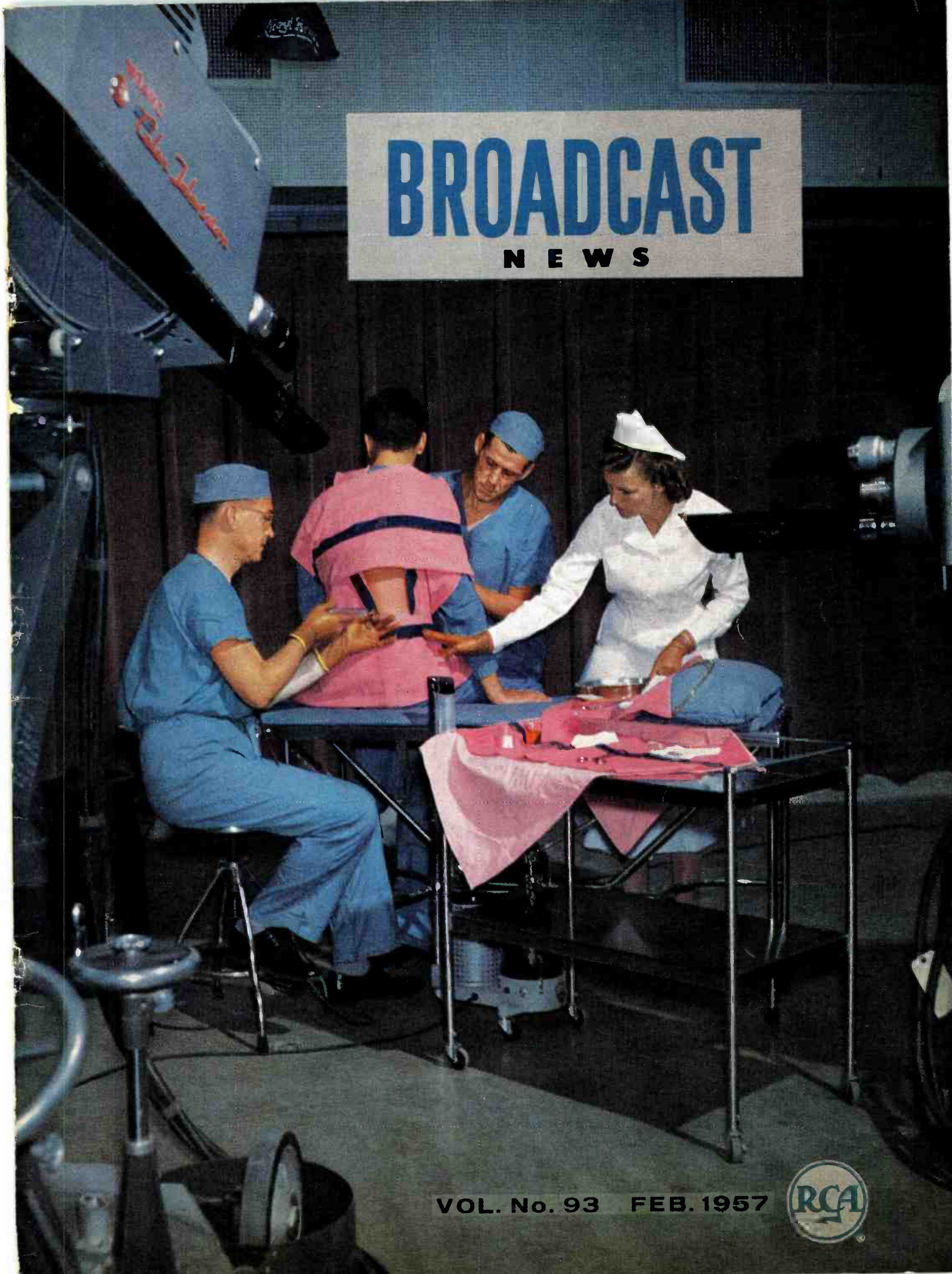
BROADCAST NEWS



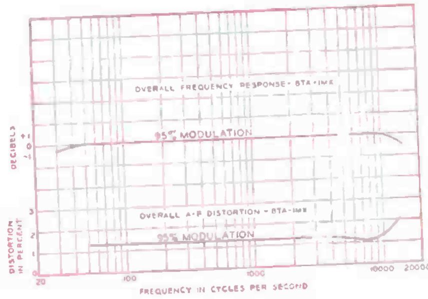
VOL. No. 93 FEB. 1957

RCA

500 WATT and 1 KW RCA AM TRANSMITTERS

TYPE BTA-500MX • TYPE BTA-1MX

for economical and reliable broadcast operation



Typical BTA-1MX/500MX frequency response and distortion curves . . . AM radio at its clear, crisp best!

These two new transmitters are designed specifically to meet critical broadcast needs. Both provide maximum adaptability for dependable remote control operation.

Simple to install and maintain, they offer maximum efficiency and economy in continuous broadcast service. The RCA "MX's" are today's best transmitter buy with outstanding performance features to meet today's competition.

SUPER PERFORMANCE—Here's proof of outstanding performance. Lowest distortion ever . . . less than 2% typical at 15,000 cps. Wide-range frequency response . . . essentially flat between 30 and 15,000 cycles. Bi-level modulation incorporated in both units means absolute minimum distortion, reduced carrier shifts, over-all increase in broadcast efficiency. Conservatively rated components and cooling add long-life reliability.

SIMPLIFIED OPERATION—Single control tuning located on functional front panel is the only control needed for all normal adjustments. The crystal oscillator trimmer can be adjusted through the front panel while the transmitter is in operation. Filament voltages on all transmitter tubes can be adjusted from the operating panel.

SPACE SAVING . . . TUBE SAVINGS—Important space savings are achieved with only 6.2 square feet required overall. Operating with fewer tubes and fewer tube types (15 tubes in the 1MX, 14 in the 500MX and only 4 types), the problem of stocking tubes is helped from a space-saving as well as a money-saving standpoint.

COMPLETE ACCESSIBILITY—Vertical construction, exclusive at these powers, provides instant access to all components for visual inspection or ease of replacement.

TOP QUALITY AT A NEW LOW PRICE!

500 WATT TYPE BTA-500MX $3995*

*1 KW Type BTA-1MX $4685**

**Complete with operating tubes and crystal, F.O.B. Camden, N. J.*

Prices subject to change without notice.

See your nearest RCA Radio Broadcast Sales Representative or write for brochure containing complete technical specifications. In Canada: RCA VICTOR Company Limited, Montreal.

REMEMBER—RCA TRANSMITTERS HAVE THE HIGHEST RESALE VALUE OF ANY TRANSMITTER ON THE MARKET!

RADIO CORPORATION of AMERICA

BROADCAST AND TELEVISION EQUIPMENT
CAMDEN, N. J.

Vol. No. 93 | February, 1957

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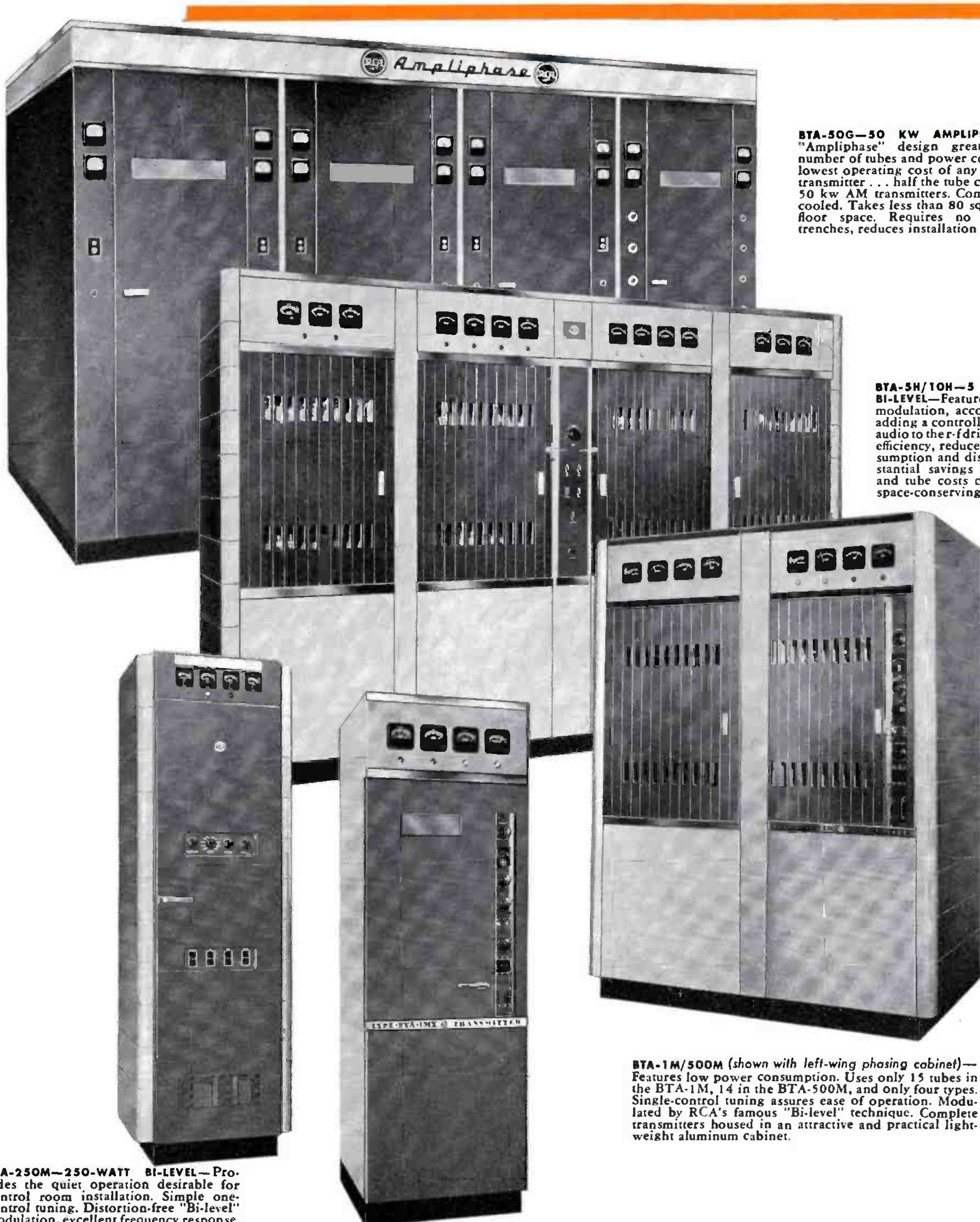


BTA-50G—50 KW AMPLIPHASE—New "Ampliphase" design greatly reduces number of tubes and power costs, assures lowest operating cost of any 50 kw AM transmitter . . . half the tube cost of older 50 kw AM transmitters. Completely air-cooled. Takes less than 80 square feet of floor space. Requires no under-floor trenches, reduces installation costs.

BTA-5H/10H—5 and 10 KW BI-LEVEL—Features "Bi-level" modulation, accomplished by adding a controlled amount of audio to the r-f driver, increases efficiency, reduces power consumption and distortion. Substantial savings in operating and tube costs combine with space-conserving design.

BTA-1M/500M *(shown with left-wing phasing cabinet)*—Features low power consumption. Uses only 15 tubes in the BTA-1M, 14 in the BTA-500M, and only four types. Single-control tuning assures ease of operation. Modulated by RCA's famous "Bi-level" technique. Complete transmitters housed in an attractive and practical lightweight aluminum cabinet.

BTA-250M—250-WATT BI-LEVEL—Provides the quiet operation desirable for control room installation. Simple one-control tuning. Distortion-free "Bi-level" modulation, excellent frequency response. Uses only 10 tubes of three tube types. An ideal "economy package."

BTA-1MX/500MX—Designed for high-fidelity operation, transmitters BTA-1MX (1KW) and BTA-500MX (500 watts) offer single-control tuning, desirable Bi-level modulation, low power consumption, fewer tubes and fewer tube types. Minimum floor space required . . . approximately 6 square feet.

REMOTE CONTROL EQUIPMENT—RCA Remote Control Equipment provides facilities to switch program lines, adjust plate or filament voltage, operate a line variac control on emergency transmitter, control Conelrad switching, operate power contactors and reset manual overload breakers, from any desired control point, regardless of transmitter design or power.

RCA AM transmitters

FOR 25 YEARS RCA broadcast transmitters have been widely acknowledged as *the* best. During this period they have been the transmitters most often chosen by those stations which wanted, and could afford, the very best. Thus they early became, and have remained, the standard to which all others are compared.

Unfortunately, some stations have believed that they could not afford such quality—no matter how much they wanted it. Today any station can "afford" one of these top-quality transmitters. In fact, it is hard for us to see how a station can afford *not* to buy one.

Why is this so? Simply because today RCA transmitters cost only a very little more than the lowest-priced (sometimes no more). And the small extra original cost (if any) is more than made up for by these two *facts:*

1. RCA transmitters are generally less expensive to operate. This is so because in almost every power class RCA transmitters either use less power, or have lower tube cost (in some cases both).

2. RCA transmitters almost always have higher resale value. This becomes very important when you go to higher power, or if you should decide to sell your station.

What is the moral? Simply this: don't jump to the conclusion you can't afford RCA. We believe you can, and we would like an opportunity to prove it. Call our nearest *AM Specialist* (see list). He will be glad to go over your situation with you, give you the benefit of his (and RCA's) broadcast equipment knowledge, and leave with you a complete and fair proposition. With such *facts* at hand you can make a correct decision. There's absolutely no obligation. You owe it to your station to find out. Act now!

See Your Nearest Radio Broadcast Sales Representative

ATLANTA 3, GA.
522 Forsyth Bldg., Lamar 7703

BOSTON 16, MASS.
200 Berkeley Street, Hubbard 2-1700

CAMDEN 2, N.J.
Front & Cooper Streets, Woodlawn 3-8000

CHICAGO 54, Ill.
Delaware 7-0700 Merchandise Mart Plaza, Room 1186

CLEVELAND 15, OHIO
1600 Keith Bldg., Cherry 1-3450

DALLAS 1, TEXAS
1907-11 McKinney Avenue, Riverside 1371

DAYTON 2, OHIO
120 West Second Street, Hemlock 5585

HOLLYWOOD 28, CALIF.
1560 N. Vine Street, Hollywood 9-2154

KANSAS CITY 6, MO.
1006 Grand Avenue, Harrison 6480

NEW YORK 20, N.Y.
36 W. 49th Street, Judson 6-3800

SAN FRANCISCO 2, CALIF.
420 Taylor Street, Ordway 3-8027

SEATTLE 4, WASHINGTON
2250 First Avenue, South, Main 8350

WASHINGTON 6, D.C.
1625 K Street, N.W., District 7-1260

Typical AM Tower

RADIO CORPORATION of AMERICA
BROADCAST AND TELEVISION EQUIPMENT
CAMDEN, N. J.

Unlimited system plus superb picture quality...make RCA best

Improved technical quality in your film programs need not require a big investment

ICONOSCOPE CONVERSION

You can start simply and build gradually, if you prefer, first by converting iconoscope film cameras to RCA vidicon film cameras. You'll get marked improvement in gray scale, tremendously increased signal-to-noise ratio, improvement in resolution, and provision for automatic black level control . . . all with a minimum of operating attention. The "snap," clarity and live effect will be immediately reflected in advertiser preference.

MONOCHROME SYSTEM EXPANDABLE TO COLOR

Or, you can start with the superior vidicon film system expandable to color. Using the RCA TP-15 universal multiplexer, color and monochrome film equipment can be completely integrated—by adding a TK-26 color film camera at any time. This new multiplexer accommodates up to four projector inputs, all of which are available to two film camera outputs.

COLOR FILM SYSTEMS

To go to color *now,* you can select from various equipment combinations which use the RCA TK-26 three-vidicon film camera. In TV stations where superb picture quality and operational simplicity count, the TK-26 is the preferred system for color film programming. It has been selected after careful comparative evaluation with other systems and found to produce finer quality film pictures in both monochrome and color. Superior results are achieved at minimum cost with maximum operational simplicity.

LIVE COLOR, TOO

It is possible to use the RCA three-vidicon film system for pickup of opaques, live commercial products and demonstrations within a limited area.

See your RCA Broadcast Representative for more details on Vidicon Film Systems. He will be glad to answer your questions. Let him help plan a film system that can start you on the road to the new and additional revenue that will come from color!

NEW STANDARDS OF QUALITY

The RCA Vidicon Film System has established a standard of film reproduction by which all other methods are judged. You can expect and get the highest quality reproduction, with protection against obsolescence for years to come. To give some idea of the wide range of system possibilities with RCA equipment we submit four diagrams, at right, from the very simplest equipment to a Dual Color Film System.

Monochrome film system expandable to color.

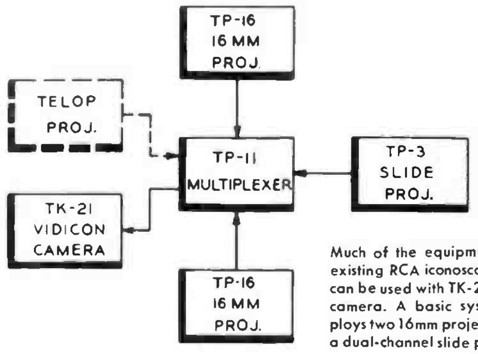
RADIO CORPORATION of AMERICA

BROADCAST AND TELEVISION EQUIPMENT **CAMDEN, N.J.**

possibilities . . .

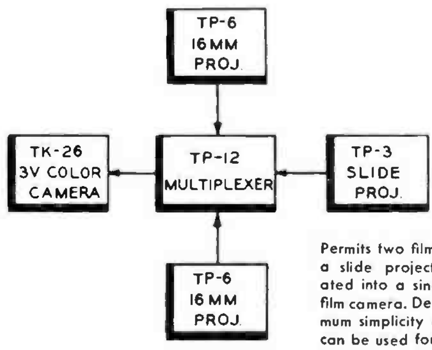
buy in film equipment—monochrome and color

1. CONVERSION OF ICONOSCOPE FILM SYSTEM TO VIDICON



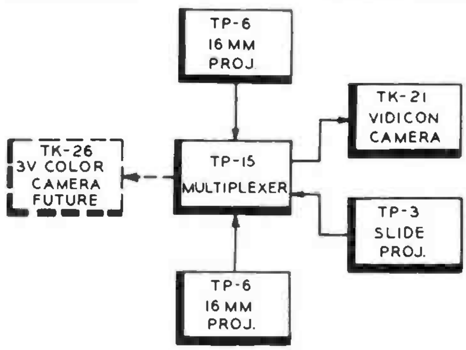
Much of the equipment in an existing RCA iconoscope chain can be used with TK-21 vidicon camera. A basic system employs two 16mm projectors and a dual-channel slide projector.

3. BASIC COLOR FILM SYSTEM



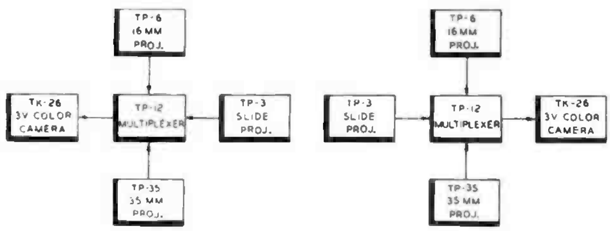
Permits two film projectors and a slide projector to be operated into a single TK-26 color film camera. Designed for maximum simplicity and economy, it can be used for both color and monochrome film.

2. MONOCHROME FILM SYSTEM EXPANDABLE TO COLOR



Combines a TK-21 monochrome film camera with projectors and multiplexing equipment, which are usable in color as well as monochrome. At any time a TK-26 color film camera can be added, retaining the TK-21 for the monochrome channel.

4. DUAL COLOR FILM SYSTEM



Will handle a large number of inputs and therefore provides maximum program protection. Two completely independent program channels provide the ultimate in reliability and assure continuous programming. Permits previewing in color.

Best for color and monochrome because it uses proved-in components!

VIDICON TUBE . . . . RCA development

Vidicon storage tube is outstanding from standpoint of high signal-to-noise ratio, reliability and low-cost operation. It produces a sharp lifelike picture—equally good in monochrome or color. Replacement involves minimum of equipment readjustment.

STANDARD-TYPE PROJECTORS FOR 35 and 16MM

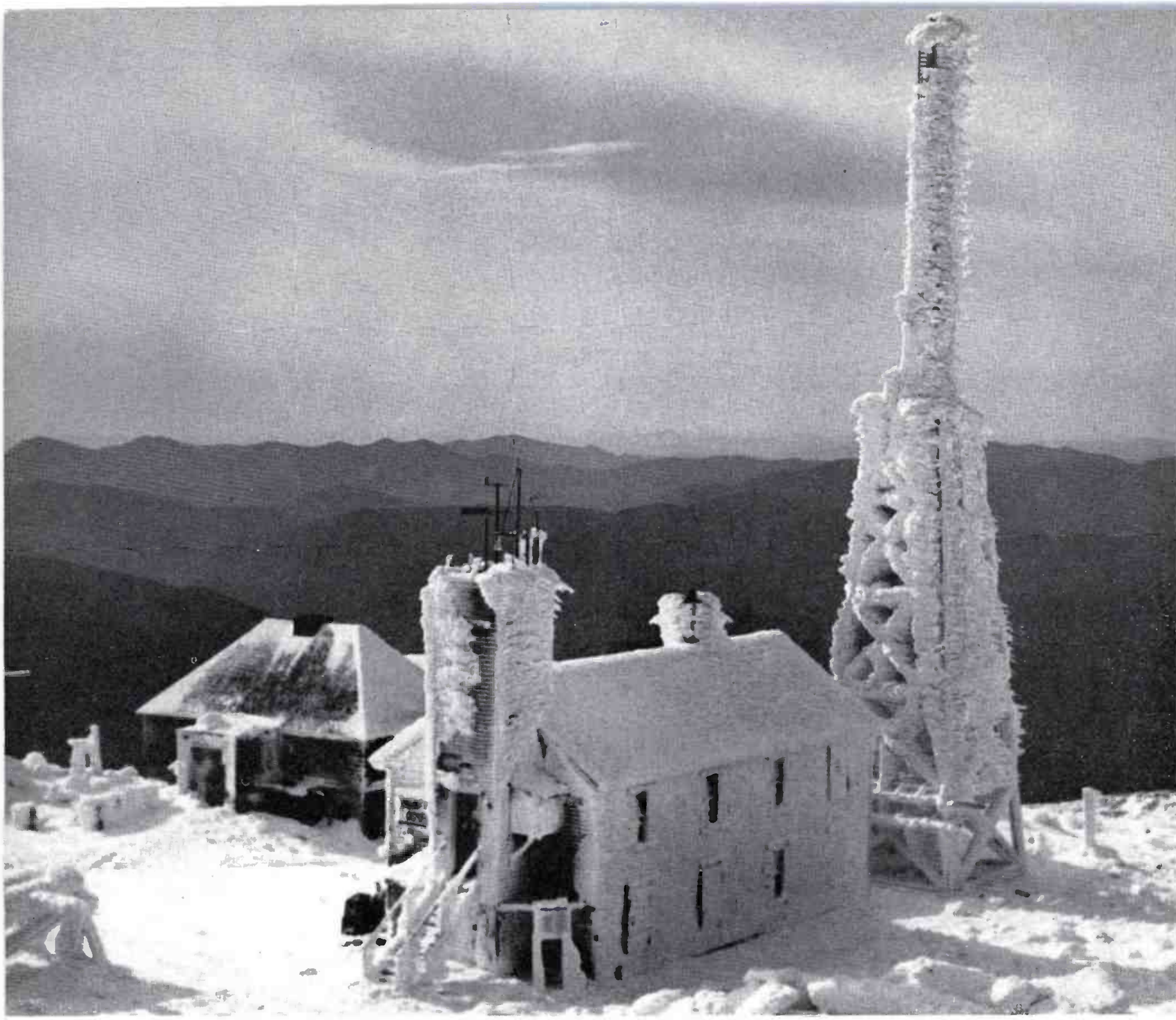
Standard of the motion picture industry, the intermittent projector produces a beautiful steady picture. It involves none of the critical mechanical tolerances of the continuous projector for 16mm. RCA now offers the TP-6 series projector designed from the beginning for professional 16mm television use. Provides maximum video and audio quality with operating convenience and dependability. RCA neutral-density-filter light control makes it possible to achieve satisfactory results with practically all kinds of film.

NEW TYPE TP-15 MULTIPLEXER

Provides for complete integration of color and monochrome. Offers flexibility and protection of two-camera system without the necessity of buying separate projectors for each camera. Permits preview of one program while another is on-air.

OPERATING CONVENIENCE AND SIMPLICITY

Only two simple controls are employed in "on-air" operation. Pedestal level and Master Gain. For assuring picture perfection, all controls, together with waveform and picture monitors, are located at the operating position.



▲ FIG. 1. Winter's arrival turns WMTW antenna, transmitter house and Mt. Washington Observatory into a study in table-top photography.

FIG. 2. The WMTW Transmitter House overlooks a thousand-foot drop and a million-dollar view of Crawford Notch and the Lake of the Clouds. ▼

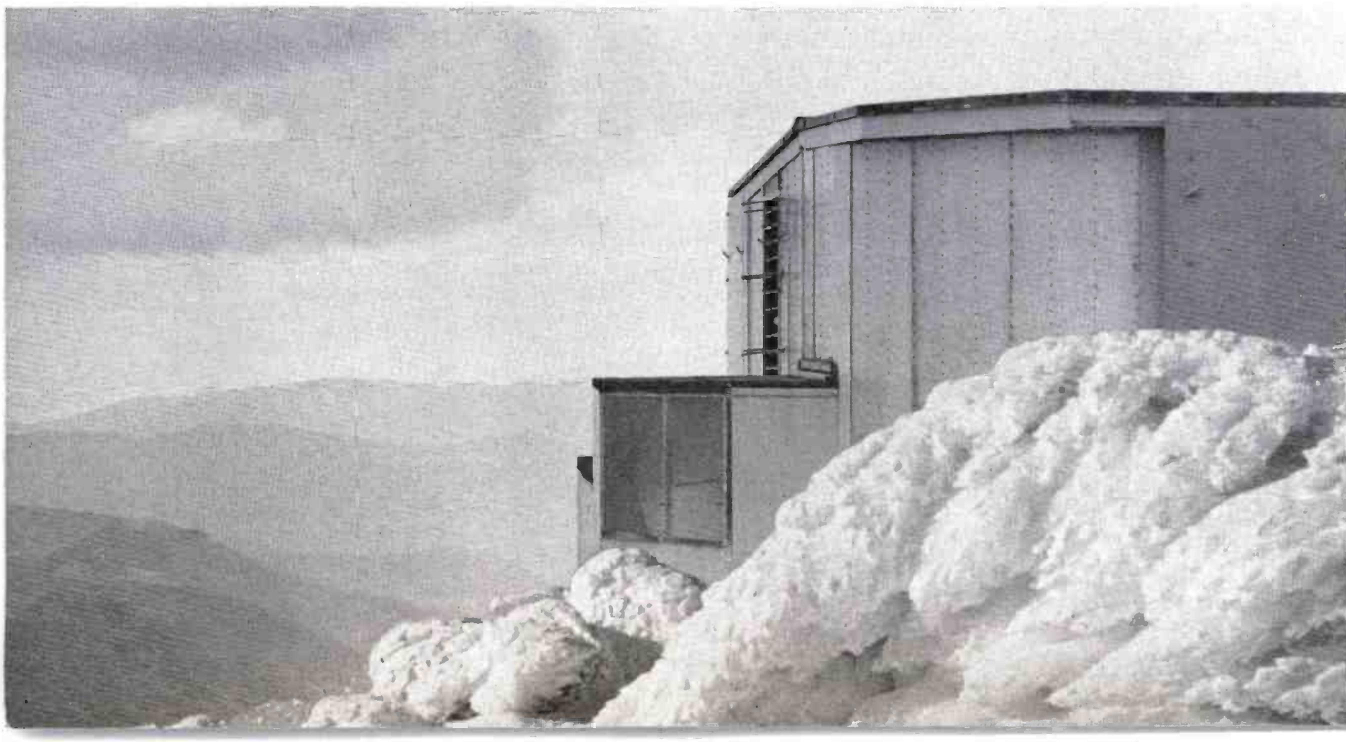


FIG. 3. Sno-cat shown here at the timber line provides vital winter transportation for station operating personnel.

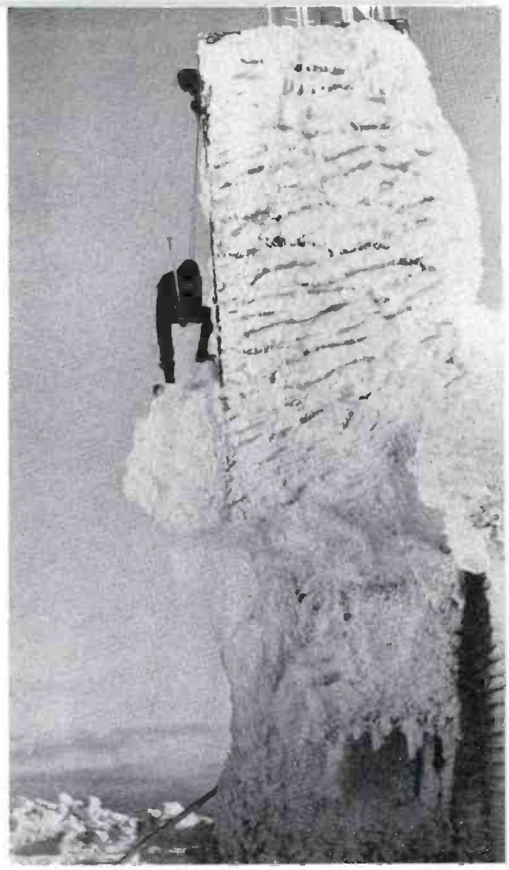


FIG. 4. "Deicing" of antenna tower often requires a pickax and a strong back. Antenna is deiced electrically.

TV WEATHERS MT. WASHINGTON

by PARKER H. VINCENT,
Chief Engineer, WMTW,
as told to
MILES G. MOON,
BROADCAST NEWS Staff

WMTW in Third Winter of Successful Operation From Scene of World's Worst Livable Weather

Television from "a mile high in the sky" is today a practical reality. WMTW has proved that a successful TV operation can be carried on despite the elements and an almost inaccessible location. More than two years' operation has confirmed WMTW's choice of its skytop transmitter site.

From the standpoint of antenna height, Mt. Washington, New Hampshire is just about ideal. The WMTW antenna is situated 6393 ft above sea level (3847 ft above average terrain). Operating on Channel 8 with an ERP of 105 kw, visual, the station provides primary coverage of a sizable portion of New England —blanketing Vermont, New Hampshire, South and Central Maine.

From the standpoint of convenient operation, Mt. Washington poses two big problems . . . *inaccessibility* and *inclement weather*. Perseverance and ingenuity on the part of WMTW personnel have solved these problems.

The studios of WMTW are located on the site of the famed Poland Springs Hotel, Poland Springs, Maine. This is forty-eight air miles from the transmitter site. However, eighty-seven road miles separate the two locations; the last eight of these miles curl up a steep, rocky road to the summit. This road is inaccessible to ordinary vehicles eight months of the year.

The summit of Mt. Washington is admittedly the site of the world's worst livable weather. The highest wind velocity ever recorded on earth, 231 mph, was recorded here. The wind exceeds hurricane force in every month of the year, about every other day in six winter months. Temperatures reach 49 degrees below zero and have never gone above 71. Summer of a sort arrives in July and is gone in September with the arrival of ice and snow.

On September 1, 1954, the first test pattern emanated from the WMTW transmitter on the summit. The transmitter building was only partially completed, but station engineers and technicians had beaten old man winter in. Finishing touches were soon completed, and on September 15, men and equipment settled down for their first winter at the transmitter site.

Would the equipment operate at peak efficiency under such adverse conditions? Would the building be able to take the ice and wind? Had careful plans accounted for every contingency? Could communications be maintained between studios and transmitter? These were big questions then. Now they can be answered in the affirmative. Television has come to stay at Mt. Washington.

WMTW TRANSMITTTER HOUSE

The WMTW Transmitter House has become one of the tourist attractions of the Mt. Washington summit. It is open to the public during the summer months and thousands of visitors who have ascended the mountain, via Cog Railway, toll road and on foot get their first look at television transmitting equipment. This is probably the most widely visited transmitter installation in the world, the guest log having recorded as many as one thousand names in a single day.

The Transmitter House is shown in Fig. 5. It is a 78 by 36 foot building, especially constructed to withstand extreme wind velocities as well as damage from falling ice. Adjacent to the building is a 50 foot tower which supports the station's specially designed antenna. The antenna is so constructed that it may easily be deiced under conditions where ice build-up occurs at a rate in excess of six inches per hour. The building houses the transmitter equipment, emergency power equipment and living quarters for operating personnel. Figure 6 is an installation diagram of the transmitter building.

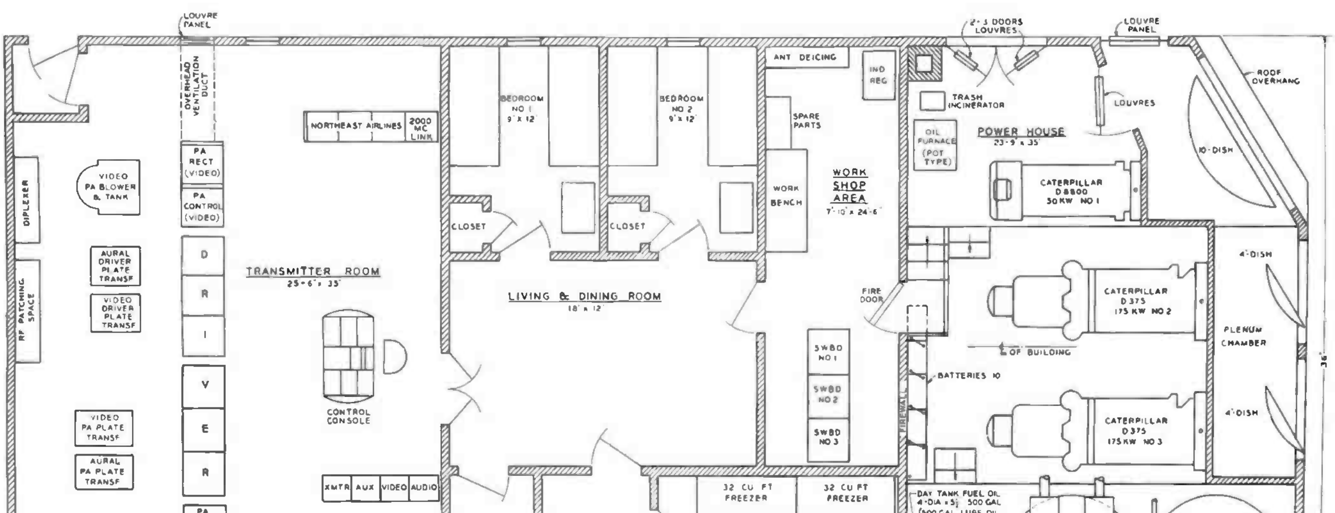
TT-25AH Transmitter

WMTW operates on Channel 8 with an ERP of 105 kw, visual and 52.5 kw, aural, using an RCA 25-kw Transmitter, Type TT-25AH. A conventional "in-line" transmitter cabinet arrangement is used (see Fig. 7). A manual transfer panel has been installed, so either aural or visual section of the 10-kw driver can be used directly on the air in emergencies. The two-section antenna can be split into aural and visual or operated one section at a time. This feature together with "power cutback" in the transmitter results in a very reliable combination.

Auxiliary equipment includes RCA demodular, sideband response analyzer, RF-load and wattmeter, stabilizing amplifiers and sync generator, Type TG-2A. A vidicon camera chain, Type TK-21 has been

FIG. 5. WMTW's Transmitter House, tower and antenna on a "balmy" day in July.

