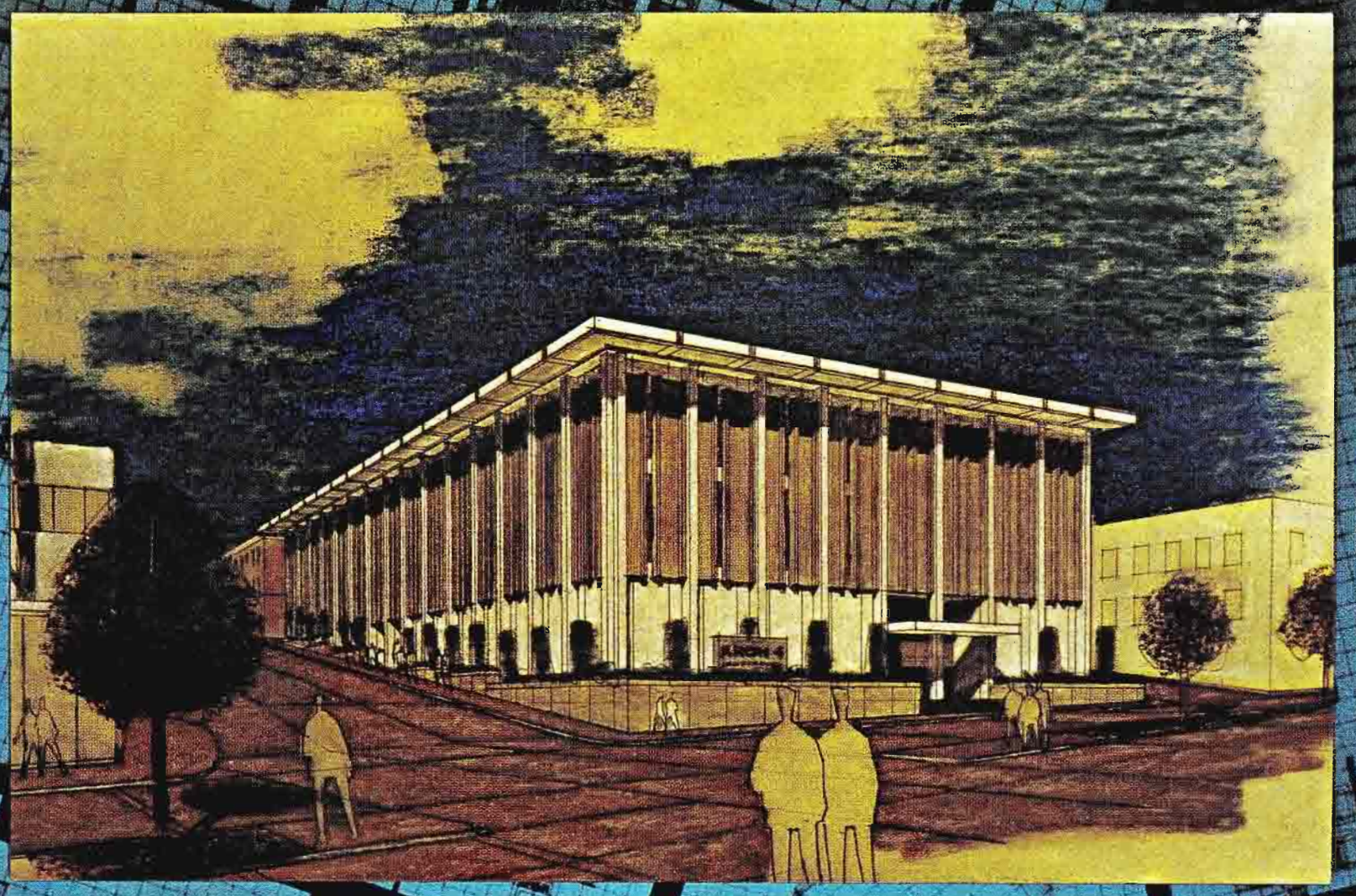
BROADCAST NEWS



KRON-TV Plans a New Look Station

Vol. No. 131 DEC 1966

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BUILDING 15-5, CAMDEN, NEW JERSEY

The Most Trusted Name in Electronics

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As We Were Saying

KRON-TV is featured on the cover, and in the lead article of this issue. The cover shows two of the architect's sketches for the new KRON-TV building—and the article describes the planning of the new KRON-TV installation. We've given this a lot of space, and it may seem that we have gone overboard—but we don't think so. This new KRON-TV installation represents the largest investment in all-new color equipment yet made by an independent station—and when completed, it will be one of the finest station installations in the country. It is notable and interesting for still another reason—namely the careful and detailed planning which has gone into it. In fact this impressed us so much that we decided to do an article just on the planning—and it is this article that starts on Page 10. Next year, after the installation is completed, we will have a second article describing the station and equipment.

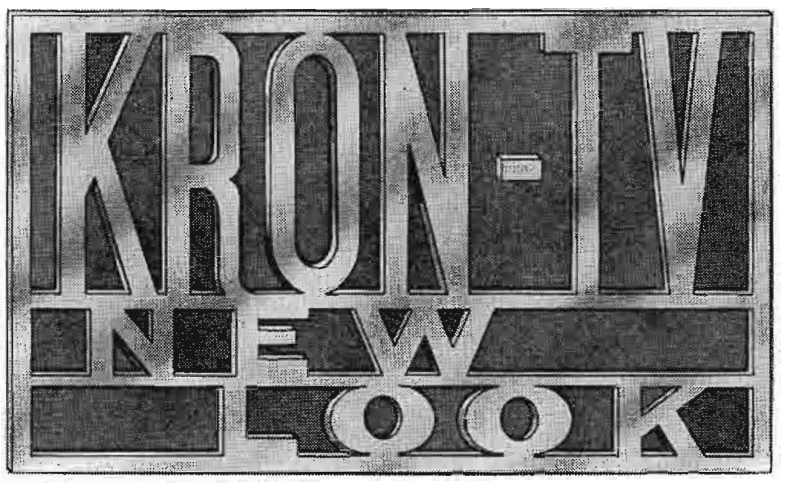
HOW the planning was done is emphasized in this KRON-TV article—because we think this is the aspect of most interest to our readers. It is not often that an engineer gets a chance to plan an all-new station—and when he does, he needs all the help he can get. One of his best aids is information on how other stations have gone about it. That's why we run as many good planning stories as we can. Many station engineers have told us they keep a file of these—for use when they start planning their dream station.

As We Were Saying

WHO takes the lead in planning a new facility depends somewhat on the station. Obviously a new building involves every part of the station operation—and a lot of people get into the act. However, a TV studio installation is primarily a technical facility with a business area wrapped around it. Thus the planning has to start with the technical planning, and more often than not it devolves upon the technical people in the station to plan not only the layout of the technical area but also to work with the architects on the layout of the rest of the building. At KRON-TV the "technical people" means not just Lee Berryhill, Chief Engineer, who did the development engineering and designed the custom-built units and assignment switcher concepts, and his technical crew, but also Harold See, President of Chronicle Broadcasting. Before he moved into management, Harold See was one of the industry's best known broadcast technicians. His record includes 17 years with NBC engineering in pioneering development and operations activities. One of his early assignments with NBC was to install and operate NBC equipment on Pan American's China Clipper, which was used for broadcasting radio remote special events during the ship's trial flights. This equipment was later transferred to the Philippine Clipper and in December, 1935, Mr. See was aboard the maiden flight of the Philippine Clipper, from San Francisco to the Orient via Hawaii. This was 18 months before the first scheduled passenger flights. Soon afterward he became a member of NBC's first field television operation. He designed the operating features of the first TV mobile units in the country and supervised the installation of their equipment in the old RCA 53 Building, Camden. In 1940, he directed the NBC engineering crew that televised the Republican Convention. During the war he worked on BLOCK and RING, the first airborne television reconnaissance and bombing equipments. After the war he headed NBC's television operation in Washington. In 1948, he went to WBAL as television manager, and in 1949, he joined the Chronicle organization as General Manager of KRON-TV. With this background you could expect that he would take a leading part in planning KRON-TV's new installation.

NBC's EXPERIENCE with PORTABLE TELEVISION EQUIPMENT

Incidentally, this is not Mr. See's first appearance in BROADCAST NEWS. He was the co-author (with the late Bob Shelby) of an article in our August, 1944 issue which described NBC's early experience with portable TV equipment (see illustration).



WHAT Harold and Lee planned is just about the most beautiful installation you can imagine—an engineer's dream of a station. A striking building—extremely functional—uniquely arranged for access and traffic flow (and separation). A well thought-out technical area with many unusual features. An array of equipment that will make any engineer drool. New TK-42 live color cameras, new TK-27 film color cameras, new high-band color tape recorders, all custom-built consoles, and the most flexible assignment and switching system we've ever seen. And all of this equipment assembled, wired and unit-tested in the RCA plant before shipment.

The people at Chronicle, starting with Charles Thierot, President of Chronicle's parent company, The Chronicle Publishing Company, and especially Harold See, Al Constant and Lee Berryhill, had talked and dreamed of this new facility for years. Now their dream is approaching reality; the building is nearly finished; the equipment almost ready—we think the result is going to be worth all their time and work.

OUR DREAM, too, is wrapped up in this KRON-TV installation. Some years ago we had a dream of a whole new look in broadcast station equipment. Our engineers started working on it and in our April 1964 issue we formally introduced the RCA "New Look." We went to some length to explain that we thought of the New Look not just as a slogan, or even just as a new line of equipment—but rather as a program to revolutionize station technical facilities. In pointing out all of the advantages of the New Look equipment — transistorization, modularization, stabilization, standardization — we emphasized that stations could make the most of these by planning a "new look" program of their own. Hundreds of stations have found the New Look equipments to their liking — and many of them have new look programs of their own. Some have already completed all new look installations. But it has remained for KRON-TV to plan an all-new, all new look, all-color installation on so large a scale. It's what we dreamed of — and we can hardly wait. When all of that beautiful, beautiful equipment is in place, we're going out there and spend a week just looking at it.

As We Were Saying

ETS and ITS, and little lambsie divie. The letters ITS (for Instructional Television Service) have joined the jargon of the industry—alongside AM, FM, VHF, UHF, ETV, CATV, etc. And all is confusion! What means what? We can resolve it — somewhat — by juxtaposition. (Webster says that means " . . . placing two or more objects in close . . . . relationship!!)" The NAEB uses ETS (for Educational Television Station) in referring to "educational" broadcast stations operating in the standard VHF or UHF bands — and they're pretty official about it. The FCC applies the term "Instructional Television Fixed Service" to stations operating in the 2500 MHz band and transmitting programs intended for classroom instructional use. Ipso facto, ETS means 54-890 MHz stations, ITS means 2500 MHz stations.

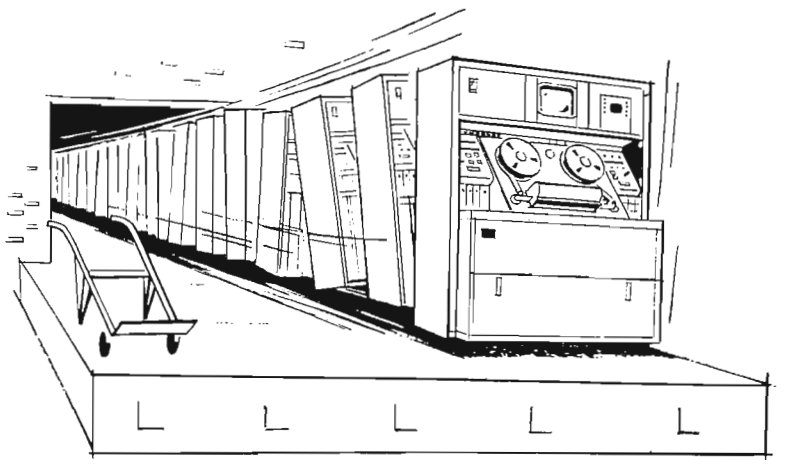
Both ETS and ITS have quite a future. If Fred Friendly and his friends have their way, there will be a nationwide "second service." That will make ETS operation more attractive and there will, no doubt, be many more ETS stations. But ITS also has its attractions. It allows a school system to have a multi-channel system — and the transmitting equipment is much less expensive. For straight classroom instructional use this is a big advantage — and ITS systems are now springing up all over the country. The article on Page 46 provides an introductory look at ITS. In future issues we will describe some operating ITS systems. The present article is based on a paper Noel Luddy presented at the recent NAEB Convention — and for more about Noel read on.

NOEL LUDDY MOVES to Washington on January 1, to fill an important new post in our broadcast sales organization. His tongue-tying title will be Manager, Broadcast and Communications Consultant Relations. His assignment—as announced by Ed Tracy, Vice President, Broadcast Sales — will be to maintain liaison with consulting engineers and attorneys, to keep them advised on new developments in equipment, and to provide them with specifications, filing data and other information they need on RCA equipment.

E. N. "NOEL" LUDDY, who has been appointed Manager, Broadcast and Communications Consultant Relations. He will make his headquarters in the RCA office at 1725 "K" Street, N. W., Washington, D. C.

THOSE WHO KNOW NOEL will certainly applaud this move, and particularly his friends in Washington (who should be tickled pink) — because we can hardly imagine a better man for this job. He has the knowledge—for the past fifteen years he's been planning and overseeing our transmitter line. He has the experience—for this same time he's been working with consultants, station engineers and FCC people. He has the touch — his presentations are always a mixture of straightforward fact, sparkling wit, and humble sagacity — a real pipe-smoking blend. He's got the taste that's right — meaning he's what you like.

Noel started in broadcasting as a student engineer at the University of Kentucky radio station in 1939. During the war, as a major in the Signal Corps, he was the Radio Officer for the Pacific Theater Air Force Command. After the war he was chief engineer at KFDA in Amarillo for five years before coming to RCA. As we were saying — it's a background you can hardly beat — and he's a guy you can hardly help liking.



OH HAPPY DAY—the TR-70's are finally rolling off the production line. The first eight recorders came out of factory test in December. Two of them we've kept for testing of high-band head-wheels. The others have been shipped—some to customers, including NBC and BBC; others are on their way to Europe where they will be PAL-ized before delivery to RAI and WDR. What a Christmas present! In January there will be lots more TR-70's—in February still more—and by NAB time TR-70's will be going out at a rate of one every working day.

So the moment of truth is upon us—the moment when they test our oft-repeated prediction (that "the TR-70 will turn out to be the finest tape recorder made"). Do we tremble, do we shake, do we crawl under the bed—uh-uh, we don't even have our fingers crossed. We're sure of the verdict. As we've said before, it takes time to do it right (and we sure took it!!*!!).

TR-70's come in for a lot of attention in this issue (no coincidence, of course). In the Viewfinder (Page 6) is a story on factory production of TR-70's. Starting on Page 28, is an article which describes in some detail the features of the TR-70 Tape Recorder. And on the back cover is a color ad we've been running for the past few weeks in the trade magazines. As we were saying—it's a happy day.

— The Armchair Engineer

...now No. 200 joins the

RCA ships 200th TK-42

"Big Tube" Color Camera

No. 200 went to Kaiser Broadcasting Corporation, one of an order of 15, for stations in Boston, Philadelphia, San Francisco, Los Angeles and Detroit. Others have gone to similar group-owned stations, independent and network-owned stations, U.S. Government and foreign broadcasters.

The overwhelming preference for the "Big Tube" TK-42 among top stations that have carefully researched their color camera requirements has created an unprecedented demand. This has now stepped up production to such a rate that over 300 are expected to be in service by NAB, April 1967.

Use of a 4½-inch image orthicon in the separate luminance channel is an exclusive feature. Besides improving color picture quality, the "big tube" assures highest quality pictures on black-and-white sets.

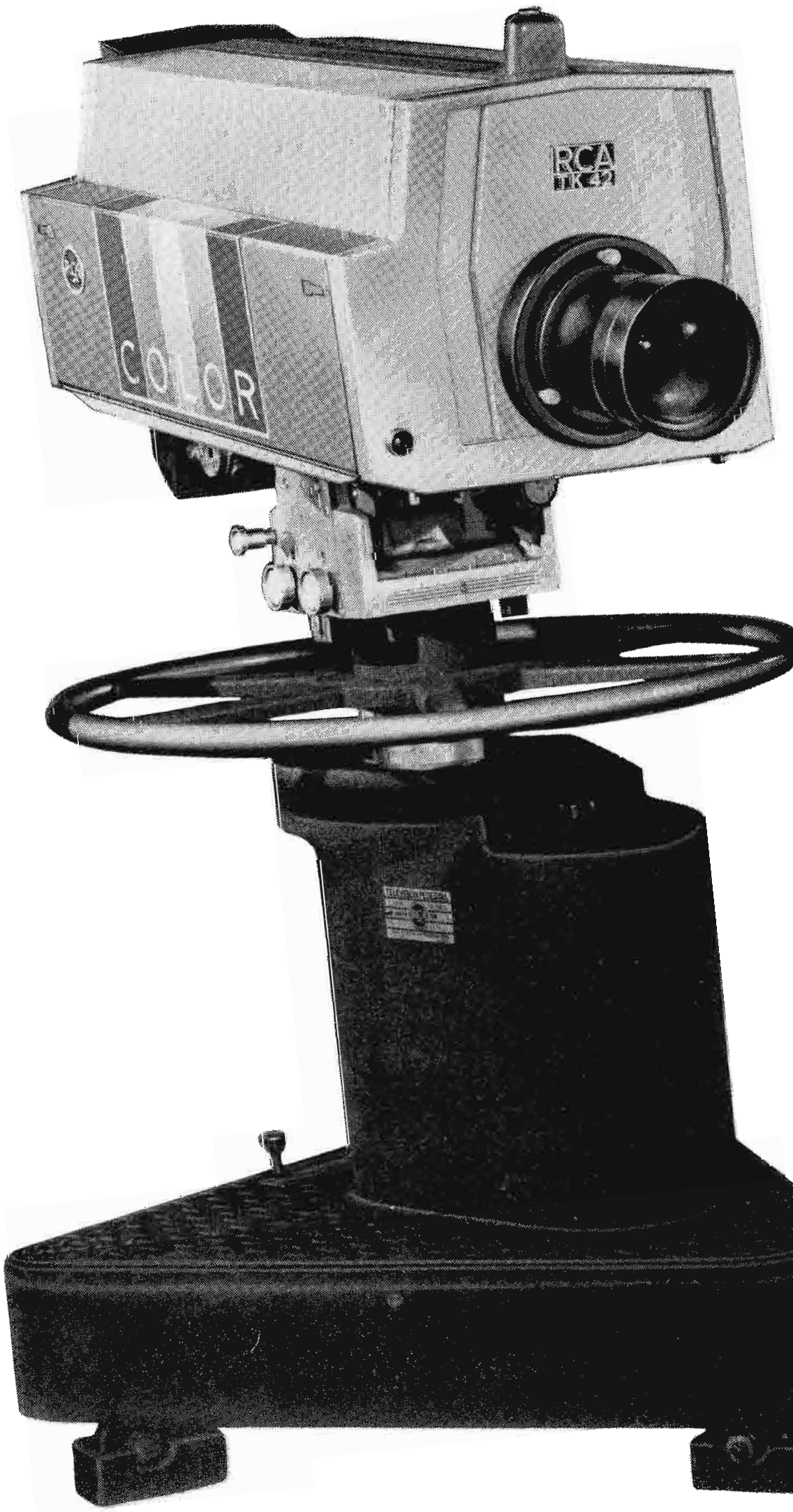
Broadcasters everywhere who are now using the TK-42 tell of its superiority in producing consistently better color pictures—including ability to handle details too fine to be passed by the chrominance circuits. No wonder color pictures are getting better and better!

For more information about the TK-42 Color Camera call your RCA Broadcast Representative.
Or write RCA Broadcast and Television Equipment, Building 15-5, Camden, N. J.

RCA ®

THE MOST TRUSTED NAME IN ELECTRONICS

Big Parade!



TR-70 COLOR RECORDERS IN FULL PRODUCTION AT RCA'S CAMDEN PLANT; DELIVERIES BEGIN

New and expanded production facilities at RCA Camden are turning out TR-70s in volume. As we went to press, first units of the industry's newest high band color tape recorder were customer bound.

