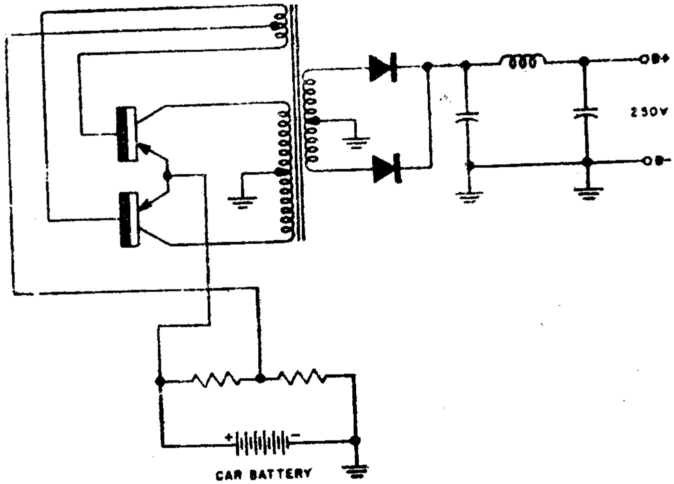


Fig. 46—Circuit Diagram of Converter 12 V to 220 V. DC

Resistors = 10Ω & 300 Ω   Capacitors = 0.01Mfd. each
Diodes = BY-100   Transistors = 2N2907

Circuit Description—

This transistorized power supply converts 12 volts DC. to 250 volts DC. in the car-radio. The circuit consists of a step-up transformer with the centre tap of the primary connected to chassis and chassis is connected to the battery negative. The two ends of primary winding are connected to the collectors of two switching transistors. The transistors are working as on-off switch, the time of switching being so controlled by the upper centre tap feed back winding of the transformer that they conduct alternately. The centre tap of feed back winding is connected to junction of two resistors which are connected across the battery. The value of resistor which is connected to negative end of the battery is 300 ohms and the other resistor which is connected to positive end having the value of 10 ohms.

The emitters are connected to the positive end of the battery. The battery voltage is thereby applied alternately across the two halves of the primary winding inducing a square wave voltage of about 1000 cycles per second which is then transfer to 250 volts across the secondary winding. This voltage is then rectified by the two silicon diodes. The diodes are working as full wave rectifier. The R.F. choke and two capactiors are used to filter the rectified voltage These filter D.C. voltage are used as high tension voltage for the anodes and screen grids of the valves used in the car radio.

36. Transistorized Power Supply.

DC 12 volts to 220 volts DC.

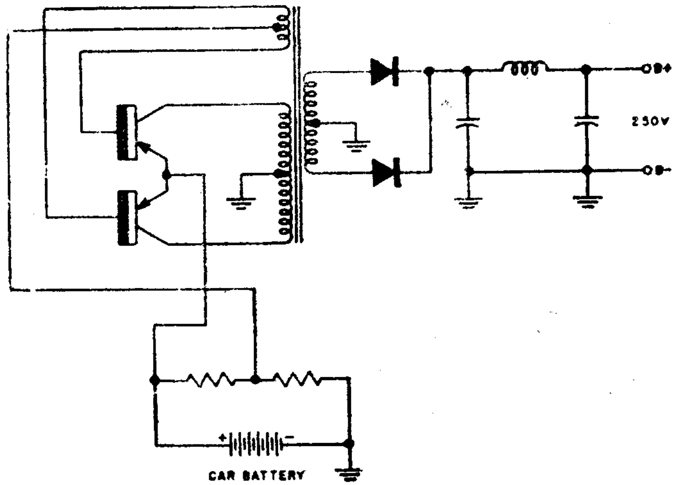


Fig. 46—Circuit Diagram of Converter 12 V to 220 V. DC

Resistors = 10 Ω & 300 Ω   Capacitors = 0.01 Mfd. each
Diodes = BY-100   Transistors = 2N2907

Circuit Description—

This transistorized power supply converts 12 volts DC. to 250 volts DC. in the car-radio. The circuit consists of a step-up transformer with the centre tap of the primary connected to chassis and chassis is connected to the battery negative. The two ends of primary winding are connected to the collectors of two switching transistors. The transistors are working as on-off switch, the time of switching being so controlled by the upper centre tap feed back winding of the transformer that they conduct alternately. The centre tap of feed back winding is connected to junction of two resistors which are connected across the battery. The value of resistor which is connected to negative end of the battery is 300 ohms and the other resistor which is connected to positive end having the value of 10 ohms.

The emitters are connected to the positive end of the battery. The battery voltage is thereby applied alternately across the two halves of the primary winding inducing a square wave voltage of about 1000 cycles per second which is then transfer to 250 volts across the secondary winding. This voltage is then rectified by the two silicon diodes. The diodes are working as full wave rectifier. The R.F. choke and two capactiors are used to filter the rectified voltage These filter D.C. voltage are used as high tension voltage for the anodes and screen grids of the valves used in the car radio.

40 *Battery Eliminator for Transistor Receiver.*

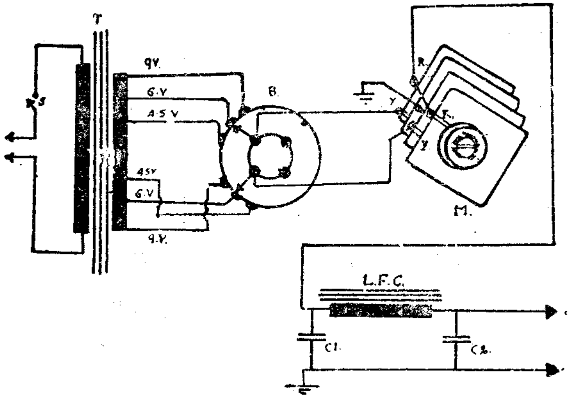


Fig. 47—Power Pack for Transistor Radio

Componens :—

1. T—Step down transformer having primary of 220 volts and secondary of 9V, 6V, 4.5V AC.
2. S—On/off switch in the primary winding.
3. B—Band change switch 4 poles, 3 positions. Only two po are being used for changing the voltage tapping.
4. M—Metal Rectifier Bridge Type. 100ma.

   Y=Yellow colour mark on the terminal for a.c. input.
   R=Black colour mark on the outer terminals for DC negative output are shorted together and centre terminal having Red colour is to be kept at chassis positive potential.
5. L.F.C.—Low frequency choke of 250 milli-henry.
6. C^1 & C^2—Filtering electrolytic capacitor of 100mfd.

Circuit Description :—

It is a full wave rectifier circuit For testing different types of transistor receivers one can set this supply 4·5 to 9 volt DC. Now the band change switch is set at 6 volts position. By switching the on/off switch at ON position, the current flows in the primary windiug of step down transformer and by mutual induction voltages are being induced in secondary winding. The a/c voltage are applied to the yellow terminals of metal rectifier through band change switch. Thus rectifier delivers d/c negative output from the red terminals which are connected together and a filter of one L.F. choke and two capacitor are used for filtering the pulsations. Always connect lower chassis terminal to the positive side of the transistor receiver terminal and L.F. choke terminal to the negtive side of the receiver.

41. *Transistors Equivalents.*

Converter	I.F. Amp.	Detector	A.F. Amp.	Power Amp.
AF114	AF117	OA78	AC125	AC128
BF194	BF195	OA79	BC147	AC127
OC170	OC45	A85	OC71	OC74
OC44	OC45	OA70	OC71	OC72
2SA234	2SA12	IN34	2SB75	2SB77
OC614	AF105	OA174	OC602	AC105
OC613	OC612	OA150	OC602	OC604
2SA58	2SA53	IS33	2SA54	2SB56
2SA10	2SA31	INA2	2SB32	2SB34
2SA102	2SA55	OA70	2SB171	2SB174
A115	OC45	OA91	OC81D	OC81
2SA93	2SA53	IN 60	2SB53	2SB56
2T201	2T76	IT23	2T64	2T86
2SA123	2SC76	OA70	2SD66	2SB51
2SA103	2SA101	,,	2SB175	2SB178
2SA70	5SA45	,,	2SA171	2SA174
2SA153	2SA155	IN38	2SB112	2SA163
AF116	AF117	OA79	AC123	AC128
2N370	2N139	IN34	2N109	2N270
2N1058	2N293	,,	T1582	2N1069
OC170	OC45	OA70	OC71	OC81
2N412	2N410	IN87	2N406	2N408
OC170	OC45	OA70	OC81D	OC81

SUPER-HETRODYNE RADIO

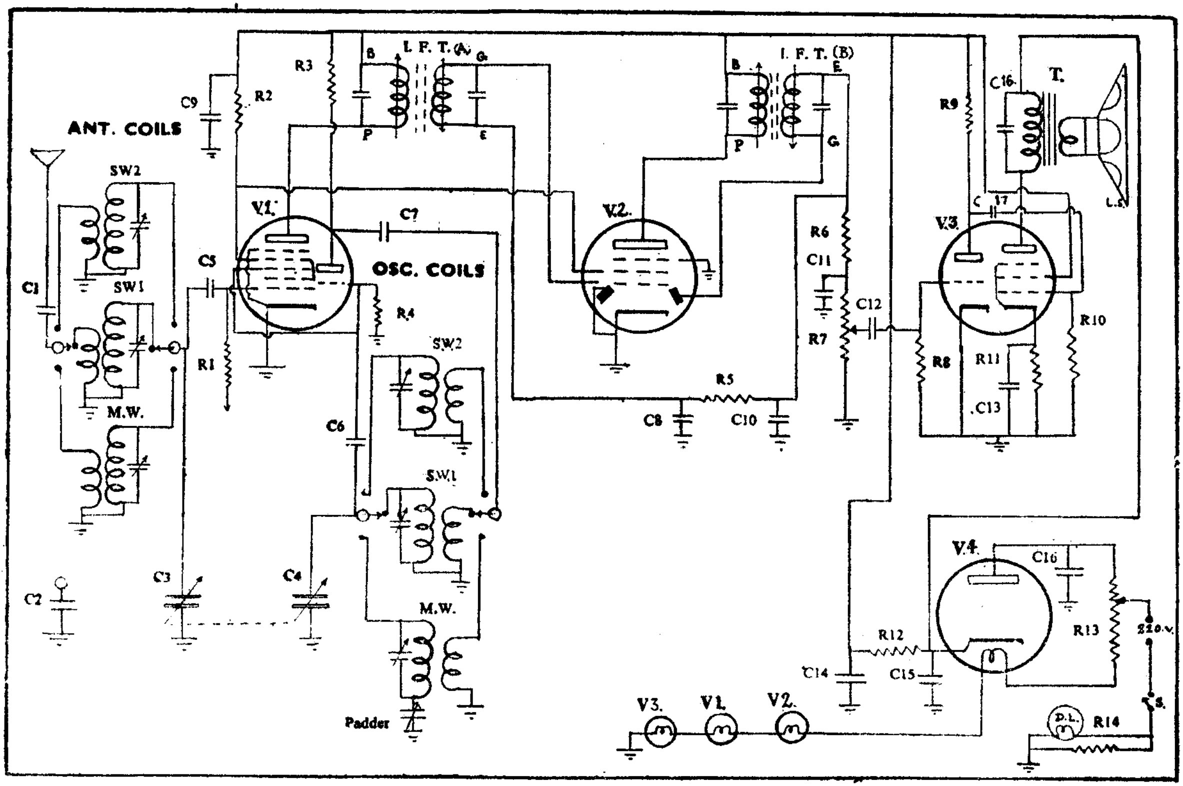


Fig. 48—Circuit Diagram of 4 Valves All World AC/DC Radio

SECTION C | *Radio Practical Circuits*

42. *Four valves All World Radio* (Fig. 48)

Parts List :—

Resistors		Capacitors		
R^1. R^{10}	=1 M ohm	C^1, C^5, C^6,	=100Pfd—Ceramic	
R^2. 1 watt	=27 K ,,	C^7. C^{10}, C^{11}	=100 ,,	,,
R^3, 1 watt	=22 K ,,	C^2, C^8, C^9	=0·5 Mfd-Paper	
R^4, R^6	=47 K ,,	C^{12}, C^{17}	=·005 ,,	,,
R^5. 1/2 watt	=2 M ,,	C^{14}, C^{15}	=32 ,,	Electrolytic
R^7, V.C.	=·5 M ,,	C^5, C^4	=500 Pfd	Gang
R^8, 1/2 watt	=5 M ,,	C^{13}	=25 Mfd.	Electrolytic
R^9 watt	=·22 M ,,	Miscellaneous :—		
R^{11}, 5 watt	=300 ,,	Padder=600 Pfd		
R^{12}, 10 ,,	=1000 ,,	Dial lamp=·15 ampere, 6 volts		
R^{13}, (vari)	=1000 ,,	Loudspeaker=3 ohm		
R^{14}, 5 watt	=100 ,,	Output transformer=L.F.T for UCL 82		
		I. F. transformer=I.F.T.A & I.F.T.B.		
		Band change switch=4 Poles, 3 Position.		

Pin Connections of the valves used in this circuits

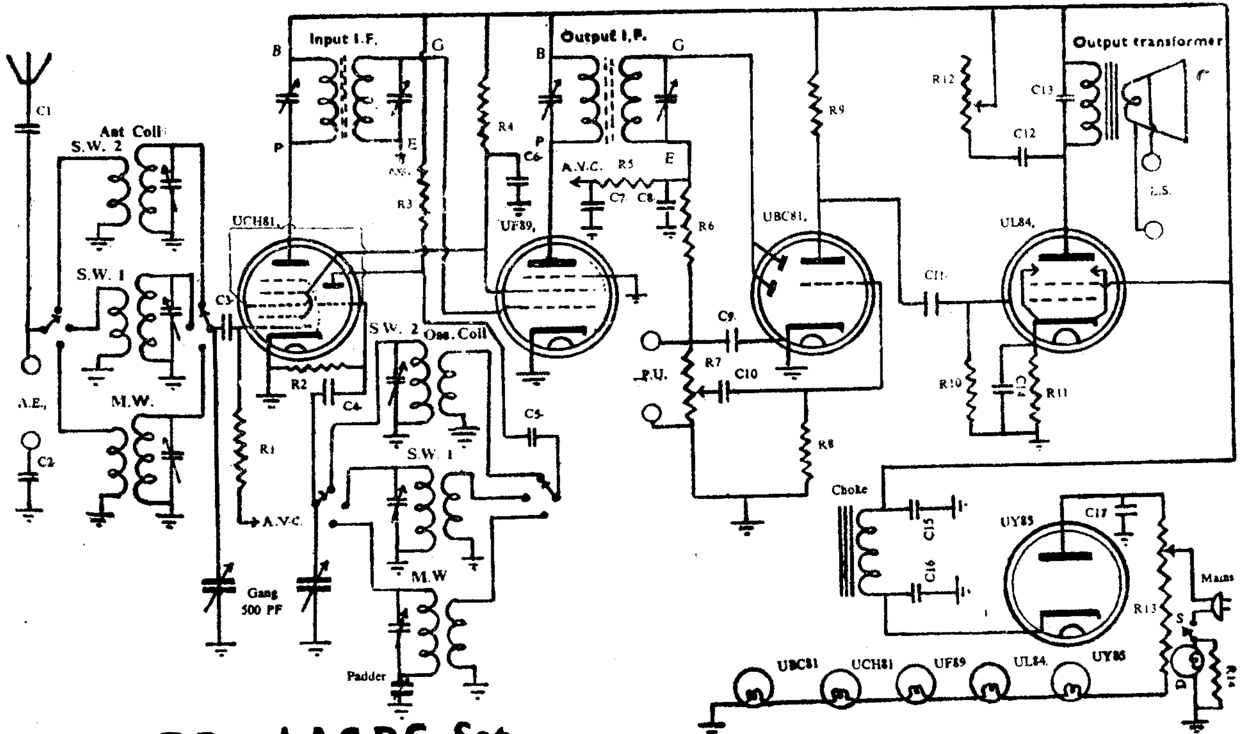
Valves No.	1	2	3	4	5	6	7	8	9	Function
V1=UCH 81	$g^{2'}, g^4$	g^1	k g^5	h	h	ah	g^3	at	g^t	Conveter
V2=UBF 89	g^2	g^1	k		h	a	ad	ad″	g^3	Det. & I. F.
V3=UCL 82	gt	k g^2	g^1	h	h	a	g^2	kt	at	1st L.F. & Power Amp.
V4=UY 85	—	—	k	h	h	—	—	—	a	Rectifier

43. Five Valves Ac-Dc Superhetrodyne Radio. (Fig. 49)

Parts List—

Capacitors	Type	Resistors	Type
C1 =0·05Mfd	Paper	R1 = 1 M Ω	Carbon 1/2 Watt
C2 =0·01 ,,	,,	R2 = 47 K ,	,, ,,
C3 =100 Pfd	Ceramic	R3 = 22 K ,,	,, 1 Watt
C4 =100 ,,	,,	R4 = 15 K ,,	,, ,,
C5 =100 ,,	,,	R5 = 1 M ,,	,, 1/2 Watt
C6 =0·05Mfd	Paper	R6 = 47 K ,,	,, ,,
C7 =0·05Mfd	,	R7 = 0 5 M ,,	Volume Control
C8 =100Pfd	Ceramic	R8 = 10 M ,,	Carbon 1/2 Watt
C9 =100 ,,	,,	R9 =0.22 M ,,	,, ,,
C10=0 005Mfd	Paper	R10=0.47 M ,,	,, ,,
C11=0.01 ,,	,,	R11= 150 ,,	Wire Wound 5 Watt
C12=0·005 ,,	,,	R12= 500 K ,,	Tone Control
C13=0·005 ,,	,,	R13= 900 ,,	Wire Wound 10 Watt
C14=25Mfd. 25V	Electrolytic	R14= 150 ,,	,, 5 ,,
C15=32 ,, 350V	,,	Choke=5 Henry or	L.F. Choke
C16=32 ,, ,,	,,	Resistor of 1 K Ω	Wire Wound 10 Watt
C17=0·05, 450V	Paper		

ALL WORLD RADIO



3 Band AC.DC. Set.

Fig. 50—Five valves AC/DC Superhetrodyne Radio Circuit diagram.