FIG. 6. Floor plan of WMTW. The building houses transmitter equipment, emergency power equipment and living quarters for operating personnel.



installed at the transmitter for use with slides and also for a live weather pickup.

Power Installation

Since commercial power is not available at the summit, a diesel power plant is required. This supplies not only the transmitter, but also the antenna deicing equipment (with a load of more than 100 kw). The installation consists of three Caterpillar diesel generators. Two of these are rated at 225 kw and one at 50 kw. Switchgear, which permits parallel operation, is also included. The generators are equipped with hydraulic governors and 0.1 per cent voltage regulators. Waste heat from the diesels is utilized in heating the building.

Adajacent to the power generator room is a plenum chamber which is constructed with a Fiberglas outer wall facing toward the studios in Poland Springs. STL microwave dishes are placed behind this wall. The high temperature in the chamber (150 deg F) prevents ice formation so that clear microwave paths can be maintained.

A main load center supplies power through individual lines to the transmitter, the antenna deicing equipment, and throughout the WMTW transmitter building. To obtain maximum efficiency from the generators, they should be operated close to full load. In order to maintain this full load, power is supplied to several other installations on the summit.

Fuel for the power generators and for heating is stored in five 20,000 gallon tanks. These provide enough fuel for a full year's operation and are located about 1500 ft down the mountainside for safety. A 500 gallon tank located beneath the powerhouse is filled each day by means of special pumping equipment. Daily filling assures a fuel reserve to allow for maintenance time in emergencies.

Living Quarters

The living quarters for operating personnel consist of a large living-dining room, two bedrooms, kitchen, bath and a storage room with five 18 cu ft freezers, washing machine, clothes dryer and copious shelf space. The kitchen window affords a "million-dollar view", looking southwest from the summit to the Lake of the Clouds and Crawford Notch, N. H.

Drinking water is stored in two 850 gallon tanks under the transmitter building. Wash water is stored in two 5000 gallon tanks in the powerhouse. These are kept filled with water from rain and melting ice collected by means of a gutter system on the roof.

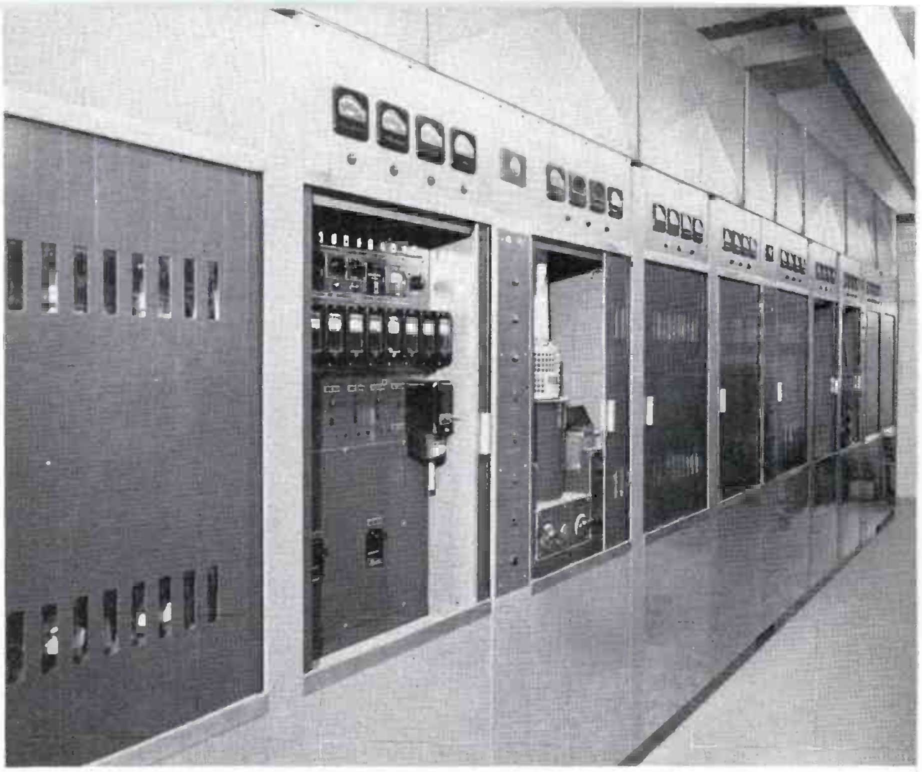


FIG. 7. RCA TT-25AH Transmitter as installed in the transmitter room. Ductwork cannot be fixed to the ceiling because of extreme wind velocity, often moves the building as much as 4 or 5 inches.

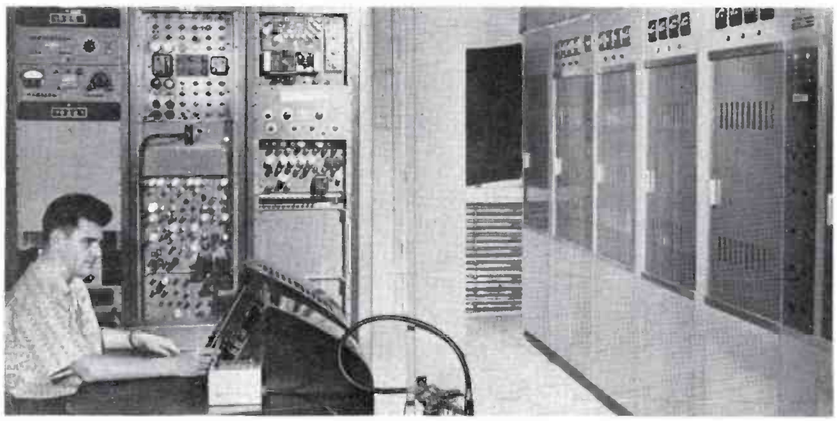


FIG. 8. View of WMTW's 25-kw transmitter showing control and auxiliary equipment. Deflection and amplifier chassis for TK-21 vidicon camera chain are mounted in the center cabinet rack.

FIG. 9. Live weather casts originate from the engineers' lounge using a TK-21 camera mounted on a tripod.

FIG. 10. WMTW's fuel is stored in five 20,000 gallon tanks. These tanks hold a full year's supply of fuel.

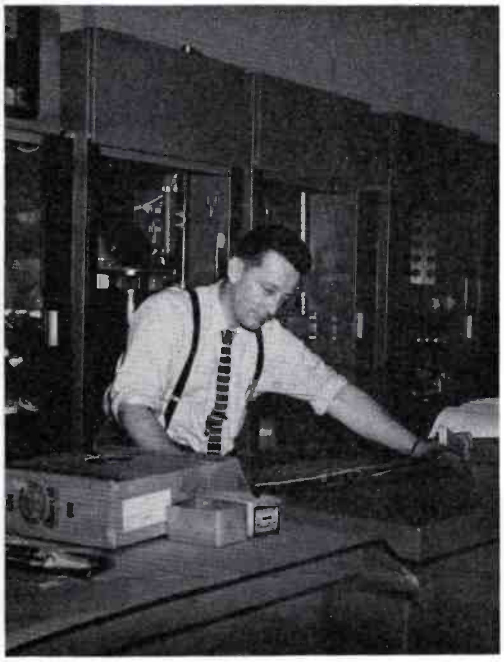


FIG. 11. Chief Engineer Parker H. Vincent supervises preassembly of transmitter equipment.

FIG. 12. Power load center is carefully laid out and preassembled. Other units usually assembled on the job, such as water systems and air ducts, were also prefabricated.

PREASSEMBLY SPEEDS INSTALLATION

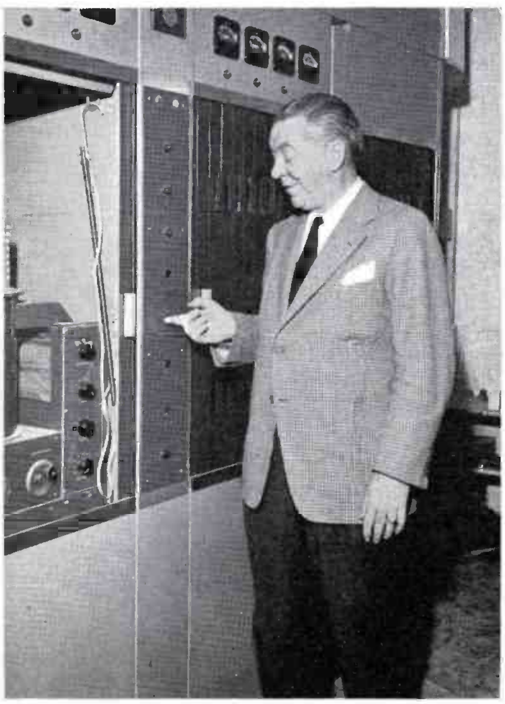


FIG. 13. John W. Guider, President, Mt. Washington TV, Inc., puts transmitter "ON AIR" for first WMTW transmission.

Since summer spends so little time atop Mt. Washington, construction and installation of WMTW had to be undertaken in only two months—from ground breaking to "ON AIR." Every phase of the venture was carefully planned by John W. Guider, President, Mt. Washington TV, Inc., together with William F. Rust, Jr., President and General Manager of the Rust Industrial Co., who offered the assistance of his plant facilities.

The task would have been impossible without the industrial facilities provided. With excellent co-ordination of all the plant units—engineering, drafting and design departments, model shop, purchasing department, the pool of skilled technicians, the installation was completed in record time. Parker H. Vincent, Chief Engineer of WMTW, executed the plans and supervised each phase of construction and assembly, assisted by Alden M. Doughty, Transmitter Supervisor; John Ricker, Studio Supervisor; and other members of the WMTW engineering staff.

Transmitter Preassembled

All transmitting equipment was received at Manchester, N. H. The TT-25AH Transmitter was assembled and wired; control equipment was installed in console and auxiliary equipment in racks. Other units, usually assembled "on-the-job", such as load centers, water systems and air ducts were prefabricated at the plant. This enabled the complete transmitter installation to be pretested in operation. It is estimated that these techniques cut assembly time on the mountain by more than 50 per cent.

The equipment was taken apart and preassembled units trucked to the mountaintop. Meanwhile, the transmitter building was only one-third complete—the roof covered the transmitter room only. Protected by this section of roof, installation speeded on. Careful co-ordination was required between widely separated Manchester, Mt. Washington and Poland Springs. The use of two-way radio communication between these points and mobile units installed in station vehicles speeded construction and movement of material to the transmitter site.

Building Specially Constructed

Every phase of the mountaintop installation required something new and different. For example, the transmitter building had to be constructed to with-

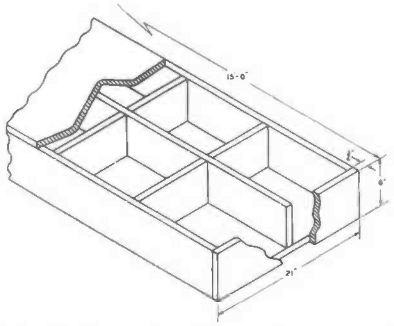


FIG. 14. Construction diagram of prefabricated plywood roof panels.

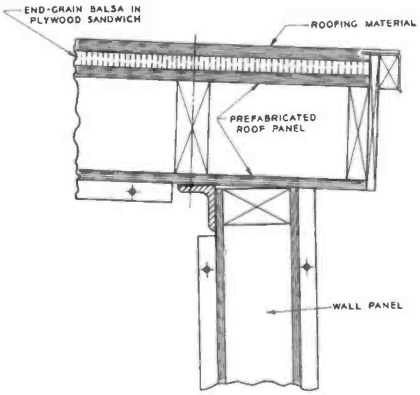


FIG. 15. Cross section of the transmitter house roof showing construction details.

stand extreme wind velocities. It was designed by Professor Albert Deitz of the Massachusetts Institute of Technology, and has the highest windloading of any building ever constructed—230 miles per hour, steady or gusty from any direction.

Prefabricated and trucked to the summit in sections, the building has a steel frame set in a concrete foundation deeply anchored in bedrock. This was done not so much to hold up the low-silhouette structure, but rather to prevent it from being blown off the summit. Inner and outer walls, floor and roof deck are fabricated of Douglas fir plywood panels—a wooden grid-work sandwich between two pieces of ¾ inch plywood (details are shown in Fig. 14).

In addition to the wood panels, the roof deck (see Fig. 15) has an overlay consisting in part of two inches of end-grain balsa wood. This acts as a shock absorber in arresting the impact of large hunks of ice which occasionally fall from the tower. To prove its capabilities a sample roof panel was tested. The panel withstood the impact of a 300-lb block dropped from a 60-foot bridge. Since then the roof has stood up under more rugged treatment—being bombarded with blocks of ice weighing several tons.

FIG. 16. Prefabricated plywood panels are set in place in the first stage of reinforcing the transmitter house roof.

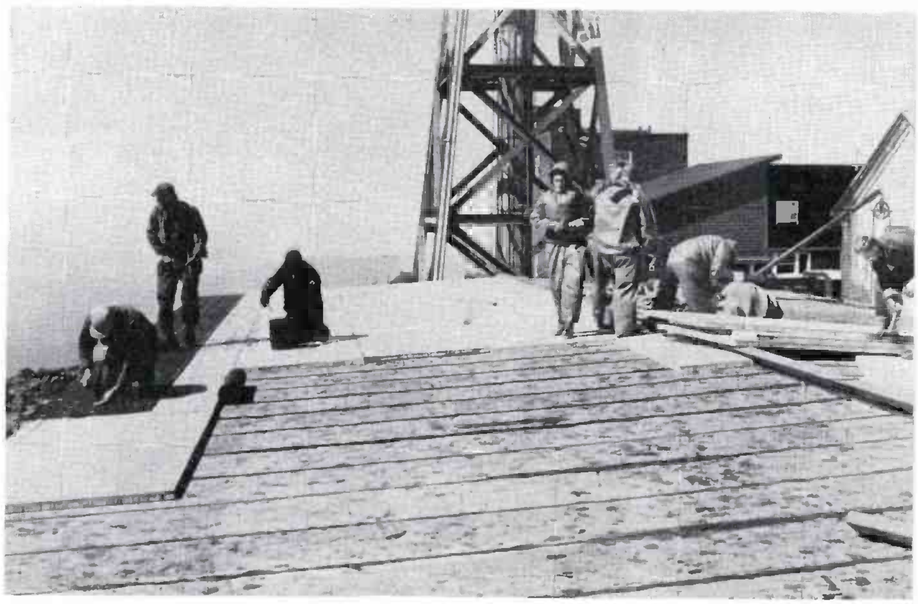


FIG. 17. End grain balsa sandwiched in plywood is added as a shock absorber.

FIG. 18. Once the transmitter room had been enclosed, the station began operation.

SPECIAL PREPARATION FOR MOUNTAINTOP OPERATION

A maximum safety factor is designed into the transmitter installation due to the inaccessibility of the location. Extra equipment reliability is a must. Power cutback to the 10-kw driver and split feed to the two-section antenna set up on a manual transfer panel, further extends the reliability inherent in the RCA transmitter design. A full complement of spare tubes, blowers and miscellaneous electrical and mechanical components is maintained. A dual microwave link is used to obtain utmost reliability. Emergency power generator equipment is available and a full year's supply of fuel is laid in each summer. Two-way radio communication is available between transmitter, studio, and a carryall truck used by the chief engineer. This truck is equipped with a signaling system so that transmitter engineers can contact the chief any time of day or night. These factors plus extra careful maintenance by a conscientious staff has reduced lost air time to a minimum. WMTW is proud of its record of 99.9 per cent of scheduled air time "ON AIR."

Preparations for Winter

When July comes the job of stocking the Transmitter House for the long winter begins. Sufficient food to satisfy hearty appetites for the following year must be purchased, delivered and stored away. Meats, poultry, frozen juices, vegetables, ice cream, are loaded into five 18 cu ft freezers while canned food, flour, cereals and other staples are stored on copious pantry shelves. Water tanks are filled.

Fuel oil for the power generators is trucked over 116 miles from Portland, Maine. Specially designed tractors hauling 5000 gallon tanks are necessary to climb the steep road to the summit. Fueling starts in July and is completed by the middle of August—a total of 20 trips being required to fill the station's supply tanks.

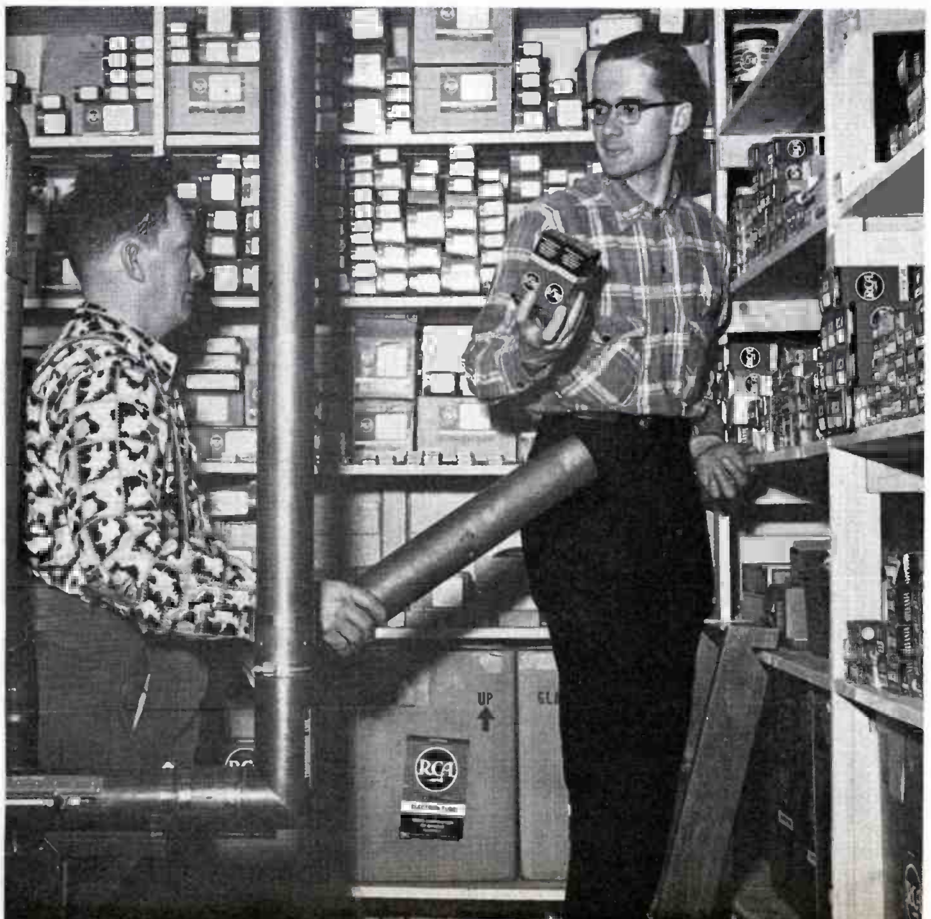
Any outdoor maintenance to the building, tower, antenna and tanks, must be performed in the summer. Stocks of spares are checked and refurbished. Any new equipments that have been purchased are installed, and the installation is made ready for another long winter.

Winter Living

WMTW engineers live at the Transmitter House year-round with a work schedule of two weeks on and one week off. The winter months offer little opportunity and less inclination for long walks through the countryside. These men are virtually snowbound for about eight months of the year. Three transmitter engineers work a staggered trick. In addition a full-time mechanic is employed. He is also an expert mountain man, who operates the station's sno-cat for vital winter transportation, and must be prepared for all emergencies.

In addition to special maintenance trips, Chief Engineer Parker Vincent makes a regularly scheduled trip each Monday to take the relief engineer up the mountain and bring the off-duty engineer down. In the winter, they leave the Vincent house in Auburn, Maine about 8 a.m., reach the base station at the foot of the mountain by 10:30, continue by 4-wheel drive jeep to the sno-cat shelter, partially up the mountain, and arrive at the Transmitter House about 12 noon. A week's supply of fresh milk, eggs, and other perishables is taken on this trip. It has only been necessary to postpone this trip due to extra hazardous weather conditions twice since the station went into operation.

As evidenced from the illustrations shown here, living is warm, comfortable and convivial atop Mt. Washington.



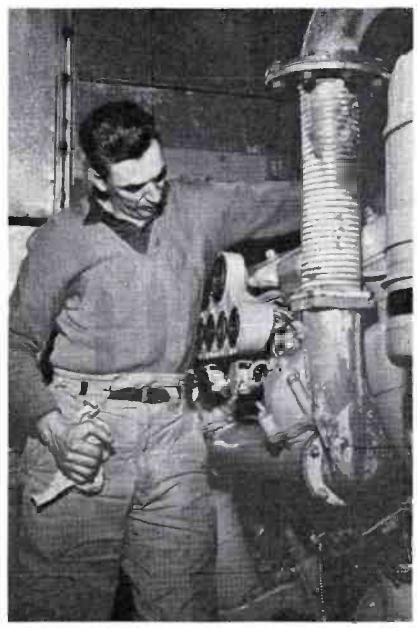


FIG. 19. Preparations for winter include careful service and maintenance of power ventilating equipment.

FIG. 20. The stock of spare tubes is carefully checked. A full complement of other miscellaneous electrical components is also maintained.

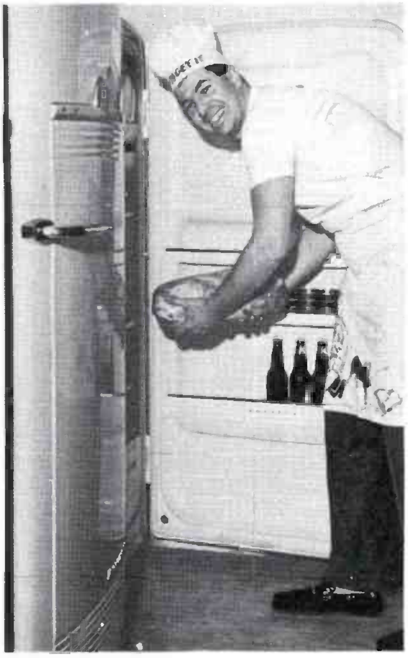


FIG. 21. Five 18-cu ft freezers house a year's supply of frozen foods.

FIG. 22. Mountain air makes for hearty appetites. Second helpings abound and a well-stocked pantry provides a varied fare.

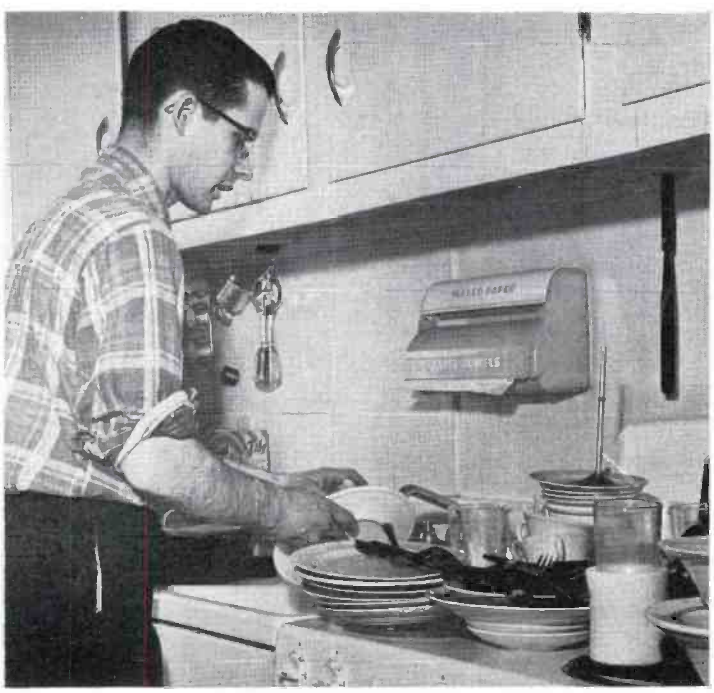


FIG. 23. There's always the dishes! 'Nuff said.

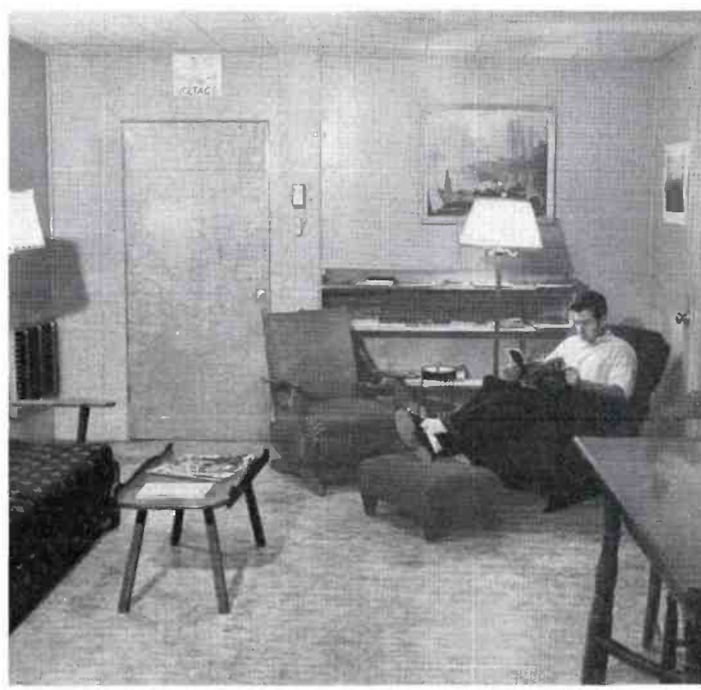


FIG. 24. The chance to relax and catch up with the outside world.

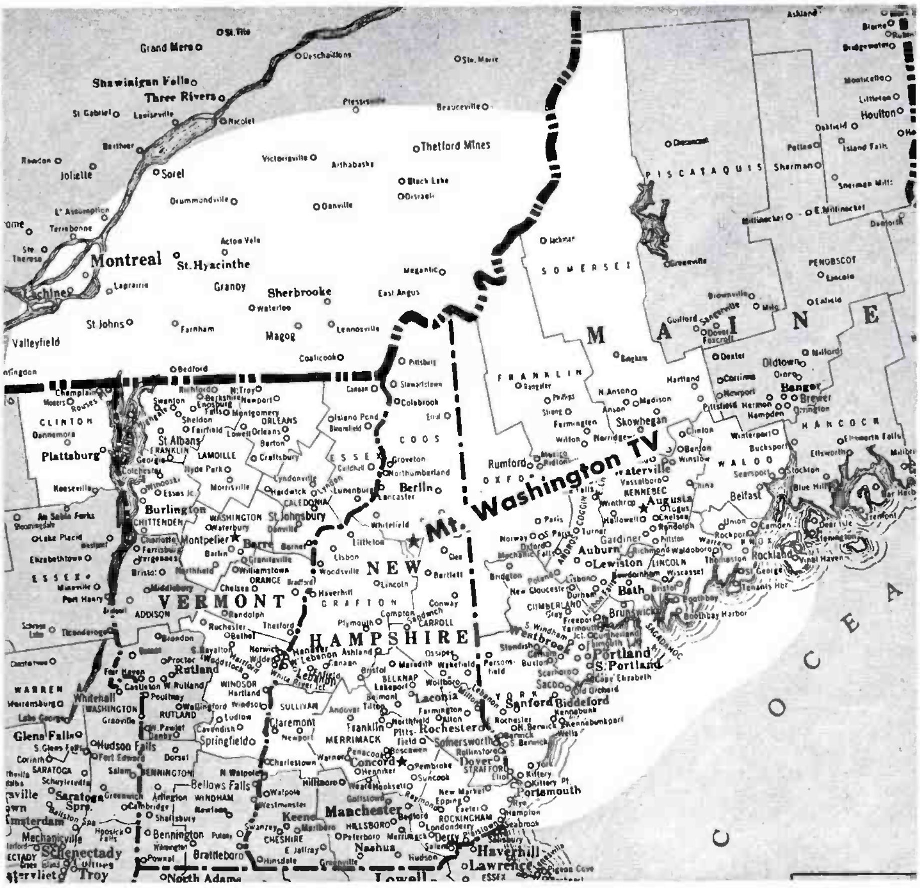


FIG. 25. WMTW coverage includes parts of Vermont, New Hampshire, South and Central Maine.

POLAND SPRINGS

WMTW studios are located on the site of the famed Poland Springs resort hotel, 87 road miles from the transmitter site. A dual-microwave link spanning 46.2 air miles connects the two points. These locations are shown on the map, Fig. 25, which also shows the coverage area.

The station devotes much of its program day to network programming. Local live programs and commercials originate in Studio "A." This studio measures 50 by 30 ft and is equipped with two RCA studio cameras, Type TK-11A. The studio accommodates several sets; among them a kitchen set.

Film provides another important program source at WMTW. The station's film room is equipped with two separate TK-21 monochrome film systems to provide utmost reliability in daily operation. Each individual film chain is equipped with a TP-6B "Professional" Film Projector, a TP-3B Slide Projector, and a TP-11 Multiplexer. A spacious film storage and editing room is adjacent to the film room.

Master control is fully RCA equipped. The control consoles overlook Studio "A." The equipment (see Fig. 30, left to right)

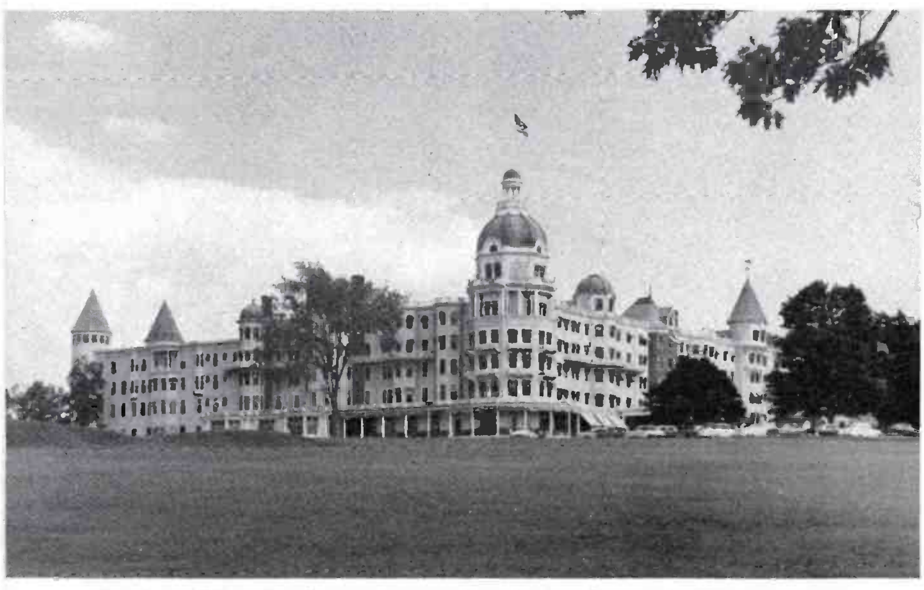


FIG. 26. WMTW studios are located on the site of the famed Poland Springs Resort Hotel.

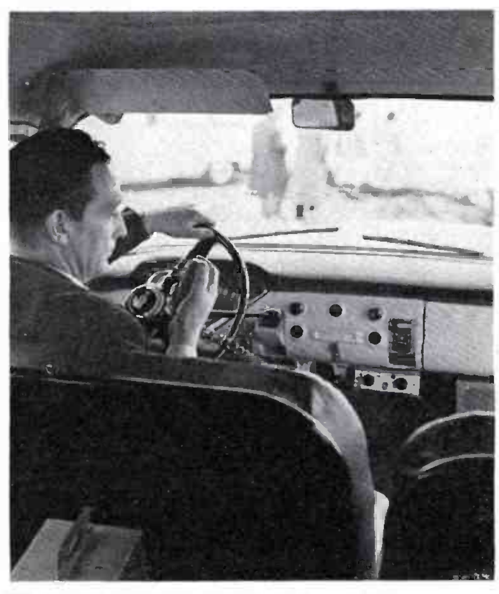


FIG. 27. Chief engineer contacts studio and transmitter via RCA 2-way radio.

STUDIO

consists of a BC-2B Audio Consolette, two control monitors for TK-21 Film Cameras, two control monitors for TK-11A Studio Cameras, a TM-6B Line Monitor with TS-5A Switcher and TC-4A "Basic Buy" Control Equipment. Network and off-air signals are shown at the utility monitor and receiver at the right wall. The equipment arrangement allows the TC-4A Switcher to be used for one man control during periods of network and film only.

Equipment racks which line the back wall of Master Control house two TG-2A Sync Generators, equipment for film and studio cameras, network termination equipment, microwave control and two-way radio communication units.

The same operating precautions and extra equipment reliability so important to the transmitter plant is also emphasized in the studio. This has resulted in very successful operation. WMTW has overcome the problems of an inaccessible location and extremely adverse weather conditions. Now in their third winter of operation, WMTW personnel have demonstrated the perseverance and ingenuity required to turn an idea into a practical reality. Television has weathered Mt. Washington.

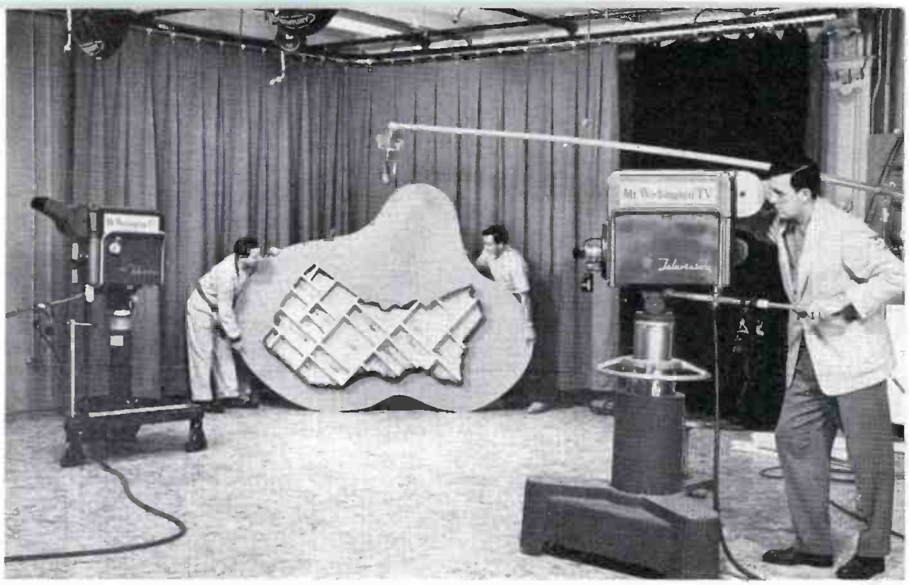
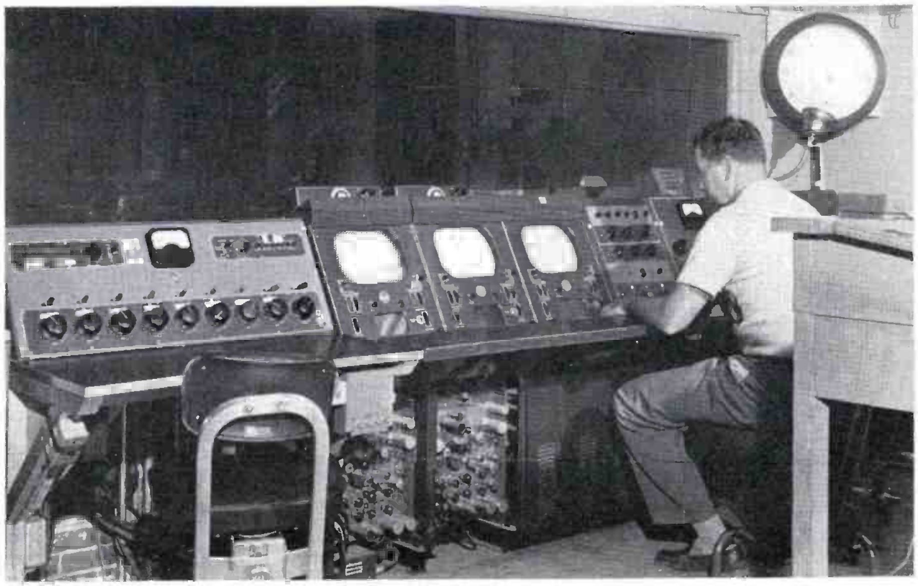


FIG. 29. Studio "A" is equipped with two RCA studio cameras. This 30 by 50 foot studio accommodates several sets including a permanent kitchen area.