Before it is pronounced ready for top performance on a day-to-day basis, every TR-70 goes through a rigorous test cycle lasting 240 hours. Only then is it stamped "OK to ship."

Broadcasters expect that kind of quality built in. TV viewers will see the end result, in color pictures of unparalleled sharpness and brilliance when the TR-70s reproduce their first color tapes on the air.

The TR-70 will provide the ultimate in recording/playback performance consistent with the "state of the art" in TV tape equipment design. It is rapidly being recognized by broadcasters as the most versatile and sophisticated television recording system currently available.

Introduced at the 1966 N.A.B. convention, the TR-70 is the first high band recording system to be completely factory assembled and ready for use upon installation at the broadcast studio.

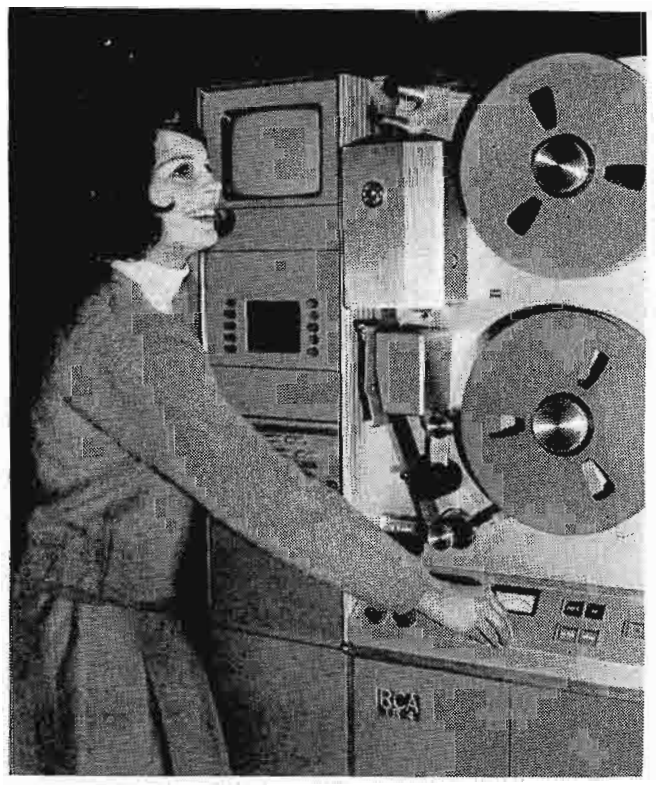
With the high band mode, a relatively new TV tape recording standard, tapes are recorded at a higher FM frequency than heretofore. This accommodates more detailed picture information and improves the signal-to-noise ratio, resulting in the sharper, more brilliant color pictures.

In busy test area, TR-70s get rigorous 240-hour check before delivery to broadcasters.

The TR-70 is capable of producing rerecordings of taped programs into the fourth generation with no significant loss in picture quality. Instant selection by switch of a choice of three recording standards — low-band monochrome, low-band color, or high-band monochrome/color—makes the TR-70-compatible with most other broadcast-quality TV tape recorders now in use. This means that tapes recorded to broadcast standards on one machine may be played back on another.

RCA produces four other color television tape recorders for the television industry: types TR-22, TR-3, TR-4 and TR-5. More than 1,200 of these and predecessor machines are in use by domestic and foreign broadcasters.

MODIFIED TR-4 SHOWS SUPERIOR COLOR PIX IN HIGH BAND



TR-4 is a delight, as Connie Martin attests.

An economical means for attaining the superior performance possible with high-band operation of color TV tape recorders was demonstrated by RCA at the National Association of Educational Broadcasters 1966 convention in Kansas City, Mo. Visitors to RCA's equipment exhibit were shown a compact TR-4 color tape recorder which had been converted to high-band operation through minor changes which include the replacement of but 12 solid-state modules.

The modifications provide users of most existing RCA color tape machines with the benefits of high-band operation without the necessity of investing in a new high-band recorder. RCA type TR-22 and TR-3 machines also may be modified. Conversion to high-band operation gives the local station the newest and best tape production tool for delaying broadcasts and for local programming needs, and its viewers enjoy superb pictures from tape. A converted machine also may be operated in low band.

RCA engineers at the exhibit reminded visitors of the advantages of high-band operation in both color and monochrome and pointed out that networks were converting to high band tape for the improved picture sharpness and elimination of undesirable effects that it provides. For networks and other heavy users of color tape, RCA produces a complete integrated high-band color tape system, the TR-70, which was introduced last spring and now is being delivered to broadcasters.

The high-band conversion kits, which make use of the basic TR-70 design, are scheduled for production at RCA's Camden, N. J., plant beginning next May.

HERE'S TINT IN YOUR EYE: NEVER SO MUCH COLOR AT AN NAEB

Hue was the view for educational broadcasters who gathered in annual convention in Kansas City, Mo., during late October. The fact was, never before had they seen so much color TV equipment in operation at an NAEB show.

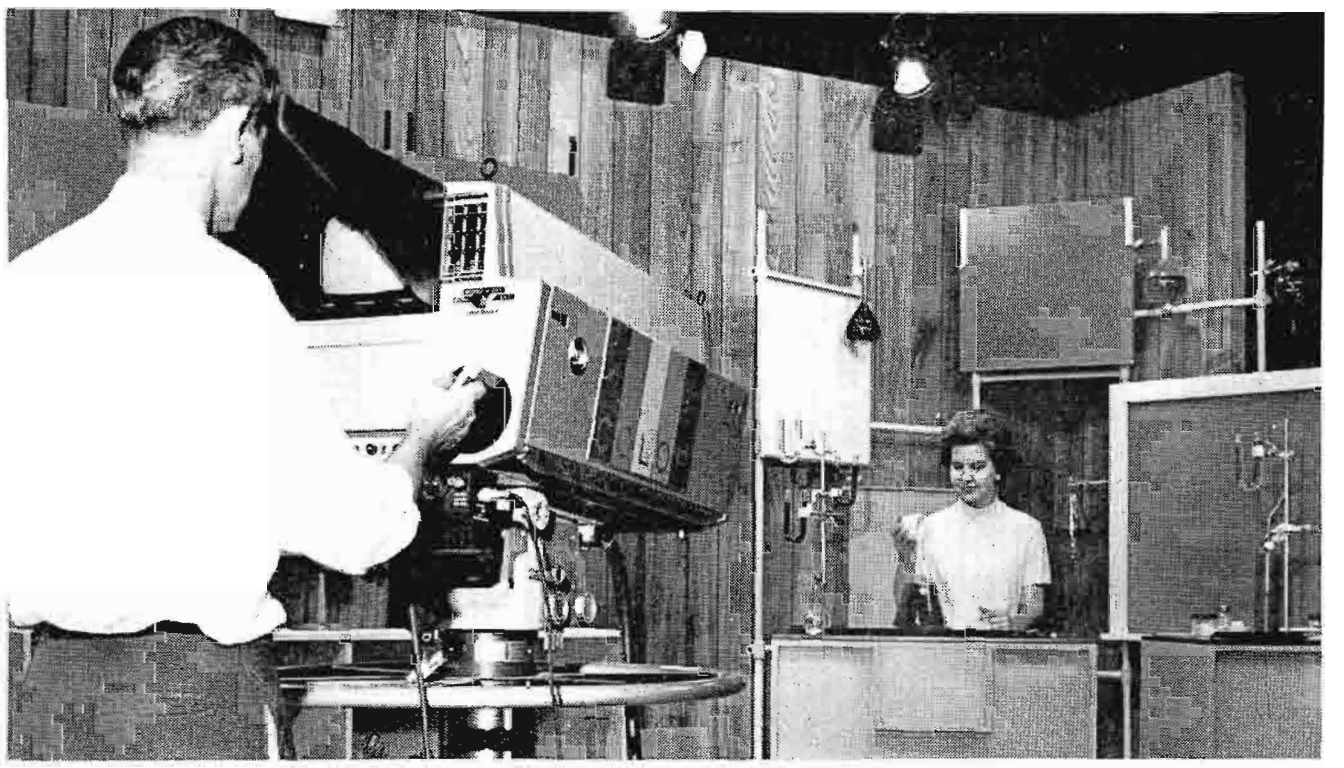
RCA billed its 2400-square-foot exhibit as a preview of the coming "Color Age" in educational television. Its representatives there told visitors that the big display was the company's response to the active interest NAEB people are showing in color programming and the new technical equipment for color.

The RCA color demonstration studio was a simulated chemistry lab where beakers of colored fluids and other laboratory trappings gave the TK-42 color camera a good choice of chromatic targets. Educators, watching the experiments unfold, could observe how color added interest and impact to the televised scene.

RCA's exhibit handlers went all the way for realism by engaging a real-life chemistry teacher, on leave from a nearby private school, to appear before the TK-42. She performed and described her experiments with the attractiveness and grace of a practiced TV player.

Besides "live" color, RCA's visitors could see color originations from a TK-27 four-

Beauty, animate and electronic, shone through big color equipment exhibit in Kansas City.



TK-42 handily outperformed competitors in NAEB preview of ETV's coming color age.

RCA's Sven Swanson shows new PK-310 film camera.

tube color film system and from a TR-4 color TV tape recorder, modified for high-band operation (for a separate story on the TR-4, see preceeding page).

All told, the display included enough apparatus to outfit an average-size TV station: six "live" cameras, two TV film systems, two TV tape recorders, two control consoles, and a 10-kilowatt UHF television transmitter. All but the transmitter were in full operation.

The NAEB meeting served to introduce a new starter in RCA's "Professional Television" equipment line, the new PK-310 vidicon film camera. At $3,000, it affords educators an inexpensive medium for originating black-and-white programming from motion picture film and slides. The camera is fully transistorized, uses plug-in module circuitry and a one-inch electrostatically focused pickup tube.

Another feature was an operating display of the new "Teletitle" system for inserting captions into monochrome or color video signals. On the TV receiver the captions appear as moving or stationary white letters superimposed on the picture.

Typical uses are insertion of news bulletins, identifications and program credits. The system includes a typewriter modified to produce white letters on black tape, equipment for dispatching and controlling the tape, built-in lighting and an RCA type PK-301 transistorized camera.

THE R'S WON THE ELECTION? THAT'S OUR FIRST INITIAL

Election Night television coverage proved, among other things, that the new TK-43 color camera is a shoo-in candidate when it comes to putting the best color picture on the home screen.

NBC used five TK-43's in its coverage from Studio 8-H, New York, of races for senator and governor. They made long, medium and closeup shots of commentators, tally boards and other targets with full color fidelity and picture snap unapproached by any competitive camera.

The election coverage marked a TV milestone: the first time that as many as five of RCA's new four-tube cameras have been used to cover a single event. Since then, two of the TK-43s have been assigned to the network's "instant news" color studio and the others are doing duty elsewhere.

Because the TK-43s' transistorized design virtually eliminates warmup, the news studio cameras are in effect on constant standby and able to provide "instant color" when fast-breaking news events call for an "instant special."

Election Night at NBC was "crucible of color technology" for these massed TK-43 cameras.

Long shot of NBC's Studio 8-H where Election Night's best color TV pictures originated.

Electronically, the TK-43 is identical with the TK-42, RCA's and the industry's first four-tube color camera. Only the lens systems vary. The TK-42 uses a built-in zoom, the TK-43 an external zoom.

TK-43s now being delivered come with a Varotal V 10-to-1 lens which provides 1.6 to 16 inches focal length at maximum aperture of f.4. The external lens system permits the use of range extenders which triple the lens focal length, making the camera particularly useful for sports events and other outdoor assignments without a change of lenses.

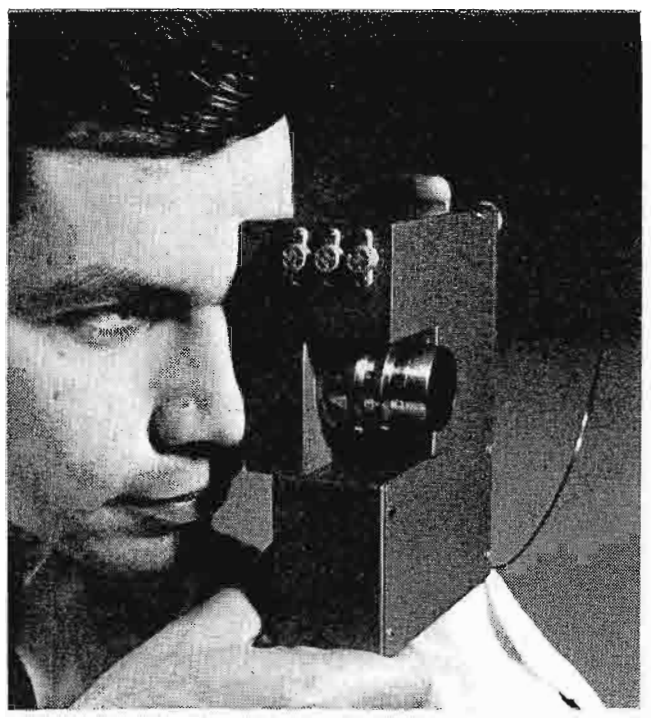
NEW 'EYE' FOR SPACE

Dielectric tape camera system for spacecraft was announced by RCA in October. It records images electrostatically on special plastic tape that can be erased, stores pictures for long periods without resolution loss. Built for NASA, 35mm. system can be fitted with color filters for mapping distant planets, such as Mars, in color.

TUBELESS CAMERA MAY BE FIRST STEP TO PERSONAL TV

A revolutionary, tubeless camera, announced last month by RCA, was hailed by Dr. James Hillier, Vice-President of RCA Laboratories, as a "highly encouraging first step towards a new era in personal TV communications systems." The experimental device is smaller than a man's hand.

The RCA official said cameras of this type could find the widest possible application in the military, in space, in medicine, in home and industry. "There is much work to be done," he added, "but the promise is definitely there."



Tiny camera with transmitter and antenna attached.

Such compact cameras could become a permanent part of the equipment carried by artillery spotters operating behind enemy lines, of policemen walking their beats, of TV news reporters, of astronauts exploring the surface of the moon, or of housewives monitoring children at play.

The experimental camera was developed by Dr. Paul K. Weimer and a group of associates at RCA Laboratories for the U.S. Air Force Avionics Laboratory, RTD, Wright-Patterson Air Force Base, Dayton Ohio, which sponsored the research program. Dr. Henry R. Lewis, Director of the Electronic Research Laboratory, RCA Laboratories, was in charge of the program.

The camera, which can be operated on battery power, takes pictures by means of networks of 132,000 thin-film devices deposited on four glass slides only one-inch square. Among the thin-film elements are some that respond to the presence of light and others that perform various circuit functions, so that the networks take the place of the conventional pickup tube and other picture processing elements of a standard television camera. A miniature transmitter, separate from the camera and employing conventional transistors, makes it possible to send the pictures directly from the camera to a television receiver.

The camera's image sensing area consists primarily of 32,400 microscopic dots of photoconductive material deposited at the intersections of thin metal conductors that have been evaporated onto a glass slide in a grid pattern. Along two of the four edges of the image sensing slide are attached two other slides on each of which have been deposited circuits containing 540 thin-film transistors.

These are arranged in such a way that the output transistors of one slide connect with all of the horizontal lines in the image sensing grid, and the output transistors of the other connect with the vertical lines of the grid. A fourth slide carries arrangements of thin-film elements that perform a variety of control functions.

The camera is operated by focusing the televised scene onto the image sensing array and employing the transistor circuits to scan the array to produce a television signal.

PLANT'S FIRST COLOR TV SET TO MEMPHIS PIONEERS

Henry W. Slavick (left), Vice President of Scripps-Howard Broadcasting Company, receives first color TV set produced at RCA's new Memphis, Tenn., plant from Thomas H. Whitten, Plant Manager. The presentation honored pioneering role by WMCT, S-H Memphis station, in bringing first color broadcasts to area viewers.

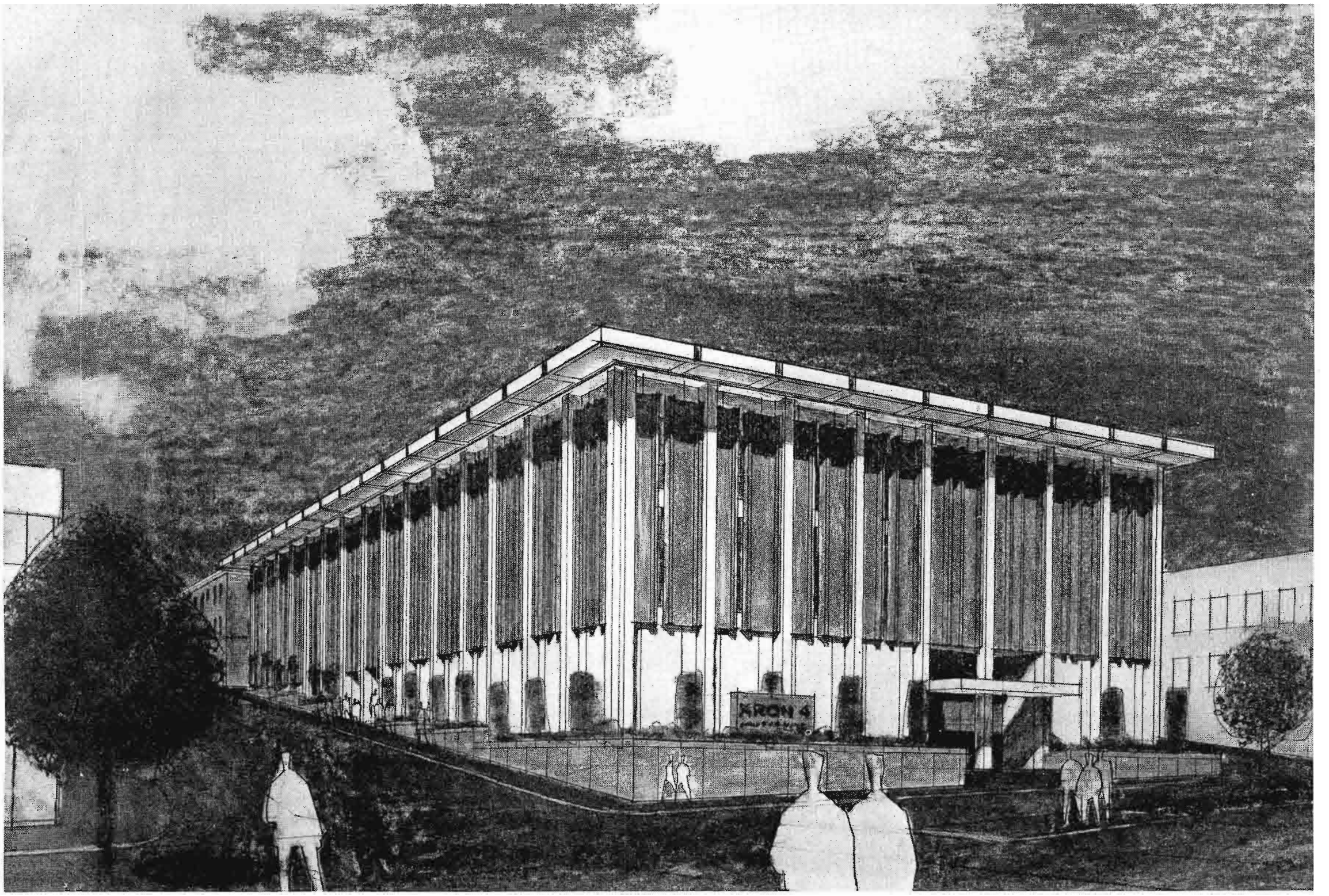


FIG. 1. Architect's sketch of the new studio building that KRON-TV is erecting at Van Ness Street and O'Farrell Street, San Francisco. Poured-concrete, four-story building is 125 feet wide by 250 feet deep. Location on a steep hillside makes possible direct street-level access to each of the first three floors (from front, side and rear entrances, respectively). When completed (in early 1967), it will be the newest and finest station installation in the country.

