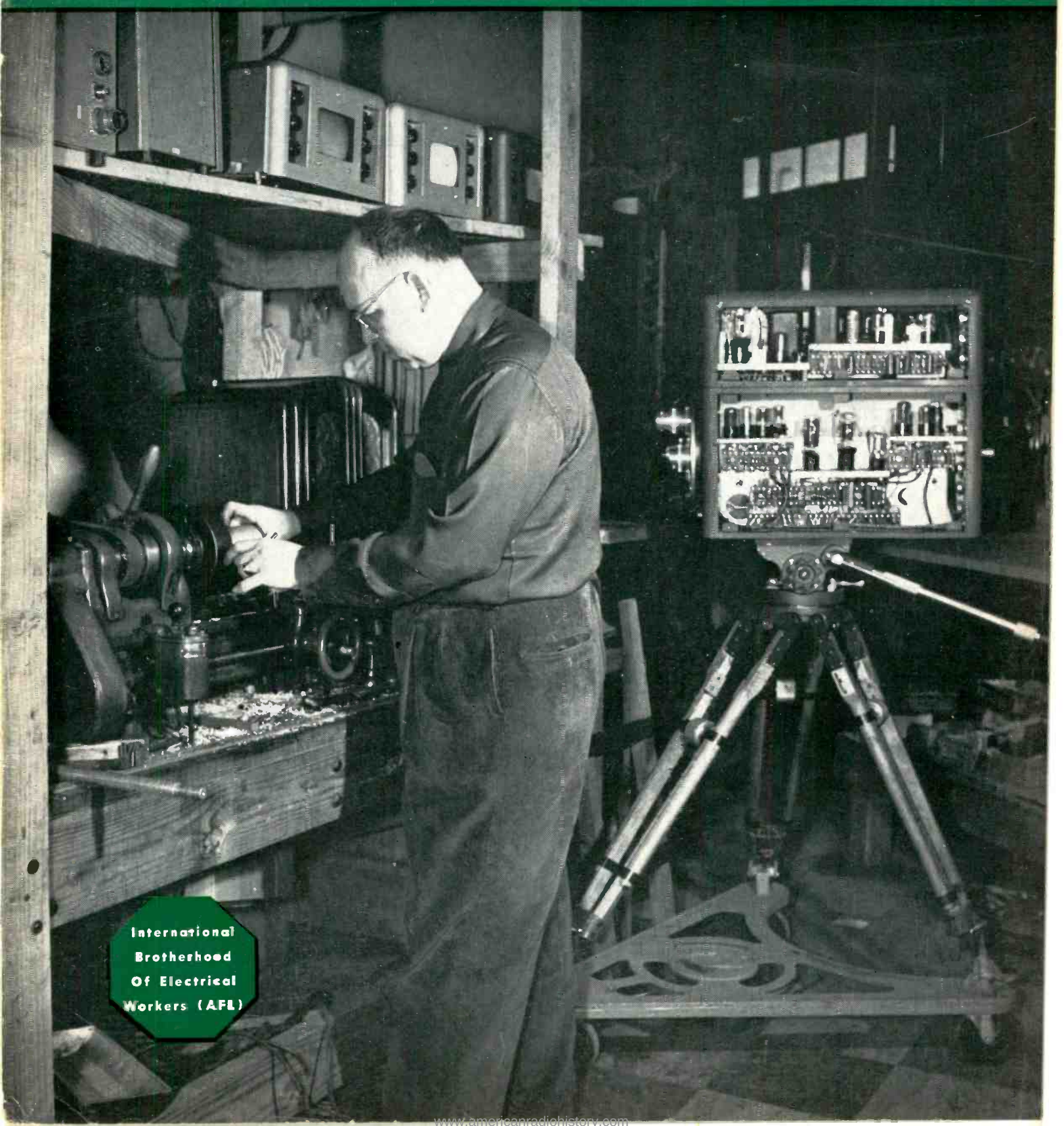
RADIO, TV and RECORDING

TECHNICIAN-ENGINEER

DECEMBER, 1953



International Brotherhood Of Electrical Workers (AFL)

RADIO, TV and RECORDING
TECHNICIAN-ENGINEER

VOLUME 2 — NUMBER 11

PRINTED ON UNION MADE PAPER

Published monthly by the International Brotherhood of Electrical Workers, AFL, 1200 Fifteenth St., N. W., Washington, D. C., for the men and women in the recording, radio and television industries.

D. W. TRACY, *President* • J. SCOTT MILNE, *Secretary*

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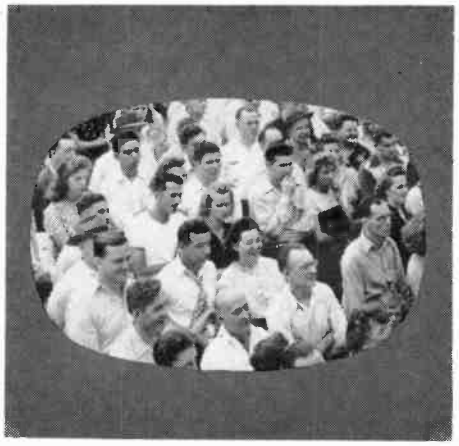
Entered February 20, 1952 as second-class matter at Washington. D. C., under Act of August 24, 1912. Subscription Price: United States and Canada, $2 yer year, in advance.



1953 Facts and Figures Justify Current Optimism In Broadcasting Industry, Foretell Good Year in '54

As of the end of last month, 318 television stations were on the air in the continental United States. Some 213 of them are VHF and the balance UHF. Bow-tie, roof-top antennae are now appearing in many cities which have previously sported only the more conventional folded dipoles. Converter and new set sales are running neck and neck in several of the cities which now have UHF service. Most radio-TV manufacturers' third-quarter, 1953, sales reports indicate a heartening and steady rise, but some sales figures indicate that certain market areas have suffered a slack recession during the third quarter.

Over-extension of credit and surplus inventories have accounted for the bankruptcy and closure of three large Washington, D. C., appliance dealers in the last six months. This market is exceptional and certainly cannot be construed to have had a typical market reaction. The feeling of the merchants of the District of Columbia area is that the slump was primarily due to the termination, uncertainty and fear of Government and Government-connected employes. Only very recently has there been an upturn in the morale of Government employes and a lessening of the feeling of insecurity of employment.

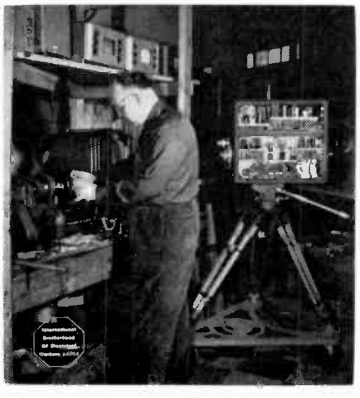
On the broadcasting side, the picture is much brighter than it was a year ago—or even six months ago. For the first nine months of 1953 CBS reports net profits are 49 per cent greater than for a similar period in 1952, with sales up 28 per cent and earnings increased by 58 per cent. The CBS report is for the whole of the company's operations—all of its subsidiaries (tube and television manufacturing, recording laboratories, etc.).

The American Broadcasting Company report for this same period indicates a loss sustained in broadcasting operations but an overall profit on the American Broadcasting-Paramount Theaters operation. Loss in the broadcasting field is attributed largely to the initial cost of reorganization and expenses incurred in strengthening the radio and TV networks, along with the seasonal slack of the summer months, according to company executives.

Further capital investments loom on the horizon for television broadcasting — higher power transmitters, transmitter replacements, changes in antenna systems and so on. One major upcoming investment for present licensees will necessarily be that involved in the conversion to color equipment. Some FCC Commissioners have gone so far as to predict NTSC standards will be approved by Christmas.

Most of the viewers at the color demonstrations held at the Waldorf-Astoria Hotel in New York in October were satisfied that color "has arrived." Thirteen manufacturers made sets for the demonstrations, with three different makes of tubes and two different types of camera pickup equipment being used. Some of the receivers had as many as 36 tubes and up to four rectifiers.