▲ FIG. 30. Equipment arrangement in the control room allows RCA TC-4A switcher to be used for one main operation during periods of network and film only.

FIG. 31. Two separate TK-21 monochrome film systems, each equipped with a RCA TP-6 projector, provide utmost reliability in daily operation. ▼

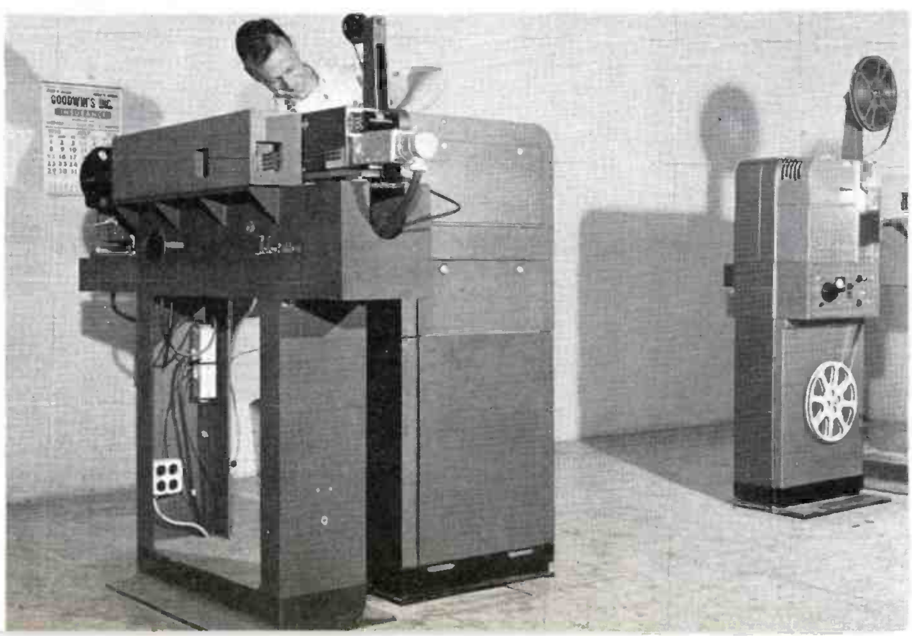


FIG. 28. Editing and film storage room is both spacious and complete.

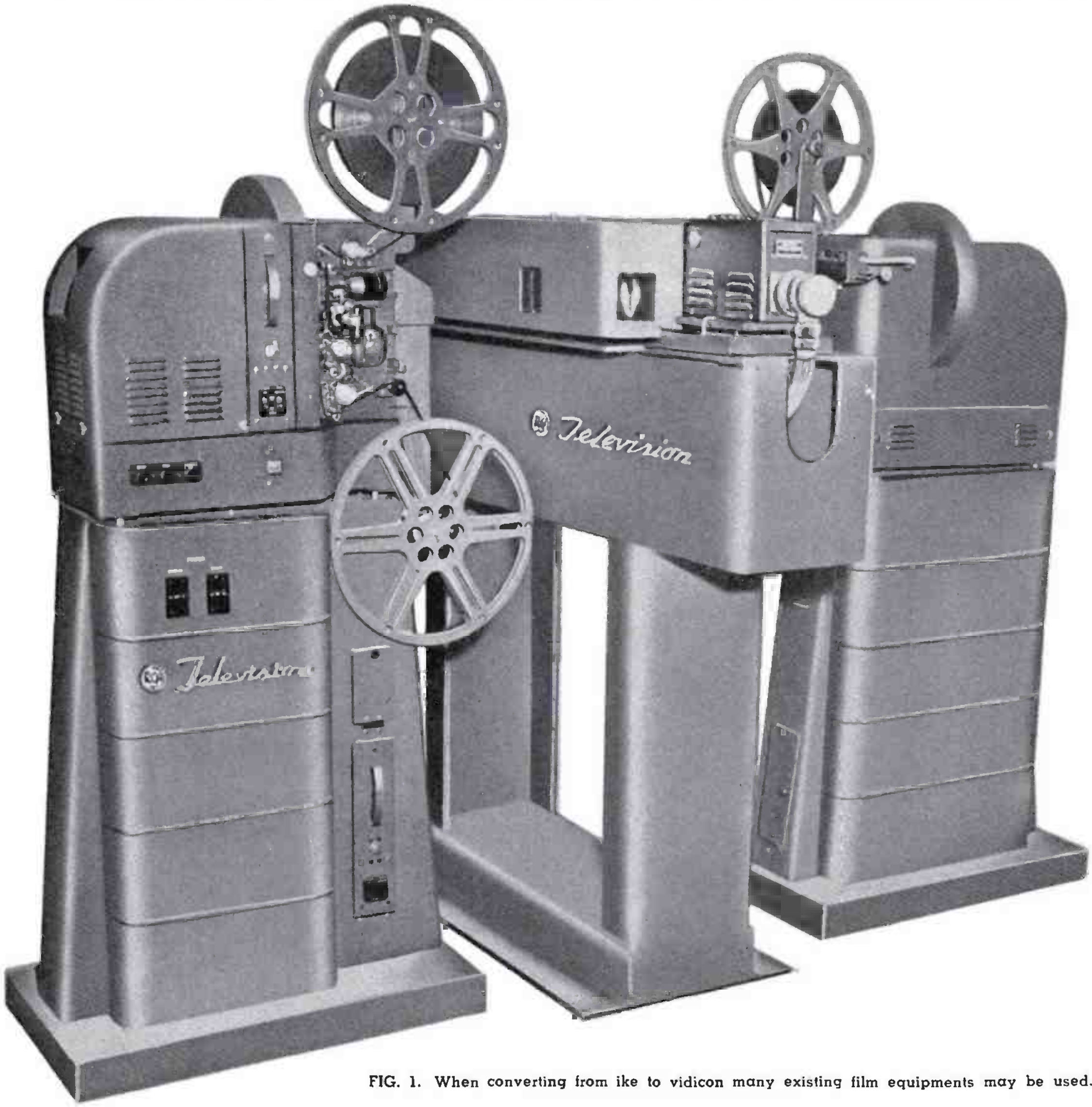


FIG. 1. When converting from ike to vidicon many existing film equipments may be used.

HOW TO GET BEST TV PICTURE QUALITY FROM FILM AND SLIDES

Part One — Ike to Vidicon Conversion *by R. F. ROUNDY, Broadcast and Television Sales*

The use of film is taking on increasing importance in the television industry today. Numerous Hollywood feature film packages have been released. Independent producers are filming series especially designed for TV. Amidst all this activity advertisers and agencies are placing more and more emphasis on film quality—both programwise and technically. This article describes the initial, basic step to improved technical quality—the conversion from the iconoscope to the vidicon film camera.

Since the introduction of the RCA Vidicon Film Camera, Type TK-21, in 1954, more than 300 television stations have taken this first step to improved film quality. However, the changeover to vidicon has not been one hundred per cent; a number of stations still offer the outmoded iconoscope as their primary film source at a time when film quality is receiving much attention. Also, in many more stations, the iconoscope may be found operating side by side with newly installed vidicons. To stations who want improved film quality or are planning to increase their film handling capacity, conversion of an existing iconoscope film chain to *all vidicon* operation is a worth-while step.

Technical Advantages of the RCA Vidicon Camera

The RCA Vidicon Film Camera, Type TK-21, offers many superior performance advantages not found in the iconoscope camera. Significant among these are:

(1) marked improvement in gray-scale rendition
(2) increased signal-to-noise ratio
(3) improvement in resolution
(4) automatic black level control
(5) minimum operator attention
(6) nonsynchronous operation of projectors

With the iconoscope cameras, the video signal is buried in large shading and flare signals which are generated by the iconoscope tube *even when no light is reaching it*. To compensate for this condition, the operator must introduce canceling wave forms or signals to even approximate results that are inherent in the vidicon camera. Since the condition of flare and shading introduced by the iconoscope will vary from scene to scene, the operator must "ride" shading controls continually. The ability to shade the iconoscope varies from operator to operator; hence, the quality of the film picture will largely depend on the operator's "feel" for the equipment and his ability to outguess the iconoscope tube. Furthermore, up to this point, the operator has not even begun to compensate for film density variations. In the vidicon, no electrical shading cancellation signals are required. The video signal is "clean" and the picture is a direct replica of picture information. The only operating requirement of the RCA vidicon camera is to adjust the light according to varying film densities.

The iconoscope can introduce noise into the film picture even before the film information is applied. For the operator to eliminate this noise, he must continually adjust the iconoscope controls. During this adjustment, he must compromise between high flare and low noise or low flare and high noise. In the vidicon camera no flare is present. The high sensitivity of the vidicon tube provides the best available noise-free picture.

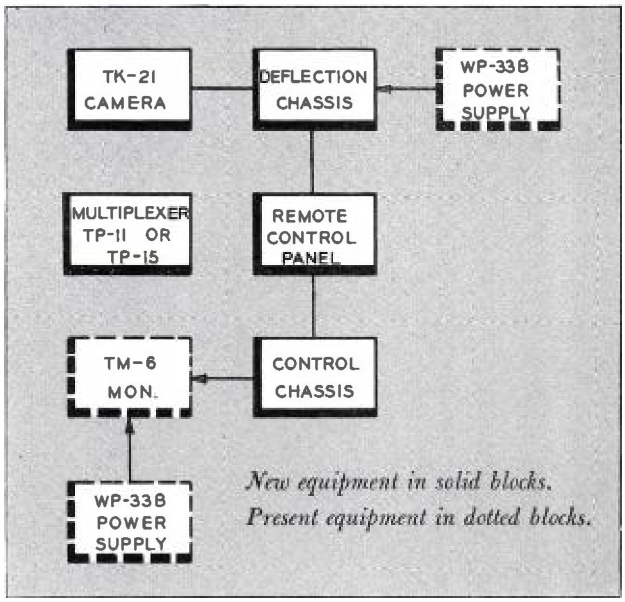


FIG. 2. Functional diagram showing equipment requirements for conversion to vidicon operation.

Equipment Required for Conversion

The master monitor, power supplies and console housing that are presently in use with each iconoscope chain can be retained when converting to the vidicon operation, see Fig. 2. Of course, existing film and slide projectors can also be used.

To convert from iconoscope to vidicon film cameras the equipments shown in Table I, seen at right, are required.

Table I

Equipment Required for Iconoscope to Vidicon Conversion

Item	Quan.	MI	Description
1	1	26021-C	Vidicon Camera Head
2	1	26671	Vidicon Camera Tube
3	1	26061-C	Control Chassis
4	1	26081-C	Deflection Chassis
5	1	26241-A	Remote Control Panel
6	1	*	Camera Lens
7	1	**	Multiplexer

* Camera lens dependent upon type of multiplexer obtained:
for TP-11B Multiplexer use MI-26630 1 in Fl. 9 lens;
for TP-15 Multiplexer use MI-26669-2 2.04 in Fl. 5 lens.

** Multiplexer can be either TP-11 or TP-15 types.

Multiplexing Equipment Requirements

The vidicon has a picture diagonal of slightly less than ⅝ of an inch, giving a magnification ratio of about unity for 16-mm film and demagnification ratio of 2 to 1 for 35 mm. Hence, the lens throw is about 7 to 10 inches. RCA TP-11B and TP-15 multiplexers provide excellent facilities for this multiplexing requirement. These equipments create a working distance to accommodate the required multiple mirrors, prisms and projector sources. This is accomplished by projecting a real image (whose diagonal is 5.55 inches) in space. This image is picked up by a lens on the vidicon camera itself. A suitable field lens in the 5.55-inch image plane is used to direct the peripheral rays into the vidicon lens aperture.

The TP-15 Multiplexer is more flexible, allowing the same projectors to be used with two separate vidicon film cameras. Figure 3 indicates the possible combinations of film cameras (maximum number—2), film projectors (maximum number—2) and slide projectors (maximum number—2) that can be used with the TP-15 Multiplexer. Figure 4 indicates the layout of the TP-11B Multiplexer. Figure 5 indicates layout of the TP-15.

Slide Projector Requirements

With the iconoscope cameras, it was common practice to use two slide projectors, side by side, or a dual lens slide projector directed into the camera and the keystoning which resulted was not too objectionable. The present emphasis upon quality makes one look favorably upon the vidicon which completely eliminates keystoning. However, the field lens principle used by the vidicon camera, plus the small size of the mosaic on the vidicon tube, requires that a single optical path be directed into the field lens of the multiplexer. This optical path must be right on axis. Therefore, some slide projectors presently in use must be modified for single lens operation. The RCA TP-3A Slide Projector (dual lens unit) can easily be modified in the field with a single lens kit (MI-26619). In addition the new RCA Professional Projector, Type TP-7 is available for this specific single lens use.

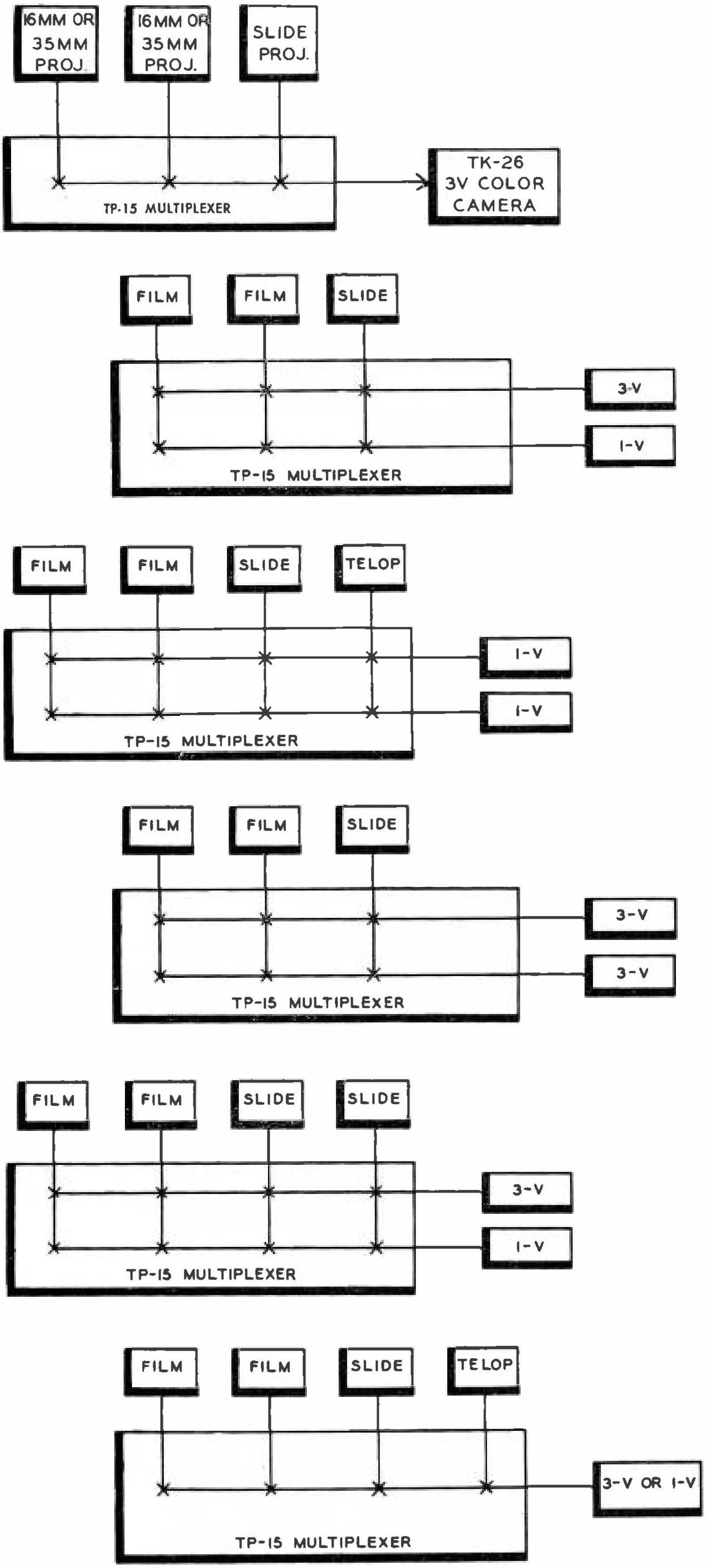


FIG. 3. Functional diagrams showing possible combinations of film cameras, film projectors and slide projectors which can be used with the TP-15 Multiplexer.

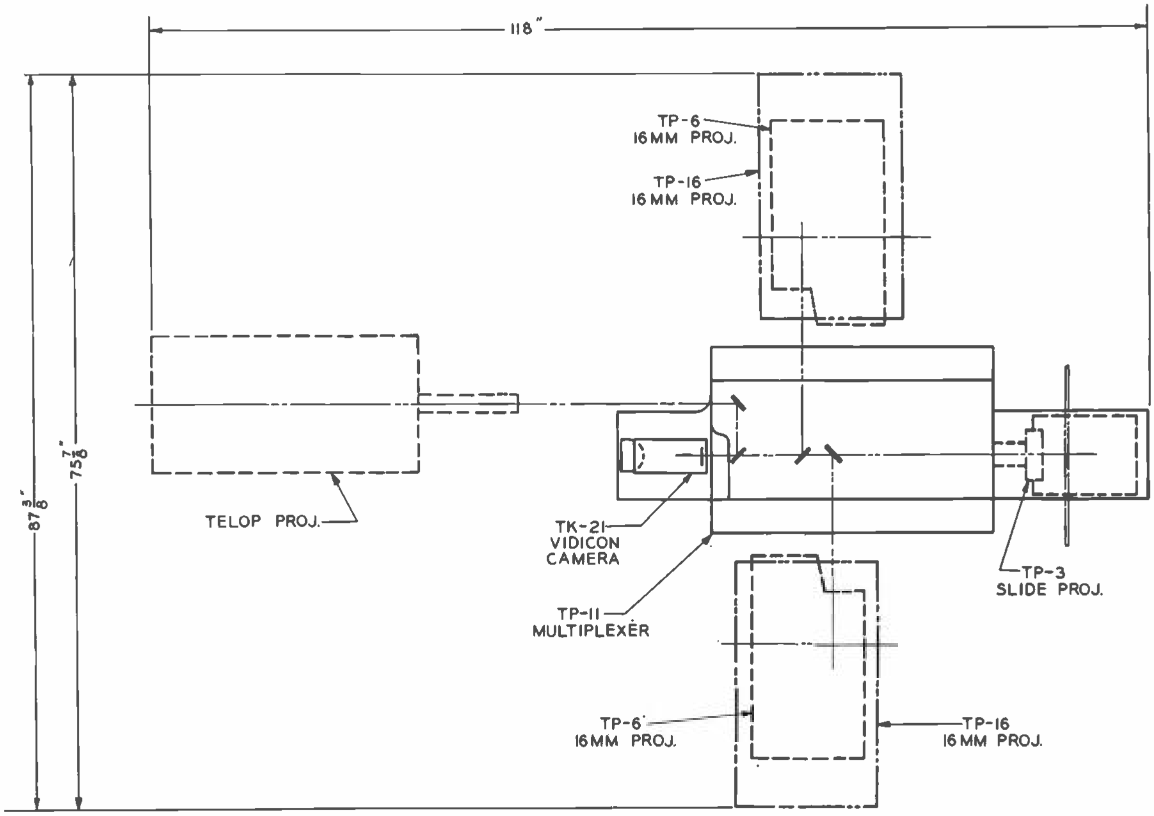
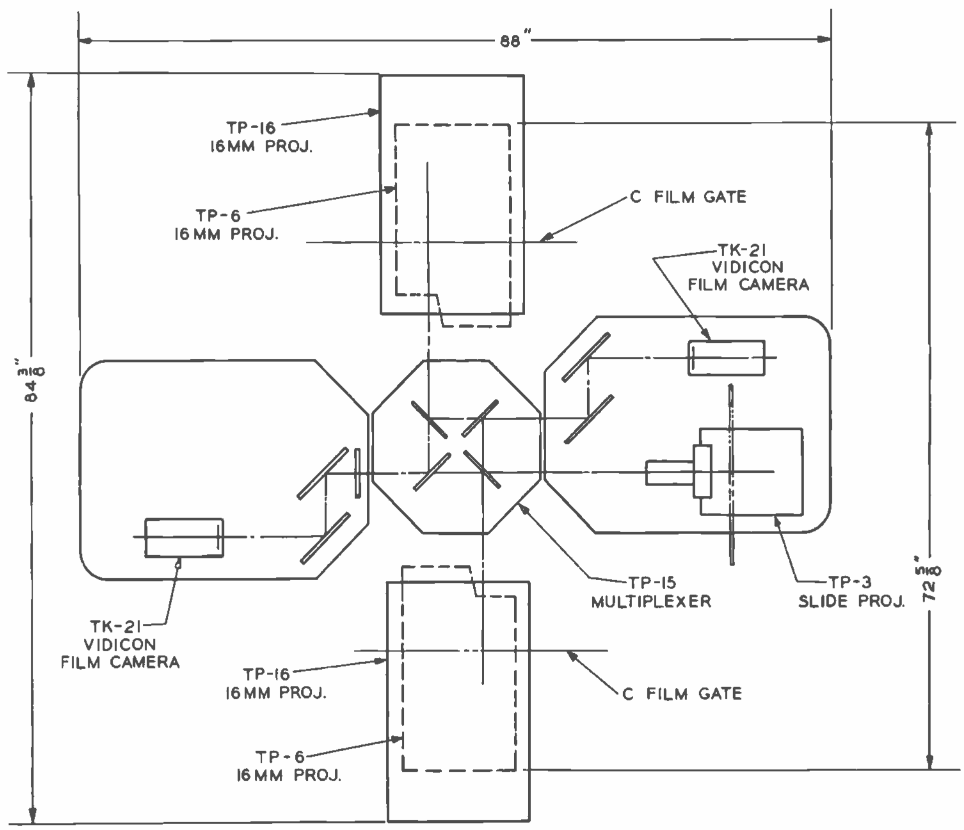


FIG. 4. Layout of typical film system utilizing a TP-11B Multiplexer.

FIG. 5. Layout of a typical film system utilizing a TP-15 Multiplexer.



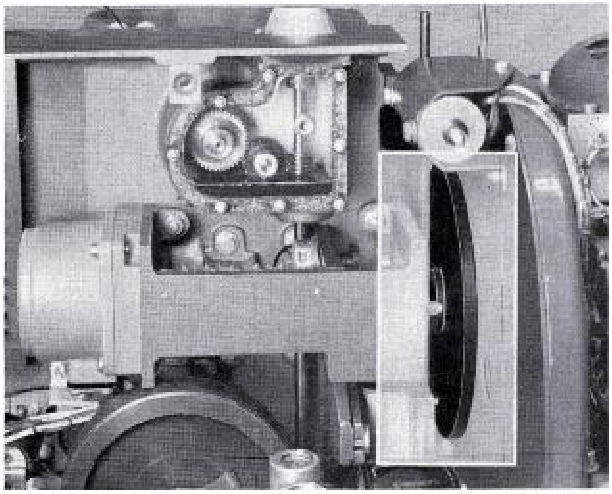


FIG. 6. Variable neutral density disk mounted in a TP-6 Projector.

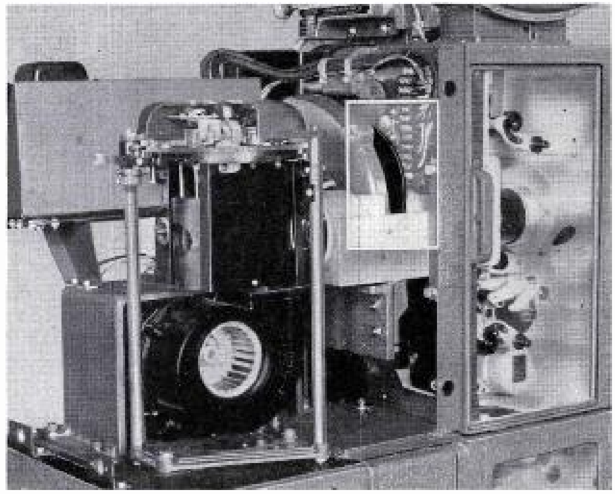


FIG. 7. Variable neutral density disk mounted in a TP-35CC Projector.

Table II

Lens Requirements for TP-15 Multiplexer

1. When *no TP-16 Projectors* are used:
   - For TP-6 Film Projectors—
     - One MI-26799 projector lens (2½" F2.6)
   - For TP-35 Film Projectors—
     - One MI-26806 projector lens (135mm F4.5)
   - For TP-3 Slide Projectors—
     - One MI-26793 projector lens (7½" F4.0)

2. *When *one or more TP-16 Projectors* are used:
   - For TP-6 Film Projectors—
     - One MI-26325 projector lens (3½" F1.5)
   - For TP-16 Film Projectors—
     - One MI-26322 projector lens (3½" F2.6)
   - For TP-35 Film Projectors—
     - One MI-26317 projector lens (6½" F2.7)
   - For TP-3 Slide Projectors—
     - One MI-26809 projector lens (9")

* Since the film reel of a TP-16 Projector extends in front of the projector it becomes necessary when using it with a TP-15 Multiplexer to move the TP-16 farther away from the multiplexer than for other installations. This increases the optical distances and makes it necessary to use an MI-40859-4 field lens. It is also necessary in this case to use different projector lenses for all slide and film projectors used in the system.

The lenses of the film and slide projectors now in use with iconoscope cameras will be satisfactory for use with the TP-11B multiplexer. When a TP-15 multiplexer is used, the projection lenses may have to be changed as outlined in Table II.

Nonsynchronous Operation of Film Projectors

Nonsynchronous operation of the projector with respect to the sync generator is a desirable attribute of a film reproduction chain. Network affiliates find this most desirable for inserting film commercials at station break intervals. Present techniques call for fading to black; dropping the network synchronizing signal; switching to the local sync generator, which is locked to and properly phased with the local AC power supply; and operating the iconoscope film chain conventionally. All of this is essential because the iconoscope must be exposed during the vertical blanking interval. Misphasing or nonsynchronous operation produces the well-known iconoscope application bar whose amplitude may be 10 to 20 times the useful normal video signal. Several synchronous projector drives providing driving power with frequency controlled by the sync generator have had marginal success in solving this problem.

By comparison, vidicon cameras behave beautifully under nonsynchronous projector conditions. With the projector light exposure of 7 per cent of vertical field time (standard iconoscope exposure conditions) the "application pulse" signal is perceptible to a critical viewer, but is not particularly annoying. With longer application time, 30 to 40 per cent, the transition from "light on" to "light off" is not detectable even to the most critical viewer. These long application times also cut down peak illumination requirements. This means that projector lamps can be used at lower voltage and the lamp life can be increased by a factor of 3 or more. Inserts in network programs can be made merely by operating the projector from the local power supply with the local sync generator tied to network through a Genlock or similar device. Both the RCA TP-6 Series Projectors and the RCA TP-16 Series Projectors can be converted to long application by installation of a replacement shutter. For the TP-6

…tion kit is …13422. A long …tock No. 211580, is …-16A to 16E series pro… …d a long application shutter, … No. 211581, for the TP-16F Projector. All are available from the RCA Replacement Parts Department.

Projector Light Control for Varying Film Density

The ideal way to operate a television film system is to set film camera controls for the best possible operating conditions and leave them alone during actual film programming. With iconoscope film cameras this is not possible, because the operator must constantly adjust for flare and noise independent of the varying density of the film. Since vidicon cameras provide fixed black level and a noise-free picture, they can be set for the best possible operating conditions and left that way during film projection. However, some means will be necessary to compensate for the varying amount of light that will be directed on the vidicon tube due to varying film densities. This may be accomplished by using a reactance dimmer on the projection lamp or a variable neutral density disc type light control on the film and slide projectors. The reactance dimmer type of light control is limited to monochrome vidicon applications; the neutral density type light control can be used for monochrome and color vidicon operation.

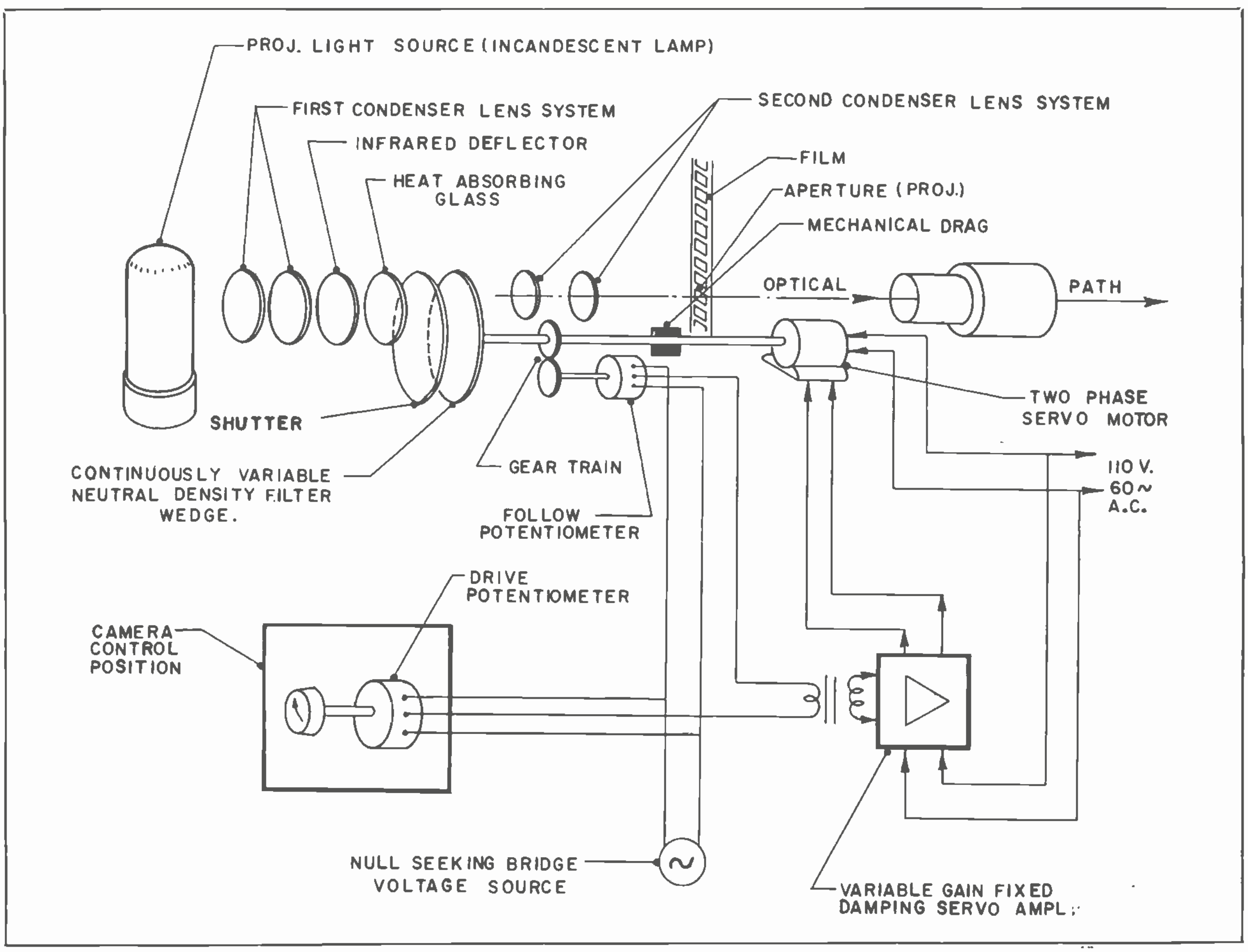
The variable neutral density disc (6 inches in diameter) is mounted in the lens path of the film projectors. (TP-6 and TP-35CC types, see Figs. 6 and 7.) In the case of the slide projector, it is mounted on front. The disc can be controlled from a remote location by a servo motor system using balanced potentiometers, one at the servo motor and disc and the other at the remote location, see Fig. 8. The light control (MI-26595) for the TP-6 series projector and the light control (MI-26798) for the slide projector can also be installed in the field. The reactance dimmer (MI-26795) is available for light control of TP-16 series projectors.

Conclusion

The basic step to improving a station's over-all film quality is to convert to *all vidicon* operation. This also makes it possible to achieve nonsynchronous operation of projectors, with its attendant benefits. Furthermore, the film system controls require far less manipulation in order to compensate for varying film densities.

(Editor's Note: In an endeavor to show how to get technical quality in film operations further articles on selection and operation of equipment will be presented in succeeding issues of BROADCAST NEWS.)

FIG. 8. Functional diagram of projector light control.



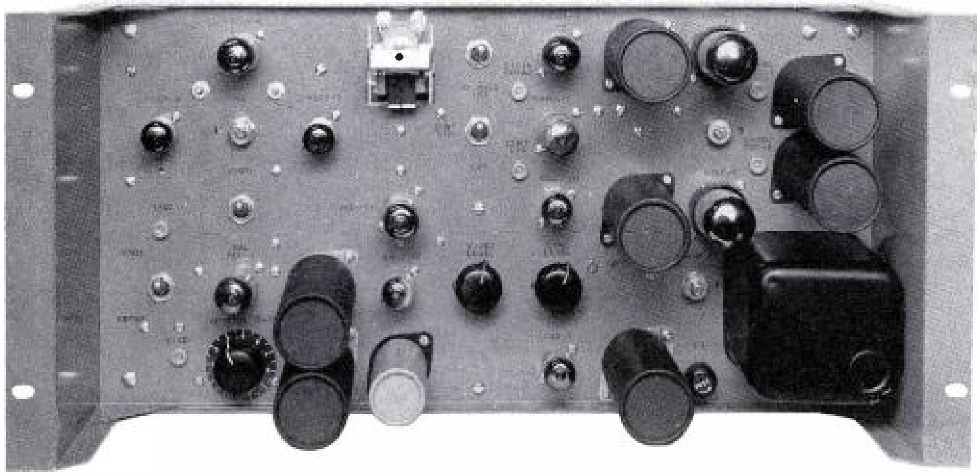


FIG. 1. New Video AGC Amplifier Type TA-21 fills the need for a fast automatic video level correcting device.

AUTOMATIC GAIN CONTROL FOR MONOCHROME VIDEO

New AGC Amplifier is Basically a Variable Gain Device Controlled by a DC Voltage Developed by Rectifying the Peak Video Output Signal

by A. H. TURNER, *TV Terminal Equipment Engineering Group*

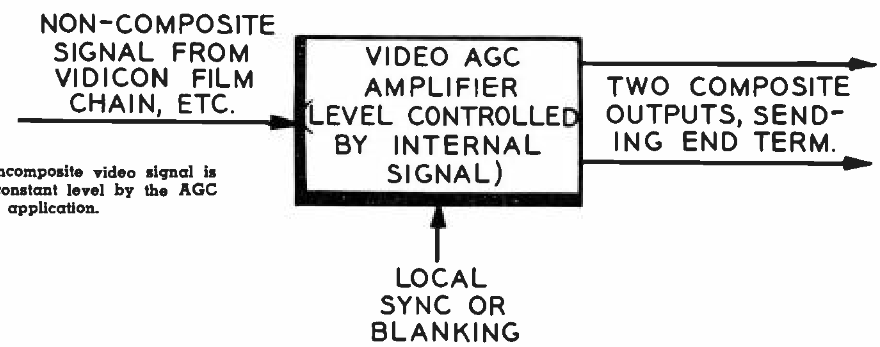


FIG. 2A. A noncomposite video signal is maintained at constant level by the AGC amplifier in this application.

