RADIO - TELEVISION

Practical Training

NATIONAL SCHOOLS

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J. A. ROSENKRANZ, *Pres.*

Television

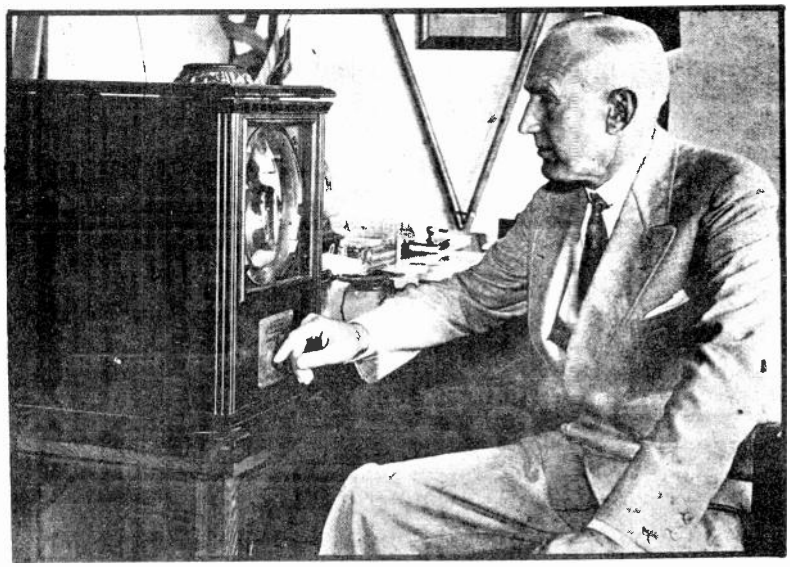
LESSON NO. 1

THE ESSENTIALS OF TELEVISION

YOU HAVE ALREADY WITNESSED THE WONDERS, WHICH HAVE BEEN ACCOMPLISHED IN THE TRANSMISSION AND RECEPTION OF SOUND BY RADIO AND ALTHOUGH THIS IS A MARVELOUS ACHIEVEMENT OF MODERN SCIENCE, YET STILL GREATER RADIO WONDERS AWAIT US IN THE VERY NEAR FUTURE. THE AMBITION OF SCIENTISTS AND ENGINEERS HAS ALWAYS BEEN TO GO A BIG STEP FARTHER, SO THAT THEY WOULD EVENTUALLY BE ABLE TO NOT ONLY TRANSMIT SOUND BUT TO TRANSMIT IMAGES OR SCENES AS WELL. IN OTHER WORDS, THEIR DESIRE HAS ALWAYS BEEN TO ENABLE THE ARDENT RADIO LISTENER TO SEE THE PERFORMING ARTISTS, AS WELL AS TO HEAR THEM.

THE ART OF TRANSMITTING AND RECEIVING IMAGES BY RADIO HAS ALREADY BECOME A REALIZATION AND WE CALL THIS NEW BRANCH OF RADIO "TELEVISION" IT IS TRUE THAT TELEVISION IS STILL IN ITS EARLY STAGES OF DEVELOPEMENT BUT REMARKABLE PROGRESS HAS BEEN MADE IN THIS NEW FIELD WITHIN THE LAST FEW YEARS.

A NUMBER OF TELEVISION BROADCASTING STATIONS ARE ALREADY OPERATING ON REGULAR SCHEDULE AND SEVERAL WELL KNOWN FIRMS ARE OFFERING TELEVISION RECEIVING EQUIPMENT TO THE RADIO PUBLIC. WHEN WE CONSIDER HOW QUICKLY RADIO RECEIVERS WERE DEVELOPED



NO. 1

"Tuning-In" a Television Program.

FROM THE SMALL CRYSTAL AND PHONE STAGE TO THE ULTRA MODERN ALL-WAVE SUPERHETERODYNES WITH DYNAMIC SPEAKER, WE CANNOT HELP BUT EXPECT A BRILLIANT FUTURE FOR RADIOS' PARTNER, TELEVISION.

ENGINEERS, TODAY, HAVE A MUCH MORE THOROUGH UNDERSTANDING OF COMPLICATED RADIO PRINCIPLES THAN WAS POSSESSED BY THE EARLY EXPERIMENTERS. YEARS OF DEVELOPMENT HAVE OF COURSE MADE THIS POSSIBLE AND ALL OF THE PRESENT DAY KNOWLEDGE OF RADIO IS EQUALLY APPLICABLE TO TELEVISION. THIS NATURALLY MEANS THAT TELEVISION IS AT AN ADVANTAGE, FOR ALL OF THIS ADVANCED KNOWLEDGE IS ALREADY AVAILABLE, SO THAT IT CAN BE APPLIED TO TELEVISION RESEARCH AND DEVELOPMENT.

THE RELATION BETWEEN RADIO AND TELEVISION

AS YOU PROGRESS WITH YOUR TELEVISION STUDIES, YOU WILL BE IMPRESSED WITH THE FACT OF THE CLOSE RELATION BETWEEN TELEVISION PRINCIPLES AND RADIO PRINCIPLES. THE TRUTH OF THE MATTER IS THAT YOU HAVE ALREADY MASTERED THE MOST DIFFICULT PART OF TELEVISION IN THAT IN THIS SCIENCE WE USE EVERYTHING WHICH YOU HAVE SO FAR LEARNED CONCERNING RADIO THEORY

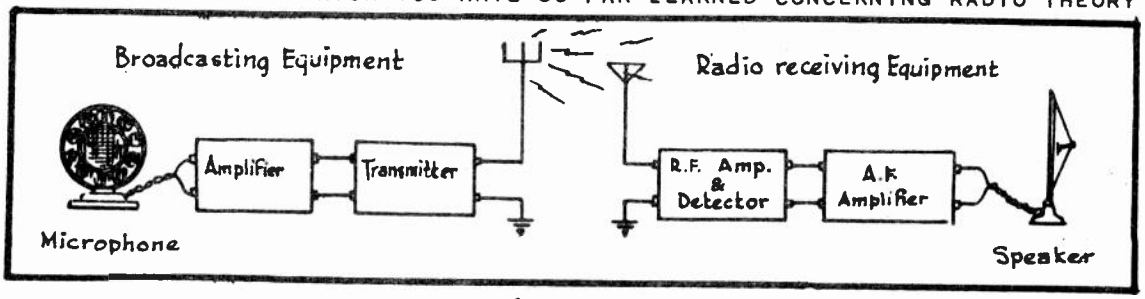


FIG. 2

General Lay-out of Sound Broadcasting and Receiving Equipment.

IN GENERAL, RECEIVERS, R.F. AND A.F. AMPLIFIERS, TUNING CIRCUITS, DETECTORS, POWER SUPPLIES, TRANSMITTERS, ETC. IN OTHER WORDS, ALL OF YOUR STUDIES UP TO THIS POINT HAVE BEEN JUST AS MUCH A PART OF YOUR TELEVISION INSTRUCTION AS ARE THIS SPECIAL SERIES OF TELEVISION LESSONS.

THIS MEANS THAT YOU DO NOT HAVE A GREAT DEAL MORE TO LEARN CONCERNING TELEVISION AND THE SOLE PURPOSE OF THIS SPECIAL LESSON SERIES IS TO SHOW YOU HOW TO ADAPT YOUR PRESENT KNOWLEDGE TO TELEVISION CIRCUITS IN PARTICULAR, AS WELL AS TO FAMILIARIZE YOU WITH THE VARIOUS METHODS OF CONVERTING SCENES TO ELECTRICAL IMPULSES AND CONVERTING ELECTRICAL IMPULSES INTO CORRESPONDING SCENES.

THE RELATION BETWEEN THE SOUND BROADCASTING AND TELEVISION BROADCASTING SYSTEM IS CLEARLY ILLUSTRATED IN FIGS. 2 AND 3. TURNING YOUR ATTENTION TO F.IG.2 FIRST, WHERE THE SOUND BROADCAST SYSTEM IS SHOWN, YOU WILL NOTE THAT HERE WE IMPRESS SOUND WAVES UPON THE MICROPHONE, WHICH CONVERTS THEM INTO CORRESPONDING VARIATIONS OF ELECTRIC CURRENT, AND VOLTAGE IMPULSES ARE THEN SUCCESSIVELY AMPLIFIED, USED TO MODULATE THE CARRIER FREQUENCY, AND THE MODULATED CARRIER WAVE IS THEN RADIATED FROM THE ANTENNA OF THE TRANSMITTER.

THE RECEIVER ANTENNA "PICKS-UP" THE MODULATED CARRIER WAVE AND THE RECEIVER CIRCUITS AMPLIFY IT, SEPARATE THE AUDIO COMPONENT FROM THE CARRIER FREQUENCY, AMPLIFIES THE AUDIO FREQUENCIES, AND CONVERTS THEM BACK INTO SOUND WAVES BY MEANS OF A SPEAKER. THIS IS AN OLD STORY TO YOU BY

THIS TIME BUT NOTE HOW CLOSELY IT LINKS UP WITH THE CORRESPONDING SERIES OF EVENTS AS OCCUR IN THE TELEVISION SYSTEM OF FIG.3

IN FIG.3, A PHOTO-ELECTRIC CELL REPLACES THE MICROPHONE. CHANGES IN LIGHT INTENSITY ARE IMPRESSED UPON THE PHOTO-ELECTRIC CELL, WHICH CONVERTS THESE LIGHT VARIATIONS INTO ELECTRIC CURRENT AND VOLTAGE VARIATIONS OF CORRESPONDING FREQUENCY. THESE VOLTAGE IMPULSES ARE THEN AMPLIFIED AND ARE USED TO MODULATE A CARRIER FREQUENCY IN THE TRANSMITTING EQUIPMENT AND THE RADIATED CARRIER WAVE IS THEN SENT OUT INTO SPACE, CARRYING WITH

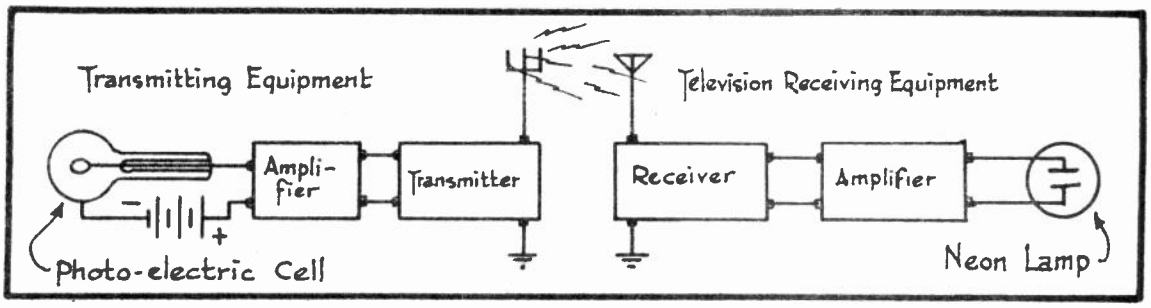


FIG. 3

General Lay-out of Television Transmitting and Receiving Equipment.

IT, THE MODULATION FREQUENCY CORRESPONDING TO THE ORIGINAL LIGHT VARIATIONS, WHICH WERE IMPRESSED UPON THE PHOTO-ELECTRIC CELL.

THE RECEIVER "PICKS-UP" THE MODULATED WAVE, AMPLIFIES IT, AND SEPARATES THE FREQUENCIES OF LIGHT VARIATION FROM THE CARRIER FREQUENCY. THE FREQUENCIES OF LIGHT VARIATION ARE THEN AMPLIFIED THE SAME AS THE A.F. CURRENTS IN THE BROADCAST RECEIVER AND THEN THEY ARE APPLIED TO A NEON LAMP. THE NEON LAMP, AS YOU WILL LEARN LATER, CONVERTS THE VOLTAGE CHANGES OF THE ORIGINAL LIGHT VARIATION BACK INTO LIGHT VARIATIONS WHICH ARE IDENTICAL TO THOSE IMPRESSED UPON THE PHOTO CELL AT THE TRANSMITTER.

OBSERVE THAT THE ONLY ESSENTIAL DIFFERENCE BETWEEN FIG.2 AND FIG.3 IS THAT IN THE TELEVISION SYSTEM, THE NEON LAMP REPLACES THE LOUD SPEAKER AND THE PHOTO ELECTRIC CELL REPLACES THE MICROPHONE. OTHERWISE, THE TWO SYSTEMS ARE PRACTICALLY THE SAME AND IN THIS WAY YOU ARE SHOWN BEFORE-HAND, THE CLOSE RESEMBLANCE BETWEEN RADIO AND TELEVISION. FROM YOUR PRESENT KNOWLEDGE OF RADIO, YOU CAN NO DOUBT ALREADY VISUALIZE THE POSSIBILITIES OF THE PRINCIPLES AS OUTLINED RELATIVE TO FIG.3.

FIG. 4

Guglielmo Marconi

SO FAR, WE HAVE GIVEN YOU A BIRD'S-EYE-VIEW OF TELEVISION, SO THAT YOU WILL HAVE SOMEWHAT OF AN IDEA OF THE COMPLETE SYSTEM, BEFORE WE GO INTO A DETAILED STUDY OF THE COMPONENT PARTS OF WHICH IT IS COMPOSED. WITH THIS COMPLETE PICTURE IN MIND, WE WILL NOW START AT THE

VERY BEGINNING WITH AN ANALYSIS OF HOW THE IMAGE TO BE TRANSMITTED IS PICKED UP BY THE PHOTO-ELECTRIC CELL AND THEN STEP BY STEP THROUGHOUT THIS LESSON AND THE LESSONS IMMEDIATELY TO FOLLOW, WE WILL COVER THE SUBJECT OF TELEVISION IN DETAIL.

SOME FUNDAMENTAL PRINCIPLES CONCERNING SIGHT

NOW WHEN WE LOOK AT A PERSON OR OBJECT, WE ARE ABLE TO DISTINGUISH FORM, SHAPE, AND COLOR DUE TO THE VARIATIONS OF DARK AND LIGHT SHADINGS OF WHICH THE IMAGE IS COMPOSED. FOR EXAMPLE, IN THE PHOTOGRAPH OF FIG. 4, WE RECOGNIZE THIS PHOTOGRAPH AS BEING THAT OF GUGLIELMO MARCONI, THE FAMOUS RADIO ENGINEER, BECAUSE THE SHADING OF THE PHOTOGRAPH OUTLINES THIS IMAGE, SO THAT THE IMPRESSION IS CARRIED TO OUR BRAIN BY WAY OF OUR EYES. SINCE WE ALREADY HAVE A MENTAL PICTURE OF MARCONI, THE PHOTOGRAPH HERE SHOWN IS A GOOD COMPARISON WITH OUR MENTAL CONCEPTION, SO THAT WE RECOGNIZE THE MAN.

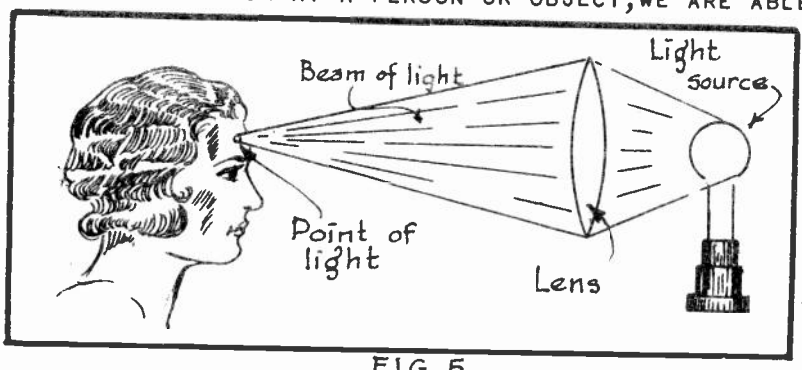


FIG. 5
Concentrating a Beam of Light Upon an Object.

SHOULD THIS SAME PICTURE BE SOLID WHITE, SOLID BLACK, OR ANY OTHER SINGLE COLOR WITHOUT ANY SHADING WHATEVER, THEN WE WOULD NOT BE ABLE TO TELL WHO THE PERSON IS. HOWEVER, UPON ANALYZING THIS PHOTOGRAPH, WE NOTE THAT THE FEATURES OF THE FACE ARE BROUGHT OUT DUE TO THE LIGHT AND DARK SHADING AND THE SAME IS TRUE WITH RESPECT TO THE COLLAR, COAT, ETC., AND THE DARK OUTLINE OF THE BODY AGAINST THE WHITE PAPER PROVIDES THE FORM OF THE IMAGE.

NOW THERE IS ANOTHER THING WHICH WE MUST CONSIDER RELATIVE TO VISION AND THAT IS THE FACT THAT WHEN THE IMAGE IS EXPOSED TO LIGHT, THE LIGHTER COLORS OF THE IMAGE WILL REFLECT MORE LIGHT THAN THE DARKER COLORS. THAT IS, WHITE WILL REFLECT THE MOST LIGHT AND BLACK THE LEAST LIGHT.

THIS CAN PROBABLY BE ILLUSTRATED SOMEWHAT BETTER WITH THE AID OF FIG. 5. HERE THE SOURCE OF LIGHT IS BEING SUPPLIED BY A LAMP, AND A CONDENSING LENS, WHICH IS PLACED BETWEEN THIS LAMP AND THE OBJECT OR IMAGE, FOCUSES THE LIGHT BEAM TO A TINY SPOT OF LIGHT. WITH THIS SPOT OF LIGHT FOCUSED UPON THE WOMAN'S LIGHT COLORED FOREHEAD, CONSIDERABLE LIGHT WILL BE REFLECTED, BUT IF THIS SMALL BEAM SHOULD BE MOVED TO SOME DARKER PORTION OF THE WOMAN, SUCH AS HER HAIR OR DRESS, THEN LESS LIGHT WILL BE REFLECTED FROM THE SPOT OF LIGHT ETC.

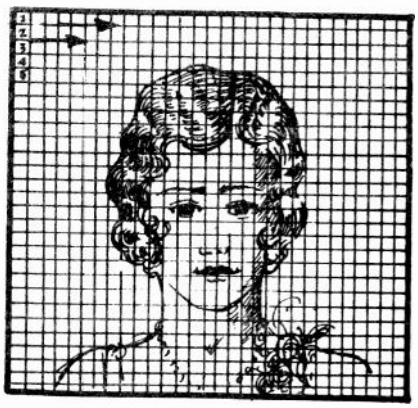


FIG. 6
Horizontal Division of Image.

NOW IF THE WOMAN IS FLOODED WITH ONE MASS OF SOLID LIGHT, THEN THOUSANDS OF SUCH TINY SPOTS WILL REFLECT A CERTAIN AMOUNT OF LIGHT, DEPENDING UPON HOW DARK OR LIGHT THESE SPOTS ARE. ALL OF THESE LIGHT REFLECTIONS OF VARIOUS INTENSITIES WILL STRIKE THE OBSERVER'S EYES SIMULTANEOUSLY, THUS REPRODUCING THE IMAGE ON THE BRAIN, WITH THE DARK AND LIGHT PATTERN ARRANGED IN THE SAME FORM AS ON THE OBJECT BEING SEEN.

EVEN THOUGH THE HUMAN EYE WILL RESPOND TO A GREAT MANY LIGHT REFLECTIONS AT THE SAME TIME AND THUS "PICK UP" THE ENTIRE IMAGE AT ONCE, YET UP TO THE PRESENT TIME, IT IS NOT POSSIBLE TO TRANSMIT THE ENTIRE IMAGE IN ITS COMPLETE FORM BY TELEVISION.

IN "PICKING UP" THE IMAGE FOR TELEVISION TRANSMISSION, WE "PICK UP" THE IMAGE IN SECTIONS AND ALSO TRANSMIT IT IN SECTIONS AT THE RECEIVER, THESE VARIOUS SECTIONS ARE AGAIN PUT TOGETHER IN THE PROPER ORDER, SO AS TO FORM THE ORIGINAL COMPLETE IMAGE WHICH IS LOCATED IN THE STUDIO OF THE TRANSMITTER.

DIVIDING THE OBJECT INTO SECTIONS

WE WILL BEGIN DIVIDING THE IMAGE TO BE TRANSMITTED INTO A NUMBER OF SMALL SQUARES AS SHOWN IN FIG.6. THESE SQUARES ARE MADE UP OF A NUMBER OF HORIZONTAL AND VERTICAL LINES. NOW LET US SUPPOSE THAT WE HAVE AT OUR DISPOSAL A CONCENTRATED BEAM OF LIGHT, WHICH WILL JUST COVER ONE OF THESE SMALL SQUARES AND NO MORE.

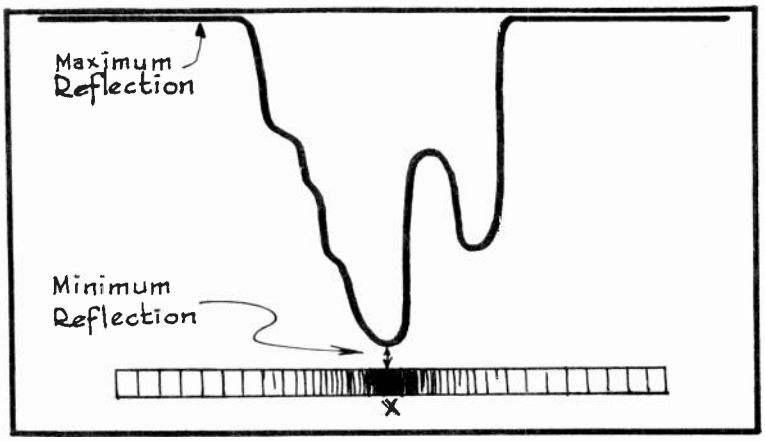


FIG. 7
Variations of Light Reflections.

WE WILL FIRST FOCUS THIS BEAM OF LIGHT UPON THE UPPER LEFT HAND SQUARE OF THE FRAME AT (1) AND WE WILL GRADUALLY MOVE THIS BEAM OF LIGHT ACROSS THE TOP ROW OF SQUARES IN A HORIZONTAL DIRECTION, FROM LEFT TOWARDS RIGHT AS INDICATED BY THE UPPER ARROW. THUS IT IS SEEN THAT EACH OF THE SQUARES IN THIS TOP ROW WILL BE ILLUMINATED ONE AT A TIME AND IN CONSECUTIVE ORDER.

EACH OF THE SQUARES IN THIS ROW, HOWEVER, IS PLAIN WHITE AND THEREFORE, THE LIGHT REFLECTED BY EACH WILL BE THE SAME. AFTER HAVING PASSED THIS LIGHT BEAM CLEAR ACROSS THIS UPPER ROW OF SQUARES, WE WILL FOCUS IT UPON THE EXTREME LEFT HAND SQUARE OF THE SECOND ROW AND THENCE GRADUALLY PASS THE BEAM ACROSS THIS SECOND ROW OF SQUARES FROM LEFT TOWARD RIGHT. AGAIN EACH OF THE SQUARES IN THIS ROW WILL REFLECT THE SAME AMOUNT OF LIGHT BECAUSE THE SHADING OF ALL OF THEM IS IDENTICAL.

IN THIS SAME WAY, WE PASS THIS LIGHT BEAM OVER ONE HORIZONTAL ROW OF SQUARES AT A TIME, GRADUALLY WORKING FROM THE TOP OF THE FRAME TOWARDS THE BOTTOM AND FROM THE LEFT TOWARDS THE RIGHT. FINALLY, LET US ASSUME THAT WE COME TO ROW #5. IN FIG.7, THIS ROW OF SQUARES IS SHOWN IN DETAIL, WITH THE VARIOUS DEGREES OF SHADING CORRESPONDING TO THE CONDITION IN

FIG. 6 AT THIS SAME SECTION OF THE FRAME.

THE FIRST NINE SQUARES FROM THE LEFT ARE PLAIN WHITE AND SO FROM THESE, WE GET THE SAME AMOUNT OF LIGHT REFLECTION, AS THE BEAM IS GRADUALLY MOVED FROM THE LEFT TOWARD THE RIGHT. FINALLY WE COME TO THE TENTH SQUARE FROM THE LEFT IN FIG.7, WHICH IS PARTIALLY SHADED BY THE WOMAN'S HAIR (REFER TO FIG.6) AND THE FOLLOWING FEW SQUARES IN FIG.7 EACH HAVE A VARYING AMOUNT OF SHADING, WITH THE DARKEST REGION BEING AT THE SECTION MARKED "X" IN FIG.7.

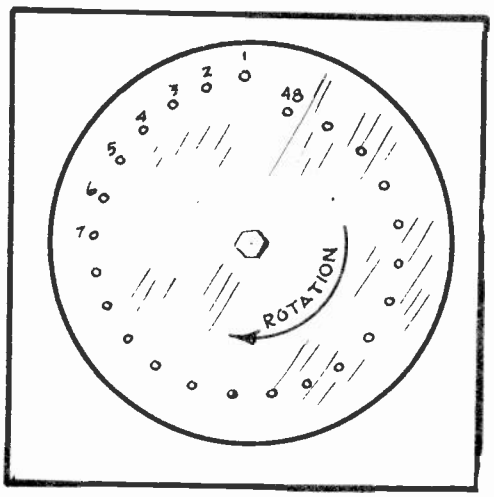


FIG. 8
A Typical Scanning Disc.

THESE SHADED SQUARES WILL NOW EACH REFLECT A DIFFERENT PERCENTAGE OF LIGHT, WITH THE DARKEST PORTION REFLECTING THE LEAST. SHOULD WE INDICATE THIS VARIATION OF LIGHT REFLECTION AS A CURVE WHILE THE BEAM IS BEING PASSED FROM THE LEFT TOWARD THE RIGHT OF ROW 5, WE WOULD OBTAIN A CURVE WITH VARIATIONS SOMEWHAT AS PICTURED AT THE TOP OF FIG.7. NOTE THAT THE CURVE INDICATES MAXIMUM LIGHT REFLECTION ABOVE THE WHITE SQUARES BUT THEN IT DECREASES AND INCREASES OVER THE SHADED REGION, COMING TO ITS MINIMUM VALUE OVER THE DARKEST REGION (X).

THIS LIGHT REFLECTION CURVE OF FIG.7, YOU WILL NOTE, LOOKS A GREAT DEAL LIKE THE CURVES ILLUSTRATING VARIATION IN MICROPHONE CURRENTS, AS CAUSED BY SQUNDS OF VARYING FREQUENCIES BEING IMPRESSED UPON ITS DIAPHRAGM AND SO WE CAN GIVE YOU A HINT AT THE PRESENT TIME, THAT IT IS THE VARIATIONS OF LIGHT REFLECTIONS AS ILLUSTRATED IN FIG.7 THAT ARE GOING TO BE USED TO MODULATE THE TRANSMITTER'S CARRIER FREQUENCY.

RETURNING TO FIG.6, YOU WILL OBSERVE THAT AS WE GRADUALLY MOVE DOWNWARD ONE ROW OF SQUARES AT A TIME AND PASS THE BEAM OF LIGHT FROM THE LEFT TOWARDS THE RIGHT, WE WILL OBTAIN A WHOLE SERIES OF CHANGES IN LIGHT REFLECTION, SUCH AS SHOWN IN FIG.7 BUT THE REFLECTION CURVE OF EACH HORIZONTAL ROW WILL BE DIFFERENT, BEING DEPENDENT ENTIRELY UPON THE DEGREE OF SHADING AT THAT PARTICULAR SECTION OF THE IMAGE.

WE CALL THIS ACTION, NOW UNDER DISCUSSION, "SCANNING", WHICH SIMPLY MEANS THAT THE IMAGE IS BEING DIVIDED INTO TINY SECTIONS. NOW THAT YOU ARE FAMILIAR WITH THE PRINCIPLES ENVOLVED IN SCANNING, YOU WILL NEXT BE INTERESTED IN LEARNING HOW SCANNING IS ACCOMPLISHED IN ACTUAL PRACTICE.

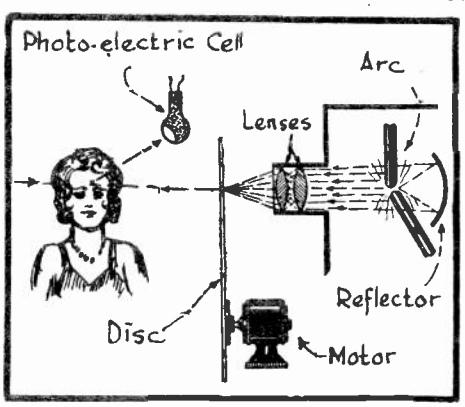


FIG. 9
The Scanning System and Photo-Cell Pick up.

IN FIG.8 YOU ARE SHOWN A TYPICAL

SCANNING DISC AND THIS UNIT IS A THIN, LIGHT, CIRCULAR, METALLIC DISC, HAVING A MOUNTING HOLE AT ITS CENTER AND A ROW OF SMALL HOLES ARRANGED IN A SPIRAL FORMATION NEAR ITS RIM.

THIS SCANNING DISC IS MOUNTED TO THE ARMATURE OF AN ELECTRIC MOTOR BY MEANS OF ITS CENTER HOLE, AS PICTURED IN FIG.9. THE IMAGE TO BE SCANNED (THE WOMAN IN THIS CASE) TAKES HER POSITION IN FRONT OF THE SCANNING DISC AND A LIGHT SOURCE, OR ARC LAMP IS PLACED ON THE OTHER SIDE OF THE SCANNING DISC.

THE LIGHT SOURCE IS FOCUSED UPON THE ROW OF HOLES IN THE RIM OF THE SCANNING DISC AND WITH ANY ONE OF THE DISC HOLES LINED UP WITH THE LIGHT SOURCE, A THIN BEAM OF LIGHT WILL PASS THROUGH THE HOLE AND AND STRIKE ONE POINT ON THE IMAGE TO BE TELEVISED. IN FIG. 9, FOR EXAMPLE, THE PARTICULAR DISC HOLE, WHICH IS ALIGNED WITH THE LIGHT SOURCE, DIRECTS A TINY BEAM OF LIGHT UPON THE WOMAN'S FORHEAD. THE LIGHT, WHICH IS REFLECTED FROM THIS TINY SPOT, IS THEN DIRECTED TOWARDS A PHOTOELECTRIC CELL.