While on the subject of color tests, it is interesting to note that the concensus of observers' opinions was that all 13 receivers seemed to work satisfactorily, with only minor quality variations between them being noted. One particularly important aspect of the test was demonstrated by periodic switches from micro-wave to



THE COVER

Bert Brouse shapes a part from a station television camera in the workshop of WFBM-TV, Indianapolis, Ind. The members of IBEW Local 1225 employed at WFBM-TV have produced much of the station equipment themselves, including parts and units for both TV and AM.

coaxial and to direct cable pickup. The ordinary A. T. and T. 2.6 mc. coaxial facility proved completely satisfactory when the 3.6 mc. color subcarrier was converted to 2.4 mc. Prize and proof of the performance was the signal fed from New York to Washington and back again. Most observers felt there "wasn't a bit of difference."

Crosley has made a set with the much discussed Lawrence tube but no manufacturer displayed a set utilizing this tube in the demonstrations. Previous comment, that the number-one fault of the Lawrence tube is the radiation from it, has been answered by at least one company which reports that this problem has been satisfactorily overcome. Picture tubes used in the receivers at the demonstrations were manufactured by RCA, Rauland and CBS-Hytron. Approximately an 11½-inch picture resulted from the use of 15-inch (glass) envelopes employed by all three manufacturers.

To get back to our original subject, there is a growing optimism prevalent in the industry. The usual Christmas boom has begun in appliance stores and radios as well as television sets are moving in good quantities. According to Martin Codel's "Television Digest" 85 per cent or more of the television sets in use in 11 cities having UHF service available can receive UHF. Converter sales seem to be directly proportional to the amount of promotional activity by broadcasters and retailers in cities which have long-established VHF service. Bearing out this theory is the success enjoyed by a Midwest UHF TV Station which recently reported that "it has been in the black" since the first two months of its operation. Servicemen in the area say that they are still 30 to 60 days behind on converter orders and estimate that nearly 67,000 conversions had been requested and completed six weeks before the station went on the air. Six weeks after the station was on the air the number of conversions had increased to approximately 127,000. No one will go so far as to say that this is a typical situation but it certainly is concrete proof of what can be done and evidence of thorough planning and extensive promotion.

It is reasonable to conclude that the slump in several markets is over and that, barring future rate cuts and cut-throat competition, the industry—from advertiser to consumer—is in a generally healthy condition at the end of 1953 and that it enjoys good prospects of a continuously prosperous future. A spokesman for the FCC recently said that the responsibility of the Commission ends when it determines that an applicant is qualified to operate a broadcasting station. In line with previous comments made by the present Commissioners that the FCC expects the broadcasters to run their own businesses with a minimum of regulation and interference, it has been said that the highly competitive business of broadcasting should set an example for the free enterprise system dear to the hearts of the American public and American businessmen. "He governs best who governs least." This time-worn tenet is again going to be tested, apparently. Such a principle should prove to be a substantial contribution to the welfare of the broadcasting industry and to the satisfaction of its audience.

Footnote to '53 Facts and Figures

Evidence of the great potential for the broadcasting industry comes from the stronghold of IBEW Local 1216:

There are more TV receivers in use in the Minneapolis-St. Paul area than home telephones or bathtubs, according to a survey by Admiral Corp. W. C. Johnson, Admiral vice president, estimated 405,000 receivers in the area, compared to 370,000 phones and 280,000 bathtubs, on the basis of telephone company and census figures. Number of TV receivers still lags behind telephones throughout the U. S.—about 25 million compared to 50 million—but television has had an amazing acceptance in seven short years, he noted.

CBS Stations Affected by Recent FCC Order

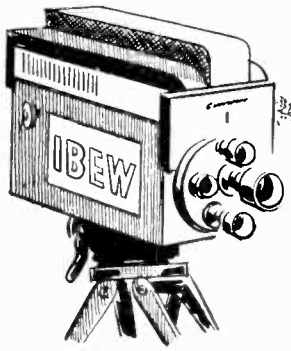
The FCC ordered the Columbia Broadcasting System and others to show cause why they should not dispose of some of their radio station holdings.

The order was given shortly after the commission issued a new rule which provides that no one person or company may have even a minority influence in more than seven AM radio stations, seven FM stations, or five television stations.

The FCC said CBS now owns six AM radio stations and has minority interests in three others and that other investors have an interest in as many as eight standard radio stations.

The FCC said their holdings are in conflict with the new rule. It told them to submit written statements by December 31 to show why they should not dispose of some holdings within three years in order to conform with the new seven station limit.

CBS owns radio stations WCBS in New York City, KCBS in San Francisco, KMOX at St. Louis, KNX at Los Angeles, WBBM at Chicago, and WEEI at Boston. The FCC said CBS has a minority interest in Stations WTOP, Washington, D. C., WCCO at Minneapolis and KQV at Pittsburgh.



Yuletide Wishes

WE HAVE come again to that season of the year when men of good will wish each other well and count the blessings they have already received.

In a world torn by struggles for power, where men still search desperately for peace, let us hope that peace on earth can be made permanent.

To your house from ours and to all of you from all of us, a very Merry Christmas and a Happy and Prosperous New Year.

D. W. TRACY
International President

J. SCOTT MILNE
International Secretary

International Representatives

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Left to right: Donald Herr, engineer of IBEW Local 1215; Ken Evans, announcer; John Trimble, announcer, and Sam Potter, engineer, Local 1215.

Change of ownership at Washington, D. C., radio station results in firing of announcers and engineers; combo men are brought in; unions picket and demand equal broadcast time; men finally rehired with full rights.

IBEW, AFTRA Locals Dispute Claims of New WOL Owners

AT 1 a. m., November 18, Radio Station WOL, in Washington, D. C., changed hands. The Peoples Broadcasting Co. retired, and the Washington Broadcasting Co. became the new owner.

The station's staff announcers and engineers were notified that their services would be no longer needed after the close of the day's broadcasting. WOL was off the air the rest of the day, as the union men began leaving work at 4 p. m. The following morning at 6 a. m. the station signed on with new combination men. Charles Dillon, new general manager, announced that the station had adopted a new program policy based on hit tunes, news as it happens, and announcements instead of using disc jockeys. Henry Rau, former Memphis appliance dealer and president of the new WOL ownership, said that former employes had been replaced by combination men.

The new owners contended that they had only acquired the station's physical assets and not its contracts with the unions. Union men termed the move a lockout.

Couriers were sent by the unions to agencies and advertisers, informing them of developments; union officials reported later that this step showed results.

After learning of the new owners' employment plans, Peoples Broadcasting directed that all affected employes receive two-week terminal pay plus accumulated vacation pay. Sales and clerical employes were retained at the station.

Peoples placed an ad in *Broadcasting-Telecasting* magazine, to wit: "The sale of WOL, Washington, D. C., by the Peoples Broadcasting Corporation makes available a group of experienced, highly competent radio personnel including the station manager, chief engineer, top announcers, program director, news editor, and FCC first class engineers. These are outstanding people with our unqualified recommendation. . . ."

The AFTRA and IBEW launched a coordinated "information campaign" about WOL. Evelyn Freyman, local AFTRA executive secretary, told the press that the unions were not on strike. Union members had been fired without notice and had been "locked out." The two unions were considering filing unfair labor practices with the National Labor Relations Board as well as a civil suit based on a contract clause construed as binding the new owners to the station contracts.

A unique "equal time" controversy arose during the first week under the new owners. WOL broadcast to its listening audience its explanation of union picketing. The statement said that the station had "the highest priced, and probably the most talented picket line ever thrown around a little radio station by a large and powerful union." It added that the picketers "are not and never have been our employes" but were "employes of a big corporation located in Columbus, Ohio, from whom we bought just the physical equipment of this station and nothing else."

Gerhard P. Van Arkel, AFTRA counsel, demanded equal time on WOL for his union. Charles Dillion, WOL general manager, agreed, but then he later refused to carry a union transcription which was prepared, because of what he called errors of fact. He asked that changes be made in it.

The union disc was then broadcast over WWDC, another Washington station, with AFTRA listed as sponsor and the Alvin Epstein Agency handling the account.