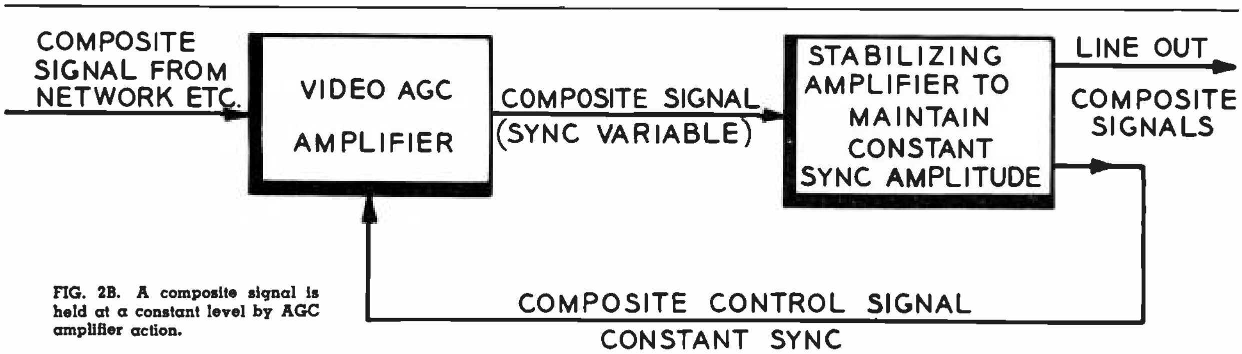


FIG. 2B. A composite signal is held at a constant level by AGC amplifier action.

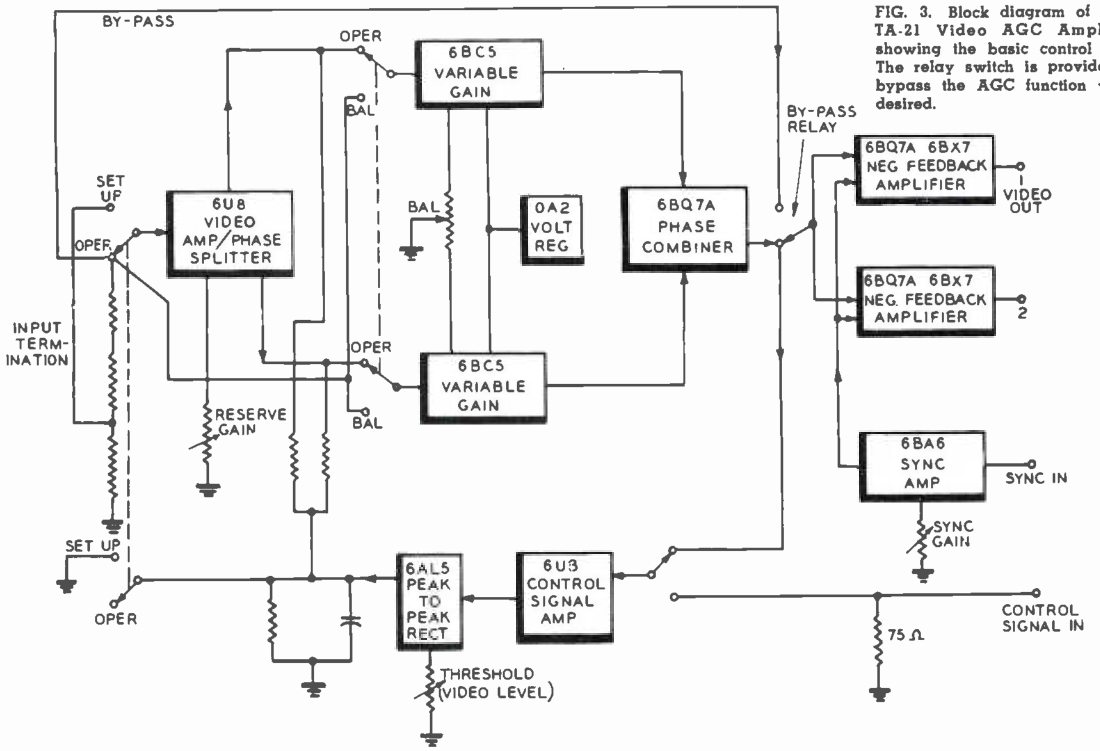


FIG. 3. Block diagram of Type TA-21 Video AGC Amplifier showing the basic control loop. The relay switch is provided to bypass the AGC function when desired.

Most television stations, for one reason or another, are plagued with changes of video level. These changes usually occur suddenly and without warning. Manual correction is not fast enough. To fill the need for a fast automatic level-correcting device, RCA and NBC engineers* have developed the TA-21 Video AGC Amplifier as shown in Fig. 1.

There are at least two general applications for this amplifier and these are illustrated in Fig. 2. In the application shown in Fig. 2A the AGC Amplifier is used to maintain a noncomposite monochrome video signal at constant level.

Composite Video

Figure 2B shows how the AGC Amplifier may be used to maintain a composite signal at a constant level. This signal may be from a network feed where complex switching schedules increase the chances of level jumps despite the care exercised by the telephone companies. An automatic level-setting device is also helpful at a transmitter input to stabilize the modulation level. A stabilizing amplifier, such as the Type TA-5D or modified TA-7B, is used after the AGC Amplifier in this composite signal application to maintain sync amplitude constant. The stab amp output signal with constant sync is fed back into the AGC Amplifier to serve as the level control signal. The AGC Amplifier will then keep the total signal constant which means, of course, that the video portion will remain at constant level also.

Basically, the Type TA-21 AGC Amplifier is a variable gain device controlled by a dc potential obtained by rectifying the total peak-to-peak signal. Considerable engineering development was required to obtain fast control action without introducing overshoot surges. The time interval required for a large pullup in level or a large pulldown in level is approximately 0.3 seconds, which is hardly perceptible to the naked eye. This fast control action does not introduce surges because, as shown on the block diagram of Fig. 3, control is applied simultaneously to two parallel channels carrying video of opposite polarities.

Control Loop

The basic control loop may be traced easily in Fig. 3. For noncomposite signals, the loop remains within the AGC Amplifier and consists of the two variable gain amplifiers, the phase combiner, the control signal amplifier and the peak-to-peak rectifier. When the stab amp is added for composite signals, the control point is switched to the output of the stab amp to include it in the level control loop.

Any AGC system operating from the peak-to-peak signal voltage will brighten low-key scenes if all white area in the picture is absent. In monochrome this occasional shift of the black level is not very serious. But in a color system the brightnesses of the primary colors, which are added to produce white, are all different. Hence, in the absence of white or bright colors in the picture, the AGC will increase the brightness and saturation of the low-key colors such as blue and red. For this reason, the AGC Amplifier is not recommended for color and a convenient relay switch is provided to bypass the AGC function when desired.

AGC Bypass

As shown on Fig. 3, this bypass switch connects the two output amplifiers directly to the input signal. Because these output amplifiers may at times be called upon to carry color, they have been designed to have very low differential gain

* John Schroeder, NBC, New York, Fred Bechly, RCA, Camden and the author.

and phase. The amplifiers are nearly independent, thus providing good isolation between the two output cable feeds. Sync or blanking may be added to the signal in these amplifiers when desired.

The video input termination of the Type TA-21 AGC Amplifier is an accurate voltage divider to permit the operator to make a rapid check of the reserve gain available for signal pullup. As originally wired, the 12-db attenuation point of this voltage divider is connected to the setup switch. However, at the option of the operator, the 6-db point may be used instead. When the amplifier is adjusted for 12 db of reserve gain, the input signal can fall 12 db before the decrease in output signal becomes appreciable. The ouput-versus-input curves for 12 db and 6 db reserve gains are shown in Fig. 4. The signal pulldown range is approximately 12 db and is limited by gradual overload of the first video amplifier which is not in the AGC loop.

The choice of reserve gain is left to the operator because he may prefer one or the other, depending upon his fading technique. Inasmuch as the AGC Amplifier will at first oppose intentional fading of the signal to black, the action of the fading control will be delayed noticeably, especially when using the larger reserve gain.

A switch has been provided to bypass the video phase splitter for a rapid check and adjustment of the balance in the variable gain amplifiers. This balance is not critical and should not need adjustment except when replacing the variable gain tubes.

The over-all frequency response of the AGC Amplifier is flat with 0.5 db to 7 mc. The over-all differential gain error is less than 1.5 per cent at the normal input and output levels of 1 volt.

A First Step Toward Automation

The TA-21 Video AGC Amplifier is the first device in RCA's video product line to provide automatic control of a major function. While the temptation is strong to suggest that the AGC Amplifier can replace a video operator, it is better to say that the TA-21 can be used to help an operator to do a better job. It can free large "blocks" of his time for more interesting and profitable duties than routine level-riding.

The TA-21 is much less complex than the human brain, so its "sense of judgment" is poorer than that of a good human operator. It will stabilize the output level only for a predetermined range of input levels. Also, its output level is to some extent influenced by picture content (low key scenes with very small white areas tend to be increased slightly in level). On the other hand, the AGC Amplifier can respond more rapidly than a human operator, and can operate for extended periods of time without fatigue or carelessness.

This AGC Amplifier is offered, not as a panacea for all the level-setting problems in the television industry, but as a valuable tool for the alert telecaster who is seeking new techniques to reduce the routine burdens of his video operators and to improve the quality of his operation.

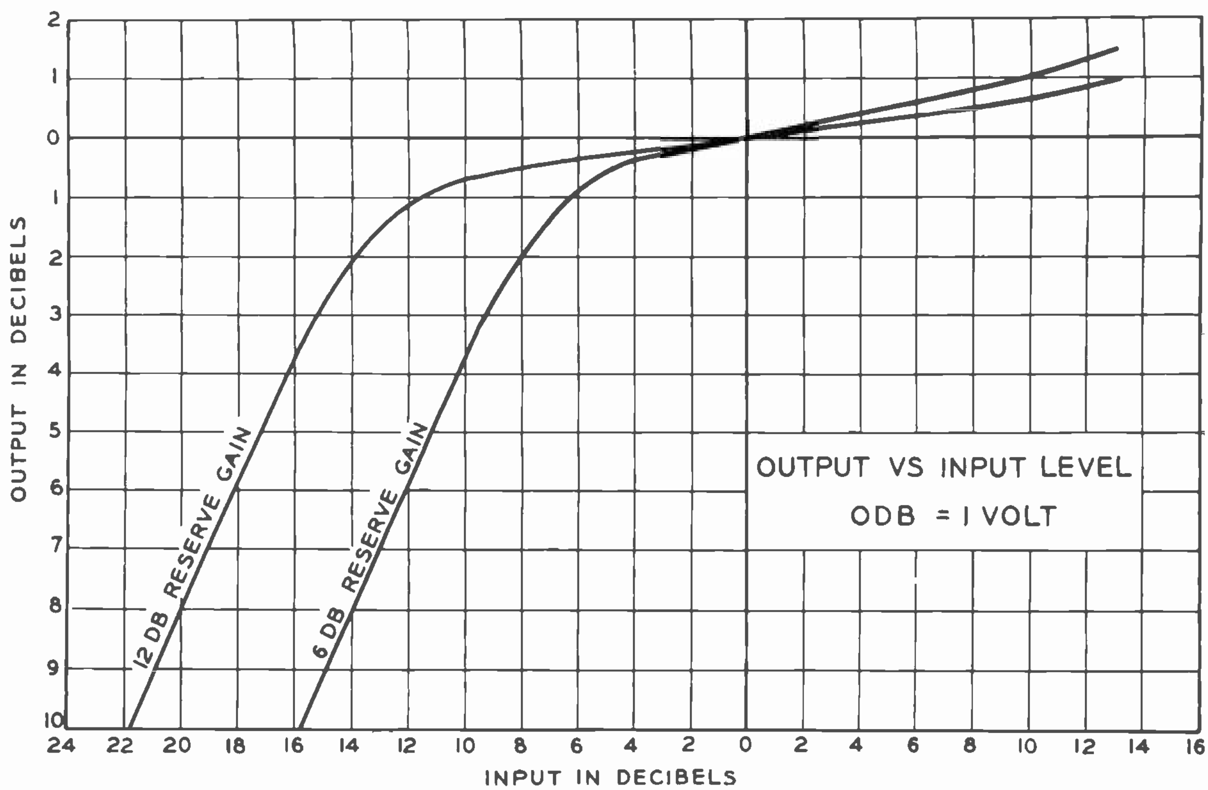
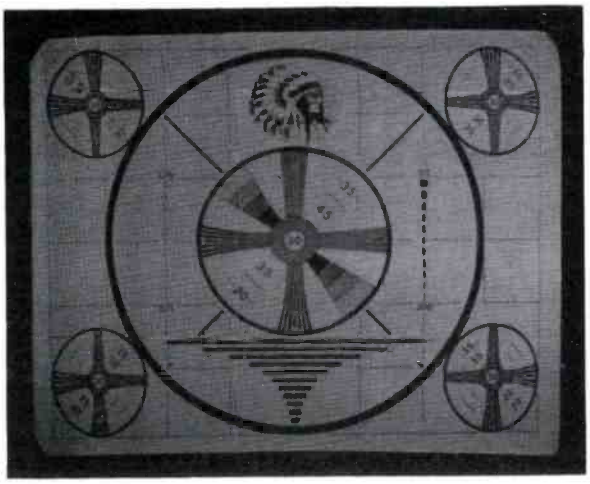


FIG. 4. Output-versus-input curves for 12 db and 6 db gains in the Video AGC Amplifier.

HOW THE VIDEO AGC OPERATES WITH PLUS OR MINUS 12DB VARIATIONS



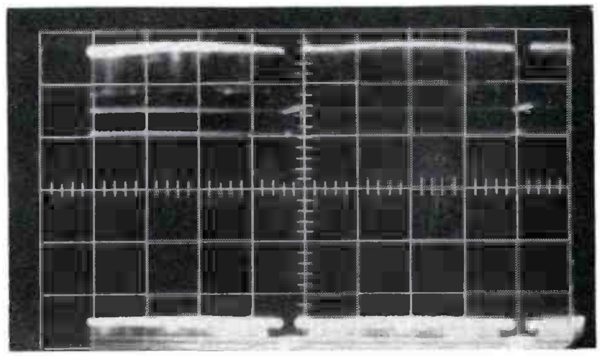
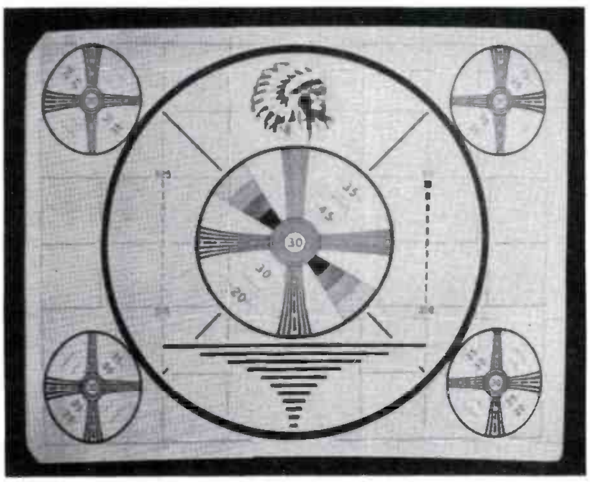


FIG. 5. Test pattern at the left represents a signal which is down 12 db. Input waveform to amplifier at −12 db is shown above as lower waveform on dual-trace scope. Waveform at top represents amplifier output at level of one volt—with each large scale division equal to ½ volt. In this case the amplifier has been adjusted for 12 db of reserve gain.



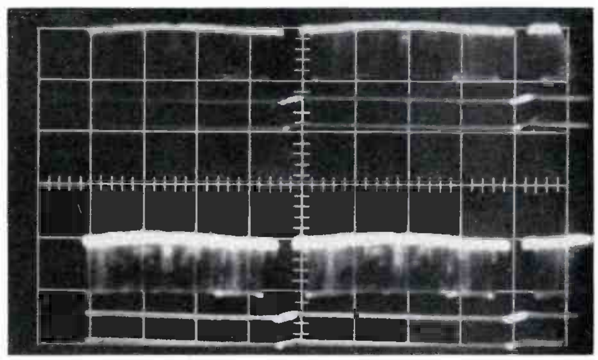
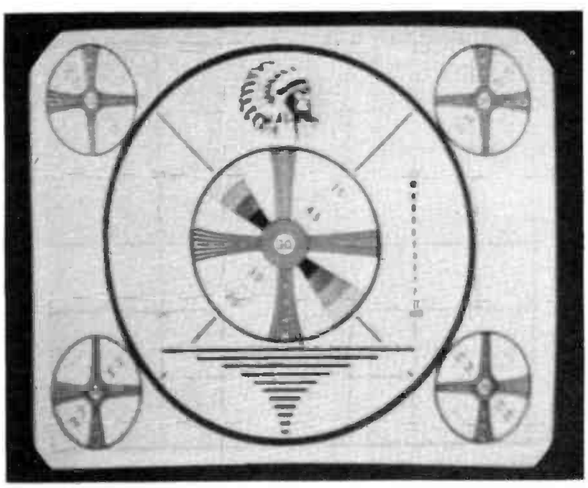


FIG. 6. The monoscope pattern at the left shows a normal one-volt signal at the AGC amplifier unit. Above, input and output waveforms are both at a level of one volt.



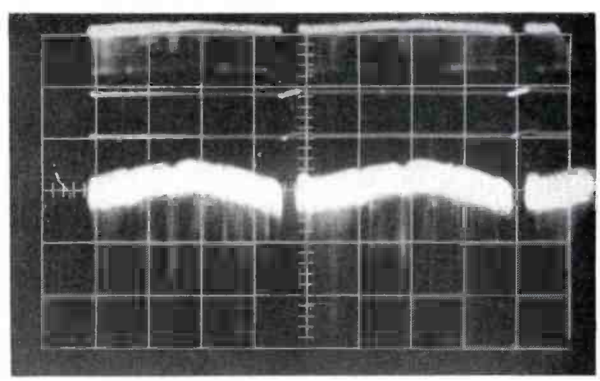


FIG. 7. The AGC amplifier has a signal pulldown range of about 12 db. A signal of +12 db is shown at the left. Above, the lower waveform shows the input signal and the upper waveform shows the one-volt output of the video AGC amplifier.

TEST CHART TRANSPARENCIES SPEED MATCHING OF LIVE TV CAMERAS

Rear Illuminated 8 by 10 Inch Transparencies for Aligning and Matching Both Color and Monochrome Cameras Take Less Time and Give Better Results

by EDWARD P. BERTERO, NBC Engineering Development Group

A test chart transparency system has been developed and put into use at NBC in answer to the pressing need for a simple device to provide the necessary visual test information for the adjustment, alignment and matching of live cameras. We have long felt that the use of opaque test charts, particularly for the evaluation of gray-scale rendition and matching, was inadequate. Our experience with the new system indicates that rear-illuminated transparencies of test charts is a forward step in reducing and controlling some of the time-consuming variables in camera setup procedures.

Matching cameras for color or gray-scale rendition becomes a time-consuming job unless all of the cameras to be used together on the same show are "matched" under identical conditions. The consistent achievement of high quality television pictures requires careful attention to camera alignment procedures. The day-to-day pressures of TV broadcasting, however, tend to limit the time which can be allotted to camera alignment and matching.

Our design objective was a method which would make available to the several cameras being aligned and matched simultaneously, all of the necessary test charts, illuminated to equal light levels by sources of known and reproducible color temperature. Essentially, the method used is to mount photographic transparencies of the standard RETMA test charts and other test material on a large disc so that the selected transparency can be positioned in front of a light box. The illumination level is controllable and the correct value is easily reproducible.

Transparency vs. Opaque

This system makes all of the normally used test charts available to operating personnel in one easily handled stand. One test-chart stand is assigned to each live camera, so that several cameras may be aligned simultaneously. The decision to use rear-illuminated test chart transparencies was prompted by the recognition of several inherent problems associated with the use of opaque test charts, particularly on a day-to-day basis in live television studio setup procedures. The major difficulties with printed opaque test charts are:

(1) Variations in reflectance from equivalent areas of the same chart.

(2) Differences in gray-scale value from chart to chart.

These two problems are inherent in printing processes and in actual studio experience. The second situation is also aggravated by soilage which is the natural result of constant use.

(3) The illumination of test charts under actual studio conditions is difficult to control since many other activities are usually in progress at the same time. For example, lighting adjustments in adjacent areas may cause spill light to reach the test chart. The glossy paper on which the charts are usually printed creates another problem in the form of specular reflections from wrinkles, etc., which produce "hot spots."

Methods Investigated

The development of the present system followed experiments with interim measures, none of which were found wholly satisfactory. Some of the methods investigated are included here to indicate that they were tried and found wanting.

The standard 18 by 24 inch RETMA Resolution Chart was mounted in a shadow box with a carefully arranged system of lights shielded from the camera surrounding the pattern. While this method reduced the illumination problems, it did not overcome the uneven reflectance due to printing irregularities. A further objection to such a method for color use is that several different charts are required for color camera alignment and the handling of several full-sized charts by each cameraman becomes a problem.

Direct projection of 2 by 2 inch slides into the camera from a small slide projector attached to the lens turret was another approach. This method while partially successful in monochrome operations, proved to be inconvenient in color because of the necessity for changing field lenses in the color cameras in order to use the projector. The direct projection method when used for gray-scale slides, suffers from the additional fault that lens flare acts to dilute the gray scale tonal values.

Attempts were also made to rear-project the 2 by 2 inch slides on a screen measuring about 11 by 14 inches. The washing out of the image by ambient light and the loss of resolution due to the scattering inherent in any rear projection process more than offset any advantages of this method.

Preparation of Test Transparencies

In the light of these findings we decided to investigate the possibilities of rear illuminated transparencies for test chart use. The preparation of transparencies of several RETMA test charts and several special NBC transparencies is described below.

The 8 by 10 inch transparencies of the RETMA Registration Chart and the RETMA Resolution Chart were made by direct photography of the 18 by 24 inch RETMA paper originals. Since reflectance measurements made on the paper original

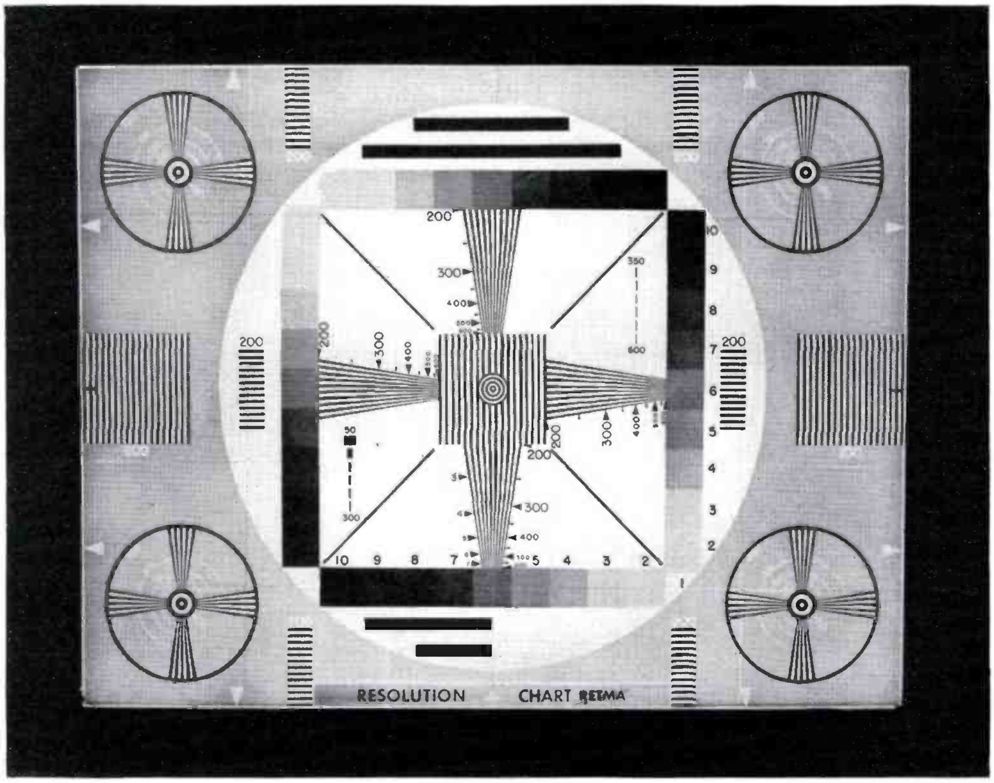


FIG. 1. Rear illuminated RETMA Resolution Chart Transparency used by NBC.

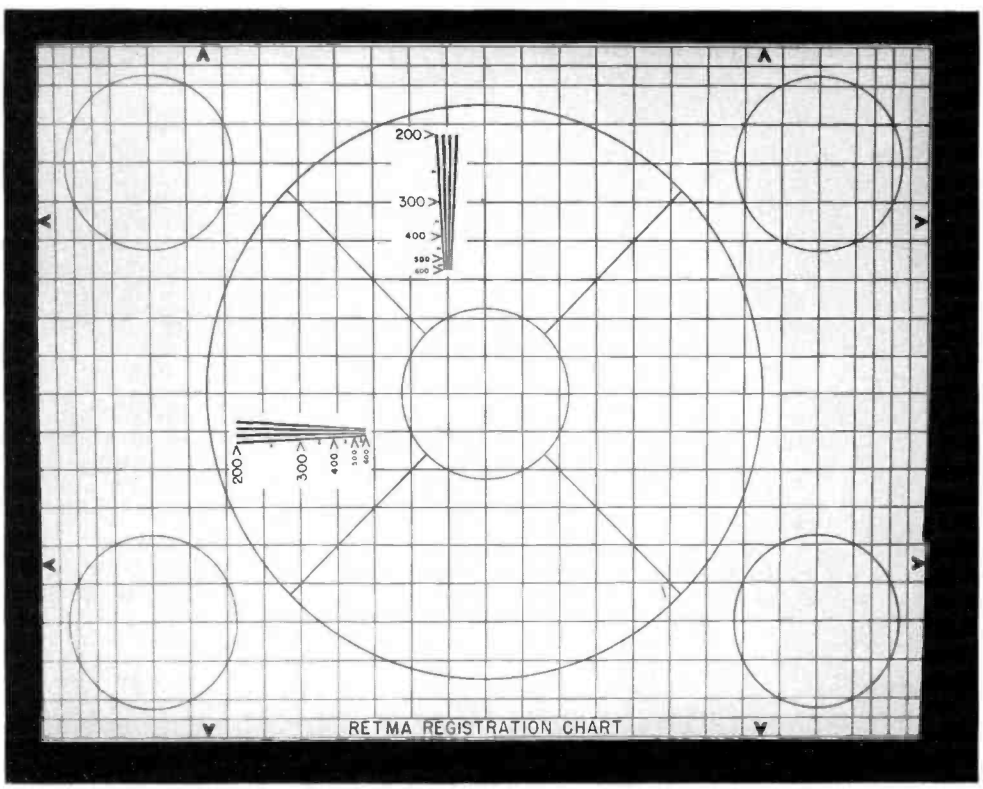


FIG. 2. Specifications for 8 by 10 inch Transparency of RETMA Registration Chart can easily be met by any commercial photographic house.

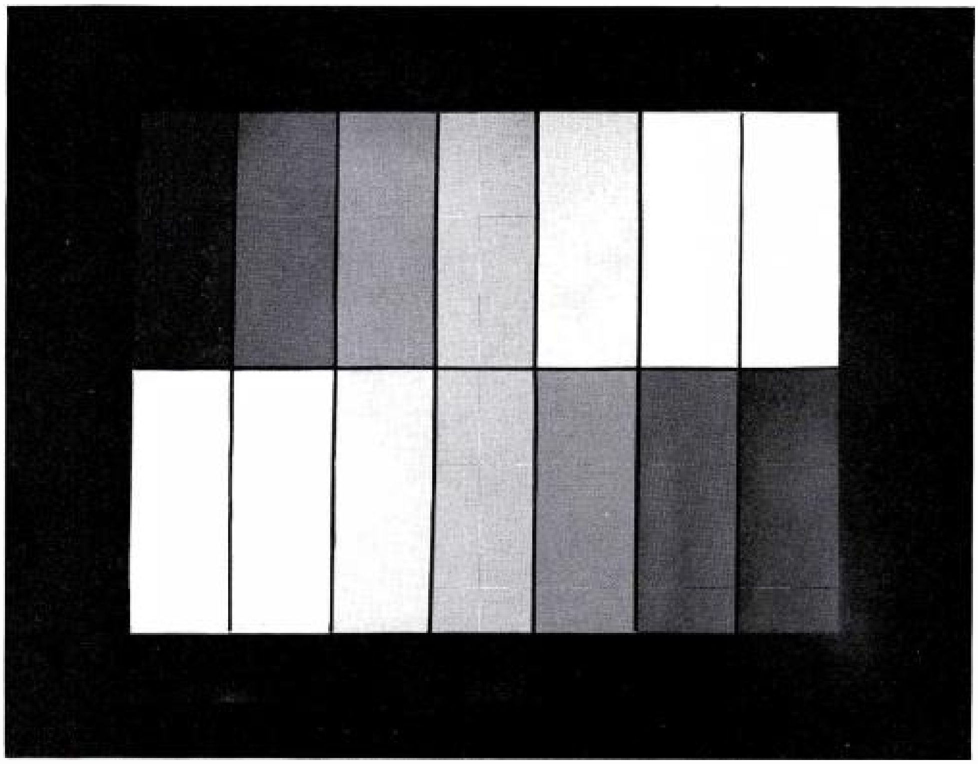


FIG. 3. Diagram at right illustrates composition of the early NBC gray-scale transparency with a gray-scale range of about 20 to 1.

of the resolution chart showed relatively large variations in gray-scale values between similar portions of the same chart, the photographic efforts were directed toward obtaining a high definition print consistent with the best obtainable gray-scale rendition. Our experience indicates that if high resolution film is used the gray-scale values will be badly distorted while fine grain film gives superior gray-scale rendition (at the expense, of course, of some loss of resolution). Hence, we used fine grain film for the resolution chart.

RETMA Resolution Chart

The specifications of the RETMA Resolution Chart Transparency used at NBC and shown in Fig. 1 are as follows:

Film: 8″ x 10″ fine grain positive.

Size: Positive of Test pattern 6 111/128″ x 9 5/32″ (6.86″ x 9.156″) ±1% in each dimension.
Clear border to edge of film.
Reduction ratio when prepared from 18″ x 24″ master 2.621.

Contrast Range[1]: White or clear film 0.2 ±0.05 diffuse transmission density.
Gray background 0.35 ±0.05 diffuse transmission density.
The top black bars 1.5 ±0.05 diffuse transmission density. (Approximately 20-to-1 contrast range.)

Mounting: (1) Two pieces 8″ x 10″ Luster White 0.06″ (nominal) glass, free of striations and free of air bubbles in the test pattern area.
(2) Test pattern must be centered ±1/16″ when mounted in glass. Horizontal line of test pattern must be parallel ±1/64″ with bottom edge of glass. Use ½″ black photographic tape to bind the slide.

[1] These are measurements made on the unmounted film.

RETMA Registration Chart

The 8 by 10 inch transparency (see Fig. 2) of the RETMA Registration Chart (18 by 24 inch) offered no special problem. The specifications easily met by any commercial photographic house are as follows:

Film: 8″ x 10″ film.

Size: Positive of Test pattern 6 111/128″ x 9 5/32″ (6.86″ x 9.156″) ±1% in each dimension, clear border to edge of film. Reduction ratio if prepared from 18″ x 24″ master 2.621.

Contrast Range: White or clear film 0.2 ±0.05 diffuse transmission density.
Black lines 2.00 or higher diffuse transmission density.
Line width 0.0119″ maximum.

Mounting: (1) Two pieces 8″ x 10″ Luster White 0.06″ (nominal) glass, free of striations and air pockets in test pattern area.
(2) Test pattern must be centered ±1/16″ when mounted in glass. Horizontal line of test pattern must be parallel ±1/64″ with bottom edge of glass. Use ½″ black photographic tape to bind the slide.

NBC Logarithmic Transparency Chart

Because it is virtually impossible to make a faithful photographic reproduction of a gray scale by ordinary photographic methods, our first gray-scale transparency was made by butting together pieces of Eastman Kodak neutral density filters. The completed transparency approximated the seven Munsell chips, numbers two to eight, or a gray-scale range of 20 to 1. The early NBC gray-scale transparency is illustrated in Fig. 3.

The color cameras showed a slight shift from neutrality in the green direction with the Eastman Kodak neutral density filter material used, particularly in the denser values. Further investigation confirmed this fact and a search was undertaken for a truly neutral light-attenuating material. Many materials were tried, including a neutral density material formed by metallic deposition on glass. This was rejected because, when used as a rear-illuminated transparency, specular reflections from ambient light almost completely defeated the purpose for which this material was used. The material finally selected for the gray-scale steps is Eastman Kodak "Flashed Density Film" which is available in 8 by 10 inch sheets of uniformly exposed film. Figure 4 illustrates the proposed RETMA 8 by 10 inch Logarithmic Transmission Transparency.

The diffuse transmission density of each of the nine steps which form the Logarithmic transparency are as follows:

Step	1	0.22 (white)
"	2	0.38
"	3	0.55
"	4	0.71
"	5	0.87
"	6	1.03
"	7	1.20
"	8	1.36
"	9	1.52 (black)

Each step measures 2⅜ by ¾ inches. The completed transparency contains eighteen neutral density strips arranged in two horizontal rows. In the top row the No. 9 step is in the upper left hand position and the No. 1 step in the upper right. The lower row is the reverse, starting with the No. 1 step in the lower left position and ending with the No. 9 step. The two rows form a rectangle 6¾ by 4¾ inches, which is fitted into a rectangular cutout centrally located in an 8 by 10 inch sheet of Eastman Kodak Flashed Density Film which has a diffuse transmission density of 1.0. This assembly is mounted and bound in the same manner as indicated for the other transparencies.

RETMA Action

The detailed results of NBC's efforts in making the transparencies have been made available to the RETMA Committee TR 4.4.2, of which the author is a working group chairman. This committee also explored some of the knotty photographic problems inherent in the preparation of transparencies which must meet rather rigid specifications of gray-scale values. Dr. J. H. Ladd of the Eastman Kodak Company, who is a member of this committee, has agreed to help in the preparation of the RETMA Logarithmic Diffuse Transmission Gray Scale Transparency. It is expected that the RETMA will have transparencies of these Resolution, Registration and Logarithmic Reflectance Charts available for the broadcaster in the not too distant future.

Light Source

The light source for use in the NBC test chart system was designed to meet the following specifications:

(1) Aperture should be 8″ x 10″.

(2) Illumination to be as uniform and diffuse as possible.

(3) Brightness value[2] selected was a minimum of 600 ft lamberts.

(4) Color temperature was specified as 3000° K.

[2] The value of brightness was chosen to approximate the equivalent brightness of an opaque test chart under average color studio illumination levels.

A light source which meets the above specifications was constructed. The enclosure is an open-ended box, 12 by 12 by 15 inches. Interior surfaces are coated with a flat titanium paint. The actual source of illumination consists of five 60-watt "white" 120-volt lamps, mounted on a plate facing an 8 by 10 inch aperture. These lamps are connected in parallel with an ammeter in series with the group. An auto-transformer is used to adjust the current to a prescribed value, nominally 2.52 amperes.