HOW KRON-TV PLANNED A $5 MILLION ALL-COLOR "NEW LOOK" STATION

Four Years of Unusually Careful Preparation, Planning, Design and Construction Have Gone into This "Dream Station"

KRON-TV in San Francisco is well along with a new studio plant which will give this station one of the finest completely "new look" installations in the country. The new KRON-TV plant will be notable:

(a) for a spacious and beautiful new building contoured to its San Francisco surroundings — and carefully designed to precisely meet the present and future needs of the station,

(b) for a remarkably efficient arrangement of space, facilities and personnel—the result of comprehensive and painstaking planning by KRON-TV's executive and engineering personnel and the architects, Gardner A. Dailey, F.A.I.A. and Associates, including Alec Yuill-Thornton,

(c) for one of the largest, most elaborate, and most flexible, equipment installations in use today — an equipment system which provides for the future addition of even more program sources, and for advancing degrees of sophistication,

(d) for the use throughout of all-new, all "new look" deluxe RCA camera, film, tape and switching equipment — equipment which provides a new degree of performance and which makes possible new and improved modes of operation.

Comprehensive Planning

None of the notable features of the new KRON-TV installation — the beauty, the efficiency, the flexibility, the modernity — happened just by chance or good fortune. On the contrary, it was all planned to come out that way. Harold See, President; Al Constant, Vice President; and

FIG. 2. "Breaking ground" for the new KRON-TV studio building on July 27, 1955. Left to right, A. H. Constant, Vice President and General Manager; Harold P. See, President of the Chronicle Broadcasting Company (owners of KRON-TV) and Charles deYoung Thierot, President of The Chronicle Publishing Company, the parent company.

Lee Berryhill, Chief Engineer, started planning the new KRON-TV more than four years ago. More than two years of intensive planning preceded the letting of contracts. Another two years will have elapsed by the time the new installation goes into use early next year. It could have been done quicker — but not so well. Harold See, whose record in broadcasting goes back to the early thirties, had envisioned this "dream" station for a long while. When the time finally came to build it, he wanted to be sure it came up to his dream in every way.

The planning began with the basic requirements of the building and followed a logical step-by-step development: from general requirements, to specific departmental requirements, to traffic flow, to floor arrangements, to model (for checking it all out) and finally to equipment. At each step hundreds of details were checked with meticulous care — and repeated conferences held with department heads, architects and management. The comprehensiveness of this planning, and the care with which it was carried out is something of a record. In fact the planning is a story in itself. Space does not allow us to detail all the preliminary thinking, the many conferences and hundreds of revisions. But we can illustrate the "tools" used by the KRON-TV planners and the general approach they followed. These should be of considerable interest to station engineers and others involved in station planning.

General Building Requirements

With more than fifteen years' experience in Television (the station originally went on the air in November 1949) the management of KRON-TV had very definite ideas of what they wanted in a studio building. The basic requirements were:

(a) Two large studios with audience seating space — plus a third smaller studio for interviews and the like,

(b) Separate studio control rooms so that both studios could be operated simultaneously and independently— and independent of master control, if desired (as for rehearsal or taping),

(c) A large and well-equipped film and tape room — arranged to operate independently, or as an adjunct of either studio control room or master control,

(d) A very flexible master control designed to handle a large number of program inputs and arranged so that all station operations could be carried on from this point when desired,

(e) Two closed-circuit TV viewing areas, one of them furnished with seating for public use,

(f) Executive, Business, Sales and Program areas on a scale in keeping with the technical areas and with space for likely future station needs,

(g) Interior parking area sufficient for non-employee generated traffic and company vehicles.

(h) A reinforced concrete building, completely air-conditioned and with appropriate soundproofing for critical areas,

(i) A building arrangement which would facilitate movement between operating areas but which would avoid mingling of public traffic with interior station traffic.

How KRON-TV management and engineering tackled these requirements is described in the following pages.

KRON-TV SPACE REQUIREMENTS

	Planned Space
Executive Suite	2,410
Business Office	3,670
Sales Department	1,986
Promotion Department	1,286
Program Department	1,640
Public Affairs	419
Film and Editing	1,272
Art and Art Storage	2,634
News and Documentary	2,050
Receiving Department	1,107
Subtotal	18,474
Technical Department	
Technical Office	670
MCR and Equipment	1,290
VTR and Film	1,316
Kine and Film Lab	522
Technical Shop and Storage	1,205
Control Rooms	840
Announce Booth	72
Technical Locker Room	522
Remote Shop	744
Remote Truck Garage	600
Hallways	686
Subtotal	8,467

	Planned Space
Garage Space	21,000
Public or Semi-Public Areas	
Studio "A"	2,600
Studio "B"	2,600
Studio "C"	434
Dimmer Rooms	321
View Room	945
Subtotal	6,900
Miscellaneous Space	
Talent Lounge	210
Dressing Rooms	610
Promotional Lounge and Lunch Room	1,243
Janitor	145
Telephone Switch Room	504
Rest Rooms	1,356
Power and Mechanical	2,204
Building Service	-
Elevators	-
Halls	4,078
Foyer	1,973
Dead Storage	708
Subtotal	13,031
TOTAL	67,872

FIG. 3. This chart showing space requirements for each of the departments of the KRON-TV operation was prepared as the first step in laying out the floor plans for the new building. The individual figures were arrived at by studying the space used by each department in the old setup and adding (or changing) as deemed necessary for future station operation.

Planning the Building

In the description of KRON-TV's planning which follows, the planning of the building and the arrangement of floor areas will be discussed first — followed by a discussion of the technical equipment planning. In the actual case, of course, both of these went forward more or less simultaneously.

Space Requirements

The first step in planning a new building is to determine how much floor space is required. KRON-TV planners approached this by (1) measuring off how much space each operating department (and function) was using in their old installation, (2) calculating how much space it should have for efficient operation and (3) estimating how much more would be required for likely future expansion. The result of this department-by-department (almost office-by-office) calculation is shown in Figure 3. Originally this chart had two columns of figures — one for "present space," one for "planned space." In the interest of simplicity only the second is shown here.

The allotted spaces shown on this chart were the subject of much discussion and considerable revision. However, once established, they became the firm basis on which all building layout plans were made.

Specific Building Requirements

The requirements of the various areas obviously vary in such things as ceiling height, interior finish, soundproofing, air conditioning, power requirements and lighting. All must be specified before building plans can be finalized. Here again the KRON-TV approach was to study each planned area as to functional requirements, population, classification, mode of operation, etc. The results of this study are shown in Figure 4.

Sound Level Requirements

One column of Figure 5 indicates the "sound rating intensity" considered allowable for each area. These ratings are defined in the upper chart of Figure 5. In the lower chart of Figure 5 are the estimated maximum sound levels which will be generated in each kind of area.

The numbers in these charts were carefully worked out by Mr. Berryhill from available literature and from consultation

FIG. 4. As the second step in planning (and as a guide to the architect) this chart was prepared showing the department-by-department requirements for ceiling height, interior finish, soundproofing, air conditioning, power and lighting.

TENTATIVE KRON-TV BUILDING REQUIREMENTS

Area	Special Power Requirements	Service Outlets and Lighting	Air Conditioning Load Other Than Occupants & Lighting In Kilowatts	Maximum Number of Occupants	Finished Ceiling Height	Maximum Sound Rating Intensity**	Interior Finish	Floor Covering
Executive	4-117VAC .5 KVA 1-117VAC 1.5 KVA	Executive	3 KW	8	8	3	Accoustic Tile or Plaster	Carpeting
Business	4-117VAC 1 KVA 1-117VAC 2.5 KVA	Office	2 KW	13	8	3	"	Tile
Employee Lounge	1-117VAC Stove 6 KVA 2-117VAC Coffee Maker 2.5 KVA etc.	Restaurant & Lounge	3 KW	10	10	3	"	"
Sales	2-117VAC .5 KVA 1-117VAC 1.5 KVA	Office	1 KW	10	8	3	"	"
Promotion	-	Office	-	6	8	3	"	"
Program	2-117VAC 1.5 KVA 1-117VAC .5 KVA	Office	2 KW	15	8	3 (Small View Room - 1)	"	"
Public Affairs	-	Office		3	8	3	"	"
Film	6-117VAC 2 KVA 1-117VAC 2.5 KVA 3-240 VAC 3 Phase 30 KVA	Industrial	5 KW (Provide separate exhaust blower)	6	8	3	"	"
Telephone Switch Room	2-117VAC 2.5 KVA	Industrial	-	-	10	-	Shop	Concrete
Art	1-220VAC 1.5 KVA 2-220VAC 3.0 KVA 1-117VAC .5 KVA 2-117VAC .75 KVA 3-117VAC 2.0 KVA	Industrial	- (Provide exhaust blower)	4	15	-	Shop	Painted Concrete
News and Documentary		Industrial		19	8	3	Accoustic Tile or Plaster	Tile
Studio A	4-117VAC 1 KVA 4-220VAC 1 Phase Stove 6 KVA 1-3 Phase 4-Wire 117VAC 75 KVA/leg	Industrial Work Lights & Outlets	200 KW	100*	25	2	Special	1/8" / 10' Painted Concrete
Studio B	4-117VAC 1 KVA 4-220VAC 1 Phase Stove 6 KVA 1-3 Phase 4-Wire 117VAC 75 KVA/leg	Industrial Work Lights & Outlets	200 KW	100*	25	2	"	"
Studio C	1-3Phase 4-Wire 117VAC 7.5 KVA/leg 1-220VAC 1 Phase Stove 6 KVA	Industrial Work Lights	20 KW	5	10	1	"	"
View Room	1-117VAC 1.8 KVA 1-117VAC 1.8 KVA 1-117VAC 2.5 KVA	Theatre	4.5 KW	75*	15	2	"	Tile
Technical								
MCR	40-117VAC 2.4 KVA	Shop	80 KW	5	10	2	Special	Tile
A CR	8-117VAC 2.4 KVA	"	15 KW	5	10	2 (Announce Booth & Audio-1,	"	"
B CR	8-117VAC 2.4 KVA	"	15 KW	5	10	"	"	"
Film & VTR	30-117VAC 2.4 KVA	"	60 KW	5	10	2	"	"
Kinescope	2-117VAC 2.4 KVA 2-117VAC 1.8 KVA	"	5 KW	2	10	2	"	"
Shop & Locker Room	6-117VAC 2.4 KVA 1-117VAC Stove 6 KVA	"	2 KW	2	10	3	"	"
Mobile Shop	1-4 Wire 3 Phase 117VAC 36 KVA 2-117VAC 2.4 KVA 1-1 Phase 220VAC 6 KVA	"	-	2	10	-	Shop	Concrete
Receiving Room	6-117VAC 2.4 KVA	"	(Provide exhaust Blower)	4	12	-	"	"
TOTAL	840.2 KVA		617.5 KW	404*				

*This is maximum peak occupancy. Total permanent occupants would number approximately 160.

**See Figure 5, next page, for explanation of Maximum Sound Rating Intensity.

** Maximum Permitted Sound Level Intensity in DB Above 10^{-16} Watts Per Centimeter^2

Rating	Octave Bands, Cycles Per Second							
	20/75	75/150	150/300	300/600	600/1200	1200/2400	2400/4800	4800/10,000
1	-	38	30	23	18	15	12	-
2	57	47	39	32	28	25	22	21
3	60	51	43	37	32	30	28	27

Maximum Expected Sound Level Intensity in DB Above 10^{-16} Watts Per Centimeter^2

Location	Octave Bands, Cycles Per Second							
	20/75	75/150	150/300	300/600	600/1200	1200/2400	2400/4800	4800/10,000
Studios	76	84	89	90	87	86	84	75
Offices	45	57	61	64	65	60	53	46
Shops	78	82	85	85	85	79	77	70
Control & Viewing Rooms	61	69	74	75	72	71	69	60

This criteria recognizes that under some conditions, these internally generated maximum sound levels may be exceeded, and that conflicts will be resolved by studio scheduling.

FIG. 5. This chart defines the sound rating intensities specified in the chart of Figure 4 — and also indicates the sound levels which, it is estimated, will be generated in each type of area. These are the two figures the architect needs to know in order to calculate the necessary degree of soundproofing between areas.

with acoustical experts. Such information is of vital importance to the building architect in planning the relative placement of various functions and in calculating the necessary sound absorption to be provided.

Traffic Flow Requirements

One additional type of information is required before the architect or planner can start making his floor plans. This is a prediction of traffic flow patterns. A standard aproach to this is to make up a functional and/or departmental flow chart. In the case of KRON-TV this took the form shown in Figure 6. Here the flow of both "foot traffic" and materials between areas is indicated by lines and arrows. The planner (and architect) use this chart in planning the location of the various areas. The goals, of course, are (1) to keep the high-density traffic paths as short as possible, and (2) to keep the paths followed by the public separate from the internal station traffic. In some cases planners also try to keep a third classification, "talent," away from both of the other two. Usually it is not possible to do this entirely, but good planning will avoid all but occasional intermingling of traffic patterns.

Access Requirements

There is a corollary to traffic flow — and this is access. In many cases this represents a very difficult problem (because of the difficulty of providing separate access for the various types of traffic). KRON-TV planners utilized a natural characteristic of the site (on a steep hill) to arrive at an ingenious solution. Their access requirements were as set down in the chart of Figure 7. How they achieved a fine solution is detailed in the discussion which follows.

Site Considerations

With the information developed above the architect/planner is ready to start laying out his floor arrangements. This, of course, must go hand in glove with the overall design of the building — and that involves site considerations such as topography, surroundings, traffic problems (noise) and, above all, access.

The overwhelming consideration in the case of KRON-TV was the topography. The new building (Figure 1) is located on Van Ness Street at the corner of O'Farrell Street ("1001 Van Ness"). Van Ness is a relatively flat street (at least by San Francisco standards). O'Farrell, however, is a typical San Francisco hill. From the front of the new building to the back it rises the equivalent of two stories. KRON-TV architects have used this fact to great advantage.

Street Level Access at Three Floor Levels

The main first-floor entrance to the KRON-TV building is at street level on Van Ness Street. The second floor has an entrance halfway back on O'Farrell Street—and this, too, is at street level. There is also an entrance, at this second-floor level (from the alleyway at the right of the building) which leads down a ramp to the first-floor garage. Finally, the third floor has an entrance from the alley at the rear—and this also is at "street level." How KRON-TV planners have used these four access points, on three floor levels, to segregate the various types of traffic entering the building is indicated in the discussion of the floor layouts on the following pages.

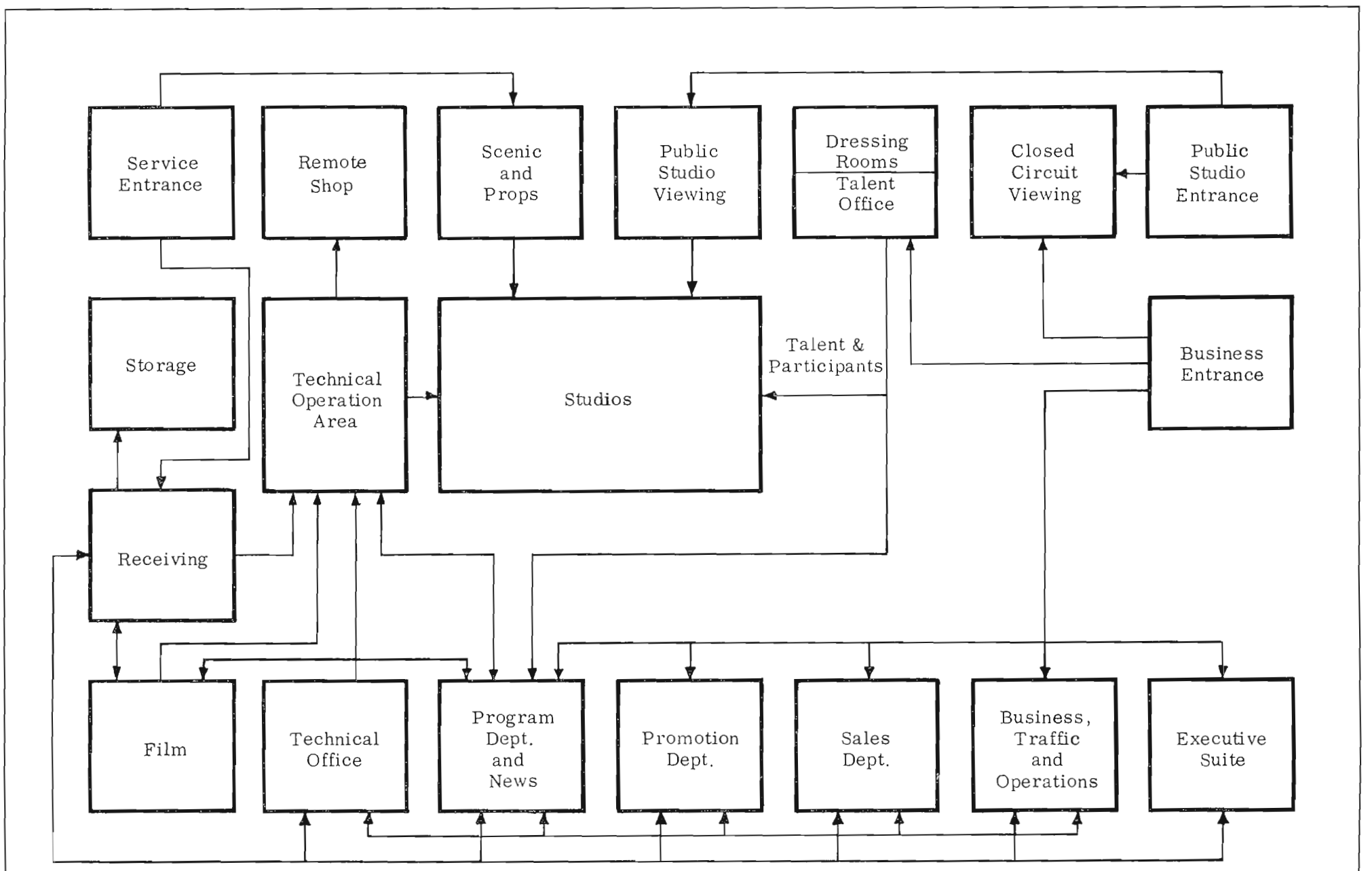


FIG. 6. "Flow Chart" indicating the pattern of traffic flow (people and materials) between the various functional areas. This chart was used in determining the best relative locations of the public, office and technical areas.

FIG. 7. Access planning was facilitated by setting down, as shown here, the requirements for each population classification. In the case of KRON-TV these requirements were ingeniously met by taking advantage of the hillside location.

GENERAL BUILDING REQUIREMENTS

Public Access	Entrance for invited public viewers to accommodate (1) Live Programs and (2) Closed Circuit Programs. Both (1) and (2) to be so located that foot traffic and distance from entrance be held to a minimum and that public does not cross or intermingle with routes taken by employees in the performance of their duties. Both areas (1) and (2) to fill requirements of fire safety code. Talent and participants to Studio. Limited public access to Executive, Business, Promotion, Sales, Public Affairs, Technical and Program Departments.
Vehicle Access	From parking or street into Studio.
Prop and Scenic Access	From loading dock through Art Department to Studio.
Receiving Access	For shipping and receiving film, video tape and supplies.
Technical Access	Can be shared with Receiving for loading remote truck, etc.