Pin Connections of the Valves used in circuit.

Valve No.	1	2	3	4	5	6	7	8	9
UCH 81	g^2,g^4	g^1	k	h	h	ah	g^3	at	gt
UF 89	s	g^1	k	h	h	s	a	g^2	g^3
UBC 81	a	g^t	k	h	h	a′d	s	a″d	—
UL 84	—	g^1	kg^3	h	h	—	a	—	g^2
UY 85	—	—	k	h	h	—	—	—	a

44. *Five Valves Ac Superhetrodyne Radio (Fig 50)*

Parts List—

Resistors.

R^1 = 1M Ω R^2 =47 K Ω R^3 =22 K Ω R^4 =33 K Ω
R^5 = 1M ,, R^6 =47 K ,, R^8 =10 M ,, R^9 =0.2 M ,,
R^{10}=0·5M ,, R^{11}=150 ,, R^{12}=0·5M ,, R^{13}=1 K ,,
Volume Control R^7=0·5M ,, Tone Control R^{12}=0·5 M ,,

Capacitors.

C^1 =0 005Mfd C^2 =0.01Mfd. C^3 =100Pfd. C^4 =100Pfd.
C^5 =100Pfd. C^6 =0·05Mfd. C^7 =0·05Mfd. C^8 =100Pfd.
C^9 =100Pfd. C^{10} =0·05Mfd. C^{11}=0·01Mfd. C^{12}=·005Mfd.
C^{13}=0·05Mfd. C^{14}=25Mfd. C^{15}=32Mfd. C^{16}=32Mfd.
Gang Capacitor—2 section=500Pfd each. Padder=600Pfd.
Six Trimmers across secondary of each coil=70Pfd.

Transformers.

Two—I.F. Transformers.
One—Power Transformer 80ma. → HT. 250 volts and LT. 6·3 volts.
Three Ant. R.F. Transformers.
One—L.F. Output Transformer
Three Osc. R.F. Transformers

ALL WORLD RADIO

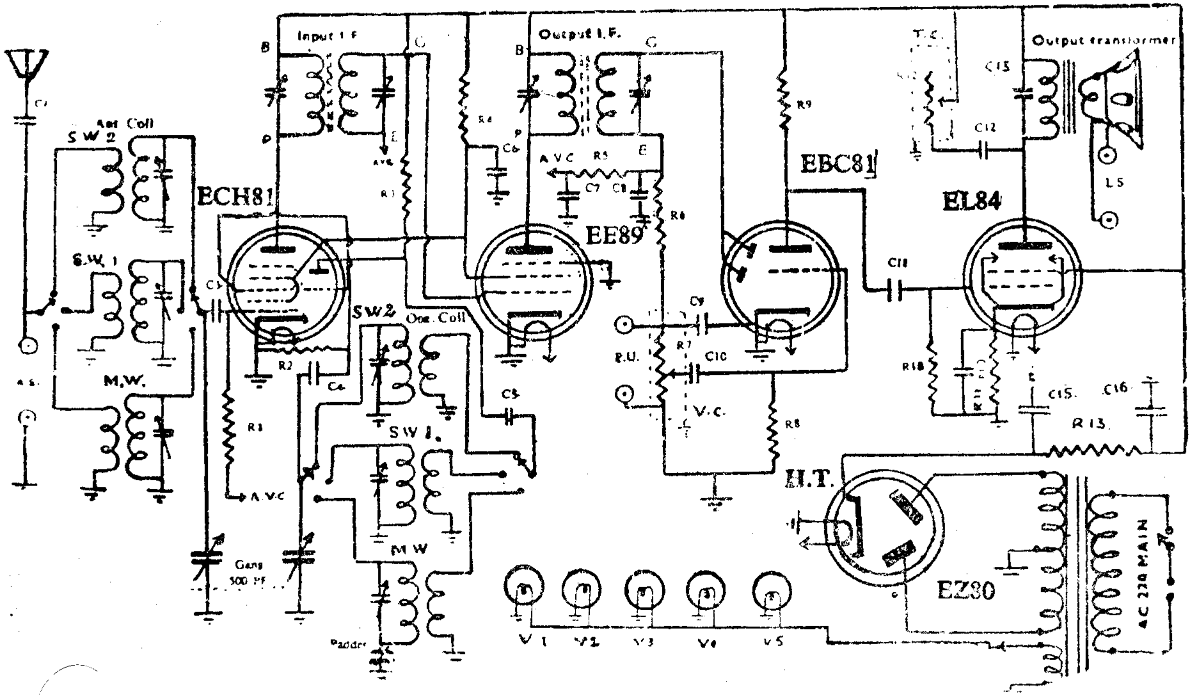


Fig. 50—Five Valves A/C Superhetrodyne Radio Circuit-diagram

Pin Connections of the Valves used in this circuit

Valve	1	2	3	4	5	6	7	8	9
EZ 80	a'	ic	k	h	h	ic	a''	ic	ic
EL 84	ic	g^1	k, g^3	h	h	ic	a	ic	g^3
EBC 81	a^t	g^t	k	h	h	ad'	s	ad''	ic
EF 89	s	g^1	k	h	h	s	a	g^3	g^3
ECH 81	g^2, g^4	g^1	k, g^5	h	h	ah	g^3	at	g^t

45 *Six valves A/c Superhetrodyne Radio* (Fig. 50)

Circuit Description

This basic six valves superhetrodyne radio receiver operates directly from an AC power line of 220 volts. AC power inputs are converted to DC Power by the EZ40 full wave rectifier circuit. The receiver uses a parallel heater arrangement. The on/off switch is connected in the primary of man's transformer. This power traosformer has three secondary windings. The middle secondary winding of five volts is not used in this circuit. One or two dial lamp can be connected across the 6.3 volts L.T. winding for dial light.

Now the band change switch is set at SW^2 band (7.5 to 22Mc/s) and tuning circuit selects the desire r.f. modulated signal of this band and couple this signal to the control grid of the ECH42 triode hexode converter valve. A local osciliator signal developed by the resonant circuit formed by the SW^2 oscillator coil and other section of gang capacitor is also applied to the mixer grid of this valve. The modulated r f and local oscillator signals are mixed in this valve to produce the 455Kc/s intermediate frequency used in this received Trimmer capacitors connected across the coils are adjusted to assure that the desire tracking relationship is maintained across the band.

A single I.F. stage which uses EF41 remote cut-off pentode provides the required amplification of intermediate frequency signals. This stage is made selective at 455Kc/s by the double tuned input and out-put I.F. transformers. The audio signal components are extracted from the I.F. signal by the 2nd detector circuit which consists of diode section of EBC41 tube and associated components.

The audio signal voltage across the volume control potentiometer is amplified by the triode section of EBC41 and is then used to drive the EL41 audio output stage The output stage develops the audio power required to produce an audible output from the speaker.

ALL WORLD RADIO

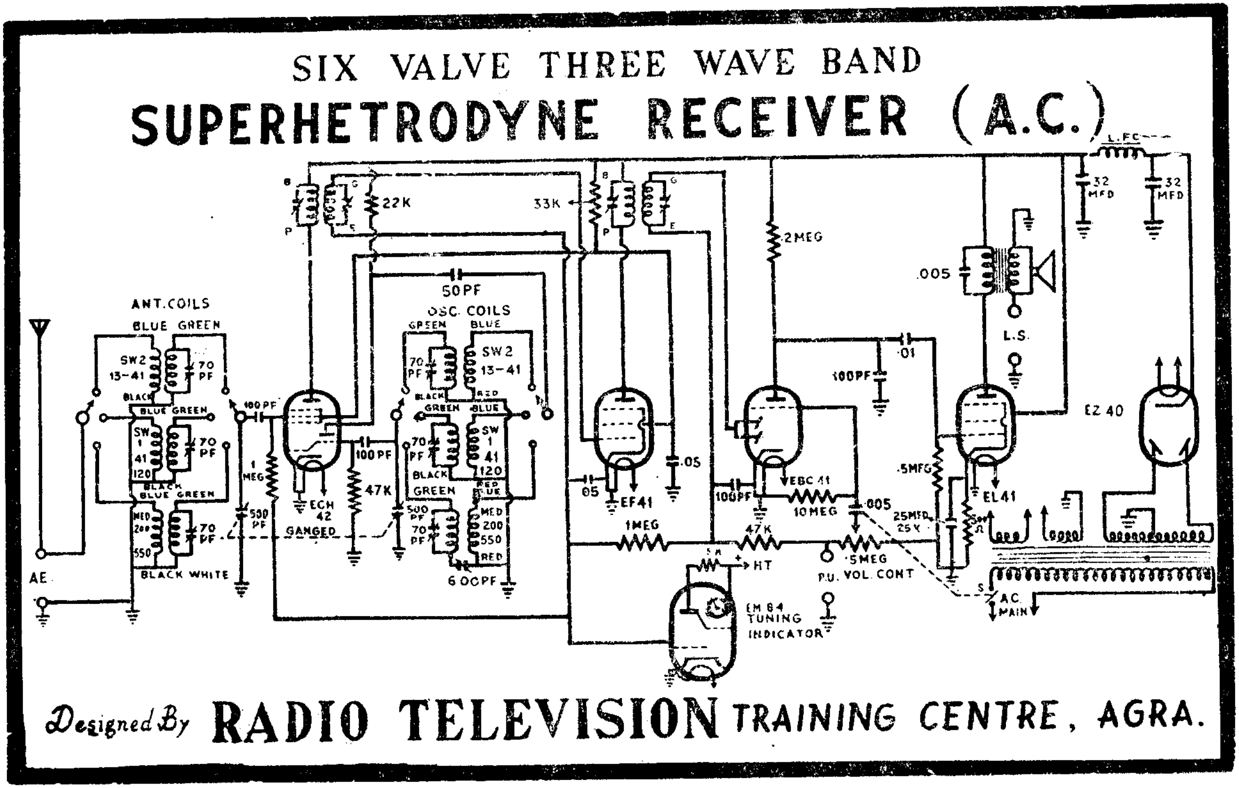


Fig. 51—Ciruit Digram of A/C Radio with Tuning Indicator.

Pin Connections of the Valves used in circuit.

Valve No.	1	2	3	4	5	6	7	8	9
ECH 42	h	a^h	a^t	g^t g^3	g^2,g^4	g^1	k	h	—
EF 41	h	a	—	—	g	g^1	k, g^3	h	—
EBC 41	h	a^t	g^t	s	a'd	a''d	k	h	—
EL 41	h	a	—	—	g^2	g^1	k, g^3	h	—
EZ 40	h	a'	—	—	—	a''	k	h	—
EM 84	g^t	ic	k	h	h	Ta	Def a	ic	a^t

46. *Six Valves High Fidelity Audio Amplifier. (Fig. 51)*

Circuit Description :-

This hi-fi. audio amplifier can deliver power output of 15 watt. The circuit operates from 220 volts AC and 6 volt battery. The vibrator is used to convert six volts DC to pulsating DC. The valve 6X5 is full wave rectifier which converts the AC input to DC output.

A high gain pentode voltage amplifier is used as tha input stage for the audio amplifier The R.C. coupling is used in the first and second valve. The output of this second stage 6N7 is coupled to the control grid of a triode split load type of phase inverter valve 6SC7. The outputs of each triode of 6SC7 which are equal in amplitude and opposite in phase are used to drive a pair of 6V6 beam power pentodes.

The pushpull output transformer couples the audio amplifier output to the speakers The taps on the secondary of this transformer match to the different number of speakers of 4 to 500 ohms.

General Instructions :—

1. The power transformer and rectifier stage should be placed near by the output end of the amplifier rather than near the input for the following reasons. If a slight hum is picked up by the first stage, it will be amplified by all the following stages and so become very objectionable The same volume of hum picked up by the power amplifier is not so amplified and therefore does no harm.

2. Keep the 220 volts A/C leads as short as possible. The main line cord should enter the chassis close to the power transformer and On/Off switch should be placed close to the main's transformer.

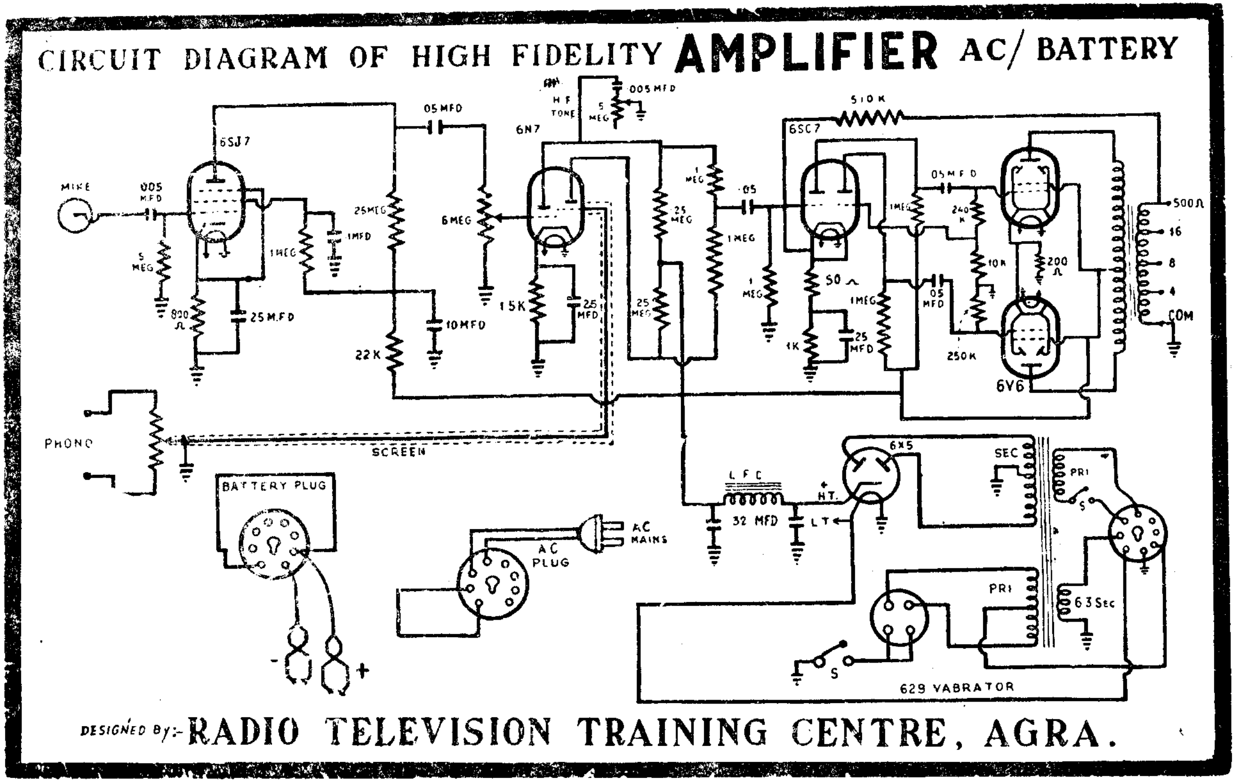


Fig. 50—Six Valves A/C and Battery Amplifier

3. Hum may be picked up from AC heater wiring. To avoid this trouble, the two leads should be twisted together as much as possible and kept as far from the control grid and plate leads as is convenient.