The 8 by 10 inch aperture is covered with a sheet of Plexiglass No. W2447 Type A, which acts as a diffuser. A sheet of Eastman Kodak Wratten Filter No. 82C is used in conjunction with the Plexiglass diffuser, to raise the color temperature of the illumination source. The initial brightness setting is made by adjusting the position of the light source relative to the

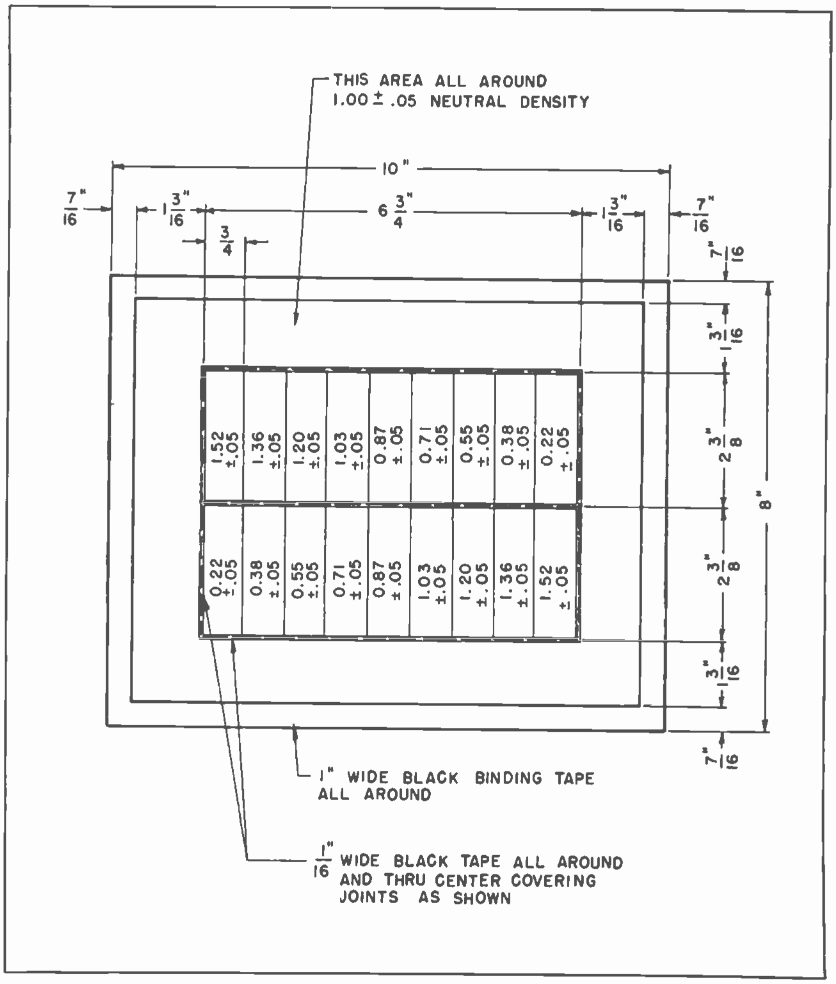


FIG. 4. Proposed RETMA 8 by 10 inch Logarithmic Transmission Transparency.

aperture. Uniformity of illumination can be held to within 5 percent at 600 ft lamberts, the value chosen for our use. A 100 cfm blower is used to cool the assembly and is mounted so that the air is directed toward both the aperture and the light source.

Test Chart Stand

The 8 by 10 inch transparencies are mounted on a disc of Masonite, three feet in diameter. There are five slide apertures, one of which is blank so that the uniformly lighted diffuser can be used as a source of illumination for use in eliminating the effects of burns on a "sticking camera." The other four positions contain the RETMA Resolution Chart Transparency, the RETMA Registration Chart Transparency, an NBC Gray-Scale Transparency and an NBC Color-Bar Transparency or other color test material.

The Masonite disc is mounted on the stand so that the center of the selected transparency is about four feet from the floor. A detent is provided to lock the selected transparency in position. A Masonite cover is fixed in position, while the upper half is hinged in such a way that it may be used as a canopy to shield the transparency in use from ambient light. The stands are equipped with an extension cord and a general utility outlet. These stands may be interconnected so that only the last stand need be plugged into the house current. Figures 5 and 6 show front and rear views respectively of the test chart stand.

Use of Test Transparencies

The use of the television test transparency assemblies is simple. They are meant to replace the old test charts and "gamma test stands" and are used in the same manner; that is, each monochrome or color camera is supplied a transparency assembly for alignment purposes.

Current in each light source is adjusted to read 2.52 amperes for proper color temperature. The brightness of the light source is initially adjusted to be 600 ft lamberts. As the bulbs age and dust accumulates in the enclosure, the brightness may go down slightly. Test transparency assemblies should all be kept at the same brightness.

Having determined a stand which is satisfactory, the other stands can be made to have the same brightness by placing a foot candle meter at the aperture of the acceptable stand and observing the meter reading. The light meter reading of the other test stands in the same area of the aperture should be made equal by positioning the plate on which the lamps are mounted. If a brightness meter is available it should be used since absolute readings are more desirable.

Maintenance

These television test pattern transparencies require only a nominal amount of maintenance. Lamps are operated well below rated voltage and should give long life. The blower may deposit some dust in the light source enclosure reducing the illumination level. Therefore, periodic inspection and cleaning is recommended. Since slides need not be handled, they should require no special attention. Once installed, the slides occasionally may require a light brushing to remove dust which may adhere to the glass due to a static charge.

Color Camera Matching

The 8 by 10 inch transparencies of the Resolution, Registration and Logarithmic Diffuse Transmission Gray Scale Charts are used in the adjustment and alignment of color cameras. These charts permit the adjustment and evaluation of the resolution, registration and transfer characteristics of the image orthicon tubes and the adjustment of the gamma control circuits.

Vectorscope presentation of a color-bar signal has become one of the more powerful tools in evaluating color performance. While there are many valuable tests and adjustments which can be made with electronically generated color-bar signals, none of these tests include the camera optical system nor the effects of image orthicon adjustments. To provide an over-all check of color camera performance, we prepared a Color Bar Test Chart Transparency which combines a set of color bars and a gray scale arranged in two horizontal rows with the color bars on top and the gray scale on the bottom. This arrangement gives a convenient check of the over-all performance of the color camera.

The NBC Color Bar Transparency (shown in Fig. 7) is made of pieces of Eastman Kodak Wratten filters in the values listed in Table I. The gray scale section of this transparency consists of Eastman Kodak Flashed Density Film of the values shown.

The entire gray scale has an overlay of an Eastman Kodak Flashed Density material of the value 0.3. This was used to adjust the brightness value of the gray scale to conform to the brightness component of the color bars as seen by a properly adjusted color camera.

FIG. 5. Front view of television test chart transparency stand developed at NBC.

TABLE I.
Gray Scale Section Color Bar Values

EK Flashed Density Film (Neutral Density Filters)	
Step 1.........	0.0
Step 2.........	0.1
Step 3.........	0.2
Step 4.........	0.4
Step 5.........	0.7
Step 6.........	1.3

Causes of Color Camera Mismatch

Some of the causes of color mismatch which we have encountered in our tests are:

(1) Inequality of objective lenses due to difference in the low reflectance coating.

(2) Differences in the settings of the gamma amplifiers.

(3) Improperly adjusted colorplexers.[3]

(4) Difference in black level settings between cameras.

(5) Difference in shading correction between cameras.

[3] In color operation, it is standard practice to use a colorplexer with each camera chain.

FIG. 6. Test chart transparency stand (rear view) shows lamp housing, auto-transformer and ammeter.

Any shifting of the vectorscope presentation of the color-bar signal while switching between cameras trained on color-bar transparencies is indicative of a mismatch.

Skin Tones in Color

Many of us in color television have come to regard the reproduction of suitable skin tones as the stamp of approval for color performance. Capturing the elusive quality of skin tones, with any color system, both real and imagined, places the colorimetrist at the mercy of many subtle variables not easily explained nor controlled. In fact, a live model has frequently been used for the so-called "skin-tone test." The positioning of three or more color cameras so that each one can "see" the model under identical conditions is extremely difficult. Slight differences in camera angles and lighting are sufficient to change the skin-tone values to a noticeable degree.

In an attempt to eliminate one more elusive variable, a "skin-tone" transparency has been prepared. A group of 8 by 10 inch Ektrachrome transparencies were exposed from the same batch of film with each shot taken in quick succession, using a live model as the subject. The exposed film was all processed at the same time and the resulting transparencies were later hand selected for acceptable "match." These transparencies have been used for skin-tone matching and the results have proven quite satisfactory.

Conclusion

Although the test chart transparency system has been in use at NBC for a relatively short period of time, our experience indicates it to be a forward step in reducing and controlling some of the time-consuming variables in camera setup procedures. Work is continuing on reproducing processes which will make the charts available in quantities in the not too distant future. The operating group which uses these tools on a day-to-day basis has reported that the camera-alignment time, particularly in color, has been shortened and what is more important, the results have been better and more consistent.

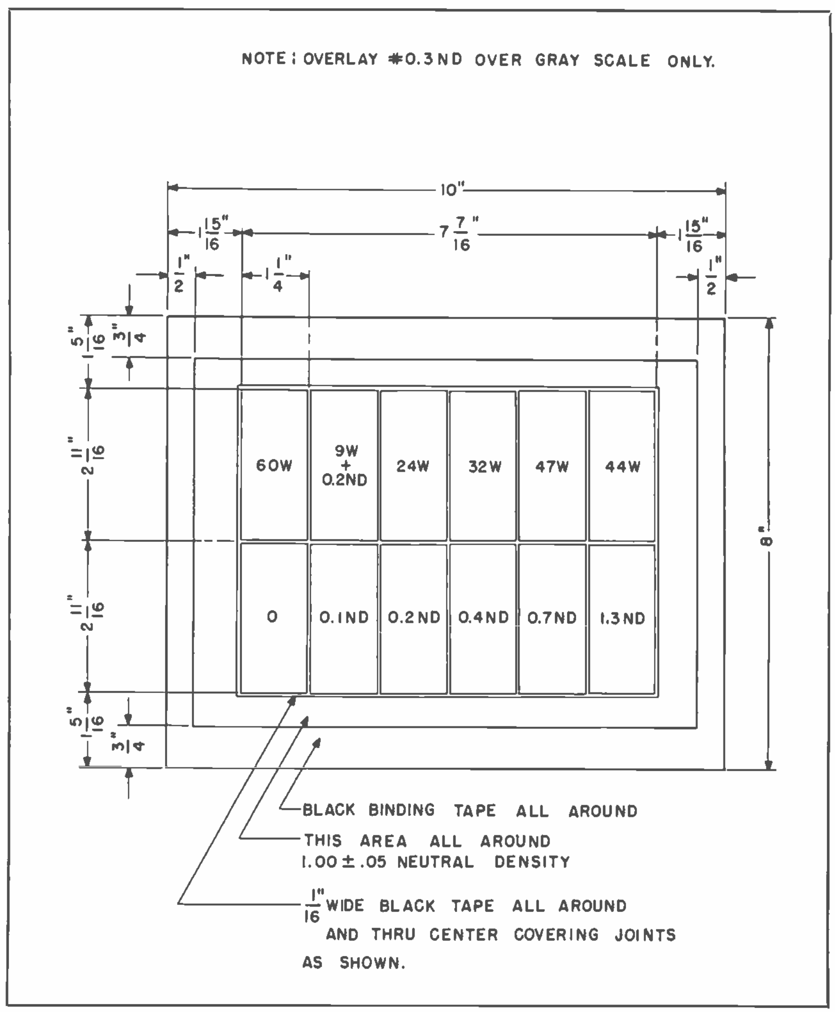
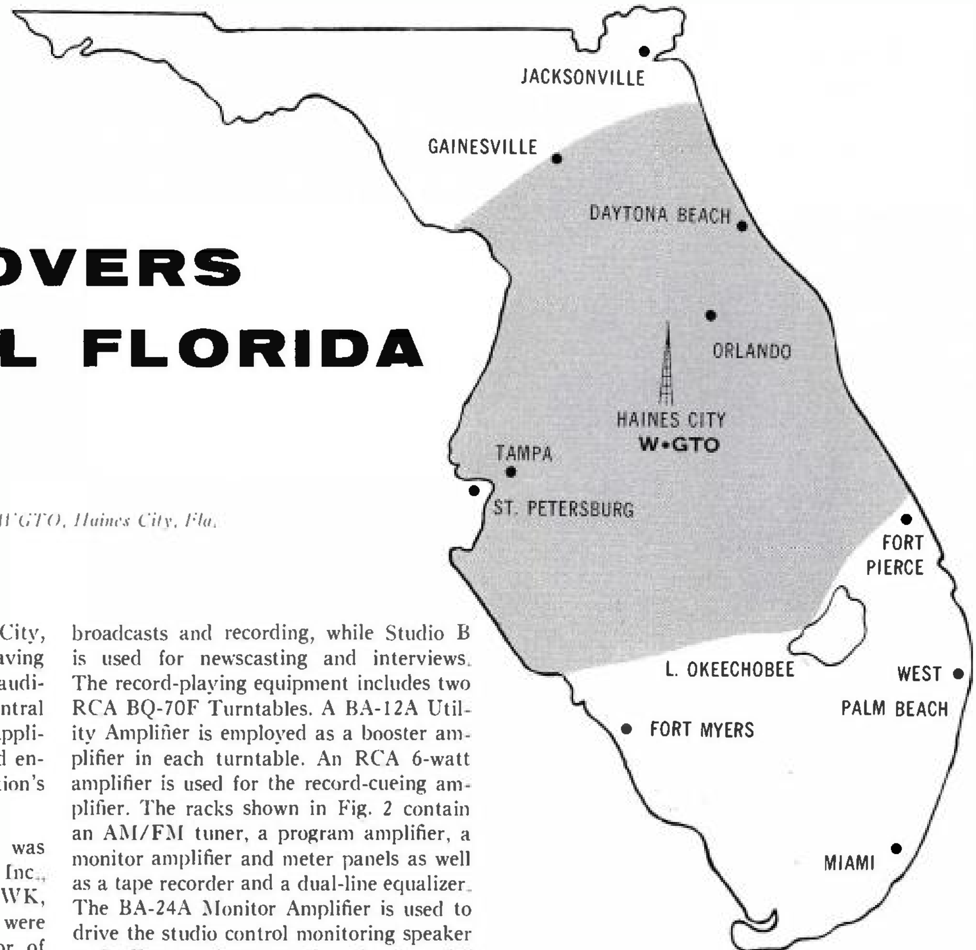


FIG. 7. NBC Color Bar Transparency is made up of pieces of Eastman Kodak Wratten filters.

WGTO COVERS CENTRAL FLORIDA



by *DAVID H. SCHICK*, *Chief Engineer, WGTO, Haines City, Fla.*

Radio station WGTO in Haines City, Florida is a relatively new voice, having gone on the air September, 1955. Its audience is growing as rapidly as the Central Florida area in which it is located. Application of proved program concepts and engineering practices account for the station's rapid build-up.

The idea behind this radio station was conceived by the operators of KWK, Inc., St. Louis (WGTO is also owned by KWK, Inc.). Preliminary surveys and studies were made by Vice-President and Director of Operations, Roy E. Dady, who with President Robert T. Convey and Vice-President V. E. Carmichael, supervised the WGTO program concept from the very beginning. Studio and transmitter planning, and the actual installation of these facilities were supervised "on the site" by KWK Chief Engineer, Nick Zehr—applying the same sound engineering practices he used at KWK.

WGTO is located in the center of a group of metropolitan areas as contrasted to the more usual establishment of a station in a principal city of its own. Its coverage, on 540 kc, encompasses such major cities as Gainesville, Daytona Beach, Orlando, Lakeland, Tampa, Clearwater and St. Petersburg. This area, covering the more populous sections of Central Florida, extends from Gainesville to Okeechobee and from Gulf to Ocean—hence the call letters WGTO.

Studio Facilities

The studios are located in the Palm Crest Hotel in Haines City, Florida. See floor plan layout in Fig. 1. An RCA BC-2B Consolette is used on the control room operating desk in a two-studio arrangement. Studio A is used for group live broadcasts and recording, while Studio B is used for newscasting and interviews. The record-playing equipment includes two RCA BQ-70F Turntables. A BA-12A Utility Amplifier is employed as a booster amplifier in each turntable. An RCA 6-watt amplifier is used for the record-cueing amplifier. The racks shown in Fig. 2 contain an AM/FM tuner, a program amplifier, a monitor amplifier and meter panels as well as a tape recorder and a dual-line equalizer. The BA-24A Monitor Amplifier is used to drive the studio control monitoring speaker and office speakers carrying the "on air" signal. The BA-23A Program Amplifier is

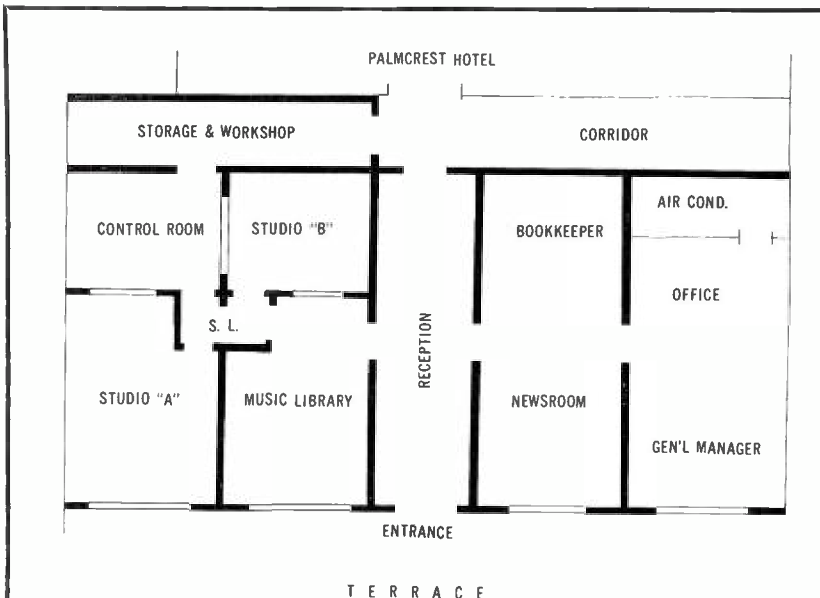


FIG. 1. Floor plan showing layout of WGTO studios.

used as a utility line amplifier. An AM/FM receiver provides the "off-the-air" signal.

Two utility lines in addition to microphone lines are run to jacks in each studio so that other equipment, such as tape recorders, can be patched into the jack field. A microphone line and signaling circuit are also run to the newsroom, so that bulletins can be aired as soon as they come over the wire—if a big news story breaks. This arrangement of equipment and flexibility of circuits in the jack field allows the DJ to achieve smooth "on-air" operation.

Automatic Announcer Timer

Many announcers, particularly personality disc jockeys, have a tendency to overexpose their listeners to their high-powered salesmanship. WGTO programmers have long been aware of this shortcoming and the effect it has on the listeners. Our air men have constantly been cautioned about keeping proper balance between chatter and platter at WGTO—a one-to-three ratio is usually maintained.

To be doubly sure the talk cuts off on time, our engineering department developed a foolproof signaling device to indicate to the announcer that his time is up. The "announcer timer" automatically goes into operation when the mike switch is thrown. After an adjustable interval (at the present time, 1 minute and 45 seconds) a brilliant light flashes, warning that "time's up." It has been designed so that it will reset itself only after the microphone has been off for ten seconds (Fig. 3).

Program Concept

Two basic fundamentals of good production, namely balance and pacing, are observed when scheduling records from the categories shown in the WGTO basic format. The station discourages all interviews on DJ programs unless the interviewee is an outstanding personality in the music world. If an interview is scheduled, we feel that it should never exceed five minutes in length. All records are auditioned for quality of sound and lyrics before they are entered into the file. When it becomes

FIG. 2. Studio control room illustrates compact arrangement of technical facilities which is typical of station's sound engineering practices.

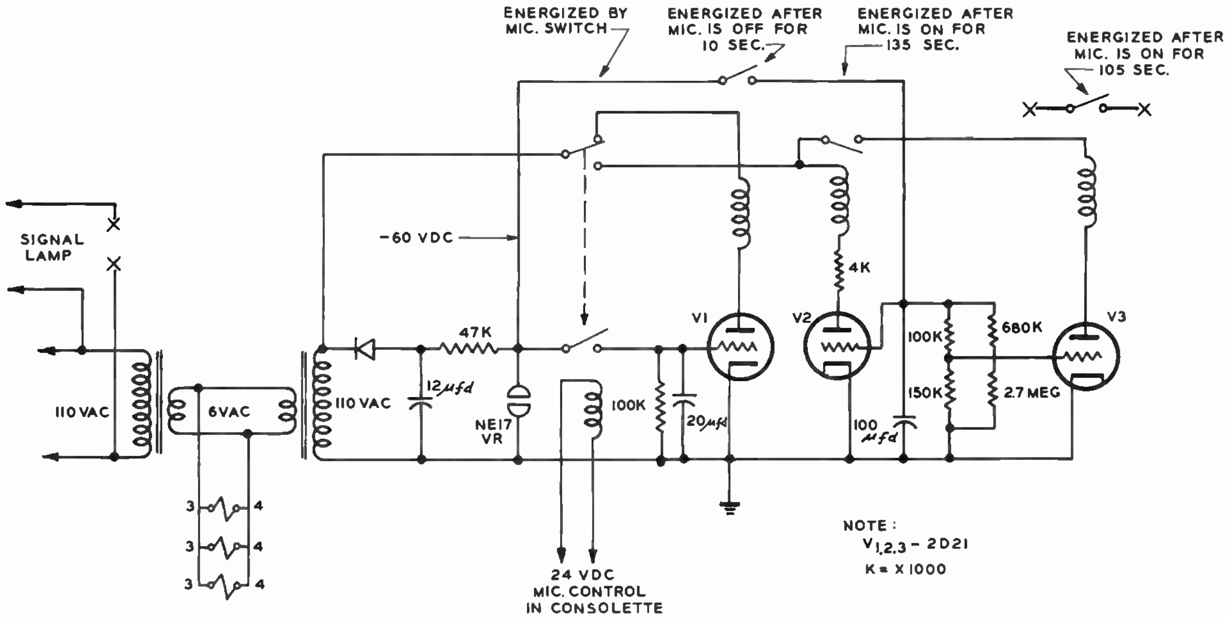


FIG. 3. Schematic diagram of automatic announcer timer used to limit announcing time at WGTO. The announcer timer is keyed when the microphone switch is thrown.

FIG. 4. Complete announcer timer is shown just to the right of the BC-2B Consolette. A brilliant light flashes, warning the announcer that his time is up.

apparent that a record will become very popular, eight or ten additional records are normally ordered and kept on hand in order to present quality-sounding music at all times.

Basic Format for Disc-Jockey Shows

The basic format for WGTO is a one-hour show. For this, a total of fifteen records seems desirable. If the program is more than an hour, the same ratio is maintained.

The recommended "balance" of recorded material for a one-hour show is as follows:

(A) One current First-Five record.

(B) One current Six-to-Ten record.

(C) Four First-Five revue records (if additional records are needed, they should be drawn from this category).

(D) Six standards.

DJ Programming Guide

The following DJ Programming Guide describes the foregoing record categories in detail:

(A)—*Current First-Five Records*—The current First-Five records are the records that have been derived from a daily record poll, from reports we receive from leading record outlets. In scheduling these recordings on disc-jockey programs, a constant cross-check is made on contiguous programs. If First-Five selections Nos. 2 and 4 are used on a one-hour program, selections 1 and 3 are scheduled on the following program. If the two contiguous programs are long enough to require the scheduling of more than two current First-Five records on each program, we allow at least a 30-minute interlude between the presentation of the same recording on both shows.

(B)—*Current Six-to-Ten Records*—In compiling the results of the First-Five poll, additional records show up as the Six-to-Ten most sold. These are often records coming up into the First-Five or records that have been on the First-Five that are losing their popularity. The same rules regarding the scheduling of the First-Five records apply to this category. A tune losing popularity after it slips past fifth place is "retired" for six months unless it regains a position in the First-Five.

(C)—*First-Five Revue Records*—For the past eight years we have maintained a file of the daily First-Five poll. These records are drawn from this file.

(D)—*Standards*—The standard file consists of alltime hits by the recording artists who made the hit recordings. We believe that if a standard tune cannot be associated with one main artist, every effort should be made to use the most prominent recording artists in scheduling it.

The WGTO Basic Format for Disc Jockey Shows includes six "Standards" to be used in the basic format for a one-hour show. This category, "Standards" should include hit songs that probably would have appeared on the First-Five poll—if we had been conducting a poll when the recordings were first released.

WGTO Transmitter

The transmitter site is located on a cattle ranch 6.4 miles west-northwest of Haines City, Florida. The transmitter building is of concrete-block construction with an industrial type built-up roof. The building includes the transmitter room and workshop. It is air-conditioned for the comfort of the personnel in the summertime and a 10-kw electric heater is provided for the colder weather. A smaller structure close by, houses the well-water pump and also provides storage space.

The transmitter is an RCA BTA-10H 10-kw unit with an adjacent phasing cabinet to match the output to the two towers. The hot exhaust air from the transmitter is caught by duct work installed on top of the transmitter cabinets and expelled by a

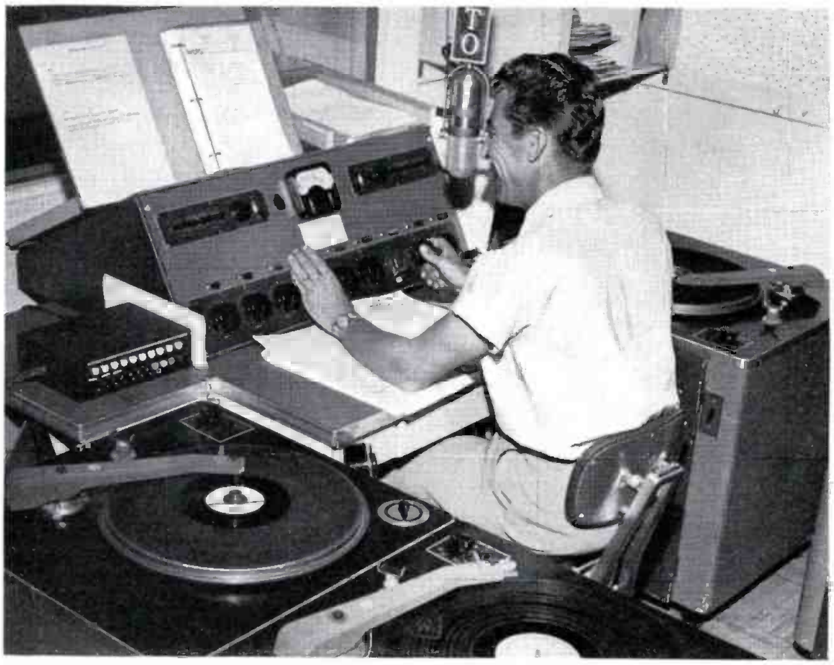


FIG. 5. Close-up view of studio control room BC-2B Consolette and turntables. A BA-12A Utility Amplifier is used as a booster amplifier in each turntable.

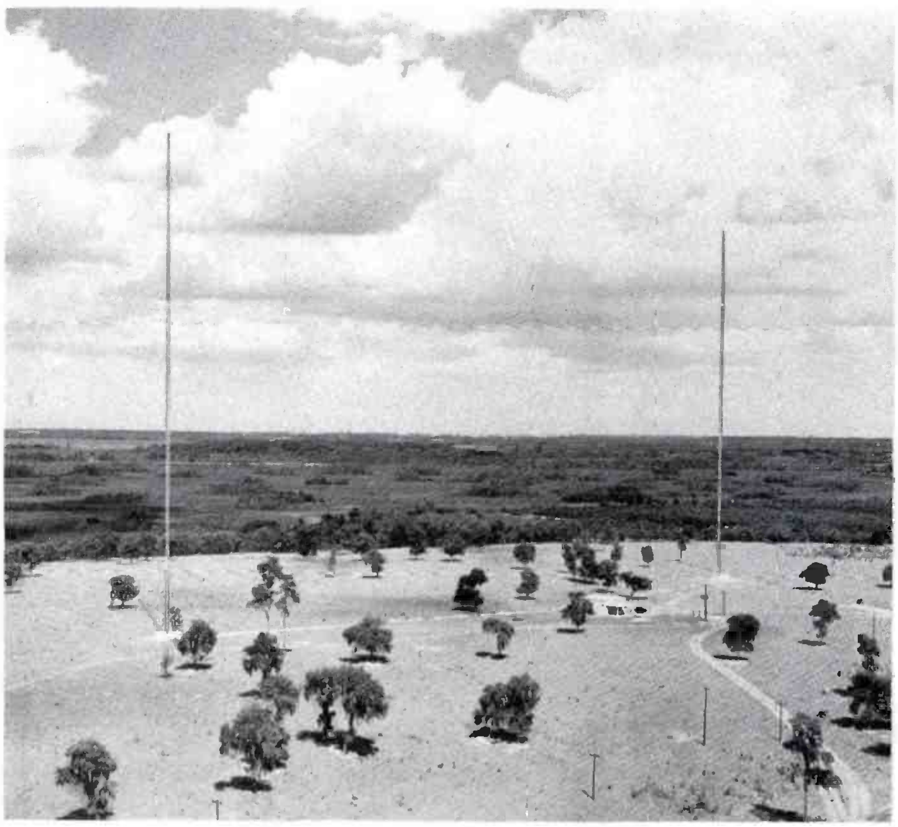


FIG. 6. Two-tower antenna array at WGTO is situated on a cattle ranch about 6.4 miles from Haines City, Florida.

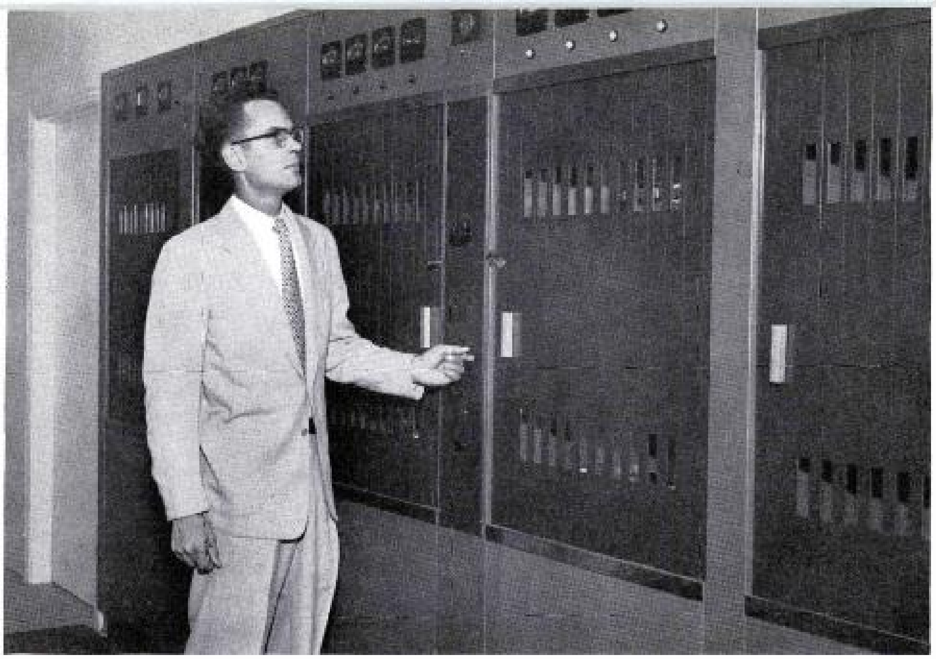


FIG. 7. The author is shown at the BTA-10H 10-KW Transmitter. An adjacent phasing cabinet matches the output of the two towers in the array.

belt-driven fan mounted in an opening in an outside wall.

The transmitter control desk position has facilities such as a remote amplifier, tape recorder and turntable. This equipment is used to record off the air and also to feed a signal to the transmitter in case of program line failure from the studio or for testing purposes during routine maintenance procedures at station WGTO.

FIG. 8. Transmitter control desk contains facilities for off-air recording. Monitoring equipment is mounted in the two racks at the left of the control desk.

The RCA monitoring and audio equipment, shown in Fig. 8, are mounted in a double rack to the left of the transmitter. These contain monitoring and limiting amplifiers, Conelrad equipment, a modulation monitor as well as phase and frequency metering facilities.

Conelrad Operation

An automatic Conelrad transmitter control puts the transmitter through a complete Conelrad test alert transmission cycle at the push of a button and then resets itself for the next cycle.

A push-button switch on the desk turns the carrier off momentarily in case of an arc at the base of the tower. Another push-button switch feeds the audio oscillator tone to the transmitter for manual control of the Conelrad test alert signal. The automatic Conelrad transmitter control can be also triggered by a push-button switch on the transmitter control desk.

Transmission Lines and Antenna System

Transmission lines are run parallel from the phasing cabinet through the back wall of the building and down into a pit where they feed their respective towers through 8-inch tile pipe buried 12 inches below the surface. Advantages of using tile pipe are that the transmission line is protected from the weather and also from cattle which graze on the antenna field. At 20-foot intervals, where a flange joint occurs in the transmission line, the tile is split horizontally so that the top is removable and the joint accessible (see Fig. 10).

When the tile pipe was buried, a concrete marker was placed flush with the surface of the ground above each split tile to indicate its position. The lines running through this pipe include: 1⅝-inch transmission line, ⅞-inch coaxial sampling line, telephone line, and remote antenna meter line. The power lines for the tower grounding relays, tower lights, and 110-volt ac utility outlet in the "doghouse" also run through the tile pipe. The tower shorting relays are automatically activated when the main transmitter on-off switch is in the off position.

WGTO's antenna array consists of two 350-foot Stainless towers on 5-foot pedestals. At the foot of each tower is a "doghouse" that shelters the line terminal unit and sampling line isolation coil. The ⅞-inch coaxial sampling line runs to the sampling loop positioned about 30 feet up from the base of the tower and is also used as the feed line to the tower. Austin transformers are used to isolate the power lines for the tower lights.

The antenna pattern is such that the points of minimum radiation are on the N150-deg E radial to protect a Cuban 1-kw station on 540 kc, and on the N330-deg E radial to protect a Canadian clear channel 50-kw station and other adjacent channel stations in this country. The antenna system is illustrated in Fig. 6.

Conclusion

The operators of WGTO have effectively transplanted a proved type of technical facilities planning. The same framework and style of air entertainment, and informative programming is used which has proved enormously successful at KWK. As a result WGTO's operations in Central Florida have been quite successful.

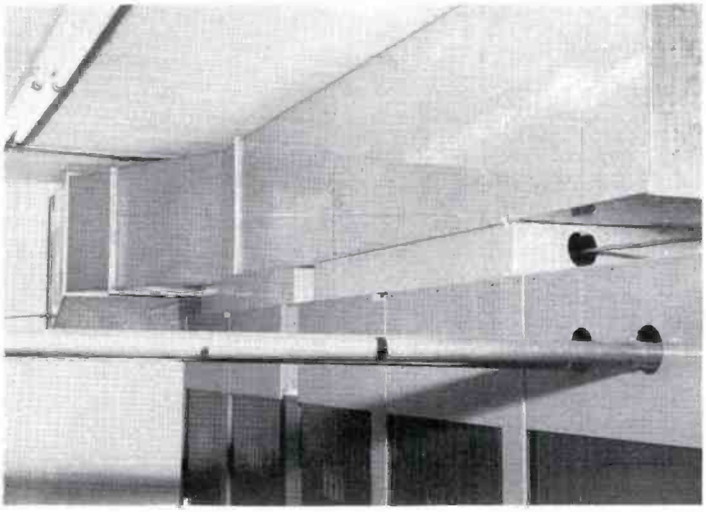


FIG. 9. Duct work on top of transmitter cabinets exhausts hot air to outside of building.