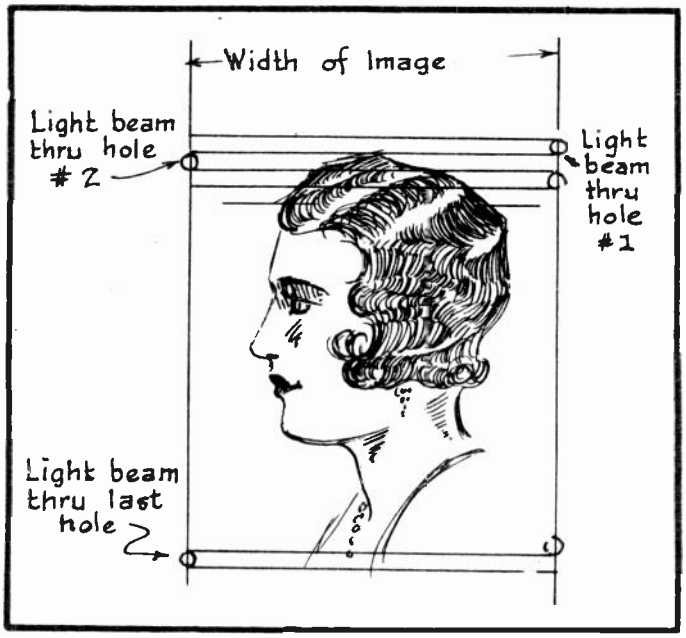


FIG. 10
Scanning the Image.

RETURNING TO THE DETAILED ILLUSTRATION OF OUR SCANNING DISC OF FIG.8, WE FIND THAT AS THE DISC IS DRIVEN IN THE DIRECTION SHOWN AND HOLE #1 COMES IN TO THE PATH OF THE LIGHT SOURCE, THIS FIRST HOLE WILL DIRECT THE SMALL PENCIL OF LIGHT ACROSS THE IMAGE FROM THE LEFT TOWARDS THE RIGHT, AS SHOWN IN FIG. 10. THE INSTANT THAT HOLE #1 HAS PASSED ACROSS THE PICTURE, HOLE #2 OF THE DISC WILL NEXT COME INTO THE PATH OF LIGHT AND THUS PASS A PENCIL OF LIGHT ACROSS THE PICTURE. NOTICE, HOWEVER, IN FIG.10 THAT THE LIGHT FROM #2 PASSES ACROSS THE PICTURE AT A LOWER LEVEL THAN THE BEAM FROM HOLE #1. THE REASON FOR THIS IS THAT THE DISTANCE BETWEEN HOLE #2 AND THE CENTER OF THE SCANNING DISC IS EQUAL TO THE DISTANCE FROM HOLE #1 TO THE DISC CENTER MINUS THE DIAMETER OF ONE HOLE. (ALL HOLES ARE OF EQUAL DIAMETER.)

ANOTHER IMPORTANT POINT TO NOTICE RELATIVE TO FIGURES 8 AND 10 IS THAT THE WIDTH OF THE PICTURE FRAMED BY THE SCANNING DISC IS EQUAL TO THE DISTANCE BETWEEN ADJACENT HOLES.

AFTER HOLE #2 HAS SCANNED THE PICTURE, IT WILL BE FOLLOWED BY HOLE #3 ONE LINE LOWER ETC. UNTIL ALL 48 HOLES OF THE DISC HAVE PASSED ACROSS THE PICTURE. WE THEN SAY THAT THE PICTURE HAS BEEN DIVIDED INTO 48 LINES. FROM THE EXPLANATION JUST GIVEN, YOU WILL ALSO NOTE THAT THE HEIGHT OF THE PICTURE FRAMED BY THE SCANNING DISC IS EQUAL TO THE DIFF

ERENCE BETWEEN THE DISTANCE OF THE FIRST AND LAST HOLE FROM THE CENTER OF THE DISC.

THEN TOO, IT IS CLEAR THAT THE PICTURE WILL BE COMPLETELY SCANNED AFTER ONE REVOLUTION OF THE DISC. HOWEVER, IN ORDER TO MAKE THE PICTURE APPEAR CONTINUOUS AT THE RECEIVER, IT IS NECESSARY TO SCAN THE PICTURE COMPLETELY 15 TIMES PER SECOND AND THIS MEANS THAT THE DISC WILL HAVE TO BE DRIVEN BY THE MOTOR AT THE RATE OF 900 REVOLUTIONS PER MINUTE.

THE EFFECT OF SCANNING SPEED

THE NECESSITY OF SCANNING THE PICTURE 15 TIMES PER SECOND, IN ORDER TO PRODUCE A CONTINUOUS PICTURE, CAN PROBABLY BE BEST ILLUSTRATED WITH THE MOVING PICTURE FILM. AS YOU ALREADY KNOW, MOVING PICTURE FILM CONSISTS OF A STRIP OF SMALL INDIVIDUAL PICTURES. SHOULD EACH OF THESE PICTURES BE PROJECTED UPON THE SCREEN INDIVIDUALLY, THEN THE CHARACTERS WOULD NOT APPEAR TO BE IN MOTION AND WE WOULD MERELY SEE THE REPRODUCTION OF A SERIES OF PHOTOGRAPHS.

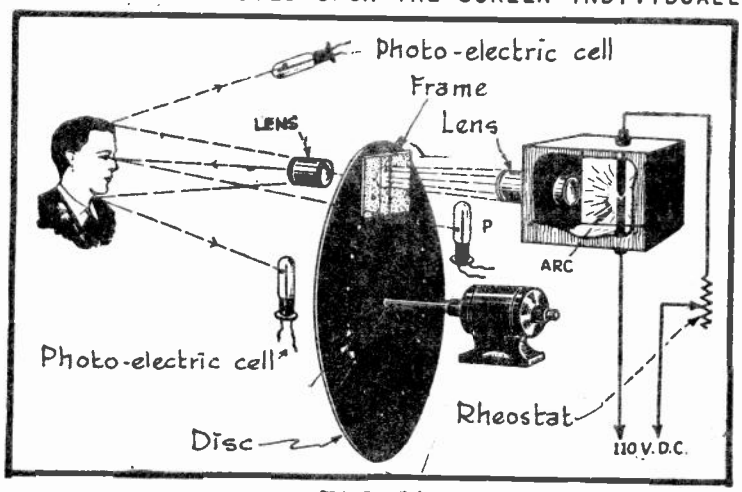


FIG. 11

Using A Group of Photo-electric Pick-up Cells.

OUR EYES, HOWEVER, HAVE A PECULIAR PROPERTY, WHICH TO SCIENCE IS KNOWN AS "PERSISTENCE OF VISION THIS MEANS THAT AFTER WE FIRST LOOK AT AN OBJECT, WE STILL RETAIN A VISION OF IT FOR MORE THAN 1/20 OF A SECOND AFTER THE OBJECT IS TAKEN FROM VIEW. THEREFORE, IF THE PICTURES OF THE MOVIE FILM ARE PROJECTED ON THE SCREEN CONSECUTIVELY IN RAPID SUCCESSION, WE WILL STILL RETAIN THE VISION OF THE FIRST WHEN THE SECOND ALREADY COMES INTO VIEW ETC. THE RESULT IS THAT THE CHARACTERS ON THE PICTURE APPEAR TO US AS BEING IN MOTION AND THE STANDARD RATE ADOPTED BY THE MOVIE INDUSTRY FOR SHOWING THESE FRAMES, OR INDIVIDUAL PICTURES MAKING UP THE FILM, IS 15 PICTURES PER SECOND.

THIS RATE IS SUFFICIENT TO DECEIVE OUR EYES INTO "SEEING MOTION PICTURES" AND THIS SAME PRINCIPLE APPLIES TO SCANNING IN TELEVISION, FOR HERE TOO, IF 15 SEPARATE PICTURES ARE SHOWN TO THE EYE IN EACH SECOND, THE CHARACTERS OF THE PICTURE WILL APPEAR AS BEING IN MOTION.

PICTURE DETAIL

YOU WILL ALSO FIND THAT THE GREATER THE NUMBER OF HOLES IN THE SCANNING DISC, THE GREATER WILL BE THE DETAIL OF THE PICTURE BEING SCANNED AND THIS IN TURN MEANS A CLEARER REPRODUCTION OF THE IMAGE. THAT IS, THE SMALLER THE SIZE OF THE HOLES IN THE DISC AND THE GREATER THE NUMBER OF THEM, THE SMALLER WILL BE THE ELEMENTARY AREAS INTO WHICH THE PICTURE IS DIVIDED. THIS OF COURSE WILL MEAN THAT A GREATER NUMBER OF INDIVIDUAL

LIGHT REFLECTIONS WILL BE OBTAINED FROM THE OBJECT BEING SCANNED, THEREBY MAKING IT POSSIBLE TO MORE CLEARLY DIFFERENTIATE BETWEEN SMALL CHANGES OF SHADING.

FOR THE ABOVE REASON, YOU WILL FIND SCANNING DISCS HAVING 24; 48; 50; 60 OR 72 HOLES BUT AT PRESENT, THE 48 HOLE DISC IS THE MOST COMMON. TELEVISION SETS USING A 48 HOLE SCANNING DISC ARE GENERALLY REFERRED TO AS BEING A 48 LINE SYSTEM, MEANING THEREBY THAT THE DISC DIVIDES THE PICTURE INTO 48 LINES PER REVOLUTION OF THE DISC.

ALTHOUGH A DISC WITH MORE HOLES WILL PROVIDE GREATER PICTURE DETAIL, YET SUCH A SYSTEM CALLS FOR A MORE EXPENSIVE AMPLIFIER, CAPABLE OF HANDLING A WIDER RANGE OF FREQUENCIES.

TELEVISION "PICK-UP" UNITS

THE MODERN PRACTICE IS NO LONGER TO "PICK UP" THE LIGHT REFEECTIONS FROM THE OBJECT BEING TELEVISED BY A SINGLE PHOTO-ELECTRIC CELL BUT TO CONNECT A BANK OF PHOTO-ELECTRIC CELLS IN PARALLEL WITH EACHOTHER. THE CELLS ARE THEN SUITABLY ARRANGED, SO THAT THEY WILL BE AFFECTED BY LIGHT REFLECTIONS COMING AT DIFFERENT ANGLES AS THE OBJECT IS BEING SCANNED. THIS IS ILLUSTRATED IN FIG.11.

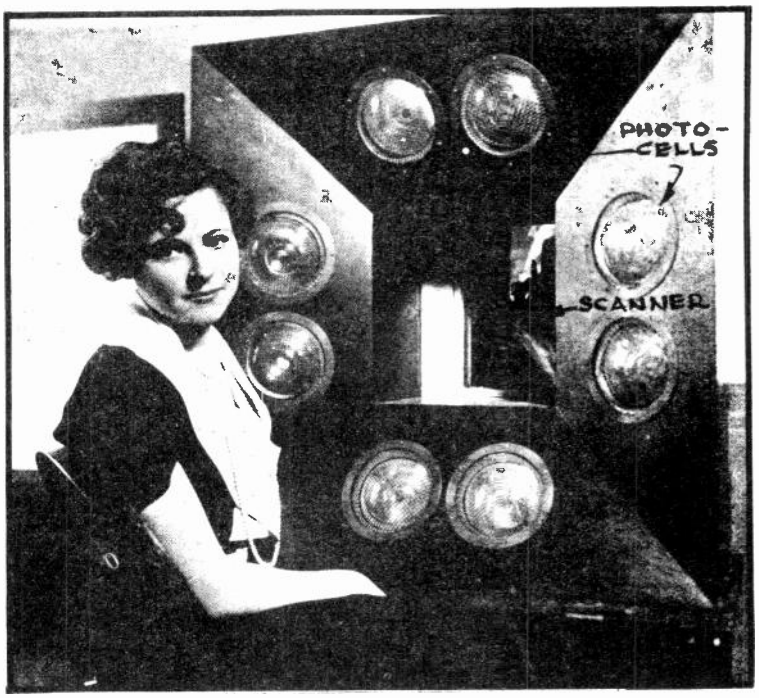


FIG. 12
The Photo Cell Pick-up.

THE ACTUAL PHOTOELECTRIC CELL PICK-UP AS USED BY MODERN TELEVISION TRANSMITTERS IS SHOWN IN FIG.12. THE OBJECT OR PERSON TO BE TELEVISED TAKES HIS POSITION IN FRONT OF THIS LARGE PICK-UP UNIT AND THE SCANNING BEAM COMES THRU THE SQUARE OPENING AT THE BACK OF THE PICK-UP UNIT. THE REFLECTIONS FROM THE OBJECT ARE DIRECTED TOWARDS THE ENTIRE GROUP OF PHOTO-ELECTRIC CELLS, ACTING CHIEFLY UPON THOSE IN THE DIRECT PATH OF THE REFLECTED BEAM.

THE "DIRECT-VISION" METHOD OF ILLUMINATING AND SCANNING AN OBJECT IS ILLUSTRATED IN FIG.13. IN THIS CASE, A BANK OF STRONG LIGHTS WITH REFLECTORS ARE ARRANGED ABOUT THE OBJECT BEING TELEVISED, SO THAT THEIR STRONG LIGHT BEAMS WILL BE DIRECTED UPON AND FLOOD THE OBJECT WITH ILLUMINATION. THE REFLECTED LIGHT FROM THE MAN'S FACE IN FIG.13 IS ALL DIRECTED TOWARDS A CONDENSING LENS, BY MEANS OF WHICH IT IS FOCUSED UPON THE ROW OF HOLES IN THE SCANNING DISC. THE PHOTO-ELECTRIC CELL IS HOUSED IN A "DARK BOX", BEING SEPARATED FROM THE SCANNING DISC BY A RECTANG

ULAR SHAPED DIAPHRAGM OF BLACK MATERIAL, HAVING A RECTANGULAR HOLE CUT IN IT. THIS DIAPHRAGM ACTS AS A SHIELD OR FRAME, PERMITTING THE LIGHT THROUGH ANY ONE DISC HOLE TO PASS TO THE PHOTO-ELECTRIC CELL FOR ONLY A LIMITED TIME AS THE HOLES OF THE ROTATING DISC MOVE PAST THE OPENING IN THE DIAPHRAGM.

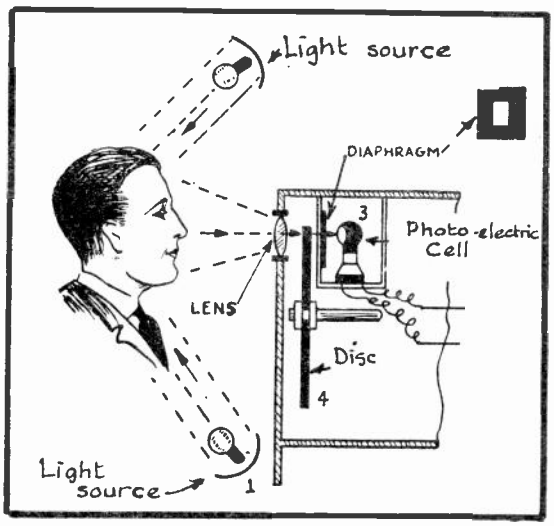


FIG. 13
"Direct Vision Method" of Illumination and Scanning.

SO BY THIS METHOD, IT IS ALSO SEEN THAT THE REFLECTION FROM ONE SPOT OF THE MAN'S FACE AT A TIME WILL ACT UPON THE PHOTO-ELECTRIC CELL, DEPENDING ENTIRELY UPON THE ALIGNMENT OF THE DISC HOLES WITH THE REFLECTED LIGHT BEAMS.

OUR AIM SO FAR HAS BEEN TO DIVIDE THE OBJECT BEING TELEVISED INTO AS MANY SMALL PARTS OR ELEMENTARY AREAS AS POSSIBLE, SO THAT AN INDIVIDUAL REFLECTED BEAM WILL BE PROVIDED FROM EACH OF THESE AREAS OR SPOTS. FURTHERMORE, THESE REFLECTED BEAMS ARE GOING TO DEPEND ENTIRELY UPON THE SHADING OF THAT PART OF THE OBJECT AND THEREFORE IT IS CLEAR THAT THESE VARIATIONS IN INTENSITY OF THE REFLECTED LIGHT WILL ACT UPON THE LIGHT-SENSITIVE PHOTO-ELECTRIC CELL.

CHANGING LIGHT VARIATION INTO CURRENT VARIATIONS

NOW THAT WE HAVE OUR REFLECTIONS OF LIGHT DIRECTED UPON THE PHOTOELECTRIC CELL, LET US PROCEED BY INVESTIGATING THE CONSTRUCTION OF THE PHOTO-ELECTRIC CELL AND THE MANNER IN WHICH IT CHANGES VARIATIONS OF LIGHT INTENSITIES INTO CORRESPONDING ELECTRICAL CURRENT VARIATIONS.

TWO DIFFERENT TYPES OF PHOTO-ELECTRIC CELLS ARE SHOWN IN FIG. 14 AND THE SYMBOL FOR THE PHOTO-CELL, AS IT IS FREQUENTLY CALLED, IS SHOWN IN THE LOWER PORTION OF FIG. 14. THE CELL AT THE LEFT IS KNOWN AS THE "VISITRON" PHOTO-ELECTRIC CELL AND IN THIS CASE, THE CATHODE CONSISTS OF A CONCAVE METAL SURFACE UPON WHICH A LIGHT-SENSITIVE MATERIAL IS DEPOSITED AND THE ANODE IS IN THE FORM OF A CENTRALLY LOCATED WIRE. BOTH OF THESE ELEMENTS ARE SEALED WITHIN A GLASS BULB, WHICH IN SOME CASES IS EVACUATED WHILE IN OTHER CASES

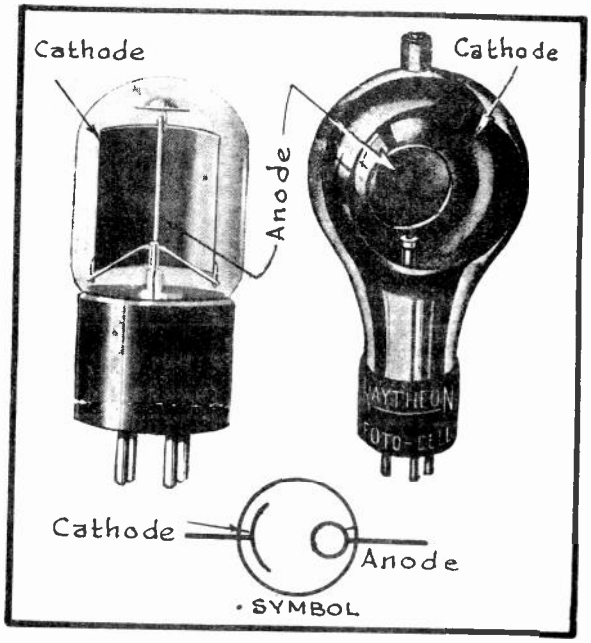


FIG. 14
Photo Electric Cells.

BEING FILLED WITH SOME INERT GAS, SUCH AS HELIUM, ARGON, OR NEON AT LOW PRESSURE. CELLS OF THE LATTER TYPE ARE GENERALLY REFERRED TO AS BEING OF THE GAS-FILLED TYPE. FROM ITS OUTER APPEARANCE THIS PHOTO-CELL SOMEWHAT RESEMBLES A RADIO TUBE.

THE PHOTO-CELL AT THE RIGHT OF FIG.14 IS A "RAYTHEON" AND IN THIS CASE, THE SHAPE OF THE GLASS BULB IS DIFFERENT AND THE ANODE TAKES THE FORM OF A METALLIC RING. THE ACTIVE OR LIGHT SENSITIVE MATERIAL IN THIS RAYTHEON PHOTO-CELL IS APPLIED TO A METALLIC COATING ON THE INNER SURFACE OF THE GLASS BULB, THUS FORMING THE CATHODE.

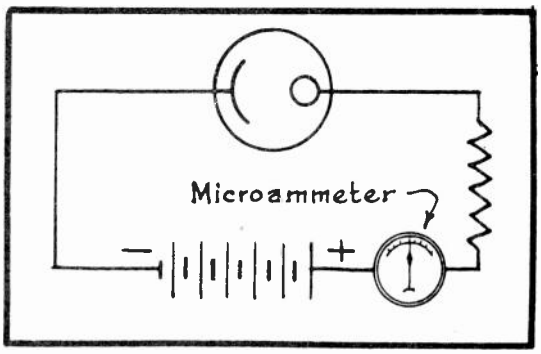


FIG. 15
A Circuit for the Photo-Cell.

A CIRCULAR PORTION OF THE GLASS, HOWEVER, IS LEFT CLEAR AND THIS IS KNOWN AS THE "WINDOW" AND THROUGH THIS TRANSPARENT PORTION, WE PASS A BEAM OF LIGHT FROM THE OUTSIDE SOURCE. SO MUCH FOR THE CONSTRUCTION OF PHOTO-CELLS. NOW LET US CONTINUE WITH THE DISCUSSION CONCERNING THEIR OPERATION.

OPERATION OF THE PHOTO-ELECTRIC CELL

IN FIG.15, WE HAVE A FUNDAMENTAL PHOTO-ELECTRIC CELL CIRCUIT AND AS YOU WILL NOTE, WE HAVE THE POSITIVE END OF A BATTERY CONNECTED TO THE ANODE OF THE PHOTO-CELL THROUGH A RESISTOR AND THE NEGATIVE END OF THE BATTERY IS CONNECTED TO THE CATHODE SURFACE OF THE CELL. THE ANODE OF THE CELL NOW CORRESPONDS TO THE PLATE OF AN ORDINARY RADIO TUBE AND THE CATHODE TAKES THE PLACE OF THE FILAMENT OR CATHODE OF A RADIO TUBE.

IN ALL TYPES OF RADIO TUBES, WE DEPEND UPON HEAT, IN ORDER TO OBTAIN AN ELECTRON EMISSION AND THE HEAT IS FURNISHED BY A FILAMENT

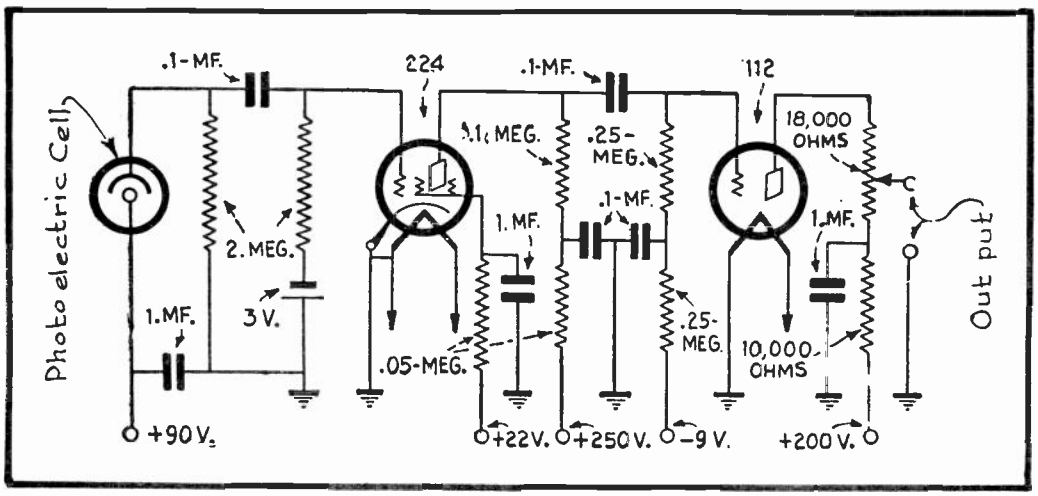


FIG. 16
A typical Television Amplifier for use With a Photo-Cell.

CURRENT. IN THE CASE OF THE PHOTO-CELL, WE HAVE NO HEATING ELEMENT BUT IN PLACE OF THIS, ELECTRONS ARE EMITTED FROM THE CATHODE DUE TO THE EFFECTS OF LIGHT RAYS STRIKING THE LIGHT-SENSITIVE SURFACE OF THE CATHODE.

MANY SUBSTANCES WILL EMIT ELECTRONS WHEN PLACED UNDER THE INFLUENCE OF LIGHT BUT CERTAIN SUBSTANCES WILL EMIT MANY MORE ELECTRONS UNDER THESE CONDITIONS THAN OTHERS. ALKALI METALS OR ALKALI-METAL HYDRIDES ARE QUITE SENSITIVE TO LIGHT RAYS AND AMONG THE MOST COMMONLY USED ALKALI-METAL HYDRIDES FOR PHOTO-CELL PURPOSES ARE SODIUM HYDRIDE, POTASSIUM HYDRIDE AND CAESIUM HYDRIDE. THERE ARE STILL OTHER SUBSTANCES, WHICH EXHIBIT PRONOUNCED EFFECTS WHEN SUBJECTED TO LIGHT RAYS BUT THOSE MENTIONED ARE THE MOST EFFECTIVE MATERIALS, WHICH HAVE BEEN FOUND UP TO THE PRESENT TIME. WE SPEAK OF THESE SUBSTANCES AS BEING "LIGHT-SENSITIVE".

SHOULD THE PHOTO-CELL OF FIG. 15 BE PLACED IN TOTAL DARKNESS, THEN THE MICROAMMETER WOULD INDICATE NO CURRENT FLOW BECAUSE NO ELECTRONS

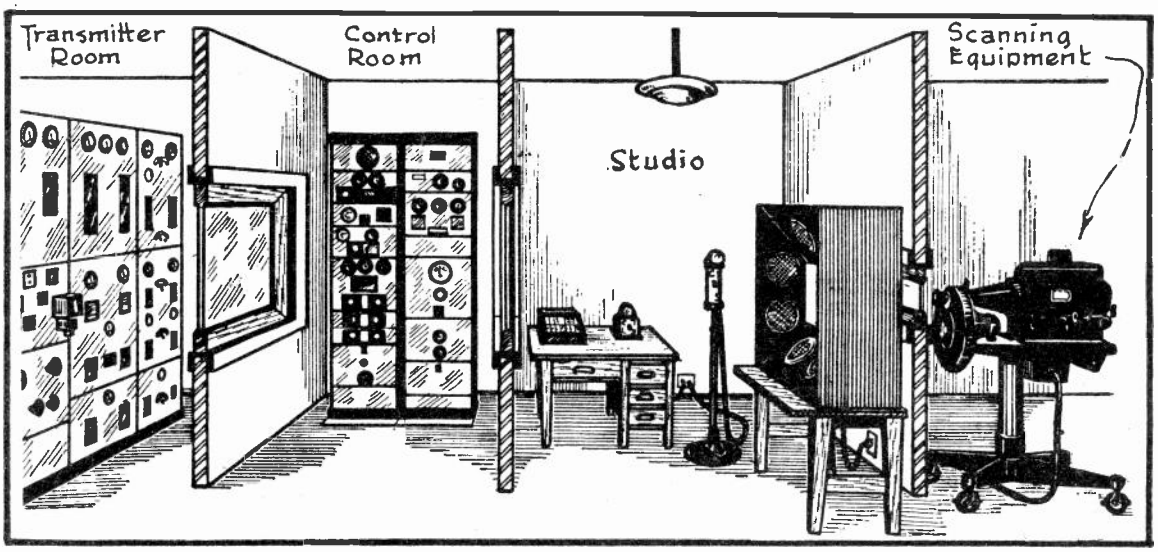


FIG. 17

General Lay-out of Television Transmitting Equipment.

ARE BEING EMITTED FROM THE CATHODE SURFACE. NOW IF A BEAM OF LIGHT WERE TO BE DIRECTED TO THE LIGHT SENSITIVE SURFACE OF THE CATHODE, A STREAM OF ELECTRONS WILL BE EMITTED FROM THIS SURFACE AND SINCE THE ANODE IS AT A POSITIVE POTENTIAL, DUE TO THE BATTERY CONNECTION, IT WILL ATTRACT THE EMITTED ELECTRONS. THE RESULT IS THAT WE HAVE A STREAM OF ELECTRONS AT THIS TIME FLOWING FROM THE CATHODE OVER TO THE ANODE AND THEREFORE CURRENT WILL FLOW THROUGH THE SYSTEM AS INDICATED, THE SAME AS PLATE CURRENT FLOWS THROUGH THE CONVENTIONAL RADIO TUBE.

IF THE LIGHT BEAM IS INTENSIFIED, THEN THERE WILL BE AN INCREASED ELECTRON EMISSION FROM THE CATHODE, ACCOMPANIED WITH A CORRESPONDING INCREASE IN THE SO CALLED "PLATE CURRENT", OR PHOTO-CELL CURRENT. THUS IT IS SEEN THAT THE CURRENT FLOW WILL VARY AS THE INTENSITY OF LIGHT, WHICH IS FOCUSED UPON THE PHOTO-CELL VARIES.

THE PHOTO-CELL CAN BE COMPARED VERY NICELY TO A MICROPHONE, FOR THE MICROPHONE CHANGES AIR PRESSURE VARIATIONS INTO ELECTRICAL CURRENT VARIATIONS OF CORRESPONDING FREQUENCY, WHEREAS THE PHOTO-CELL CHANGES LIGHT VARIATIONS INTO ELECTRICAL CURRENT VARIATIONS OF CORRESPONDING FREQUENCY. THE CURRENT THROUGH THE PHOTO-CELL IS SO SMALL THAT IT IS MEASURED IN MICROAMPERES (MILLIONTHS OF AN AMPERE).

GAS-FILLED PHOTO-CELLS ARE MORE SENSITIVE THAN THE VACUUM TYPE. THE REASON FOR THIS IS THAT THE PHOTO ELECTRONS IONIZE THE INERT GAS IN THEIR PASSAGE FROM THE CATHODE SURFACE OVER TO THE ANODE. THAT IS, THE PHOTO-ELECTRONS FLOW FROM THE CATHODE OVER TO THE ANODE AT SUCH A TREMENDOUS VELOCITY, THAT WHEN THEY COLLIDE WITH MOLECULES OF THE INERT GAS, THEY BREAK THESE MOLECULES UP INTO THE ELECTRONS AND PROTONS OF WHICH THEY ARE COMPOSED. WE CALL THIS ACTION "IONIZATION BY COLLISION". THESE EXTRA ELECTRONS ARE THEN ALSO ATTRACTED TO THE POSITIVELY CHARGED ANODE, IN ADDITION TO THOSE LIBERATED BY THE CATHODE AND THE RESULT IS THAT THE PHOTO-ELECTRIC CURRENT IS INCREASED OVER WHAT IT WOULD BE WITH THE FLOW OF PHOTO-ELECTRONS ALONE. (PHOTO-ELECTRONS ARE THE ELECTRONS

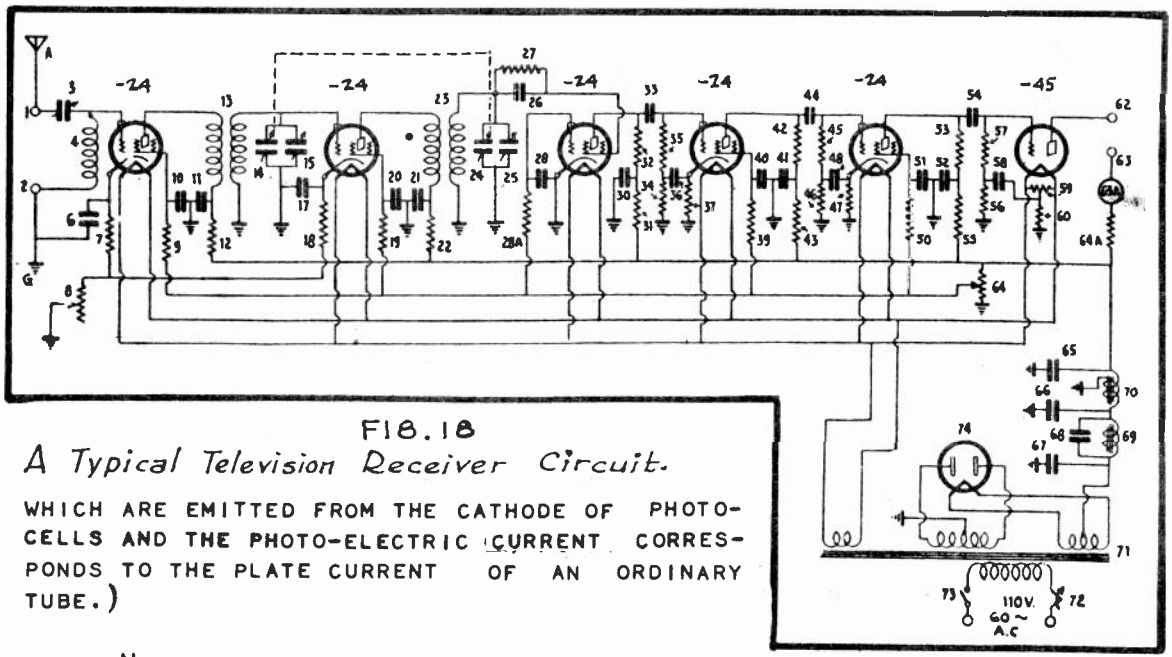


FIG. 18
A Typical Television Receiver Circuit.