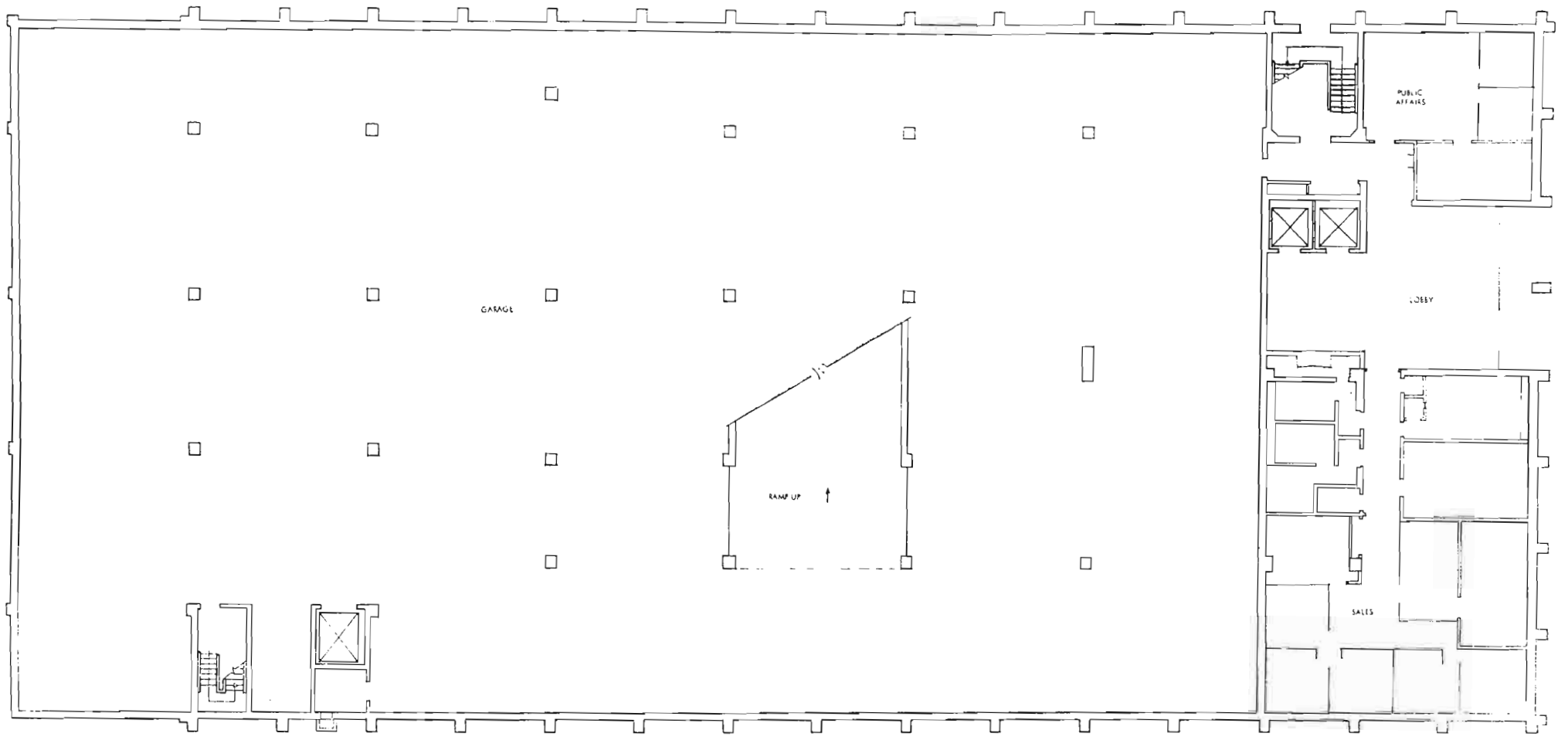


FIG. 8. First-floor plan — new KRON-TV Building.

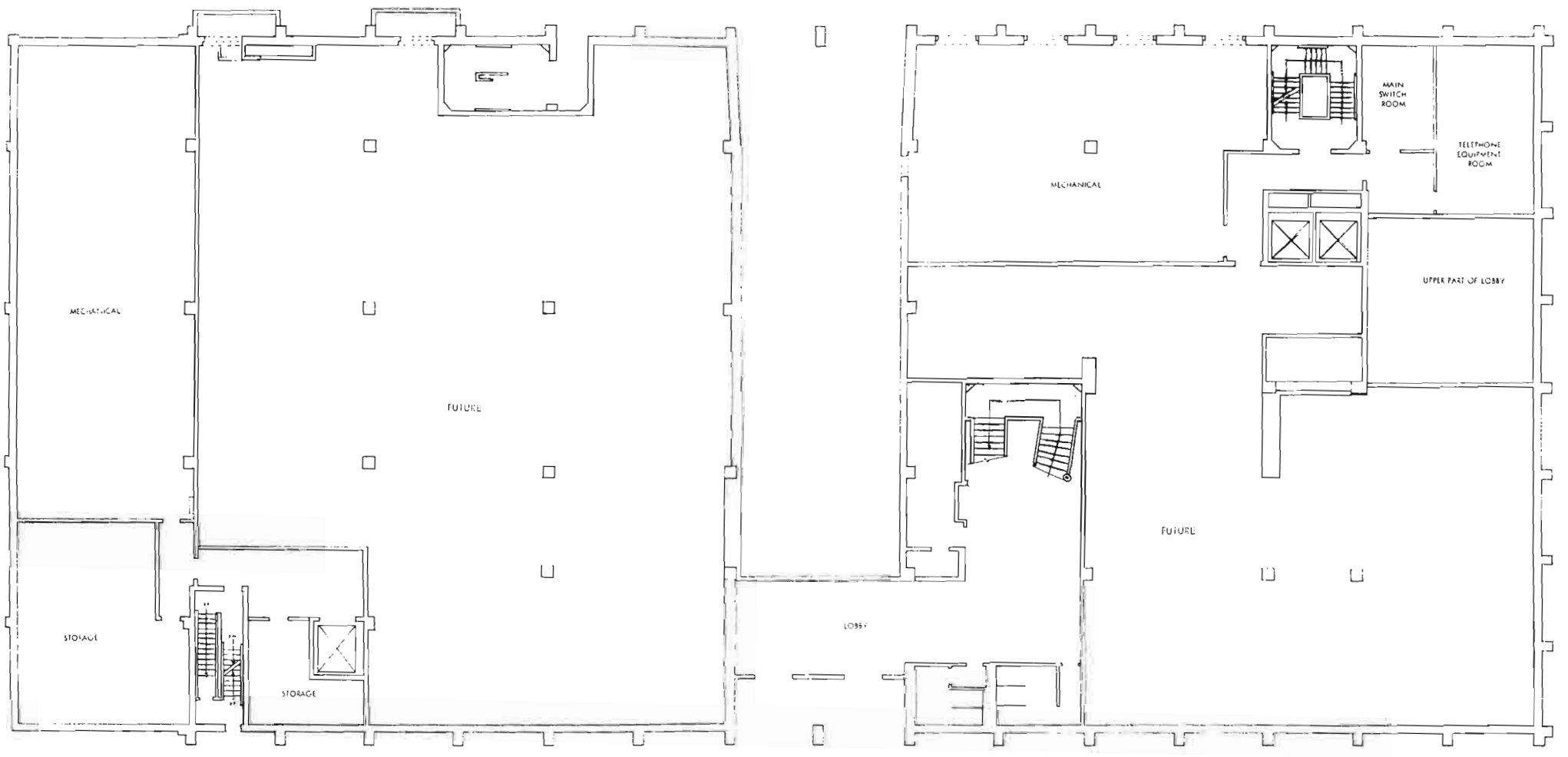


FIG. 9. Second-floor plan — new KRON-TV Building.

Floor Layouts

With all of the basic material described previously at hand, the architect and the KRON-TV engineers were ready to start making their floor plans. This is where there is room for real creativity. Although certain basic tenets must be adhered to—keeping business operations together, locating technical area near studios, segregating public from station operations, providing easy access, etc.—there are many possible ways of doing it. At KRON-TV dozens of possible arrangements were drawn up, discussed at length, modified, further discussed, further modified — far into the night. The floor arrangements finally agreed on are shown in Figures 8 to 11. (These can be more easily visualized by studying them in conjunction with the models shown in Figures 14 and 15.) Space does not permit a detailed discussion of these but some of the features are worth pointing out.

First Floor The main entrance—into an impressive two-story lobby area—is at the front of the first floor (street level on Van Ness Street). The Sales Department is

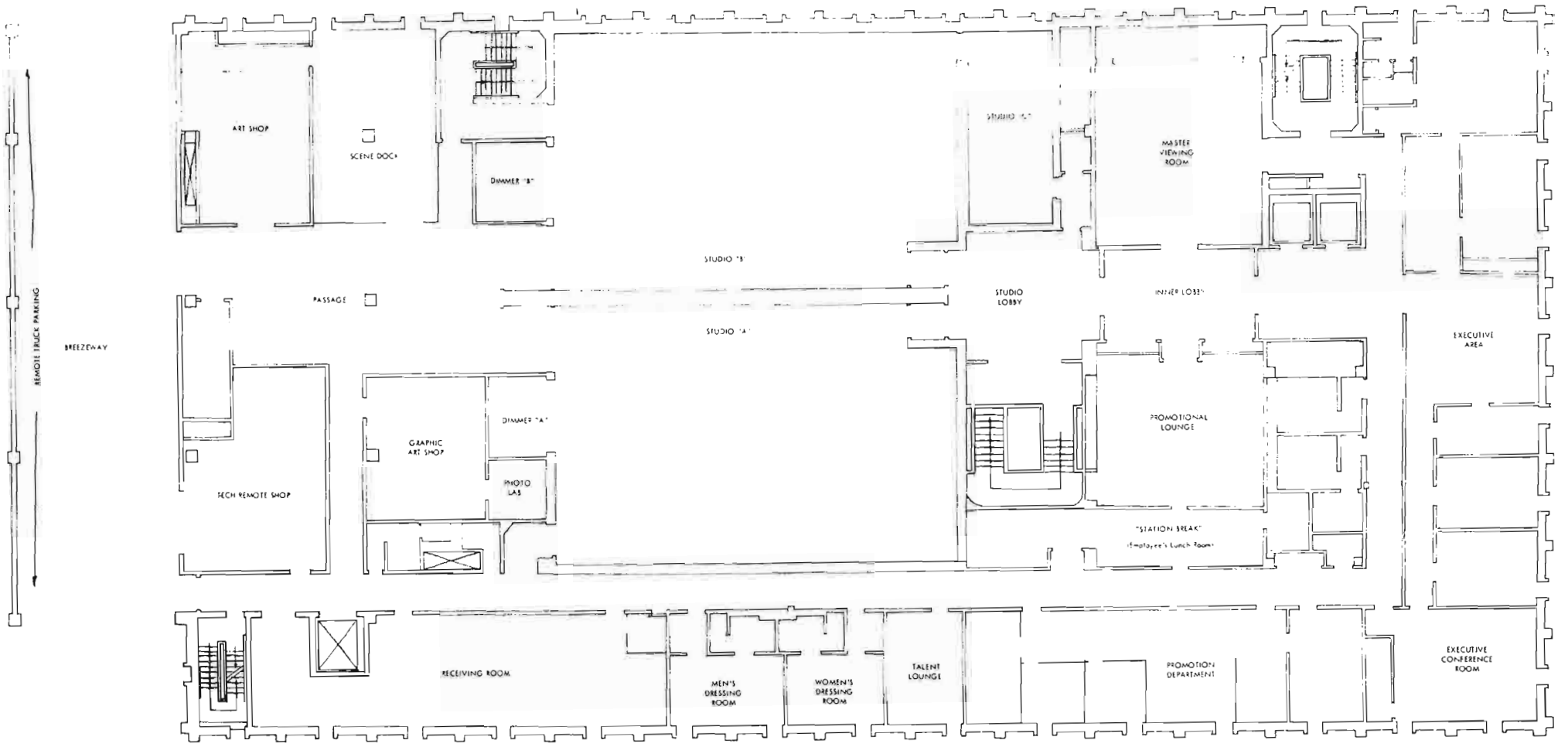


FIG. 10. Third-floor plan — new KRON-TV Building.

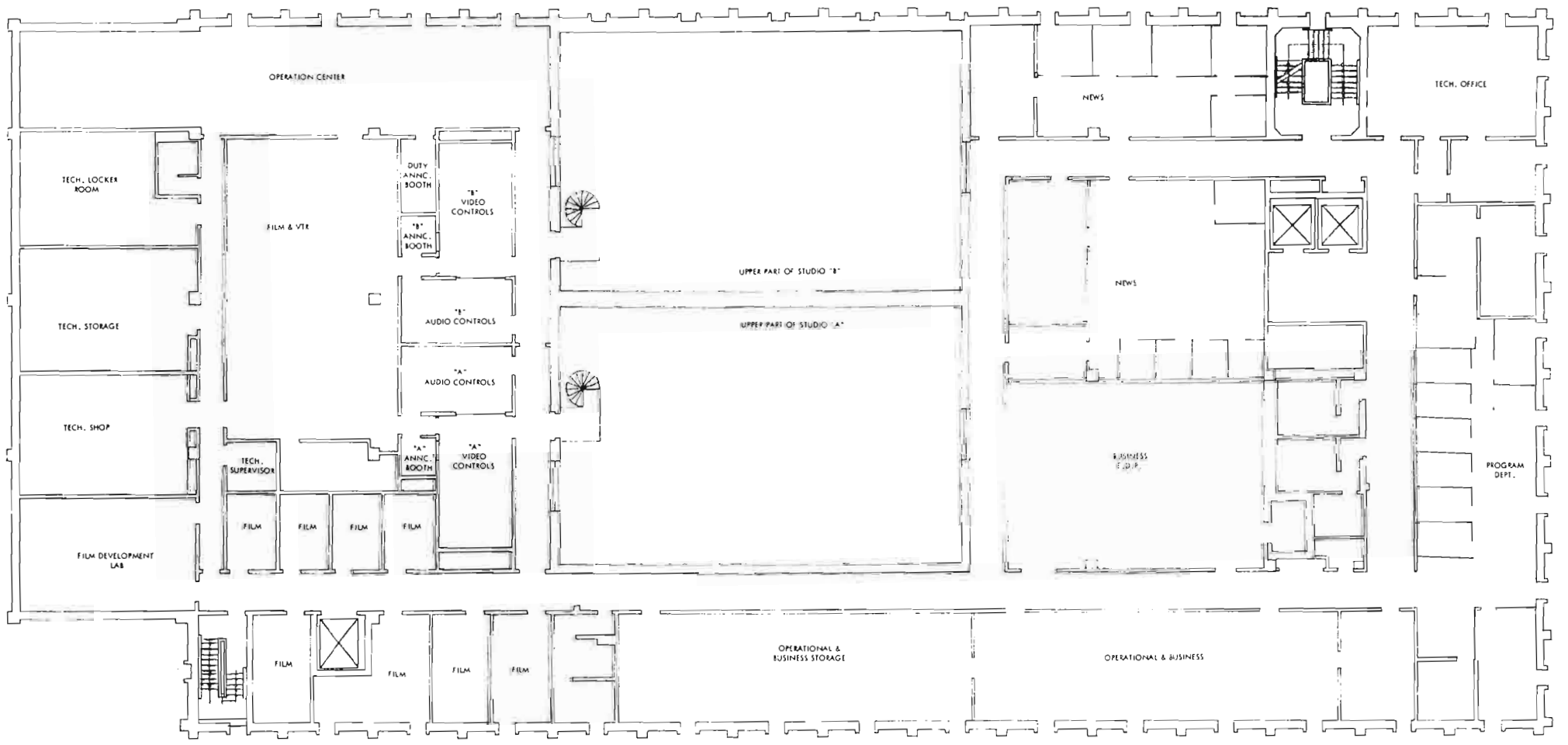


FIG. 11. Fourth-floor plan — new KRON-TV Building.

located in a group of offices just to the left of the lobby—the Public Affairs office at the right. These are the two groups having the most local business contacts and hence are logically placed in the most accessible location. Together with the elevators these offices occupy about one-fourth of the first-floor area. The garage—down a ramp from an entrance halfway back on the alleyway—occupies the other three-fourths of the floor. Space is provided for 48 cars.

Second Floor The entrance lobby for public attending studio shows is halfway back along the building on O'Farrell Street. From this public lobby stairs lead to the third-floor studio lobby—and to the studio seating area. This arrangement keeps the public away from business operations (and VIP's). Also on this floor are business operations, a large, consolidated "library" and file room, and space for telephone and other equipment. These take about one-fourth of the floor space. The remainder is for future expansion.

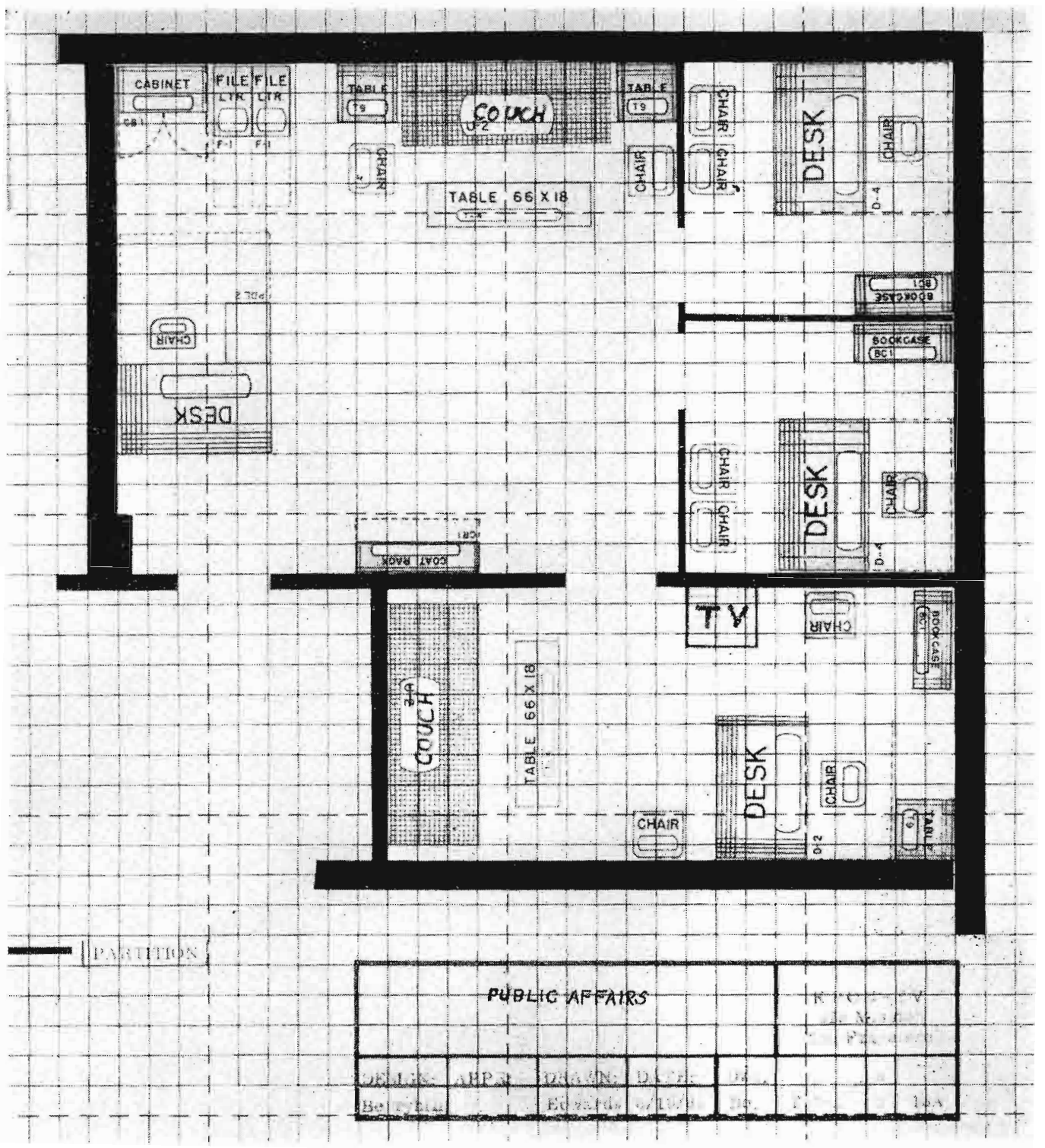


FIG. 12. (Left) One of the departmental "templates" used in planning the KRON-TV building — this one shows the floor layout of the space allocated to the Public Affairs activity.

FIG. 13. (Right) A total of 27 of these departmental "templates" were made up — one for each functional activity. They were found very useful in detailed planning of the various functional areas.

Third Floor This is the executive and studio floor. At the front of the building are the executive offices (President at the right front, General Manager next), the program department and an executive conference room. Note that a private passageway isolates VIP traffic from other station business. Off the center lobby—reached by elevator from the main entrance on the first floor, or stairs from the public entrance on the second floor, are the following: (a) a small theater (viewing room) for the public, (b) a conference "viewing room" for station promotional business, (c) entrances to the two large (45 feet by 60 feet) studios and (d) the small 18 by 31 studio (announcements, VIP's, etc.). Along the left side of the building (and isolating the studios from the street noise) is a corridor off of which are the promotion department offices, the talent lounges and dressing rooms, and the "receiving" department. At the rear of the big studios is the art shop and the art storage area. At the very back is an area into which trucks can be driven from the street level (alley entrance). There is a large elevator which could be used to move props to a (future) second-floor storage area. Note that "receiving" is directly adjacent to this truck drive-in area. Also that "talent" and "prop" areas have their own corridors to separate them from the public at the front of the building.