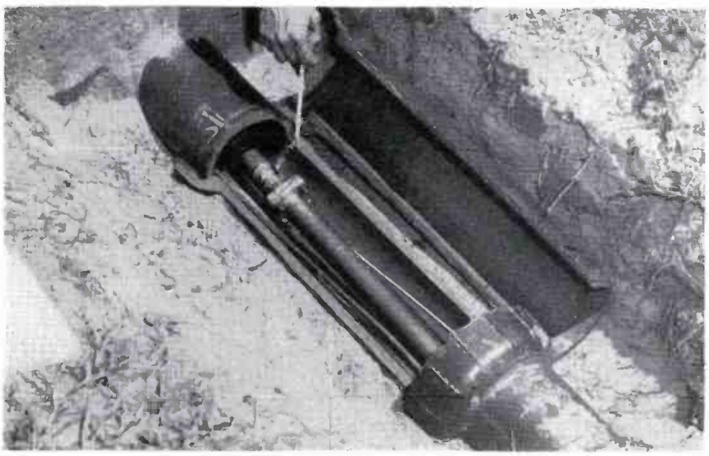


FIG. 10. Tile pipe is split at 20-ft intervals to permit access where flange joints occur in the transmission line.

FIG. 11. The power lines are isolated from the tower lights by Austin transformers at the base of each tower.

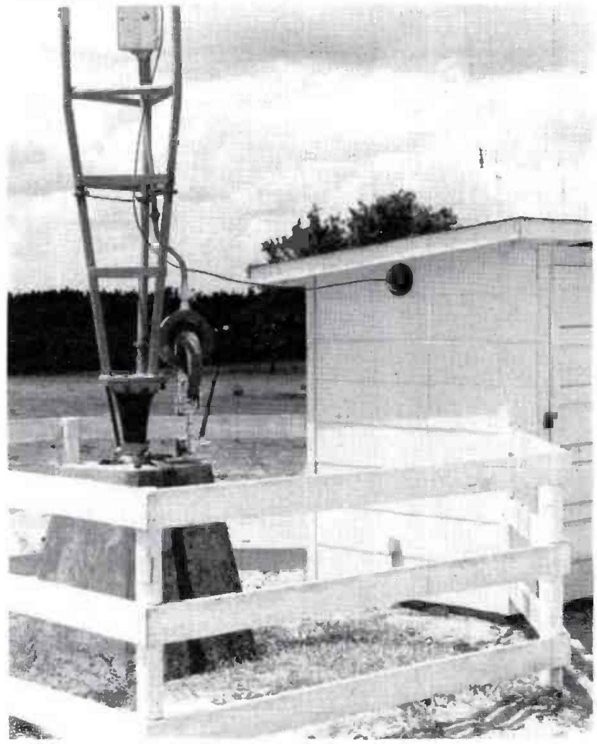


FIG. 12. A concrete-block transmitter building houses WGTO's transmitter room and workshop. Entire building is air-conditioned in the summertime.

THE EFFECT OF ELECTRICAL LOADING ON MICROPHONE RESPONSE

by RICHARD E. WERNER, *RCA Transducer Design Group*

Current applications of transistors to microphone preamplifiers require consideration of the effects of resistive loads upon microphone frequency response. In the past, microphone output impedance versus frequency curves have not been supplied because of the negligible loading effect of a conventional vacuum-tube preamplifier. However, a transistorized preamplifier has a resistive input impedance (not essentially frequency dependent). The loading effect of this transistorized preamplifier on a ribbon microphone, whose output impedance varies with frequency, usually results in loss of low frequency response. A preamplifier designed for use with a particular ribbon microphone may be equalized for loading effects as an alternative for a high input impedance. This equalization, however, will be suitable only for the particular microphone used. In this analysis the effects of load impedance are determined using direct measurement.

Load Impedance

The "low-impedance" input terminals of a conventional vacuum-tube preamplifier effectively offer a high-impedance load to the microphone because the primary inductance of the input transformer is normally very high, and the capacitive load on the primary and secondary of the transformer is generally slight. Figure 1 is a curve of input impedance versus frequency of a typical 250-ohm vacuum-tube studio preamplifier. It can be assumed that the

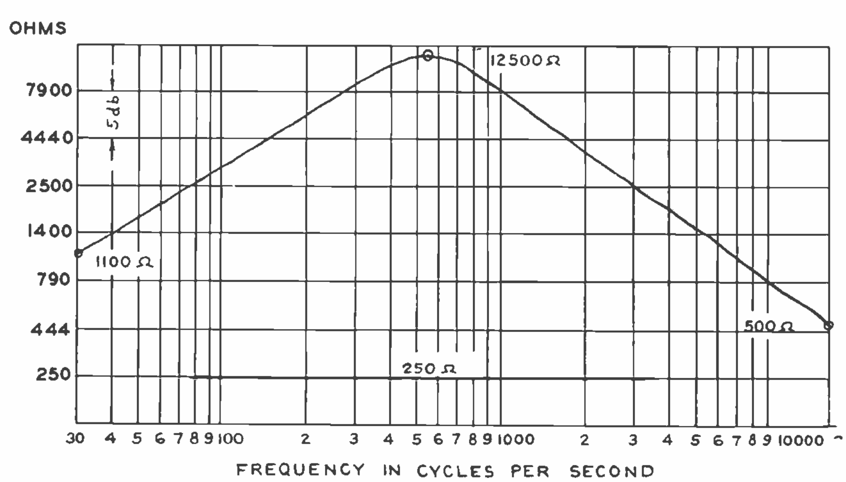


FIG. 1. Input impedance versus frequency plot at the 250-ohm terminals of a standard studio preamplifier.

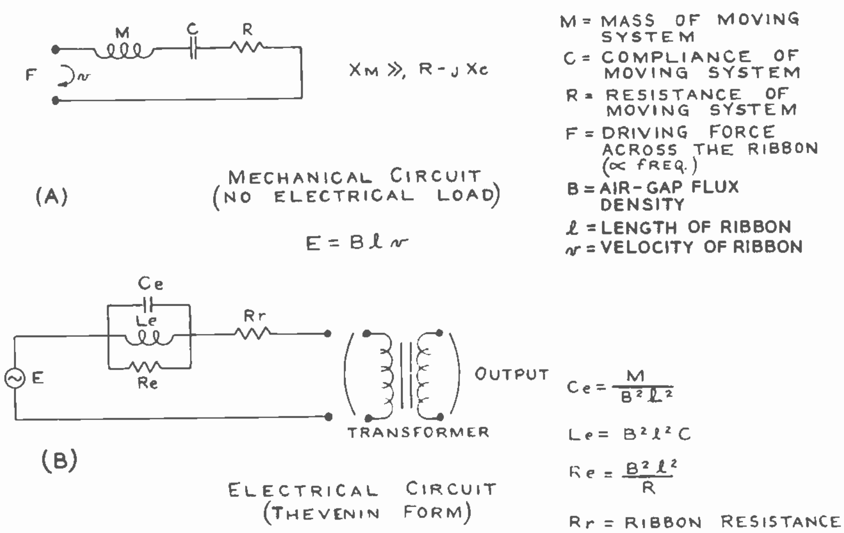


FIG. 2. Simplified equivalent circuits of a ribbon microphone with the mechanical circuit shown in (A) and the electrical circuit (B).

load presented by this preamplifier to a 250-ohm microphone is negligible in its effect on the microphone.

Transistorized preamplifiers, on the other hand, are generally characterized as having a resistive input impedance—an impedance essentially independent of frequency. In order to obtain the highest possible gain, it is desirable that the input impedance approximately equal the nominal impedance of the assortment of microphones with which the preamplifier may be used. Higher input impedances normally result in reduced gain.[1]

Microphone Impedance

How is a microphone's frequency response affected by the electrical load of these two types of preamplifiers? It is obvious that a microphone whose output impedance is essentially resistive and independent of frequency will be unaffected by a resistive load or by the loading of the preamplifier of Fig. 1, whose impedance at the frequencies of interest is very much higher than the microphone's impedance.

Moving-coil dynamic-pressure microphones have essentially resistive output impedances and so do not concern us here. Condenser microphones require specifically designed exciter-preamplifiers which are beyond the scope of this paper. There remains but one type of broadcast microphone, the ribbon microphone, which does have an output impedance which varies widely with frequency. This variation in output impedance is inherent in all bidirectional and unidirectional ribbon microphones and is also normally encountered in nondirectional, pressure-actuated ribbon microphones.

Ribbon Microphone Characteristics

Let us now study the bidirectional ribbon microphone impedance variation. The ribbon in a bidirectional microphone is a conductor in a magnetic field whose generated voltage is proportional to its velocity. For an output which is independent of frequency, the velocity of the ribbon must be independent of frequency. The ribbon is exposed on both sides (front and back) to the sound field. Therefore, the net force on the ribbon is proportional to the instantaneous sound-pressure difference between the front and back of the ribbon.

At a distance from the sound source the absolute rms pressure is the same on both sides of the ribbon, since the dimensions across the front of the microphone are generally small compared to a wave length of the audio frequencies. The driving force must then come from the phase difference, which is proportional to frequency. If the distance from the front to the back of the ribbon is small compared to the wave lengths of the sound frequencies being considered this force will also be proportional to frequency. Since the driving force is proportional to frequency and velocity is to be independent of frequency, the mechanical impedance of the ribbon must be proportional to frequency—a mechanical inductance.

Figure 2A shows the mechanical circuit of a bidirectional ribbon microphone, in which B represents the magnetic field density and l the length of the ribbon. The mass of the moving system (the mechanical inductance) is the controlling impedance. Therefore, its resonance with the compliance of the moving system must occur at a very low frequency. The electrical circuit of the microphone is shown in Fig. 2B and it can be seen that the magnitude of B and l determine the extent to which the mechanical impedance influences the electrical impedance. The higher the Bl product, the higher the output voltage, E.

Unfortunately, with the ribbon resistance unchanged, the output impedance then becomes even more dependent upon the mechanical impedance which is pro-

[1] The RCA Type BN-6A Transistor Portable Remote Amplifier is designed to provide proper loading for ribbon-type microphones with no resultant loss of low-frequency response.

portional to frequency above the resonant frequency. The impedance inversion resulting from the manner of transduction (electrical impedance equals $B^2 l^2$ *divided* by the mechanical impedance) makes the electrical impedance *increase* with *decreasing* frequency. The electrical impedance is constant at higher frequencies where ribbon resistance dominates, and increases at lower frequencies where C_e (in Fig. 2) dominates. The higher the value of $B^2 l^2$ the higher the efficiency and the higher the output impedance of the microphone at low frequencies.

At this point we are able to make some approximate predictions concerning load impedance. For example, if the load resistance should be equal to the microphone's impedance at resonance, there will be a 6-db attenuation at that frequency. If the ribbon resistance is small compared to this impedance (a very efficient microphone), the attenuation at higher frequencies will be negligible. The net result, therefore, is a loss approaching 6 db at low frequencies.

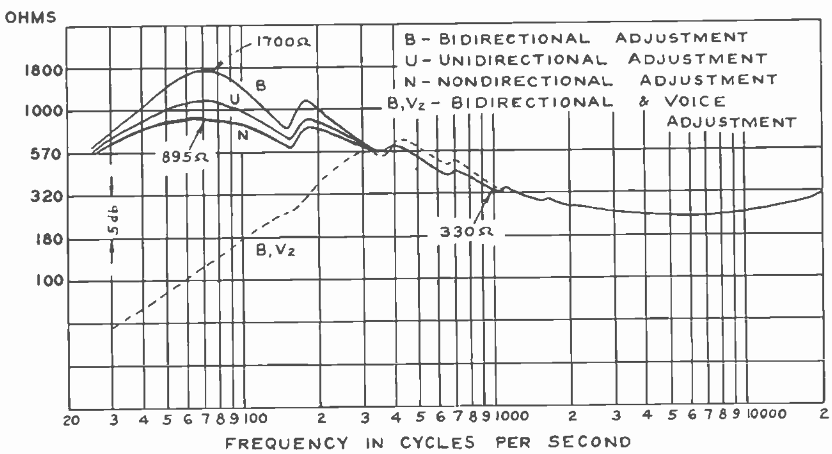


FIG. 3. Plot of output impedance versus frequency of a high-sensitivity ribbon microphone of 250 ohms nominal impedance.

Typical Ribbon Microphone

Let us look at the output impedance of one highly efficient ribbon microphone (see Fig. 3). This microphone has a directional characteristic which is adjustable by mechanical means. The nondirectional adjustment shows the least variation in impedance with frequency since the microphone is then pressure sensitive and the moving system is more nearly resistance controlled. The series of lesser resonances at odd multiples of the fundamental are due to higher modes of vibration in the ribbon and are perfectly normal in a ribbon microphone. In high-quality ribbon microphones these higher order modes are of a minor nature and do not detract from the excellent transient response and low distortion which are recognized as the outstanding attributes of the ribbon microphone.

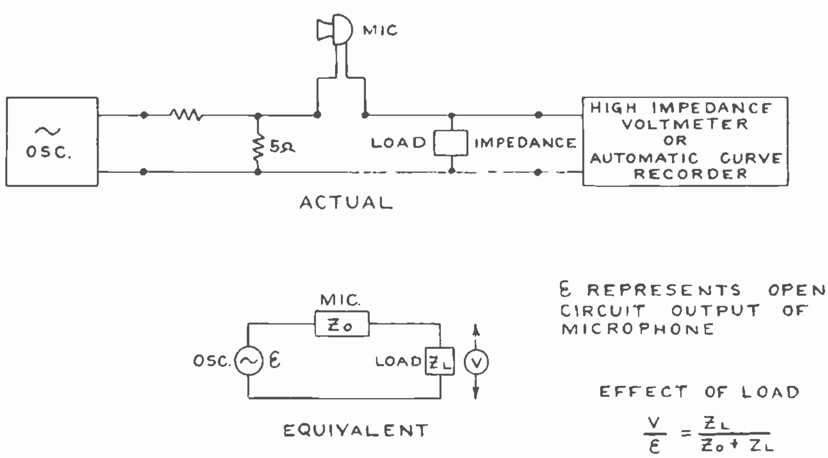


FIG. 4. Circuit used to measure the effect of load upon frequency response of a microphone. The actual circuit is shown at the top and the equivalent circuit at the bottom.

It is apparent, however, that these resonances considerably complicate the mathematical expression for the microphone's output impedance. The ribbon microphone (Fig. 3) has a three-position switch allowing two degrees of low-frequency attenuation to compensate for the rise in low-frequency response which occurs when a bidirectional or unidirectional microphone is used in close proximity to the sound source. The lower curve in Fig. 3 illustrates the effect of this switch on the output impedance. This "voice" compensation is accomplished by placing an inductance across the secondary winding of the microphone transformer.

It is apparent from these curves, that loading the microphone with a resistive impedance will cause a reduction in low-frequency response of the normal microphone and an increase in low-frequency response of the microphone when adjusted for compensation of the proximity effect. This action then effectively incapacitates the functioning of the "voice-music" switch.

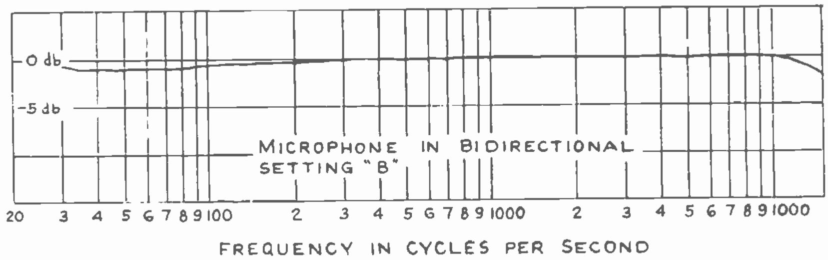


FIG. 5. Frequency response relative to no load with the microphone of Fig. 3 loaded by the preamplifier shown in Fig. 1.

Measuring Loading Effect

Since a mathematical determination of the effect of load impedance upon frequency response appears arduous, the alternative of direct measurement is chosen. The test circuit shown in Fig. 4 is a practical application of the Thévenin equivalent circuit of the microphone. The load impedance can be that of a particular preamplifier or an adjustable impedance upon which a suitable design may be based. This circuit is useful, in practice, for determining the equivalent circuit of the microphone and the equalization necessary for the loading effect of a preamplifier designed for a particular microphone. The five-ohm resistor is selected as normally being negligibly small compared to the microphone impedance.

Where accuracy of measurement requires it, a reference curve of the system's response may be taken by short circuiting the microphone terminals. It is important that the voltage appearing across the microphone terminals never exceed a few millivolts to prevent, not only nonlinear impedances resulting from high ribbon excursions, but also, attendant damage to the microphone under test.

Data obtained in this fashion on this microphone are shown in Figs. 5 and 6. Figure 5 shows the loading effect of the vacuum-tube preamplifier (Fig. 1) and, as anticipated, the effect is indeed negligible. Figure 6 shows the effect of various resistive loads upon the ribbon microphone for a few of its many available adjustments. The shapes of these curves are what had been expected after a study of the output impedance curves. The output becomes lowest where the output impedance is highest. For heavy loading, the "voice" adjustment becomes ineffective.

The presumedly matching load of 250 ohms has a severe effect—a loss of almost 12 db at 70 cps in the bidirectional-music setting and a boost of about 4 db at the same frequency when the microphone is adjusted for close talking and bidirectional pickup. With a load of 3000 ohms the microphone is down only 3 db at 70 cps, which places the response within 1½ db of the open-circuit response. Furthermore, the wiggles at the higher resonances have become insignificant. Dropping the load impedance to 1500 ohms results in a loss of 5 db at 70 cps, which might be considered the absolute maximum allowable for broadcast purposes.

Notice that, as the load impedance is decreased below this value (which is approximately equal to the microphone's impedance at resonance) the frequency distortion increases rapidly. The marked differences among the 250-ohm curves preclude the use of equalization circuits to compensate for the loading effects of a low input-impedance preamplifier. Individual equalization is required to compensate for each adjustment of the microphone and further equalization is necessary to compensate for variations among similar types of microphones.

Conclusion

A microphone preamplifier for general use must therefore have an input impedance not less than the highest impedance appearing at the output terminals of any microphone with which it may be used if a frequency-response deviation of less than 6 db is to be maintained. The maximum impedance, at the present state of the art, can be as high as five times the nominal microphone impedance.

When a low-impedance preamplifier is being designed for use with a particular microphone of frequency-sensitive output-impedance characteristics, the effect of the load upon the frequency-response-characteristic must be determined. This is done so that suitable equalization can be provided. In addition, this equalization will be suitable only for that particular microphone output-impedance characteristic.

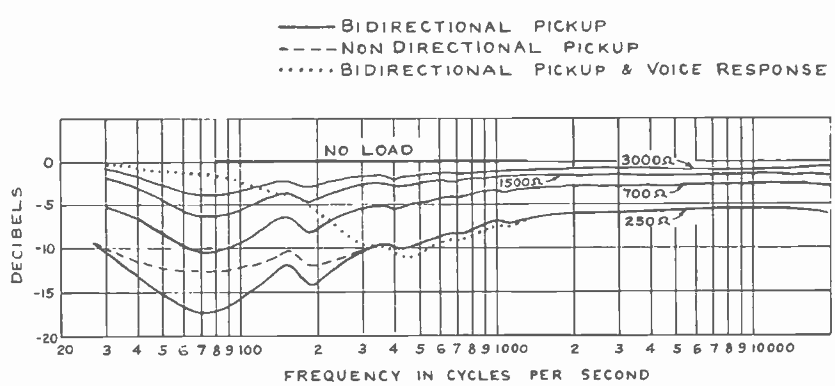


FIG. 6. Frequency response characteristics illustrate the effect of a resistive load on a high-sensitivity ribbon microphone of 250 ohms nominal impedance.

CRANE SERVES AS TEMPORARY TOWER FOR MICROWAVE TRANSMITTER

by ARTHUR R. O'NEIL
Chief Engineer, WSBT, South Bend, Indiana

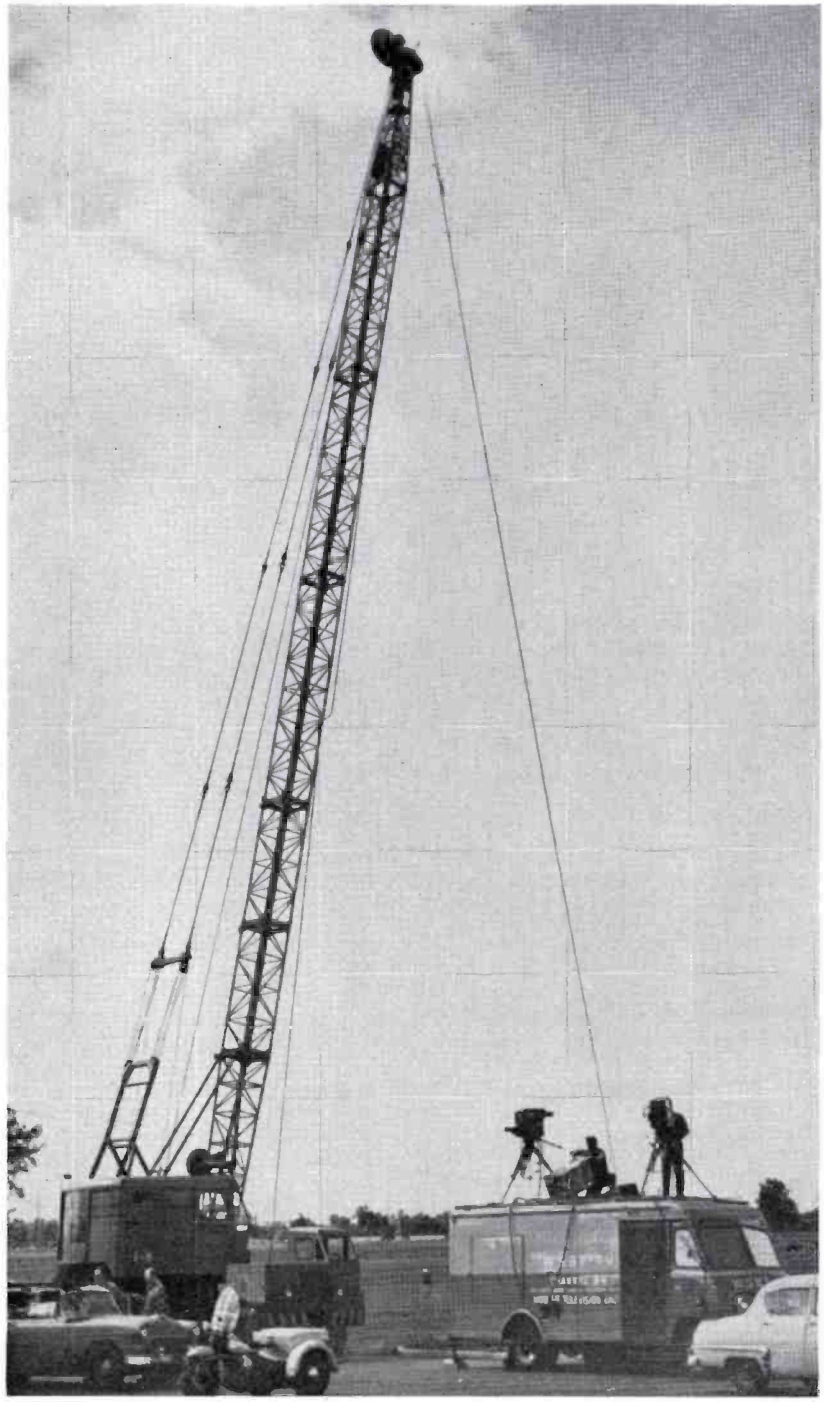
This microwave installation was used to relay TV coverage of the recent opening of the new Indiana toll road which extends from the Ohio turnpike, across the state of Indiana to the Illinois-Indiana state line. The South Bend interchange was the location for the opening ceremonies which were attended by many dignitaries, including the governor of Indiana and governors of adjoining states. The location was not ideal for a line-of-sight path to the studios of WSBT-TV in Broadcast Center located in downtown South Bend. In order to get a picture from the dedication site it would have been necessary to erect a tower over 100 feet in height, which would have been quite expensive and time consuming. WSBT solved this tough problem by mounting a microwave dish on a 110-ft boom crane.

Through the co-operation of a local construction company, one of its cranes was transported to the site and the RCA microwave transmitter and dish clamped to a bracket mounted on top of the 110-ft boom. Only one bracing guy was run. This guy is shown at the right of the boom. The cable which formed the bracing guy is a natural part of the rig.

A lead ball, which is normally used for demolition, is attached to the end of this cable. With the lead ball as an anchor, it was not necessary to bury an anchor for the cable. A check with a transit showed the sway at the top of the boom to be less than 1/16 inch during a 15-mile-per-hour wind.

Rough adjustments in azimuth and elevation were made by the crane operator who proved to be a craftsman in his own right. Final minute corrections were made by an ironworker who crawled up the boom and made the necessary adjustments.

Since the crane is mounted on rubber-tired wheels and is easily transportable, this system should prove effective as a "portable" microwave tower which could have many uses for the broadcaster. In our case the use of the crane turned out to be a most satisfactory solution to a vexing problem.



BROWN IS BACK!

Dr. George H. Brown Appointed Chief Engineer, RCA Commercial Electronic Products

Broadcast engineers, everywhere, will whoop with joy at RCA's newest shuffle of engineering talent. For here's "Doc Brown" back in our midst—right where he started 24 years ago. Only now he's running the show.

The official announcement read: "Dr. G. H. Brown, who has been Director of the Systems Research Laboratory, RCA Laboratories, is appointed Chief Engineer, RCA Commercial Electronic Products."

This announcement of Dr. Brown's appointment followed announcements that Dr. D. H. Ewing, formerly head of RCA Laboratories, was moving up to the position of Vice-President, Research and Engineering, and Dr. James Hillier, formerly Chief Engineer, Commercial Electronic Products, to General Manager, RCA Laboratories.

Most journals will, no doubt, report the story as a general moving-up of RCA engineering managers. Routine VIP stuff—duly noted, and soon forgotten. But not so for BROADCAST NEWS. For us it's a great occasion. Something akin to the return of Halley's comet.

For those who don't know, George Brown first arrived in Camden in December of 1933—with a still-wet Ph.D. from Wisconsin under his arm. He was unheralded and unknown. But not for long! An unusual combination of mathematical genius, practical engineer and human dynamo, he stirred up the dust wherever he turned. And, fortunately for broadcasters, the first thing he turned to was broadcast antennas.

Vertical radiators were just coming into use, and needed a lot of explaining. For one thing, they didn't seem to work exactly as the simple theory predicted. In a series of mathematical analyses, measurements on models and confirming field tests, Dr. Brown demonstrated that the departure from theory was due to nonsinusoidal distribution of current on the antenna, and that the error was particularly large for antennas of nonuniform cross-section (such as the guyed cantilever type then in vogue). Field experiments with top-loading by means of "top hats" confirmed this and led to the now universal use of uniform cross-section towers.

Dr. Brown's very first published article on antennas, entitled: "A Brief Survey of the Characteristics of Broadcast Antennas"[1], appeared in BROADCAST NEWS for December 1934 (a BROADCAST NEWS "exclusive"). In the April 1935 issue of BROADCAST NEWS Dr. Brown and Mr. Gihring presented the full results of their work in a paper entitled "General Considerations of Tower Antennas for Broadcast Use."[2] This very comprehensive study of the radiating properties of AM antenna towers immediately became, and has remained, the standard reference in this field.

In the January 1937 issue of the IRE PROCEEDINGS Dr. Brown published his now-famous paper on "Directional Antennas." Explaining the method of calculating directional patterns, and including illustrations of a large number of standard patterns, this paper, along with his earlier papers, found its way into the notebooks of every station engineer—and most consultants. A whole generation of broadcast engineers learned about directional arrays from this paper, and most of the directional arrays in use today were probably calculated from it.

In 1936 Dr. Brown developed the progenitor of today's turnstile antennas. The first model, described in BROADCAST NEWS for December 1936, was actually developed for VHF AM broadcasting, which at the time was enjoying a brief flurry of interest. A short time later he developed models for FM and for television. Today's superturnstiles (and bat-wings) are adaptations of the same basic idea.

While studying antennas Dr. Brown made innumerable field trips and worked with hundreds of station engineers—both in the field and in Camden. It is safe to say that every one of these engineers will remember the enthusiasm, good humor and practical sense with which he tackled their problems.

In 1937 Dr. Brown left RCA for a short fling in the consulting business. However, he soon tired of "doing the same thing over and over again" and in 1938 came back to RCA. For several years, as a member of the research staff, he directed a group working on antennas, television and radio-frequency heating. During this time he developed the "whisker" or ground-plane antenna universally used in 2-way radio today, the vestigial side-band filter used by most TV stations, and many of the basic principles of r-f heating.

During the war he continued his work in these fields, moving to Princeton with the RCA Laboratories in 1942. He was awarded a War Department Certificate of Appreciation "for his outstanding work in research, design and development of radio and radar antennas during World War II."

Following the war he turned his attention to UHF propagation and color television. He supervised RCA's field test of UHF in the Washington area in 1948, and with co-workers published what have become the definitive papers on UHF propagation.

Since 1948 Dr. Brown has been in charge of RCA's color television research, and he was one of the leading figures in the lengthly development work which led to the adoption of the NTSC color standards. In 1951 he was appointed Director of the Systems Research Laboratory of the RCA Laboratories, from which position he now moves to Commercial Electronic Products.

In his new position, as Chief Engineer of Commercial Electronic Products, Dr. Brown will have functional supervision of all engineering activities associated with the development, design and manufacture of all broadcast, communications, sound and industrial types of equipment sold by RCA. This means, of course, that he will not be able to put *all* of his time on broadcast equipment. However, we strongly suspect "Doc" has a warm place in his heart for his old love. And we more than suspect that it will be only a matter of weeks before he is stirring things up in the broadcast field. We know he is looking forward to seeing his old friends among the broadcasters. And we feel sure they will welcome him as we do.

[1] Coauthored with H. E. Gihring, then RCA Transmitter Engineer, now Manager, Antenna Engineering.

[2] Published simultaneously in the April 1935 issue of THE PROCEEDINGS OF THE IRE.

A MOBILE CONTROL ROOM FOR COLOR TV

by HENRY H. KLERX,
RCA Broadcast Video Equipment Sales Department

This latest color mobile unit in RCA's line has been designed for use at both studio and remote locations. No longer does an investment made in "remote" facilities have to remain idle except for irregular intervals. The unit is a live color camera "mobile control room"—which can function as an extension of a station's regular studio control facilities. The design techniques employed in constructing this 32-foot, three-color camera, mobile unit permit ready integration with existing studio facilities.

The mobile control room can be "patched" into master control, studio control, or when desired, taken out for use on remote pickups. In a matter of hours, complete live color facilities can be made available to a television station without any major disruption of existing equipment. Some stations, going into color or expanding their color operations, may find justifiable economic reasons for securing a color mobile control room in preference to modifying existing plant facilities for color. Here is a complete color package—all checked out and ready to operate. Video, audio, intercom and genlock connections are all provided in such a manner as to permit a station's existing monochrome and color equipment, live or film, to be mixed, superimposed and switched at either the mobile or fixed location.

The design of RCA's new color mobile control room allows for expansion at a future time. Two color cameras, audio, switching, terminal and test equipment can be considered the basic equipment complement. Off-air monitoring, program previewing and rehearsal facilities are an integral part of the equipment complement. The basic layout, however, will accommodate either one color camera and four monochrome cameras, two color cameras and two monochrome cameras, or three color cameras. Figure 1 shows a plan view of the mobile control room.

The forward section "control room" contains all operating control equipment. This area is temperature controlled by a three-ton air conditioner and heating elements. The control room will comfortably seat seven people, however, three people can adequately perform the necessary operating functions. Figure 3 shows a side elevation view of the mobile control room. The video operators sit in a recessed area to allow an unobstructed view for operating personnel sitting behind them.

To the rear of the control room the equipment racks which house the distribution, test and terminal equipment are located. Intercom facilities are provided in the equipment area to permit communication with the individual camera control positions. This permits rapid trouble shooting as well as simplification of setup and adjustment procedures.

The area behind the equipment section is utilized for storage of microwave, spare parts and tubes, cameras and mounting equipment. Cable for cameras, microphones, power and microwave are stored underneath the unit. The power supplies, ac power control circuits, isolation transformer and automatic voltage-regulating equipments are located at the extreme rear of the unit.

An entrance panel is provided on the side wall. This panel contains the connectors for feeding color cameras, microwave, audio output, microphone inputs, intercom input and output, sync, video line and monitor, and additional inputs to the switcher.

The RCA color mobile control room has been designed to facilitate station expansion in color. Equally important, however, is the programming flexibility a mobile control room affords. Special-events programs, too large to accommodate in existing studios, can be originated from leased buildings. A television mobile control room can be a tremendous asset to both TV broadcasting and closed-circuit plants from an operations standpoint. In addition, the promotional and publicity values which can be realized should not be overlooked.

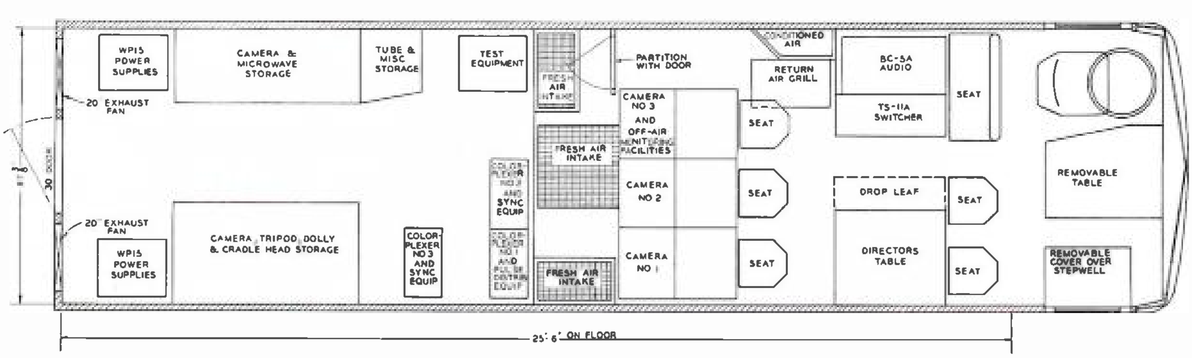


FIG. 1. Plan view of mobile control room.

FIG. 2. New 32-foot, three-color camera, mobile unit designed to facilitate station expansion in color.

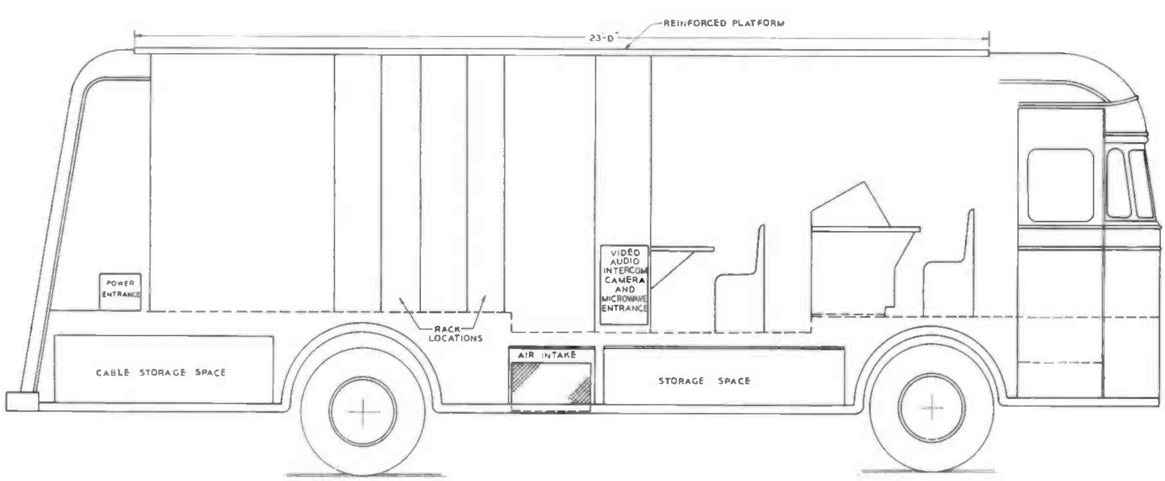


FIG. 3. Side elevation view of mobile control room.