WHICH ARE EMITTED FROM THE CATHODE OF PHOTO-CELLS AND THE PHOTO-ELECTRIC CURRENT CORRESPONDS TO THE PLATE CURRENT OF AN ORDINARY TUBE.)

NOT ONLY IS THE PHOTO-ELECTRIC CURRENT AFFECTED BY THE INTENSITY OF THE LIGHT DIRECTED UPON ITS CATHODE SURFACE BUT A CHANGE IN THE POTENTIAL APPLIED TO THE ANODE WILL ALSO PRODUCE A PRONOUNCED EFFECT UPON THIS CURRENT.

WITH THIS INFORMATION OF PHOTO-CELL ACTION WELL IN MIND, YOU CAN READILY SEE THAT BY HAVING THE PHOTO-CELL CONNECTED IN A CIRCUIT WITH A BATTERY IN THE TELEVISION TRANSMITTER EQUIPMENT, THE BEAM OF LIGHT AS REFLECTED FROM THE OBJECT BEING TELEVISED CAN BE DIRECTED UPON THE PHOTOCELL AND THEREBY CONVERT THE LIGHT AND DARK SHADES OF THE OBJECT INTO ELECTRICAL CURRENT VARIATIONS HAVING CORRESPONDING CHARACTERISTICS.

NOW THAT WE HAVE A METHOD OF OBTAINING THE PROPER LIGHT VARIATIONS TO OPERATE A SINGLE OR GROUP OF PARALLEL CONNECTED PHOTO-ELECTRIC CELLS, LET US NEXT CONSIDER THE AMPLIFIER INTO WHICH THE CURRENT VARIATIONS ARE PASSED. A TYPICAL TELEVISION AMPLIFIER FOR USE WITH A PHOTO

ELECTRIC CELL IS SHOWN IN FIG.16 AND NO DOUBT YOU WILL IMMEDIATELY RECOGNIZE IT AS BEING A RESISTANCE-CAPACITY COUPLED AMPLIFIER, SIMILAR TO THAT USED IN REGULAR RADIO PRACTICE, ONLY THAT THE PHOTO-ELECTRIC CELL IS CONNECTED ACROSS THE INPUT.

IN CASE THAT SEVERAL PHOTO-ELECTRIC CELLS ARE USED TO"PICK-UP"THE OBJECT BEING TELEVISED, THEN THEY ARE CONNECTED IN PARALLEL AND THE ENTIRE GROUP IS CONNECTED ACROSS THE INPUT OF THE AMPLIFIER. SUCH A PARALLEL COMBINATION OF PHOTO-ELECTRIC CELLS OFFERS A GREATER ENERGY PICK-UP THAN WHEN ONE CELL IS USED ALONE. FURTHERMORE, THIS ARRANGEMENT MAKES IT POSSIBLE FOR THE PHOTO-CELL GROUP TO SATISFACTORILY PICK-UP AT VARIOUS ANGLES THE LIGHT REFLECTIONS FROM THE OBJECT BEING TELEVISED, AND THUS MAKES A CLEAR PICTURE POSSIBLE.

NOTICE IN FIG.16 THAT THE ANODE OF THE PHOTO-CELL IS CONNECTED TO THE POSITIVE END OF THE "B" SUPPLY, WHILE THE CATHODE OR LIGHT SENSITIVE ELEMENT IS CONNECTED TO GROUND (B-) THROUGH A 2 MEGOHM RESISTOR. THE VOLTAGE CHANGES DEVELOPED ACROSS THIS RESISTOR BY THE LIGHT VARIATIONS IMPRESSED UPON THE PHOTO-CELL FORCE THE "SIGNAL" THROUGH THE .1 MFD. FIXED CONDENSER, ONTO THE GRID OF THE -24 TUBE AND THUS THIS SIGNAL CORRESPONDING TO LIGHT INTENSITY CHANGES IS SUCCESSIVELY AMPLIFIED BY THE FOLLOWING STAGES, THE SAME AS REGULAR RADIO SOUND SIGNALS.

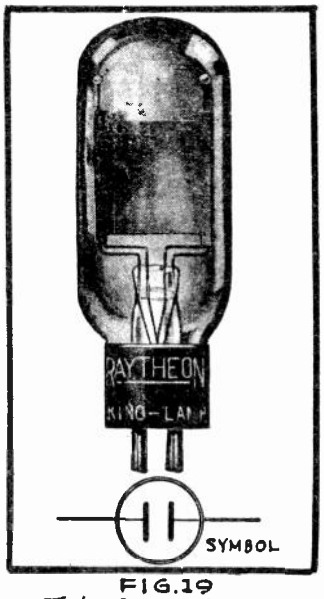


FIG.19
Television Lamp.

PRACTICALLY ALL TELEVISION AMPLIFIERS,WHETHER IN THE TRANSMITTER OR RECEIVER, ARE OF THE RESISTANCE-CAPACITY COUPLED TYPE BECAUSE THIS CLASS OF AMPLIFIER IS BETTER ABLE TO HANDLE THE REQUIRED WIDE FREQUENCY RANGE THAN IS THE TRANSFORMER COUPLED AMPLIFIER.

TRANSMITTING THE PICTURE

AT THE OUTPUT OF THIS PHOTO-CELLAMPLIFIER WE NOW HAVE THE SCANNED PICTURE IN THE FORM OF ELECTRICAL CURRENT AND VOLTAGE CHANGES JUST LIKE THE SOUND WAVES WOULD BE IN THE FORM OF CURRENT AND VOLTAGE CHANGES AT THE OUTPUT OF THE MICROPHONE AMPLIFIER. THEREFORE, IT IS REASONABLE THAT THE OUTPUT OF THE PHOTO-CELL AMPLIFIER CAN BE USED TO MODULATE A CARRIER FREQUENCY, WHICH IS GENERATED BY A REGULAR TRANSMITTER, THE SAME AS CAN BE DONE WITH THE OUTPUT OF THE AUDIO AMPLIFIER IN A REGULAR BROADCAST STATION. THIS IS JUST EXACTLY WHAT IS DONE IN TELEVISION AND THERE IS NO NEED FOR US TO GO INTO THE DETAILS CONCERNING THE GENERATION OF THE CARRIER WAVE BY THE TRANSMITTER, MODULATION, RADIATION ETC. BECAUSE THE PRINCIPLES ENVOLVED ARE EXACTLY THE SAME AS THOSE COVERED IN YOUR RADIO TRANSMITTER LESSONS.

THE ONLY THING WILL BE THAT IN THE CASE OF TELEVISION,THE CARRIER WAVE IS MODULATED ACCORDING TO THE VARIATIONS IN THE INTENSITY OF THE LIGHT BEAMS, WHICH ARE REFLECTED FROM THE SCANNED OBJECT BEING TELEVISED. WHEREAS IN THE CASE OF RADIO, THE CARRIER FREQUENCY IS MODULATED ACCORDING TO THE SOUND WAVES WHICH ARE IMPRESSED UPON THE STUDIO MICROPHONE.

THE GENERAL LAY-OUT OF A TYPICAL TELEVISION TRANSMITTING STATION, IS SHOWN IN FIG.17. AT THE RIGHT OF FIG.17 WE SEE THE SCANNER AND LAMP HOUSE (LIGHT SOURCE) MOUNTED AS A SINGLE UNIT ON A COMMON STAND. THEN COMES THE STUDIO WITH THE PHOTO-CELL PICK-UP FOR TELEVISION AND THE LIGHT BEAM FROM THE SCANNER PASSES THROUGH AN OPENING IN THE WALL AND TELEVISION "PICK UP"BOX".NEXT TO THE STUDIO COMES THE CONTROL ROOM AND THEN THE TRANSMITTER ROOM.

THE TELEVISION RECEIVER

NOW THAT WE HAVE THE MODULATED CARRIER WAVE RADIATED INTO SPACE, OUR FOLLOWING PROBLEMS WILL CONCERN THE MANNER IN WHICH WE ARE ABLE TO REPRODUCE THE TRANSMITTED IMAGE AT THE RECEIVER. PRESENT TELEVISION TRANSMISSION IS BEING CARRIED ON AT SHORT WAVE LENGTHS AND THEREFORE, IT IS NECESSARY THAT THE TUNED R.F. STAGES OF THE TELEVISION RECEIVER BE OF THE SHORT WAVE TYPE. ANOTHER IMPORTANT POINT RELATIVE TO THE TELEVISION RECEIVER IS THAT THE R.F. CIRCUITS SHOULD TUNE BROAD ENOUGH, SO AS TO PASS ALL OF THE MODULATING FREQUENCIES WITH THE CARRIER.

IN BROADCAST RECEIVERS, THE R.F. STAGES MUST ONLY PASS A BAND APPROXIMATELY 10 Kc. IN WIDTH, IN ORDER TO RETAIN ALL OF THE BROADCASTED AUDIO FREQUENCIES, WHEREAS IN THE CASE OF TELEVISION, THE R.F. STAGES OF THE RECEIVER MUST BE CAPABLE OF PASSING A BAND FROM 40 TO 100 Kc. IN WIDTH AND THEREFORE, THE TELEVISION RECEIVER MAY NOT BE AS SHARP TUNING AS THE BROADCAST RECEIVER.

THE CIRCUIT DIAGRAM OF A TYPICAL TELEVISION RECEIVER IS SHOWN IN FIG.18 AND ALTHOUGH IT DOES NOT EMPLOY THE LATEST TYPES OF TUBES, IT NEVERTHELESS ILLUSTRATES THE PRINCIPLE CLEARLY. IN LATER LESSONS, MORE MODERN CIRCUITS WILL BE BROUGHT TO YOUR ATTENTION. THE PARTS VALUES FOR THIS RECEIVER ARE AS FOLLOWS:

3 = .00026 MFD. TUNING CONDENSER.
4 = SPECIAL R.F. INDUCTANCE FOR TELEVISION.
6 - 10-11-17-20 AND 21=.1 MFD.
7 - 18-37-AND 47=1,000 OHMS.
8 - ELECTRAD TYPE R.I.=202 VOLUME CONTROL.
9 - 19-28A-32-34-39-42-46-50-53-56=50,000 OHMS.
12 - -22-=75,000 OHMS.
13 - 23 -- TELEVISION R.F. TRANSFORMERS.
14 - 24=.0002 MFD. VARIABLE CONDENSERS.
15 - 25=140 MFD. (MAX.) ADJUSTING CONDENSERS.
26 = .0001 MFD. GRID CONDENSER.
27 = 50,000 OHM LEAK.
28 = 1 MFD.
30 = 4 MFD.
31 - 43-55=25,000 OHMS
33 - 44-54=.25 MFD.
35 - 45-57=250,000 OHMS.
36 - 40-41-48-51-52-58=2 MFD.
63A=MILLIAMMETER 0-50 MA.
64A=TYPE B-30 ELECTRAD TRUVOLT RESISTOR.

65 - 66-67 = 8 MFD.
68 = .1 MFD.
69 - 70 = 30 HENRY CHOKES
71 = POWER TRANSFORMER
72 = AMPERITE SELF-ADJUSTING LINE VOLTAGE REGULATOR.

NOTICE IN FIG.18, THAT THE DETECTOR IN THIS PARTICULAR RECEIVER EMPLOYS A -24 TYPE TUBE USED AS A SPACE-CHARGE TUBE BUT THIS IS NOT THE CASE IN ALL TELEVISION RECEIVERS. THE MODULATED CARRIER FREQUENCY IS AMPLIFIED IN THE R.F. STAGES BY THE SAME PROCESS AS CARRIED OUT IN BROADCAST RECEIVERS AND THE GRID CONDENSER AND LEAK TYPE DETECTOR SEPARATES THE CARRIER FREQUENCY FROM THE MODULATING FREQUENCY IN THE CUSTOMARY MANNER.

A RESISTANCE-CAPACITY COUPLED AMPLIFIER FOLLOWS THE DETECTOR IN FIG. 18 AND THIS CORRESPONDS TO THE A.F. AMPLIFIER OF THE BROADCAST SET, ONLY IN THE CASE OF THE TELEVISION RECEIVER, THE ELECTRICAL EQUIVALENT OF THE ORIGINAL LIGHT VARIATION IS BEING AMPLIFIED HERE IN PLACE OF VOICE CURRENTS.

FINALLY, AT THE OUTPUT OF THE POWER STAGE, WE FIND THAT A FLAT PLATE NEON LAMP IS CONNECTED IN THE PLATE CIRCUIT OF THE POWER STAGE TO REPLACE THE LOUD SPEAKER. THE NEXT THING THEN WILL BE TO SEE WHAT PURPOSE THAT THIS NEON LAMP SERVES.

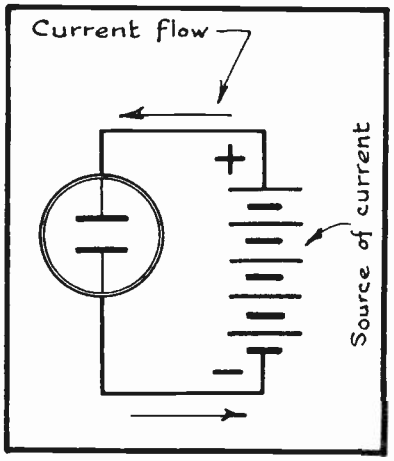


FIG. 20
Fundamental Circuit

THE NEON OR TELEVISION LAMP

A PHOTOGRAPH OF ONE TYPE OF TELEVISION LAMP IS SHOWN IN FIG.19. SOMETIMES THIS LAMP GOES BY SOME OTHER NAME SUCH AS A "GLOW TUBE," "NEON-LAMP" ETC., ALL MEANING THE SAME THING. THE SYMBOL FOR THE LAMP IS ALSO SHOWN IN FIG. 19 AND BECAUSE OF THE IMPORTANT WORK THAT IT DOES, THIS LAMP CAN BE CONSIDERED AS THE HEART OF THE TELEVISION RECEIVER.

THE TELEVISION LAMP, AS ILLUSTRATED HERE, CONSISTS OF A GLASS BULB FROM WHICH ALL AIR HAS BEEN PUMPED. A CERTAIN AMOUNT OF NEON GAS AT A DEFINITE PRESSURE IS THEN PUMPED INTO THE EVACUATED BULB. INSIDE OF THE BULB YOU WILL FIND AS THE CATHODE, A THIN METAL PLATE AND AS THE ANODE A FRAME WHICH GOES AROUND THE SURFACE OF THE CATHODE. IN ONE PARTICULAR STYLE, THE ANODE OR PLATE IS 1½ INCHES SQUARE AND SINCE IT IS NECESSARY THAT THE PLATE AREA OF THIS PLATE BE A LITTLE LARGER THAN THE IMAGE REPRODUCED AT THE RECEIVER, A LAMP OF THE SIZE JUST MENTIONED WILL BE ABLE TO TAKE CARE OF A PICTURE ABOUT 1 INCH SQUARE OR A TRIFLE LARGER.

A CUSTOMARY FOUR-PRONG BASE IS MOUNTED ON THE LOWER END OF THE GLASS BULB AND THIS FITS INTO A STANDARD FOUR-PRONG SOCKET. SO MUCH FOR ITS CONSTRUCTION AND NOW LET US SEE HOW THIS LAMP OPERATES.

SHOULD THE TELEVISION LAMP BE CONNECTED ACROSS A SOURCE OF VOLTAGE, AS IN FIG.20, THEN AN ORANGE GLOW WILL APPEAR AROUND THE LAMP ELEMENT WHICH IS CONNECTED TO THE NEGATIVE END OF THE BATTERY. IN TELEVISION RECEIVERS FOR HOME USE, THE VOLTAGE APPLIED ACROSS THE PLATES OF THE LAMP

GENERALLY AMOUNTS TO ABOUT 180 VOLTS. AS LONG AS SUFFICIENT VOLTAGE IS IMPRESSED ACROSS THE LAMP, PLATE CURRENT WILL FLOW THROUGH THE CIRCUIT FROM THE POSITIVE FRAME, THROUGH THE ELECTRON STREAM BETWEEN THE PARTS AND THENCE INTO THE NEGATIVE SIDE OF THE CIRCUIT. THIS DIRECTION OF CURRENT FLOW IS CLEARLY INDICATED BY MEANS OF THE ARROWS IN FIG.20. IN LAMPS SUCH AS GENERALLY EMPLOYED FOR HOME USE, THIS CURRENT WILL VARY FROM ABOUT 10 TO 20 MILLIAMPERES, PROVIDED THAT THE LAMP IS BEING OPERATED ACCORDING TO FACTORY SPECIFICATIONS REGARDING THE APPLIED VOLTAGE ETC.

SO FAR, WE HAVE A STEADY ORANGE-COLORED GLOW SURROUNDING THE CATHODE PLATE, WHICH IN ITSELF WOULD NOT SOLVE THE PROBLEMS OF TELEVISION BUT THE IMPORTANT THING IS THAT THE BRIGHTNESS OF THIS GLOW DEPENDS UPON THE VOLTAGE APPLIED ACROSS THE ELEMENTS OF THE LAMP. THE GREATER THIS VOLTAGE, THE BRIGHTER WILL BE THE GLOW AND VICE VERSA.

COUPLING THE TELEVISION LAMP TO THE RECEIVER

NOW WE WILL CONNECT THE TELEVISION LAMP TO THE OUTPUT OF THE RECEIVER'S POWER STAGE BY MEANS OF THE CIRCUIT ARRANGEMENT SHOWN IN FIG.21. HERE YOU WILL SEE THAT THE "B" SUPPLY OF THE RECEIVER HAS ITS POSITIVE END CONNECTED TO THE PLATE OF THE POWER TUBE THROUGH LOAD RESISTOR "R_1''". THE TELEVISION LAMP IS ISOLATED FROM THE RECEIVER'S POWER STAGE BY MEANS OF THE BLOCKING CONDENSER AND THE LAMP HAS ITS INDIVIDUAL SUPPLY CONNECTED ACROSS ITS PLATES.

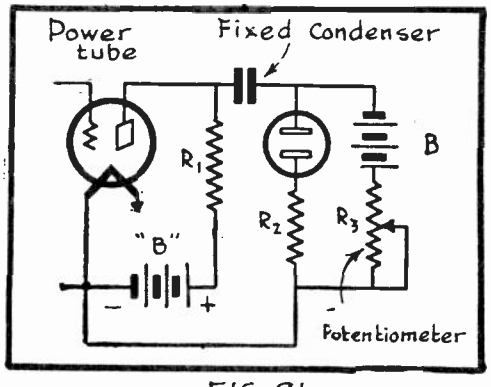


FIG. 21
Coupling the Television Lamp To The Receiver.

THE POTENTIOMETER IS USED AS A MEANS WHEREBY THE INITIAL BRILLIANCE OF THE LAMP IS ADJUSTED. NOW BY HAVING THE LAMP SO CONNECTED TO THE RECEIVER CIRCUIT, IT IS CLEAR THAT THE SIGNAL VOLTAGES DEVELOPED ACROSS THE LOAD RESISTOR "R_1''", IN THE PLATE CIRCUIT OF THE POWER TUBE, WILL CAUSE THESE SAME VOLTAGE CHANGES TO BE IMPRESSED ACROSS THE LAMP CIRCUIT THRU THE COUPLING CONDENSER.

THESE VARYING VOLTAGE CHANGES WILL ADD TO AND SUBTRACT FROM THE INITIAL VOLTAGE BEING IMPRESSED ACROSS THE LAMP AND THE RESULT IS THAT THE BRILLIANCE OF THE LAMP WILL INCREASE AND DECREASE FROM ITS NORMAL OR INITIAL BRILLIANCE IN DIRECT STEP WITH THE SIGNAL VOLTAGE CHANGES, WHICH ACT THROUGH THE COUPLING CONDENSER. THESE SIGNAL VOLTAGES, HOWEVER, ARE THE EXACT ELECTRICAL REPRESENTATIONS OF THE LIGHT VARIATIONS ACTUATING THE PHOTO-ELECTRIC CELL AT THE TRANSMITTER, THEREFORE, THE NEON LAMP AT THE RECEIVER WILL NOW BE PRODUCING VARIATIONS IN LIGHT INTENSITY CORRESPONDING TO THOSE IMPRESSED UPON THE PHOTO-ELECTRIC CELL.

RESISTOR "R_2''" IN FIG. 21 IS A CURRENT LIMITING RESISTOR. THE REASON FOR USING IT IS TO COUNTER-BALANCE THE NEGATIVE CHARACTERISTICS OF THE NEON LAMP. THAT IS, THE RESISTANCE OF THE LAMP BECOMES LESS WITH AN INCREASE IN CURRENT FLOW AND THUS IT IS OBVIOUS THAT WITH NO CURRENT

LIMITING RESISTANCE EMPLOYED, THE CURRENT FLOW THROUGH THE LAMP WOULD CONTINUALLY INCREASE. FINALLY, IT MIGHT BECOME GREAT ENOUGH TO CAUSE ARCING WITHIN THE LAMP AND THEREBY DESTROY THE LAMP ENTIRELY.

SINCE THE TELEVISION LAMP ONLY SERVES TO REPRODUCE THE ORIGINAL LIGHT VARIATIONS ACTING UPON THE PHOTO-ELECTRIC CELLS AT THE TRANSMITTER, WE ARE ONLY SO FAR REPRODUCING THE TINY SECTIONS OF THE OBJECT BEING TELEVISED AS IT IS BEING DIVIDED INTO THE SMALL ELEMENTARY AREAS BY THE SCANNER. THE NEXT THING THEN WILL BE TO RE-ASSEMBLE THE LIGHT VARIATIONS PRODUCED BY THESE ELEMENTARY AREAS INTO A DUPLICATE OF THE ORIGINAL OBJECT.

USE OF THE SCANNING DISC AT THE RECEIVER

SINCE WE USED A SCANNING DISC TO DIVIDE THE OBJECT INTO TINY PARTICLES, IT IS LOGICAL THAT WE CAN AGAIN USE A SIMILAR SCANNING DISC TO REASSEMBLE THESE ELEMENTARY AREAS INTO THEIR ORIGINAL FORMATION AND THIS IS JUST EXACTLY WHAT WE DO.

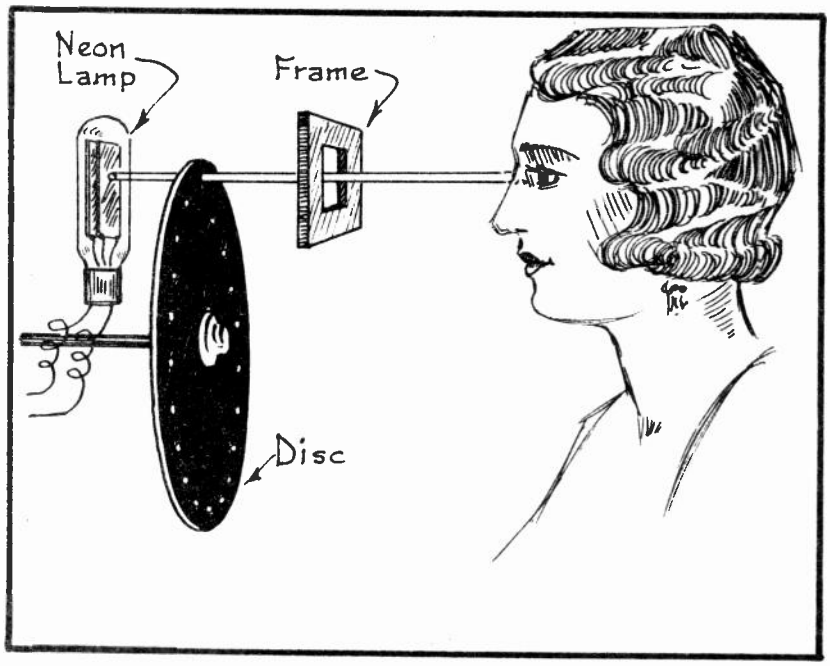


FIG. 22
Reproducing the Image.

AT THE RECEIVER, A SCANNING DISC OF THE SAME TYPES AS THAT USED AT THE TRANSMITTER IS PLACED BETWEEN THE OBSERVER AND THE TELEVISION LAMP. WITH THE DISC STATIONARY AND ANY ONE OF THE HOLES ALIGNED WITH THE LINE OF VISION BETWEEN THE OBSERVER'S EYE AND THE CATHODE (NEGATIVE PLATE) OF THE TELEVISION LAMP, THE OBSERVER WILL BE ABLE TO SEE ONLY ONE PARTICULAR SPOT ON THE LAMP'S CATHODE AS ILLUSTRATED IN FIG. 22.

SHOULD THE OBSERVER CONCENTRATE HIS VISION UPON THIS ONE DISC HOLE, AS THE DISC IS SLOWLY TURNED BY HAND, THIS SPOT MOVES ACROSS THE PLATE OF THE LAMP IN A HORIZONTAL PLANE. IF THE SCANNING DISC IS ROTATED CLOCKWISE, THIS SPOT WOULD MOVE ACROSS THE CATHODE ELEMENT FROM THE LEFT TOWARDS THE RIGHT.

NOW BY PLACING A DARK SCREEN OR FRAME IN THE LINE OF VISION BETWEEN THE DISC AND THE OBSERVERS EYE, THE AREA OF VISION WILL BE LIMITED. THAT IS, THE CATHODE CAN ONLY BE SEEN AS LONG AS THE DISC HOLE IS IN

LINE WITH THE RECTANGULAR OPENING IN THE SCREEN. CONSEQUENTLY, AS ANY ONE HOLE COMES INTO THE LINE OF SIGHT, THE OBSERVER'S VISION WILL BE DIRECTED ACROSS THE LAMP'S CATHODE FROM LEFT TO RIGHT BUT AS SOON AS THIS HOLE DISAPPEARS OFF TO THE RIGHT SIDE OF THE SCREEN'S OPENING, THE FOLLOWING HOLE OF THE DISC WILL APPEAR IN THE LINE OF SIGHT AND WILL AGAIN DIRECT THE OBSERVER'S VISION ACROSS THE CATHODE OF THE LAMP FROM THE LEFT TOWARDS THE RIGHT BUT THIS TIME, HE WILL SCAN THE SECTION OF THE CATHODE SLIGHTLY BELOW THAT AS OBSERVED BY THE FIRST HOLE. THIS IS DUE TO THE SPIRAL ARRANGEMENT OF THE HOLES IN THE SCANNING DISC.

FINALLY, AFTER ONE COMPLETE REVOLUTION OF THE SCANNING DISC, THE OBSERVER, WILL HAVE COMPLETELY SCANNED AN AREA OF THE LAMP'S CATHODE PLATE EQUIVALENT TO THE AREA OF THE OPENING IN THE SCREEN. BY REVOLVING THE SCANNING DISC AT A SPEED OF 900 R.P.M., HOWEVER, THE OBSERVER WILL NO LONGER BE ABLE TO DISTINGUISH THE INDIVIDUAL HOLES OF THE DISC BUT INSTEAD OF THIS HE WILL SEE A COMPLETE SECTION OF THE PLATE ALL AT ONCE.

BY APPLYING THE INITIAL VOLTAGE ACROSS THE TELEVISION LAMP, WHILE THE SCANNING DISC IS ROTATING AT 900 R.P.M., THE OBSERVER WILL SEE AN ORANGE COLORED SQUARE DUE TO THE GLOW ON THE CATHODE PLATE. THIS ORANGE SQUARE WILL NOT VARY IN BRILLIANCE AND IT WILL BE OF EQUAL SIZE TO THE OPENING IN THE SCREEN, WHICH BY THE WAY, IS GOING TO BE THE SIZE OF THE REPRODUCED PICTURE.

IT IS IMPERATIVE THAT THE SCANNING DISC AT THE RECEIVER BE DRIVEN AT EXACTLY THE SAME SPEED AS THE SCANNING DISC AT THE TRANSMITTER AND THAT THESE TWO DISCS WILL BE SO SYNCHRONIZED THAT THE SAME HOLE OF THE DISC AT THE RECEIVER WILL BE IN THE LINE OF SIGHT OF THE OBSERVER AS THE DISC HOLE PASSING THE BEAM OF LIGHT AT THE TRANSMITTER AT THIS SAME INSTANT.

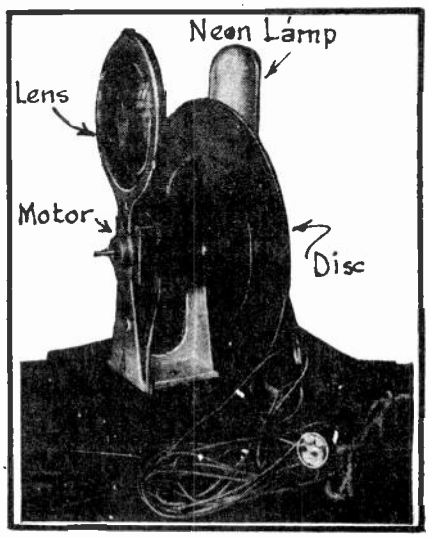


FIG. 23

The Jenkins Radiovisor.