Fourth Floor Is the "operating" floor. Here are the business, programming, news, documentary, operations and engineering areas. At the left of the studios is a corridor off of which open news, film and tape editing rooms; tape and film storage. Programming offices are in front—also engineering offices. In the center there is an electronic data processing room. The "technical block" is directly behind the studios but separated by a corridor. A more detailed description of the technical area is given later.

Departmental Templates

In jumping to the final floor plans we skipped over two of the most interesting "tools" which were used in KRON-TV's planning sessions. One of these was a series of some 27 "departmental templates." Actually these are simply pieces of the large-scale (¼-inch) floor plans cut out along departmental lines—and with all desks, chairs, files, equipment, etc., drawn in to scale. One is shown in Figure 12, others in Figure 13. These templates were found to be exceedingly useful for many purposes—such as checking as to adequacy of allotted areas, discussing with departmental managers, ordering of furniture, etc. They are easier to work with than a full floor plan—and they serve to divide the problem up into pieces which can be tackled one by one. It's a simple idea, and perhaps not original, but certainly very useful.

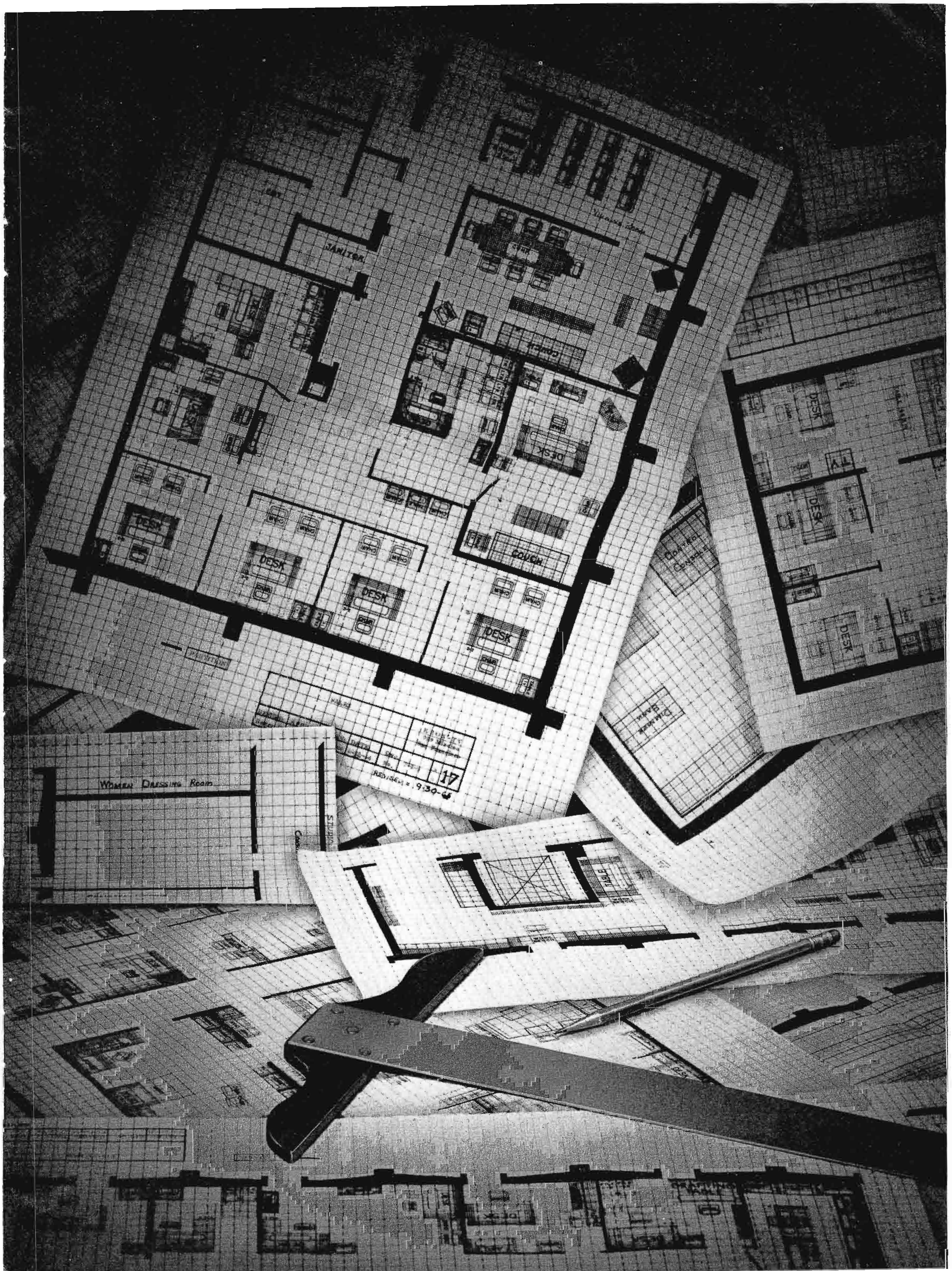

JANITOR
DESK
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TABLE
WOMEN DRESSING ROOM
17

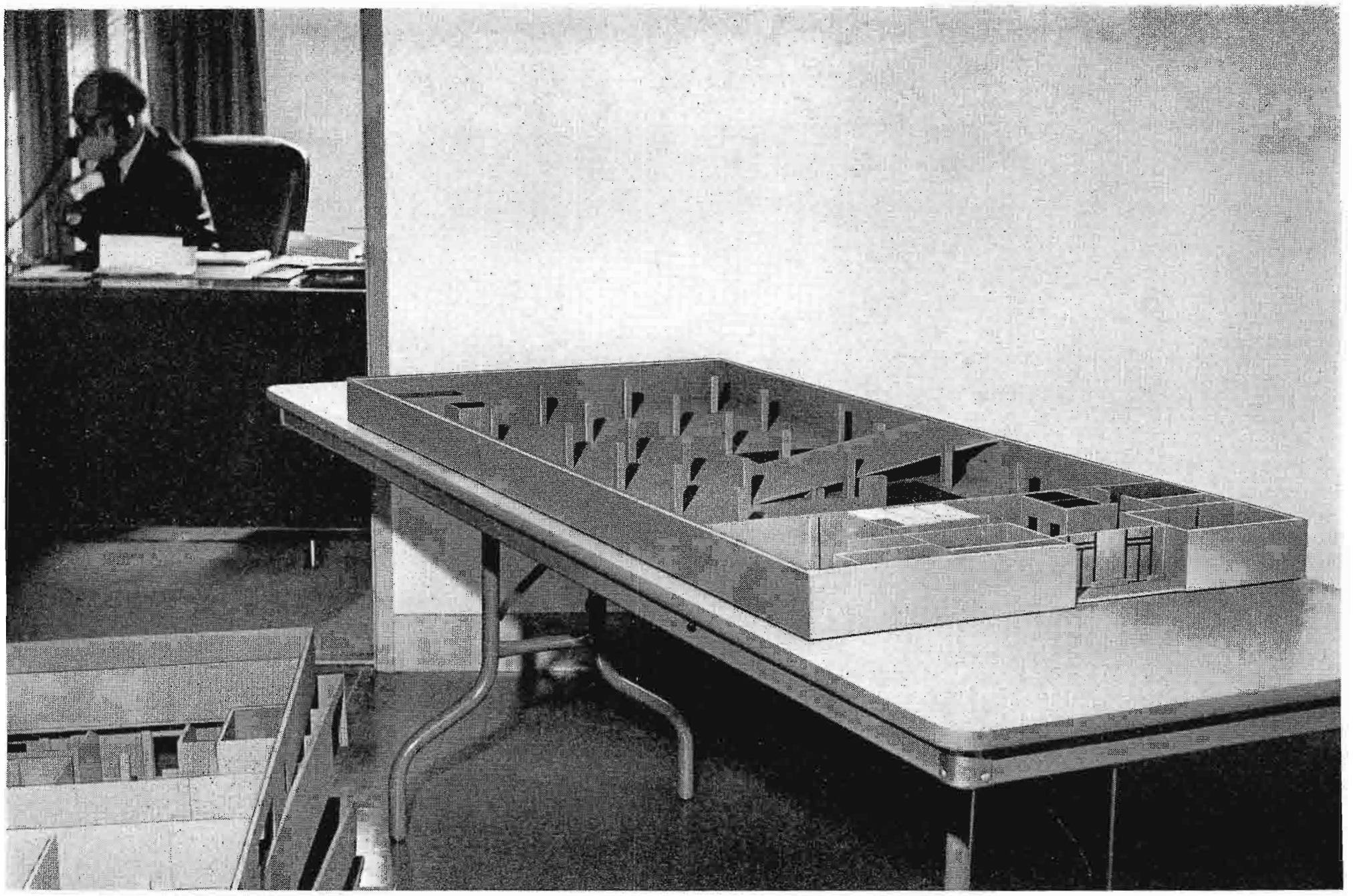


FIG. 14. (Above) This ¼-inch demountable scale model of the building stood in a convenient spot just outside Chief Engineer Berryhill's office during most of the period of planning and construction.

FIG. 15. (Right) The model — shown here in the several stages of assembly — was particularly useful in discussing layout plans with management and with the heads of departments.

The Building Model

Another "tool" used in KRON-TV planning—and perhaps the most intriguing of all—is a demountable model of the building itself. This model, which is shown in Figure 14, and by floors in Figure 15, stood in a room just outside Chief Engineer Berryhill's office all during the long months of discussion and planning. Made of plywood (on a ¼-inch scale) and unadorned, this model made no attempt to picture what the completed building would look like. But what it did do, and did very well, was to give a quick visualization of the relationship of the various interior areas of the building. Easier to understand and to comprehend than engineering drawings it was particularly helpful in discussions with management and with non-technical department heads.

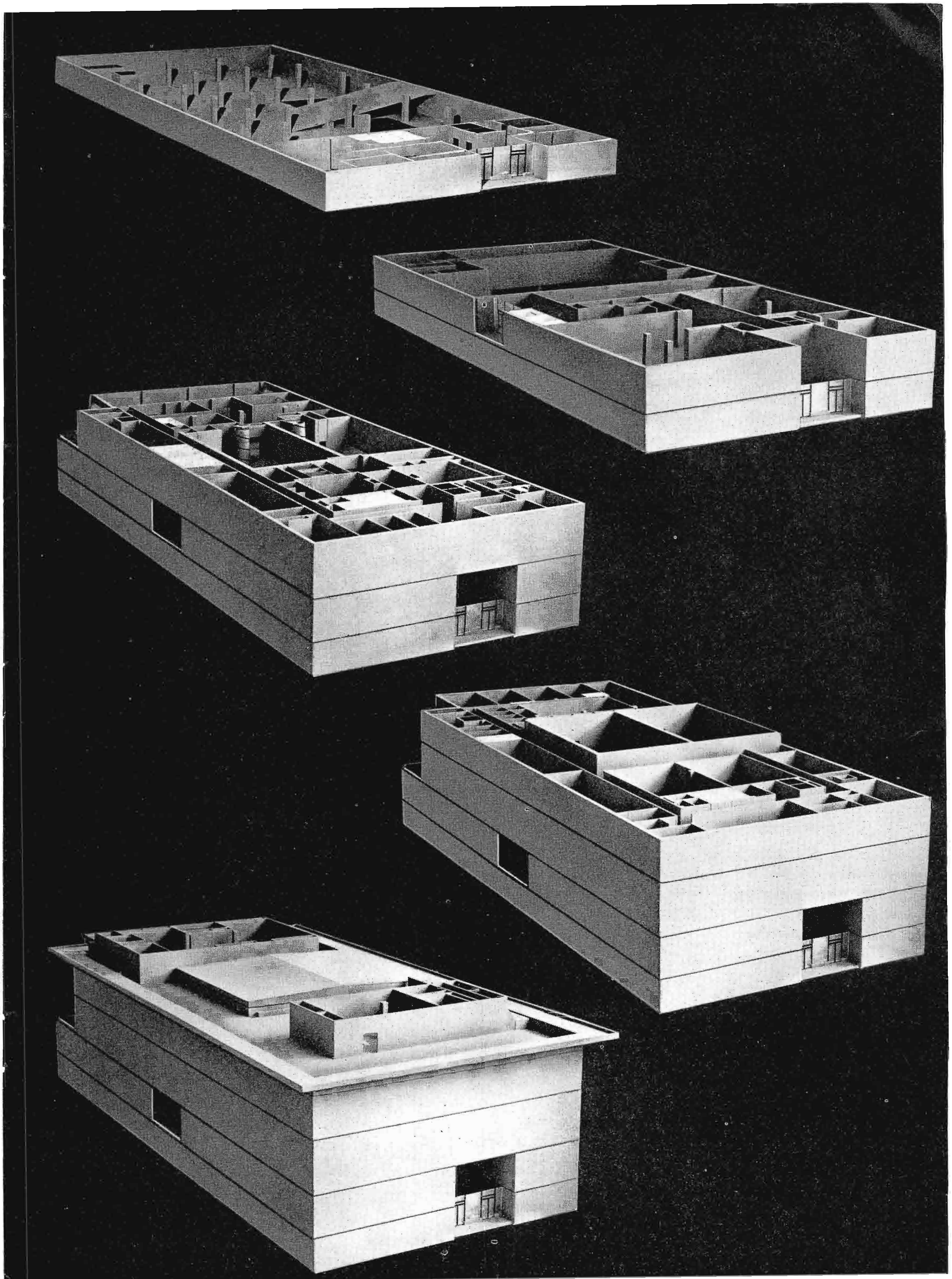
During the planning stages of the new installation Chief Engineer Berryhill frequently found himself called on to describe the new building. He soon found that by beginning with the bottom (first floor) layer—and adding layers as he talked, he was able to do this far easier, and quicker, than in any other way. Using the model in this way and with the architect's rendering of the building exterior (Figure 1)—he could, in minutes, give a visitor to his office a very good idea of the features of the completed installation.

Even technical people—who often look down their noses at such simple devices—were soon enthralled. They found that the model was of tremendous help in visualizing traffic patterns, problems of moving sets, getting equipment in and out of the building—and even in the planning of equipment arrangement in the technical area.

Technical Planning

The story on KRON-TV's planning turns now to the planning of the technical facilities — which for most engineers is the most interesting part. KRON-TV will be particularly so, for the technical facilities planned represent something every chief engineer has dreamt of. First there is the completeness of the equipment list—just about the most imposing "original equipment" list we've ever seen. It includes, just to mention a few of the main items, five Studio Color Cameras, four complete color film "islands", eight deluxe film projectors, five color tape equipments, separate audio and video control consoles for each studio control room and five (count 'em, five) TS-40 Switching Systems, and, of course, racks and racks of auxiliary equipment to go along. Second there is the tremendous flexibility which the equipment arrangement (with its three "operation centers") provides. And third there is the fact that all of this equipment is color, all of it is of deluxe type and all of it is RCA "New Look" (which means that it will have a beautiful, matching appearance, will have matching operating characteristics and will have standardized maintenance routines). It's enough to make one drool!

How did all of this come about? It has been mentioned before that KRON-TV management and engineering had been dreaming up this installation for a long time. Harold See, KRON-TV president,



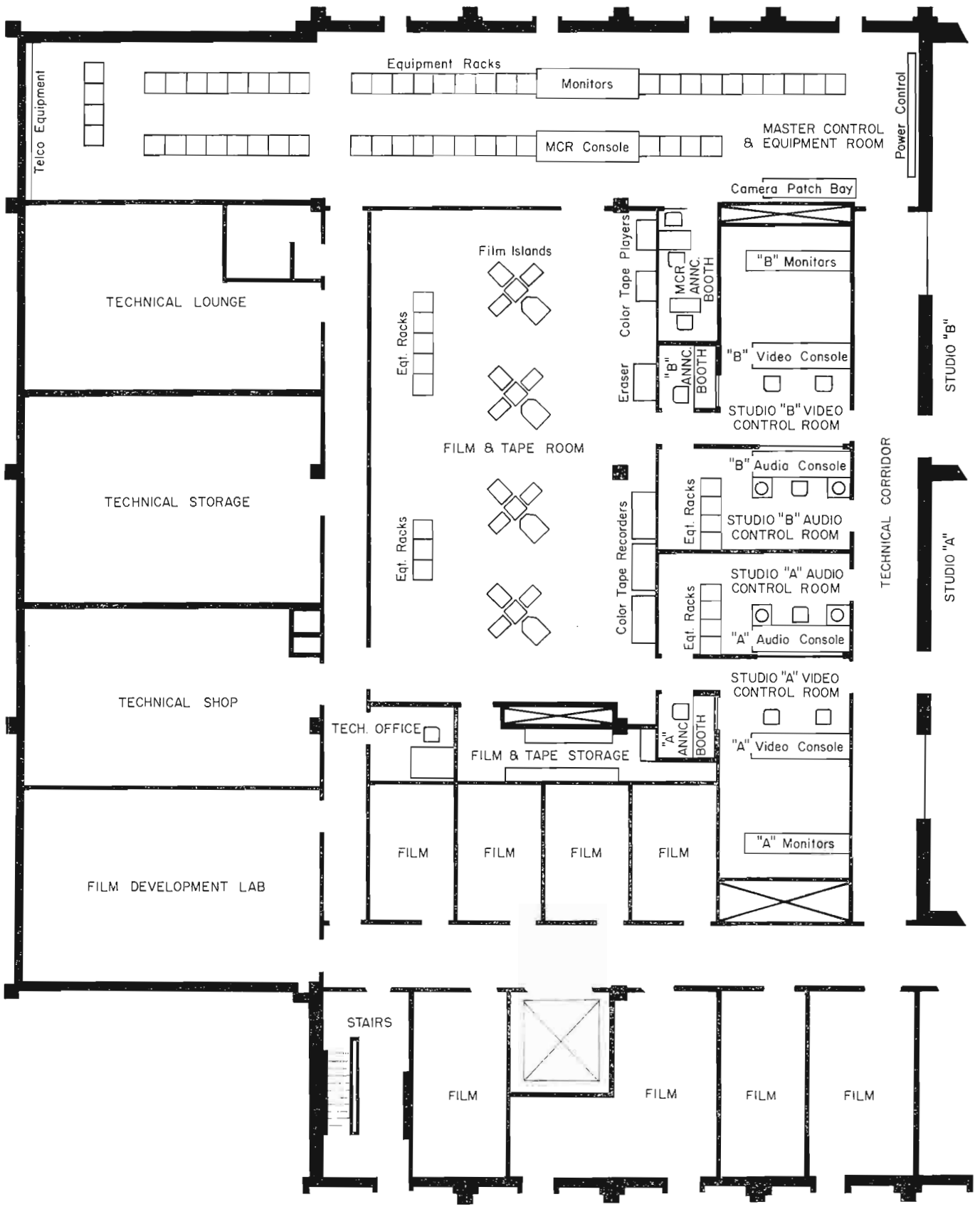


FIG. 16. Floor plan of the technical area of the new KRON-TV Building.

was himself an engineer with NBC for 17 years before joining the station. He had an intense desire to make this an outstanding installation. Lee Berryhill, his chief engineer, was certainly not adverse. Together they worked out the technical features—the arrangement of the technical areas, the mode of operation, the main items of equipment, the location of the equipment and how it would be used. When they had decided what they wanted, they brought it to RCA engineers for help with the systems details. From that point on, KRON-TV engineers and RCA systems engineers worked together to make up a detailed equipment plan. However, before going into that, it will be best to describe the planning of the technical area (or "block" as it is sometimes called).

The Technical "Block"

The technical area, or "block," is located at the rear of the fourth floor of the building (See Figure 11, Page 17). This area, which is shown in more detail in Figure 16, is adjacent to the upper part of the two large studios—but the studio control booths do not look down into the studios (as in many installations). KRON-TV feels that there is no advantage in this because the view is usually poor at best. Instead there is an exclusive technical corridor between the "block" and the studios. Doors from this corridor lead to the studio control booths, master control and special stairways which provide direct access to studio floors. (There are windows from the corridor looking into the studios.)