FIG. 1. Main studio at WQED, Pittsburgh, an example of a community educational TV station.

EDUCATIONAL TV STATIONS GET PROGRAM AID FROM NBC

Specially Produced Series of Live Programs to be Furnished Via Network Lines

The first live programming ever produced expressly for educational television stations on a national basis will be provided by the National Broadcasting Company beginning in March.

The network will furnish specialized educational programs to all of the nation's noncommercial educational stations. The programs will be produced in the NBC studios and furnished live to the educational stations over network lines.

The programming service will be provided at no charge to the stations. NBC has committed more than $300,000 for programs, production facilities and personnel in connection with the project. The Educational Television and Radio Center at Ann Arbor, Mich., which has received funds from the Ford Foundation, is supplying the local loops to connect the educational stations with the NBC network lines and is consulting closely with NBC on the design of the programs.

The plan was announced December 13 by Robert W. Sarnoff, President of NBC, at the network's 30th Anniversary Convention in Miami Beach, Florida. Mr. Sarnoff said: "These programs will be telecast during an afternoon time period which does not conflict with our regular schedule. They will also be kinescoped for repeat broadcast or subsequent classroom use, thus creating an important and enduring educational television library."

The programs will consist of three half-hour presentations each week with instruction in mathematics, the humanities and government. The project will extend through twenty-six weeks in 1957, beginning in March for thirteen weeks, and resuming in October for another thirteen-week period. The three program series will be conducted by experts in the fields. James R. Newman, author and editor of "The World of Mathematics," already has agreed to supervise the mathematics course.

Twenty-five noncommercial educational stations are now on the air, and this number is expected to increase. The stations fall into two broad classifications—the community-type stations and those run by a single educational institution. In the first group, the general direction is provided by a board representing the various educational and cultural interests of the community. The Pittsburgh and St. Louis stations are of this kind. The second type of educational station is exemplified by those managed and directed by the University of Illinois, Ohio State University and Michigan State University. Alabama has a state-wide network administered by a state commission, with production centers at the university, Alabama Polytechnic and the Birmingham area public schools. North Carolina has a single station with programs fed in from several institutions.

The educational TV stations operate an average of more than twenty-five hours weekly, with some of them broadcasting as much as fifty hours a week. In general, their programs are of two kinds: those planned for in-school use, and those designed for general education of a less formal nature.

"We see our twenty-six-week project as a demonstration operation," Mr. Sarnoff said. "We believe that when our project terminates at the end of 1957, its values and lessons can be carried forward in ways that will help enrich the whole future of education by television.

"Every citizen has a stake in the success with which these educational stations carry out their mission. The drastic national shortage of teachers and classrooms lends a special urgency to their efforts to build themselves into a major educational force. Those of us who live in television and who seek its full development in every area in society have a particular sympathy for the difficult problems of financing and programming which the educational stations face. In my judgment, we also have an interest going beyond that of the average citizen to lend such support as we can in solving these problems.

"This interest has already been recognized by many of our affiliates. On the local level they have served as good neighbors in many ways to their educational counterparts. Now we propose to be good neighbors on the national level."

Leaders in education were quick to voice their approval of the NBC plan.

Dr. Grayson Kirk. President of Columbia University, said: "In formulating and carrying through this project, the National Broadcasting Company earns the gratitude of all who are devoted to the field of education."

Dr. H. K. Newburn, President of the Educational Television and Radio Center at Ann Arbor, Michigan: "We feel that this co-operative arrangement not only is an expression of your faith in the practical educational uses of the television medium, but it is in a real sense an indication of your broad interest in the educational welfare of the American people."

Dr. Herman Wells, President, University of Indiana: "I believe that the National Broadcasting Company's pioneering plan to supply live programs to the nation's educational television stations is one of the boldest and most important forward steps yet taken by television on behalf of our schools and colleges. I salute NBC for this fine public service."

Mr. Frank E. Schooley, President, National Association of Educational Broadcasters, Champaign, Illinois: "This is a recognition of the value of educational television by NBC that deserves the commendation of all interested in education. My congratulations to NBC and the Center."

Dr. Franklin Dunham, Chief of Radio-Television, U. S. Office of Education, Washington, D. C.: "Nothing could come to me at this time which would give me a greater feeling of elation than the news that NBC will serve directly the noncompetitive educational television stations now fast becoming an important factor in American cultural life."

Dr. Carroll V. Newsom, President, New York University: "The National Broadcasting Company's plan is an important step. I congratulate the National Broadcasting Company for its concern and interest in education via television."

Educational stations now on the air are in Alabama (Munford, Birmingham and Andalusia); California (San Francisco); Colorado (Denver); Florida (Miami); Illinois (Chicago and Urbana); Massachusetts (Boston); Michigan (Detroit and East Lansing); Missouri (St. Louis); Nebraska (Lincoln); North Carolina (Chapel Hills); Ohio (Cincinnati and Columbus); Oklahoma (Norman); Pennsylvania (Pittsburgh); Tennessee (Memphis); Texas (Houston); Washington (Seattle) and Wisconsin (Madison).

FIG. 2. Robert W. Sarnoff, NBC President, who outlined aid program at NBC's 30th Anniversary Convention, held at Miami Beach, Florida.

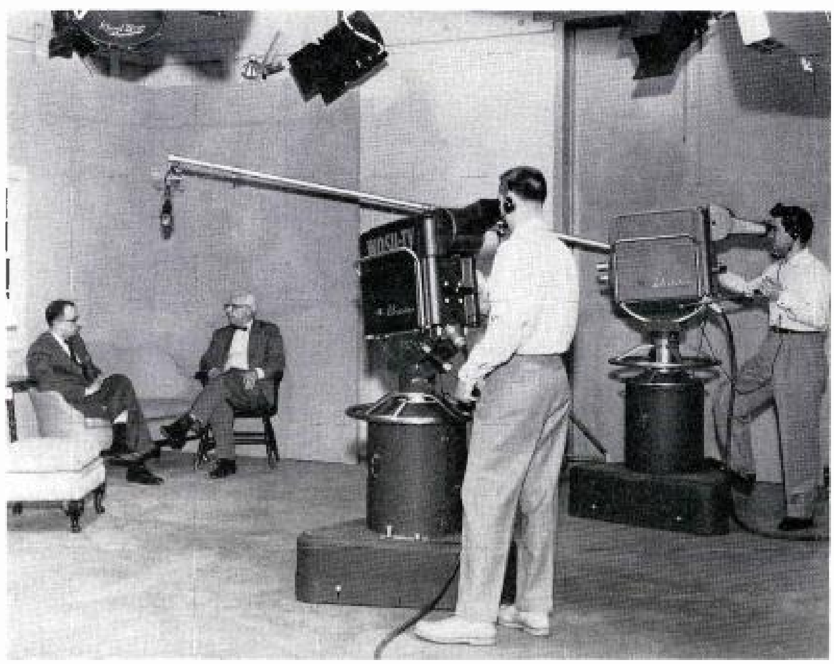


FIG. 3. Ohio State University cameras pick up discussion program for presentation on WOSU-TV, one of a group of university managed and directed educational television stations.

WALTER REED ARMY MEDICAL CENTER USES RCA COMPATIBLE COLOR TV SYSTEM FOR MEDICAL EDUCATION

Three-Channel System With Seven Color Cameras, Color Film System and Three Studios, Provides for 150 Training and Demonstration Programs Per Month as Tests Prove it Upgrades Quality and Cuts Costs of Medical Instruction

FIG. 1. (Left) Shows use of RCA medical color TV surgical camera which is installed in ceiling and is always focused on operating field without distracting or disturbing the operating team. No personnel are required in the operating room for the TV camera since the camera is remotely operated from a control room in the basement.

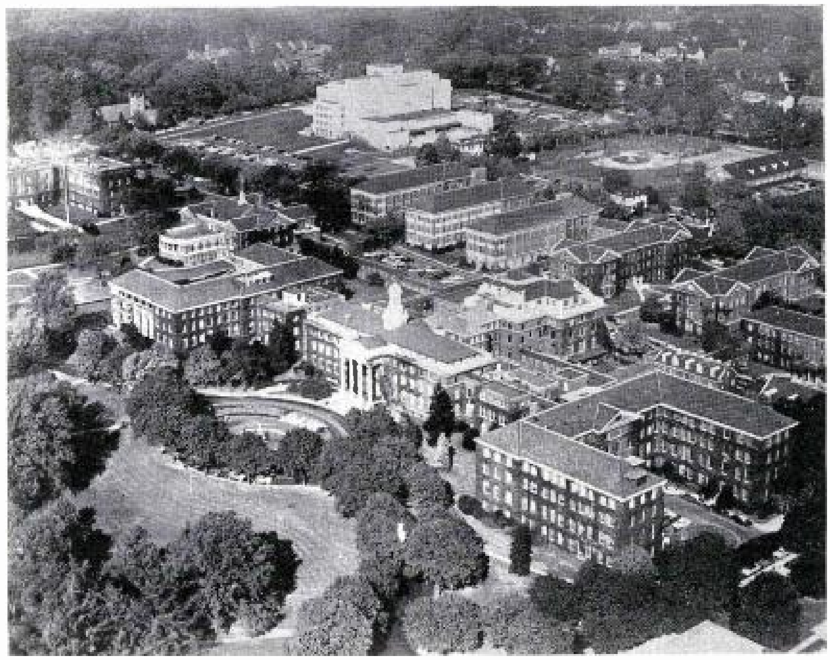


FIG. 2. Walter Reed Army Medical Center, Washington, D. C. Here are located the Walter Reed Army Hospital, the Walter Reed Army Institute of Research, and the Armed Forces Institute of Pathology. There are three separate color TV systems installed for educational applications.

Television at the Walter Reed Army Medical Center has for several years been an increasing force in training and education programs. The educational possibilities were found to have such substantial value that new and more extensive facilities have recently been installed. The original field sequential system has been replaced and expanded with compatible color TV equipment. Three interconnected TV centers have been established. The system is unique in that it employs the first color TV equipments designed specifically for medical instruction and demonstration purposes.

Experience with the color TV system originally installed at the Center has convinced the Army Medical Service that television can be an effective and potent force in training and education programs. The TV system lets unlimited numbers of students peer closely over the surgeon's shoulder, or view a microscopic field with the instructor. There need be no remote, back-row seats at televised demonstrations. Instructors have found that TV has an almost hypnotic ability to focus the students' attention, hence teaching results as good as direct instruction to small groups are possible.

The Walter Reed system is unique in that it contains the first Medical Color TV Camera designed for ceiling mounting in operating and autopsy rooms. It also includes a specially designed color TV system of microscopy utilizing standard instruments. In the film area, 3¼ x 4-inch slides, as well as 2 x 2-inch slides and motion pictures, can be accommodated. Finally, for projection to large groups, several newly developed color TV picture projectors are installed.

For the medical profession, as well as educators and the military, this installation is ideal for exhibiting the educational potential of television, since the Center conducts an unusual variety of medical-scientific activities. Here are the functions of a large general hospital. Here is the Walter Reed Army Institute of Research, which spearheads the Army's medical, dental, and veterinary research and graduate education projects. Here is the Army Prosthetics Research Laboratory, recognized for development of prosthetic devices for the amputee. The Central Dental Laboratory has here an extensive teaching mission. The latest establishment to locate at Walter Reed is the Armed Forces Institute of Pathology (AFIP), which is the central laboratory of pathology for the Army, Navy, Air Force, Veterans Administration, Public Health Service and other agencies.

The television activity at Walter Reed was found to have substantial value in supporting scheduled courses. Therefore, as early as 1954, the whole question as to where emphasis should be placed in relation to television was brought under discussion. It was decided that the television needs of the Army Medical Service would be fulfilled by a closed-circuit compatible color television system.

Bids for such a system were requested and, in June 1955, a contract was awarded to Radio Corporation of America. This provided for a television system to serve the requirements of the three major organizations at Walter Reed Army Medical Center—the Walter Reed Army Hospital, the Walter Reed Army Institute of Research, and the Armed Forces Institute of Pathology (AFIP).

Initial delivery of equipment began in the late summer of 1955, and installation of the new system was undertaken early in the fall of 1955. The installation was completed late in 1956, and initial programming began before year's end.

Three Studio Areas

The TV activity is the responsibility of a newly created Television Division of the Center. Headquarters' offices of this Division are located in the AFIP building. Here, too, is the main production studio, this being a substantial and well-equipped area in which as many as five general production sets can be used simultaneously.

FIG. 3. Master control at AFIP. Programs from all three buildings are received and distributed from here. Window at left overlooks main studio.

A smaller studio is located in the Institute of Research. This studio will allow as many as three sets to be used simultaneously and provides floor space for two-camera operation. A smaller studio area has been arranged in the Hospital. It will be used for patients too ill to be moved to the main studio.

Control Rooms and MC

At each of the studio locations there is a control room and an announcement booth. Control rooms associated with the studios at the Hospital and at the Institute of Research are relatively small. However, that located at the AFIP is of substantial proportions and quite adequate to meet the requirements not only for programs originating locally in the AFIP but also for master control of the entire system.

Although each of the three studios can simultaneously originate separate programming, the system has been so engineered that from the master control room in AFIP it is possible to use for a single major program all of the television equipment located at the Center. Thus, it is possible to consider the facilities at the Hospital and at the Institute of Research as similar

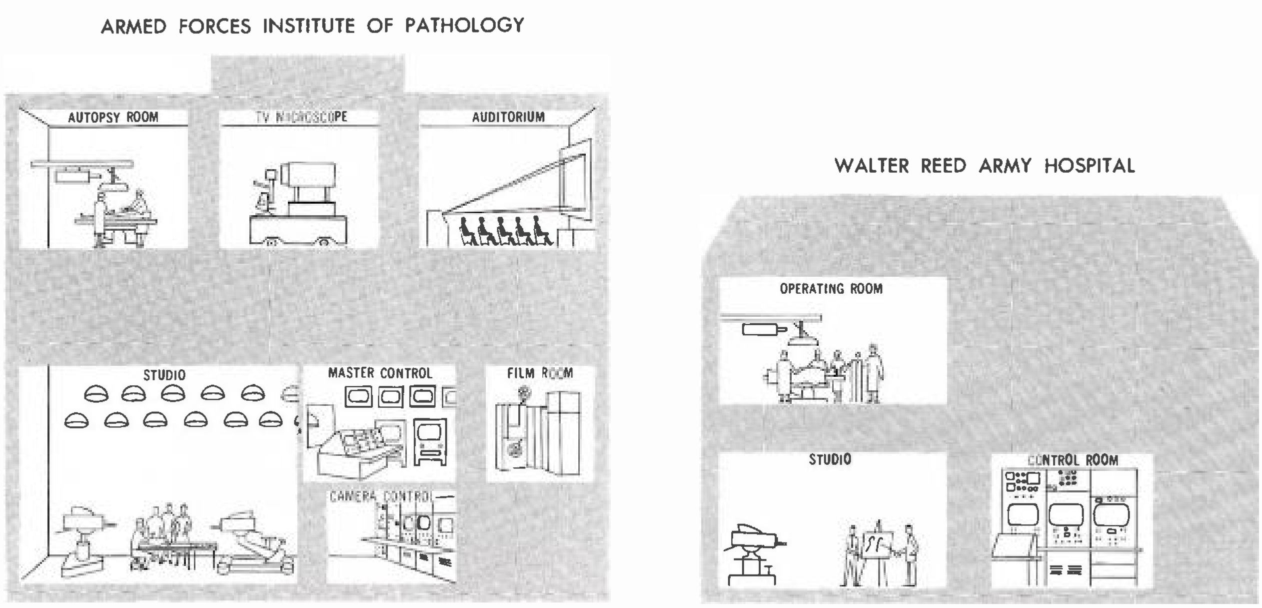


FIG. 4. These drawings show the three independent Color TV systems in the Walter Reed Army Medical Center—

to studios B and C in a single large television establishment. In addition to the potential for originating three separate simultaneous programs or a single complex program, it is also possible to feed into the local system programs originating from outside sources.

Compatible Color Equipment

At this point it perhaps would be well to comment specifically on the point of compatibility. This means, for instance, in connection with reception of programs from outside sources that be they in either black and white or color, it is possible for them to be displayed within the Center's own system exactly as they are received from outside. Indeed, the color programs of outside origin can, when desired, be viewed in either color or black and white. Similarly, programs originating here within the Center's system, though they are initially developed in color, may be viewed either in color or black and white. In addition they can be transmitted to outside users there to be displayed either over closed circuits or as broadcast transmissions, to be viewed in color (if color receivers are available) or in black and white.

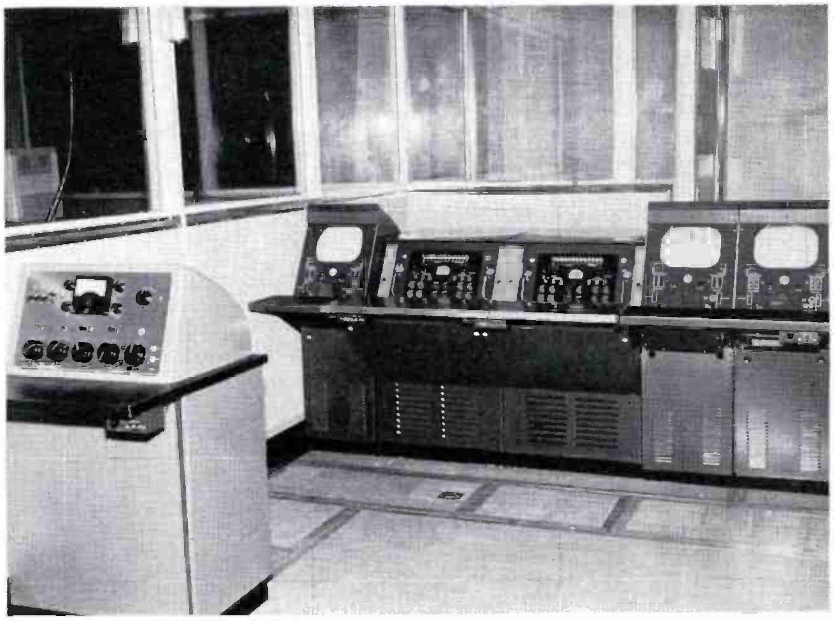
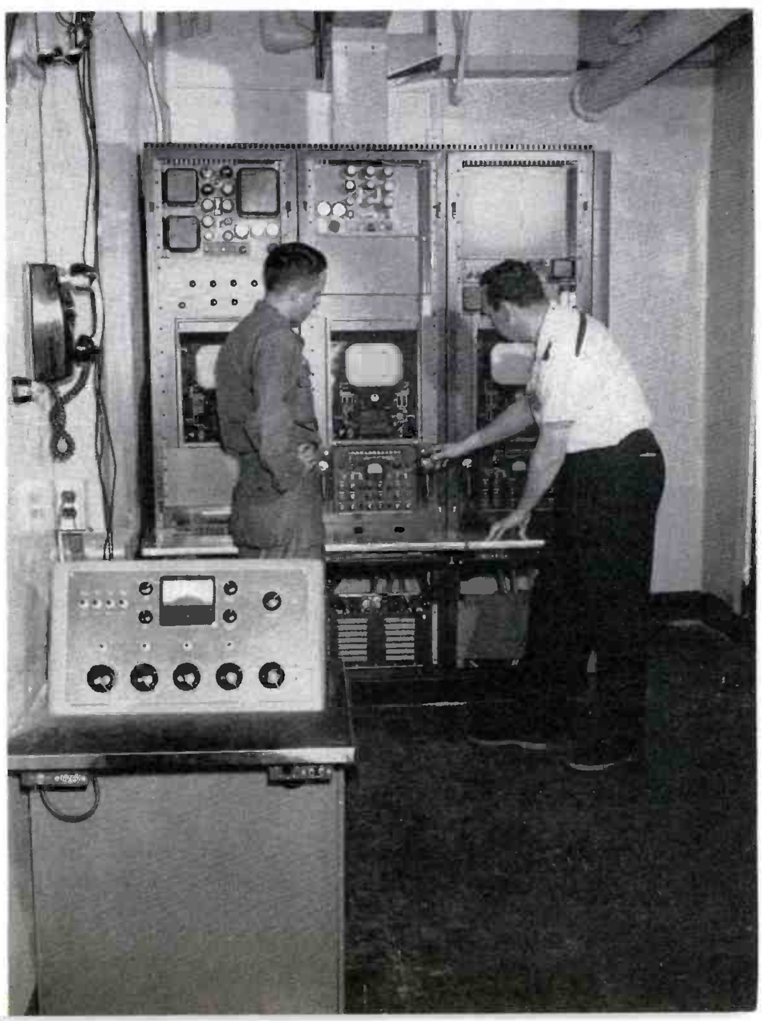
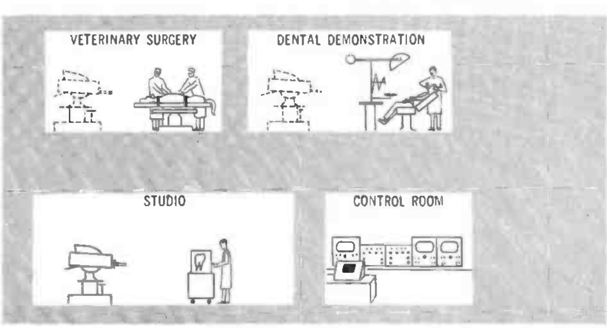


FIG. 5. Control room in the Institute of Research. Audio control in foreground, video in background. Two TV cameras are controlled here. A studio, at the left, is used for teaching demonstrations.

FIG. 6. Control room in the Army Hospital. The surgical TV camera in operating suite is controlled here. An adjoining studio is used for clinical demonstrations.



WALTER REED ARMY INSTITUTE OF RESEARCH



and the facilities available in each building.

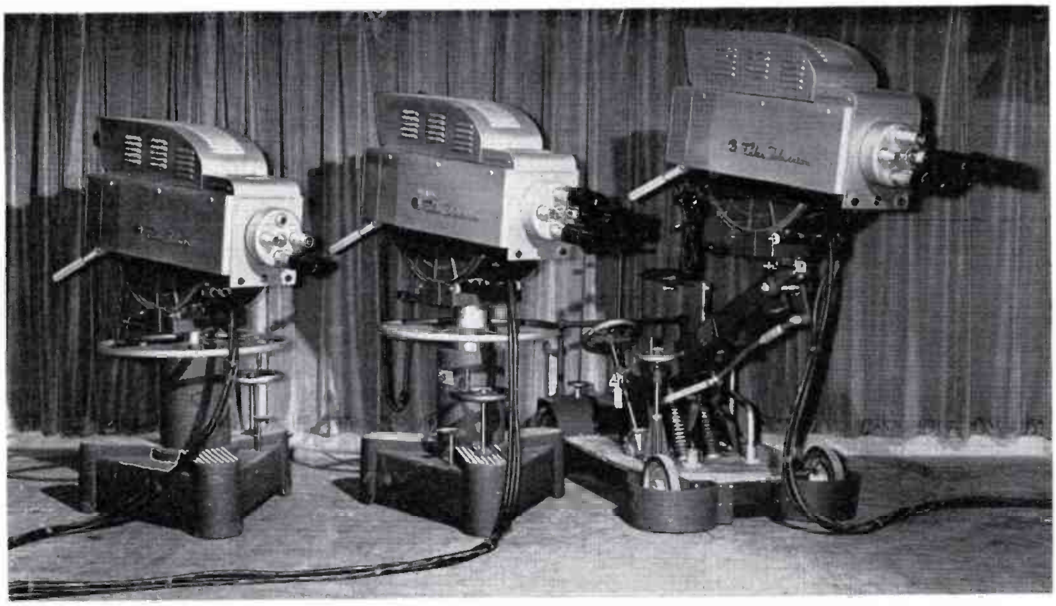


FIG. 7. Facilities in the main studio at AFIP include these three TK-41 Color TV Cameras.

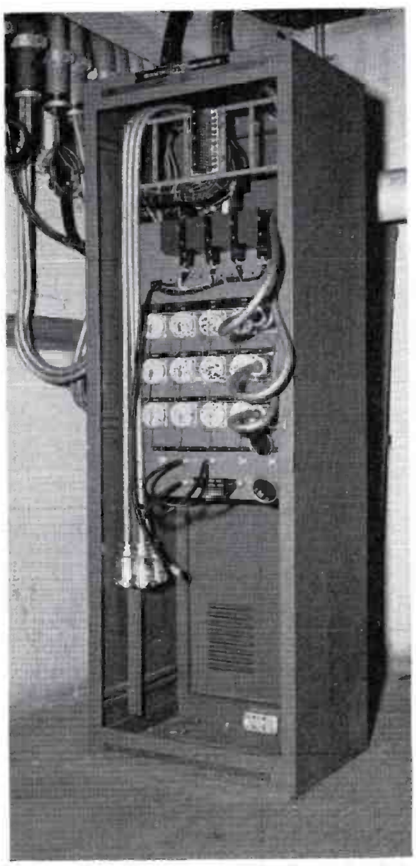


FIG. 8. Camera patch panel in Army Hospital is used to connect TV cameras in operating suite with control room.

Live Color Studio Cameras

Now for the specific distribution of equipment and identification of its functions: To support the requirement for studio operations, four image-orthicon camera chains have been procured. Currently two of these chains are based in the AFIP studio and one in each of the other two studios, at the Institute of Research and at the Hospital. Obviously, as program requirements fluctuate these cameras will be floated from one point to another in support of specific increased demands in any one location.

Medical Color Cameras for O.R. and Autopsy

At the Hospital permanent camera cables have been installed in two operating rooms, to equip them for television originations. In one of these operating rooms a special overhead surgical TV camera assembly is installed. The RCA 3-Vidicon Medical Color Camera used in this connection is of special design, which permits completely remote operation of its electronic characteristics as well as of its mechanical and optical adjustments, such as selection and change of lens and focus of the optical system. The suspension, the light, and the camera are so designed that at all times the center point of view for the camera coincides with the center point of focus of the operating room light. Though only one camera of this sort will be permanently installed in the operating room, sufficient cabling exists for the use of an image-orthicon chain simultaneous with the use of the overhead camera.

Similarly at the Institute of Research, permanent camera cables have been installed in the veterinary surgery area, thus permitting television originations of animal surgery and of major animal demonstrations. A conference room also has camera cables installed so that important meetings may be documented via TV. Cables also have been placed into the dental demonstration area on the second floor, and although permanent cables have not been installed in Sternberg Auditorium on the first floor, the proximity of this room to the television studio immediately underneath makes possible the origination of programs from the auditorium with normal camera cable lengths directly to the control room below.

At the autopsy suite in the Institute of Pathology a TV surgical camera, similar to that in the Hospital, is being installed in the ceiling. In addition, cables are available for the simultaneous use of an image-orthicon chain from the floor. The lighting requirements peculiar to autopsy have necessitated a somewhat different light and camera suspension mechanism from that used in the operating room, however, essentially the same functions are involved. Camera cables have also been extended to the surgical pathology laboratory of the AFIP, to several of the teaching classrooms and to Dart Auditorium.

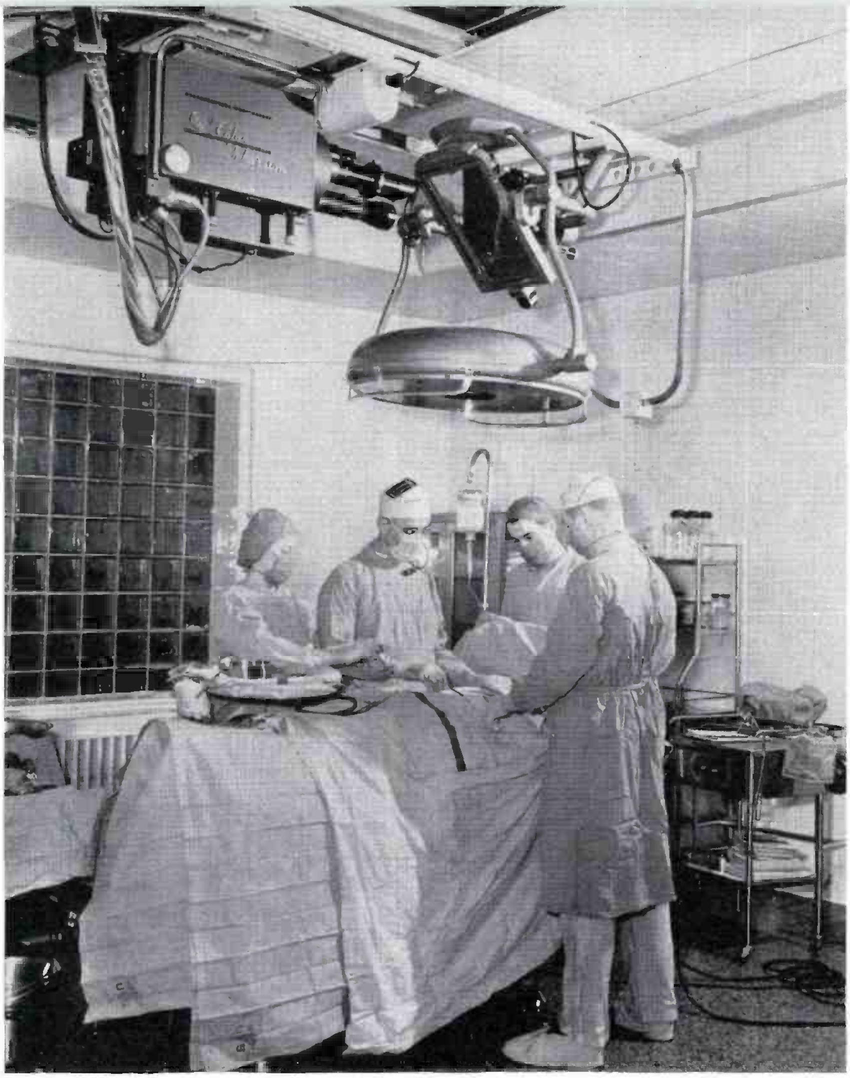


FIG. 9. Medical Color TV Camera is always focused on operating field by means of a mirror used in combination with a special ceiling light, which has a hole in center. Mirror movement and lens switching are remotely operated from the basement control room.

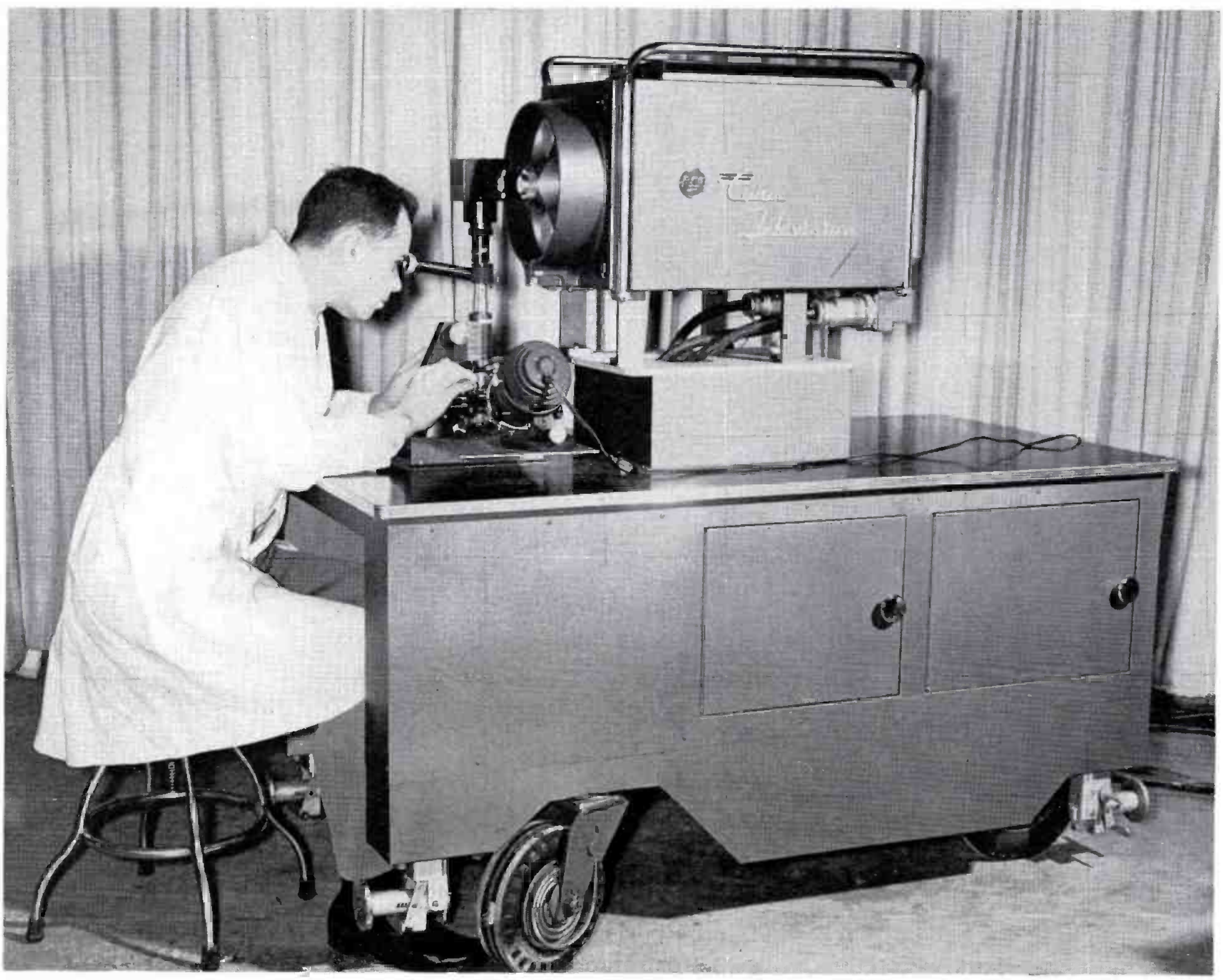
FIG. 10. Medical Color TV Camera is also used in autopsy suite to demonstrate post-mortem surgical procedures. Camera is remotely controlled.

FIG. 11. Ceiling-mounted camera can be swung through full 360 degrees. Travel in north-south and east-west direction controlled by wall switches.

Color TV Microscopy

For use in color TV microscopy there has been developed a television microscope assembly. This utilizes an RCA 3-V color camera, similar to that installed in the operating room and in the autopsy suite. It is mounted on a microscope bench which was developed in the Biophysical Instrumentation Division of the Institute of Research. This bench has mounted on its surface a lathe bed, such as that used in a heavy-duty precision machine tool. On this bed are mounted keyed plates, adapted to fit the bases of several standard types of microscopes used for ordinary microscopy, for dark field microscopy and for phase contrast work. Illuminators of several types are similarly aligned optically, using the device of a keyed base operating on the lathe bed. The television camera itself is suspended in such fashion as to insure alignment with the optical system of the several microscopes employed. The TV camera views essentially the same field as that displayed on the eyepiece of the microscope for use by the demonstrator. The whole of this assembly is mounted on heavy-duty, rubber-tired casters which allow it to be somewhat portable. In order to insure high quality, vibrationless operation, provision has been made for the unit to be suspended from retractable steel plates once it has been placed in a required area of operation. Thus, the television microscopy function can be quickly established in any one of the several locations where cables are available. It is envisaged that primarily it will function in the Surgical Pathology Laboratory, though undoubtedly it will also be used in the AFIP teaching classrooms, in Dart Auditorium, and occasionally in the AFIP studio.