4. Motor boating is common trouble encountered in the construction of audio amplifier. This difficulty causes a noise in the loud speaker that resembles the exhaust of motor boat. The common cause of this difficulty is a lack of regulation of the voltage in the power supply.

5. Excessive plate or screen grid voltage will often cause howling poor quality.

6. The grid bias on all the valves should be high enough to prevent any of the grids from becoming positively charged. However, if the bias is unnessarily high it will result in lowered amplification.

7. When using only unit-speaker connect the leads across common and 16 ohms terminal.

8. For using two unit speaker in parallel, connect the leads across common and 8 ohms terminal.

9. For using four unit-speakars in parallel connect the leads across common and 4 ohms terminal.

10. When using matching transformer with the unit speaker, then connect the leads across common and 500 ohms terminals.

47. Superhetrodyne Radio with Piano Band switch

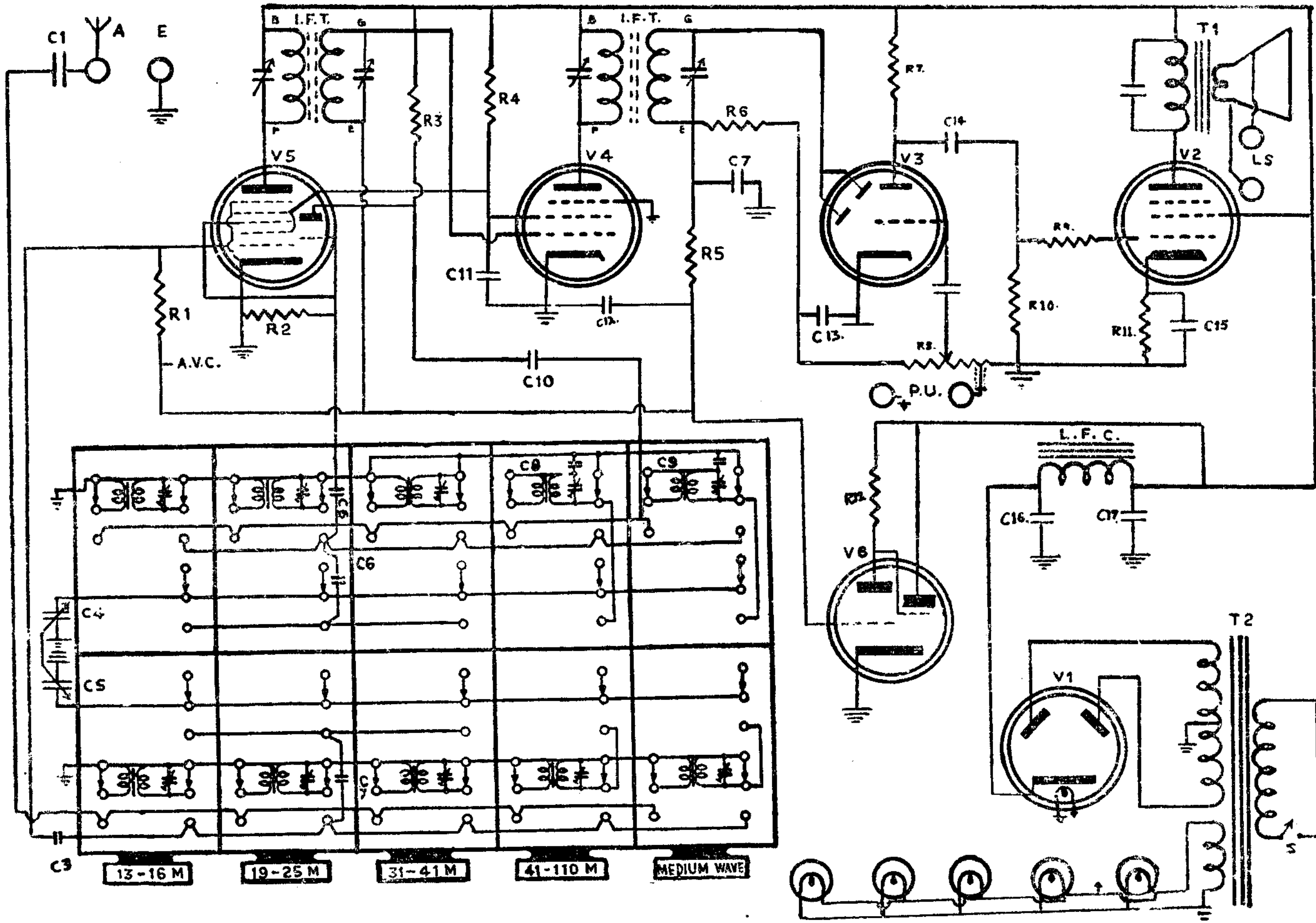
Circuit Description

All the lower coils are the antenna coils. The range in meters is written in front of each coil. Trimmers are connected across the secondary of each coil.

All the upper coils are the oscillators coils. The coil in front of each antenna coil is the oscillator coil of thet particular band. C8 and C9 are the padder capacitor of SW4 and MW. band.

All the windings of antenna and oscillator coils are being shorted with a moving strips of band switch which are indicated by the arrows.

By pressing the button of particular band change switch removes the shorting of the both primary and secondary winding of the antenna and oscillator coil of that band and the moving strips make the contacts with pole terminals and the set works on that band.



SIX VALVES FIVE BANDS SET.

USING PIANO BAND SWITCH

For selecting an other station on the next band press the button of that band. Mechanical device is being used which will release the shorts of the coil of new band and simultaneously short circuited the windings of the coils which is previously working

When you release all the buttons set will not work.

Poles Connections of Band Change Switch :—

Aerial capacitor C^1 is connected to the 1st pole terminal of the primary winding of the antenna coil. Grid capacitor C^3 is connected the 2nd pole terminal of the secondary winding of the antenna coil. Gang capacitor (Ant. section) C^5 is connected to the 3rd terminal of band change switch. Gang capacitor (Osc. section) C^4 is connected to the 4th pole terminal of the band change switch Osc. band spread capacitor C^6 is connected to the 5th pole terminal of the band change switch. Ant. band spread capacitor C^7 is connected to the 6th pole terminal of band change switch

Important Note—Connect one resistor of 10 MΩ in the control grid of valve V^3 and connect the other end of this resistor to chassis. This is the grid leak resisror which is not shown in the circuit.

Parts Lists

Resistors.

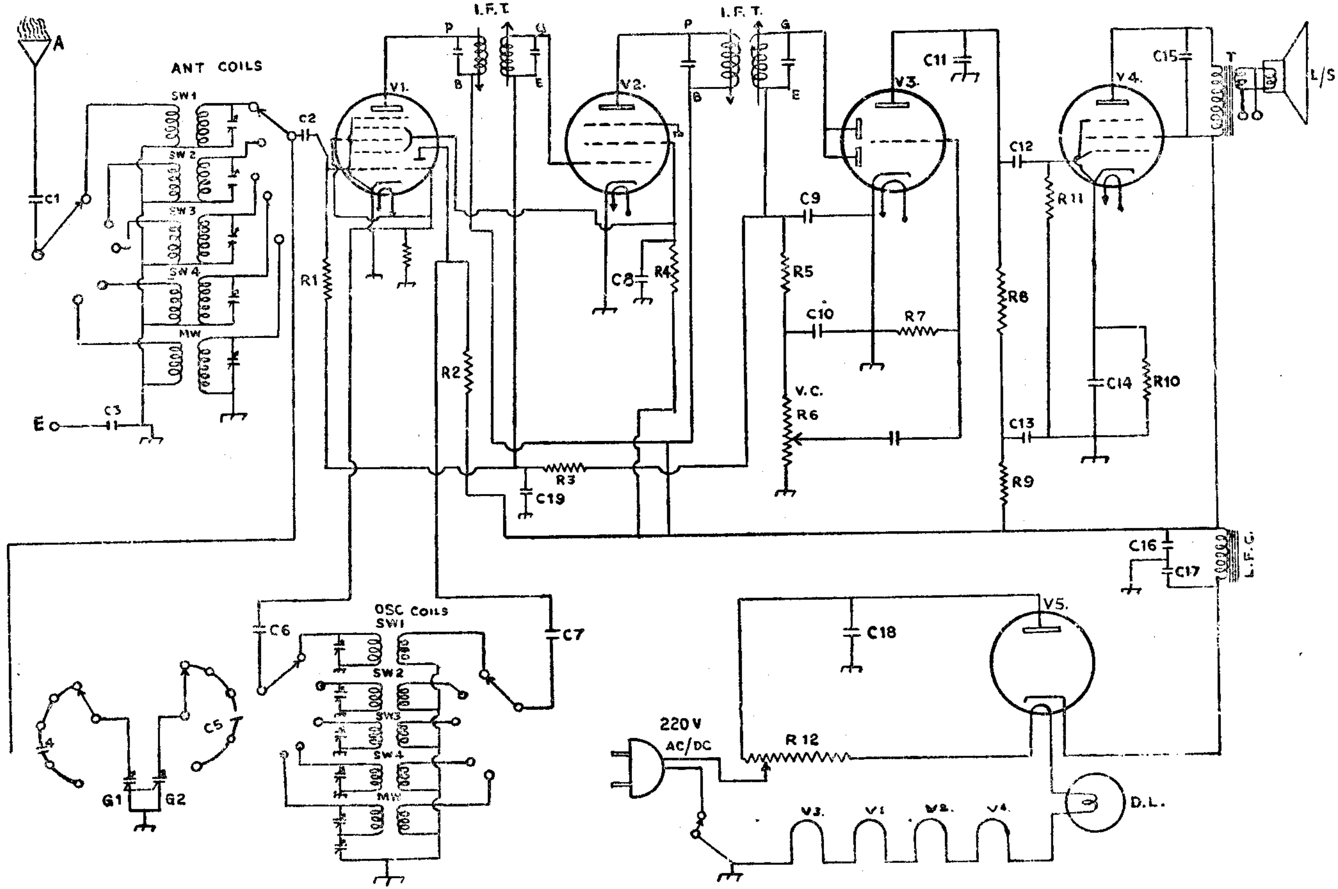
R^1=1 MΩ	R^2 =47 K Ω	R^3 =22 K Ω	R^4 =33 K Ω
R^5=1 M ,,	R^6 =47 K ,,	R^7 =0·2 M ,,	R^8 =0.5 M ,, VC
R^9=10K ,,	R^{10}=0·5M ,,	R^{11}=150 ,,	R^{12}=0·47M,,

Capacitors

C^1, C^{14}=·005 mfd	C^3, C^6, C^7, C^{10}, C^{13}=100 Pfd	C^4, C^5=Gang capacitor
C^8=5000Pfd	C^9=600Pfd	C^{11}, C^{12}=0.05mfd.
C^{15}=25mfd.	C^{16}, C^{17}=32 mfd.	

BAND SPREAD RADIO

5 VALVES — 5 BAND AC/DC.



48. Five Valves Band Spread Radlo.

Value and function components.

Capacitors	Function	Resistors	Function
C1 = ·005Mfd	Aerial capacitor	R1 = 1M Ω	Grid leak resistor.
C2 = 100Pfd	Grid leak capacitor	R2 = 22K ,,	Osc. anode load resistor.
C3 = ·01Mfd	Earth capaciter	R3 = 2M ,,	AVC Filter resistor,
C4 = 100Pfd	Band spread capacitor	R4 = 15K ,,	Screen grid resistor
C5 = 100Pfd	Band spread ,,	R5 = 47K ,,	I.F filter resistor.
C6 = 100Pfd	Osc. grid capacitor	R6 = 0 5M ,	Volume control.
C7 = 100Pfd	Osc anode capacitor	R7 = 10M ,,	Grid leak resistor.
C8 = 0.05Mfd	Screen grid capacitor	R8 = 200K ,,	Anode load resistor.
C9 = 100Pfd	I.F. by-pass capacitor	R9 = 20K ,,	Anode decoupling resistor.
C10 = 100Pfd	I.F. by-pass ,,	R10 = 150 ,,	Cathode bias resistor.
C11 = 100Pfd	R.F. by-pass capacitor	R11 = 0.5M ,,	Grid leak input resistor.
C12 = 0·005Mfd	Coupling capacitor Paper	R12 = 900 ,,	Balast resistor.
C13 = 8Mfd	Decoupling capacitor	R = 47K ,,	Grid leak resistor of UCH81
C14 = 25Mfd	Cathode by-pass capacitor	R = 150 ,,	Anode resistor of V5
C15 = ·005Mfd	Fixed Tone capacitor		Portion of R1.
C16 = 32Mfd	Smoothing capacitor	**Valves**	
C17 = 32Mfd	Reservoir capacitor	V1 = UCH 81	Converter.
C18 = ·05Mfd	Anode by-pass capacitor	V2 = UF 8	I.F. Amp. lifier.
G1, G2 = 500Pfd	2 Section gang—capacitor	V3 = UBC 81	Det and L.F. Amp. lifier.
Trimmer = 70Pfd	Variable capacitor	V4 = UL 84	Power pentode.
		V5 = UY 85	Rectifier.

Note : (i) Connect the pole terminal of Sec. Ant. coil to the lower terminal of C4.

(ii) Connect the pole terminal of Pri. Osc. coil to the lower terminal of C5.