Finally, on December 2, the new owners of the station agreed to rehire 14 employes—six announcers and eight engineers—with back pay and full seniority rights. The dispute was settled, new contracts were signed, and the members of AFTRA and IBEW returned to work.

A bird's-eye view past the steel framework of a 200-foot tower shows the new Navy transmitter building nestled in a valley between 3,000-foot mountains.

More than 27 railroad freight cars were needed to move the big Navy transmitter across country to its site high in the mountains of Washington State. About 2,000 kilowatts are required to power the mammoth 1,200,000-watt installation so that the Navy can circle the globe.

The World's Most Powerful Transmitter

FROM a sturdy, steel and concrete building high in the wooded mountains of the State of Washington, protected by 3,000-foot ridges, a message went out last month to all the ships and installations of the U. S. Navy:

"To the men and women of the U. S. Navy around the world: I greet you from Jim Creek Valley in the Cascade mountain range of America's northwest. Here today we and the Radio Corporation of America are dedicating to the service of the Navy and the nation, the most powerful radio transmitter ever built. Its wireless messages will penetrate to our submarines beneath the water, to our Arctic outposts, to our ships and aircraft on and above distant seas. With this first message we forge another link between you and your homeland. With it, we build a new security channel from America to the naval units which form its outer ramparts of defense. To each of you, best wishes and Godspeed.—ROBERT B. CARNEY."

Within minutes, the message was acknowledged by a battleship off Japan, a carrier in the Western Pacific, and by a submarine far off in the Atlantic. The test proved that now, for the first time in history, the Navy can communicate instantaneously with all its ships anywhere on earth.

The giant transmitter, located 55 miles northeast of Seattle and 20 miles inland from Puget Sound in a place called Jim Creek Valley, is a $14,000,000 wonder which took six years to complete. As it goes into full operation this month it is manned by four Navy officers, 70 enlisted men, and 35 Civil Service employes. "Way out from nowhere," so to speak, the installation is highly self-sufficient.

A separate electrical sub-station, located in nearby Arlington, Washington provides 110,000 volts to the transmitter site. The primary source of power is the transmission line from Bonneville Dam.

Fire protection is provided by a completely equipped fire house and the station has its own water and sewage disposal system.

The transmitter building is without windows, air-conditioned, and copper sheath-lined throughout. Its foundation extends 35 feet below the ground surface and is stabilized against earthquake.

Other buildings on the station include barracks, mess hall, family quarters, fire station, machine shop, carpenter shop and electrical and plumbing shops. For maintenance purposes, there is also an antennal rigging loft to care for the more than 150,000 feet of steel and Copperweld cable used in the antenna.

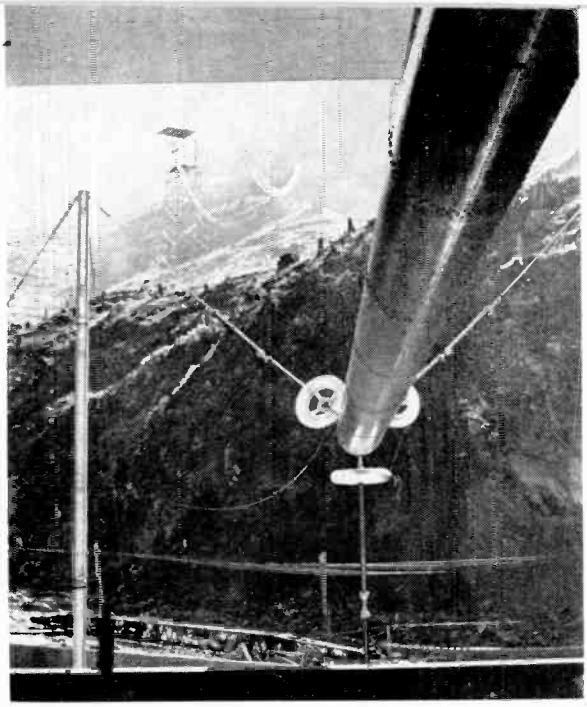
The transmitter was designed and built at the Camden, N. J., plant of RCA. It is designed to be used at a power of either 1000-KW or 500-KW. When operated at the lower power, a complete spare 500-KW unit is available for alternate use. The frequency range is 14 to 35 kilocycles.

The antennas are suspended from 12 200-foot towers located on the crests of surrounding mountains. The antenna system, in effect, forms a "roof" over Jim Creek Valley, for ten spans of the antenna ranging in length from 5,640 feet to 8,800 feet stretch from ridge to ridge.

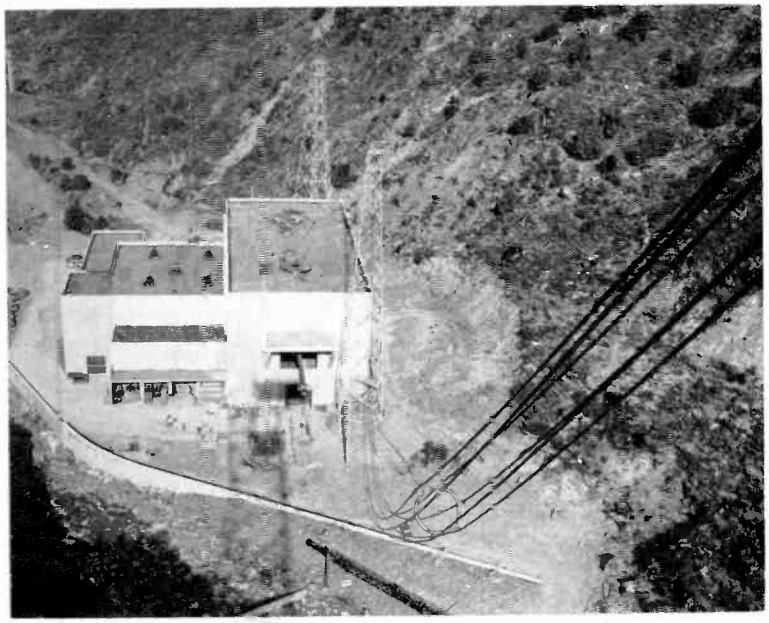
Among the engineering achievements in the design of the new Navy equipment, the manufacturer, RCA, cited the following:

- A conservatively rated 1,200,000-watt output from four superpower electron tubes designed specifically for

Data for this article was supplied by the Chief of Information of the Navy Department. Accompanying pictures are from official Navy photographs.



LOOKING UP—View from transmitter building, along antenna lead-in trunk, shows 145-foot bus tower halfway up the mountain, one of 13 which support the transmission line. The "doughnuts" are corona shields which guard the trunk from corona discharge.



LOOKING DOWN—Looking down along the transmission line to the lead-in trunk and the transmitter building. Some early visitors to the site thought the tube jutting from the side of the building was an atomic gun.

this type of service. This represents a four-fold advance over older equipments which use eight tubes to develop 500,000 watts.

● Microsecond fault-protection developed specifically for this Navy equipment. This electronic device relieves overload faults in the superpower amplifier tubes in the fantastically short time of seven millionths of a second and prevents the build up of currents that could damage the tubes.

● Elimination of tuning controls in all low power stages through the penultimate amplifier. Tuning adjustments are confined to remote push-button control of the antenna and power amplifier tuning. This is accomplished by special broadband amplifiers developed by RCA and widely used in the company's standard broadcast transmitters.

● Simplification of complex control functions such as the mimic bus controls on the operator's supervisory console which tell at a glance which units are in use and which are in an idle or test status.

● Development of a variable frequency oscillator having a frequency stability of 0.001 per cent. Advanced development based upon experience with binary computer circuitry resulted in this extremely stable frequency source which may be set to any frequency in the 14.5 to 35 kilocycle VLF band.

● Design of the highly efficient catenary-type antenna system. The ten catenary spans represented the largest antenna ever erected.

The windowless transmitter station is several stories in height and shielded against the intense electromagnetic field. The structure not only houses the transmitting equipment, but has facilities supporting machine, electrical, sheet metal, and other servicing shops, and storehouses. Living and recreation facilities for a 46-man staff are included on the reservation nearby.