THIS BEING THE CASE, THEN WHEN THE SIGNAL VOLTAGES ARE APPLIED ACROSS THE LAMP AT THE RECEIVER, THE OBSERVER WILL NOT ONLY SEE VARIATIONS IN THE INTENSITY OF THE ORANGE GLOW AS HE LOOKS THROUGH THE FRAME BUT THESE CHANGES IN LIGHT INTENSITY WILL OCCUR AT DEFINITE SPOTS ON THE LAMP'S CATHODE, SO THAT THE CHANGES OF LIGHT AND DARK WILL BE ARRANGED IN THE SAME PATTERN AS ON THE ACTUAL IMAGE BEING TELEVISED.

DO NOT MISUNDERSTAND THIS STATEMENT BECAUSE CERTAIN SPOTS ON THE CATHODE OF THE TELEVISION LAMP DO NOT ACTUALLY CHANGE IN BRILLIANCE BUT THE BRILLIANCE OF THE ENTIRE PLATE VARIES AT THE SAME TIME. HOWEVER, DUE TO THE HOLES IN THE SCANNING DISC, THE OBSERVER ACTUALLY SEES ONLY ONE TINY SPOT OF THE CATHODE AT A TIME AND THE INSTANT THAT HE OBSERVES THIS ONE SPOT, THE ENTIRE CATHODE WILL ALREADY HAVE BECOME BRIGHTER OR DIMMER BUT HE IS UNAWARE OF THIS FACT AND NOTES ONLY THE CHANGE IN LIGHT INTENSITY AT THE ONE PARTICULAR SPOT. HENCE DUE TO THE PRESISTENCE OF VISION, HE STILL SEES THIS SAME SPOT AS THE OTHERS RAPIDLY COME INTO VIEW,

WITH THE RESULT THAT IN HIS MIND, HE SEES THEM ALL AT ONCE, PROPERLY ARRANGED SO THAT THE SHADING OF LIGHT AND DARK IS IN A DEFINITE PATTERN, THEREBY REPRODUCING THE ORIGINAL IMAGE.

ENLARGING THE REPRODUCED PICTURE

THE PRESENT IMAGES REPRODUCED BY TELEVISION IN THE HOME ARE STILL RATHER SMALL, BEING APPROXIMATELY ONE INCH SQUARE AND SO TO INCREASE THEIR SIZE, THE GENERAL PRACTICE IS TO MOUNT A MAGNIFYING LENS BETWEEN THE SCREEN OR FRAME AND THE OBSERVER. THE OBSERVER THEN SEES THE PICTURE THROUGH THE LENS WHICH ENLARGES IT TO SUFFICIENT SIZE FOR COMFORTABLE RECEPTION. AN EXAMPLE OF THE PICTURE REPRODUCER OR "RADIO-VISOR" FOR A TELEVISION RECEIVER IS SHOWN IN FIG.23 AND THROUGH THE LENS IN THIS CASE, THE PICTURE WILL APPEAR AS BEING ABOUT 4" SQUARE.

IN THIS LESSON, WE HAVE DISCUSSED THE FUNDAMENTAL PRINCIPLES UNDERLYING THE TRANSMISSION AND RECEPTION OF TELEVISION AND IN THE FOLLOWING LESSON, WE WILL CONTINUE THE STUDY OF TELEVISION, CONSIDERING AT THAT TIME OTHER METHODS OF SCANNING, VARIOUS TELEVISION RECEIVER CIRCUITS, METHODS OF SYNCHRONIZING TELEVISION EQUIPMENT ETC.

Examination Questions

LESSON NO. TEL-1

1. - WHAT ARE THE ESSENTIAL DIFFERENCES BETWEEN A TELEVISION RECEIVER AND A BROADCAST RECEIVER?
2 - DO DARK SURFACES REFLECT LIGHT BETTER THAN DO SURFACES OF A LIGHTER COLOR?
3. - AT A TELEVISION TRANSMITTER, IS THE ENTIRE IMAGE TO BE TELEVISED "PICKED-UP" ALL AT ONCE BY THE PHOTO-ELECTRIC CELLS? EXPLAIN.
4. - AS FAR AS THE SCANNING DISC ITSELF IS CONCERNED, WHAT DETERMINES THE WIDTH AND HEIGHT OF THE "PICTURE"?
5. - WHEN USING A SCANNING DISC HAVING 48 HOLES, HOW MANY REVOLUTIONS OF THE DISC ARE REQUIRED TO SCAN THE OBJECT ONCE?
6. - WILL PICTURE DETAIL BE BETTER IF A SCANNING DISC OF A GREATER NUMBER OF HOLES IS USED?
7. - IF THE VOLTAGE ACROSS THE NEON LAMP IS INCREASED, WILL THE LAMP INCREASE IN BRILLIANCE?
8. - DOES THE GLOW IN THE NEON LAMP OCCUR AROUND THE POSITIVE PLATE OR AROUND THE NEGATIVE PLATE?
9. - WHAT IS THE PURPOSE OF THE SCANNING DISC AT THE TELEVISION RECEIVER?
10 - ARE SOME PORTIONS OF THE NEON LAMP'S CATHODE ILLUMINATED BRIGHTER THAN OTHERS? EXPLAIN.

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Television

LESSON NO. 2

NEON LAMP CIRCUITS -- MECHANICAL SCANNERS

IN THE PREVIOUS LESSON, YOU WERE SHOWN ONLY ONE FUNDAMENTAL NEON LAMP CIRCUIT CONNECTED TO THE OUTPUT OF THE TELEVISION RECEIVER. ALTHOUGH THIS ONE CIRCUIT SERVED TO ILLUSTRATE HOW THE TELEVISION LAMP IS MADE TO OPERATE, YET YOU SHOULD ALSO BECOME FAMILIAR WITH OTHER POPULAR LAMP CIRCUITS.

DIRECTLY COUPLED LAMP CIRCUIT

PROBABLY THE THOUGHT HAS ALREADY PRESENTED ITSELF TO YOU AS TO WHY THE TELEVISION LAMP CANNOT BE CONNECTED DIRECTLY INTO THE PLATE CIRCUIT OF THE POWER TUBE AS ILLUSTRATED IN FIG.2, INSTEAD OF USING A COUPLING CIRCUIT. ALTHOUGH THE CIRCUIT OF FIG.2 CAN BE USED, YET IT IS NOT ADVISABLE BECAUSE NO PROVISION IS MADE, WHEREBY THE INITIAL INTENSITY OF THE LAMP CAN BE ADJUSTED FOR BEST RESULTS. FURTHERMORE, THIS SYSTEM DOES NOT PERMIT THE USE OF VOLTAGES BEST SUITED FOR BOTH THE NEON LAMP AND POWER TUBE.

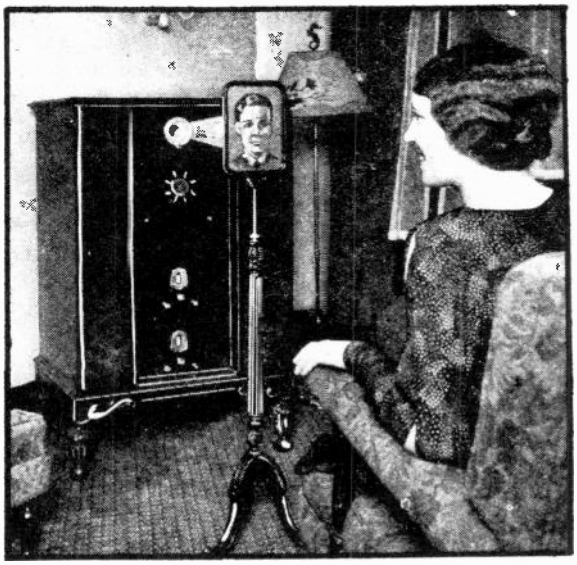

FIG. 1
Television in the Home.

THE SYSTEM OF FIG. 2 HAS BEEN IMPROVED UPON IN THE CIRCUIT DIAGRAM OF FIG.3. THE ESSENTIAL IMPROVEMENTS BEING THE POTENTIOMETER AND THE 2000 OHM RESISTOR, WHICH AIDS IN OBTAINING A BETTER IMPEDANCE MATCH BETWEEN THE POWER TUBE AND ITS PLATE CIRCUIT. EVEN WITH THESE ADDED IMPROVEMENTS, THE SYSTEM IS NOT AL

TOGETHER SATISFACTORY, CHIEFLY BECAUSE IF THE POTENTIOMETER IS ADJUSTED FOR THE MOST SUITABLE BRILLIANCY OF THE LAMP, THE PLATE VOLTAGE OF THE TUBE WILL ALSO BE EFFECTED AND WOULD THUS PREVENT THE TUBE FROM OPERATING AT ITS RECOMMENDED VALUES.

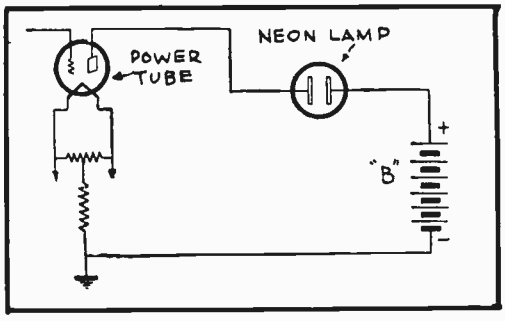

FIG. 2
Neon Lamp Connections.

SO YOU SEE, CONSIDERING ALL OF THESE CONDITIONS, IT IS BEST TO USE A SEPARATE SOURCE OF VOLTAGE FOP THE LAMP. THIS VOLTAGE SOURCE FOR THE LAMP, HOWEVER, DOES NOT NECESSARILY HAVE TO BE SUPPLIED BY BATTERIES BUT MAY BE FURNISHED BY ANY CONVENTIONAL TYPE OF "B" ELIMINATOR. IN THIS CASE, THE CURRENT, AS FURNISHED BY THE ELIMINATOR, MUST BE ABSOLUTELY FREE FROM A.C. RIPPLE AS OTHERWISE IT WILL SPOIL THE PICTURE.

INDIRECT LAMP COUPLING WITH COMMON "B" SUPPLY

FIG. 4 ILLUSTRATES A GOOD SYSTEM IN WHICH THE SAME "B" SUPPLY CAN BE USED FOR BOTH THE POWER TUBE OF THE RECEIVER AND THE NEON LAMP. NOTICE THAT IN THIS EXAMPLE, THE "B" SUPPLY AS FURNISHED TO THE POWER TUBE, WILL NOT BE AFFECTED BY ANY CHANGE OF RESISTANCE IN THE LAMP CIRCUIT BECAUSE AS FAR AS D.C. IS CONCERNED, THE POWER TUBE AND LAMP CIRCUITS ARE CONNECTED IN PARALLEL WITH EACHOTHER AND A FIXED CONDENSER PREVENTS THE D.C. OF THE LAMP CIRCUIT FROM FLOWING THROUGH THE LOAD OF THE POWER TUBE. AN IRON CORE IMPEDANCE OR CHOKE COIL IS USED AS THE LOAD IN THE PLATE CIRCUIT OF THE POWER TUBE.

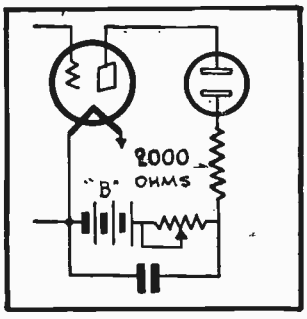

FIG. 3
Additional load.

THE RESISTOR R_1 OF FIG. 4 IS USED TO ADJUST THE INITIAL INTENSITY OF THE TELEVISION LAMP, WHILE THE 1000 OHM RESISTOR IS THE CURRENT LIMITING RESISTOR. RESISTOR R_3 SERVES AS A LOAD ACROSS WHICH THE SIGNAL VOLTAGES CAN BE DEVELOPED TO ACT UPON THE LAMP AND THIS SAME RESISTOR ALSO SERVES TO COMPLETE THE "B" CIRCUIT THROUGH THE LAMP.

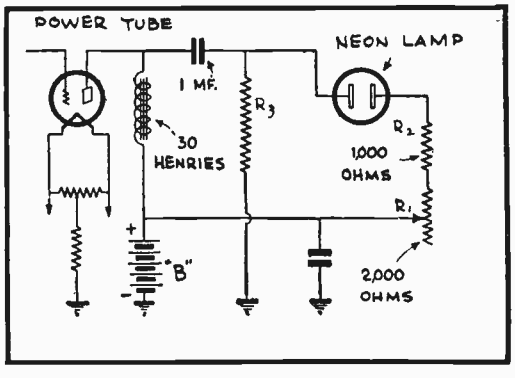

FIG. 4
Indirect Coupling.

THE GLOW LAMP IS EXCEEDINGLY SENSITIVE TOWARD VOLTAGE VARIATIONS ACTING UPON IT AND IT HAS BEEN ESTIMATED THAT SUCH A LAMP IS CAPABLE OF CONVERTING VOLTAGE CHANGES INTO VARIATIONS IN LIGHT INTENSITY AT THE REMARKABLE RATE OF 100,000 CYCLES PER SECOND. IN OTHER WORDS, VOLTAGE AND CURRENT VARIATIONS AS RAPID AS 100,000 CYCLES CAN BE FOLLOWED BY THE GLOW-LAMP.

MORE ABOUT MECHANICAL SCANNING

NOW LET US RETURN TO THE SUBJECT

OF SCANNING. YOU WILL RECALL THAT IN THE PREVIOUS LESSON, THE ONLY SCANNING DEVICE, WHICH WE CONSIDERED, WAS THE DISC HAVING A NUMBER OF HOLES ARRANGED IN A SPIRAL FORMATION NEAR ITS RIM. THIS TYPE OF SCANNING DISC IS KNOWN AS THE "NIPKOW SCANNING DISC" BUT BESIDES THIS TYPE, STILL OTHERS ARE BEING USED AND IT IS WITH SOME OF THESE OTHER TYPES TO WHICH WE SHALL DEVOTE THE PRESENT DISCUSSION.

THE SANABRIA SYSTEM OF SCANNING

A DIFFERENT TYPE OF SCANNING DISC IS SHOWN IN FIG.5. THIS IS THE "SANABRIA DISC" AND IN THIS CASE, INSTEAD OF HAVING ONE CONTINUOUS SPIRAL, WE HAVE THREE SECTIONS, NAMELY "A", "B" AND "C". THIS TYPE OF DISC WILL COMPLETELY SCAN THE PICTURE THREE TIMES DURING ONE REVOLUTION. THAT IS, EACH SECTION OF HOLES SCANS THE PICTURE ONCE AND SHOULD WE START WITH THE HOLE MARKED 1, THE ENTIRE PICTURE WILL HAVE BEEN SCANNED ONCE BY THE TIME THE LAST HOLE OF GROUP "A" COMES INTO THE LINE OF VISION. THE HOLE MARKED 2 WILL THEN COMMENCE SCANNING THE PICTURE FOR THE SECOND TIME, COMPLETING THE JOB WITH THE LAST HOLE IN SECTION "B" THIS SAME PROCESS IS THEN BEGUN BY HOLE #3 AND SECTION "C" WILL SCAN THE PICTURE FOR THE THIRD TIME AS THE DISC COMPLETES A SINGLE REVOLUTION.

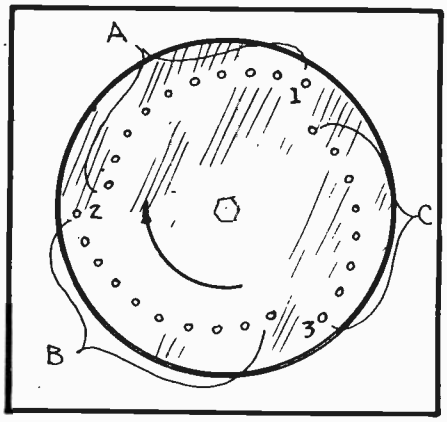

FIG. 5
The "Sanabria" Scanning Disc.

IN THIS CASE, HOWEVER, THE OBJECT IS NOT REALLY COMPLETELY SCANNED BY EACH SECTION OF THE DISC BECAUSE THE ADJACENT HOLES IN ANY ONE SECTION APPROACH THE CENTER OF THE DISC AT TWICE THE RATE AS IN DISCS OF THE CONTINUOUS SPIRAL TYPE. THIS CAN PROBABLY BE BEST ILLUSTRATED BY MEANS OF FIG.6, WHERE THE PICTURE FRAME HAS BEEN DIVIDED INTO 45 HORIZONTAL LINES TO CONFORM WITH THE 45 HOLES IN THE DISC.

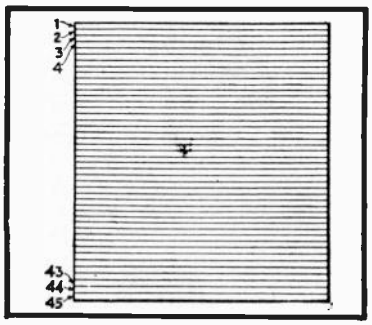

FIG. 6
Sequence of Scanning.

NOW AS SECTION "A" DOES THE SCANNING, IT DOES NOT SCAN THE LINES IN CONSECUTIVE ORDER BUT IT SCANS LINE #1 FIRST AND THEN LINES 4-7-10-13-16 ETC. AND FINISHES WITH THE 43rd LINE. SECTION "B" OF THE DISC COMMENCES ITS SCANNING OPERATION WITH LINE #2 IN FIG.6 AND THEN CONSECUTIVELY LINES 5-8-11-14 ETC., FINISHING WITH THE 44TH LINE.

SECTION "C" THEN FOLLOWS BY SCANNING THE LINES IN THE ORDER OF 3-6-9-12-15 ETC. AS SEEN IN FIG.6 AND THEN AFTER ONE COMPLETE REVOLUTION OF THE DISC, THE PICTURE WILL HAVE BEEN SCANNED IN DETAIL. BY ROTATING THE DISC AT SUFFICIENT SPEED, THE FIELD OF VIEW, AS OBSERVED THROUGH THE HOLES OF THE DISC, WILL TAKE ON THE APPEARANCE OF A SQUARE OR RECTANGLE, WHOSE WIDTH IS EQUAL TO THE DISTANCE BETWEEN ADJACENT HOLES AND WHOSE HEIGHT IS EQUAL TO THE DIFFERENCE BETWEEN THE CENTER OF THE DISC AND THE FIRST AND LAST HOLE OF EACH SECTION.

LENS-EQUIPPED SCANNING DISCS

LIGHT RAYS HAVE A NATURAL TENDENCY TO SPREAD APART AS THEY GET FARTHER AWAY FROM THEIR SOURCE. THIS MEANS THAT THE FARTHER WE GO FROM THE LIGHT SOURCE, THE GREATER WILL BE THE AREA COVERED BY THE BEAMS AND TO COVER A LARGER AREA WITH A GIVEN AMOUNT OF LIGHT, IT IS CLEAR THAT THE ILLUMINATION WILL DECREASE WITH AN INCREASE IN AREA ON WHICH THE LIGHT RAYS ARE SPREAD.

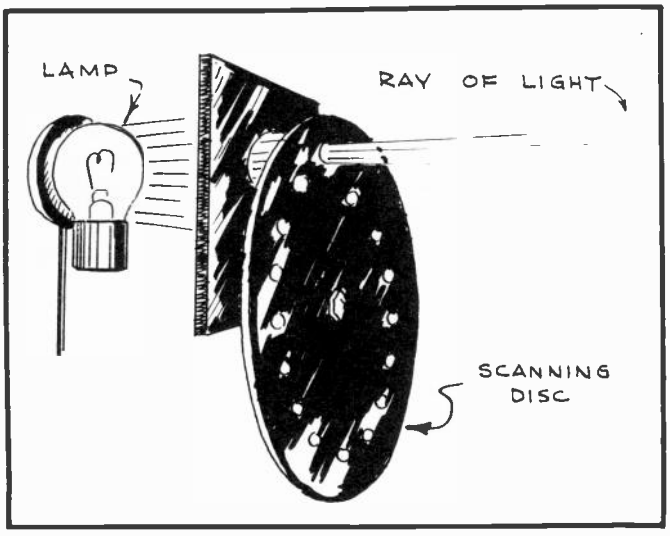

FIG. 7
Spreading of Light Rays.

THE LAW CONTROLLING THIS PHENOMENA IS KNOWN AS THE "INVERSE SQUARE LAW" AND THIS LAW STATES THAT AS THE DISTANCE FROM THE SOURCE IS DOUBLED, THE ILLUMINATION AT THE LATTER OR FARTHER POINT IS ONLY 1/4 THAT AT THE POINT NEARER THE LIGHT SOURCE. IN OTHER WORDS, AT 10 FT. FROM THE LIGHT SOURCE, THE ILLUMINATION IS ONLY 1/4 THAT AT A POINT ONLY 5 FT. FROM THE SOURCE.

THIS CONDITION WILL TEND TO SPREAD THE LIGHT BEAM OVER TOO GREAT AN AREA WHEN SCANNING THE SUBJECT TO BE TELEVISED AND THIS OF COURSE IS UNDESIRABLE IF GOOD PICTURE DETAIL IS EXPECTED. TO REMEDY THIS UNFAVORABLE CONDITION, SOME SCANNING DISCS HAVE AN INDIVIDUAL CONDENSING LENS MOUNTED IN EACH HOLE OF THE DISC.

THE CONDENSING LENS ACTS THE SAME AS AN ORDINARY MAGNIFYING LENS, IN THAT IT COLLECTS THE SPREADING LIGHT RAYS AND FOCUSES THEM DOWN TO A SMALL SPOT. THE USE OF SUCH A LENS-EQUIPPED SCANNING DISC IS SHOWN IN FIG. 8 AND HERE YOU WILL NOTE HOW A SHARP, CONCENTRATED BEAM OF LIGHT COVERS BUT A VERY SMALL AREA AT A TIME, AS THE TELEVISED SUBJECT IS BEING SCANNED.

LENS-EQUIPPED SCANNING DISCS CAN ALSO BE USED AT THE RECEIVER AS ILLUSTRATED IN FIG. 9. HERE YOU WILL NOTE THAT THE CONCENTRATED LIGHT BEAM IS FOCUSED UPON A SEMI-TRANSPARENT SCREEN, UPON WHICH THE TELEVISED IMAGE IS FORMED BY THE BEAM

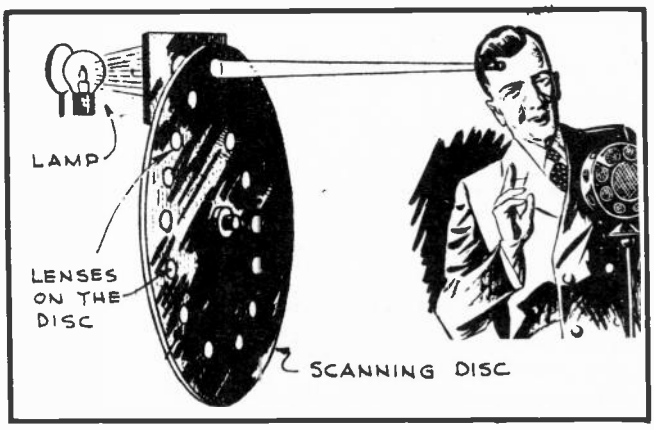

FIG. 8
Lens-Equipped Scanning Disc.

OF THE GLOW LAMP. THIS SYSTEM IS BEING USED IN THE PHOTOGRAPH SHOWN IN FIG.1 OF THIS LESSON.

MULTI-SYSTEM SCANNING DISC

SINCE NO STANDARD HAS YET BEEN ADOPTED AS TO THE NUMBER OF LINES INTO WHICH AN OBJECT SHOULD BE DIVIDED WHILE SCANNING, YOU WILL FIND SOME SYSTEMS USING 48 LINES, OTHERS 60 LINES ETC. THIS BEING THE CASE, IT IS OBVIOUS THAT A DIFFERENT SCANNING DISC MUST BE USED AT THE RECEIVER, IN ORDER TO RECEIVE PICTURES FROM STATIONS TRANSMITTING WITH ANY ONE OF THE POSSIBLE SYSTEMS. HOWEVER, THE NECESSITY OF SEPARATE DISCS CAN BE DONE AWAY WITH QUITE EASILY, SIMPLY BY MAKING A DISC SUCH AS ILLUSTRATED IN FIG.10, WHERE TWO SETS OF SPIRAL HOLES "A" AND "B" ARE PROVIDED.

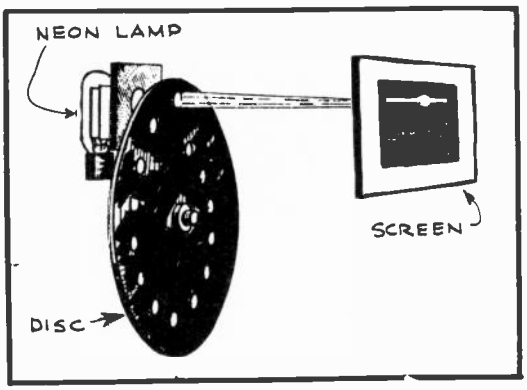

FIG. 9
Reproduction of Picture Upon a Screen

ASSUMING ONE OF THESE SPIRALS OF FIG.10 TO CONSIST OF 60 HOLES AND THE OTHER OF 48 HOLES, YOU CAN USE EITHER SECTION MERELY BY CHANGING THE POSITION OF THE GLOW LAMP SO THAT IT WILL BE ALIGNED WITH WHATEVER SET OF HOLES IS BEING USED AT THE TIME. THE TWO SETS OF HOLES ARE SPACED FAR ENOUGH APART, SO THAT BOTH OF THEM CANNOT BE IN THE FIELD OF VIEW AT THE SAME TIME. IT IS ALSO POSSIBLE TO MAKE A SIMILAR DISC, HAVING ONE OR MORE SETS OF HOLES FOR THE NIPKOW SYSTEM OF A DIFFERENT NUMBER OF LINES PER SET AND IN ADDITION, TO ALSO HAVE A THREE-SECTION SET OF HOLES FOR THE SANABRIA SYSTEM, THUS HAVING WHAT MIGHT BE CLASSIFIED AS A UNIVERSAL SCANNING DISC.

THE SCANNING BELT

IN FIG.11 YOU WILL SEE STILL ANOTHER SCANNING DEVICE. THIS UNIT IS EMPLOYED WITH THE BAIRD TELEVISION EQUIPMENT AND AS YOU WILL NOTE, THE SCANNING MEMBER CONSISTS OF A THIN METALLIC BELT OR HOOP, HAVING THE SCANNING HOLES SPIRALLY ARRANGED AROUND ITS CIRCUMFERENCE. THE SCANNING BELT IS MOUNTED ON A SPIDER AND THE SPIDER IS DRIVEN BY AN ELECTRIC MOTOR.

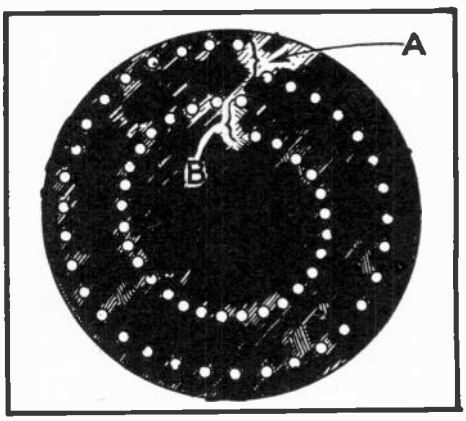

FIG. 10
Two Scanning Discs in One.

THE GLOW LAMP IS MOUNTED IN POSITION BEHIND THE SCANNING BELT, THAT IS, INSIDE THE DRUM-SHAPED CHAMBER SO THAT THE GLOWING PLATE CAN BE OBSERVED THRU THE SCANNING HOLES AS THE BELT IS RAPIDLY ROTATED. ONE COMPLETE REVOLUTION OF THE BELT WILL SCAN THE PICTURE ONCE, THE SAME AS IN THE CASE OF THE NIPKOW DISC TYPE SCANNER.

THE BELT IS REMOVABLE FROM THE SPIDER AND CAN BE REPLACED WITH BELTS HAVING A DIFFERENT NUMBER OF HOLES, SO THAT THE UNIT IS ADAPTABLE TO THE 48 LINE, 45-LINE, AND 60 LINE SYSTEM.

SCANNING WITH A DRUM

IN FIG.12, YOU ARE SHOWN A REAR VIEW PHOTOGRAPH OF THE IMPROVED JENKIN'S DRUM TYPE RADIOVISOR. THIS UNIT CONSISTS OF A SCANNING DRUM AND SHUTTER OR OBSCURING DISC, BOTH DRIVEN BY THE SAME ELECTRIC MOTOR.

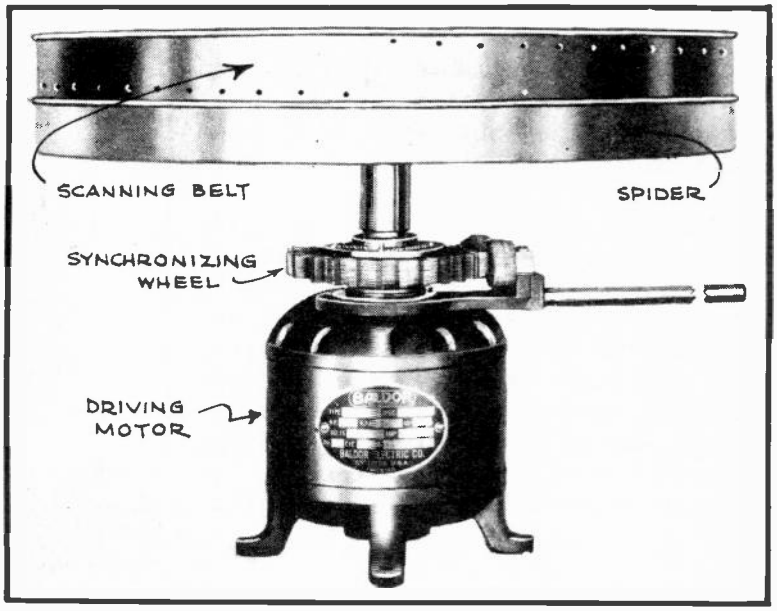

FIG. 11
Belt Type Scanner.

THE CIRCUMFERENCE OF THE DRUM IS PERFORATED WITH FOUR ROWS OF HOLES, EACH ROW FORMING ONE COMPLETE TURN AND EACH ROW IS ARRANGED SO AS TO FORM ONE TURN OF A HELIX. THAT IS, THE FOUR ROWS OF HOLES ARE JUST LIKE FOUR THREADS AROUND A SCREW. TWO MORE VIEWS OF THIS SAME UNIT ARE SHOWN IN FIGS. 13 AND 14.