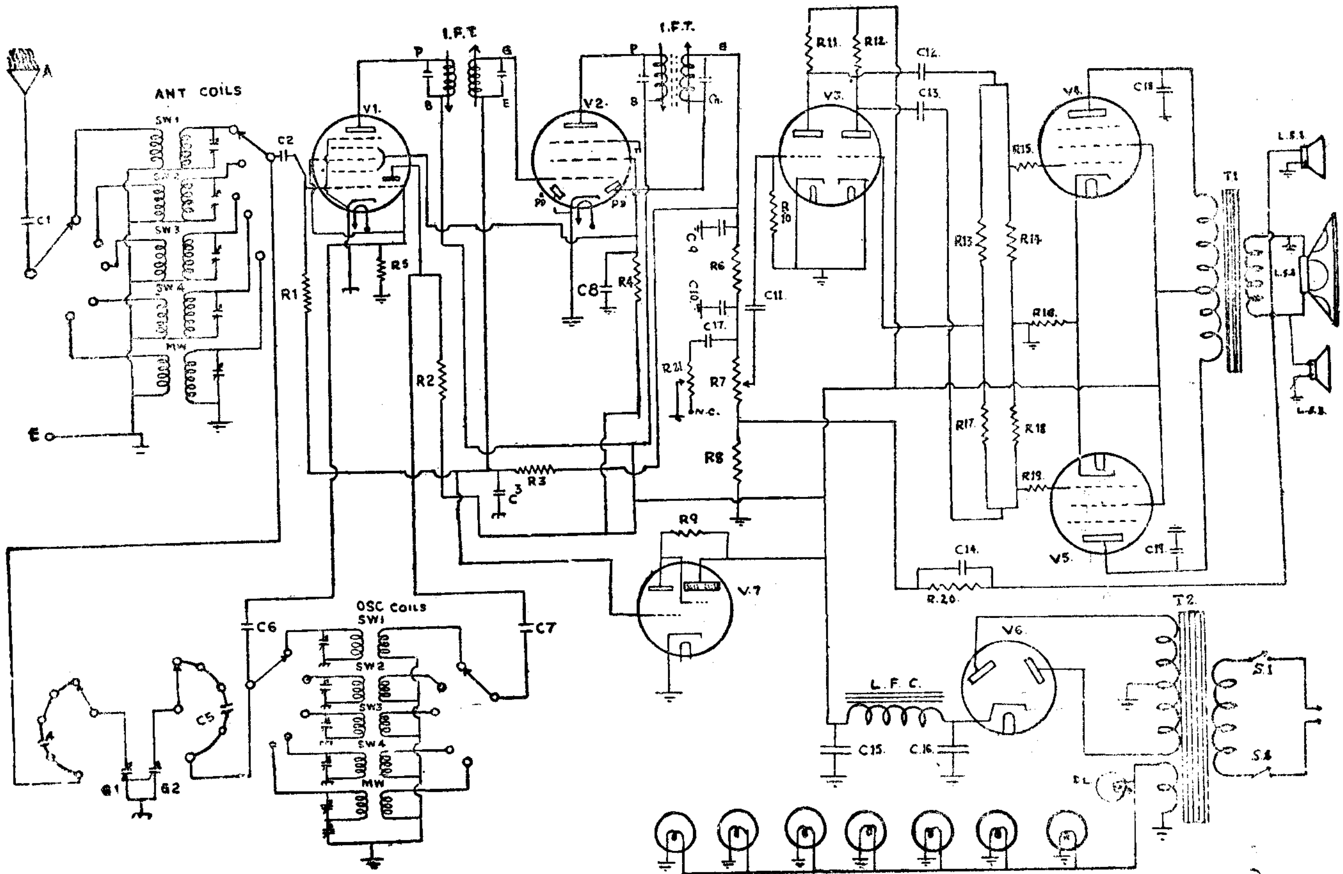


Fig. 55—Five Bands Seven Valves Hi-Fi Radio Receivers

49. Seven Valves High Fidelity Radio Receiver.

Parts List :—

Resistors

R^1=1 MΩ	R^6 =47 K Ω	R^{11}=47 K Ω	R^{16}=60 Ω
R^2=22K ,,	R^7 =0·5M ,,	R^{12}=47 K ,,	R^{17}=22 ,,
R^3=2·2 M,,	R^8 =5 ,,	R^{13}=22 K ,,	R^{18}=.68 M ,,
R^4=22 K ,,	R^9 =10K ,,	R^{14}=·68 M,,	R^{19}=10 K ,,
R^5=47 K ,,	R^{10}=1M ,,	R^{15}10 K ,,	R^{20}=47 K ,,

R^{21}=250 K Ω Tone control R^7=500 K Ω Volume control.

Capacitors

C6, C7, C9, C10=100Pfd	C2, C4, C5=100Pfd	C3, C8, C14=·05 Mfd
C11, C12, C13 = 01Mfd	C15, C16 =15Mfd.	C17 =·004Mfd
C1, C18, C19 =·005mfd.		

Special Features of this Circuit—

It is extremely difficult to design a receiver with single speaker to provide a full range of musical frequencies for good quality reproduction. For this in High-Fidelity receiver two are more speakers are used For reproducing the lower notes a large diaphragm is required and one or two small speakers for high notes.

The net work, R^{20} & C^{14}, is providing negative feed back, reproduction is thus more faithful than when the power pentodes are used without negative feed back, In this arrangement by feeding the voltage from the secondary of output transformer to the input V^3 reduces the amplitude of undesired harmonic and so obtain a marked improvement quality.

Detection is being done in the valve EBF 89. The diode PD' is functioning as 2nd detector. The second diode PD'' is kept at chassis potential

A.V C. voltage is provided to I. F. and converter stage through a filter consists of R^3 & C^3. To test the A.V.C connect a milli-ammeter in the anode circuit of V^2 or V^1, and tune the radio to a local or strong station. The tuning point should be passed one or two times and see the meter. If no change in the current take place in the meter, the A.V.C. system is not functioning then check the A.V.C. circuit R^3 and C^3.

The highest quality receivers usually employ a pushpull output stage. In push pull coupling 2nd harmonics distortion is completely cancelled. An increase in power output per valve is another one result of the pushpull circuit. Instead of pushpull input transformer, R C. coupling is used here, which causes less distortion than transformer coupling.

F. M. SUPERHETRODYNE RADIO

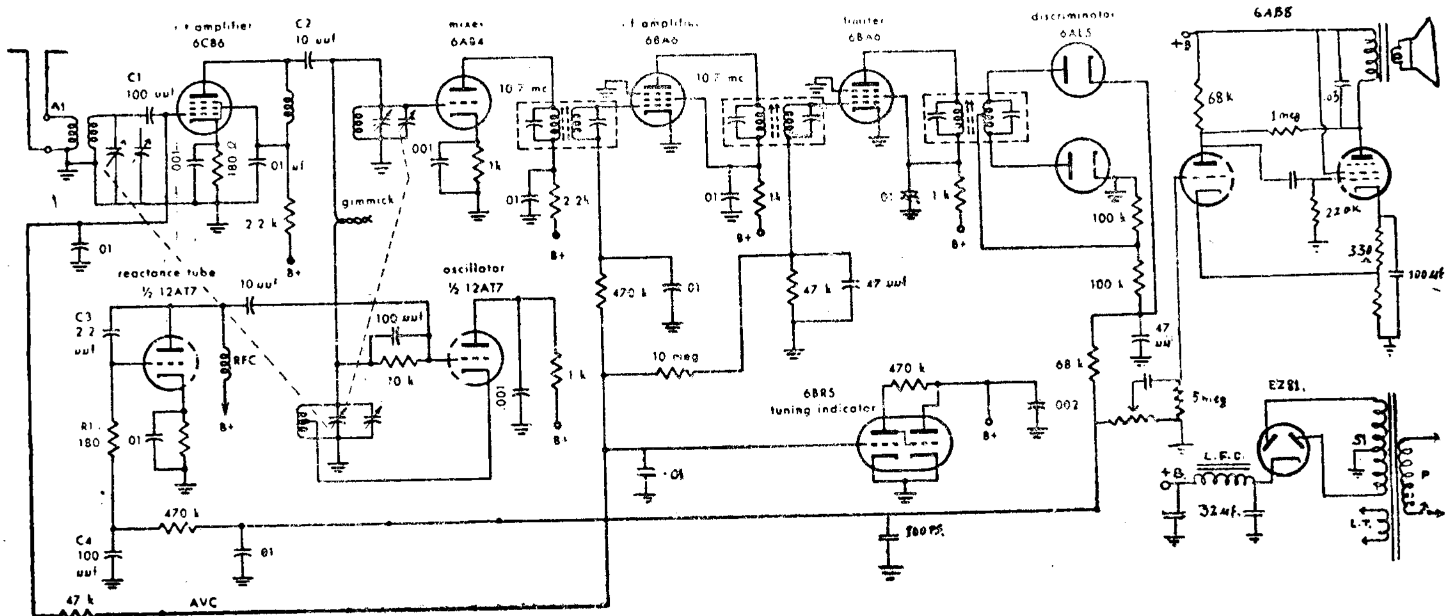


Fig. 56—Frequency Modulated Superhetrodyne Receiver Circuit Diagram.

Band spread circuits are used to obtain a tuning curve that should be wider one to receiver higher and lower notes. If high fidelity reception is to be attained all these frequencies must be received equally well. One section of gang condenser with a series capacitor C^4 and tuning coil of short wave form a band spread circuit.

6. *F.M. Superhetrodyne Radio Receiver.*

Principles of F. M. Receiver—

In frequency modulation system the frequency of the r. f. carrier is varied or deviated to a higher or lower number of cycle as per the frequency of the audio signal. In amplitude modulation system the amplitude of r. f. carrier is varied according to the audio-signal.

In Television sound receiver F. M. system is being used now a days. In F. M. receiver basically the r.f. and a.f stages are similar with A.M. receiver. Because of high frequencies there are some difference in the antenna r. f. and mixer circuit. The reactance tube is used to control the oscillator frequency of the oscillator. The major difference lies in the de-modulator, special type of circuit known as descriminator is required to demodulate the a.f. signal. The limiter valve 6BA6 acts as 2nd I. F. amplifier and clips offt he amplitude variations of the input signal, making its output more constant in amplitude. The output of limiter is fed to double diode vaive 6AL5. This is Foster Seelay descriminator named after its inventor. This type of descriminator is com monly used in F.M. receiver and TV sound system. The descriminator output across the potentiometer, also serves double functions. It delivers a rectified signal voltage for A.F.C. to the reactance valve for stabilizing the frequency of oscillator 12AT7. The audio output is fed to the audio amplifier which is exactly similar as in AM receiver FM sets which are to be used to receive high fidelity radio signal, the audio stages must be capable of reproducing the wide range of audio frequencies.

The advantage of F.M. is that it provides excellent noise free reception of sound signal. Magic eye valve 6BR5 is also used in this receiver which provides tuning indication of desire incoming signai.

Pin Connections of the valves used in this circuits

Valves No.	Function	1	2	3	4	5	6	7	8	9	Base
1. 6CB6	R.F. Amplifier	g	k	h	h	a	g^2	g^3	—	—	7 Pin
2. 6AB4	Mixer	a	is	h	h	hc	g	k	—	—	7 Pin
3. 12AT7	Reactance-osc.	a	g	k	h	h	a′	g′	k′	h^{tap}	Noval
4. 6BA6	I F. & V^5 Limiter	g^1	k^3	h	h	a	g^2	k	—	—	7 Pin
5. 6A5	Discriminator	k	a′	h	h	k	s	a′	—	—	,,
6. 6AB8	Triode-PowerAmp.	at	g^t	k,s	h	h	a	g^3	g^2	g^1	Noval
7. 6BR5	Tuning Indicator	g	k,g	ic	h	h	ic	a	ic	t	,,
8. EZ81	Full wave Rectifier	a″	ic	k	h	h	ic	a′	ic	ic	,,

SECTION D

Radio Servicing

51. Instructions for Installation Radio Antenna.

If programme is not clear in radio or if there is a lot of disturbance, then first of all check the aerial and the earth system. If aerial and earth are not fitted well, even good and perfectly all-right radio will not give good reception. While checking aerial and earth be careful about the following things.

1. There shouldn't be any joint in the lead-in-wire
2. Aerial's antenna shouldn't be in pararalel to the Main's wire,
3. Lead-in-wire shouldn't touch walls etc, while coming down.
4. Antenna should neither be more than nor less than 25 to 30 feet long.
5. If aerial poles are smaller, change them with longer ones. Higher the antenna more the signal voltage will it receive.
6. Always use plugs while fitting-in aerial and earth to the radio.
7. Use earth-wire nearer the radio so that lesser wire is consumed.
8. If earth wire is connected to the water pipe, do use C-clamp for proper connection
9. If there is no earth-connection with the radio, make a point to use one. This will reduce noise in the radio.
10. If antenna-wire is loose, fit it tightly. Loose antenna-wire causes fading.

VISUAL INSPECTION OF THE RECEIVER

Before repairing the radio, ascertain the cause of the trouble and for that reason inspect the set properly. Check mains cord and plug before repairing the set or opening cabinet of the radio.

Now take out the set from the cabinet and be sure that there is no dry-joint any where. If you find one, resolder it. If insulation of any wire is perished or is cracked either change that wire or put new sleeve over it And now look if any resistance is broken or has become blacky due to over-heating. Particulary check all wire-wound resistances with a meter. Check transformer and see, it is not over-heated Now capacitors must be checked. See if wax etc. does not seem oozing out due to over-heat, and if you find any capacitor like that, replace it. Now check gang capacitor and be sure that rotor and stator plates do not touch each-other. Revolve fully the gang and check it with an ohm-meter. Sometimes the plates get shorted due to dust particles. Check the valves and see that these are fitted in their proper sockets. Their sockets and valve-pins should be clean. Even if slightly dirty, clean them with petrol.

To wash Band-change switch is also a necessity because dirt etc. can result in bad contacts In this way the cause of the defect can be found by Visual Inspection.

Checking the Heater Circuit of A/C Radio

In A/C Radio, all the valves are connected parallel to 6 volt secondary winding of the power-transformer. In that radio, as such, even if one valve is fused, the other continue to glow. To test the heaters of the valve pull them out from sockets and check valves with an ohm-meter. If heater doesn't show continuity, the valve is bad and should be replaced. If, however, heaters of all the valves are O.K. and even then if a certain valve is not glowing then check the voltage across 6-volt winding of the power transformer using voltmeter in parallel to it. Also check the wire connecting heaters of all the valves. If voltages are not present in the winding, go for the checking of the power transformer.

Advantage of A/C Radio

1. Less filtering capacity is required in the filter circuit due to full wave rectification, and there is less electrical interference noises
2. Power consumption is less than AC/DC-radio.
3. More power output due to higher H. T. voltage produced in power transformer.
4. No danger of shock as chassis is always neutral.
5. Heat produced inside the receiver is less as compared to AC/DC Radio.

52. *Servicing Superheterodyne Radio Receiver.*

First of all check the continuity at the plug terminals by putting the on/off switch at on position. If the meter does not show any continuity, the heater circuit of the valves is open circuited. A circuit which does not form a complete path for the flow of current is called open circuit Check the heater of each valve with ohm-meter and replace the faulty one which does not show any countinuity.

If the valves are checked up properly and the receiver is electrically operated, the main's voltage should be checked with a suitable-volt-meter. For this, check the anode voltage of rectifier valve with AC volt-meter and cathode voltage with DC volt-meter

After the source of power to the radio set has been checked the next procedure is to check the voltage supplied to the anode and screen grid of each tube, The usual practice is to check the valves in the order in which the signal passes through them i.e start with converter stage and end with power amplifier stage.

If the voltages on different electrodes of the stage are OK. Then the valves should be examined. Their emission should be tested by inserting a milliammeter into their anode circuits.

Audio Section—Check the operation of the audio frequency amplifier section of the radio by touching the centre terminal of the volume control with a damp finger or screw-driver. If the noise is heard in the speaker during this finger test the audio section is working properly. If not then suspect that A.F. Section of the receiver is defective.

Detector Stage—Apply a signal from the signal injector to the diode anode of detector valve. If this is functioning properly, a loud response will be heard from the speaker.

I.F. Amplifier Stage—Apply a modulated I.F. signal from the signal generator to the control grid of I.F. amplifier and check the alignment of the I.F. transformers.

Mixer Stage—Apply a modulated I.F. signal to the signal grid of first converter valve ECH81 at pin No. 2 and if the modulation note is heard in the speaker then the alignment of Input I.F. transformer is OK.

Oscillator Section-Connect the meter between the triode anode of converter valve and chassls and then apply a short circuit across the capacitor C4 which is the section of gang condenser of oscillator portion. When a short circuit is applied, a marked alternation in the reading of the volt-meter will take place if the valve is oscillating. In that circuit the oscillator anode voltage falls by as much as 15 to 20 volts.

Converter Stage—Apply a modulated signal of some frequency say 1000kc/s to the aerial terminal and tune the radio on the dial at this same frequency if the response is heard in the speaker then the complete receiver on MW. Band ls functioning properly.