The powerful transmitter, itself, is contained within an enclosure 80 feet wide and 50 feet deep. The transmitter is actually a dual 500-KW transmitter arranged in the shape of the letter U. Between the wings of the U is the supervisory control console including the operator's desk. To each side are the main rectifiers followed by the exciters and 500-KW power amplifiers.

For full power operation both power amplifiers are driven by either exciter. Either frequency generator-monitor may be used to furnish keyed signals to the exciter in use. The main rectifiers have sufficient capacity for either unit to supply plate power to both power amplifiers. The idle units are thus in a reserve status and available for maintenance and testing. When desired, either power amplifier of the transmitter may be operated with either exciter to provide an output of 500-KW. The idle amplifier can then be simultaneously operated with its test load up to 500 kilowatts.

The central supervisory console contains the extension controls and instruments for trimming (critical tuning) amplifier and antenna circuits. The intricate switching operations are simplified by a mimic bus control which features lights representing the various transmitting units. Lighted bulbs show at a glance which circuits are in operation and which are in idle or test status.

Both frequency generator-monitor units are grouped with the supervisory console to provide a central operating position from which the more important instruments may be observed. This assembly also includes the CW or FSK teleprinter tone-keying equipment. The master control panel contains meters for the switch gear, water temperature and flow, pressure pumps and other auxiliary equipment.

All side units of the transmitter are enclosed by a continuous steel front in two-tone cobalt blue enamel. Each rectifier, exciter and power amplifier is compartmentalized for r-f shielding by aluminum panels attached to structural aluminum framing behind the front enclosure. An elaborate safety system for operating personnel is provided. Aluminum interconnection wiring ducts and catwalks are mounted on top of the shielding structure just behind the upper section of the front enclosure.

The transmitter is situated on the second floor of the transmitter building. Power transformers, switchgear, pumps, distilled-water tanks, heat exchangers, shops and telephone-cable terminals are located directly below on the ground floor. At the rear of the transmitter and machinery spaces are two integral helix houses, each 75 feet square and 60 feet high, housing the loading inductances and variometers used to tune the antenna circuits.

The megawatt transmitter has been designed around the special RCA type 5831—500-KW high vacuum triode. Each of the two power amplifiers employs three 5831's, two in the push-pull circuit with the third available as a spare. The tubes are cylindrical, with disk electrode connections. They are about 10 inches in diameter and 38¾ inches in length, and weigh 135 pounds. The anode, grid supports and cathode beam former are water cooled. The six-volt filament structure of thoriated tungsten will require approximately 13-KW heating power. Each tube requires about 500 watts grid drive for 285-watt output at 80 per cent plate efficiency. Plate voltage is 11.5 KV. The four operating tubes in both power amplifiers will deliver 1,000 KW to the antenna system.

Circuit Details

The transmitter begins with a crystal variable oscillator which is monitored and automatically controlled by crystal controlled circuits. It is capable of either on-off keying or frequency shift keying plus or minus 25 cps. The oscillator output is approximately one watt. By coaxial cable either two such oscillators may excite either of the exciters that follow. Only one oscillator is in use at a given time on a single frequency.

The exciters are a cascade series of R-C coupled amplifiers terminating in a cathode follower driving a pair of air-cooled 892R tubes. No tuning is required over the frequency range. Either one or both of the power amplifiers may be driven by either of the exciters.

The power amplifiers are push-pull circuits, with mica tank capacitors. Litzendraht-cable variometer tank inductances and inductive antenna couplers. Normally the left power amplifier will drive the left half of the antenna and the right side similarly will drive the right. Provision is made, however, so that either power amplifier may be connected to either half of the antenna or to its own water-cooled dummy load for test purposes.

New Low-Powered rf TV Transmitter Designed for Monitoring

The Monitran, a new low-powered r-f TV transmitter designed to meet broadcasting station monitoring needs, is now available from the Broadcast Equipment Section of the Engineering Products Department, has been announced by the RCA Victor Division.

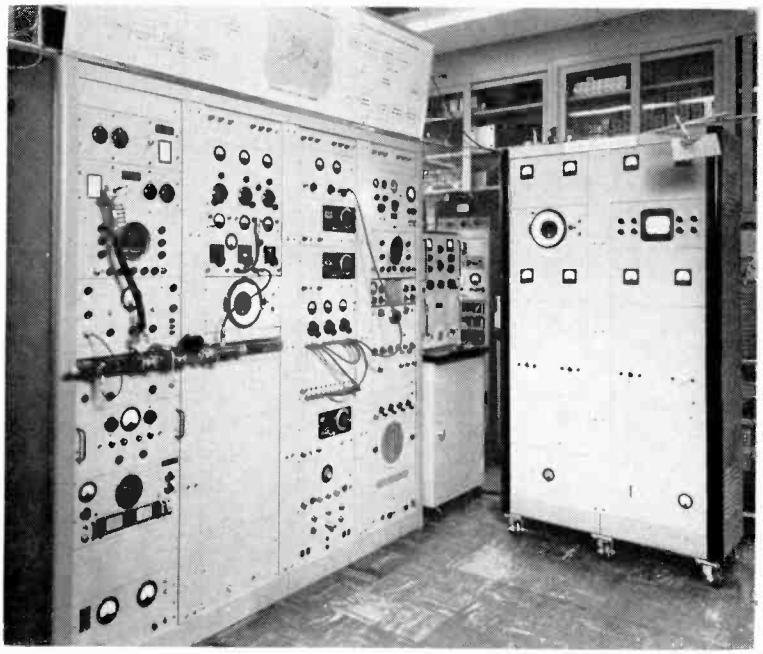
The Monitran develops both a picture and a sound carrier on any one of the VHF television channels, and requires but a single coaxial cable to feed its monitoring signal to one or more receivers at any point in the TV studio. Several Monitran units can be used simultaneously on different channels to provide a selection of signals at TV monitor receivers by tying their outputs together with an inexpensive resistor matching network and connecting the common r-f output, in turn, to the station's coaxial feed line.

The new unit consists of a 12-channel crystal controlled oscillator, frequency multiplier, and amplifier turret which produces the r-f picture carrier on each TV channel. Rapid channel selection is obtained by a selector switch on the front panel. The r-f output is 50,000 microvolts into a 75 ohm terminated coaxial cable. A continuously variable front panel input control permits varying the percentage of picture modulation from 0 to 87 per cent.

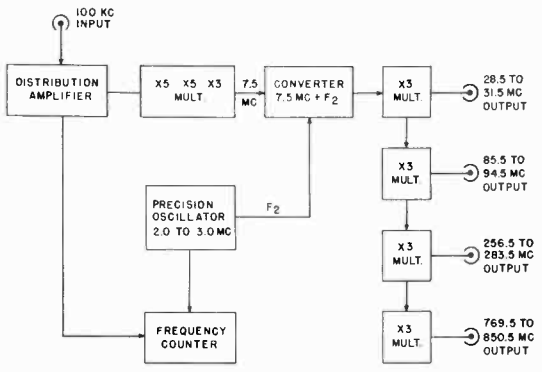
The FM sound carrier has two components 4.5 mc above and below the picture carrier; only the upper sideband is used by the TV receiver while rejecting the lower. Sound modulation may be turned on or off by means of a front panel switch. Modulation of the sound carrier is obtained from the associated 6 milliwatts audio signal of the picture program or by means of a switch as the panel is modulated by a 400 cps internal audio oscillator. A standard 75 microsecond pre-emphasis network is incorporated, and 40-kc deviation can be obtained. The deviation is continuously variable by means of a panel control. A switching facility is also available to change the external audio output from 600 ohms to unbalanced high impedance.

The Monitran is designed for rack mounting, the unit measuring 19 inches wide, 8¾ inches high, and 10 inches deep. It is finished in standard RCA dark umber gray. Standard coaxial connectors are used for all video and r-f terminations at the rear. The audio is terminated by a Jones type barrier strip also at the rear of the unit.

An electronically regulated power supply assures stable performance regardless of line voltage fluctuations between 105 and 125 volts. The power input and supply is rated 80 watts, 60 cycle, single phase, 105-125 volts a-c.