There are separate audio and video control rooms for each studio. In the video control room the operators look over the console at a bank of wall-mounted monitors. The associated audio operator can see the same monitors through the window between audio and video control. There is also an announce booth associated with each studio control. This, plus the provision of a separate switcher for each studio, makes it possible for each studio-control complex to operate as a completely independent "operations center."

A notable feature of the technical area is a large film-tape room. Noting the increasing trend to recorded programs, KRON-TV has planned generously for this type of operation. To begin with, this area will have four color film islands and five color tape machines. There is room for future addition of more tape machines and a TV film recorder.

Master control and most of the auxiliary equipment racks are located in one long room (16 feet by 85 feet) at the top of the technical block. The live camera patch bay,

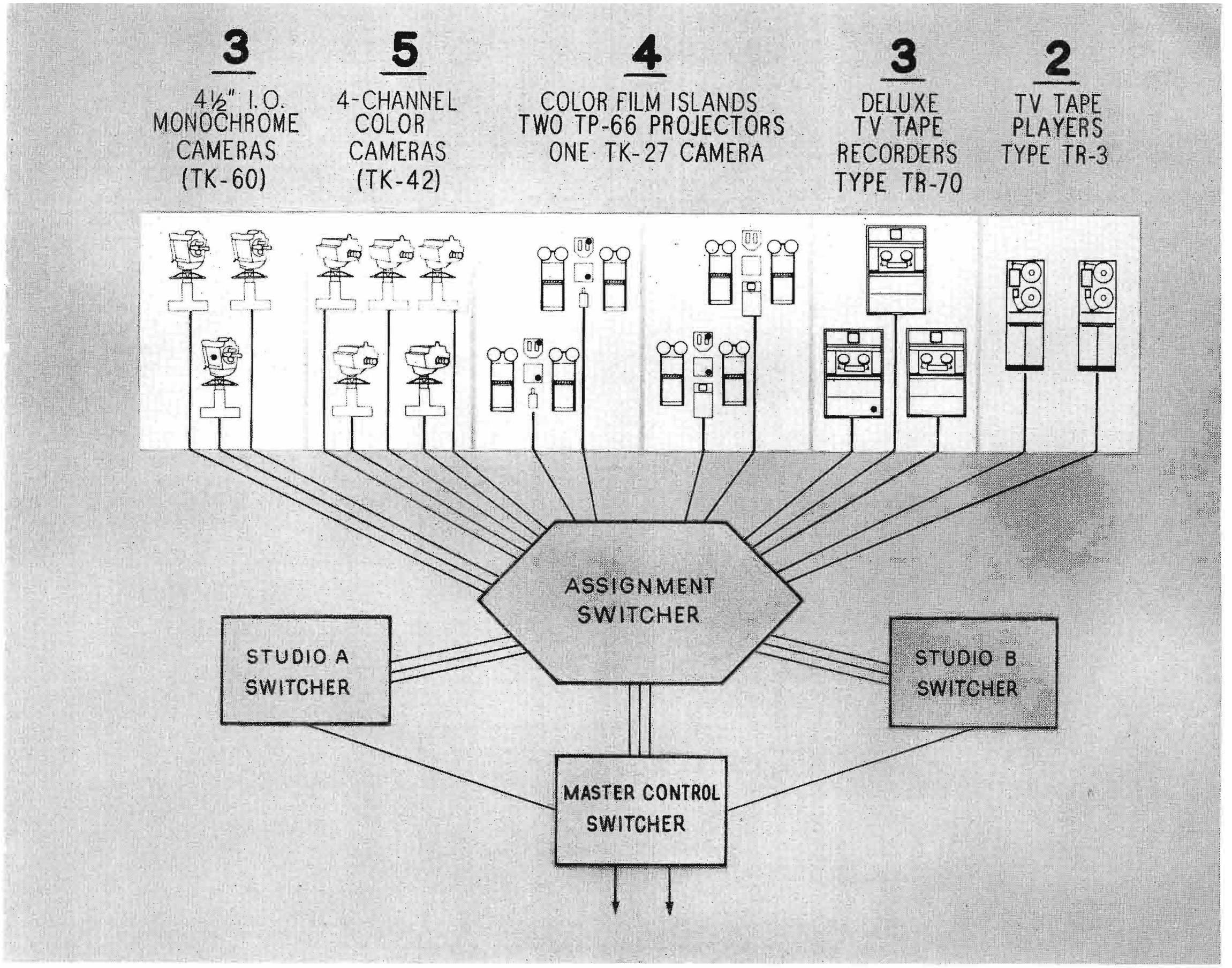


FIG. 17. A simplified Block diagram of the equipment being installed in the new KRON-TV Building.

Telco equipment and power panels are also in this single, big room.

In addition to these operating areas, the technical block contains storage areas, a shop and a technical locker room. There is also a large space reserved for film developing and editing.

Equipment Planning

RCA engineers, after being briefed on KRON-TV requirements (as to equipment and mode of operation), drew up three alternative equipment plans for station consideration. As submitted, these were voluminous documents covering every detail and specification of the proposed systems. Even simplified block diagrams would be too large for these pages. However, the chart shown in Figure 17 (used in a presentation to management) will serve to indicate the planning philosophy.

In basic concept all three proposed systems were the same. The difference was simply in the number of sources (live cameras, film cameras, tape, network remotes) to be installed. In fact, even the simplest system called for the same number of switching inputs and outputs as the largest (thereby providing for later installation of additional sources without system alteration). It turned out to be a wise way to plan—for although the station originally ordered what was essentially the simplest system, they made a number of major changes (additions) during the time the equipment was being constructed. One of these was to use all new film equipment (instead of moving some of their old equipments). Another was to install all color cameras instead of part monochrome. The effect of these was to bring the equipment on order up to the maximum plan (as shown in the chart of Figure 17). Although these represented a major increase in the size of the planned installation, they did not require appreciable change in the systems components being assembled in the RCA systems laboratories.

Equipment Philosophy

Referring again to Figure 17 it will be noted that the "heart" (or maybe it should be called the "brain") of the KRON-TV studio system is an "assignment switcher." As mentioned previously, an essential feature of KRON-TV's planning was that either of the two studios, or master control, be capable of operating as a completely independent "operation center." Thus, for example, Studio A might be producing a taped show while Studio B was being used for rehearsal and Master Control was airing a program from tape, film or network. Most stations can do this to a limited degree by patching or manual switching. KRON-TV wanted complete, unrestricted flexibility—with automatic switching. The

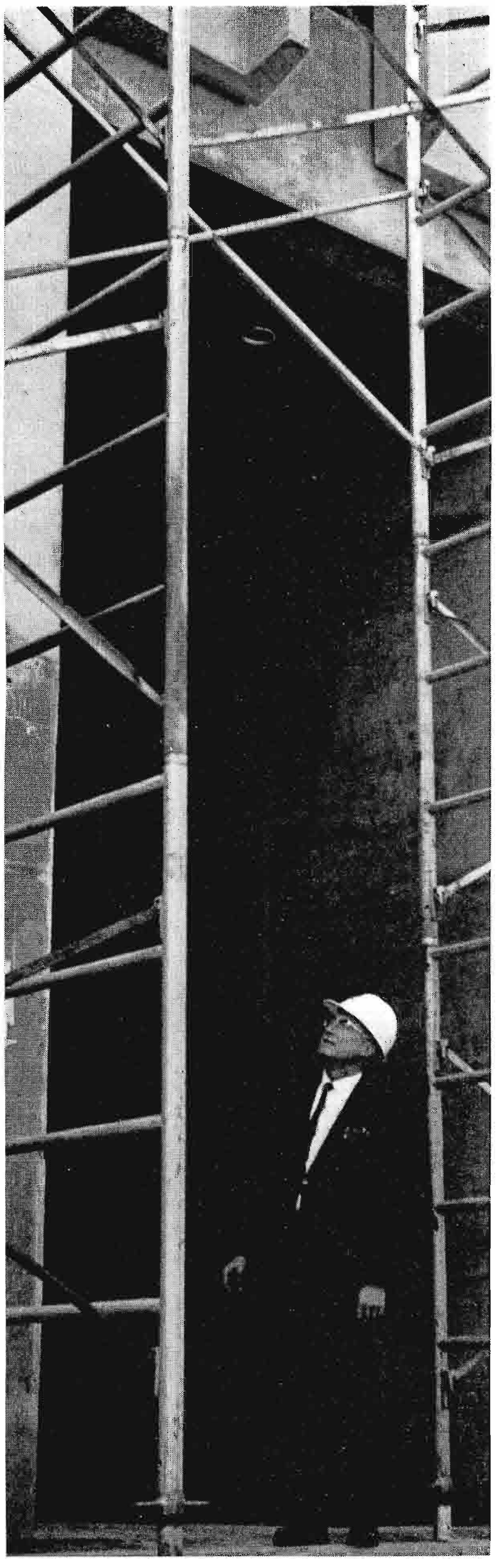


FIG. 18. Lee Berryhill, Chief Engineer of KRON-TV, inspects construction progress at the entrance of the new building.

answer RCA systems engineers arrived at was the "assignment switcher."

The "assignment switcher" allows any of the program sources to be "assigned," individually or in groups, to any of the three operating centers (Studio A, Studio B, Master Control). When so assigned, the operator at the studio control console not only has the use of the source equipment but also full control over its operation. Thus, for example, if the Studio A operating center is to produce a taped show, the studio control operator may have assigned to him not only the live cameras in Studio A but also one or more film islands and one or more tape machines. Thus he can "insert" film or tape sections as needed and can control the taping of his output. Such an arrangement makes each of the three operating centers a complete, independent production center.

The Assignment Switcher

Technically, the "assignment" switcher consists of a group of individual units, each designed to handle a section of necessary control leads or signals to be switched from one area to another. The groups are broken into Video, Audio, Pulse Intercom and Control Circuitry. The "group" switchers are not mounted next to each other, they rather appear within the associated equipment racks of their function sources. (Audio racks, Video, etc.) A control panel enables the operator to assign any of the chosen sources to one of the three operating areas.

When assigning a live studio camera to an operation area, the video output signal of that camera is handled by the video portion (a TS-40 type switcher) of the assignment switcher together with the control circuitry of the individually mounted camera control panels through the control switcher (a crossbar-type switcher). Additionally, a third switcher portion (crossbar-type) will transfer the intercom leads to the assigned area of operation. In case of a machine having its own audio source (film or tape), the fourth group of the assignment switcher is activated and transfers the audio to the assigned area. A fifth switcher selects the appropriate sync and drive pulses so that all equipment assigned to any particular studio switcher will receive pulses timed from only one of the three sync generators (clamp, genlock or standby).

The Other Switchers

In addition to the assignment switcher there are four other TS-40 switchers in the KRON-TV system. Three of these are used in Studio A, Studio B and Master Control. These are employed in essentially the standard configurations (more detail is given in the paragraph on consoles). The fourth TS-40 switcher is for House Monitoring switching. This is a 12 by 16 switching unit which enables any one of twelve input signals to be selected (audio and video simultaneously) for viewing at sixteen remote points. At each of these remote points (offices, conference room, lounges) there is a small box with a volume control and 12 interlocked push buttons. When a button is depressed, a 24 VDC signal sent through a multi-conductor cable to the switcher location energizes the corresponding audio and video relays. The selected picture appears on the monitor at the remote point and the accompanying sound comes from the associated speaker.

Equipment Location

The location of the main equipment items has been referred to previously in the description of the technical "block." The isometric drawing in Figure 19 shows the location of these more clearly. Each studio has associated with it a complex consisting of (1) an audio control booth, (2) a video control booth and (3) an announce booth.

In each audio booth there is a custom-built audio control console, two transcription turntables and four equipment racks containing associated amplifiers and other audio equipment. In each video booth there is a custom-built video console, and a bank of wall-mounted monitors. The director and the video operator, who sit side by side, look over the console at these monitors. The audio operator can also see them—through the window between audio and video booths. Each announce booth contains a desk, video monitor and microphone. There is a window from these booths into the video booths so that the announcer can be cued visually.

In the film/tape room there are four film islands. Each consists of two TP-66 Film Projectors, a TP-7 Slide Projector and a TK-27 Color Film Camera. There are two TR-70 Deluxe High-Band Color Tape Recorders, one TR-22 Tape Recorder, and two TR-3 High-Band Color Tape Players (which, by taking much of the playback load off the big machines, provide more total recording hours). Audio equipment associated with the projectors and tape machines is mounted in eleven equipment racks.

In the master control room are two long rows of equipment racks. These house the switching, distribution and auxiliary equipment. In the center of the front row of racks is the master control console. In the