Similarly check the S.W. Bands by applying short wave signal to the receiver and check the alignment of tuned circuits.

Voltage and Current Specifications at Testing Points of A/C and AC/DC Radio Receiver

AC RADIO

Pin Point	Voltage.
Heater voltage of each valve	=6·3 Volts AC
Anodes voltage of EZ80	=250 ,, ,,
Cathode voltage of EZ80	=250 Volts DC
Screen grid of EL84—V^4	=220 ,,
Anode of EL84—V^4	=210 ,,
Cathode of EL84—V^4	=7·5 ,,
Anode of EBC81—V^3	=100 ,,
Anode of EF89—V^2	=200 ,,
Screen grid of EF89	= C0 ,,
Anode of ECH81—V^1	=200 ,,
Screen grid of ECH81	=100 ,,
Osc Anode of ECH81	=100 ,,
Target Anode of EM84	=220 ,,
Anode of EM84	=200 ,,

Circuit.	Current in ma.
Cathode of EZ80	=90 8 ma
Anode of EL84	=48 ,,
Screen grid of EL84	=5·5 ,,

AC/DC RADIO

Pin Point.	Voltage.
Total heater voltage of 5 valves	=128 6 Volts AC or DC
Anode voltages of UY85	–210 Volts AC
Cathode voltage of UY85	=220 Volts DC
Screen grid of UL84	=184 ,,
Anode of UL84	=170 ,,
Cathode of UL84	=–12.5 ,,
Anode of UBC81	=90 ,,
Anode of UF89	=180 ,,
Screen grid of UF89	=100 ,,
Anode of UCH81	=180 ,,
Screen grid of UCH81	=100 ,,
Osc. Anode of UCH81	=100 ,,
Target Anode of UM84	=180 ,,
Anode of UM84	=150 ,,

Circuit	Current in ma.
Cathode of UY85	=108·5 ma
Anode of UL84	=70 ,,
Screen grid of UL84	=3·5 ,,

AC RADIO

Circuit.	Current in ma
Anode of EBC81	= 1 ma
Anode of EF89	= 9 ,,
Screen grid of EF 89	= 3 ,,
Anode of ECH81	=11 ,,
Screen grid of ECH81	=7·8 ,,
Osc. Anode of ECH81	=4·5 ,,
Anode of EM84	= 1 ,,
Heater circuit total current	= 2 Amp.
Heater current of ECH81	= 0·3 ,,
Heater current of EF81	= 0·2 ,,
Heater current of EBC89	=0 23 ,,
Heater current of EL84	=0 76 ,,
Heater current of EZ80	= 0·6 ,,
Heater current of EM84	=0·21 ,,

AC/DC RADIO

Circuit.	Current in ma.
Anode of UBC81	=1.5 ma
Anode of UF 89	=12 ,,
Screen grid of UF89	=4·5 ,,
Anode of UCH81	=3·5 ,,
Screen grid of UCH81	=8·0 ,,
Osc Anode of UCH81	=4·5 ,,
Anode of UM84	=1 ,,
Current in Heater Circuit	=100 ,,
Heater voltage of UCH81	=19 Volts
Heater voltage of UF89	=12·6 ,,
Heater voltage of UBC81	=14 ,,
Heater voltage of UL84	=45 ,,
Heater voltage of UV85	=38 ,,
Heater voltage of UM84	=12 ,,

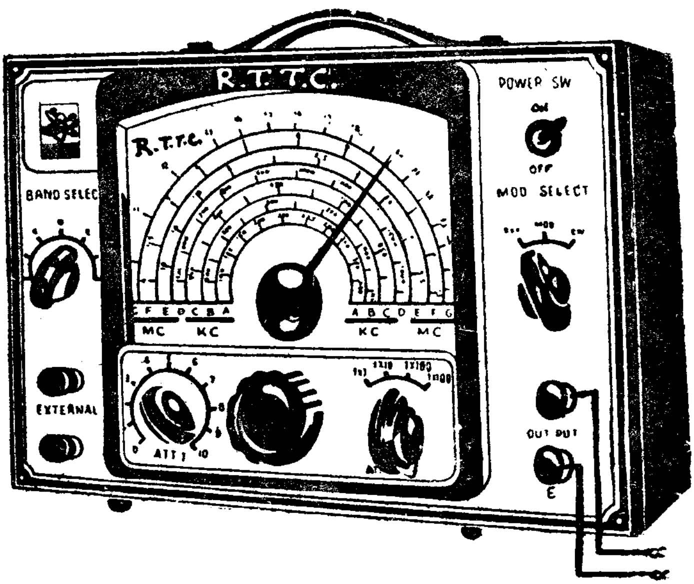


Fig. 55—Front Panel View of Srgnal Generator

54. *Servicing Receiver With Signnal Generator*

When injecting the signal from the signal generator it should be remembered that the further the stage is away from the power amplifier stage of the set, the higher is the total amplification of the signal provided in the radio receiver. Consequently for a given signal output the smaller will be the signal that is required to be injected by the signal generator so the attenuator on the signal generator should be adjusted to reduce the injected signal.

Points of Signal Injection	Results
1. Apply the strong A.F signal from the signal generator to the control grid of the power amplifier valve (UL84).	1. The loud note of 400 cycle will be heard from the loudspeaker if the power stage is functioning normal. If no response check the whole power stage, including rectifier circuit.
2. Apply the A.F. signal to the control grid of 1st Audio amplifier stage (UBC81).	2. Audio note in the Loudspeaker. is heasd If no response. Check the triode portion of UBC81.
3. Apply the modulated I F. signal to the control grid of Intermediate frequency amplifier valve (UF89). (Mostly receiver's intermediate frequency is 455 Kc/s.)	3. Audio note will be heard in the speaker if the I.F. amplifier stage is in order.
4. Apply the modulated I.F. signal to the control grid of frequency changer valve (ECH81).	4. The audio note will be heard in the speaker if all the stages are functioning normal.
5. Tune the radio at 1000Kc/s and set the signal generator at this same frequency. Now apply this modulated signal of 1000Kc/s to the aerial terminal.	5. If no audio note in loudspeaker then check the oscillator portion.
6. Set the radio at 1000Kc/s and signal generator at 1455 Kc/s if the I.F. of the set is 455 Kc/s. Now apply the modulated signal of 1455 Kc/s to the oscillator grid of the converter stage.	6. Near the 1000Kc/s on the dial if the response is heard then the oscillator is not working previously.

55. *Alignmənt of I.F. Amplifier stage*

1. Before starting to align the receiver's I.F amplifier stage the radio serviceman must know the intermediate frequency of the particular radio to be aligned.
2. Generally intermediate frequency of the local assembled radio is 455 Kc/s.
3. Allow signal generator and radio to operate for ten minutes as a warm up period before aligning.
4. Set the band change switch of the receiver at medium wave band position.
5. Set the volume control and tone control of the receiver for maximum gain.
6. Set toe gang condenser at minimum capacity (Rotor plates fully out side).
7. Short the oscillator section of gang capacitor for inoperation of oscillator of the reciver.
8. Connect the output meter or AC volt-meter across the secondary of out-put L.F. traneformer, and set the meter at the range of 2.5 volts.
9. Set the signal generator at the intermediate frequency of the receiver.
10. Set the signal generator for a modulated out-put at I.F. of the radio.
11. Connect the capacitor of ·05 mfd with the positive lead of the signal generator for I.F. alignment.
12. Adjust the attenuators of the signal generator to give the out-put as low as possible. If the response is very low then increase the out-put of signal generator.
13. Now connect the positive lead of the signal generator to the control grid of the I.F. amplifier valve and the negative lead to the chassis.
14. Adjust the trimmers or cores of last I F. transformer for maximum response from the loud-speaker and see the output meter for maximum deflection. Now apply this modulated signal to the control grid of the frequency changer valve and adjust the trimmers or cores of the in-put I.F. transformer for maximum response from the loud-speaker.
15. Repeat the adjustment of all trimmers or cores of I F. transformer starting from the secondary of I F.T. from the maximum deflection in the output meter or AC volt meter.

When all the four trimmers or cores have been readjusted to give peak response in the loud-speaker, the I.F. alignment is now completed :

56. *Alignment of R.F, and mixer stage*

Before starting the alignment of R F. oscillator circuit you have to check the dial threading by rotating the shaft of the tuning spindle. The cursor is normally set at the end of low frequency side of the scale then the capacity of gahg condenser is maximum at this end of the scale

1. Set the receiver band change switch to the M.W. Band.
2. Tune the receiver at 1500 Kc/s.

3. Set the singal generator at this frequency (1500 Kc/s) this signal should be modulated one.
4. Connect the output leads of the signal generator to the aerial and earth of the receiver. The positive lead is joined to the aerial socket through a capacitor of 250Pfd.

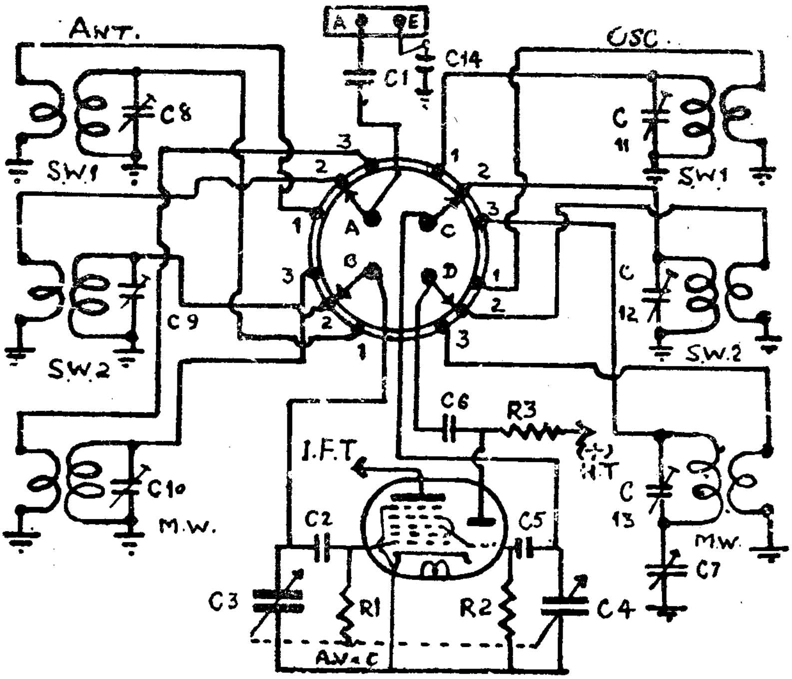


Fig. 58—Antenna R. F. & Oscillator Circuit of 3 Band Radio

5. Now adjust the trimmer C^{13} of the M.W. oscillator coil for maximum out-put and then adjust the trimmer C^{10} of the M.W. Ant. coil for maximum response.
6. Tune the receiver and signal generator at 600 Kc/s.
7. Now adjust the padder capacitor C^{7} for maximum out-put.
8. Tune the signal generator and repeat the process until each screw requires no further adjustment.
9. Now adjust the oscillator and antenna or R.F. trimmer on the S.W. Band in a similar way beginning at the oscillator circuit and ending at the aerial circuit Choose a frequency at each end of the tuning dial scale 2·5 Mc/s and 7·5 Mc/s

for S.W.1 and 7·5 Mc/s and 22 Mc/s for S.W.2 and adjust the particular trimmer of that band at higher frequency and core and padder at lower end of the scale.

57. *Causes of hum in a Receiver*

1. Open filter capacitor 32 mfd. in the power supply.
2. Old electrolytic capacitor having high leakage.
3. Low emission of rectifier valve.
4. Grounded an audio out put transforuer winding.
5. Shorted low frequency choke in the power supply.
6. Half portion of the main's transformer secondary winding open.
7. Plate current of power amplifiers is unbalanced in Push-pull output stage.
8. Shielded wire is not used in the control grid wiring.
9. Defective or old valve, having heater cathode leakage.
10. Less filtering, use high capacitor.

58. *Causes of distortion in a Receiver*

When rhe output wave from is not the exact reproduction of the input signal, it is said to be distorted. Amplitude distortion is produced from various causes which are as follows :

1. When the signal input voltage is very large, there is grid current flow during positive half cycle. This current flow damps the input circuit ahd cause distortion
2. Leaky coupling capacitors used in a resistance capacitor coupled amplifier circuit. A capacitor that is leaky to the slightest degree will cause distortion.
3. In case of transformer coupled A.F. amplifier. distortion is due to saturation of the iron core produced by the large value of plate current.
4. Incorrect grid bias voltage to the amplifier valve will also cause amplitude distortion. The selection of proper grid bias, anode voltage and the load impedence will kept this type of distortion at a minimum level.

59. *Causes of noisy reception in a Receiver*

1. Poorly insulated lead in wire of antenna which is touching the wall.
2. Bad joints in the antenna circuit.
8. Overheated or partly open resistors create noises in a receiver.
4. Loose shield of I F. transformers.
5. Loose any component in a receiver.
6. To much dirt in the tuning capacitor eausing a partial short between rotor and stator plate of gang capacitor.

7. Poor contact at main's plug or wires loose at the plug.
8. Leaky capacitors in grid or plate circut.
9. Defective volume control having worn out plate.

The quickest way of locating nosiy stage in a receiver is to short the grid circuit of the valve one at a time starting from power amplifier to converter stage, and note which one cuts out the noise first. The stage ahead of that point is the source of the noise. If shorting the antenna and earth eliminates the noise th n look for trouble in the antenna earth system or in the house wiring and plug connections,

60. Instructions for assembling Radio Receiver

1. Use the shield wire for the control grid of UBC81 and pick-up connections
2. To avoid hum keep the heater wires away from the control grid wire,
3. Use the connecting wires as short as possible.
4. There should be no loose component on the chassis.
5. Use big soldering iron for chassis connections, dry joints with small iron creat noise and poor reception.
6. Use resin core good quality solder for connections.
7. Fixed the gang condenser on the chassis with rubber grommets to avoid booming or microphony sound

6 . Instructions for the safety of multimeter

1. Do not keep the meter in the moisture.

2. When the meter is not in use, keep the selector switch to the highest A/C voltage range the damping effect will prevent the needle from flapping.

3. Do not test resistance when voltage is present in the circuit. Switch off the set, then check the resistance.

4. Always connect the red prod to possitive and black prod to negative terminal.

5. Before starting resistance measurement, short the testing prods by touching together adjust the zero set knob at zero ohm position, This adjustment is reset every time the resistance range is changed. Do it quickly as the internal batteries will go on discharge while the prods are shorted.

6. If the adujstment is ineffective while rotating the zero set knob, the internal battery should be replaced with a new one.

7 Keep the fingers off the testing prods when measuring high resistance, the body resistance in paralled will result incorrect indication on the scale.

8. While testing voltage, always start with highest voltage range if the voltage is not known in the circut. Suppose the deflection is very small now reset to a lower range for more accurate reading.

9. Be very careful, the meter will be damaged if the voltage is applied to it with the selector switch set to a current or an ohm range.

10. In voltage measurement, connect the negative prod to chassis and positive prod to that electrode of valve or transistor where the voltage to be checked.

11. While checking the voltage in between two points if the needle deflects to the left across the zero position, then reverse the prod connections.

12. Set the meter on AC voltage range while checking the anode voltage of rectifier valve.

13. On AC 2·5V range only, the receiver out-put can be checked by connecting the prods across the voice coil of the loudspeaker.

14. Connect the meter in series with the circuit while measuring current, and observe polarity by connecting the black prod to negative and red one to the positive side of the circuit.

15. Be very careful in selecting the current range. As the meter is set to a low current range if the current of circuit to be measured is higher that the set range the meter will be damaged immediately.