FIG. 12. The Three-Vidicon Color TV Camera is used in conjunction with microscope to demonstrate microscopy before a group. Ordinary microscopy, phase contrast and dark field can be utilized.



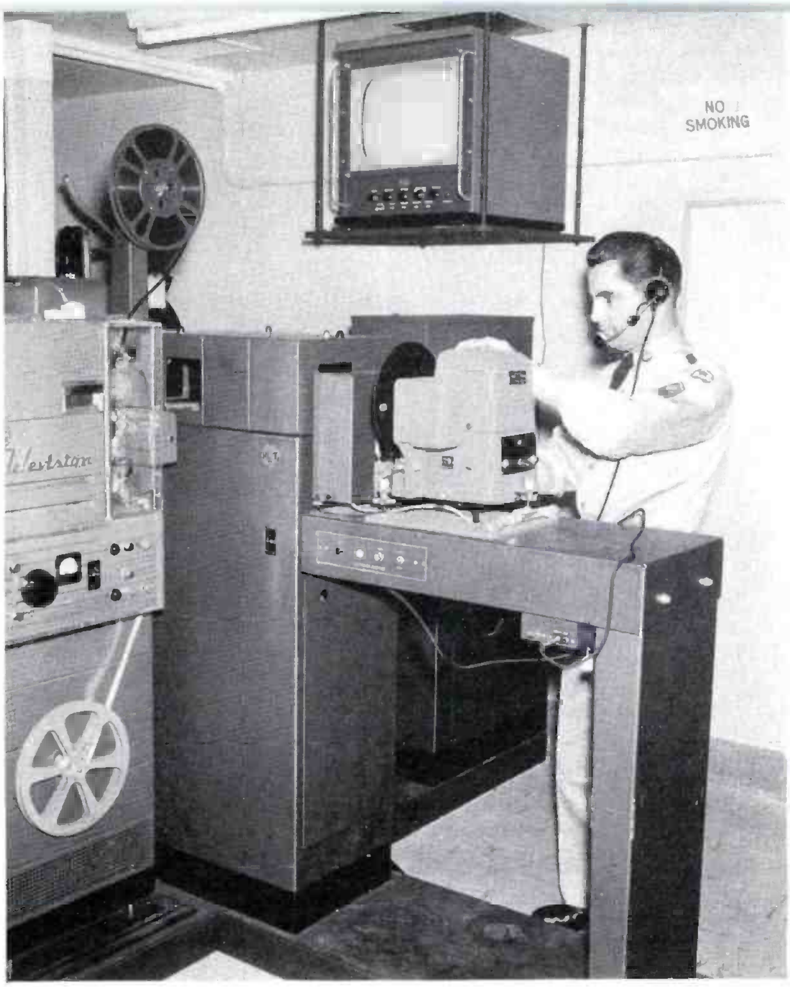


FIG. 13. Central film area in AFIP building serves the entire Walter Reed Army Medical Center. Operation can be controlled locally, or remotely from master control.

TV Film System

Another camera input, located in AFIP, is a film camera chain situated in an area adjoining the AFIP studio. Equipment consists of a TK-26 3-V color film camera, a TP-6 TV film projector, TP-3 dual-disc slide projector and a specially adapted B&L projector. Thus the unit will accept 16mm motion picture films, 2 x 2-inch slides, and 3¼ x 4-inch slides—color as well as black and white.

A point of interest in relation to the film camera chain is that it may be operated either locally or remotely. Remote operation is possible from any one of the three control room areas. This permits slide and motion picture film information to be integrated into programs originating in any one of the three primary locations of the TV Division's activities.

Other limited video inputs are available in the form of a monochrome flying spot scanner, and a monoscope. The flying spot scanner will be used essentially for superimposition of titles and identifications. This unit, incidentally, is located in the same room as the film camera chain. The monoscope is rack-mounted in the camera control room of the AFIP.

FIG. 14. The Three-Vidicon Color Film Camera is employed in film area in conjunction with 16mm motion-picture projector, 35mm and 3¼ x 4-inch slide projectors. Color as well as monochrome may be projected. These films and slides can be integrated into teaching demonstrations from any of the three buildings whenever needed.

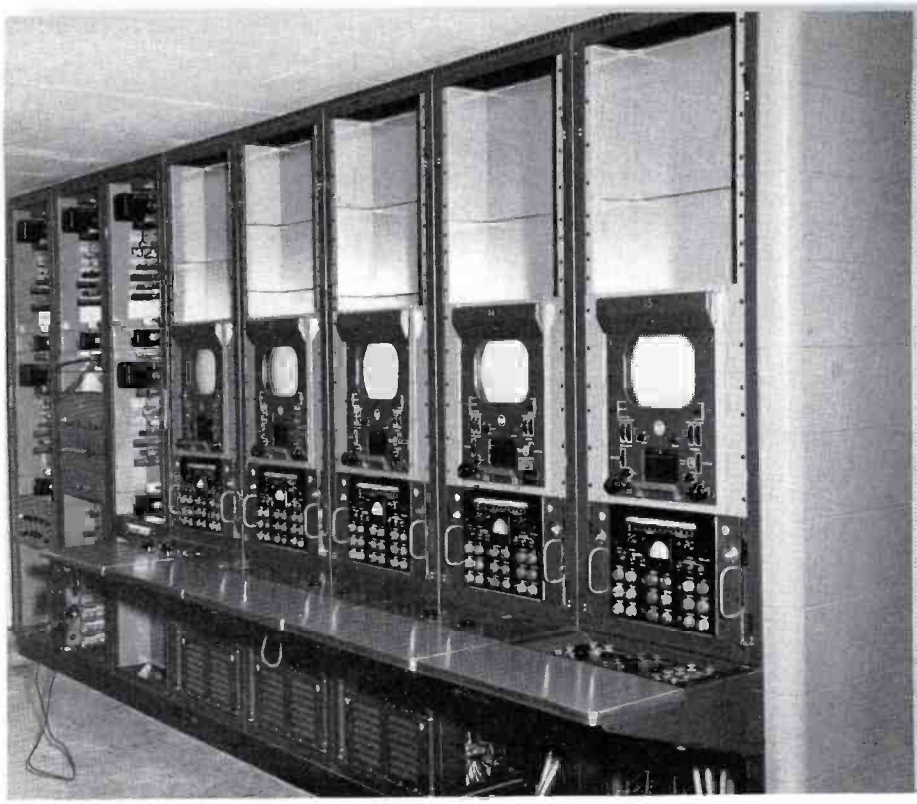


FIG. 15. Camera control room in AFIP building handles three studio cameras, the autopsy camera, and the film camera (also inputs from other areas to which studio cameras may be moved).

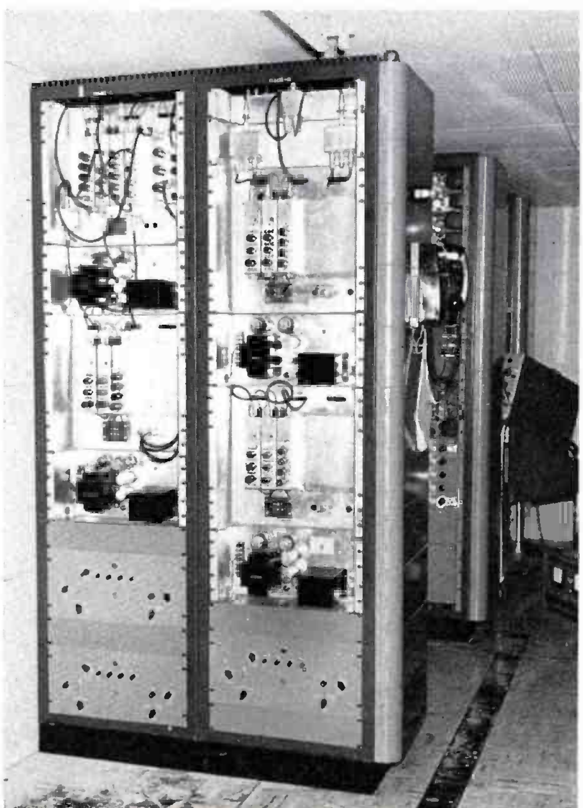


FIG. 16. Three-channel distribution system uses RCA Monitrans. This enables viewer to choose from three programs at any location.

Camera Control Room

In an area immediately adjoining the main studio is concentrated much of the rack-mounted gear used in conjunction with the television equipment located in the AFIP. For instance, in this room, which is separate from the master control room, are situated five color camera controls. These are used for the I.O. cameras in the studio, the input from the 3-V color film camera chain, and the 3-V input from the autopsy unit, as well as any other I.O. inputs which might be used in Dart Auditorium. In the camera room are also located colorplexers, rack-mounted test equipment, rack-mounted switching gear, and the control units for the Antenaplex distribution system and the three monitrans.

Three-Channel Distribution System

In addition to being able to originate three separate and simultaneous programs, these can be simultaneously distributed over cable on channels 2, 6 and 11. RCA monitrans are used for this purpose. One hundred twenty-eight video display areas are represented in the installed cable distribution network. These picture-viewing sites are located throughout almost all of the strategic areas of the Hospital, the Institute of Research, and the AFIP. Presently, sixty 21-inch RCA color receivers are being procured for location according to specific program requirements. In addition, there are two large-screen TLS-50 color TV projection systems, one for the Dart Auditorium of the AFIP and the other for Sternberg Auditorium at the Institute of Research. These units will project a brilliant high-quality image to a size of approximately 4 x 6 feet in color and 6 x 8 feet in black and white.

Kine Recording

Provisions have been made for recording video information from the three program lines. A monochrome kine-recorder utilizing 16 millimeter film has been received on loan from the Army Signal Corps, and it is intended that black and white 16 millimeter motion picture recordings will be made of essentially all information distributed. These films will be used for documentary purposes, but in addition will serve as an excellent basis for continuing program critiques, to upgrade constantly the standards of television performance.

Administration

The Television Division activity functions under the headquarters of the Walter Reed Army Medical Center, Major General Leonard H. Heaton, commanding. Policies are defined and guidance given through the medium of a Department of Army level television policy and guidance committee which includes in its membership the Surgeon General of the Army, the Chief Signal Officer of the Army, the Commanding Generals, Walter Reed Army Medical Center and Brooke Army Medical Center, and selected division chiefs of the several organizations.

Medical TV Programming

At the Post level, the TV Division is assisted in its programming functions by a local program advisory committee numbering in its membership representatives from each of the major interested agencies of the Post and representatives of the several major professional staffs. The local program advisory committee has been meeting regularly and has explored a widely ranging number of program areas. It is considered that from these explorations it will be possible first of all to identify present interest in educational television and simultaneously to stimulate increasing interest by those groups which to date have had little opportunity to explore the medium. This, together with already established courses of training and instruction, insures that there will be no paucity of program material to be developed after the initial program date. Presently, it is projected that during the remainder of fiscal year 1957, there will be a steady increase in both local and off-post program transmissions, these reaching a level of approximately 100 per month by the year's end.

The ultimate capacity of the Division is difficult to ascertain. However, it is expected that this point will be reached during fiscal year 1958, and that it is approximately 150 to 200 programs per month.

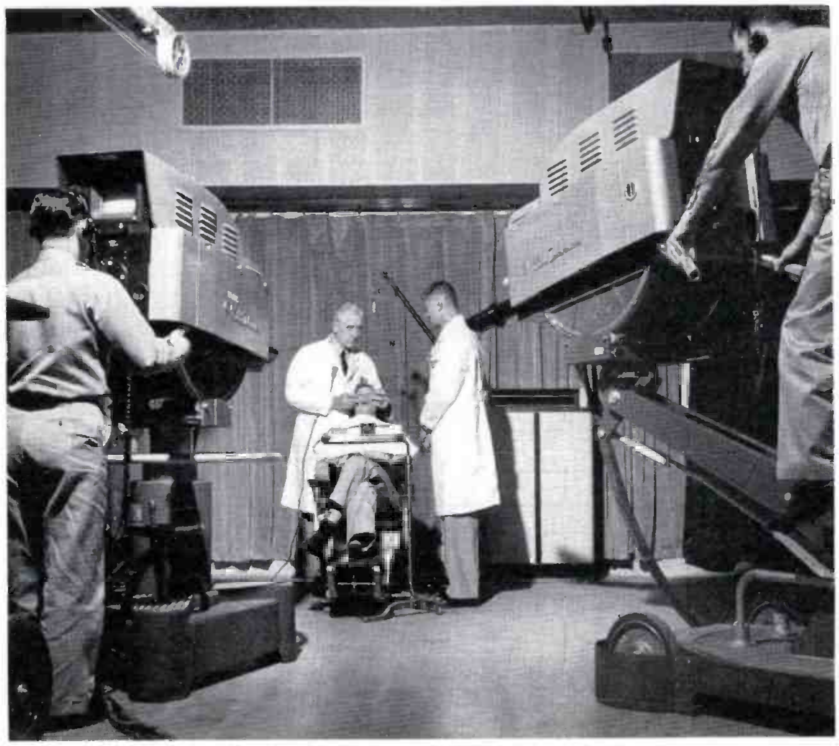


FIG. 17. Typical dental demonstration conducted in the main studio at AFIP building. This program can be distributed to viewing locations in all three buildings and can also be fed to outside networks for distribution to other cities for medical conventions.

FIG. 18. Typical clinical procedure being demonstrated in main studio as part of program to nurses and doctors in viewing classrooms. Professional equipment and techniques are employed.

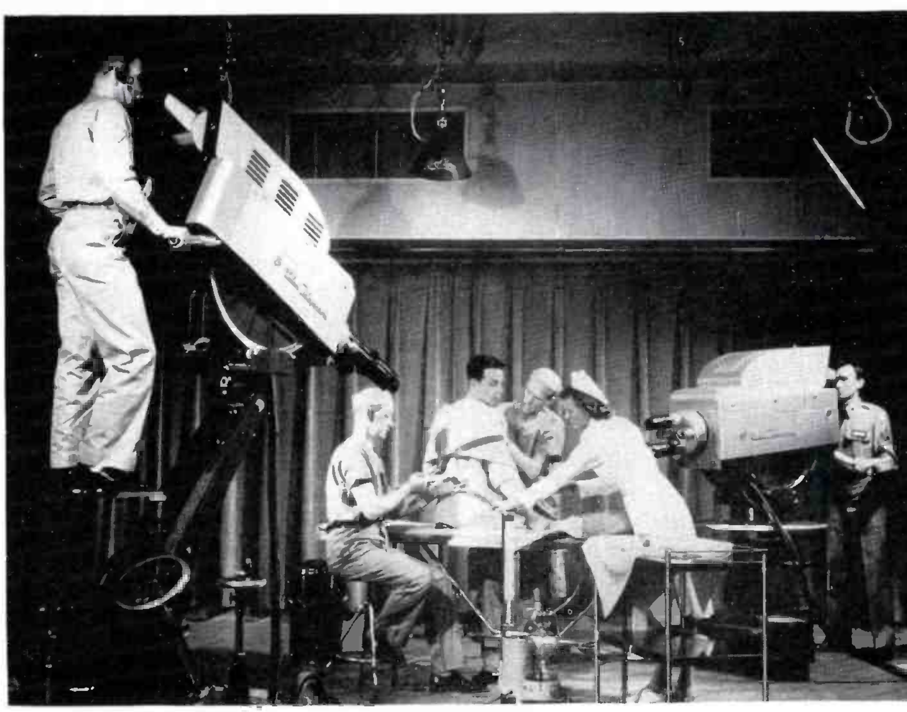


FIG. 19. Professional production techniques are utilized in order to present teaching and training programs with as much impact as possible.

Personnel

Personnel required for satisfactory function of the television system is presently estimated at 47 people, approximately half being civilian and half military. Two-thirds are identified with technical operations responsibility, and one-third with program matters. For instance, in addition to the executive director of the division and his assistant, the program branch consists of a producer, a production co-ordinator, program directors, floor managers, an art director, a writer, a film editor and studio personnel. The technical branch is headed by a chief engineer and an assistant chief engineer, assisted by technical directors. The remaining engineering personnel may be identified as serving video operation and audio operation, maintenance functions, kine-recording and lighting functions. Higher echelons of maintenance on the television system are the responsibility of the Post Signal Officer, who has on his staff for this purpose ten individuals—two civilian and eight military. These persons are also available for technical operation functions in support of the Television Division. Additional assistance, both in maintenance and operation, is available in the form of technical representatives from the Office of the Chief Signal Officer.

Potent Force of TV Instruction

Now, to identify some of the basic reasons for developing an organization of this magnitude: First of all, it represents an implementation of the conviction that television is an effective and potent force in support of the training and education mission of the Army Medical Service. This conclusion was reached after substantial deliberation by several committees of qualified experts representing all of the interested agencies defined with the above responsibility. Not the least significant factor in their decision was the demonstrated effectiveness of the medium of television as it was explored by the Television Section of the Medical Audio-Visual Department of the Walter Reed Army Institute of Research. Further, an analysis of nongovernmental experiences with the medium suggests that limited though its application has been, its potential is very real. It has been ascertained that television has an almost hypnotic attention-focusing characteristic as it has been observed in the commercial broadcast field, and a similar effect has seemed to characterize its application in the training and educational area. Indeed, the documented studies which exist suggest that the television medium has the potential for information transmission essentially equal to that of a live instructor before a class.

Even a kine-recording seems to retain a large percentage of this effectiveness. Some studies suggest that the use of live television modified to take advantage of its several unique characteristics has in fact a larger effectiveness in information transmission than that inherent in the live instructor before a class. Such things as the use of close-ups and the incorporation of high-quality forceful programming into the presentation should be pointed out.

Economics of TV Teaching

It would probably be meaningless to outline in detail the advantages the use of such an effective medium would have to those charged with major training and educational responsibilities within the Army Medical Service. Perhaps one example will suffice: The present course for instruction concerning the care of mass casualties has now been presented for approximately three years. Rarely has it been effectively displayed before an audience exceeding 100 persons, and this at very substantial cost when one considers dislocation from normal duty, the cost of per diem—the cost of transportation of faculty, and even then many of the participants have had a remote, back-row seat.

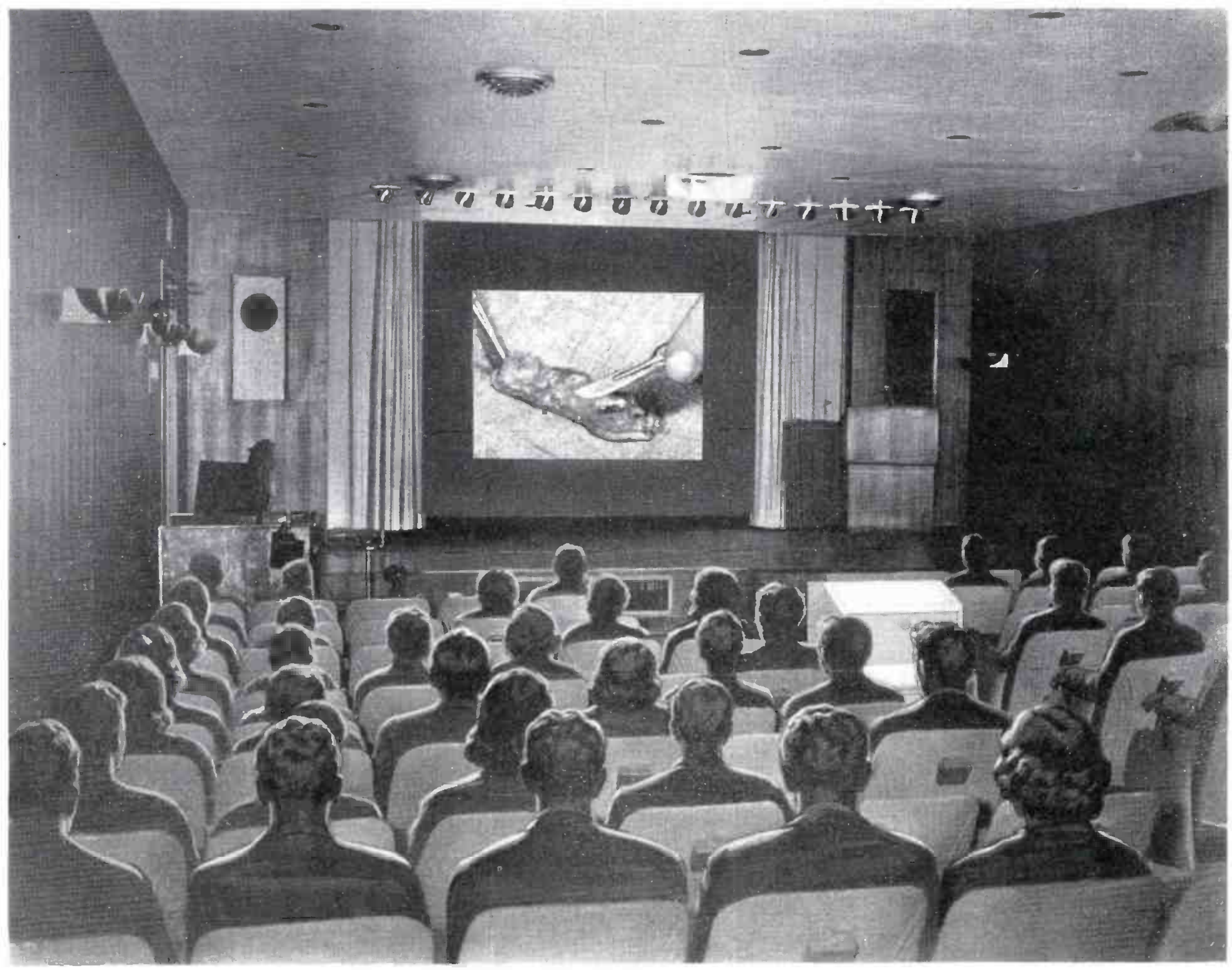
Utilizing the medium of television, a similar or perhaps even better program can be presented simultaneously to an essentially unlimited audience of physicians, nurses, dentists, veterinarians, semiprofessional medical personnel, and the laity—and this at a very small per-student cost.

Unique Advantages of TV

To go to another extreme, television makes possible the viewing by large numbers of phenomena which either can at best be viewed by only a limited few, or perchance cannot be seen at all directly by the human eye either due to extreme personal hazard or some other limiting factor. The television camera can be regarded essentially as a projection of one's ability to see, and this projection is unlimited by such matters as time and space.

Actually one is able to create an almost ideal one-to-one student-teacher relationship for an unlimited number of people, widely dispersed over an unlimited geographic area and, through the medium of recording, without the limitation of time. These, then, are some of the factors basic to the decision for implementing a major television activity in support of those many areas in the Army Medical Service wherein the projection of information represents a vital requirement, this certainly existing in many of the training, educational, research, informational, service and administrative programs of the Army Medical Service.

FIG. 20. RCA color TV picture projector is used in auditorium and large classrooms. This presents a picture in full color in size suitable for an audience of several hundred persons. Note typical use in auditorium shown in illustration below.



RCA INTRODUCES A COMPLETELY
"FAMILY" OF AUDIO

A model to "fit" every station requirement...

ALL HAVE "BUILT-IN" POWER SUPPLIES, MONITORING AMPLIFIERS AND SPEAKER RELAYS

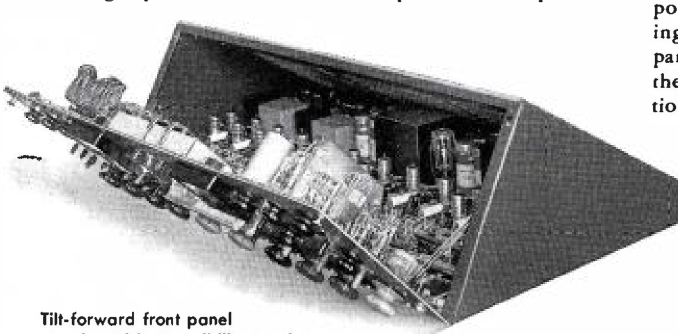
Here is a "family" of three consolettes that give you the widest choice of facilities ever offered. All have printed-wiring amplifiers in modular construction, providing the utmost in circuit uniformity and performance. Each model has its own "built-in" power supply (the BC-6A has two). Each has built-in monitoring amplifiers and speaker relays.

INSTALLATION IS QUICK, EASY...INEXPENSIVE

The "self-contained" feature of all three models makes them easy to install. There is no need for costly external wiring and "hunting" for a place to mount such items as power supplies, monitoring amplifiers and speaker relays. The reduction of external wiring minimizes the chance of stray hum pick-up greatly improving system performance.

CONVENIENT OPERATION

The low height of each consolette affords maximum studio visibility . . . no stretching to observe cues. Relaxed wrist comfort is provided by mixer controls on the right slant . . . at the right position above the desk top. RCA-developed finger-grip knobs provide convenient, positive control and are color coded for "function identity."



Tilt-forward front panel permits quick accessibility to mixer pads and spring contacts; makes maintenance easy.

EASE OF MAINTENANCE

Routine maintenance time is reduced by the quick accessibility of all components . . . easy-to-clean mixer pads, simple-to-adjust leaf-spring contacts on key and push-button switches. This is achieved by a snap-off top cover and a tilt-forward front panel, in addition to strategic placement of components.

RCA MATCHED STYLING PERMITS EXPANDABILITY

Styled with 30-degree sloping panels which match previous equipments such as the BC-2B consolette, BCM-1A mixer, and compatible among themselves, a wide range of augmented facilities is possible. Paired BC-5As provide dual channel operation and extended facilities. Addition of the BCM-1A mixer to any of these consolettes is simple and provides added microphone inputs.

THEY WORK WELL INTO CUSTOM ARRANGEMENTS

Simple functional design and "engineered" compactness makes any number of custom installation arrangements possible. A custom "U" arrangement of two BC-5As flanking a BCM-1A mixer is possible. The 30-degree front panels match the slope of video control equipment making them suitable for use in television studio custom applications as well as in radio.

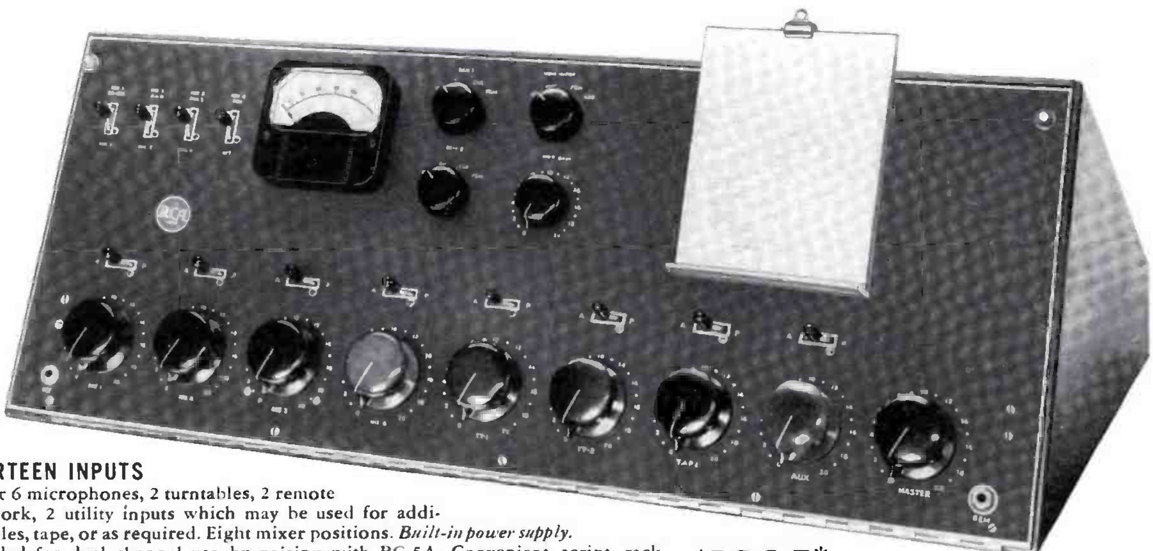
Ask your **RCA** *Broadcast Sales Representative for detailed information*

RADIO CORPORATION of AMERICA

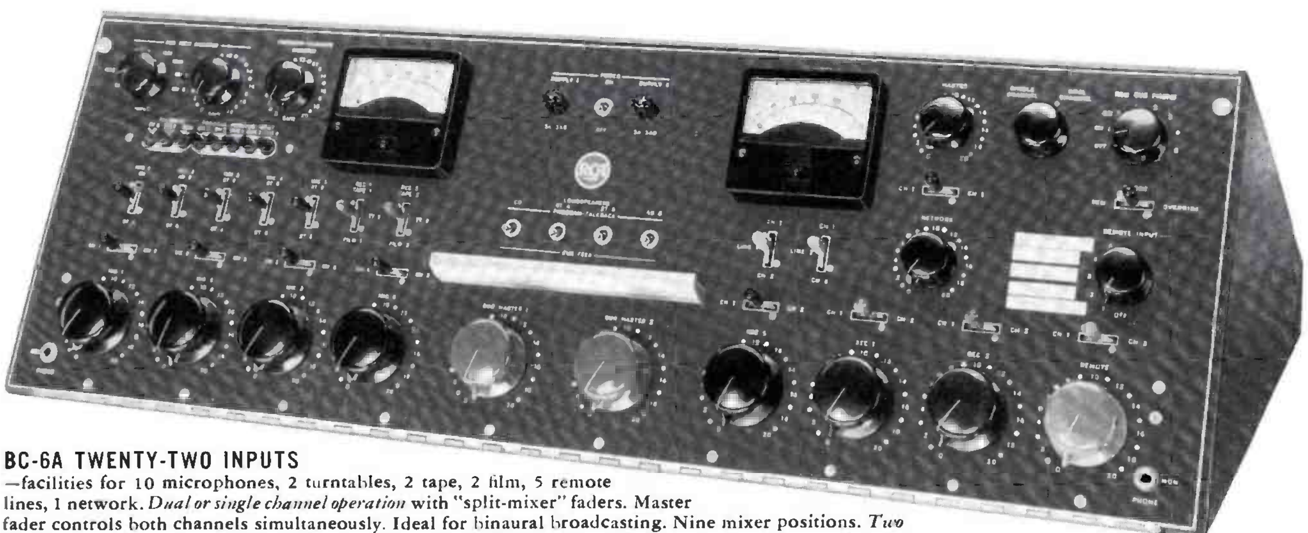
BROADCAST AND TELEVISION EQUIPMENT • CAMDEN, N. J.

NEW CONSOLETTES

BC-5A NINE INPUTS
—facilities for 4 microphones, 2 turntables, 2 remote lines, 1 network or tape. 4 mixer positions. *Built-in power supply.* Easily expanded for dual channel use by "pairing." Block building lends "custom touch" when paired with existing BC-2B's................. **$875***



BC-3B THIRTEEN INPUTS
—facilities for 6 microphones, 2 turntables, 2 remote lines, 1 network, 2 utility inputs which may be used for additional turntables, tape, or as required. Eight mixer positions. *Built-in power supply.* Easily expanded for dual channel use by pairing with BC-5A. Convenient script rack. **$1095***



BC-6A TWENTY-TWO INPUTS
—facilities for 10 microphones, 2 turntables, 2 tape, 2 film, 5 remote lines, 1 network. *Dual or single channel operation* with "split-mixer" faders. Master fader controls both channels simultaneously. Ideal for binaural broadcasting. Nine mixer positions. *Two built-in power supplies* (one for each channel) for greater reliability. Two monitoring channels, one for program monitoring and talkback, one for cueing and feeding background to studios. Convenient script rack. **$1750***

**Less Tubes—Prices subject to change without notice.*

COLOR

RCA LIVE COLOR CAMERA

"ALL-IN-ONE" PROCESSING AMPLIFIER — All-electronic unit provides identical control equipment for both live and film camera chains.

SPACE SAVING EQUIPMENT — Only 100 inches of rack space required for all equipments necessary to operate camera chain. With monitors and processing amplifier at the console, only ¾ of a rack needed for efficient complete installation.

NEW POWER SUPPLY — Occupies only ½ space of former d-c power supplies . . . high efficiency plus high output . . . 1500 ma.

CENTRALIZED CONTROLS — Minimize setup time . . . only two controls in "on-air" operation. In addition, over-all stability, peak camera performance and picture quality are assured.

means business!

STATIONS NOW USING LIVE COLOR TO BUILD HIGH SPONSOR INTEREST

Equipped with RCA Live Color Camera Equipment, alert station managements are trail-blazing along the new frontiers of television . . . adding brilliant dimensions to programming techniques, transforming commercial products into thrilling reality. These progressive television stations are using local color originations to build prestige and stimulate sponsor interest.

LIVE COLOR STATIONS

KHQ, Spokane	WBAL, Baltimore	WJAC, Johnstown
KJEO, Fresno	WBEN, Buffalo	WKY, Okla. City
KMTV, Omaha	WBTV, Charlotte	WNBQ, Chicago
KOMO, Seattle	WCBS, New York	WOAI, San Antonio
KRCA, Los Angeles	WCCO, Minneapolis	WRCA, New York
KRON, San Francisco	WDSU, New Orleans	WSAZ, Huntington
KTLA, Los Angeles	WFBM, Indianapolis	WTMJ, Milwaukee
WBAP, Fort Worth	WGN, Chicago	WTVJ, Miami
WFIL, Philadelphia	WRCV, Philadelphia	WCAU, Philadelphia
WBRE, Wilkes-Barre	KARD, Wichita	WGAL, Lancaster
KCMO, Kansas City	WJBK, Detroit	KGW, Portland

Local studio originations, and live commercials in color are making sponsors sit up and take notice. Your station can spark the same type of advertiser interest in production of live color with RCA's color camera equipment! For complete technical information call your RCA Broadcast Sales Representative. In Canada write RCA VICTOR Company Limited, Montreal.

RCA PIONEERED AND DEVELOPED COMPATIBLE COLOR TELEVISION

RCA®

RADIO CORPORATION of AMERICA

BROADCAST AND TELEVISION EQUIPMENT CAMDEN, N. J.

New Standard of Comparison in Pick-up Tubes

RCA MICRO-MESH IMAGE ORTHICONS

Commercially Proved-In On-Air for dependable, improved picture quality

Designed to keep pace with ever-improving programming techniques, RCA "MICRO-MESH" Image Orthicons are being acclaimed by station men as the finest camera tubes ever used in commercial television.

With a mechanical exactness heretofore unattainable, RCA MICRO-MESH design has increased the mesh fineness of camera tubes from 500 lines per inch—*to 750 lines per inch!* This improvement works for you three ways. (1) It enables you to "kill" mesh pattern and moiré effect without need for defocussing the picture—whether you are on black-and-white or color. (2) It substantially improves picture-detail contrast. And (3) RCA Image Orthicons with MICRO-MESH are particularly effective in permitting the use of adequate aperture correction to improve detail contrast when the tube is operated below the "knee" of its transfer characteristic—as occurs in color television.

MICRO-MESH design—another RCA original development in TV camera tubes—exceeds all present-day requirements for high-quality pictures in all RCA Image Orthicons and Vidicons—*at no extra cost to you.* RCA camera tubes with MICRO-MESH are available from your RCA Tube Distributor. For technical data on RCA camera tubes, write RCA Commercial Engineering, Harrison, N.J.

Why Station Men like MICRO-MESH

- Eliminates mesh pattern and moiré effect without defocussing.
- More than meets all technical requirements of 525-line TV system.
- 750-mesh tube with aperture-correction circuit provides 100% response for 350-line information. 500-mesh tube without aperture-correction circuit permits only about 60% response for 350-line information. Although correction circuit can be used with 500-mesh tube, such use emphasizes moiré and beat-pattern problems.
- Micro-Mesh minimizes beat pattern between color subcarrier and frequency generated by beam scanning mesh-screen pattern.
- Improves detail of color pictures.

CAMERA TUBES FOR TELECASTING

® RADIO CORPORATION OF AMERICA Tube Division, Harrison, N. J.

3J2985 Tmk(s) ® Printed in U. S. A.