THE NEON LAMP IS MOUNTED INSIDE OF THE DRUM, SO THAT THE CATHODE PLATE FACES ONE SIDE OF THE DRUM AS SHOWN IN FIGS. 13 AND 14. THE OBSERVER SEES THE GLOW OF THE LAMP THROUGH THE HOLES OF THE DRUM, AS THE DRUM RAPIDLY REVOLVES AROUND THE STATIONARY LAMP. BEING THAT THERE ARE FOUR DRUM HOLES CONTINUALLY VERTICALLY ALIGNED WITH EACHOTHER, THE OBSERVER WOULD ACTUALLY SEE FOUR DIFFERENT SPOTS ON THE CATHODE OF THE NEON LAMP AT THE SAME TIME. TO PREVENT THIS, HOWEVER, AN ENGENIOUS SHUTTER OR OBSCURING DISC IS USED IN CONJUNCTION WITH THE DRUM.

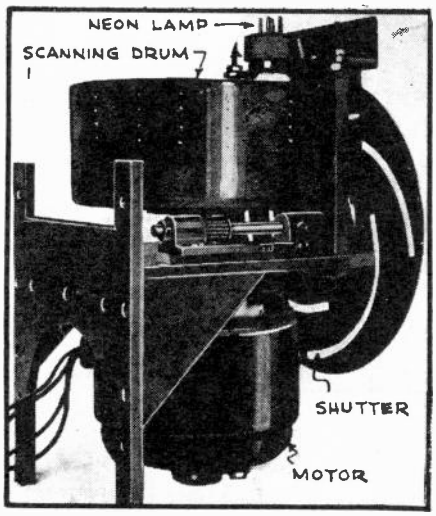

FIG.12
The Jenkins Radiovisor.

THIS SHUTTER DISC HAS SLOTS CUT IN IT AT SUCH ANGLES, SO THAT WHEN THE SHUTTER DISC AND DRUM ARE DRIVEN SIMULTANEOUSLY, ONE SLOT WILL ONLY UNCOVER ONE ROW OF DRUM HOLES AS THE DRUM AND SHUTTER COMPLETE ONE REVOLUTION. THAT IS, AS THE PICTURE BEGINS, ONE SHUTTER SLOT WILL UNCOVER THE TOP ROW OF DRUM HOLES AND ALL OTHER DRUM HOLES WILL BE HIDDEN FROM VIEW AT THIS TIME. DURING THE SECOND REVOLUTION OF THE DRUM, THE SECOND ROW OF DRUM HOLES WILL BE EXPOSED BY A SHUTTER SLOT ETC. AND IN ORDER

TO COMPLETELY SCAN THE PICTURE, FOUR REVOLUTIONS OF THE DRUM ARE REQUIRED.

FIG. 14 ILLUSTRATES HOW THE OBSERVER SEES THE PICTURE AT THIS TYPE OF RADIOVISOR. THIS ILLUSTRATION CLEARLY SHOWS THE RELATION BETWEEN THE DRIVING MOTOR, SCANNING DRUM, NEON LAMP, SHUTTER DISC, MAGNIFYING LENS , SHADOW BOX, AND THE OBSERVER. STUDY THIS DRAWING CAREFULLY.

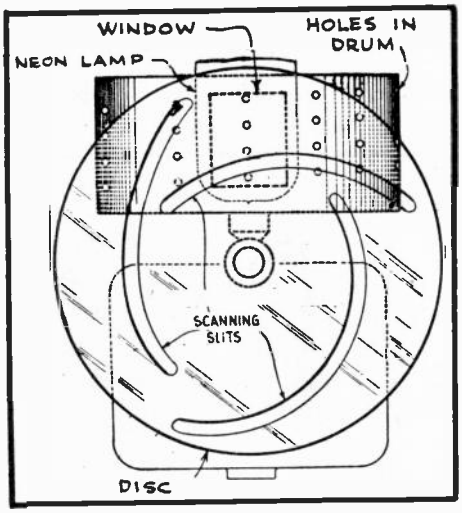

FIG. 13
Front View of Jenkins Drum Type Radiovisor.

THE ENTIRE RADIOVISOR IS INSTALLED IN A CABINET AS OUTLINED IN FIG.14 AND THE COMPLETE UNIT THEN APPEARS FROM THE OUTSIDE AS SHOWN IN FIG.15. TO OBSERVE THE PICTURE, ONE SIMPLY LOOKS INTO THE SHADOW BOX BUT IT IS NOT NECESSARY FOR ONE TO ACTUALLY INSERT THEIR HEAD INTO THE BOX AS WAS FREQUENTLY THE CASE IN SOME OF THE EARLIER EXPERIMENTAL MODELS.

THE PURPOSE OF THE "SHADOW BOX" IS TO PREVENT TOO MUCH OUTSIDE LIGHT FROM FALLING UPON THE PICTURE BECAUSE SUCH LIGHT WOULD TEND TO MAKE THE PICTURE IN DISTINCT, THE SAME AS WHEN TOO MUCH LIGHT IS PERMITTED TO FALL UPON THE SCREEN AT A MOTION PICTURE THEATER. THE SHADOW BOX SIMPLY SERVES THE SAME PURPOSE AS THE DARKENED ROOM WHERE MOTION PICTURES ARE SHOWN.

A SINGLE PLATE NEON LAMP IS USED IN THIS PARTICULAR RADIOVISOR. BY A SINGLE PLATE LAMP IS MEANT THAT THE CATHODE IS IN THE FORM OF A CUSTOMARY LAMP PLATE BUT THE ANODE INSTEAD OF BEING A PLATE, TAKES THE FORM OF A RECTANGULAR SHAPED FRAME PLACED CLOSE TO THE CATHODE. THE OPERATING PRINCIPLES, HOWEVER, ARE IDENTICAL TO THE LAMP WHERE BOTH THE CATHODE AND ANODE TAKE THE SHAPE OF PLATES.

A DOUBLE SCANNING DISC

ANOTHER SCANNING SYSTEM, WHICH HAS BEEN USED WITH SOME OF THE BAIRD TELEVISION EQUIPMENT, IS SHOWN IN FIG.16. IN THIS CASE, WE HAVE TWO SCANNING DISCS-AN OUTER ONE AND AN INNER ONE. THE INNER DISC HAS LONG NARROW HOLES PLACED RADIALLY AROUND ITS CIRCUMFERENCE AND THE OUTER DISC HAS BUT ONE CONTINUOUS SPIRAL CUT AROUND ITS CIRCUMFERENCE. THE TWO DISCS ARE PLACED BETWEEN THE NEON LAMP, SCREEN, AND OBSERVER AS ILLUSTRATED AND THEY ARE THEN DRIVEN IN OPPOSITE DIRECTIONS.

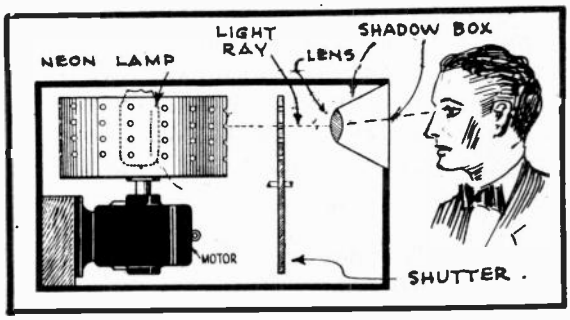

FIG. 14
Observing the Picture.

THE INNER DISC ALONE WOULD

EXPOSE A LONG NARROW SECTION OF THE LAMP'S CATHODE WHEN IN THE LINE OF VISION BUT THE WIDTH OF THE SPIRAL SLOT IN THE OTHER DISC DETERMINES THE HEIGHT OF THE PLATE SECTION SEEN BY THE OBSERVER. THUS THE INNER SLOTTED DISC DIRECTS THE OBSERVER'S VISION HORIZONTALLY OR ACROSS THE PICTURE, WHILE THE OUTER SPIRAL DISC DIRECTS HIS VISION VERTICALLY FROM THE TOP TOWARD THE BOTTOM OF THE PICTURE.

SCANNING WITH MIRRORS

THE MIRROR TYPE SCANNER IS ILLUSTRATED FOR YOU IN FIG. 17 AND HERE THE SCANNING DEVICE CONSISTS OF A WHEEL CALLED THE "MIRROR WHEEL" AND

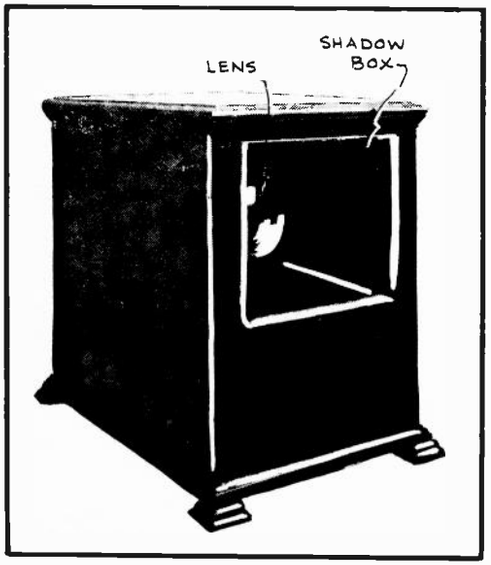

FIG. 15
Jenkins Radiovisor Cabinet.

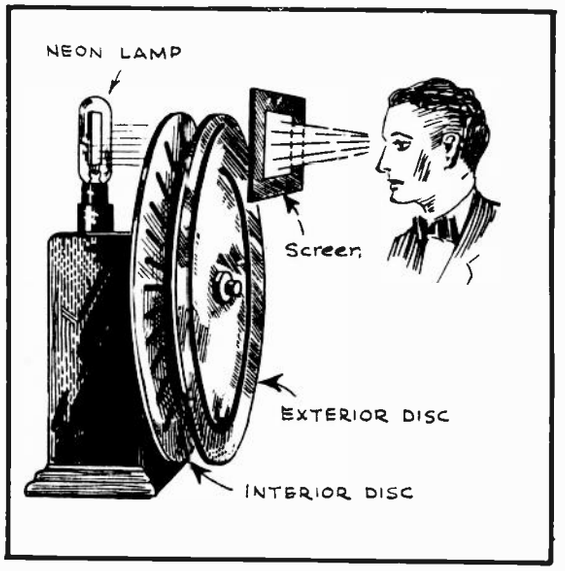

FIG. 16
A Dual Scanning Disc

MANY SMALL INDIVIDUAL MIRRORS ARE MOUNTED AROUND THE CIRCUMFERENCE OF THIS WHEEL.

THE LIGHT BEAM FROM THE TELEVISION LAMP IS PASSED THROUGH A CONDENSING LENS, WHICH DIRECTS IT UNTO THE MIRROR SURFACES AS A SHARPLY DEFINED BEAM. AS THE MIRROR WHEEL IS CAUSED TO ROTATE BY THE ELECTRIC MOTOR, EACH OF THE SMALL MIRRORS WILL TAKE ITS TURN IN HAVING THE LAMP'S LIGHT BEAM FOCUSED UPON IT. THE LIGHT STRIKING ANY ONE OF THE MIRRORS WILL BE REFLECTED FROM IT AT AN ANGLE AND WE CALL THIS REFLECTED LIGHT THE "SCANNING BEAM".

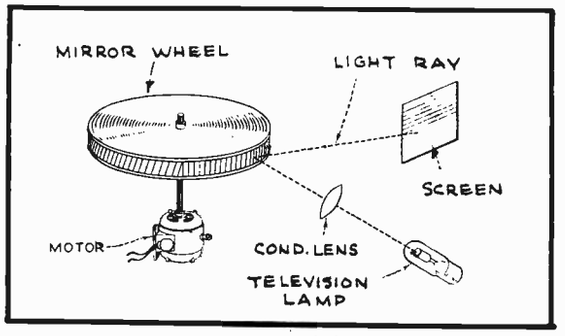

FIG. 17
Scanning With the Mirror Wheel.

A "TRANSLUCENT", THAT IS, A SEMI-TRANSPARENT SCREEN IS PLACED IN THE PATH OF THE SCANNING BEAM, SO THAT AS ANY ONE MIRROR QUICKLY PASSES THE BEAM GIV-

EN OFF BY THE NEON LAMP. IT WILL DRAW THE SCANNING BEAM HORIZONTALLY ACROSS THE SCREEN. THIS IS OF COURSE POSSIBLE DUE TO THE CHANGE IN THE ANGLE OF REFLECTION AS THE MIRROR MOVES IN ITS CIRCULAR PATH OR ORBIT. THIS ACTION, AS JUST DESCRIBED, ACCOUNTS FOR THE HORIZONTAL SCANNING.

THE VERTICAL SCANNING OF THE PICTURE IS ACCOMPLISHED BY THE FACT THAT EACH OF THE SMALL MIRRORS IS TILTED IN A SLIGHTLY DIFFERENT VERTICAL PLANE, SO THAT AS THE MIRROR WHEEL IS ROTATED, EACH MIRROR WILL SCAN A HORIZONTAL LINE SLIGHTLY BELOW THE ONE SCANNED BY THE PRECEEDING MIRROR. FINALLY, AFTER ONE COMPLETE REVOLUTION OF THE WHEEL, THE PICTURE WILL HAVE BEEN SCANNED COMPLETELY FROM THE TOP TOWARD THE BOTTOM, AS WELL AS HORIZONTALLY.

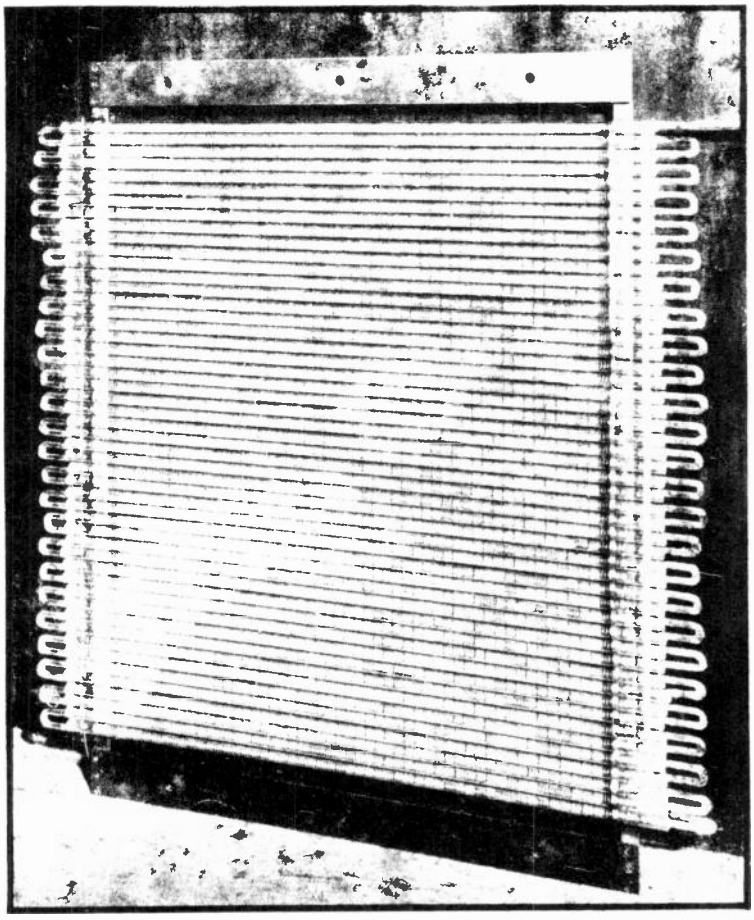

FIG. 18
Reproducing Grid of Bell Laboratories.

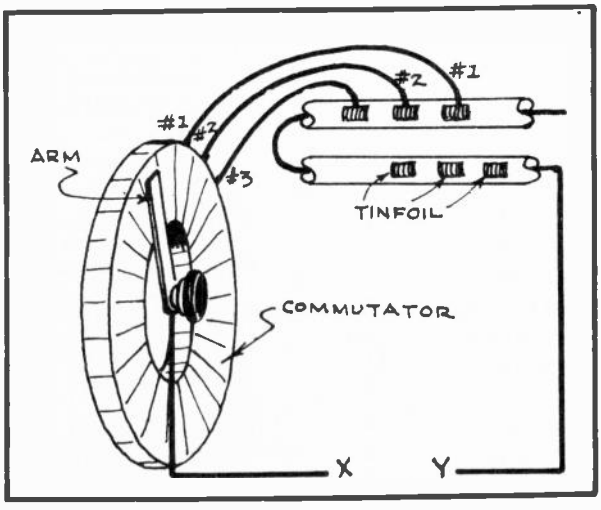

FIG. 19
Diagram of the Bell Reproducing Grid.

THE BELL SYSTEM OF REPRODUCING PICTURES

QUITE A COMPLEX TELEVISION REPRODUCING DEVICE WAS CONCEIVED BY THE BELL LABORATORIES. THE UNIT IS ILLUSTRATED IN FIG. 18 AND IT CONSISTS OF A CONTINUOUS GLASS TUBING, WHICH IS BENT BACK AND FORTH ACROSS A FRAME-WORK, THUS FORMING A GRID SHAPED BODY. THIS GLASS TUBING IS FILLED WITH NEON GAS AND A CONTINUOUS SPIRALLY WOUND WIRE RUNS THROUGH THIS TUBING THRUOUT ITS ENTIRE LENGTH. UNIFORMLY SPACED ON THE OUTSIDE OF THE GLASS TUBING, THERE ARE 2500 SMALL RECTANGLES OF FOIL.

EACH OF THESE SMALL PIECES OF FOIL IS CONNECTED TO A COMMUTATOR BAR BY MEANS OF A PIECE OF WIRE. THIS COMMUTATOR IS SHOWN IN FIG.19 AND THE BARS ARE ALL INSULATED FROM EACHOTHER. ALSO NOTICE THE CONNECTION BETWEEN THE PIECES OF FOIL AND THE COMMUTATOR BARS IN FIG.19.

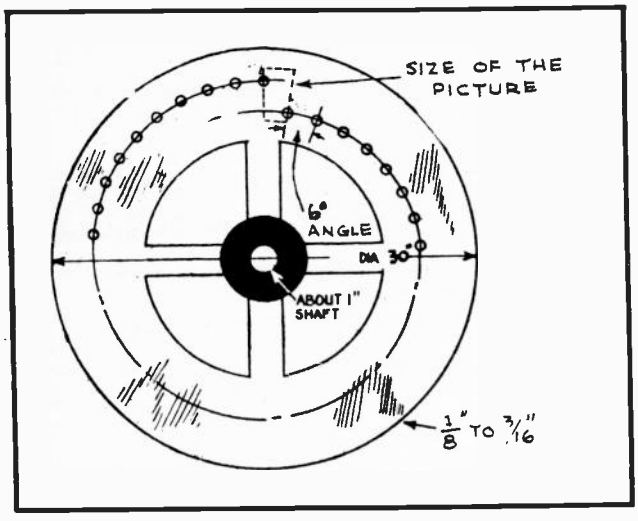

FIG. 20
Scanning Disc Layout.

SINCE 2500 PIECES OF FOIL ARE MOUNTED ON THE OUTSIDE OF THE GLASS TUBING, THERE MUST BE 2500 BARS IN THE COMMUTATOR AND 2500 WIRES FOR CONNECTIONS. ONE END OF THE TUBE'S CENTRAL WIRE TERMINATES AT POINT "Y" AND THE ARM OF THE COMMUTATING DEVICE IS CONNECTED TO POINT "X". POINTS "X" AND "Y" ARE THEN CONNECTED IN THE OUTPUT OF THE TELEVISION RECEIVER'S POWER STAGE IN PLACE OF THE CUSTOMARY NEON LAMP. THE SIGNAL VOLTAGES WILL THEREFORE BE IMPRESSED ACROSS POINTS "X" AND "Y" AND WITH THE CONTACT ARM ON COMMUTATOR SEGMENT #1 IN FIG.19, THE SIGNAL VOLTAGE WILL BE IMPRESSED ACROSS FOIL #1 AND THE CENTRAL WIRE AND THEREFORE THE NEON TUBE WILL GLOW AT THIS PARTICULAR POINT, WITH THE BRILLIANCE OF THE GLOW DEPENDING UPON THE APPLIED SIGNAL VOLTAGE AT THIS PARTICULAR INSTANT.

SHOULD THE CONTACT ARM BE DRIVEN IN A CLOCKWISE DIRECTION BY A MOTOR, THEN THE CIRCUIT WILL AT THIS INSTANT BE COMPLETED THROUGH CIRCUIT #2 AND THE SECTION OF THE NEON TUBE AT FOIL #2 WILL GLOW. IN LIKE MANNER, AS THE COMMUTATOR ARM COMPLETES ONE REVOLUTION, THE NEON TUBE WILL GLOW AT EACH OF THE 2500 RECTANGLES OF FOIL AND THE BRILLIANCE OF THE GLOW AT ANY ONE OF THESE POINTS WILL DEPEND ENTIRELY UPON THE SIGNAL VOLTAGE BEING APPLIED ACROSS X AND Y AT THE TIME.

BY REVOLVING THE CONTACT ARM FAST ENOUGH, THESE SEPARATE GLOWS WILL APPEAR TO THE EYE AS ONE MASS OF LIGHT, AND THE VARIATIONS IN BRILLIANCE AT THE DIFFERENT SECTIONS OF THE NEON GRID WILL BE ARRANGED INTO A DEFINITE PATTERN, SO AS TO REPRODUCE THE LIGHT AND SHADING EFFECT AS THEY ARE ON THE ORIGINAL OBJECT BEING TELEVISED. THE PICTURE WILL BE COMPLETELY SCANNED AFTER EACH REVOLUTION OF THE COMMUTATOR ARM.

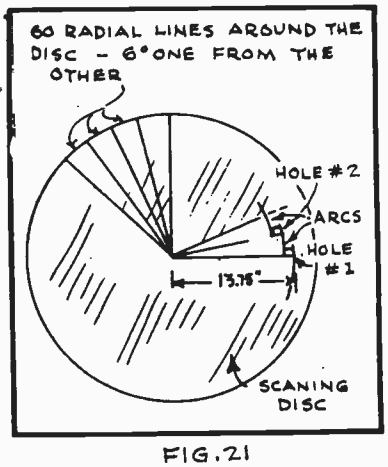

FIG.21
Spotting the Holes.

CONSTRUCTION OF A NIPKOW SCANNING DISC

SINCE THE NIPKOW SCANNER IS THE CHEAPEST, AS WELL AS THE MOST EASILY CONSTRUCTED SCANNER, IT IS USED MORE THAN ANY OTHER SYSTEM

BY THE HOME EXPERIMENTER. FOR THIS REASON, THE FOLLOWING CONSTRUCTIONAL INFORMATION HAS BEEN PREPARED. OUR FIRST STEP IN THIS DIRECTION WILL BE TO LAY-OUT A 60 HOLE DISC AS A SPECIFIC EXAMPLE.

IN THIS CASE, THE IMAGE WILL BE 60 ELEMENTS HIGH AND 72 ELEMENTS WIDE, WHICH MEANS THAT THE PICTURE WILL BE OBLONG RATHER THAN SQUARE. THE IMAGES FOR THIS SYSTEM ARE SCANNED AT A RATE OF 20 PICTURE PER SECOND AND THIS CORRESPONDS TO A SCANNING DISC SPEED OF 1200 R.P.M.

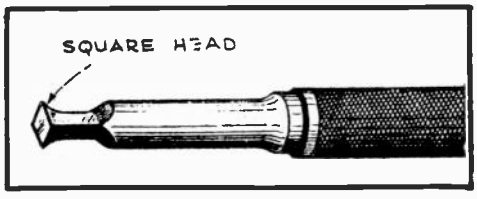

FIG.22
The Punching Tool.

THE GENERAL LAY-OUT FOR THE REQUIRED DISC IS SHOWN IN FIG.20 AND IN THIS ILLUSTRATION ROUND SCANNING HOLES ARE SHOWN. YOU WILL FIND, HOWEVER, THAT SQUARE SCANNING HOLES WILL GIVE STILL BETTER RESULTS BECAUSE THEY MAKE A GREATER AMOUNT OF LIGHT AVAILABLE TO THE OBSERVER'S EYE THAN DO ROUND HOLES.

FOR THIS DISC, YOU CAN OBTAIN A CIRCULAR BLANK OF 20 GUAGE ALUMINUM, WHICH IS ABOUT 30" IN DIAMETER. THE NEXT STEP IS TO LAY-OUT THE HOLES IN THIS DISC AND WE COMMENCE BY FIRST LOCATING THE EXACT CENTER OF THE DISC. NOW THEN, WE ALREADY KNOW THAT THE NUMBER OF HOLES REQUIRED IS 60 AND SINCE THESE 60 HOLES MUST ALL BE EQUALLY SPACED AROUND THE CIRCUMFERENCE OF A CIRCLE IN WHICH THERE ARE 360°, THEN THE ANGLE OF DISPLACEMENT OR THE ANGULAR DISTANCE BETWEEN THESE HOLES WILL HAVE TO BE EQUAL TO $\frac{360}{60} = 6°$.

THE WIDTH OF THE PICTURE WILL BE DETERMINED BY THE SIZE OF THE PICTURE AND THE SIZE OF THE NEON TUBE'S PLATE, WHICH IS AVAILABLE FOR THE FIELD OF VIEW. WE WILL ASSUME THAT FOR THE CONDITIONS AT HAND, THE WIDTH OF THE PICTURE CAN BE MADE 1.44". THEN SINCE THIS PICTURE WIDTH IS TO CONSTITUTE 72 ELEMENTS AS ALREADY STATED, IT IS CLEAR THAT THE SIZE OF EACH OF THE SCANNING HOLES MUST BE $\frac{1.44"}{72} = .02"$ SQ.

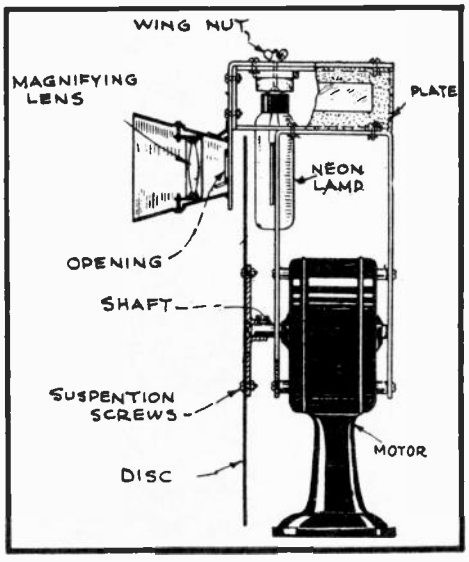

FIG.23
The Assembled Scanner.

THEN SINCE THE PICTURE IS TO BE 60 ELEMENTS HIGH, THE HEIGHT OF THE PICTURE WILL BE 60 X .02" OR 1.2 INCHES.

WITH A SHARP PUNCH OR SCRIBER, CAREFULLY MARK THE CENTER OF THE DISC AND MARK A LIGHT LINE FROM THIS CENTER POINT TO THE EDGE OF THE DISC. NOW BY USING A PROTRACTOR, DRAW LINES FROM THE CENTER TO THE DISC EDGE AT INTERVALS OF 6° UNTIL YOU HAVE DRAWN 60 OF THESE RADIAL LINES. THESE LINES SHOULD BE DRAWN AS LIGHT AS POSSIBLE, FOR THEIR ONLY PURPOSE IS TO SERVE YOU AS A GUIDE, INDICATING THE DISTANCE BETWEEN ADJACENT SCANNING HOLES.

NOW THE CIRCUMFERENCE OF THE CIR-

CLE, ON WHICH HOLE #1 IN FIG.20 IS LOCATED, WILL BE 1.44" X 60 OR 86.4" AND THE RADIUS FOR A CIRCLE OF THIS SIZE WILL BE EQUAL TO 86.4" DIVIDED BY 6.2832 OR 13.75 INCHES. THEREFORE, PICK OUT ANY ONE OF THE RADIAL LINES, WHICH YOU DREW ON THE DISC AND MEASURE OFF A DISTANCE ON IT OF 13.75" FROM THE CENTER OF THE DISC AS SHOWN IN FIG.21. THIS WILL FIX THE LOCATION FOR HOLE #1. THIS DONE, TAKE A PAIR OF DIVIDERS AND WITH THE RADIUS ADJUSTED TO 13.75" DRAW AN ARC THROUGH THIS POINT.

A TYPICAL TOOL FOR PUNCHING SQUARE HOLES IS SHOWN IN FIG.22. YOU CAN EITHER MAKE THIS TOOL YOURSELF OR ELSE HAVE ONE MADE BY A MACHINIST. THIS TOOL CAN BE MADE READILY FROM AN ORDINARY DRIFT, NAIL-SET, OR CENTER PUNCH, WHICH FOR THIS PURPOSE SHOULD BE GROUND DOWN TO A FLAT SURFACE .02" SQUARE. FIG. 22 SHOWS THE GROUND END OF THE TOOL CONSIDERABLY ENLARGED, SO THAT THE DETAIL OF THE GRINDING WORK CAN BE CLEARLY VISIBLE.

AFTER THE TOOL IS FINISHED AND READY FOR USE, THE NEXT THING IS TO OBTAIN A BLOCK OF SOFT WOOD TO USE AS AN ANVIL WHILE PUNCHING THE HOLES. THE LARGER THIS BLOCK, THE BETTER, AND THE END GRAIN SHOULD BE CAREFULLY LEVELLED OFF.

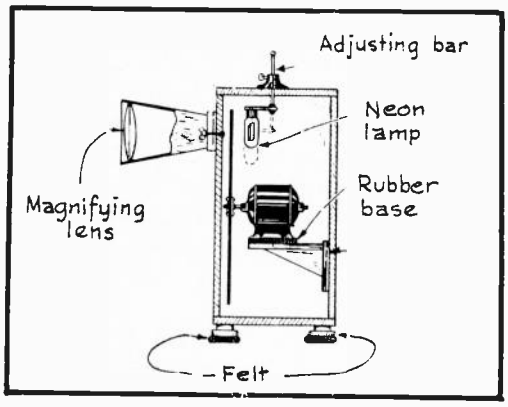

FIG. 24
Installation in Cabinet.

NOW LAY THE DISC OVER THE END GRAIN OF THIS BLOCK OF WOOD, SO THAT THE POINT WHERE YOU ARE GOING TO PUNCH THE FIRST HOLES IS RESTING UPON THE BLOCK FIRMLY. PLACE THE WORKING END OF THE PUNCH AT THE MARK WHICH YOU MADE 13.75" FROM THE DISC CENTER ON ONE OF THE RADIAL LINES AND ALIGN ITS SQUARE CUTTING END AGAINST THE RADIAL LINE AND ARC WHICH CROSS EACHOTHER AT THIS POINT, AS SHOWN IN FIG.21 AND STRIKE THE PUNCH A SHARP BLOW WITH A HAMMER. THUS HOLE #1 IS FORMED.

THE REASON FOR PUNCHING INTO THE END GRAIN OF THE WOOD BLOCK IS THAT THIS WILL PERMIT THE METAL TO CUT CLEARLY WITHOUT LEAVING A BURR. SHOULD, HOWEVER, BURRS REMAIN, THEN YOU CAN REMOVE THEM BY CAREFUL FILING.