The microwave adjustable-frequency standard with which the National Bureau of Standards calibrates secondry frequency standards for government agencies and defense activities, as well as science and industry. The 4-rack system includes the frequency multipliers, adjustable frequency oscillators, and the necessary metering and monitoring equipment. The adjustable-frequency standard occupies the two center racks. Two transmission-type wavemeters are shown mounted for a calibration; the meter to the left has been sent to the Bureau to be calibrated against the standard. Variations in output with change in meter setting are monitored on the visual analyser mounted in the first rack. The system of panel jacks permits the mixing of many standard frequencies. The pair of dolly-mounted racks to the right contain the electronic components of the Model II ammonia clock.



BLOCK DIAGRAM OF MICROWAVE ADJUSTABLE-FREQUENCY STANDARD

Block diagram of the microwave adjustable-frequency standards maintained by the National Bureau of Standards. The diagram shows the 100-kc reference signal entering a distribution amplifier, from which it goes to the frequency multipliers, mixers, converter, and to the output terminals. A wide range of frequencies is derived from this standard by combining a fixed multiple of the 100-kc source with the signal from a precision adjustable oscillator. Complete coverage begins at 300 Mc and extends up to 25,000 Mc.

The NBS Microwave Frequency Standard

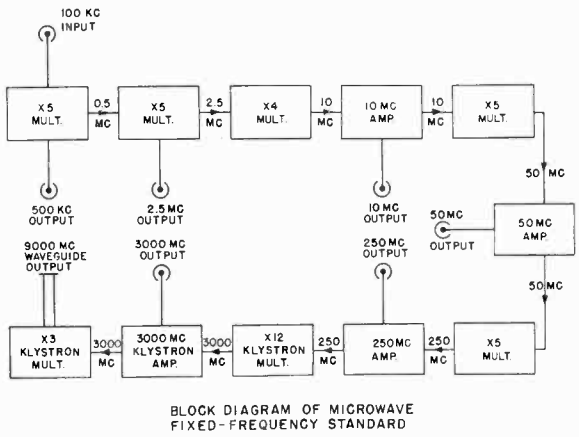
IN an effort to keep pace with the growing utilization of an ever-expanding radio frequency spectrum, the National Bureau of Standards maintains a program of research and development that is aimed to make available to science and industry accurate standards of frequency measurement.

Research and development of frequency standards in the regions of the microwave frequency spectrum is the responsibility of the NBS Microwave Frequency Standards group under the direction of Dr. Harold Lyons and L. J. Rueger. The laboratory is equipped to operate between 300 and 40,000 Mc with completely standardized equipment, and up to 75,000 Mc with instruments currently in the final stages of development. In addition to the board research program in microwave principles and techniques, the laboratory calibrates the secondary microwave frequency standards used in science and industry.

The vast spectrum of radio frequencies above 300 Mc is presently employed in such military applications as radar, navigation systems, blind bombing and guided missiles. Research in microwave has been responsible for better FM and television relay systems presently in operation and under construction. Microwave standards are equally important to medicine and to those industries utilizing electronic equipment, as in dielectric heating for case hardening of metals, rubber curing, plastic molding, food processing, textile fabrication, and radio frequency therapy. Extended use of the millimeter bands (above 30,000 Mc) is important to work in microwave spectroscopy, microwave optics, and in applications requiring sharp microwave beams of high resolution, such as short-range target-seeking equipment for rockets and guided missiles. However, to fully exploit the far reaches of the microwave region it is necessary to have national standards and measurement methods which provide the necessary tools for the design, development, and production engineering of practical electronic equipment, and for basic research.

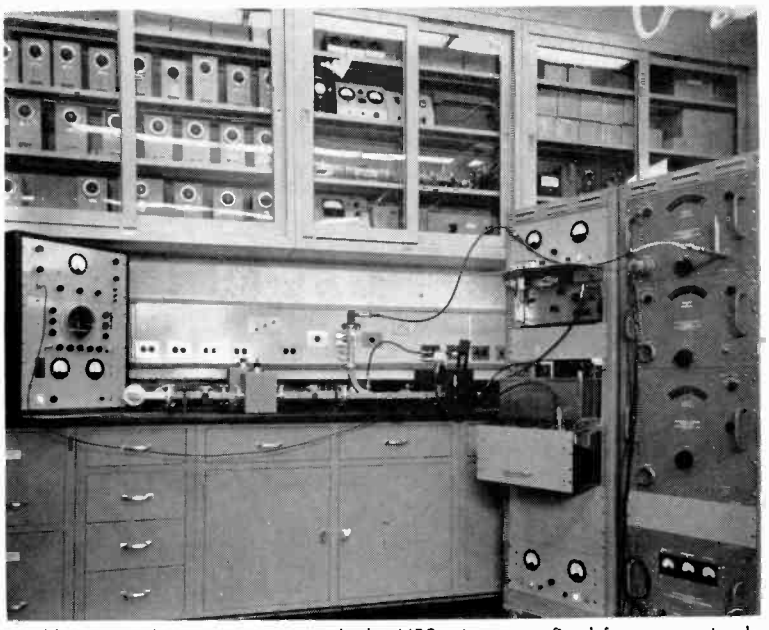
Derived from 100-kc Oscillator

The microwave frequencies used by the National Bureau of Standards for calibration are derived directly from one of the stable 100-kc oscillators maintained by the Bureau for time and frequency standards. The frequency of the driving oscillator is determined to better



BLOCK DIAGRAM OF MICROWAVE FIXED-FREQUENCY STANDARD

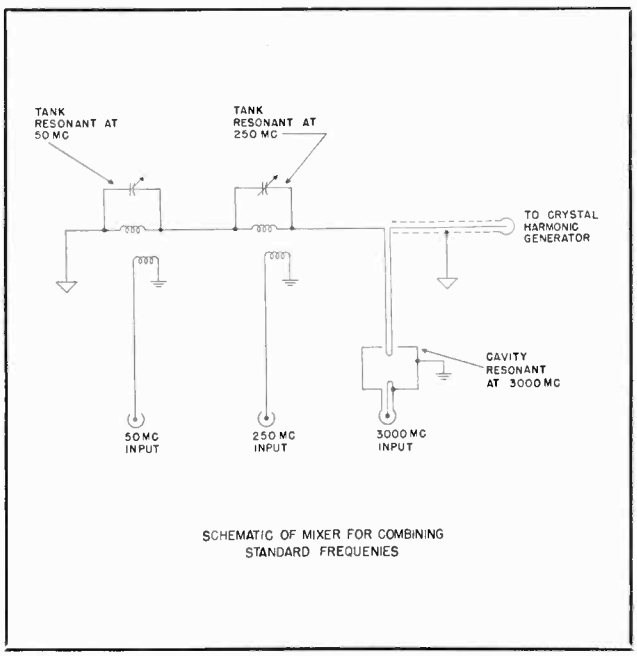
Block diagram of the NBS microwave fixed-frequency standard. The 100-kc reference source is multiplied in evenly spaced intervals. Strongest signals are obtained at 10-Mc steps through 5000 Mc; 50-Mc steps through 25,000 Mc, and 250-Mc steps through 40,000 Mc. Conventional vacuum tubes are used for frequencies up to 250 Mc, whereupon, klystron amplifiers and multipliers provide the higher frequencies. The klystrons are immersed in a temperature-controlled oil bath to stabilize their power output.



Calibrating a frequency meter with the NBS microwave fixed-frequency standard. The rack to the far right contains the local oscillator and associated power supplies; the rack to the left of the first contains the fixed standard. The r-f components on the bench include, in a clockwise direction: directional coupler, matching section and coaxial-to-waveguide transformer; variable attenuator; the frequency meter to be calibrated (similar to those in the shelves above); another attenuator; buffer; tunable transmission filter; another buffer and matching section; crystal harmonic generator; a connector for the standard; and a mixer (black box and cylinder) for mixing the standard signals. The output of the system (an intermediate frequency) is fed to the spectrum analyser at far left. The diagram below shows the relative positions of the r-f components in the calibration.