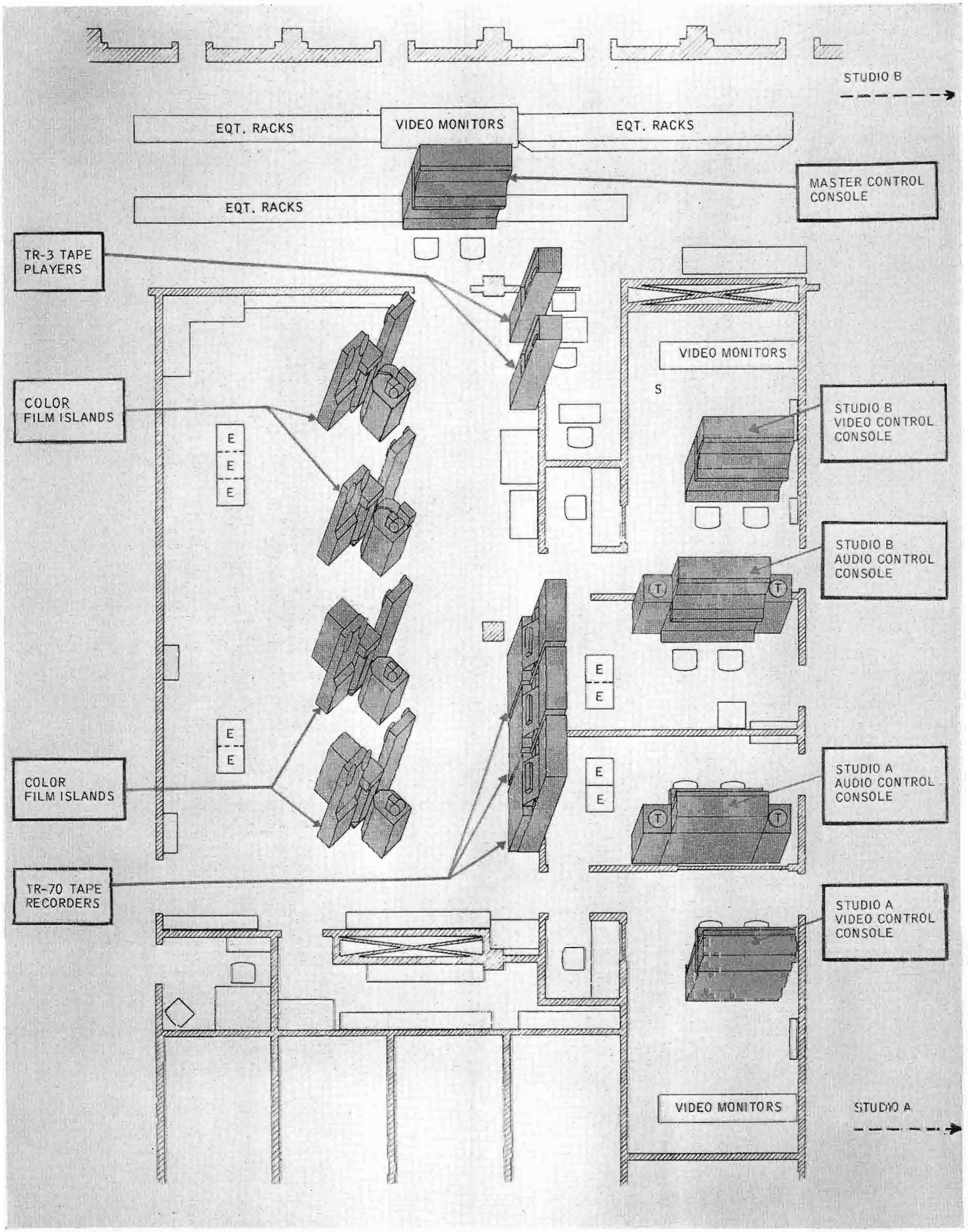
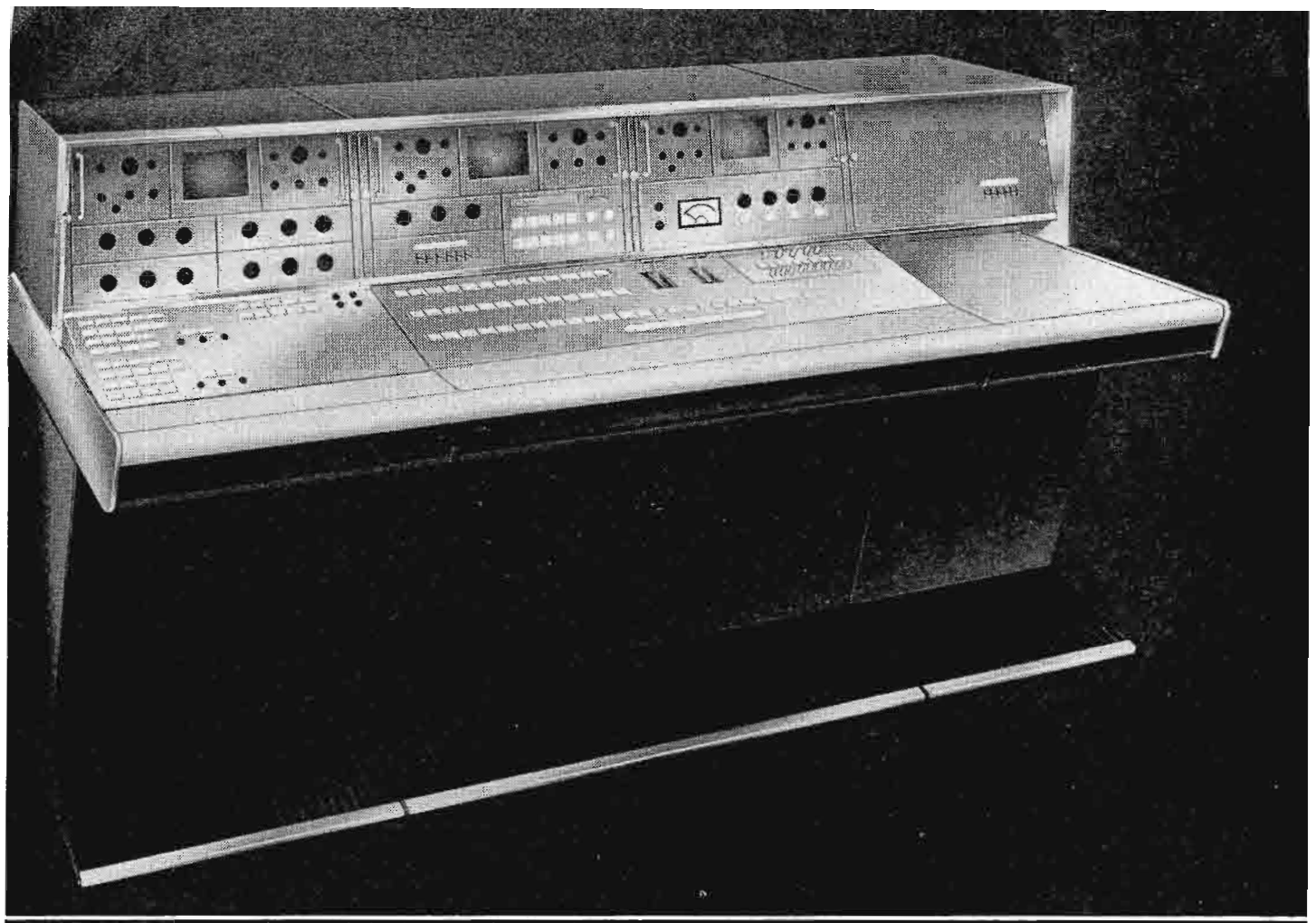
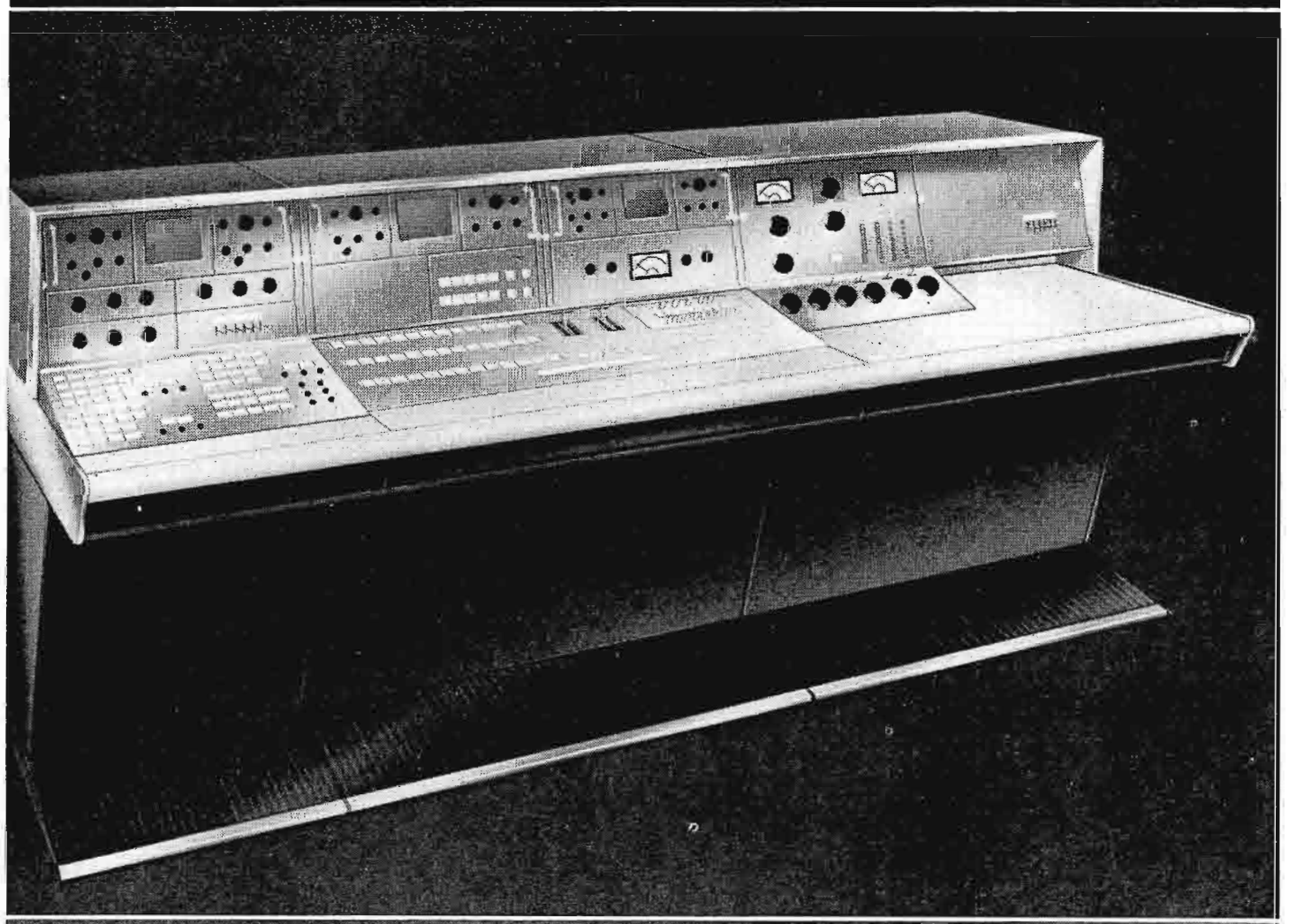
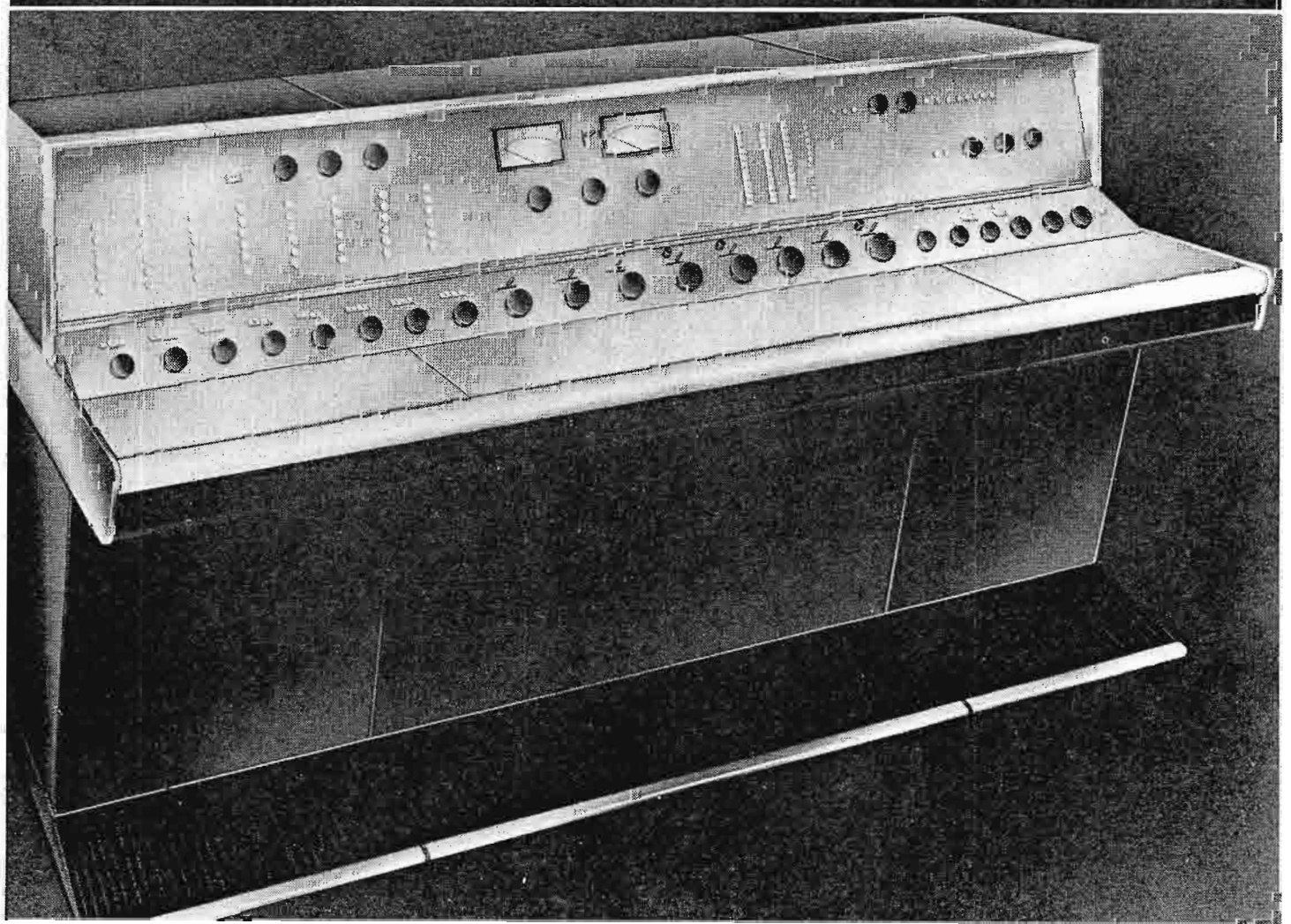


FIG. 19. Isometric view of technical area showing location of the main equipment items. Since this preliminary drawing was made, a number of equipment racks have been added as indicated in the copy.







center of the rear row of racks (and located so they can be easily viewed by the operator) is a group of video monitors. Other equipment in this room includes a camera patch panel, Telco equipment and power panels.

Custom-Built Control Consoles

A highlight of the KRON-TV installation will be the control consoles which RCA engineers designed especially for KRON-TV and which are being built in the RCA plant at Camden, New Jersey. Artists sketches of these consoles (as prepared for the original equipment proposal) are shown in Figure 20. These equipments will be a thing of infinite beauty (well, anyway, to the engineer). The Console housings (standard items in the RCA deluxe New Look line) are finished in two shades of blue with heavy, brushed aluminum trim. The control panels have a harmonizing silver-gray finish. Many of these panels are standard modular units from the RCA New Look line. Switching panels, of course, must be made up to order. All of the panels on the Audio Console are special.

The video consoles incorporate camera control panels, switching and machine control. The camera control panels are switched to perform with the assigned cameras (live and/or film) by the control portion of the assignment switcher (as are the VTR controls). Control functions for live cameras are Gain, Iris, Lens Cap and Pedestal as well as on-air tally. There are corresponding controls for film cameras. Operating modes of tape machines, film projectors and slide projectors may also be controlled.

The TS-40 Switchers associated with each video console (and master control console) incorporate all of the most modern concepts -- including "program" and "preset" buses, transition control by cut-bar or levers, built-in dissolves and special effects, provision for mixing composite and non-composite signals, etc.

A simple but effective "machine control" is also incorporated. Using these controls the operator can "preset" for any combination of machines (projectors, multiplexers, film cameras) coming up — and

FIG. 20. Artist's sketches of the custom control consoles RCA is building for the new KRON-TV installation. Top left, video control console. Center left, master control console. Lower left, audio control console. Since these preliminary sketches were made, many changes in detail have been made. For example, in the final design of the audio console vertical-type attenuator controls are used.

have them go into operation automatically when he presses a master start button.

The audio consoles house multiple audio control facilities which with the associated audio equipment racks form the basic audio system. Each audio console is, in effect, "tied" to its associated video console. Thus when a film or tape source is assigned to a particular video control by the assignment switcher, the associated audio is simultaneously routed by the audio section of the assignment switcher to the corresponding audio control console. Microphones in the studios may be similarly associated if desired. A special feature of the audio consoles are voice-triggered AGC-type microphone channels for multi-microphone panel discussions or similar applications.

Assembly and Test

All of the KRON-TV equipment — rack units as well as consoles — is being assembled, wired and tested (as units) in the RCA plant. RCA will also supply critical interconnecting cables (such as those between control panels and switching racks). The equipment will be installed and site-tested by the KRON-TV engineering department. RCA engineers will assist in the checkout. All of these things are a part of the RCA contract.

Summary

In this first article on the magnificent new KRON-TV installation we have described some of the thinking and planning that has been such an important part of this big project (with special emphasis on the planning "tools" that KRON-TV engineers have used to great advantage). We have done this with the thought that other stations who are thinking about, or planning, new installations will find these things not only of great interest but also of direct and immediate value.

When the installation has been completed (the forepart of next year), we will present another article on KRON-TV in which we will show how the completed building looks (including, of course, many photographs of that beautiful equipment). At that time we will also provide more detail on the arrangement and operation of the equipment — and how KRON-TV plans to use it.

FIG. 21. This shows the KRON-TV building during the construction phase. The nature of the location can be seen by noting the sharp incline of the street. The front entrance is at first-floor level. An entrance halfway back along the side is at second-floor level. An entrance at the rear is at third-floor level.

EAR-LEVEL AUDIO MONITORING

Hi-Fi Audio

EYE-LEVEL VIDEO MONITORING

Picture Waveform

SOLID-STATE MONITORS

SLIDE-OUT MONITORS

PUSH-BUTTON STANDARDS SELECTOR

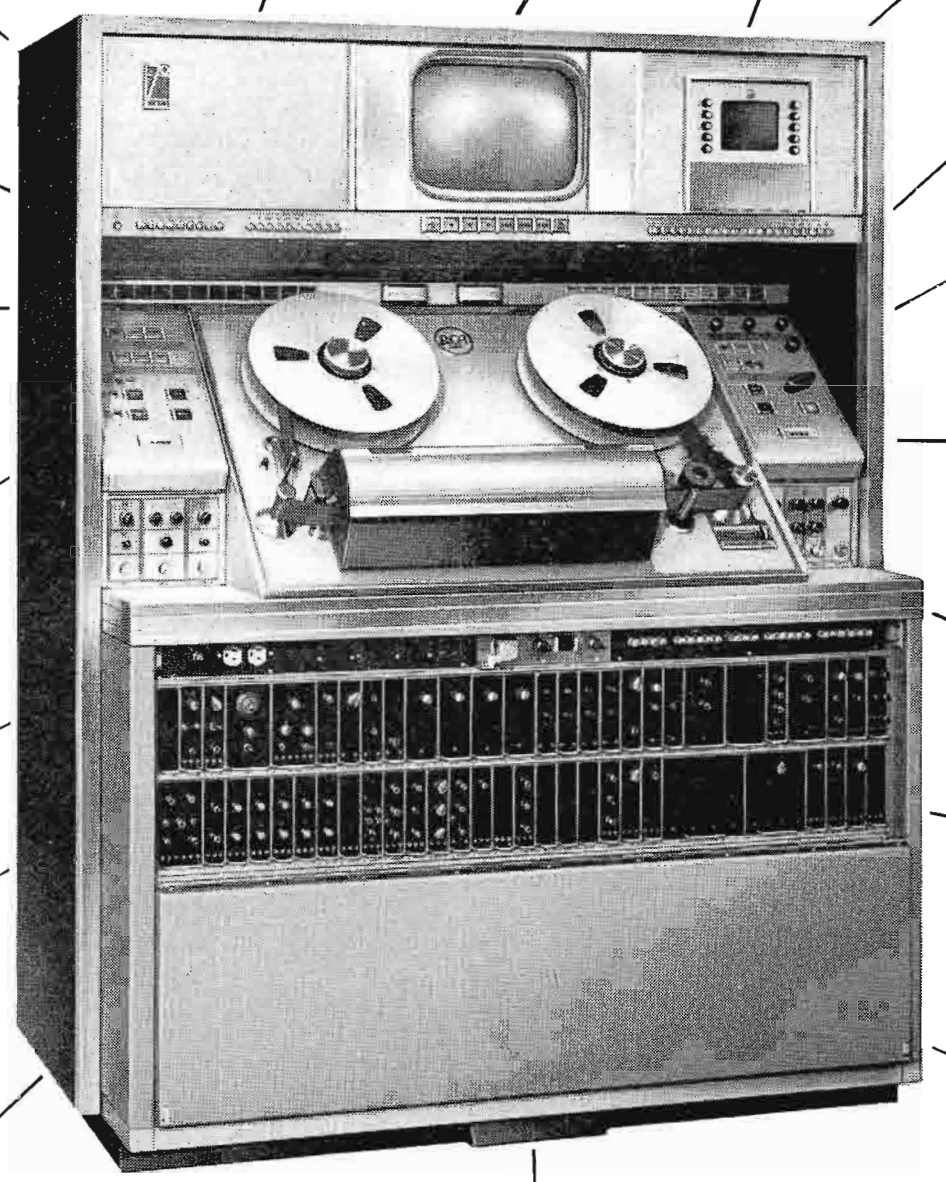
- FM Standards
- Line Standards
- Machine Speed

EYE-LEVEL METERING

SPACE AGE INSTRUMENTATION

- Automatic Indicators
- Color Coded for Fast Action
- 50 Signals can be Monitored

WAIST HIGH TAPE DECK



OUTPUT/PLAY CONTROLS

- Choice of 3 Servo Modes
- Variable Speed Wind Control
- CT Phase Control

INPUT/RECORD CONTROLS

- Automatic Guide Positioner
- 2-Channel Input Selector
- H-F Compensation Control

4-MODE FM TEST FACILITY

HIGH-PERFORMANCE HEAD WHEEL

ALL-FRONT EASY-ACCESS SERVICING

- 30 Push Button Monitoring Points
- 130 Test Points
- Hinged Control Panels

STANDARD MODULES

- One Type
- All Plug-in
- Pre-wired for Accessories
- Single Service Extender

COMPRESSOR BUILT-IN
(with automatic drain)

SYSTEM POWER SUPPLY
(No Individual Supplies Required)

FOOT SWITCH

(Leaves Both Hands Free for Tape Threading)

REQUIRES ONLY 9.4 sq. ft.
FLOOR SPACE

FIG. 1. The TR-70 is the world's newest and most highly developed high band color recorder. It incorporates all the essential refinements that assist in producing color tapes free from imperfections — without undue difficulty. It includes automatic indicators and devices to ease the task of production people in making multiple copies that look like originals. And the operator has all this sophistication at his fingertips, to command and to control with ease. This advance moves high band tape operation into the area of standard broadcast reliability. When you turn this machine on, you know it's going to work, and you know it's going to keep on producing the finest quality color tapes.

NEWEST HIGH BAND COLOR TV RECORDER

Unsurpassed Performance and Unmatched Design Features Make the TR-70 the Fastest and Most Reliable Producer of Live Quality Multiple Generation Color Tape Pictures

by R. E. ABBENANTE
TV Tape Product Analyst

Technical performance inherent in the TR-70 High Band Color Tape Recorder brings forth a new standard of excellence. It produces up to four generations of the sharpest, most brilliant, truest color pictures ever seen. For today's market, wherein color television is the dominating factor, the TR-70 is the ultimate choice.

It is designed, tested and delivered as a high band color machine, rather than a converted monochrome machine. It is switchable to all color and monochrome standards. Furthermore, it is designed as a completely integrated, color taping system — including electronic editing, velocity error correction, color dropout compensation and automatic chroma correction. It is, however, available without these plug-in options, which may be added at the convenience of the user.

The TR-70 incorporates many important features not available in other machines. Included are: (1) grouped operating controls; (2) full instrumentation; (3) standardized modules; (4) all-front access; (5) front panel test points; (6) eye and ear-level monitoring. No other recorder combines technical specifications and operating conveniences to realize the full potential that high band recording techniques have to offer.

New Standards for Color Performance

For those who wish to compare specifications, the TR-70 High Band Color Tape Recorder introduces a new standard of performance in color tape recording. Excellent signal-to-noise ratio — better than 46 dB — coupled with less than 1.5 percent color K factor rating, and a virtually flat frequency response of ±0.5 dB, produce clear, brilliant pictures. Annoying moire, down more than 40 dB, can no longer be seen in the most stringent of tests — a color bar signal.