AFTER HOLE #1 IS PUNCHED, THEN AGAIN TAKE YOUR DIVIDERS AND ADJUST THE RADIUS, SO THAT WITH ONE OF ITS POINTS PIVOTED AT THE CENTER OF THE DISC, THE OTHER POINT WILL JUST TOUCH THE EDGE OF HOLE #1 WHICH FACES TOWARDS THE CENTER OF THE DISC AND WITH THIS SETTING, DRAW AN ARC SUFFICIENTLY LONG TO CUT THROUGH THE NEXT RADIAL LINE. THIS IS ALSO ILLUSTRATED IN FIG.21. THEN PUNCH HOLE #2 SO THAT THE EDGES OF THIS HOLE WILL BE ALIGNED WITH THE NEXT RADIAL LINE AND THE ARC AS SHOWN IN FIG. 21.

THIS DONE RE-ADJUST THE DIVIDERS SO THAT WITH ONE POINT PIVOTED AT THE CENTER OF THE DISC, THE OTHER WILL JUST REACH THE EDGE OF HOLE #2 WHICH FACES THE CENTER OF THE DISC AND DRAW AN ARC LONG ENOUGH TO CUT

THE NEXT RADIAL LINE. THEN PUNCH ANOTHER HOLE AT THIS NEW POINT OF INTERSECTION ETC. UNTIL YOU HAVE PUNCHED ALL 60 HOLES AROUND THE DISC.

SHOULD YOU CARE TO PROVIDE A 48 HOLE SPIRAL ON THIS SAME DISC, SO THAT THE PICTURE WILL BE 48 ELEMENTS HIGH AND 60 ELEMENTS WIDE AND STILL USING THE SAME PUNCH, THEN THE FOLLOWING FACTS WILL HOLD TRUE. FIRST, THE WIDTH OF THE PICTURE WOULD BE 60 X .02" OR 1.2" AND THE RADIUS TO THE OUTER HOLE OR HOLE #1 WOULD BE 9.16" (CIRCUMFERENCE OF THIS CIRCLE= 1.2" X 48 = 57.6" AND SO ITS RADIUS IS 57.6 DIVIDED BY 6.2832, WHICH IS EQUAL TO 9.16").

THE HEIGHT OF THE IMAGE IN THIS CASE WOULD BE .02" X 48 OR .96" AND THE DISTANCE BETWEEN SUCCESSIVE RADIAL LINES ON THE DISC WILL HAVE TO BE $\frac{360}{48}$ = 7.5 OR 7°30'.(7 DEGREES AND 30 MINUTES). WITH THIS INFORMATION, THE HOLES FOR THIS SYSTEM COULD ALSO BE LAID OUT ON THE SAME DISC WITH COMPARATIVE EASE. GREAT CARE, HOWEVER, MUST BE EXERCISED IN MAKING ALL OF THE NECESSARY MEASUREMENTS ETC., SO THAT THE FINISHED DISC WILL BE ACCURATE.

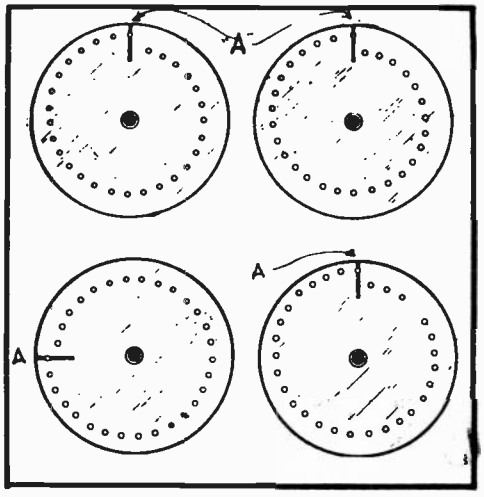

FIG. 25
Synchronism – Isochronism.

FINALLY, AFTER ALL SCANNING HOLES HAVE BEEN MADE IN THE DISC, THE HOLE FOR MOUNTING PURPOSES CAN BE MADE AT ITS CENTER BUT THE SIZE OF THIS HOLE WILL OF COURSE DEPEND UPON THE TYPE OF MOUNTING WHICH YOU ARE USING. THIS WILL BE OBVIOUS AT THE TIME OF CONSTRUCTION.

SOME EXPERIMENTERS GO SO FAR AS TO CUT AWAY A PORTION FROM THE CENTRAL PORTION OF THE DISC, SO AS TO REMOVE EXCESS WEIGHT SO THAT LESS POWER WILL BE REQUIRED TO REVOLVE THE DISC. THIS, HOWEVER, IS NOT ALTOGETHER NECESSARY, ESPECIALLY WHEN THE DISC IS MADE OF STOCK WHICH IS NOT TOO HEAVY BUT IF IT IS DONE, THEN EXTREME CARE MUST BE USED WHEN REMOVING METAL, SO THAT THE DISC IS NOT THROWN OUT OF BALANCE.

ASSEMBLING THE SCANNING EQUIPMENT

SO MUCH FOR SCANNING DISCS -- NOW LET US TURN YOUR ATTENTION TO FIG.23 WHICH SHOULD OFFER YOU A NUMBER OF SUGGESTIONS RELATIVE TO ASSEMBLING THE HOME-MADE SCANNER. HERE THE MOTOR FROM AN ORDINARY ELECTRIC FAN IS BEING USED TO SUPPLY THE DRIVING POWER FOR THE DISC. THE SAME FITTING IS USED FOR COUPLING THE SCANNING DISC TO THE MOTOR SHAFT AS WAS ORIGINALLY USED FOR THE FAN BLADE MOUNTING.

THE SHADOW-BOX IN THIS CASE IS A SECTION OF A MEGAPHONE, CUT TO LENGTH SO AS TO PROVIDE A SUITABLE FORM. A DOUBLE CONVEX LENS IS THEN MOUNTED IN THE SHADOW BOX AS SHOWN, SO AS TO ENLARGE THE SIZE OF THE IMAGE WHEN OBSERVED THROUGH THIS LENS. THE NEON TUBE IS MOUNTED IN AN INVERTED POSITION AND ITS BASE IS HELD IN PLACE BY A MACHINE SCREW AND WING-NUT, SO THAT UPON LOOSENING THE WING-NUT, THE BASE AND TUBE CAN BE

ROTATED TO THE PROPER POSITION, SO THAT THE PLATE OF THE TUBE CAN BE ALIGNED PARALLEL WITH THE FACE OF THE SCANNING DISC.

FIG.24 SHOWS YOU HOW THE SCANNING SYSTEM CAN BE MOUNTED IN A BOX-LIKE CABINET. NOTE THAT IN THIS CASE, THE MOTOR AND NEON TUBE ARE BOTH MOUNTED ON ADJUSTABLE SUPPORTS, SO THAT THE ENTIRE SYSTEM CAN BE PROPERLY ALIGNED WITH THE APERTURE OR OPENING IN THE END OF THE SHADOW BOX THROUGH WHICH THE IMAGE IS OBSERVED. ALSO OBSERVE HOW RUBBER MOUNTINGS ARE USED, SO THAT VIBRATION WILL BE KEPT TO A MINIMUM, FOR THIS WILL AID IN BRINGING ABOUT A REDUCTION IN PICTURE DISTORTION.

SYNCHRONIZATION OF SCANNING DISCS

ONE OF THE GREATEST PROBLEMS IN TELEVISION ENGINEERING IS TO MAINTAIN ACCURATE SYNCHRONISM BETWEEN THE SCANNING SYSTEM AT BOTH THE TELEVISION TRANSMITTER AND RECEIVER. YOU ARE NOW GOING TO BE SHOWN HOW THIS CAN BE ACCOMPLISHED AT THE RECEIVER WHEN USING MECHANICAL DISC SCANNERS. FIRST OF ALL, HOWEVER, LET US BE SURE THAT YOU HAVE A CORRECT UNDERSTANDING OF THE EXPRESSION "SYNCHRONISM".

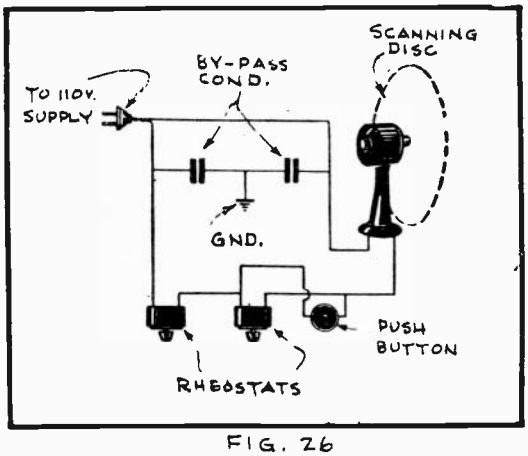

FIG. 26

Manual Synchronizing System.

AT THE TOP OF FIG.25, WE HAVE TWO DISCS WHICH ARE SYNCHRONIZED. THAT IS, THEY ARE TRAVELING AT THE SAME SPEED AND IN ADDITION, THE SAME HOLE IN EACH OF THE DISCS IS AT THE SAME POINT OF TRAVEL. NOTICE THAT THE FIRST HOLE OF THE SPIRAL OF BOTH DISCS ARE LINED UP WITH POINT "A" AT THE SAME INSTANT.

THE TWO DISCS AT THE BOTTOM OF FIG.25 ARE NOT SYNCHRONIZED, ALTHOUGH THEY ARE ROTATING AT THE SAME SPEED. AS YOU WILL NOTE, THE TWO DISCS ARE ONE-QUARTER REVOLUTION OUT OF STEP WITH EACHOTHER. THE TWO DISCS WHEN OUT OF STEP BUT ROTATING AT THE SAME SPEED ARE SAID TO BE IN A STATE OF ISOCHRONISM BUT FOR TELEVISION PURPOSES, THEY MUST BE ABSOLUTELY SYNCHRONIZED.

ONE METHOD OF SYNCHRONIZING THE TRANSMITTER AND RECEIVER SCANNING DISC IS TO DRIVE BOTH OF THESE DISCS WITH SYNCHRONOUS MOTORS WHICH ARE CONNECTED TO A.C. POWER OR LIGHT LINES OF LIKE FREQUENCY. THE SPEED OF THIS TYPE OF MOTOR IS GOVERNED BY THE FREQUENCY OF THE A.C. POWER SUPPLY WHICH OPERATES IT. ALTHOUGH IT IS TRUE THAT MOST COMMERCIAL POWER COMPANIES FURNISH 50 OR 60 CYCLE SUPPLY TO THEIR LINES, YET ALL OF THE DIFFERENT COMPANIES DO NOT REMAIN EXACTLY AT THEIR GIVEN FREQUENCY, THAT IS, THE FREQUENCY MAY BE SOMEWHAT MORE OR LESS. FOR LIGHTING PURPOSES, THIS VARIATION IS NOT NOTICEABLE BUT FOR SYNCHRONIZING TELEVISION, A VARIATION OF $\frac{1}{3000}$ OF 1% WOULD GIVE ONLY FAIR SYNCHRONIZATION.

A SIMPLE MANUAL SYNCHRONIZING SYSTEM

IN FIG.26 WE ARE ILLUSTRATING A VERY SIMPLE, ALTHOUGH A RATHER

CRUDE METHOD OF SYNCHRONIZING A FAN MOTOR AT THE RECEIVER. HOWEVER, IT DOES ILLUSTRATE A PRINCIPLE. HERE YOU ARE SHOWN HOW THE MOTOR IS CONNECTED ACROSS THE 110 VOLT A.C. OR D.C. POWER LINE BUT TWO RHEOSTATS ARE CONNECTED IN SERIES IN ONE SIDE OF THIS CIRCUIT.

ONE OF THESE RHEOSTATS HAS A MAXIMUM RESISTANCE VALUE OF ABOUT 100 TO 150 OHMS WHILE THE OTHER IS A SMALLER UNIT, HAVING A MAXIMUM RESISTANCE VALUE OF BUT 10 TO 15 OHMS AND A PUSH BUTTON, SUCH AS USED FOR DOOR BELLS, IS SHUNTED OR CONNECTED ACROSS THE SMALLER RHEOSTAT.

ALSO NOTICE THAT IN THE DIAGRAM SHOWN IN FIG.26, TWO $\frac{1}{2}$ OR 1 MFD. BY-PASS CONDENSERS ARE CONNECTED ACROSS THE POWER CIRCUIT WITH THEIR CENTER CONNECTION MUTUALLY GROUNDED. THESE CONDENSERS ARE NOT ALTOGETHER NECESSARY BUT NEVERTHELESS THEY ARE ADVISABLE WHEN USING A MOTOR HAVING A COMMUTATOR AND BRUSHES. BY USING THEM, DISTURBING INTERFERENCE CAUSED BY THE BRUSH AND COMMUTATOR OPERATION WILL BE BY-PASSED TO GROUND RATHER THAN BEING PERMITTED TO DESTROY THE QUALITY OF THE PICTURE.

TO USE THIS SYNCHRONIZING SYSTEM, YOU FIRST ADJUST THE TWO RHEOSTATS UNTIL THE SCANNING DISC ROTATES JUST BELOW THE DESIRED SPEED. AND YOU THEN PUSH THE BUTTON PERIODICALLY. WHENEVER THIS BUTTON IS DEPRESSED, IT WILL SHORT-CIRCUIT THE SMALLER RHEOSTAT AND THIS WILL PERMIT THE MOTOR TO PICK UP SPEED. THUS THE PUSH BUTTON WILL HAVE TO BE DEPRESSED PERIODICALLY WHILE THE SYSTEM IS OPERATING, IN ORDER TO KEEP THE SCANNING DISC ROTATING AT THE PROPER SPEED.

ALTHOUGH ONE RHEOSTAT WOULD GIVE AN APPROXIMATE SPEED SETTING, YET A LARGE AND SMALL ONE, WHEN USED TOGETHER AS SHOWN, WILL PERMIT THE OPERATOR TO MAKE A FINER ADJUSTMENT THAN IS POSSIBLE WHEN USING ONE RHEOSTAT ALONE.

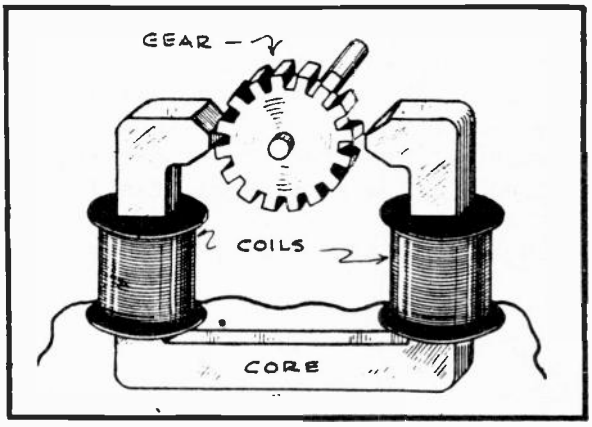

FIG. 27
The Phonic Motor.

SYNCHRONIZING WITH THE PHONIC MOTOR

AS YOU HAVE SEEN, THIS METHOD OF SYNCHRONIZING IS QUITE CRUDE AND PRESENTS THE DISADVANTAGE IN THAT IT REQUIRES CONTINUAL ATTENTION DURING THE TELEVISION PROGRAM. FOR THIS REASON, WE SHALL ALSO FAMILIARIZE YOU WITH WHAT IS NOW THE MOST POPULAR TYPE OF TELEVISION SYNCHRONIZER AND IN WHICH WE MAKE USE OF THE "PHONIC-MOTOR".

THE MOST OUTSTANDING ADVANTAGE OF THE PHONIC-MOTOR IS THAT IT PERMITS THE TELEVISION TRANSMITTER TO CONTROL THE SPEED OF THE RECEIVER'S SCANNING DISC AND IT IS NO MORE BUT REASONABLE TO EXPECT AN ARRANGEMENT OF THIS TYPE TO BE MOST PRACTICAL.

BEFORE GOING INTO THE CONSTRUCTIONAL DETAILS REGARDING THE PHONIC MOTOR, LET US FIRST BRIEFLY CONSIDER THE PRINCIPLES OF ITS OPERATION.

A SIMPLE TYPE OF PHONIC MOTOR IS SHOWN YOU IN FIG. 27 WHILE ITS OPERATING PRINCIPLE IS ILLUSTRATED IN FIG.28. AS YOU WILL NOTE IN FIG. 28, WE HAVE A "U"-SHAPED LAMINATED IRON CORE WITH THE TWO POLE TIPS A AND C.

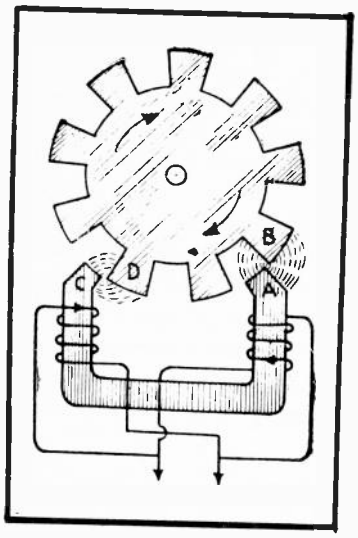

FIG. 28
Principle of Motor

WINDINGS ARE PROVIDED ON EACH OF THESE POLES, WITH THE TURNS SO WOUND THAT WHEN CURRENT FLOWS THROUGH THEM IN A GIVEN DIRECTION, ONE OF THE POLES WILL ASSUME A NORTH POLARITY WHILE THE OTHER AT THE SAME TIME ASSUMES A SOUTH POLARITY. ALSO NOTE THAT THESE TWO WINDINGS ARE CONNECTED IN PARALLEL.

JUST ABOVE THIS IRON CORE, WE HAVE AN IRON GEAR, WHICH IS PIVOTED BUT FREE TO MOVE ABOUT ITS CENTRAL AXIS. THIS ENTIRE ARRANGEMENT FORMS A SIMPLE TYPE OF SYNCHRONOUS MOTOR. THIS MOTOR, HOWEVER, IS NOT POWERFUL ENOUGH TO START RUNNING FROM A STATIONARY POSITION AND MUST FIRST BE GIVEN A START EITHER BY HAND OR ELSE BY SOME OTHER FORM OF MOTIVE POWER. YET, AFTER ONCE STARTED, THE GEAR WILL CONTINUE ROTATING UNDER ITS OWN POWER.

ASSUMING IN FIG.28 THAT AT THE INSTANT SHOWN, THE FLOW OF A.C. THROUGH THE COILS IS SUCH THAT POLE "A" IS MAGNETIZED TO A SOUTH POLARITY AND POLE "C" TO A NORTH POLARITY, THEIR MAGNETIC LINES OF FORCE WILL REACT UPON THE GEAR. THAT IS, POLE "C" WILL ATTRACT GEAR TOOTH "D" AND POLE "A" WILL ATTRACT GEAR TOOTH "B" AND THE GEAR WILL ROTATE IN THE DIRECTION INDICATED BY THE ARROWS UNTIL GEAR TOOTH "D" LINES UP WITH POLE "C" AND GEAR TOOTH "B" LINES UP WITH POLE "A".

PROVIDED THAT THE UNIT IS PROPERLY DESIGNED, YOU WILL FIND THAT THE INSTANT THAT THIS ALIGNMENT OF POLES AND GEAR TEETH OCCURS, THE CURRENT FLOW THROUGH THE COILS WILL BE AT SUCH A POINT OF ITS CYCLE, SO THAT ITS VALUE IS PRACTICALLY ZERO. THEREFORE, THERE IS NO LONGER AN ATTRACTIVE FORCE BEING EXERTED BY THE POLES OF THE CORE AND THE GEAR THENCE ROTATES A LITTLE FURTHER DUE TO ITS INERTIA. THAT IS, IT COASTS. HOWEVER, THE CURRENT FLOW THRU THE COILS HAS COMMENCED TO INCREASE AGAIN BY THIS TIME, SO THAT THE NEXT PAIR OF GEAR TEETH ARE ATTRACTED TOWARD THE POLES AND THIS ACTION CONTINUES OVER AND OVER AGAIN, WITH THE RESULT THAT THE GEAR ROTATES BUT ITS SPEED OF ROTATION WILL BE GOVERNED BY THE VARIATION OF CURRENT THROUGH THE COILS.

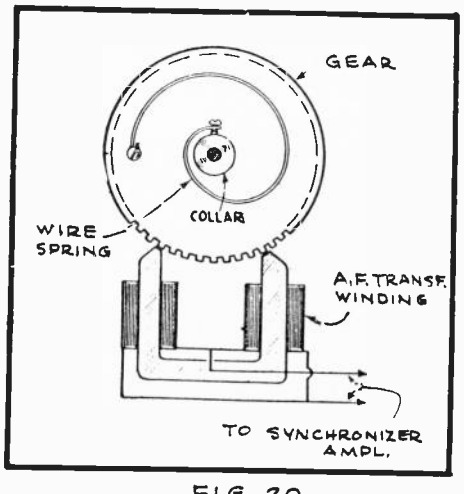

FIG. 29
Constructional Detail of Phonic Motor.

CONSTRUCTING A PHONIC MOTOR

NOW AS TO THE CONSTRUCTION OF THE PHONIC MOTOR. THE "U" SHAPED CORE CAN

EITHER BE OBTAINED FROM AN OLD POWER TRANSFORMER OR ELSE YOU CAN ASSEMBLE ONE YOURSELF FROM IRON LAMINATIONS. IT MAKES NO DIFFERENCE HOW MANY GEAR TEETH ARE INCLUDED WITHIN THE SPACE BETWEEN THESE TWO POLES BUT THE TIPS OF THESE TWO POLES SHOULD BE TAPERED, SO THAT THEIR FACES HAVE THE SAME SHAPE AS THE PORTION OF THE TEETH WHICH FACE THE POLES. THE WINDINGS FOR THIS CORE CAN BE THE PRIMARY COILS OF AN OLD AUDIO TRANSFORMER AS SHOWN IN FIG.29 BUT THEY SHOULD BE CONNECTED IN PARALLEL IN ADDITION TO HAVING THEIR POLARITY PROPERLY RELATED SO THAT ONE WILL PRODUCE A NORTH POLE AND THE OTHER A SOUTH POLE AT THE POLES OF THE CORE.

ALTHOUGH A GEAR MADE OF LAMINATED IRON OR SILICON STEEL SHEETS WOULD BE MOST PREFERABLE, YET THIS ARRANGEMENT OFFERS CONSIDERABLE CONSTRUCTION DIFFICULTIES. THEREFORE, THE GENERAL PRACTICE IS TO USE AN ORDINARY CAST-IRON GEAR, HAVING A DIAMETER OF 4 OR 5 INCHES AND BEING ABOUT 3/4" THICK.

THIS GEAR SHOULD HAVE THE SAME NUMBER OF TEETH AS THERE ARE HOLES IN THE SCANNING DISC USED FOR REPRODUCING THE PICTURE. IN OTHER WORDS, FOR RECEIVING A 48 LINE PICTURE, A GEAR WITH 48 TEETH SHOULD BE USED, FOR A 60 LINE PICTURE, A GEAR WITH 60 TEETH SHOULD BE USED ETC.

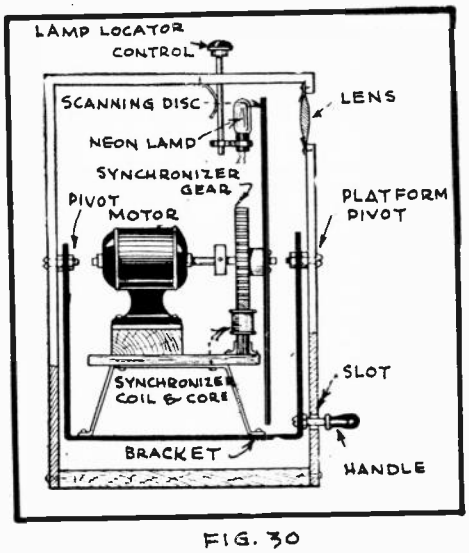

FIG. 30
The Assembled Scanner.

THE ASSEMBLY OF THE PHONIC MOTOR IS ILLUSTRATED BOTH IN FIGS. 29 AND 30. IN THE CASE OF FIG.29 YOU ARE LOOKING AT THE PHONIC MOTOR FROM THE REAR, WHEREAS IN FIG.30 YOU ARE LOOKING AT IT FROM THE SIDE. AS YOU WILL NOTE IN FIG. 30, THE GEAR IS MOUNTED ON THE SAME SHAFT THROUGH WHICH THE DRIVING MOTOR DRIVES THE SCANNING DISC BUT THE DISC IS DRIVEN BY THIS SHAFT THROUGH AN INDIRECT DRIVE OR COUPLING. THAT IS, THE SCANNING DISC IS FASTENED FIRMLY TO THE FLAT SIDE OF THE GEAR AND WHEN THE GEAR AND SCANNING DISC ARE AT FIRST SLIPPED OVER THE END OF THE SHAFT DURING ASSEMBLY, THEY ARE FREE TO ROTATE UPON THIS SHAFT AND SO FAR, IT IS CLEAR THAT THE DRIVE MOTOR CANNOT AS YET ROTATE THE DISC.

THE DRIVING FORCE IS DELIVERED FROM THE SHAFT TO THE DISC IN THE FOLLOWING WAY: A COLLAR IS MOUNTED ON THE DRIVE SHAFT, BEING LOCKED TO THE SHAFT BY A SET SCREW. THIS COLLAR IS SHOWN BOTH IN FIGS. 29 AND 30.

A SPIRAL SPRING, MADE OF BRASS WIRE, CONNECTS THIS COLLAR TO THE GEAR. THAT IS, ONE END OF THIS SPRING IS FASTENED TO THE SET SCREW IN THE COLLAR AND THE OTHER END OF THE SPRING IS FASTENED TO THE GEAR BY MEANS OF A SCREW. THIS IS CLEARLY ILLUSTRATED IN FIG.29. THUS IT IS SEEN THAT THE MOTOR'S DRIVING FORCE IS ALL TRANSMITTED TO THE GEAR AND SCANNING DISC THROUGH THE SPRING.

THE PURPOSE OF THE SPRING IS TO TAKE UP ANY VARIATIONS IN THE

SPEED OF THE MOTOR. CONSEQUENTLY, THE GEAR AND DISC WILL ALWAYS RUN AT THE CORRECT SPEED. SHOULD THE MOTOR'S SPEED VARY DUE TO POWER LINE VOLTAGE FLUCTUATIONS, THEN IT WILL TEND TO WIND OR UNWIND THE SPRING, WITH THE SPRING TENSION FINALLY ADJUSTING THE SCANNER DISC SPEED TO NORMAL.

SUPPORTING THE DRIVE MECHANISM

OBSERVE IN FIG.30 HOW THE DRIVE MOTOR AND CORE OF THE PHONIC MOTOR ARE MOUNTED ON THE SAME BASE OR BED AND THAT THIS MOTOR BED IS IN TURN MOUNTED ON A PIVOTED BRACKET OR PLATFORM, WHOSE PIVOTS ARE IN LINE WITH THE DRIVE SHAFT. THE ENTIRE SCANNING ASSEMBLY IS MOUNTED IN A WOODEN CABINET AS SHOWN AND A CIRCULAR SLOT IS CUT IN THE LOWER FRONT PORTION OF THE CABINET THROUGH WHICH PASSES A THREADED BOLT WITH A HANDLE.

THIS BOLT IS FASTENED TO THE MOUNTING BRACKET AND BY UNSCREWING THE HANDLE PART WAY, THE BOLT CAN BE PULLED ACROSS THE SLOT, SWINGING THE PIVOTED MOUNTING BRACKET WITH IT. THIS ADJUSTMENT IS PROVIDED TO AID IN FRAMING THE PICTURE AND WITH THE SETTING PROPERLY DETERMINED, THE HANDLE IS SCREWED TIGHT, THUS LOCKING THE BRACKET TO THIS SETTING. IT WILL ALSO BE WELL TO ADD AT THIS POINT THAT THE CLEARANCE BETWEEN THE GEAR TEETH AND THE POLES OF THE CORE OF THE PHONIC MOTOR SHOULD BE AS SMALL AS POSSIBLE, WITHOUT TOUCHING.

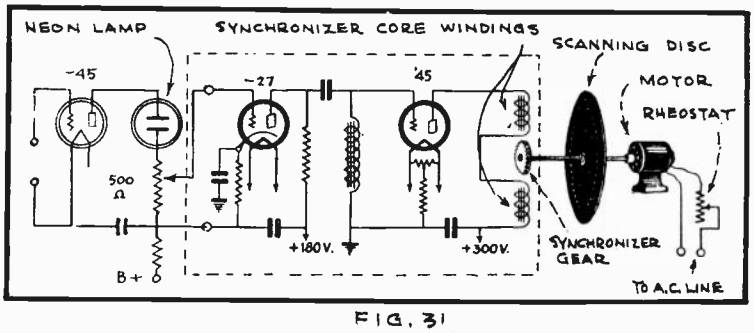

FIG. 31
Synchronizer Amplifier Connections.

USING THE TRANSMITTER SIGNAL FOR SYNCHRONIZING PURPOSES

THE TELEVISION SIGNAL, AS RADIATED FROM THE TRANSMITTER IN ADDITION TO THE PICTURE FREQUENCIES, ALSO CONTAINS A STRONG COMPONENT OF THE SCANNING FREQUENCY, WHICH IS DERIVED FROM THE NUMBER OF SCANNED LINES PER PICTURE MULTIPLIED BY THE PICTURE FREQUENCY. THAT IS, IN THE CASE OF A 48-LINE PICTURE, TRANSMITTED AT 15 PICTURES PER SECOND, THE SCANNING FREQUENCY IS 720 CYCLES PER SECOND AND A STRONG COMPONENT OF THIS FREQUENCY IS FOUND IN THE SIGNAL. THIS FREQUENCY WILL VARY WITH ANY VARIATION IN THE SPEED OF THE SCANNING DISC AT THE TRANSMITTER.

THIS SCANNING FREQUENCY CAN BE AMPLIFIED AND FILTERED OUT OF THE SIGNAL FREQUENCY BY CONNECTING AN AMPLIFIER TUNED TO 720 CYCLES TO THE LAMP CIRCUIT OF THE RECEIVER AS SHOWN IN FIG.31. THIS AMPLIFIER IS CALLED THE SYNCHRONIZER AMPLIFIER AND ITS OUTPUT CIRCUIT IS CONNECTED ACROSS THE COILS OF THE PHONIC MOTOR AS ALSO SHOWN IN FIG.31. THE DESIGN OF THIS SYNCHRONIZER AMPLIFIER IS NOT VERY CRITICAL BECAUSE THE SCANNING FREQUENCY COMPONENT IS QUITE STRONG.