Research in microwave has been responsible for better FM and television relay systems. To fully exploit the far reaches of this phase of electronics, a Federal agency has developed national standards and measurement methods

than 1 part in 1 billion by reference to the other NBS standard oscillators and with astronomical observations made by the Naval Observatory. The standard oscillators also control the operating frequencies of the NBS radio broadcasting station WWV (Beltsville, Md.). Because the 100-kc signal must be multiplied up to thousands of megacycles, some difficulties arise because of noise and other small effects which tend to create a phase modulation of the frequency multiplier chain. In all, the frequency and phase modulation produced is less than 1 part in 100 million at 300 Mc, less than 1 part in 10 million at 24,000 Mc, and less than 1 part in 100,000 at 54,000 Mc. The increase in bandwidth at the highest frequency arises primarily as a result of the low signal strength of the generating equipment at these levels. In special set-ups band widths of less than one part in 10 billion have been achieved. By comparison, resonant cavities and other secondary frequency standards are rarely dependable to better than 1 part in 10,000, although some cavities have been constructed that will consistently function within 1 part in 100,000, but only if the temperature, humidity and pressure are carefully controlled.



SCHEMATIC OF MIXER FOR COMBINING STANDARD FREQUENIES

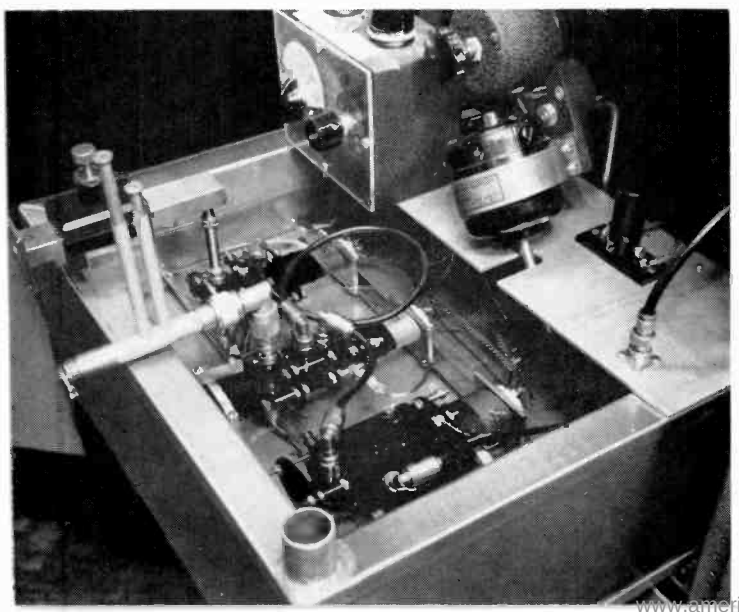
A block diagram showing the relative positions of the r-f components used in the calibration of a frequency meter with the NBS microwave fixed-frequency standard. (Other illustrations on this page tell of the fixed-frequency standard.)

The 100-kc standard signals—from which the microwave frequencies are multiplied—are developed in a Meachan bridge oscillator circuit and a carefully hand-tailored 100-kc crystal. They have a short-time stability (10 minutes) of 1 part in 10^{10} and a long-time stability (1 week) of 1 part in 10^9. Two distinctly separate multiplier chains are employed in the NBS microwave frequency standard: one a fixed-frequency and the other an adjustable-frequency standard. In both systems, unwanted sidebands or harmonics are suppressed 60 db at each stage of the chain. Conventional grid-controlled vacuum tubes multiply the frequencies up to several hundred megacycles, while fixed-frequency klystron multipliers yield frequencies up to 25,000 Mc. Frequencies above this are obtained from crystal rectifiers employed as harmonic generators, the working frequencies of which are selected by a transmission cavity filter.

The NBS fixed-frequency standard has higher outputs than the variable system but is not as versatile. Frequency mixing is accomplished at the end of the chain (high-frequency mixing), the outputs of which permit a coverage of the spectrum at very closely spaced intervals. The strongest signals are obtained from the following mixing combinations: 10-Mc intervals through 5,000 Mc; 50-Mc intervals through 25,000 Mc; and 250-Mc intervals through 40,000 Mc. Errors in transcribing and plotting data are minimized because the signals occur at evenly spaced round numbers. Power outputs are: at the 10- and 50-Mc outputs, 5 watts; 250- and 3,000-Mc outputs, 1 watt; and 9,000-Mc output, 20 milliwatts. Power stability and long life are achieved in the klystron amplifiers and multipliers by immersing them in a temperature-controlled oil bath and operating them well below their maximum ratings.

Signals are generated in the adjustable-frequency standard by combining a fixed multiple of the 100-kc source with the signal from a precision oscillator continuously adjustable between 2 and 3 Mc. The combination frequency passes through tunable multipliers with a range of 10 per cent. The adjustable range may be expanded to 100 per cent by using the tenth harmonic of any output from the multiplier chain. Radio frequency power available to the harmonic generators is at least 2 watts at each output of the multiplier chain. Excellent efficiency in the generator and the detector systems permits the use of harmonics as high as the 30th for calibration purposes and extends the range of the standard through 25,000 Mc. Frequency mixing is accomplished near the beginning (low-frequency mixing) of the multiplier chain, which has the advantage of wide separation between adjacent harmonics. A major disadvantage of the system lies in the fact that the very low difference intermodulation frequencies are multiplied in the chain together with the desired signal and consequently create unwanted sidebands.

Temperature-controlled oil bath for the klystron multipliers and amplifiers used in the NBS microwave fixed-frequency standard. The klystrons are completely immersed in the oil, which is kept gently agitated by a stirring motor. A sensitive control maintains the bath temperature to $\pm$ 0.01°C. The outputs of the klystrons are fed into the calibrating system through matching sections of waveguide.



For High Standard-frequency

When relatively high standard-frequency power (about one milliwatt) is required, a frequency transfer process can be used with the normal loss of overall precision. Here, CW klystron oscillators are synchronized to a standard oscillator, and frequency modulation of the oscillators is minimized by using battery power and by stabilizing the klystron temperature in a temperature-controlled oil bath.

In those locations that are isolated from direct connection to the NBS standard oscillators, calibration of secondary frequency standards is possible by using one of the standard frequencies broadcast by radio station WWV (2.5, 5, 10, 15, 20 and 25 Mc) as a reference for synchronizing harmonics of an auxiliary 100-kc oscillator. Precisions of about 1 part in 10^7 are attainable if reception is limited to sky wave propagation, or 1 part in 10^8 if ground wave reception is possible. The National Bureau of Standards' ammonia clock has been used as a reference for absolute calibration to 1 part in 10^7, and to a relative frequency constancy of 2 parts in 10^8.

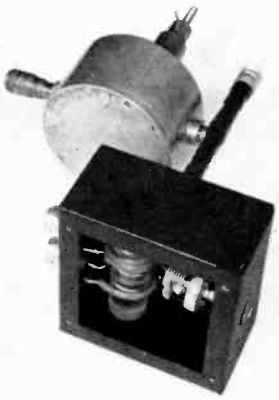
Frequency meters sent to the Bureau are calibrated, when possible, under normal operating conditions. For instance, if the meter has a built-in detector and indicator, sufficient power is used to operate the complete indicating system. Or, if the meter can be employed either as a transmission or a reaction device, the calibration includes both methods, and checks are made for any existing discrepancies between the two. The ambient room temperature of the calibration laboratory is maintained at 23° $\pm$ 2°C, and the relative humidity to 50 per cent $\pm$ 2 per cent. Meters are permitted to reach equilibrium with the room conditions before a calibration is made.

In the calibration procedure, the standard frequencies are applied to a crystal diode mixer, a non-linear device that generates all of the sum and difference combinations of the signal present. The desired signal is selected and

all others are rejected by a tunable transmission filter, which has been previously calibrated. The output of a frequency modulated local oscillator is admitted to the converter crystal through a directional coupler, where it is mixed with the standard signal.

The intermediate frequency from the converter is fed to a spectrum analyzer and the matching sections are adjusted for maximum signal strength. Attenuators placed on either side of the meter to be calibrated are set to 10 db each, which effectively isolates the calibrating equipment and prevents reactive "pulling" of the meter.

The frequency meter to be calibrated is set to resonance at each calibration frequency at least 10 times.