62. *Testing Heater Circuit of AC/DC Radio.*

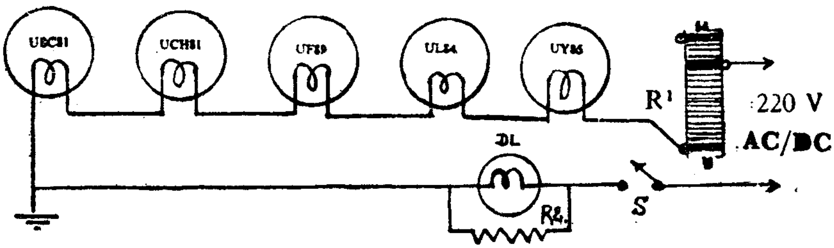


Fig. 59—Circuit Diagram of Heater Circuit of AC/DC Radio

How to find the value of resistor R¹ ?

The heater current of each valve is 0·1 ampere.

∴ I=0·1 Amp.

E=Line voltage—Heater voltage of five valves.

Heater voltage=UCH81=19V, UF89=12 6V, UBC81=14V, UL84=45V, UY85=38V.

Total Required Voltage $= 19 + 12{\cdot}6 + 14 + 45 + 38 = 128{\cdot}6$ Volts.

Dropping Voltage $E = 220 - 128\ 6 = 91{\cdot}4$ Volts.

Value of $R^1 = \frac{E}{I} = \frac{91{\cdot}4}{0{\cdot}1} = 914$ ohm

Correct value of resistance at plug terminal of AC/DC Radio $= 1050\,\Omega$

Defccts	Meter Indicationts	Possible Causes
Valves not glowing	No continuity at the plug terminals	Open resis'or R^1 Open heater of any valve on/off Switch defective Open any wire in heater circuit
Dial lamp not glowing only.	Meter showing 150Ω at dials lamp terminals	Dial lamp fused.
Dial lamp glowing brightly.	Meter showing 10Ω at dial lamp terminals	Shunt resistor R^2 open circuits
Only three valve UF89 UL84 UY85 glowing brightly and two valve UB81, UCH81 are not glowing.	Meter showing slightly less resistance at plug terminals than 1050 ohms.	Valve UF89 is internally shorts to earth as heater or cathode

Summary—

Put the on/off switch at on position. Now connect the ohm-meter across the plug terminals, if the meter does not show any continuity then trace the circut. Connect always one prod of the meter to the plug terminal of resistor R^t side then connect the other prod of the meter at the junction of R^1 and heater pin of UY85 if the pointer shows deflection. Then R^1 is O. K. then proceed for the connecting the meter prod to the heater pin of UL84 if meter does not show any deflection, the heater of UY85 valve may be open circut. Take ouit the value UY85 from the socket and cannect the meter prods at pin No. 4 & 5 If the heater is open then meter will not showing any continuity. Similarly trace the whole circut including dial lamp and shunt resistance R^2 and replace the deflective valve or component. Now if the meter showing 1050 ohm resistance at the plug terminal then the heater circuit is OK.

63. *Testing the Heater Circuit of A/C Rodio.*

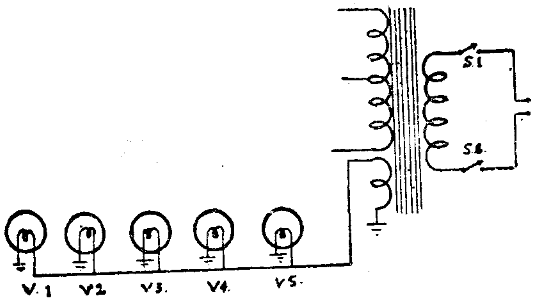


Fig. 60—Circuit Diagram of Heater Circuit of AC/DC Radio.

V[1]=ECH81, V[2]=EF81, V[3]=EBC=89, V[4]=EL84 V[5]=EZ80-No. 4 & 5 pins are the heater pins of each valves. The heaters of all the valves are connected in paralle because the voltage rating of all the valves is the same. The first letter of each valve E indicates the heater votage that is 6·3 Volts. In the above circuit all the valves are connected across the secondary L. T. Winding which is providing 6 volts to each valve.

Heater current rating of each valve is given below.

ECH81=0·3 Amp., EF89=0.2 Amp., EBC81=0·23 Amp. EL84=0·76 Amp. EZ80=0·6 Amp.

The total current which is flowing through in L.T. Secondary winding.

=·3+·2+·23+·76+ 6=2·09 Amp.

Correct resitance at plug terminal=30 to 50 ohms.

Wattage consumed in heater circuit=2×6·3=12·6 Watt.

Defects	Meter Inidication	Possible Causes
Valves are not glowing	No continuity at plug terminals.	On/off switch defective. Mains cord defective. Primary winding open circuited. Open connection at plug terminals Sec. LT winding connection open.
All the valves are glowing except one valve.	Meter showing plug continuity at the plug terminal.	The heater circuit of that which is not glowing is open circuited. Filpment of the valve is burnt out. Gassy valve and glass envelope crack.

Summary—

Put the plug in the AC main's and switch on the set. Wait for about one minute then see which valve is not glowing. Take out that valve and check the heater continuity by connecting the prods of ohm-meter across the heater pins. If the meter does not show any continuity, then the heater of that valve has gone. fused. Replace the valve with a new one of same number.

64. Servicing Chart of Halfwave Rectifier Stage.

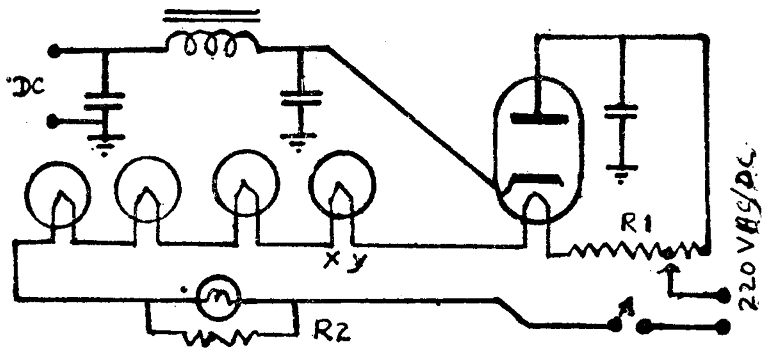


Fig. 61—Citcuit Diagram of Rectifier and Heater Circuit used in AC/DC Radio

Defect	Meter indication	Possible causes
Valves not glowing.	No continuity at plug terminals.	Faulty On Off Switch Filament resistor R[1] open circuited Open heater of any tube. Dial lamp and shunt resistor open circuited. Open main's cord. Break in the wiring of heater circuit.
Valves glowing.	Zero anode voltage	Plate resistor of 100 ohm is open circuited. Anode bypass capaitor shorted.
—do—	No voltage at cathode.	Valve's emission loss. Filtering capacitor at cathode terminal is short circuited

Defect	Meter indication	Possible ' uses
Valves glowing.	No DC voltage at H. T. terminal.	. Filtering choke open circuited. Shorted smoo:hing capacitor.
Hum noise.	Low H.T. Voltage.	Open reservoir capacitor. Leaky filtering capacitor.
Modulation hum.	Voltage normal.	Anode bypass capacitor 0 05 Mfd is open circuited.
Weak reception.	Low voltage at cathode terminal.	Valve weak cr Emi,sion Low.

Summary—

Quick check—1. All tubes glowing at normal brightness. 2. No motorboating or Sqealing noise. 3. No hum noise.

Specifications—Anode Voltage=220 Volts A/C. Cathode Voltage=220 Volts DC.

Resistance check—Cathode to chassis=50 K Ω to 1 M Ω.

65. Servicing Chart of Fullwave Rectifier.

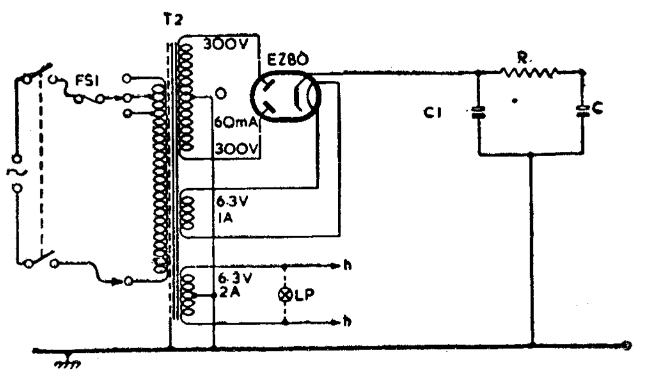


Fig. 62—Circuit Diagram of Rectifer Stage of A/C Radio

Defects	Meter indications	Possible causes
1. Valves not glowing	No continuity at plug terminals.	Defective On/Off Switch. Primary winding of power transformer T^2 open circuited. Break in main's cord. Open fuse any, Mains wire open at plug terminal. Valve's emission loss.
2. Valves glowing.	No high tension voltage.	Shorted reservoir capacitor C^7 of cathode terminal. Open filter chocke. Valve's emmission loss.
3. Weak reception	Low H. T. voltage.	Valve's weak or low emission
4. Plate glowing red.	Zero resistance between cathode and chassis.	Shorted reservoir capacitor C^7
5. Purplish glow	Voltage normal.	Gassy rectifier valve.
6. Hum noise.	Low cathode voltage.	Open or leak filtering capacitor C^6.
7. Modulation hum.	Voltage normal.	Open line filter capacitor in the primary winding of the power transformer if used.

Summary—

Quick check-1, All valves are glowing at normal brightness 2 No hum noise. 3. No smell of over heating the power transfoɹwer. 4. H. T. Voltage 250 Volts D/C.

Voltage and Resistance Specifications—

Resistance between the plug terminals=30 to 50 ohms.

Resistance between anode to chassis=200 to 250 ohms.

Resistance between cathode to chassis=100 K Ω or above.

Anodes voltage=250 to 300 A/C Volts. Cathode voltage=250 to 300 D/C volts.

66. Servicing Chart of Power Amplifiers Stage.

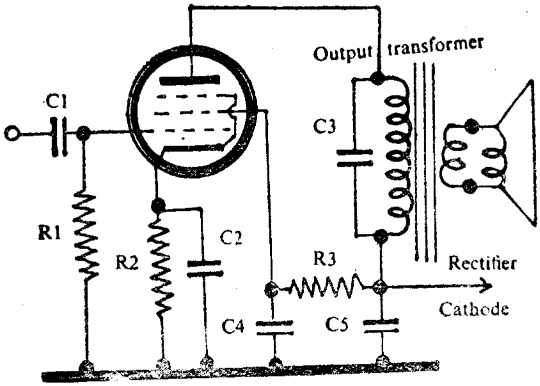


Fig. 63—Power Amplifier Stage used in AC or AC/DC Radio.

Defect	Meter indications	Possible causes
1. No sound	Voltage normal.	Open voice coil of the speaker.
2. —do—	Zero anode volage.	Open primary winding of L. F. output transformer. Shorted C^3.
3. Screen grid showin red.	—do—	Open pri-winding of L. F. output transformer.
4. No Signal.	Voltage slightly high	Valve's emission loss. Cathode resistor R^2 open circuited.
5 Weak reception.	Low voltage across cathode resistor.	Valve weak. Capacitor C^2 short circuited. Leaky coupling capacitor C^1.
6. Distorted signal.	Low anode voltage.	Open circuited grid leak resitor R^1. Valve defective.
7. Motor boating.	Voltage normal.	Open grid resistor R^1.
8. Poor Signal Quality.	—do—	L.F. output transformer is not properly match with the anode impedence of power amplifier. Tone capacitor C^3 open circuited.

Summary—

Normal operation—Touch the plugged in soldering iron to the control grid of this valve a low note will be heard in the speaker, or apply a audio signal from the signal generator to the control-grid and if a 400 cycle note is heard in the speaker the stage is functioning.

Specification :—Anode voltage=200 Volts. Screen grid=175 Volts, Control grid=7·5 Volts.

Parts list :—Valve UL84. L. F. Transformer for UL84. R^1=0·47 M Ω R^2=150Ω R^3=0·5M Ω tone control. C^1=0·01Mfd. C^2=25Mfd, 25 Volts. C^5=0·005 Mfd.

67. *Servicing Chart of Detector & L.F. Amplifier Stage.*

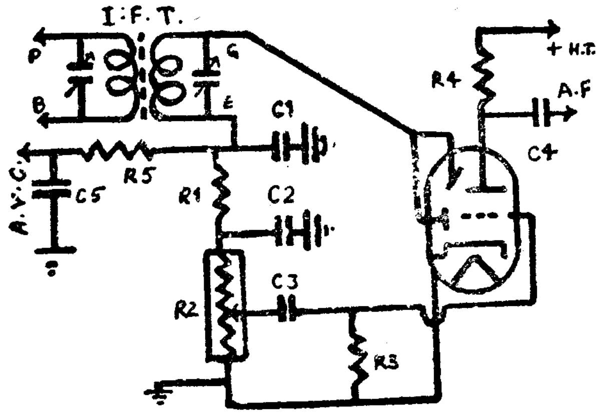


Fig. 64—Circuit Diagram of 2nd Detector & L. F. Amplifier Stage

Defect	Meter indications	Possible causes
1. No grid response.	No voltage on triode anode.	Open circuited anode resistor R^4. Anode short circuited to chassis. Open anode decoupling resistor if used.
2. No signal.	Too high anode voltage.	Tube Emission loss. Cathode open circuited.
3. Weak response at the grid.	High anode voltage	Valve weak, or Low emission.

Defects	Meter Indications	Possible Causes
4. Noisy reception.	Unsteady anode current.	Volume control scrachy. Loose components in this stage. Dry joints
5. Distortion.	Plate voltage normal	Coupling capacitor C^3 or C^4 leaky
6. Motor boating.	do	Open grid leak resistor R^3
Hum noise.	do	Valve defective. Control grid wire not shielded.
8. Intermittent reception.	do	Defective volume-control. C^3 and C^4 intermittently open. Loose joint in the stage.

Summary—

Normal operation—By touching the screw-driver to the control grid a gnarling sound will be heard in the speaker. Or Apply an audio frequency signal from the signal generator to the control grid, a 400 cycle note heard will be in the loud-speaker. For testing the detector section, apply a modulated. I. F. Singal to diode anode of this valve if a 400 cycle note is heard in the speaker. the diode portion is also functiouing.

Specifications—Anode Voltage=75 to 100 Volts. Resistance between diode anode and chassis=0·5 meg ohm.

Part List—Valve UBC 81. Output I. F. T. Volume control=0·5 MΩ. R^1= 47KΩ. R^3=10MΩ. R^4=200KΩ. R^5=1MΩ. C^1 and C^2=100Pfd. C^3 and C^4= 0·005 Mfd. C^5=0·05 Mfd.

Servicing Chart of I. F. Amplifier Stage

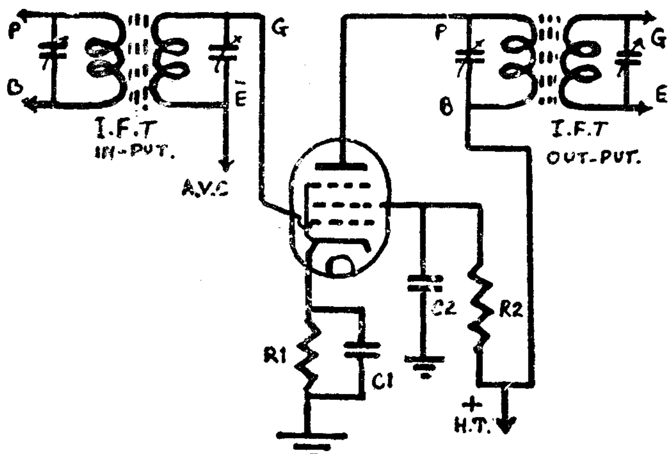


Fig. 65—Circuit Digram of Amplifier Stage used in AC or AC/DC Radio.

Defect	Meter indications	Possible causes
1. No grid response.	Zero anode voltage.	Break in the primary winding of I. F. out-put transformer. Open decoupling resistor in the anode circuit if used. Shorted anode lead to chassis through the shield of I.F.T. Open cathode resistor R^1.
2. —do—	No voltage across cathcde resistor.	Defective I.F. tube.
. —do—	Voltage normal.	Open secondary winding of input I.F. transformer. Shorted trimmer of I-F.T.
4. Noisy reception.	—do—	Partiaı break due to corrosion in the winding of I.F.T. Loose shield. Dry joints in this stage.
5. Wcak eeception.	—do—	Weak I.F. amplifier valve. Open cathode by-pass capacitor C^1 Open a.v.c Filtering capacitor. I.F. transfoːmers are not properly aligned.