THE PHONIC MOTOR WILL NOT DEVELOPE SUFFICIENT TORQUE (THAT IS, TURNING EFFORT,) TO OVERCOME THE FRICTION OF THE DISC'S DRIVING MECHAN-

ISM AND THEREFORE THE VARIABLE-SPEED MOTOR, OPERATED OFF THE A.C. LIGHTING CIRCUIT, IS ALSO COUPLED TO THE SYSTEM AS SHOWN BOTH IN FIGS. 30 AND 31.

THUS IT IS SEEN THAT THE A.C. DRIVEN VARIABLE SPEED MOTOR ACTUALLY DRIVES THE SCANNING DISC BUT THE SMALL SYNCHRONOUS MOTOR AT THE OTHER END OF THE DRIVE TENDS TO BE DRIVEN BY THE SCANNING FREQUENCY WHICH IS FLOWING THROUGH ITS WINDINGS. THEREFORE, THE SPEED OF THE VARIABLE SPEED DRIVE MOTOR IS CONTROLLED BY THE SPEED OF THE SMALL SYNCHRONOUS MOTOR AND THE VARIABLE SPEED MOTOR SIMPLY SUPPLIES THE POWER NEEDED TO OVERCOME FRICTION.

A SPEED CONTROL IS PROVIDED IN THE CIRCUIT OF THE VARIABLE SPEED MOTOR BY MEANS OF WHICH THE OPERATOR CAN MANUALLY VARY THE SPEED OF THE SCANNING DISC UNTIL THE PICTURE IS PROPERLY FRAMED. AT THIS TIME, THE RECEIVER DISC WILL BE IN STEP WITH THE TRANSMITTER DISC AND BY LEAVING THE SPEED CONTROL SET AT THIS POSITION, THE SYNCHRONOUS MOTOR WILL MAINTAIN THE PROPER SPEED RELATION BETWEEN THE RECEIVER AND TRANSMITTER SCANNING DISCS AND THUS PROVIDES AUTOMATIC SYNCHRONIZATION THROUGHOUT THE BALANCE OF THE "SHOW".

HAVING COMPLETED THIS LESSON, YOU SHOULD NOW HAVE A GOOD UNDERSTANDING OF THE MECHANICAL METHODS OF SCANNING BUT IN LATER LESSONS YOU WILL BE SHOWN HOW SCANNING CAN BE ACCOMPLISHED ELECTRICALLY WITH THE AID OF CATHODE-RAY TUBE. HOWEVER, BEFORE GOING INTO DETAILS PERTAINING TO THESE MORE COMPLICATED METHODS OF SCANNING, YOU WILL FIRST BE TOLD IN THE NEXT LESSON MORE ABOUT THE DESIGN FEATURES OF TELEVISION RECEIVERS.

EXAMINATION QUESTIONS

LESSON NO. TEL-2

"Most of us would be successful if we would keep on doing the things we KNOW we SHOULD DO -- and STOP doing the things we KNOW we SHOULD NOT DO."

1. - DRAW A CIRCUIT DIAGRAM WHICH ILLUSTRATES A PRACTICAL METHOD OF CONNECTING A NEON LAMP TO THE OUTPUT OF A TELEVISION RECEIVER AND DESCRIBE THE FEATURES OF THE CIRCUIT YOU HAVE DRAWN.

2. - EXPLAIN IN DETAIL HOW THE SANABRIA SCANNING DISC OPERATES.

3. - EXPLAIN IN DETAIL THE OPERATION OF THE JENKINS DRUM TYPE SCANNER.

4. - DESCRIBE THE SCANNER AS USED BY THE BELL SYSTEM AND EXPLAIN HOW IT OPERATES.

5. - HOW MAY SCANNING BE ACCOMPLISHED WITH THE AID OF MIRRORS?

6. - EXPLAIN IN DETAIL WHAT IS MEANT BY THE TERM "SYNCHRONISM".

7. - DESCRIBE THE CONSTRUCTIONAL FEATURES OF THE PHONIC MOTOR AND EXPLAIN HOW IT MAY BE USED FOR SYNCHRONIZING PURPOSES.

8. - DRAW A CIRCUIT DIAGRAM OF A SYNCHRONIZING AMPLIFIER, SHOWING HOW IT IS CONNECTED TO THE TELEVISION RECEIVER AND SCANNING EQUIPMENT, AND EXPLAIN HOW IT OPERATES.

9. - EXPLAIN FULLY THE PROCEDURE WHICH YOU WOULD FOLLOW IN ORDER TO CONSTRUCT A NIPKOW SCANNING DISC.

10. - WHAT IS THE OBJECT OF USING A CONVENTIONAL MOTOR IN CONJUNCTION WITH THE PHONIC MOTOR FOR DRIVING A SCANNING DISC?

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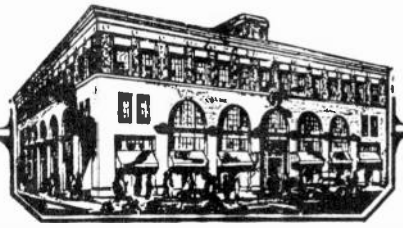

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Television

LESSON NO. 3

TELEVISION RECEIVERS

NOW THAT YOU ARE FAMILIAR WITH TELEVISION IN GENERAL, AS WELL AS WITH THE CONSTRUCTION AND OPERATION OF MECHANICAL SCANNING SYSTEMS, YOU WILL NEXT BE INTERESTED IN LEARNING MORE ABOUT THE CONSTRUCTIONAL DETAILS AND THE PROCEDURES FOR OPERATING TELEVISION RECEIVERS.

GENERALLY SPEAKING, TELEVISION RECEIVERS ARE VERY SIMILAR IN DESIGN AND CONSTRUCTION TO CONVENTIONAL BROADCAST RECEIVERS, WITH THE EXCEPTION THAT THEIR TUNED RADIO FREQUENCY SECTION IS DESIGNED TO TUNE TO THOSE FREQUENCY BANDS WHICH HAVE BEEN SET ASIDE BY THE GOVERNMENT FOR TELEVISION PURPOSES. AT THE SAME TIME, THE TUNING CIRCUITS MUST ALSO BE SO CONSTRUCTED AS NOT TO BE TOO SHARP TUNING SO THAT A BAND-WIDTH OF APPROXIMATELY 40 KC. CAN BE PASSED THROUGH THIS SYSTEM IN ORDER TO RETAIN ALL OF THE NECESSARY PICTURE FREQUENCIES.

THE AUDIO CHANNEL OF TELEVISION RECEIVERS, AS YOU HAVE ALREADY LEARNED, MUST ALSO BE DESIGNED SO AS TO AMPLIFY FAITHFULLY THE WIDE RANGE OR AUDIO FREQUENCIES (PICTURE FREQUENCIES) WHICH ARE REQUIRED FOR GOOD TELEVISION REPRODUCTION.

FIG. 1
Adjusting the Receiver Scanner.

TELEVISION STATIONS

IN TABLE I YOU

ARE GIVEN A LIST OF THE MORE POPULAR TELEVISION STATIONS, TOGETHER WITH THEIR LOCATIONS AND THE FREQUENCY BAND IN WHICH THEY OPERATE. FROM THIS LIST, YOU WILL READILY NOTE THAT THE TELEVISION BANDS ARE AS FOLLOWS: 2000-2100 Kc., , 2750-2850 Kc.; 42,000-56,000 Kc.; AND 60,000-86,000 Kc. THIS THEN, WILL DETERMINE THE TUNING RANGE OR RANGES FOR WHICH THE TELIVISION RECEIVER SHOULD BE DESIGNED.

TABLE I
TELEVISION STATION LIST

2000-2100 KC.

VE9AU -- LONDON, ONT., CAN.
VE9DS -- MONTREAL, QUE.
W2XDR -- LONG ISLAND CITY, N.Y.
W8XAN -- JACKSON, MICH.
W9XK -- IOWA CITY, IA.
W9XAK -- MANHATTAN, KANS.
W9XAO -- CHICAGO, ILL.
W6XAH -- BAKERSFIELD, CALIF.

2750-2850 Kc.

W3XAK -- PORTABLE
W9XAP -- CHICAGO, ILL.
W2XBS -- BELLMORE, N.Y.
W9XAL -- KANSAS CITY, MO.
W9XG -- W. LAFAYETTE, IND.
W2XAB -- NEW YORK, N.Y.
VE9AR -- SASKATOON, SASK.,CAN.
VE9ED -- MT. JOLI, QUE.,CAN.

42,000-56,000 & 60,000-86,000 KC.

W2XAX -- NEW YORK, N.Y.
W6XAO -- LOS ANGELES, CALIF.
W9XD -- MILWAUKEE, WIS.
W2XBT -- PORTABLE
W2XF -- NEW YORK, N.Y.
W3XE -- PHILADELPHIA, PA.
W3XAD -- CAMDEN, N.J.
W10XX -- PORTABLE & MOBILE (VICINITY OF CAMDEN)
W2XDR -- LONG ISLAND CITY, N.Y.
W8XAN -- JACKSON, MICH.
W9XAT -- PORTABLE
W2XD -- NEW YORK, N.Y.
W2XAG -- PORTABLE
W1XG -- BOSTON, MASS.
W9XK -- IOWA CITY, LA.
VE9BZ -- VANCOUVER, B.C.,CAN.
VE9DS -- MONTREAL,QUE., CAN.
VE9AU -- LONDON,ONT., CAN.
VE9RC -- QUEBEC, QUE., CAN.
VE9AG -- WALKERVILLE, ONT., CAN.

RECEIVER CONSTRUCTION

FROM AN EXAMINATION OF FIGS. 2&3 OF THIS LESSON YOU WILL READILY BECOME ACQUAINTED WITH THE GENERAL APPEARANCE OF RECEIVERS OF THIS TYPE. DUE TO THE CLOSE RESEMBLANCE BETWEEN TELIVISION RECEIVERS AND RADIO BROADCAST RECEIVERS, THERE WILL BE NO NEED FOR US TO SPEND ANY MORE TIME ON THIS SUBJECT. INSTEAD, IT WILL BE MORE ADVISABLE TO CONSIDER THE DETAILS REGARDING THE CIRCUITS OF THESE RECEIVERS.

A GOOD EXAMPLE OF A MODERN CIRCUIT DESIGN IS SHOWN YOU IN FIG.5. THIS RECEIVER IS OF CONVENTIONAL T.R.F. DESIGN AND EMPLOYS TYPE 58 TUBES IN THE FIRST THREE R.F. STAGES, A 57 POWER DETECTOR, A 57 FIRST A.F., A 2A3 POWER TUBE AND AN 80 RECTIFIER.

THE PURPOSE OF SWITCH S_1 IS TO PROVIDE A MEANS OF CUTTING THE SPEAKER IN AND OUT OF THE CIRCUIT CONVENIENTLY. WITH THIS SWITCH IN AN OPEN POSITION, THE TELEVISION SIGNALS WILL BE HEARD IN THE SPEAKER IN THE FORM OF A STEADY WHIRRING SOUND SOMEWHAT AS THAT WHICH IS PRODUCED BY A BUZZ-SAW WHEN IN OPERATION.

BY CLOSING THIS SAME SWITCH, THE PRIMARY WINDING OF THE SPEAKER OUTPUT TRANSFORMER WILL BE SHORT CIRCUITED, THEREBY PREVENTING OPERATION OF THE SPEAKER WHILE THE PICTURE IS BEING OBSERVED.

THE R.F. TRANSFORMERS AS USED IN THIS RECEIVER ARE OF THE

SOLENOID, CLOSE-WOUND TYPE, THE SECONDARY INDUCTANCE BEING SO CHOSEN THAT FOR A VARIABLE CONDENSER OF GIVEN RATING, THE ARRANGEMENT WILL TUNE OVER THE BAND DESIRED. NOTICE ESPECIALLY IN FIG.5 THAT A POWER DETECTOR IS USED IN THIS PARTICULAR CIRCUIT.

APPLICATION OF GRID DETECTION

IN FIG. 6 YOU ARE SHOWN THE CIRCUIT DIAGRAM OF A SEVEN-TUBE TELEVISION RECEIVER IN WHICH GRID DETECTION IS USED. THIS IS AN A.C. TYPE RECEIVER EMPLOYING, TWO STAGES OF R.F. AMPLIFICATION, FOLLOWED BY A SPACE-CHARGE DETECTOR OF THE GRID CONDENSERAND LEAK TYPE. THE DETECTOR FEEDS INTO TWO STAGES OF RESISTANCE-CAPACITY COUPLED A.F. AMPLIFICATION AND THE PICTURE SIGNALS ARE FINALLY IMPRESSED ACROSS THE OUTPUT OF A SINGLE POWER TUBE.

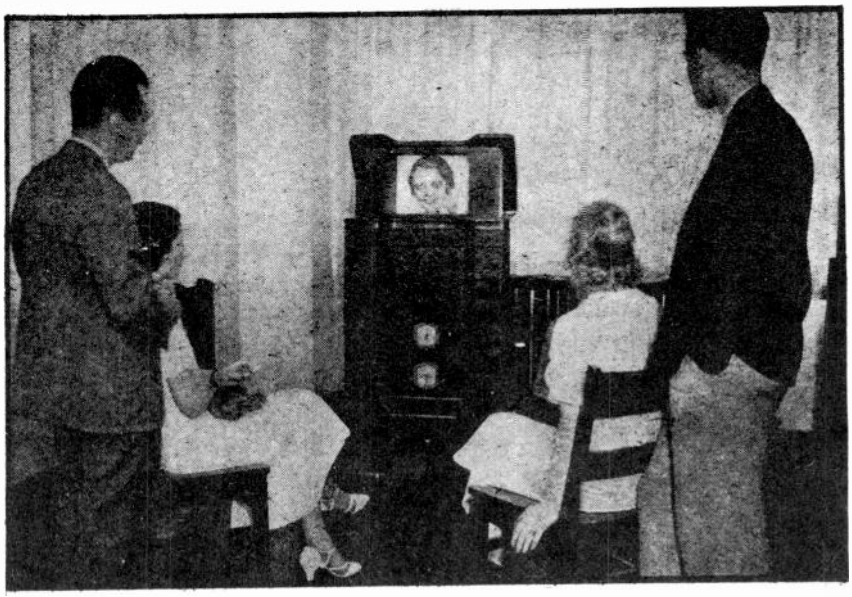


FIG. 2
Console Type Television Receiver.

TUNING CHARACTERISTICS OF TELEVISION RECEIVERS

THE R.F. AMPLIFIER IN THIS CASE IS DESIGNED TO TUNE OVER THE WAVE BAND IN WHICH THE DESIRED TELEVISION TRANSMITTER IS OPERATING. THIS R.F. AMPLIFIER IS ALSO SPECIALLY DESIGNED TO PASS A FREQUENCY BAND WHICH IS FROM 30 TO 40 KC. IN WIDTH, WHICH YOU WILL NOTE AS BEING MUCH BROADER TUNING THAN BROADCAST RECEIVERS, WHERE ONLY A MAXIMUM FREQUENCY BAND OF 10 KC. IS PASSED BY THE R.F. AMPLIFIER.

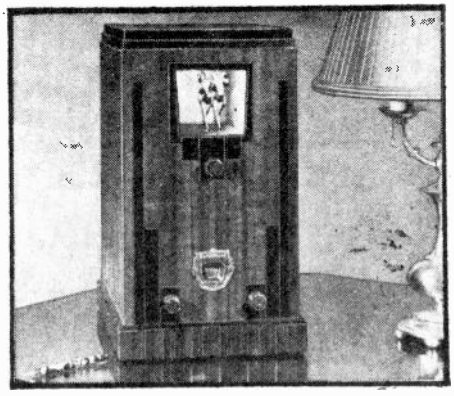


FIG. 3
Midget Type Television Receiver.

PROVIDING CORRECT BAND WIDTH

IN ORDER TO HAVE AN R.F. AMPLIFIER, WHICH IS ACCURATELY DESIGNED TO PASS A FREQUENCY BAND OF THIS WIDTH, MOST EXPERIMENTERS BUY THE R.F. TRANSFORMERS FROM CONCERNS, WHOSE LABORATORIES ARE EQUIPPED WITH THE NECESSARY TESTING APPARATUS TO PRODUCE ACCURATELY DESIGNED R.F. TRANSFORMERS, AND SUCH IS THE CASE FOR THE RECEIVER ILLUSTRATED IN FIG. 6. YOU CAN, HOWEVER, WIND YOUR OWN R.F. TRANSFORMER IF YOU SO DESIRE AND IF YOU DO, RE

MEMBER THAT THEY MUST BE WOUND SO AS TO TUNE OVER THE WAVE BAND REQUIRED.

SINCE TELEVISION STATIONS OPERATE IN VARIOUS BANDS, IT IS ALSO POSSIBLE TO EQUIP THE TELEVISION RECEIVER WITH PLUG-IN COILS SO AS TO FACILITATE CHANGING FROM ONE TELEVISION BAND TO ANOTHER, OR ELSE TO USE A MULTIPLE-COIL AND SWITCH ARRANGEMENT SIMILAR TO THAT USED IN ALL-WAVE RECEIVERS. AS A GENERAL RULE, HOWEVER, YOU WILL FIND TELEVISION RECEIVERS TO BE DESIGNED FOR BEST OPERATION IN ONE PARTICULAR BAND IN WHICH THE NEAREST STATION OPERATES BECAUSE THE REPRODUCED IMAGES BECOME POORER AS THE DISTANCE BETWEEN THE TRANSMITTER AND THE RECEIVER IS INCREASED.

TABLE I
(SPECIFICATIONS FOR TELEVISION RECEIVER CIRCUIT OF FIG.6)

#3 -- .000365 MFD.
#4 -- SHIELDED ANT. INDUCTANCE COIL
#5 -- 16,29,38,49 - TYPE -24 TUBES
#6 -- 10,11,17,20,21 - .1 MFD.
#7 -- 18,37,47 - 1000 OHM.
#8 -- TYPE RI-202 ELECTRAD VOLUME CONTROL.
#9 -- 19,28A,32,39,42,50,53 - 50,000 OHMS
#12 -- 22 - 75,000 OHMS
#13 -- 23 - TELEV. R.F. TRANSF.
#14 -- 24 - TWO-GANG COND. .0002 MFD. EACH SECTION
#15 -- 25 - 140 MMFD.
#26 -- .0001 MFD.
#27 -- 50,000 OHMS
#28 -- 1 MFD.
#30 -- 41 - 4MFD.
#31 -- 43, 55-25,000 OHMS.
#33 -- 44,54-.25 MFD.
#36 -- 40,48,51,52,58-2MFD.
#45 -- 57-250,000 OHMS
#59 -- CENTER TAPPED 20 OHM RESISTOR OR HUM ADJUSTER
#60 -- 1500 OHMS
#62A - ELECTRAD TRUVOLT - FIXED RESISTANCE TYPE B-30
#63A - MILLIAM. (0-50 MA.)
#64 -- TYPE C-200 ELECTRODE VOLTAGE DIVIDER
#64A - 4 MFD.
65 -- 16 MFD.
#66&67 8 MFD.
#68 --.1 MFD.
#69&70 30 HENRY 80 MIL CHOKES
#71 -- POWER TRANSFORMER WITH REQUIRED OUTPUT

EFFECT OF DETECTOR UPON IMAGE

BY AGAIN COMPARING THE CIRCUIT IN FIG.5 WITH THAT IN FIG.6YOU WILL NOTICE THAT WHEN POWER DETECTION IS EMPLOYED, AS IN FIG.5, THEN AN EVEN NUMBER OF A.F. STAGES FOLLOW THE DETECTOR. THAT IS, WE CAN IN THIS CASE USE 2, 4 OR 6 A.F. STAGES. WHILE ON THE OTHER HAND, WHEN USING GRID DETECTION AS IN THE CIRCUIT OF FIG.6, WE USE AN ODD NUMBER OF A.F. STAGES FOLLOWING THE DETECTOR, THAT IS, 1, 3 OR 5 A.F. STAGES.

THE REASON FOR THIS CHOICE IN THE SELECTION OF THE NUMBER OF A.F. STAGES IS THAT GRID CIRCUIT DETECTION INTRODUCES A PHASE-REVERSAL IN THE DETECTOR STAGE AND THIS MEANS THAT THE IMAGE WILL BECOME A "NEGATIVE" OR REVERSED PICTURE AT THE OUTPUT OF THE DETECTOR. THE IMAGE OR PICTURE WILL THEN BE ALTERNATELY REVERSED OR CHANGED FROM NEGATIVE TO POSITIVE AND VICE VERSA AS THE PICTURE SIGNALS ARE PASSED THROUGH EACH SUCCESSIVE A.F. STAGE.

CONSEQUENTLY, BY USING AN ODD NUMBER OF A.F. STAGES WITH GRID DE-

TECTION, A POSITIVE PICTURE WILL BE FURNISHED AT THE OUTPUT OF THE FINAL POWER STAGE. ON THE OTHER HAND, WHEN POWER DETECTION IS USED, A POSITIVE IMAGE WILL APPEAR AT THE OUTPUT OF THE DETECTOR AND THEREFORE THIS WILL BECOME A NEGATIVE AT THE OUTPUT OF THE FIRST A.F. STAGE, POSITIVE AT THE OUTPUT OF THE SECOND A.F. STAGE ETC. THUS IT IS SEEN THAT WHEN USING POWER DETECTION, AN EVEN NUMBER OF A.F. STAGES WILL RESULT IN A POSITIVE PICTURE AT THE OUTPUT OF THE RECEIVER.

TELEVISION RECEIVER WITH BAND-PASS FEATURES

ANOTHER INTERESTING TELEVISION RECEIVER CIRCUIT IS SHOWN IN FIG. 7. HERE TYPE 57 TUBES ARE USED IN THE TWO R.F. STAGES, AS WELL AS IN THE DETECTOR, FIRST A.F. AND SECOND A.F. STAGES, WHILE A 2A5 IS EMPLOYED IN THE FINAL OR OUTPUT STAGE.

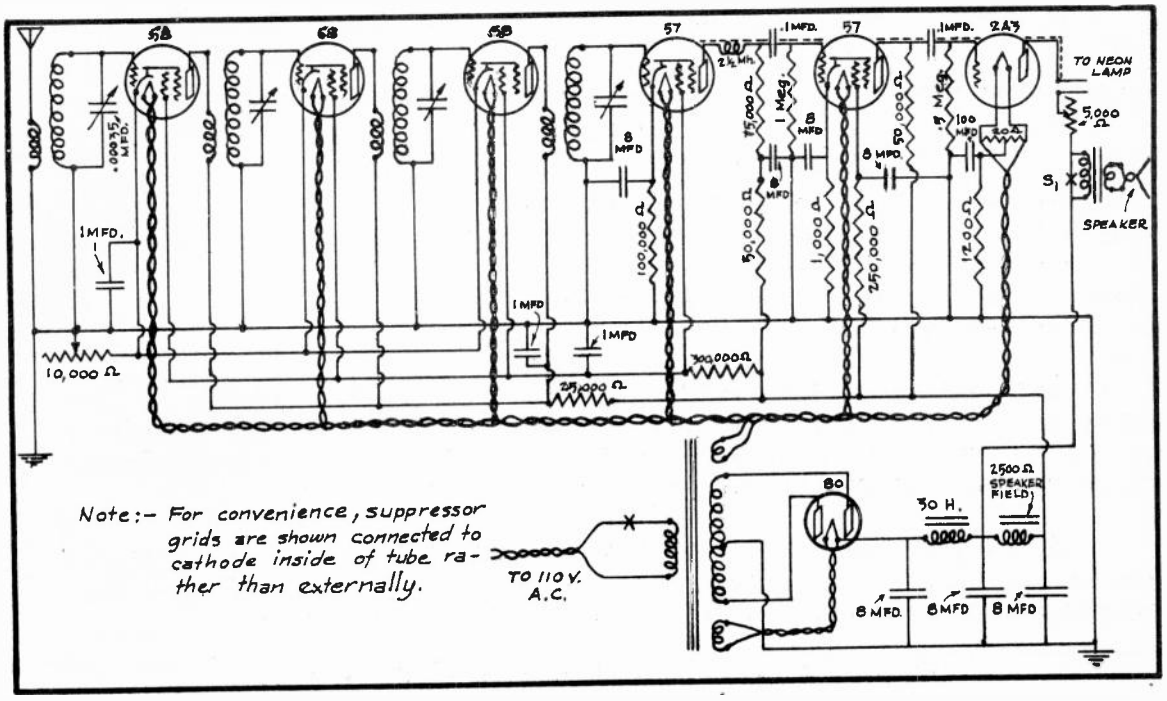


FIG. 5
A Seven-Tube Television Receiver

THE FIRST POINT OF INTEREST IN THIS CIRCUIT IS THE FACT THAT BOTH THE PRIMARY AND SECONDARY WINDINGS OF THE R.F. TRANSFORMERS USED BETWEEN THE FIRST AND SECOND R.F. TUBES AND BETWEEN THE SECOND R.F. AND THE DETECTOR TUBES ARE TUNED. THIS, YOU WILL READILY REALIZE, ! RESULTS IN A BAND-PASS EFFECT AND THE PURPOSE OF THE RESISTORS R IN THIS SAME CIRCUIT IS TO FLATTEN THE RESPONSE CURVE IN SUCH A MANNER THAT A PRACTICALLY CONSTANT OUTPUT IS MAINTAINED OVER THE DESIRED FREQUENCY RANGE.

ANOTHER POINT OF INTEREST REGARDING THIS CIRCUIT IS THAT THREE STAGES OF A.F. AMPLIFICATION ARE USED ALTHOUGH POWER DETECTION IS EMPLOYED AND WHICH DOES NOT ALTOGETHER AGREE WITH THE RULE PREVIOUSLY GIVEN. THIS CAN BE EXPLAINED, HOWEVER, IN THE FOLLOWING MANNER: THIS PARTICULAR RECEIVER WAS DESIGNED PRIMARILY TO BE USED IN CONJUNCTION WITH A CATHODE-RAY TYPE SCANNING UNIT AND WHICH IS EXPLAINED FULLY IN LATER LESSONS. FURTHERMORE, WITH THREE AUDIO STAGES AND A POWER DETECTOR, AN INCREASE IN RADIO-

FREQUENCY INPUT WILL CAUSE THE UNGROUNDED OUTPUT TERMINAL TO BECOME MORE POSITIVE. IF THIS TERMINAL IS USED TO APPLY VOLTAGE TO THE MODULATING GRID OF A CATHODE-RAY TUBE, A POSITIVE PICTURE WILL RESULT FOR MOST TELEVISION SIGNALS.

THE TRANSMITTING STATION GENERALLY INCREASES ITS OUTPUT ON THE BRIGHT PARTS OF THE PICTURE, BUT IF IT DOES THE OPPOSITE, THE PHASE OF

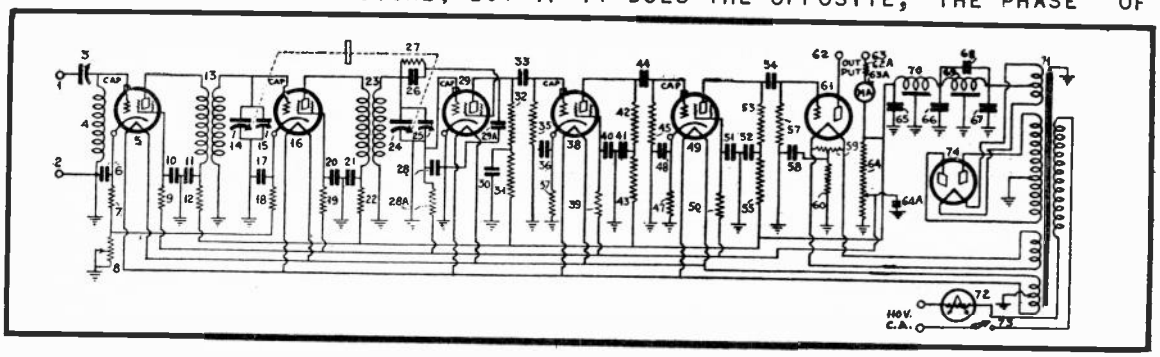


FIG. 6
Television Receiver With Grid Leak Detection.

THE CATHODE-RAY TUBE GRID VOLTAGE AT THE RECEIVER MUST BE REVERSED OR ELSE A NEGATIVE PICTURE WILL RESULT. THIS REVERSAL IN THIS INSTANCE IS BEST ACCOMPLSIHED BY ADDING AN EXTRA RESISTANCE-COUPLED AUDIO STAGE WITH LITTLE OR NO AMPLIFICATION; FOR INSTANCE, A 56 OR A 57 TUBE WITH A 1000 OHM COUPLING RESISTOR.

ALSO NOTICE IN THE CIRCUIT OF FIG.7 THAT NO R.F. FILTER IS USED IN THE OUTPUT OF THE DETECTOR. THIS HAS BEEN PURPOSELY OMITTED SO THAT THERE WILL BE NO POSSIBILITY OF BY-PASSING ANY OF THE HIGHER AUDIO FREQUENCIES TO GROUND AND THEREBY REDUCE THE CLARITY OF THE PICTURE.

SO FAR, ALL OF THE CIRCUITS WHICH WERE BROUGHT TO YOUR ATTENTION ARE OF THE T.R.F. TYPE. YOUR NEXT STEP THEN, WILL BE TO SEE HOW THE SUPERHETERODYNE PRINCIPLE CAN BE ADAPTED TO TELEVISION RECEPTION.

TELEVISION RECEIVERS OF SUPERHETERODYNE DESIGN

KNOWING THAT THE TELEVISION RECEIVER MUST BE BROAD TUNING IN ORDER

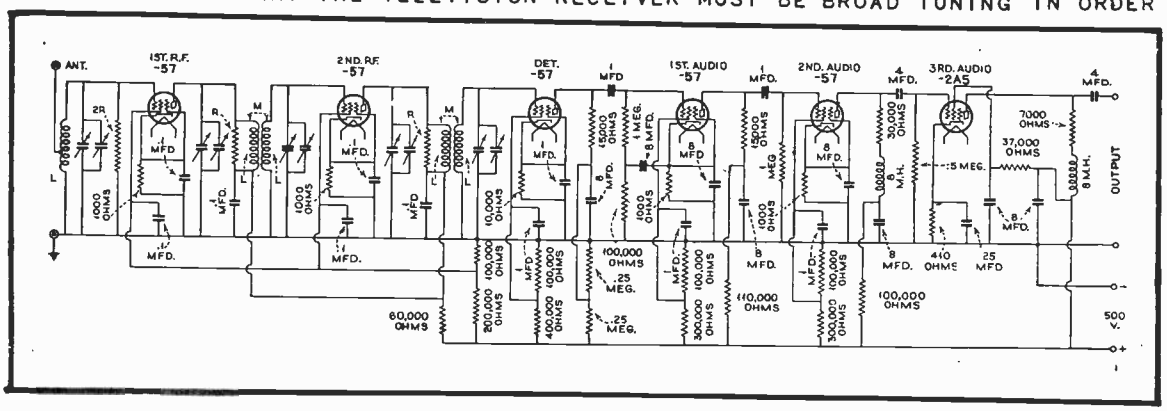


FIG. 7
Television Receiver With Band-Pass Features.