Crystal mixer for combining frequencies generated by the NBS microwave fixed-frequency standard. By means of resonant circuits in series, three standard signals—50, 250, and 3000 Mc—are applied simultaneously to the crystal converter. By extending these methods, additional frequencies may be added. The small box contains tuned circuits for the 50-Mc and 250-Mc signals. The cylinder is a cavity tuned to 3000 Mc.

The divergence or spread of the readings at a given frequency is then a measure of the backlash or other mechanical defects of the drive and indicating mechanism. This spread is included in the calibration report as the tolerance to which the readings are reproducible.

Although not included in a normal calibration, it is possible to measure the cavity temperature coefficient of frequency near room temperature and the approximate "Q" of the cavity. The temperature coefficient is determined by observing the shift of resonant frequency at a mixed setting of the meter while the temperature is changed. Changes in cavity are monitored by a thermocouple junction attached to the meter. The "Q" of the cavity is determined by observing the half-power points on the response curve of the cavity for a signal which is frequency modulated through the resonance frequency.

One Microwatt of Power

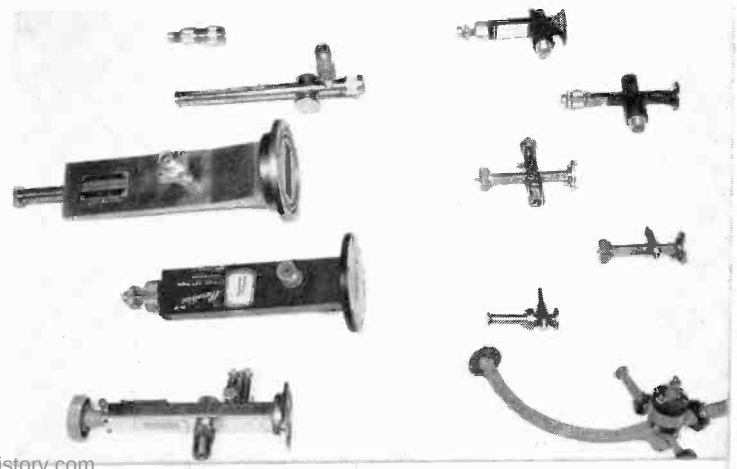
Because the power of the harmonics used as standard-frequency signals is often as low as 1 microwatt, direct detection by means of a crystal diode and a sensitive current meter is usually impractical. In addition, the useful power at the detector is further reduced by a nominal insertion loss of 10 db for the transmission filter and 10 db each for the padding attenuators. The power available at the detector is then about 0.001 microwatt. Therefore, when a frequency meter with a built-in crystal detector is to be calibrated, a higher power CW oscillator is used and adjusted to the frequency of the standard signal. Amplification of the beat note between the standard signal and a small portion of the oscillator output is sufficiently high to permit the adjustment of the oscillator to the same frequency as the standard-frequency signal. The accompanying precision is decreased approximately one order of magnitude. The remainder of the oscillator power is sufficient to permit the crystal current from the detector to be monitored with a microammeter.

When the type of calibration is such that the standard frequency signal can be passed through the meter to be calibrated, a sensitive receiver is used to detect the signal. In the frequency range 300 to 750 Mc a double superheterodyne panoramic receiver is employed; above 750 Mc a sensitive spectrum analyser detects the signal.

Direct reading local oscillators of the external cavity reflex klystron type generate the signals from 750 to 11,000 Mc. Above 11,000 Mc, internal cavity reflex klystrons, mounted directly on the waveguide connecting the meter to the standard, provide local oscillator power. Because the power of the local oscillator is much greater than that of the standard signal, the height of the pulse displayed is directly proportional to the power of the standard signal. The frequency meter being calibrated is tuned to resonance by observing the relative pulse height on the cathode ray tube of the analyzer. Voltage gains of 160 db are possible with the spectrum analyser, which can then detect microwave signals as low as 0.1 micro-microwatts.

The development work in progress at the National Bureau of Standards is aimed to improve the calibration techniques at frequencies above 40,000 Mc.

Harmonic generators used in the NBS microwave frequency standard to provide frequencies from 300 to 75,000 Mc. The generators are arranged according to increasing frequency, the column on the left ranging from 300 Mc (top) to 10,000 Mc (bottom). The mounts on the right (top to bottom) start at about 10,000 and increase to 75,000 Mc. Some of the harmonic generators are modified crystal detectors that are used in the reverse direction. The shorting capacitances are removed; the signals are inserted into the low-frequency side of the generator and harmonics are recovered from the high-frequency side. The smallest unit (right column, second from bottom) generates signals as high as 75,000 Mc. Unit below it is a frequency doubler capable of doubling frequencies from 26,000-40,000 Mc to 52,000-80,000 Mc.



Reading Time

The Techniques of Film Editing: Basic Principles for TV *by Karel Reisz and others. Farrar, Strauss and Young, 101 Fifth Avenue, New York City 3. 288 pp. $7.50.*

Here is a book that should prove helpful to both experienced and beginning TV film editors.

The author worked with ten members of the British Film Academy to produce the volume. They divided the book into three major parts. The first section deals with the history of editing. The second section discusses the practice of editing. The third details principles of editing.

Principles and Practices of Telecasting Operations; *Harold E. Ennes. Published by Howard W. Sams and Company, Indianapolis, Ind. 596 pp., $7.95.*

From the "Introduction to Television" to the "Technical Definitions and Glossary of Production Terms," this is a complete and exquisitely detailed handbook of telecasting. To the reviewer's knowledge, this is the first book which has become available offering sufficient details of all phases of television broadcasting in a simple, straightforward style so as to qualify as a primer to a reader who may have had little or no contact with the industry.

The terminology of the control room may not be of special interest to the reader who searches for the technical "hows," but the inclusion of the idioms which have developed through usage of production and engineering personnel fill in what might otherwise be gaps between the aesthetic and the practical. The treatment of routine cues and directions is quite complete. The Glossary, which occupies the closing pages of the volume, even contains elements of humor: "Blizzard head" is explained to be "a blonde."

From lens to coax, a camera is detailed and pictured; the explanation of lenses and optics is especially fine. Approached from a thoroughly practical point of view, there is much to be said for inclusion of information of this sort. The obvious relationship of lenses leads, naturally enough, to lighting and lighting problems; from lighting and camera operation, a sequence is established and, thus, succeeding elements are treated in the order of transmission. Field equipment, microwave relays, transmitter operation and maintenance receive a full share of attention.

The analysis of typical TV transmitters is a bit brief, but is as it perhaps should be. A substantial part of what appears to be one transmitter manufacturer's instruction book is not too useful; perhaps the block diagram and some of the schematics are much more appropriate for the purposes of this volume than the text of the instructions. The designation of tubes by the manufacturer's particular symbols shortens the text, but is rather difficult to follow. For instance, the text would be much clearer if the tubes were identified by their commonly-known type number and their function.

This is not a book to be read hastily; much digestion is necessary if the reader has as his object the clear understanding of the whole of it. But as a text for self-improvement and a reference volume it is eminently satisfactory.

One Moment Please

WHEN RCA and NBC scheduled a press demonstration of color TV in Chicago recently, *The Milwaukee Journal* assigned their regular television reporter, Doyle Getter, to cover the story.

Getter was preparing to take a train to Chicago when he pulled up short, went to the desk and said he couldn't cover the story.