Summary—

Normal operation—By touching the control grid of this stage with a screw driver causing a growling noise to be heard in the speaker. Or. Apply a modulated intermediate frequency signal from the signal generator to the control grid of this valve, a 400 cycle note will be heard in the speaker.

Parts list—Valve UF89. Pair of I.F. transformer. $R^1=300\ \Omega$. $R^2=22K\Omega$ $C^4=0{\cdot}1$ Mfd. $C^2={\cdot}05$ Mfd.

69. Servicing Chart of Converter Stage.

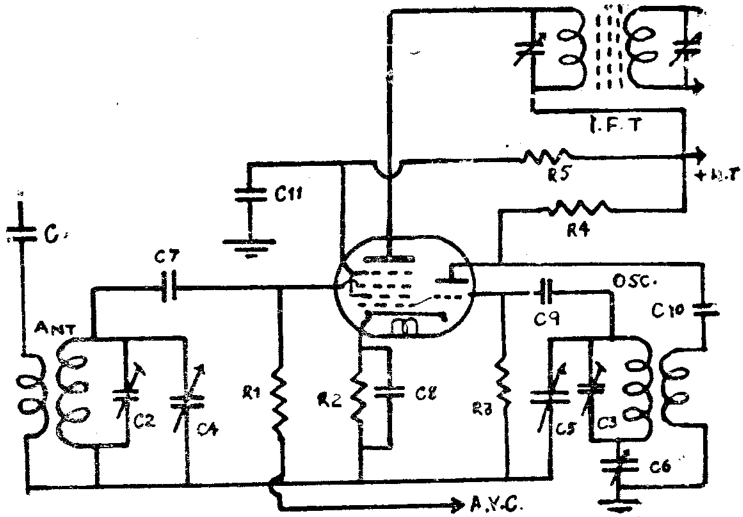


Fig. 66—Circuit Diagram of Converter Stage using 6K8.

Defect	Meter indication	Possible causes
1. No recption.	No voltage on triode ancde	Open anode resistor R^4. Valve defective.
2. —	Normal anode voltage.	Open secondary winding of oscillator coil. Shorted trimmer C^3. Shorted gang Osc. section C^5, Open padder condenser C^6. Leaky capacitor C^9. Open Capacitor C^9. Resistor R^3 too low.
3. —do—	No voltage on hexode anode.	Open primary winding of input I.F.T. Valve's emission loss. Open resistor R^2. Shorted trimmer across the winding of I.F, transformer. Open resistor R^5. Shorted capacitor C^{11}.
4. Weak reception.	Voltage normal.	Valve weak. Poor alignment.
5. No reception on lower end.	—do—	Converter tube defective. Shorted plates of Osc. section of gang capacitor C^5 when capacity increases.
6. Noisy reception.	—do—	Dust in the gang capacitor. Defective converter tube. Corrosion in the Ant. or Osc. coil. Poor wiping contacts on the gang capacitor.
7. One station on the whole band.	—do—	Gang capacitor threading broken but the needle threading on the dial is OK. I.F. transformer tuned to wrong frequency.

70. Servicing Chart of R F Amplifier Stage.

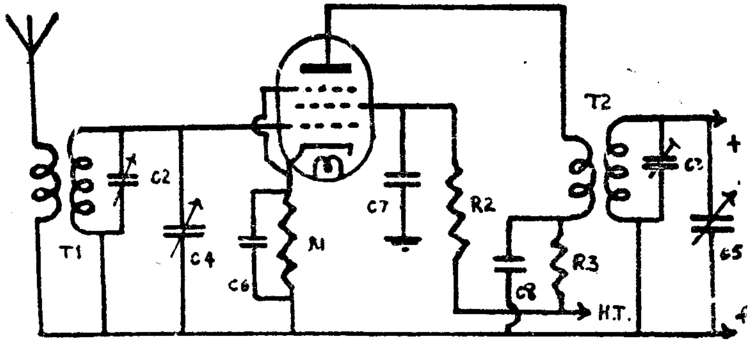


Fig. 6 —Circuit Diagram of Tuned R. F. Stage in AC or AC/DC Radio.

Defects	Meter Indication	Possible Causes
1. No grid response.	No anode voltage.	Open primary winding of T^2.Open resistor R^3. Shorted capacitor C^8
2. —do—	No Screen grid voltage.	Open resistor R^2 or shorted C^7.
3. —do—	Voltage normal.	Valve's emission loss or open R^1
4, Weak reception.	—do—	Valve weak. T^1 and T^2 are not properly aligned. Open capacitor C^8.
5. Noisy reception.	All voltage O. K.	Corrosion in T^1 or T^2. Valve or Trimmer defective Gang C^2, C^5 poor Joints.

Summary—

Normal Operation—By touching the control grid of thls stage a loud click is heard in the speaker. Apply 1000 Kc/s modulated signal to the control grid and tune the receiver at this frequency if the 400 cycles note is heard in the speaker, the stage is functioning normal.

Specifications—Anode voltage 200 volts, Screen grid voltage 100 volts, Control grid voltage—3 volts.

Parts List—R^1=300 Ω C^2, C^3, =70 Pfd. Trimmer T^1=Ant. Coil,
R^2=47 K Ω C^4. C^5, =500 Pfd. Gang T^2=R.F.T.
R^3=10K Ω C^6, C^7, C^8 =0.05 Mfd. V=UF89

71. Servicing Chart of Tuning Indicator Stage.

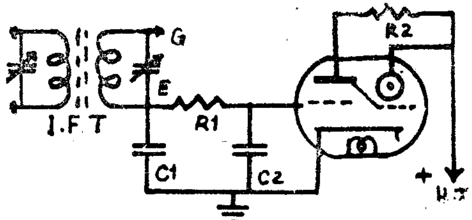


Fig. 68—Circuit diagram of tuning indicator stage

Defects	Meter indications	Possible causes
Lack of brilliance	Plate voltage normal.	Valve's emission low. Low heater voltage.
No indication.	Zero anode voltage.	Anode resistor R^2 open circuited. No a.v.c. voltage on the grid.
No green light	Plate voltage normal.	Voltages missing on the target anode.
Light portion overlaps.	Voltage normal.	To high a. v. c. voltage. Defective a v.c. voltage divider.

General Description—This tuning indicator valve consists of triode in addition to it has a ray controller which is externally connected to anode. There is one target anode which is covered with a substance that become fluorescent when bombarded by the electrons, which is directly connected to high positive potential. As the signal is tuned in the a. v. c. voltage increase on the grid which decreases the anode current. Now voltage drop across the anode resistor R^2 is less, so the ray controller is now less negative in respect to the target anode allows the more electrons to reach a greater area on the target which reduces the dark area to a thin line.

Specifications—Anode Voltage=180 Volts Target anode=200 Volts.

Resistance between anode and target anode=500K Ω.

Parts Lists—Output I.F. Transformer. Valve UM 84. R^1=1M Ω. R^2=0·5M Ω C^1=100 Pfd. C^2=0·05Mfd.

SECTION E | *For Radio Beginners*

2. *Symbols in Radio & Transistor Circuit Diagrams.*

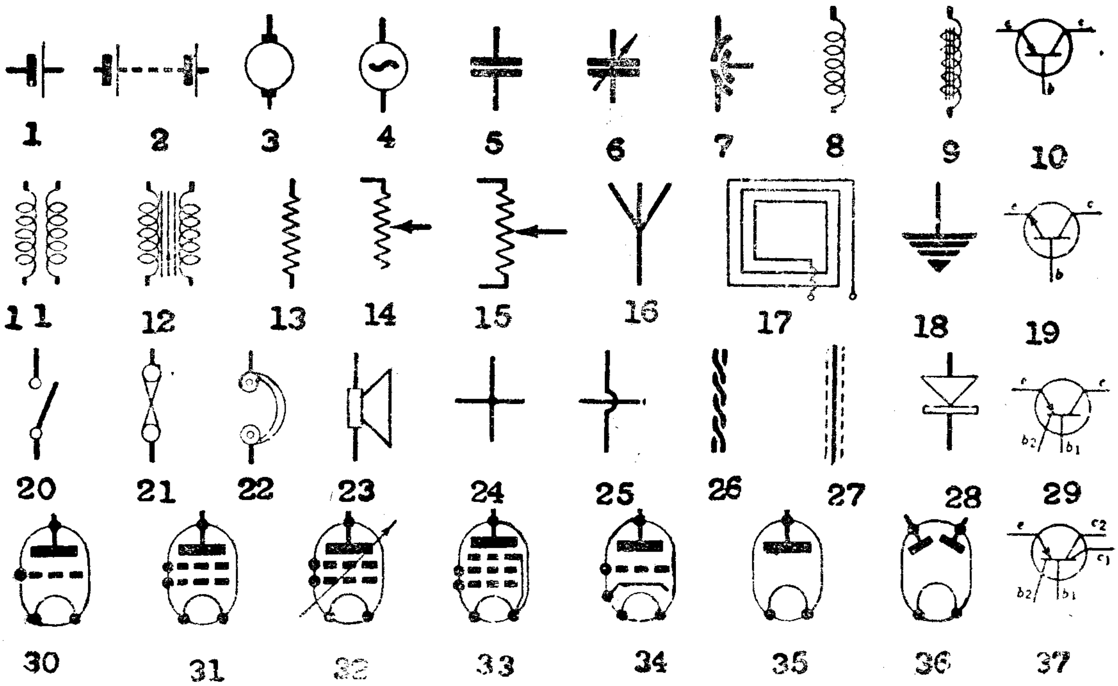


Fig 69—Symbols of Components used in Radio-Transistors.

1. Single Cell
2. Battery
3. D. C. Generator
4. A. C. Generator
5. Capacitor (fixed)
6. Capacitor (Vari)
7. Condenser (Double)
8. Inductance Coil
9. Iron core Inductor

10 P.N.P. Transistor
11. R.F. transformer
12. L.F. transformer
13. Resistor
14. Resistor (vari)
15. Potentiometer
16. Aerial
17. Frame Aerial
18. Earth connection
19. N.P.N. Transistor
20. On/Off Switch
21. Fuse wire
22. Head Phone
23. Loudspeaker
24. Wire joined
25. Wire Crossing
26. Flexible wire
27. Screened wire
28. P.N. Junction diode
29. Tetrode Transistor
30. Triode valve
31. Tetrode valve
32. Tetrode (variable)
33. Pentode valve
34. Triode-indirect heated
35. Diode valve
36. Double diode valve
37. Transistor-Pentode.

73. *Tools & Test equipments,*

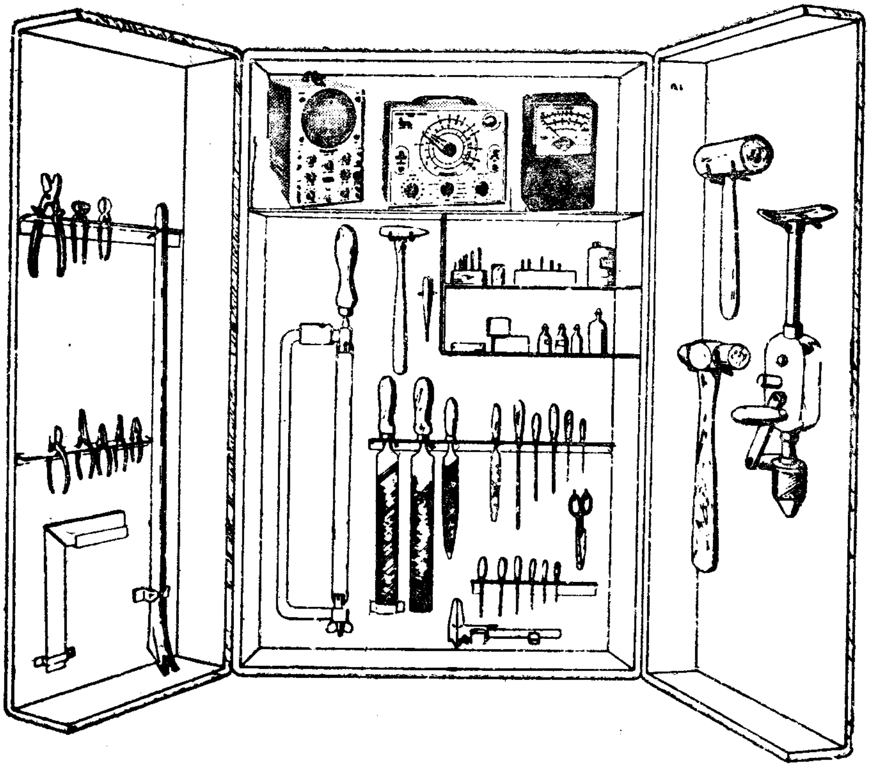


Fig. 70—Tools & Meters for Repairing Radio and Transistors.

At the time of radio assembling and repairing the following tools and test equipments are quite necessary. Keep all the tools in the proper manner as shown in the picture.

1. Solder Iron
2. Side cutter
3. Long Nose plier
4. Combination plier
5. Small Screw driver
6. Long Screw driver
7. Tweezer
8. Trimming Screw driver
9. Brush for cleaning
10. Flat file
11. Round file
12. Hammer
13. Hand drill
14. Twist drill
15, Bench vice
16. Scriber
17. Tin smith shears
18. Knife
19. Hand-saw
20. Hack-saw
21. Adjustable Rench

Test Equipments—

1 Universal Multimeter
2. Signal Generator
3. Neon Tester
2. Transistor Tester
5. Valve Tester
6. Output Meter
7. Signal Injector
8. Signal Tracer
9. Oscilloscope

74. *Workshop Service Board*

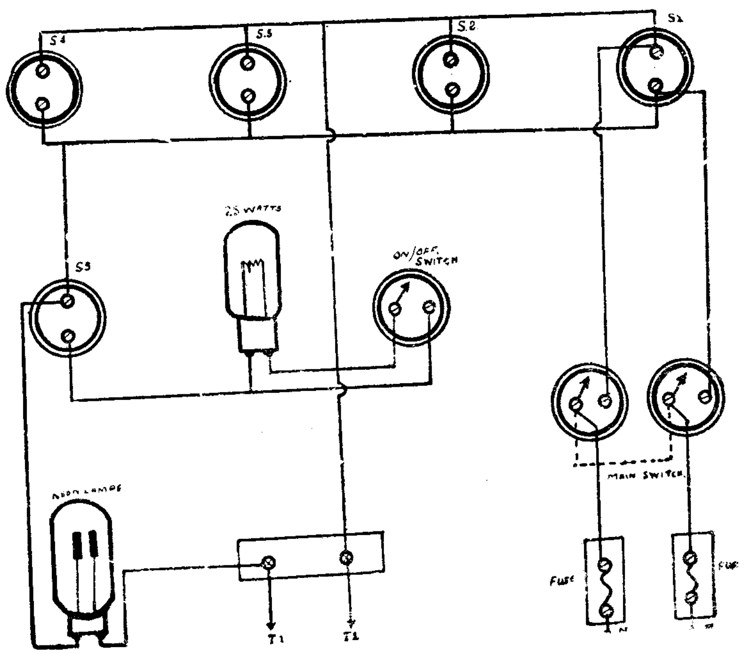


Fig. 71—Testing Board for Servicing.

Parts List—

1.	Sockets two Pins.	=5	2.	On/Off Switch	=1
3.	Main Switch	=1	4,	Electric Bulb 25 watt	=1
5.	Neon lamp 250 V	=1	6.	Fuses	=2
7.	Wooden Board	=1	8.	Testing Sockets	=2
9.	Testing Prods	=2			

For testing a radio put the plug in to the testing socket S5 and see the blub which is connected in series with this socket.