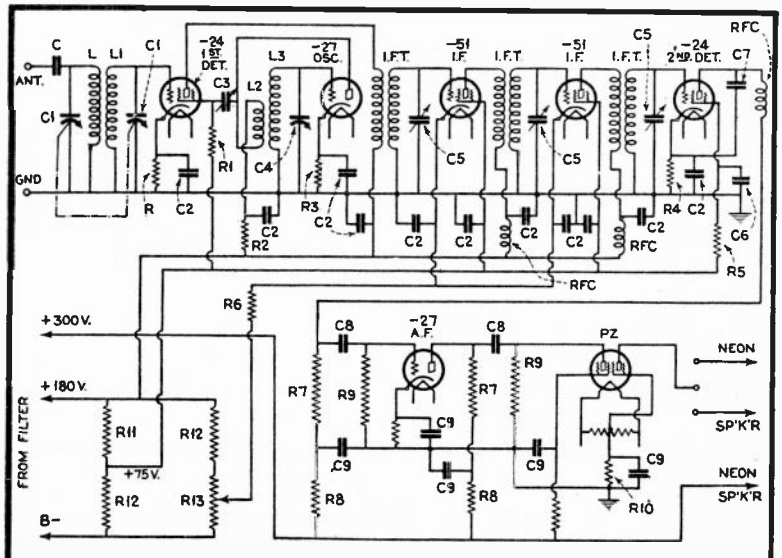
TO RETAIN THE ENTIRE BAND OF PICTURE FREQUENCIES, IT MAY AT FIRST APPEAR TO YOU THAT A RECEIVER OF SUPERHETERODYNE DESIGN MAY BE TOO SELECTIVE FOR TELEVISION PURPOSES. HOWEVER, UPON DEVOTING A LITTLE MORE THOUGHT TO THE SUBJECT YOU WILL SOON REALIZE THAT BY APPLYING CERTAIN PRINCIPLES OF DESIGN SUCH AS FLAT-TOP I.F. TRANSFORMERS ETC., THE RESONANCE CURVE OF THE SUPERHETERODYNE RECEIVER CAN BE BROADENED CONSIDERABLY.

ONE OF THE FIRST PROBLEMS TO BE CONSIDERED IN THIS RESPECT IS THE SELECTION OF THE MOST SUITABLE INTERMEDIATE FREQUENCY. IF TOO LOW AN I.F. FREQUENCY WERE EMPLOYED, THEN THE IMAGE INTERFERENCE PROBLEM WILL BECOME TOO BOTHERSOME. THAT IS TO SAY, UNDER THESE CONDITIONS, THERE WILL THEN BE CONSIDERABLE POSSIBILITY OF TWO OSCILLATOR FREQUENCIES HETERODYNING A SIGNAL TO THE INTERMEDIATE FREQUENCY. ALSO ONE OSCILLATOR SETTING WILL SERVE TO HETERODYNE TWO SIGNALS TO THE INTERMEDIATE FREQUENCY. FURTHERMORE, BY USING TOO LOW AN INTERMEDIATE FREQUENCY WILL REQUIRE EXCESSIVE SELECTIVITY OF THE FIRST DETECTOR'S TUNING CIRCUIT AND OTHER PRE-SELECTOR CIRCUITS.

ON THE OTHER HAND, BY USING TOO HIGH AN INTERMEDIATE FREQUENCY, THE I.F. AMPLIFIER BECOMES LESS STABLE IN OPERATION AND TROUBLES DUE TO FEED-BACK ARE LIKELY TO BE ENCOUNTERED.

ALTHOUGH IT IS A COMMON PRACTICE TO USE I.F. TRANSFORMERS OF THE PLATE-TUNED, GRID-TUNED TYPE AND ADJUSTING THEM FOR FLAT-TOP RESPONSE, YET YOU WILL ALSO FIND A NUMBER OF CASES WHERE ONLY THE SECONDARY WINDINGS ARE TUNED AS IN THE CIRCUIT ILLUSTRATED IN FIG.8. THIS METHOD, AS WELL AS CLOSE COUPLING BETWEEN THE PRIMARY AND SECONDARY WINDINGS OF THE I.F. TRANSFORMERS, PREVENTS EXCESSIVE SELECTIVITY IN THIS PART OF THE CIRCUIT.

ALSO, BY CLOSELY STUDYING THE SUPERHETERODYNE CIRCUIT IN FIG.8, YOU WILL NOTE THAT A BAND-SELECTOR TUNING ARRANGEMENT IS USED IN THE FIRST DETECTOR CIR-



C	Antenna coupling condenser .000025 mfd.	RFC	Long-wave r-f. chokes.
C1	Two-gang tuning condenser .00015 mfd.	R	First detector bias resistor 10,000 ohms.
C2	.1 mfd. by-pass condensers.	R1	First detector screen-grid resistor 50,000 ohms.
C3	Oscillator coupling condenser .000025 mfd.	R2	Oscillator voltage dropping resistor 25,000 ohms.
C4	Oscillator tuning condenser .00015 mfd.	R3	Oscillator bias resistor 1500 ohms.
C5	I-F. "peaking" condensers .00005 to .0001 mfd.	R4	2nd detector bias resistor 50,000 ohms.
C6	Second detector screen-grid by-pass condenser 1 mfd.	R5	2nd detector screen-grid resistor 10,000 ohms.
C7	Second detector plate by-pass .00015 mfd.	R6	I-F. bias resistor 300 ohms.
C8	Audio coupling condensers .1 mfd.	R7	Plate resistors 100,000 ohms.
C9	Audio by-pass and filter condensers 1 to 4 mfd.	R8	Filter resistors 25,000 ohms.
L, L1	Short-wave band filter coils.	R9	Grid resistors 250,000 ohms.
L2, L3	Oscillator coils.	R10	Bias resistors 400 ohms.
IFT	Intermediate-frequency transformers.	R11	10,000 ohms.
		R12	30,000 ohms.
		R13	Volume control 10,000 ohms.

FIG. 8
Television Receiver of Superheterodyne Type.

CUIT. THIS AIDS IN MAKING REASONABLY SHARP TUNING POSSIBLE WITHOUT SIDE BAND CUTTING. THE OUTPUT OF THE SECOND DETECTOR FEEDS INTO A HIGH FIDELITY RESISTANCE-COUPLED AUDIO AMPLIFIER CONSISTING OF ONE TYPE 27 TUBE AND ONE 47 TUBE. THE POWER PACK, WHICH IS NOT SHOWN HERE, IS OF CONVENTIONAL DESIGN AND ASIDE FROM THE FEATURES SO FAR POINTED OUT REGARDING THIS CIRCUIT, IT FOLLOWS THE SAME GENERAL DESIGN PRACTICE AS USED FOR RADIO RECEIVERS OF THE SUPERHETERODYNE TYPE.

RECEIVER FOR A.C.-D.C. OPERATION

ANOTHER INTERESTING TELEVISION RECEIVER CIRCUIT OF THE SUPERHETERODYNE TYPE IS SHOWN YOU IN FIG. 9. THIS PARTICULAR RECEIVER EMPLOYS A 25Z5 TUBE AS THE RECTIFIER, A 6F7 AS THE COMBINATION FIRST DETECTOR AND OSCILLATOR, AND 6C6 TUBES IN ALL OF THE OTHER STAGES.

A UNIQUE FEATURE OF THE CIRCUIT IN FIG. 9 IS THE MANNER IN WHICH A PUSH-PULL ACTION IS OBTAINED IN THE POWER STAGE THROUGH A RESISTANCE-CAPACITY COUPLING SYSTEM RATHER THAN WITH THE AID OF TRANSFORMERS. WITH A DEFINITE SETTING OF THE PHASING POTENTIOMETER, THE PROPER PHASE RELATION BETWEEN THE TWO OUTPUT TUBES IS OBTAINED WHICH WILL RESULT IN PROP

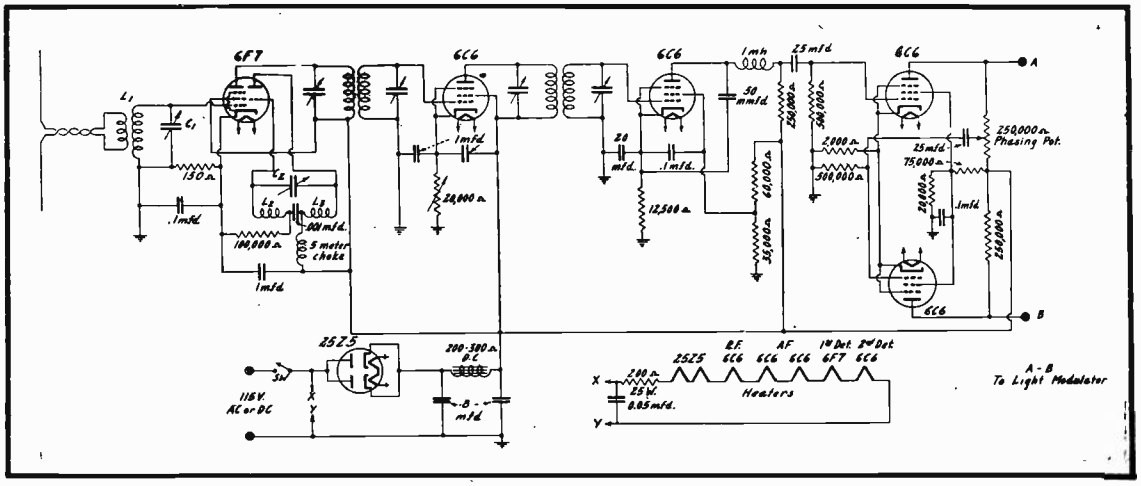


FIG. 9

The A.C.-D.C. Superheterodyne Television Set.

ER PUSH-PULL OPERATION. ANY POTENTIOMETER SETTING TO EITHER SIDE OF THIS POSITION WILL RESULT IN A SHIFTING OF PHASE AND THUS IT CAN BE SEEN THAT THE PURPOSE OF THIS POTENTIOMETER IS TO SUPPLY A MEANS FOR ADJUSTING THE PHASE RELATION BETWEEN THE TWO OUTPUT TUBES.

A 20,000 OHM RHEOSTAT IN THE CATHODE CIRCUIT OF THE FIRST I.F. TUBE SERVES AS THE VOLUME CONTROL. THE PARTICULAR CIRCUIT ILLUSTRATED IN FIG. 9 WAS DESIGNED PRIMARILY FOR THE RECEPTION OF SIGNALS FROM TELEVISION TRANSMITTERS WHICH OPERATE IN THE 5 & 6 METER CHANNEL. SINCE THIS WAVE LENGTH CORRESPONDS TO RATHER HIGH FREQUENCIES WHICH INTRODUCE COMPLICATIONS IN CIRCUIT CONSTRUCTION AND ARRANGEMENT, IT WILL BE WELL TO POINT OUT AT THIS TIME SOME OF THE MORE IMPORTANT POINTS REGARDING THIS MATTER.

ULTRA HIGH-FREQUENCY CIRCUIT

THE TUNED WINDINGS FOR CIRCUITS OPERATING AT THESE VERY HIGH FRE-

QUENCIES GENERALLY CONSIST OF COILS WOUND EITHER WITH LARGE SIZE COPPER WIRE OR WITH COPPER TUBING SIMILAR TO THOSE ALREADY DESCRIBED RELATIVE TO RADIO TRANSMITTERS. IT IS ALSO THE COMMON PRACTICE TO MOUNT THESE COILS ON STAND-OFF INSULATORS SO AS TO REDUCE LOSSES AS MUCH AS POSSIBLE.

AN EXAMPLE OF A COIL FOR THIS PURPOSE IS ILLUSTRATED IN FIG. 10. THIS COIL CONSISTS OF 12 TURNS WOUND WITH #12 B&S SELF-SUPPORTING WIRE AND WRAPPED WITH 1/32" SPACING BETWEEN TURNS TO THE DIMENSIONS DESIGNATED IN FIG. 10. FOR THIS PARTICULAR COIL DESIGN A 10 MMFD. TUNING CONDENSER CAN BE USED TO PERMIT TUNING THE CIRCUIT IN THE 56 MEGACYCLE BAND.

HAVING THUS FAR FAMILIARIZED YOURSELF WITH THE CONSTRUCTIONAL FEATURES OF TELEVISION RECEIVERS, LET US NOW PROCEED WITH THE METHOD OF OPERATING THESE RECEIVERS DURING THE RECEPTION OF TELEVISION PROGRAMS.

OPERATING TELEVISION RECEIVERS

THE LOUD SPEAKER IS A GREAT AID IN TUNING-IN THE TELEVISION SIGNAL, BECAUSE TELEVISION SIGNALS ARE AUDIBLE. IT WOULD BE RATHER DIFFICULT TO LOCATE A TELEVISION STATION ON THE TUNING DIAL OF THE RECEIVER AND AT THE SAME TIME "BRING IN" THE PICTURE WITH THE TELEVISOR (SCANNING AND OPTICAL EQUIPMENT) ON ACCOUNT OF THE NECESSITY OF SYNCHRONIZING THE SCANNER IN ORDER TO SEE A PICTURE. THEREFORE, WE DON'T USE THE TELEVISOR AT ALL WHILE TUNING IN THE STATION BUT INSTEAD, WE CONNECT A LOUD SPEAKER ACROSS THE OUTPUT OF THE TELEVISION RECEIVER.

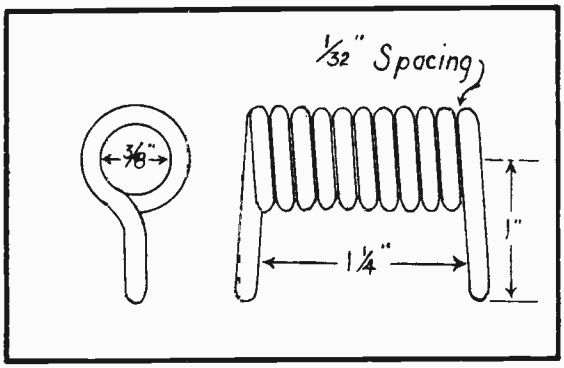


FIG.10
A Typical High Frequency Coil.

BY CONSULTING A LOG BOOK FOR TELEVISION STATIONS, WE CAN JUDGE THE APPROXIMATE SETTING OF THE TUNING CONTROLS IN ORDER TO BRING IN THE DESIRED TRANSMITTER FREQUENCY. SO WE TUNE THE SET SLOWLY AND CAREFULLY UNTIL THE TELEVISION SIGNAL IS HEARD IN THE SPEAKER. THE TELEVISION SIGNAL CAUSES A CHARACTERISTIC SOUND IN THE SPEAKER WHICH SOUNDS SOMEWHAT LIKE A BUZZ-SAW OR A STEADY WHIRRING SOUND.

WITH THE STATION THUS TUNED IN, DISCONNECT THE SPEAKER FROM THE CIRCUIT, AND CONNECT THE NEON LAMP IN ITS PLACE. THIS CHANGEOVER IS MOST EASILY ACCOMPLISHED WITH THE USE OF A SWITCH. AS SOON AS THE TELEVISION LAMP IS CONNECTED IN THE CIRCUIT, START UP THE MOTOR OF THE SCANNER.

AT THIS TIME, ADJUST THE MOTOR CONTROL RHEOSTAT SO THAT THE SCANNING DISC REVOLVES SOMEWHAT FASTER THAN REQUIRED AND GRADUALLY VARY THIS RHEOSTAT SETTING UNTIL THE IMAGE APPEARS. AS SOON AS THE SETTING IS FOUND AT WHICH THE IMAGE TAKES FORM, IMMEDIATELY CONNECT THE PHONIC MOTOR TO THE CIRCUIT, SO THAT SYNCHRONISM OF THE SCANNING DISC WILL BE MAINTAINED.

THE CAUSES AND REMEDY FOR FAULTY PICTURES

WHEN RECEIVING TELEVISION IMAGES, THE PICTURE IS NOT ALWAYS AS GOOD AS IT SHOULD BE AND THE VARIOUS CAUSES FOR SUCH TROUBLES ARE GENERALLY DETERMINED BY THE SYMPTOMS OFFERED BY THE PICTURES THEMSELVES.

FIG.11
Side to side Shifting.

FOR EXAMPLE, IN FIG.11, WE HAVE THE CASE WHERE THE IMAGE IS SHIFTING FROM SIDE TO SIDE. THE CAUSE FOR THIS TROUBLE IS THAT THE RECEIVING AND TRANSMITTING SCANNING DISCS ARE NOT SYNCHRONIZED AND THIS IS A COMMON COMPLAINT IN SUCH SYSTEMS WHERE A PHONIC MOTOR IS NOT EMPLOYED. THE ONLY REMEDY FOR THIS CONDITION IS TO USE A GOOD SELF-SYNCHRONIZING DEVICE SUCH AS THE PHONIC MOTOR. IN CRUDER SYSTEMS, ONE WILL HAVE TO CONTENT HIMSELF WITH "JUGGLING" THE RHEOSTAT CONTROLS OF THE DRIVING MOTOR, IN ORDER TO MAINTAIN SOME ORDER OF SYNCHRONISM.

FIG.12
Out, Horizontally

A COMPLAINT WHICH OCCURS IN MOST PRESENT DAY TELEVISION RECEIVING EQUIPMENT IS SHOWN IN FIG.12. HERE THE PICTURE IS OUT OF FRAME HORIZONTALLY AND THE CAUSE FOR THIS CONDITION IS THAT THE RECEIVER SCANNING DISC IS IN STEP WITH THE TRANSMITTER SCANNER ALRIGHT, BUT THEY ARE SLIGHTLY OUT OF PHASE WITH EACHOTHER. TO REMEDY THIS CONDITION, THE NEON LAMP SHOULD BE MOVED SLIGHTLY AROUND THE PERIPHERY OF THE DISC UNTIL THE IMAGE IS CENTERED.

FIG.13
Out, Vertically

IN FIG.13, YOU WILL SEE AN EXAMPLE OF WHERE THE PICTURE IS OUT OF FRAME VERTICALLY. THE REASON FOR THIS CONDITION IS THAT THE RECEIVING SCANNING MECHANISM IS OUT OF PHASE WITH THE TRANSMITTING SCANNER. IF A SYNCHRONOUS MOTOR OPERATED OFF THE A.C. POWER LINES IS USED, THEN THIS PICTURE CAN BE CENTERED BY CONTINUALLY STOPPING AND STARTING THE MOTOR UNTIL THE PICTURE BECOMES CENTERED.

A REVERSED OR "NEGATIVE IMAGE" IS SHOWN YOU IN FIG.14. THIS TYPE OF PICTURE IS SIMILAR TO THAT OF A NEGATIVE CAMERA PICTURE. THAT IS, THE DARK PORTIONS OF THE IMAGE ARE LIGHT AND VICE VERSA AND THE IMAGE IS LITERALLY REVERSED. THIS TROUBLE ONLY OCCURS WHEN AN EVEN NUMBER OF AUDIO STAGES FOLLOW THE GRID-LEAK TYPE DETECTOR OR AN ODD NUMBER OF AUDIO STAGES FOLLOW A POWER DETECTOR AND CONSEQUENTLY, THE SOLUTION TO THIS PROBLEM IS EITHER TO ADD OR SUBTRACT ONE STAGE OF RESISTANCE-COUPLED AUDIO AMPLIFICATION OR ELSE CHANGE THE TYPE OF DETECTOR.

YOU MIGHT RUN INTO A CONDITION, SUCH AS ILLUSTRATED IN FIG. 15, WHERE THE IMAGE IS INVERTED OR UP SIDE DOWN. THE CAUSE FOR THIS TROUBLE IS THAT THE DISC OR SCANNING MECHANISM IS RUNNING BACKWARDS. THE LOGICAL CORRECTION FOR THIS TROUBLE IS TO CHANGE THE DIRECTION OF THE SCANNING MECHANISM'S ROTATION.

NO DOUBT, THE MOST COMMON COMPLAINT OF ALL IS PICTURED FOR YOU IN FIG. 16. IN THIS CASE, LIGHT SPLOTCHES ARE SCATTERED OVER THE IMAGE. THE CAUSE FOR THIS TROUBLE IS EITHER STATIC, OR NOISE FROM THE RECEIVER WHICH MAY BE BROUGHT ABOUT BY A BAD TUBE, POOR CONNECTIONS, ETC. THE FIRST THING TO DO IN THIS CASE IS TO DETERMINE WHETHER OR NOT THE RECEIVER IS AT FAULT AND IF SO, TO CORRECT THE TROUBLE. HOWEVER, IF STATIC IS RESPONSIBLE FOR THE TROUBLE, THEN THERE IS NO SATISFACTORY REMEDY, ALTHOUGH IT MAY BE REDUCED BY INSTALLING STATIC REDUCING DEVICES IN THE SYSTEM.

FIG. 14
Reverse or Negative Image.

FIG. 15
Inverted Image

FIG. 16
Light Splotches over Image.

SOMETIMES, INSTEAD OF SUCH IRREGULAR SPLOTS OF LIGHT UPON THE IMAGE, YOU WILL FIND CASES WHERE REGULAR BLACK LINES CROSS THE IMAGE HORIZONTALLY. THIS MAY BE CAUSED BY ACCUMULATIONS OF DIRT IN THE HOLES OF THE SCANNING DISC OR ELSE A HOLE IN THE DISC MAY BE RADIALLY "OFF-CENTER" DUE TO INACCURATE PUNCHING. THE REMEDY FOR THE FIRST CONDITION IS TO CLEAN THE SCANNING HOLES BUT TO CORRECT THE SECCND CONDITION, YOU WILL EITHER HAVE TO ATTEMPT TO REPUNCH THE FAULTY HOLE AND DRESS IT WITH A FILE, OR ELSE AN ENTIRE NEW DISC WILL HAVE TO BE OBTAINED.

IF THE IMAGE IS OTHERWISE SATISFACTORY BUT ONLY DIM, THEN THE TROUBLE IS EITHER DUE TO INSUFFICIENT SIGNAL STRENGTH, TOO MUCH CURRENT THRU THE TELEVISION LAMP OR TOO MUCH OUTSIDE LIGHT. IF DUE TO INSUFFICIENT SIGNAL STRENGTH, USE A MORE POWERFUL AMPLIFIER. TO REDUCE THE CURRENT THRU THE TELEVISION LAMP, WHEN IT IS CONNECTED IN SERIES WITH THE OUTPUT TUBE, EITHER REDUCE THE PLATE VOLTAGE OR THE GRID BIAS FOR THE OUTPUT STAGE OR ELSE ADD A RESISTOR IN THE PLATE CIRCUIT. IF TOO MUCH OUTSIDE LIGHT IS PRESENT, DARKEN THE ROOM, USE A MORE EFFICIENT SHADOW BOX, OR BOTH.

Examination Questions

LESSON NO. TEL-3

"Improvement comes with practice."

1. - Draw a circuit diagram of a T.R.F. type television receiver.

2. - Describe the most outstanding features of the circuit which you have drawn in answer to question #1 and explain in detail how the television signal is handled by this same circuit.

3. - What important precautions must be considered in the design and construction of a superheterodyne receiver suitable for television reception?

4. - What effect does the type of detector have upon the operation of a television receiver?

5. - Explain how you would "tune-in" a television picture?

6. - What determines the number of resistance-capacity coupled A.F. stages which should be used in a television receiver?

7. - Describe the most common faults of television pictures and explain how each of these conditions can be corrected at the receiver.

8. - What is the reason for using the resistor R in the circuit of Fig.7 in this lesson?

9. - Why is switch S_1 provided in the circuit which is illustrated in Fig.5 of this lesson?

10. - If the image as produced at the television receiver is somewhat dim but otherwise satisfactory, then how may this condition generally be corrected?

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4000 S. Figueroa Street, Los Angeles, Calif.

J. A. ROSENKRANZ, Pres.

December 2, 1940

Mr. William Lieske RB-1712
1346 Hoyt St.
Salem, Oregon

Dear Mr. Lieske:

Nearly all commercial all-wave receivers have "dead spots" in the shortwave bands. These points seem to occur in practically the same place on the dial for nearly all makes of receivers. The reason they occur is due to the close coupling between various coils for the other bands and the particular shortwave band which is affected most.

Then again, you may be situated in such a position that the shortwave bands are all attenuated at this certain frequency. That is, your surroundings, the direction of your antenna, and the close proximity of mountains may all contribute to an overall reduction of the signal at this frequency.

Commercial receivers are always tuned for maximum sensitivity on the second shortwave band at about 4000 Kc. This usually leaves the middle portion of the band at a lower sensitivity than the two ends.

There is very littly you can do to correct this condition beyond realigning the r-f shortwave trimmers so that the receivers have maximum sensitivity at a lower point. However, if you do this, you will find that the sensitivity will be corresponding lower at the higher frequencies again. Therefore, it is a better policy to just leave the shortwave bands as they are, unless perhaps the oscillator alignment has been changed.

Very truly yours,

Mary Day

Technical Division
Consultation Service

MD:AG

In the Spirit of Christmas

December 6, 1940

Dear Friend:

There is no need to remind you that Christmas will soon be here -- and like the rest of us, you are undoubtedly looking forward to the Holidays.

This season of the year, with its good cheer, its happiness and expression of fellow-feeling, offers a welcome relief from the stress of daily life. And this year, more than ever before, we can rejoice that we are living in a land where peace still resides. If all men would TRY earnestly to make the Spirit of Christmas prevail throughout the entire year, we would perhaps not have the turmoil which exists in the world today.

At National, we have, for 36 years, carried the thought of giving into each day's activities. Although you may not realize it, many of the Special Features and extra Services of National Training have been made posssible because of this attitude.

However, at Christmas time, as evidence of our sincere regard for you and your fellow students, we want to do something special. Last year we made a very helpful Christmas offer -- in the form of an unusually liberal Tuition Credit Arrangement. It was so enthusiastically received that we feel we can not do anything more constructive this year than to repeat that Offer. You will find it explained in detail in the enclosed announcement. This is our gift to you -- and I want you to know that it carries with it all the sincerity and good wishes that it would if it were wrapped in tissue paper, tied with colored ribbon, and placed upon your doorstep.

SERVICE to OTHERS, we believe, is an essential ingredient of the success of individuals and of institutions. We have given unstintingly of the best that is in us, of service, help, guidance -- everything that will make life richer, fuller, happier, for the ambitious men who turn to us for assistance. And never will we cease in this effort.

So, as a student of National Schools, soon, we hope, to be a successful graduate, let yourself become imbued with the spirit of your school. Remember, too -- that the more you do to help yourself, the more you will be able to help those near and dear to us.

I send you my Best Wishes for a Joyous Christmas -- but more than anything else, I constantly wish for you a successful career built on SERVICE.

Your friend,

K. Rosenkranz

President

JAR:CDO

UNDER THIS SPECIAL CHRISTMAS OFFER, IF YOU MAKE A PAYMENT OF --

$18	YOU RECEIVE CREDIT ON YOUR ACCOUNT FOR	$20
$27	" " " " " " "	$30
$36	" " " " " " "	$40
$45	" " " " " " "	$50
$54	" " " " " " "	$60
$63	" " " " " " "	$70
$72	" " " " " " "	$80
$81	" " " " " " "	$90
$90	" " " " " " "	$100

IF YOUR BALANCE IS OVER $100 -- AND YOU WOULD LIKE TO PAY IT ALL NOW, YOU MAY DEDUCT 12% OF THE TOTAL, AND YOU WILL RECEIVE CREDIT FOR PAYMENT IN FULL.

HERE IS AN UNUSUALLY LIBERAL TUITION CREDIT ALLOWANCE REPRESENTING A WORTHWHILE SAVING FOR YOU

Study the table in the upper right-hand corner. Note the very liberal credit allowances. Do they not represent an exceptionally acceptable opportunity, in keeping with the spirit of Christmas? From past experience, we know that this offer will appeal to the man who is anxious to save every dollar he can.

Of one thing we want to make absolutely certain -- that you DO have an opportunity to share in National's Christmas Offer. Accordingly, we have made the list of credits very complete so that you may take your choice. Naturally, the larger the payment you make, the greater credit you will receive.

IMPORTANT---PLEASE READ CAREFULLY

If you have already sent your payment when you receive this offer, send the difference and you will receive credit. In other words, if you have made a payment of $10, send an additional $8 and you will receive credit for $20 -- and so on down the entire list of credits.

Of course, it is understood that the total amount sent under this Christmas Offer -- unless the amount sent pays your account in full -- can only be applied to your December payment, but the total will be deducted from your present balance.

THIS OFFER EXPIRES DECEMBER 31, 1940

To receive credit, the envelope carrying your remittance must be postmarked on or before midnight December 31, 1940. Don't wait until after Christmas to take advantage of this unusual credit allowance. Be safe -- ACT NOW, WITHOUT DELAY.

Return the coupon below with your remittance. Retain the upper part of this sheet as a record of the credit you will receive.

NATIONAL SCHOOLS
LOS ANGELES, CALIF.

DATE _____

THANK YOU FOR YOUR CHRISTMAS OFFER. I CERTAINLY WANT TO TAKE ADVANTAGE OF IT. ENCLOSED IS MY REMITTANCE OF $____, WHICH ENTITLES ME TO A CREDIT OF $____, AS DESCRIBED IN THIS ANNOUNCEMENT.

IF YOU HAVE ALREADY SENT YOUR REGULAR PAYMENT FOR DECEMBER, FILL IN THE SPACE BELOW:

I HAVE ALREADY SENT MY PAYMENT FOR THIS MONTH. ENCLOSED IS THE DIFFERENCE OF $____, WHICH ENTITLES ME TO A TUITION CREDIT OF $____.

NAME _____ STUDENT NUMBER _____

ADDRESS _____ CITY _____ STATE _____

LITHOGRAPHED BY NATIONAL SCHOOLS LOS ANGELES, CALIF. U.S.A. EG·99

NATIONAL SCHOOLS
LOS ANGELES, CALIFORNIA

Examination Sheet

GRADE

CORRECTED BY

PRINT YOUR NAME AND ADDRESS PLAINLY

DATE

LESSON NO.

STUDENT NO.

WHAT OTHER LESSONS HAVE YOU?

ANS. NO.	USE THIS SHEET FOR YOUR EXAMINATION ANSWERS ONLY - DO NOT COPY OUT THE QUESTIONS

240-RD.

USE OTHER SIDE

Printed in U.S.A.

ANS.NO.

IMPORTANT -- IF NECESSARY, USE ANY SIMILAR PLAIN PAPER TO COMPLETE YOUR ANSWERS.