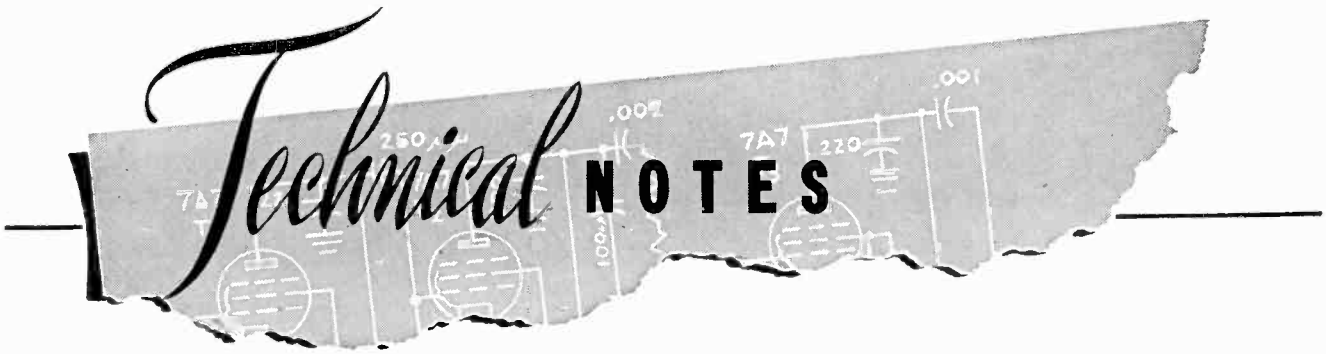
He is color blind. The *Journal* sent another reporter. Meanwhile, Getter's future in reporting the development of television is not rosy.

DANIEL A. LEARY (1920-1953)

With extreme regret and a sharp sense of loss we record the passing of Brother Daniel A. Leary, President of Local Union 1228, Boston. He was initiated by his Local Union on March 24, 1942, and was serving his second term as President at the time of his decease.

The esteem in which he was held in Boston was duplicated by many of his fellow unionists in many parts of the country and his passing is a blow to his friends in those places as well as to his family and associates in New England.

May his soul rest in peace.



Visual Modulation Monitors

Two new visual sideband demodulators for use with television master monitors to permit a complete, continuous check of signal quality delivered to the antenna of a TV transmitter have been announced by the Broadcast Equipment Section, RCA Engineering Products Dept.

The two models are the BW-4A for VHF channels 2 through 13, and Type BWU-4A for UHF channels 14 through 83. Both demodulator types will provide information on waveform characteristics such as wave shape, percent sync, white compression, depth of modulation, resolution and transient response, and also a composite picture of the radiated TV signal to serve as a basis for checking compliance with RTMA and FCC standards.

The picture information supplied by the instrument is equivalent to that which would be obtained from an ideal television receiver located remotely from the station. This signal is free of interference from the accompanying aural transmitter.

Both equipments are arranged on "bathtub" type chassis for standard 19-inch rack mounting and occupy a vertical panel space of 14 inches. The chassis contains all circuits including the i-f, video, d-c and heater-power supply and the separately mounted r-f unit. They operate from a 110-125 volt, 50 or 60 cycle power source.

Stroboscope for Hi-Fi

The built-in time pulse that keeps the nation's electric clocks right on the button has been harnessed now to make phonograph records play in tune, Maurice Hardy of the Zenith Research Division has announced.

"Heretofore some phonograph turntables have played records so far off-pitch that they were an abomination to listeners' ears," he said, "but that doesn't have to happen any more."

Whether the electric clock owner is aware of it or not, his timepiece is kept accurate by taking a free ride on the 60 alternating cycles of his electric house current. Now Zenith technicians discovered how to use the same alternating time beat to make possible true high fidelity in the playing of phonograph records.

Key to the system is a multi-speed stroboscope built into the company's high-fidelity phonograph turntables. With this new device the user can play all makes of phonograph records at their exact recorded speed—78 rpm, 45 rpm, 33 1/3 rpm (LP), or the new talking book speed of 16 2/3 rpm.

Subscription Television System

WHILE broadcasters are arguing the points of compatible color television, they might also consider the possibilities of compatible subscription-TV, for one manufacturer has come up with a method of picking up special subscription shows on the regular receiver and commercial shows as well.

A new system of subscription television was shown to 10,000 persons in New York recently. It was developed by Skiatron Electronics and Television Corporation, and company engineers assure that it is not designed to replace ordinary commercial television. Instead, it should be able to supplement it.

The system promises to permit video set owners to see first-run movies, Broadway plays, grand operas, educational and cultural programs and sports events at a "nominal cost." Persons who do not subscribe to the service would not be able to pick up the programs on their TV sets.

If such a system is approved by the FCC, it should be a boon to TV educators who cannot air many of their programs or put many of their educational stations on the air because of financial difficulties.

Subscribers to the system would receive scrambled picture and sound from the station, which would have to be "decoded" by a special device. Some sort of program card insert is supposed to permit the viewer to see and hear. The decoder is so constructed that it indicates what programs the subscriber has tuned in on. These are the only programs he will have to pay for.

In other words, if you want to see closed-circuit title boxing match, a new Marilyn Monroe movie, and an educational show on astronomy, and don't care for the opera, you insert your card for what you want, your card is punched, and you pay for what's charged against your account later.

Station Breaks

And Then There Were Nine

In Chicago, a local union of television workers voted to hold a raffle for the benefit of the family of a union member who had been killed in Korea. Union leaders purchased three television sets and announced there would be three winners, each to receive a set. Suddenly their employer's publicity man got worried. "If they raffle off sets made by one of our competitors," he told his boss, "a lot of people may get the idea that our own employes don't think much of the TV sets we manufacture." Upshot of the discussion was an announcement by the employer that he was donating three television sets for the raffle. That made six; but then this news reached the publicity director of the company from which the union had purchased the three original sets. With a fanfare of publicity this company announced it also would donate three sets. Result was that instead of one raffle the local union was able to hold three, and raised $4,200 for their benefit. *(LPA)*

And Then There Were Six

In Baltimore, Md., union electrical workers at the Bendix Aviation Corp. plant were asked to study the first Russian television set ever smuggled out from behind the Iron Curtain. After finishing, one of the union men reported, "The sound is all right but the picture is blurred and fuzzy. But one thing impressed us more than anything else. The Russians claim to have invented television 10 or 20 years before it was developed in the U. S. and England. Yet this Russian set has six different tuning dials but is manufactured to receive only one channel." *(LPA)*

WATV (TV) Moves Transmitter

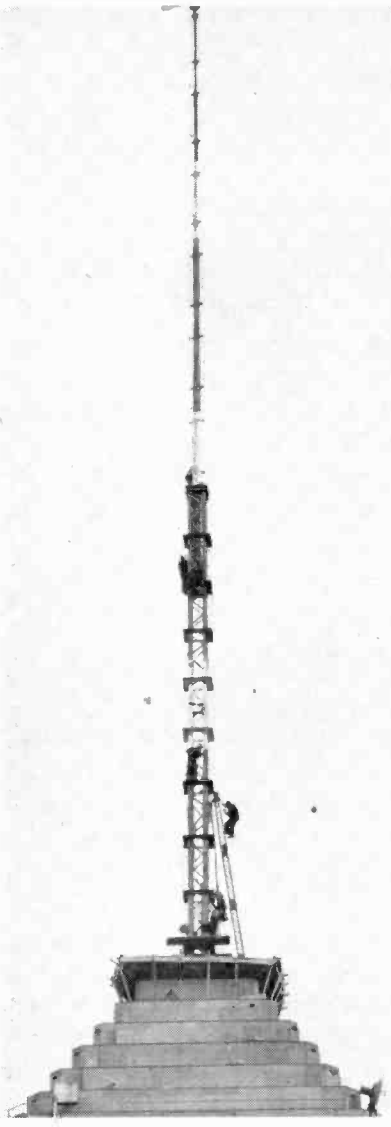
Station WATV (TV), Newark, N. J., moved its transmitter across the river last month and began broadcasting from New York's Empire State Building. The signal radiates from a new type of antenna, called the "skew" of "fishbone" antenna, which has been used successfully by government stations but had never been used before by a commercial station. The five-gain antenna is installed near the base of the mooring mast tower surmounting the Empire State Building. The six elements installed at each corner of the structure had to be perfectly matched in power flow.

Fort Worth Station's Awards

During five years of telecasting, Station WBAP-TV, Fort Worth, Tex., has received four first-place trophies for news and special events coverage from the Radio-Television News Directors Association.

San Francisco Anniversary

KRON-TV, San Francisco, marked its fourth anniversary, November 15. The station began with just 20 hours of weekly programming; it now offers 105.



LEFT: Men at work on the WCCO-TV antenna, high atop a Minneapolis, Minn., office building. The station has a contract with IBEW Local 1216.