Any short that is present in a radio will cause thc blub to glow brightly. then switch off the set and test the mains circuit of the radio with the help of ohm-meter.

A good radio receiver will cause the lamp to glow dimly. Now switch on the on/off switch and the set will get the full supply voltage.

Neon Tester

Check the circuit and components with neon tester. It is cheapest test equipment for testing the continuity of coils, chokes etc.

For continuity test connect the component across the testing prods, if the neon lamp glows then the component is in order.

The neon bulb will hot glow at the time of break in the wire.

Radio technician should have a service board in his workshop for testing and assembling the receivers.

Hecta (h) $=10^2$ Mega(M) $=10^6$ Tera(T) $=10^{12}$

Femto (f) $=\frac{1}{10^{15}}$

Nano (n) $=\frac{1}{10^9}$

Milli (m) $=\frac{1}{10^3}$

Deci (d) $=\frac{1}{10^1}$

Pica $=\frac{1}{10^9}$

Micro(u) $=\frac{1}{10^6}$

Centi(C) $=\frac{1}{10^2}$

Deka (D) $=10^1$

Kilo (K) $=10^3$

Giga (G) $=10^9$

76. *General Abbreviations in Electronics.*

VF	=Filament volts.
IF	=Filament current in ampere
VA	=Anode voltage.
VSc	=Screen grid volts.
VG	=Negative grid Volts.
IP	=Plate current in ma.
ISc	=Screen grid current in ma.
Ac/R	=AC Plate resistance
Mu	=Amplification factor.
Gm	=Mutual conductance in ma/V.
Rk	=Cathode resistor.
GT	=Triode grid.
TC	=Top cap.
A	=Anode.
K	=Cathode.
DA	=Diode anode.
G.	=Grid.
H	=Heater.
F	=Filament.
HCt	=Heater centre tap.
M	=Metal shield.
OA	=Oscillator anode.
OG	=Oscillator grid.
SG	=Screen grid.
T	=Target in magic eye valve.
TA	=Target anode.
At	=Triode anode.
G^1	=Control grid.
G^2	=Screen grid.
G^3	=Suppressor grid.
NC	=No connection.
IC	=Internal connection.
BC	=Base connection
FM	=Filament middle.
HL	=Heater tap for dial lamp.
HM	=Heater middle tap
IS	=Internal shield.
RC	=Rap controller.
S	=Shell.
Pd	=Diode plate.
Pt	=Triode plate.
Pp	=Pentode plate.
PHex	=Hexode plate.
C	=Collector.
B	=Base.
E	=Emitter.
A	=Alpha.
B	=Beta.
VC	=Collector voltage.
Ic	=Collector current.
Ico	=Collector leakage current.
Vbe	=Base emitter voltage.

77. *English Valve Numbering Code.*

First Letter	2nd Letter	3rd Letter	First Number
A=4 volts	A=R.F. Single diode	—	1=Side contact Base
B=180 volts	B=R.F. Double diode	—	2=Loctal Base
C=200 ma	C=Triode	C=Triode	3=Octal
D=1·4 Volts	E=Tetrode	—	4=Rim Lock Base
E=6·3 ,,	F=Pentode		8=Noval Base
F=13 ,,	H=Hexode or Heptode	F=Pentode	9=Miniature 7 Pins Base.
G=5 volt	K=Octode		
H=150 ma	L=Power Pentode		
K=2 volt	M=Tuning indicator		
O=Semi-Conductor			
P=300 ma			
U=100 ma			
V=50 ma			
X=600 ma			
Z=Cold cathode			

For example—ECH81→E=6·3V.	C=Triode, H=Heptode,	8=Noval	Base
EF89 →E=6·3V.	F=Pentode	8= ,,	,,
EBC81→E=6·3V.	B=D. Doide C=Triode	8= ,,	,,
EL84 →E=6·3V.	L=Power Pentode	8= ,,	,,
EZ80 →E=6·3V.	Z=Double Diode	8= ,,	,,
UY85 →U=·1 Amp.	Y=Single Diode	8= ,,	,,
UM84→U=·1 Amp.	M=Magic Eye valve	8= ,,	,,

78. *How to Solder.*

There are Four essentials points to be remembered for successful soldering.

(a) **Cleanliness**—Be sure that tne surfaces to be soldered are perfectly cleaned. Scrap the surface with a knife. blade or sand-paper whsch ever possible.

(b) **Flux**—Use a resin flux an acid flux may corrodes the wires. After soldering wipe off any excess flux.

(c) **Heat**—Heat the surface to be soldered until the solder flows over there. If possible keep the hot iron on the joint even after the solder has flowed so as to sure there is enough heat. For ordinary radio work 35 to 65 watt soldering iron is quite suitable. Keep the soldering iron bit clean by removing any oxide that may form on it.

(d) Use resin-cored which quickly melts at low temperature.

79. *Radio Waves.*

Radio wave consists of electrostatic and magnetic lines of force. Each cycle of current in a transmitter sends out one radio wave. These waves travel at the rate of 186000 miles or 3×10^{8} meters per second. Cycles are now called hertz abberivated HZ.

The relationship between wave-length, frequency and velocity of radio waves can be expressed by the following formulas.

$$\text{Wave length in meters} = \frac{\text{Velocity in metres}}{\text{Frequency in cycles}}$$

If the frequency of radio station is 1000 Kc/s then what will be the wave-length in metres.

$$\text{Wave length in metres} = \frac{300000000}{1000 \times 1000} = 300 \text{ metres.}$$

$$\text{Frequency in cycles} = \frac{\text{Velocity in metres}}{\text{Waves length in metres}}$$

Find the frequency of Delhi Radio Station having the wave-length of 370·4 metres ?

$$\text{Frequency in cycle} = \frac{300000000}{370 \cdot 4} = 810 \text{ Kc/s.}$$

Radio Communication Range=500 Kc/s. to 22 Mc/s.

1. Medimum Wave Band =500 Kc/s. to 1600 Kc/s.
2. Short Wave Band I =2·5 Mc/s. to 7·5 Mc/s.
3. Short Wave and II =7·5 Mc/s. to 22 Mc/s.

80. *Frequency & Metres of All India Rodio Stations.*

Station	Frequency Kc/s.	Metres
Ahamedabad	850	352·7
Ajmer	600	500·0
Allahabad A	760	394·7
,, B	980	306·1
Panglore A	610	491·8
Bombay A	1040	288·5
,, B	550	545·5
,, C	1230	243.9
Bikaner	1330	225·6
Calcutta A	670	447·8
,, B	1000	300.0
,, C	1540	194·8
Chandigarh	1220	245 9
Cuttack A	960	310.9
,, B	1350	222·2
Dharwar	1360	220·6
Delhi A	810	370 4
,, B	1020	294·1
,, C	1370	219·0
Gauhati	370	411·0
Gwalior	1390	215·8
Hydrabad A	740	405·4
,, B	1380	217·4
Indore A	650	461·8
,, B	1590	188·7
Jaipur A	1120	267·9
,, B	1290	232·6
Jammu	1090	303·0
Jullundar	890	337·1
Kanpur	1440	208·3
Lucknow A	760	394 7
,, B	1320	227.3
Madras A	720	416·3
,, B	1420	211·3
,, C	1550	193·5
Mathura	1530	196·1
Nagpur A	590	508·5
Poona A	780	384·6
,, B	970	309.3
Patna A	620	483.9
,, B	1500	900.0
Rajkot A	910	329.7
,, B	1420	211·3
Rampur	9020	293·1
Ranchi	560	535.7
Srinagar	1120	267·9

Radio Cylon

25 ,, or 11800 ,,
41 ,, or 7190 ,,

Vividh Bharti

41·32 Metres or 7260 Kc/s.
25.36 ,, or 11830 ,,
31.55 ,, or 9510 ,,

Delhi Television

Vision—62·25 Mc/s.

Sound—67·75 Mc/s.

81. Resistor Color Code Chart

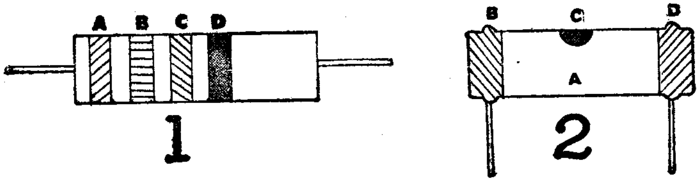


Fig. 72—New and Old Type of Carbon Resistors

Color	A	B	C	D
Color 1 ,, 2	1st ring Body color	2nd ring Tip color	3rd ring—(Multiplier) Dot color	4th ring Side dot color
Black	—	0	1.0	— +
Brown	1	1	10	1% ,,
Red	2	2	100	2% ,,
Orange	3	3	1,000	3% ,,
Yellow	4	4	10,000	4% ,,
Green	5	5	100,000	5% ,,
Blue	6	6	1,000,000	6% ,,
Violet	7	7	10,000,000	7% ,,
Gray	8	8	100,000,000	8% ,,
White	9	9	1,000,000,000	9% ,,
Gold	—	—	0·1	5% ,,
Silver	—	—	0.01	10% ,,
No Color	—	—	—	20% ,,

1. First ring or body color indicates first significant figure of resistance in ohms.
2. Second ring or Tip color indicates second significant figure.
3. Third ring or centre Dot color indicates decimal multiplier.
4. Fourth ring or side Dot color indicates tolerance in per cent. If no color appears in this position, tolerance is 20%+.

For example colors of the resistor :-A=Red. B=green. C=orange. D=silver.
2 5 000 10%

Resistance in ohm=25000Ω 10%.

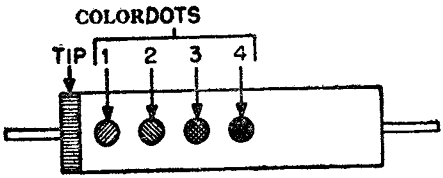


Fig. 73—Color dots on-Ceramic Capacitor.

Color	Tip	1st. Dot	2nd Dot	3rd Dot	4tb Dot
	Temperature Coefficient	1st Digit	2nd Digit	Decimal multiplier	Tolerance
Black	0	0	0	1	—
Brown	·00003 Neg	1	1	10	1%
Red	·00008 ,,	2	2	100	2%
Orange	·00016 ,,	3	3	1,000	3%
Yellow	·00023 ,,	4	4	10,000	4%
Green	00034 ,,	5	5	100,000	5%
Blue	·00048 ,,	6	6	1,000,000	6%
Voilet	·000076 ,,	7	7	10,000,000	7%
Grey	—	8	8	0·1	8%
White		9	9	0·01	9%

Temperature Coefficient—The fractional change in the resistivity of a material per degree change in temperature. It is postive for most metals and negative for many semi-conductors and non metals.

Tip color indicates the temperature coefficient of the capacitor. First dot indicates the first figure. Second dot indicates the second figure. Third dot indicates the number of zero to be added to first two figures. 4th dot indicates the tolerence in percent.

For example color dots of condenser Tip=orange. 1st dot=Green.

2nd dot=Black. 2rd dot=Red. 4th dot=White.

Capacity of this condenser=5000 Pica farad and Tolerence 10%.

83. *Capacitors SiX Dots Color Code Chart.*

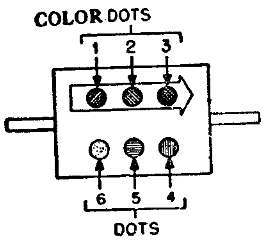


Fig. 74—Color Dots on Mica Capacitor.

Color	1st. Dot	2nd Dot	3rd Dot	4rd Dot	5th Dot	6th Dot
	1st Digit	2nd Digit	3rd Digit	Decimal multiplier	Toler-ance	Voltage
Black	0	0	0	1	—	...
Brown	1	1	1	10	1%	100v.
Red	2	2	2	100	2%	200v.
Orange	3	3	3	1,000	3%	300v.
Yellow	4	4	4	10,000	4%	400v.
Green	5	5	5	100,000	5%	500v.

Blue	6	6	6	1,000,000	6%	600v.
Violet	7	7	7	10,000,000	7%	700v.
Grey	8	8	8	100,000,000	8%	800v.
White	9	9	9	1,000,000,000	9%	900v.
Gold	...	...	...	0·1	5%	1,000v.
Silver	...	...	...	0·01	10%	2,000v.
No color	...	...	...	...	10%	500v.

Condensers are color coded by six dots. The 1st dot on the left indicates the first figure. 2nd dot indicates second figure. 3rd dot indicates third figure. 4th dot indicates the number of zeros to be added to the first three figure. The capacity is then indicated in microm, icro-farad. 5th dot indicates tolerence in percent and six dot indicates working voltage of the condenser.

84. *International Electrical Units.*

1. Ampere—Unit of current.

That current is one ampere which passed through a solution of silver nitrate in water in accordance with certain specifications deposits silver on the other electrode at the rate of 0·001118 gram per second. This is defined in terms of the chemical effect of electric current. Current penoted by the letter I.

Relationship between smaller units, 1000 micro-amp.=1 milli-ampere 1000 milli-amp.=1 Ampere.

2. Ohm—Unit of resistance.

The resistance of column of mercury at a zero degree and having a cross section of one square millimetre and a length of 106·3 centimetre is one ohm.

1000000 micro ohm=1 ohm. 1000 ohms=1 Kilo ohm.

1000 KΩ=1 Meg-ohm. Symbol of ohm=Ω

3. Volt—Unit of electro motive force.

That e.m.f. is one volt which produces a current of one ampere when applied to a resistor having a resistance of one ohm.

1000 micro volt=1 milli volt. 1000 milli volt=1 Volt. 1000 Volts=1 Kilo volt.

4. Couiomb—Unit of Quantity of electricity.

The charge of $6{\cdot}28 \times 10^{18}$ electrons is called one coulomb.

5. Fad—Unit of capacity.

That condenser has a capacity of one farad in which a potential difference of one volt causes it to have a charge of one coulomb of electricity.

1000000 micro farad=1 mfd. 1000000 mfd=1Farad.

Note—Pica farad is the new name of micro micro farad.

6. Henry—Unit of inductance,

The coil or inductor has a inductance of one henry in which one volt is induced by varying the current at the rate of one ampere per second.

1000 micro henry=1 milli henry and 1000 milli henry=1 henry.

7. Watt—Unit of Electrical Power.

The power is the rate of transfer of energy. Its unit is watt. The power Consumed by a current of one ampere in a resistance of one ohm is one watt.

1000 micro watt=1 milli watt.

746 watt=1 Horse power, 1000 watt=1 K. watt,

8. Metre—Unit of wave length.

1 metre=39·36 inches. 1000 Metre=1 km. and 1 km=0·6216 miles.

9. Frequency—Number of cycle per second.

1000 Cycle=1 Kilo cycle. 1000 Kilo cycle=1 Mega cycle.

10. Ampere-hour—Unit of quantity of electricity.

This is another unit of quantity of electricity is addition to the coulomb.

The ampere-hours, is that quantity of electricity transfered by a current of one ampere is hour and it is therefore equal to 1x60x60=3600 Joule.

11. Erg—Unit of energy the work done by the force of one dyne in moving its point of application through one centimetre.

85. *Electronic's Laws*

1. Law of Magnetism

(i) Like poles of the magnets repel each other.

(A) Two North poles repel each other. (B) Two south poles repel each other.

(ii) Unlike poles of the magnet attract each other.

A North pole attracts a South pole.

2. Laws of Electricity

(i) Like charges of elelectricity repel each other.

Two protons repel each other. Two electrons repel each other.

(ii) Unlike changes of clectricity attract each other.

A proton attracts an electron. An electron attracts proton.

3. Ohm's law

The current in an electric circuit is directly proportional to the electromotive force in the circuit, and inversely proportional to the resistance of the ciruit.

Mathematical forms of Ohm's law, (i) $I=\frac{E}{R}$ (ii) E=I.R. and (iii) $R=\frac{E}{1}$

Where I in ampere, E in volt. and R in Ohm.