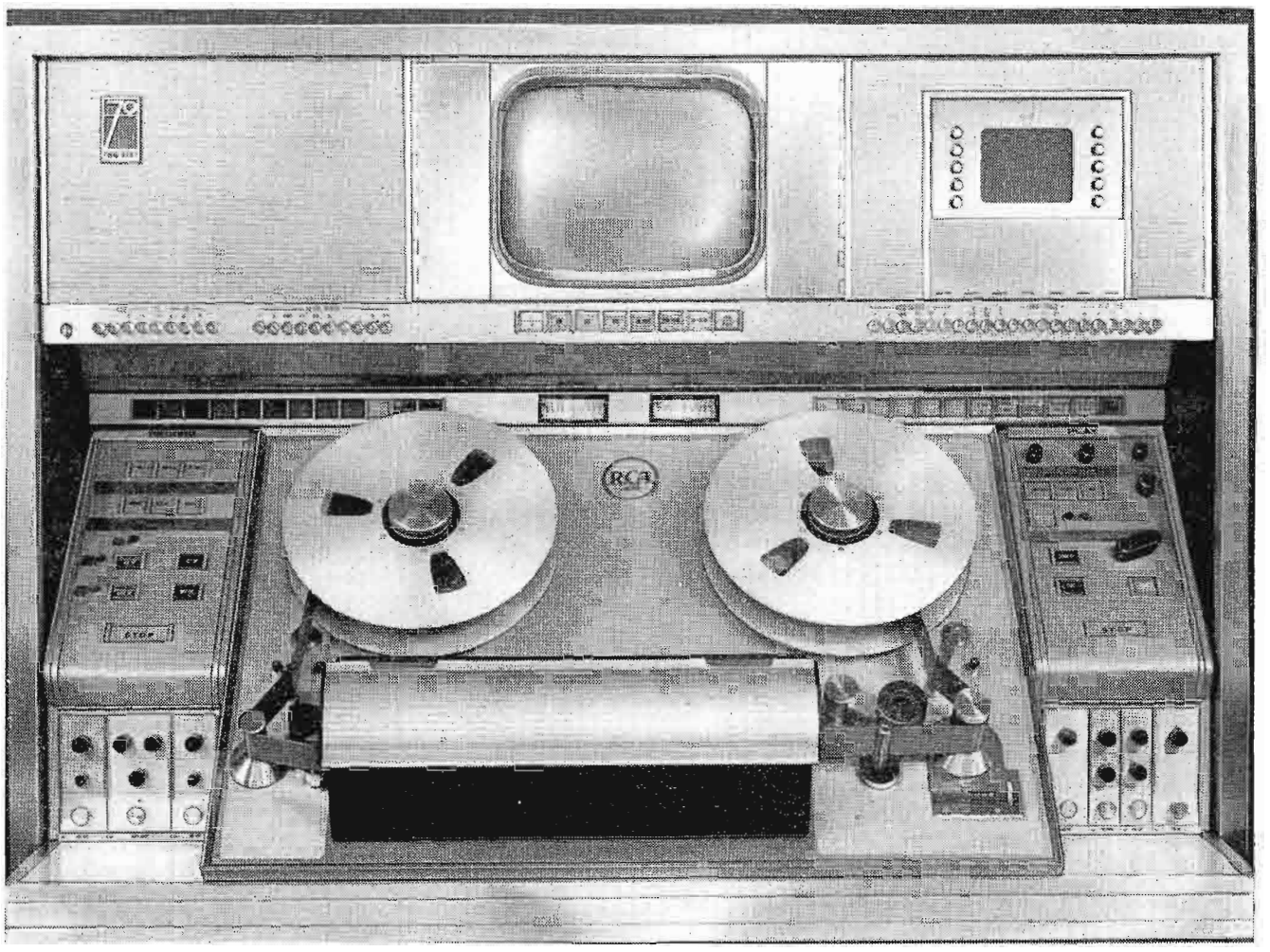


FIG. 2. The TR-70 Control Center is designed to aid the operator in getting good pictures, without undue effort. The Control Center is separated into two basic positions: (left) the input/record controls and (right) the output/playback controls. All operating controls are mounted on these two panels. Immediately above the controls and tape deck in the TR-70 are the automatic instrumentation indicators, color coded for fast response. These relieve the operator of considerable strain, easing the job of getting high quality tapes at all times. At the very top of the TR-70 are the audio and video monitors, placed at strategic ear and eye level for utmost effectiveness.

TR - 70 HIGH BAND COLOR PERFORMANCE SPECIFICATIONS

PARAMETER	625/50	525/60
Frequency Response	±0.5 dB, 25 Hz — 5.5 MHz	±0.5 dB, 30 Hz — 4.1 MHz
Signal-to-Noise	43 dB	46 dB
Transient Response	1.5% K factor	less than 1.5% K factor
Moire	34 dB or better	40 dB or better
Low Frequency Linearity	1%	1%
Differential Phase	less than 5° @ 4.43 MHz	less than 5° @ 3.58 MHz
Differential Gain	5%	4%
AUDIO	**PROGRAM**	**CUE**
Frequency Response	±2 dB, 50 Hz — 15 kHz	±2 dB, 50 Hz — 12 kHz*
Flutter and Wow	0.2% RMS	0.2% RMS
Signal-to-Noise	55 dB	40 dB or better

* 36 dB notch at 240/250 Hz

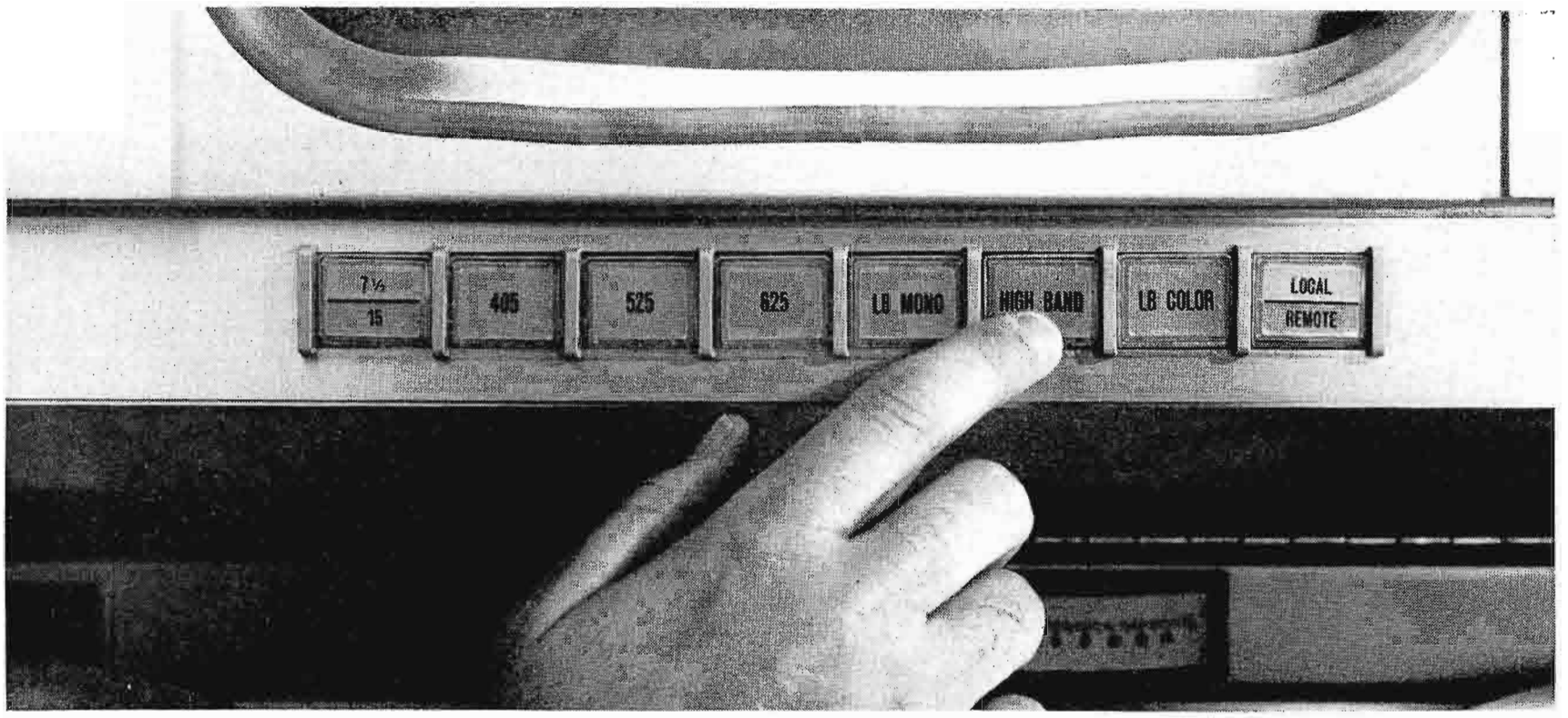


FIG. 3. The standards selector panel is conveniently positioned directly above the center of the tape deck, at eye level, and within easy reach of the operator. This provides, at the push of a button, for instant selection of FM standards, line standards, and machine speed. (On the domestic model of the TR-70, the 405 and 625 line standards switches are blank.) Note that machine speed is push button controlled for either 7½ or 15 ips operation. These push buttons also serve as visual indicators, acting as constant reminders to the operator of the standards selected.

Now, with the TR-70, highly saturated colors can be recorded and reproduced beautifully, with the absence of moire. Flexibility in the design of color settings and staging is no longer limited. Any color desired may be used; the TR-70 can handle it with ease. Differential phase (5°) and gain (4%) is a measure of the TR-70's ability to reproduce color pictures faithfully. The TR-70 can produce multiple copies of tapes to the fourth generation, with superb, original-like quality.

Operator-Engineered Design

In designing the TR-70, engineers were careful not to overlook a very essential and basic participant in color recording . . . the operator. Automatic devices, instrumentation, integrated color system design — all were conceived to make it easier for the operator to exercise command of the complete sophistication in the TR-70, and thus achieve its total color capability.

Operating efficiency is increased, and chances for operator error are reduced, because of what might be termed simple, biomechanical considerations in system layout: (1) the monitoring of audio and video at ear and eye level; (2) separated

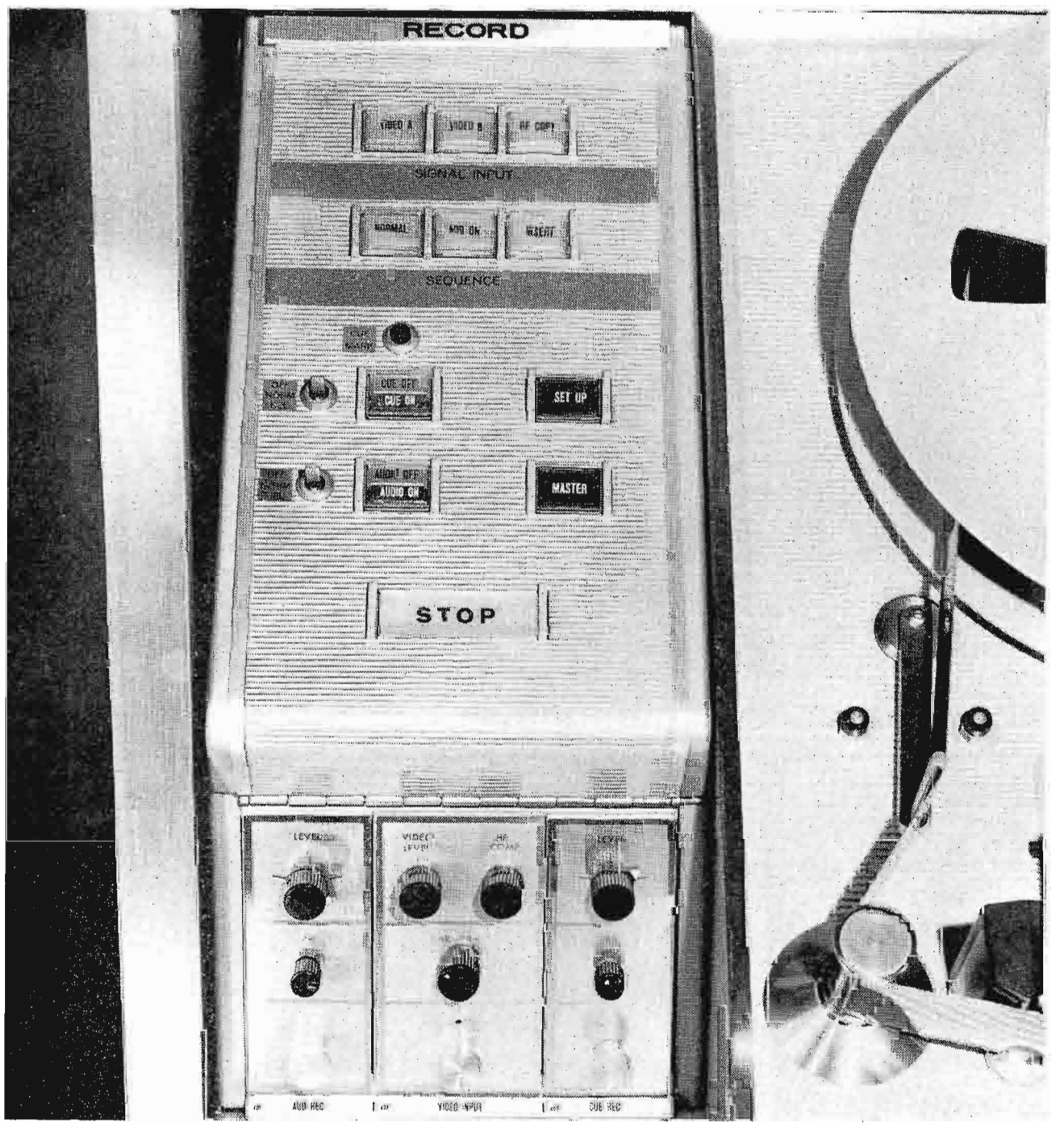


FIG. 4. Input/Record Control panel located at left of TR-70 Control Center to separate record from play functions and avoid possibility of error. Note at the top of the panel the 2-position input selection: Video A for a program line; Video B for a test signal (or any combination desired). Immediately below are controls for three modes of electronic splicing operation. These may also be remoted if desired. New features here are the HF Comp Control to permit adjustment of frequency response characteristic so that incoming signals may be correctly equalized; and the Var/Unity Control to provide proper recording level. All these controls are associated together for speed and precision in production of tapes.

record and play control panels; (3) easy-to-load tape transport (waist-high and sloped at a 45 degree angle); (4) a color-integrated electronics module bank; (5) centrally-located power supply; and (6) self-contained low and high pressure air system. All are engineered from a practical operational standpoint, a factor other tape recorder manufacturers have apparently neglected.

Instantly Switchable FM Standards

High band for both monochrome and color (7.06-10 MHz) has introduced a third recording standard to be added to low band monochrome (4.28-6.8 MHz) and low band color (5.5-6.5 MHz). Tape libraries are bursting at the seams with at least two categories of tapes, low band monochrome and low band color. Now, with the addition of high band tapes, there will be three standards to cope with — for some time to come. This means that a recorder must be able to replay for these three FM standards, hence some method of quick interchange is highly desirable to save time. The TR-70 takes care of this by incorporating circuitry in the basic machine for all standards. Thus, operation on all is available on an instantly switchable basis, with no need to change modules for different standards.

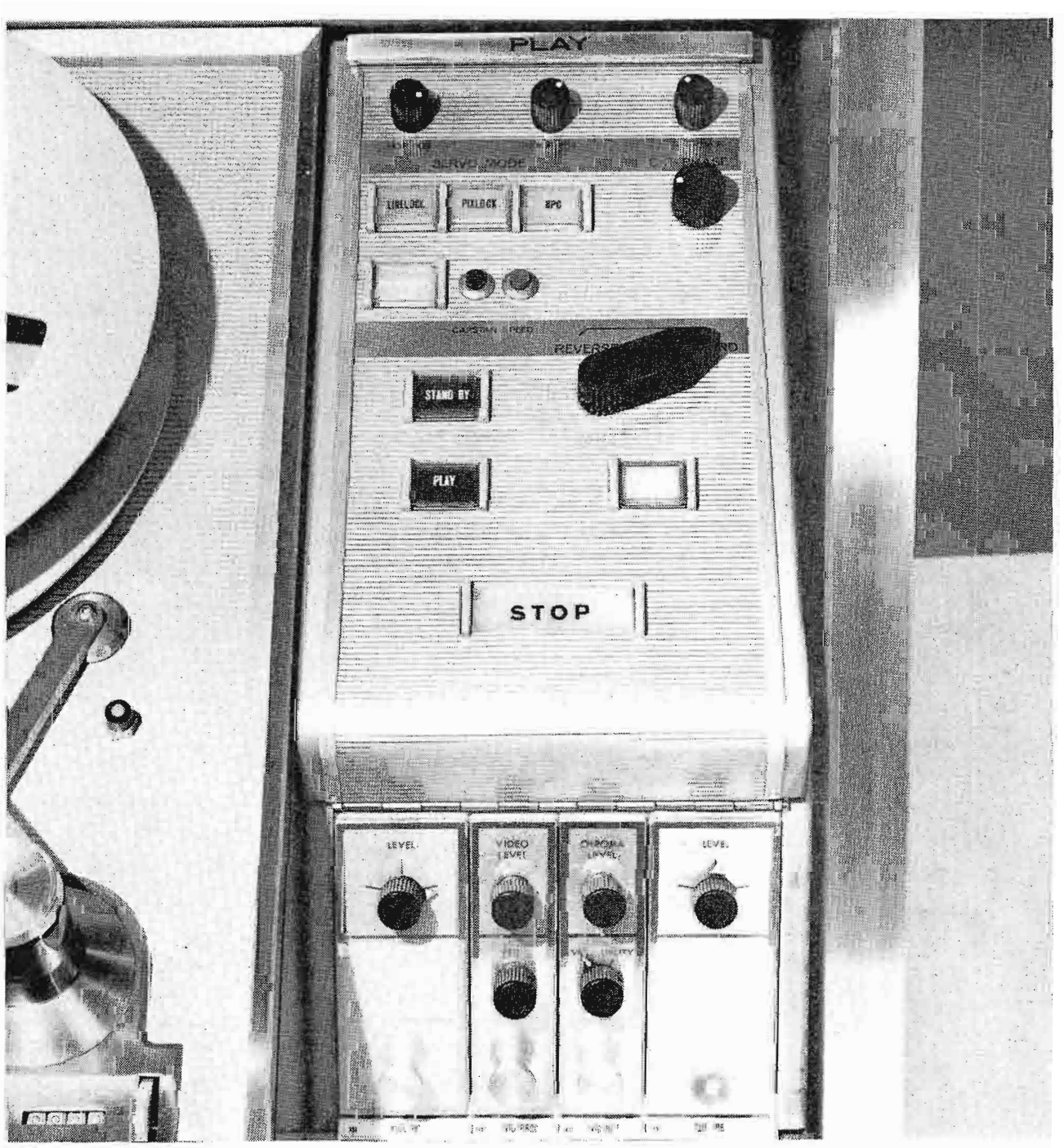


FIG. 5. Output/Playback controls are positioned at right of tape deck and Control Center, separating them from the recording function. A special feature here in the TR-70 is the choice of three servo modes: Linelock, Pixlock, NPC. These serve to give selection of conditions for finest color tape reproductions possible — whether mixing is required, fast recovery from disturbances (see text) or replay of heterodyne process tapes. Another new feature is the CT Phase Control. In one position it serves as optimizing control (when correct track has been selected for playback.) In second position, all four tracks are covered to seek the correct track. Another exclusive feature of the TR-70 is the continuously variable speed wind control.

Dual Input Selector Panel

The TR-70 record control panel houses a two-position audio/video switcher designated as Video A and Video B. Thus, the machine is capable of accepting input feeds from either of two program lines, a program line and a test signal (color bars, etc.), or whatever the choice may be for a particular application. Whichever position is selected, it is possible also to preview the audio, picture and waveform signals of the alternate feed by pushbutton selection on the monitoring bridge switching panel.

Compensation for Non-Standard Tapes

Though rigid standards exist in TV tape recording, there is always the likelihood that some tapes will be substandard for various, uncontrollable reasons. In one case, for example, a remote signal fed to the studio may be of incorrect video or chrominance level. For this condition, the TR-70 input stage provides a variable video level control as well as a high frequency compensation control to correct for non-standard video and chrominance levels before recording.

Other common problems relate to incorrect deviation, control track signal, and guide penetration. In the TR-70, correct deviation is accomplished by using a modulator AFC and crystal marker reference, to control blanking level and peak white. The modulator AFC warning light will glow red if the carrier is off the proper frequency, and the peak white reference can be checked by using the built-in crystal controlled calibration pulse; thus, the operator can be certain that the deviation will be correct. A control track warning, which functions in either record or playback, will light should the level be deficient, giving an immediate visual indication to the operator of potential trouble. Each time the TR-70 is placed in the record mode, the guide automatically returns to a fixed pre-set position, established as the recording standard. There are no levers or knobs to turn to make a standard recording.

There is no excuse for recording non-standard signals with the TR-70. Nor are substandard tapes pre-recorded on other machines any longer a total loss.

Integrated Color Machine

While still on the drawing board, the TR-70 was envisioned as a completely integrated high band color system to achieve the finest performance obtainable. Adding color and high band as appendages to a monochrome system was inconsistent

with the goal. On the other hand, it would have been shortsighted not to consider low band operation, as well as high band. Therefore, the TR-70 incorporates circuitry to produce state-of-the-art low band performance in both monochrome and color, without compromising the brilliance of high band. All facilities for low band monochrome and color are completely integrated into the machine. As a result, the TR-70 is designed, manufactured, and delivered as a complete color system.

Choice of Servo Modes

Design versatility in the TR-70 is accented to readily select any of three servo modes for color reproduction at its finest. Pixlock provides a tight lock on both vertical and horizontal sync information to allow special effects mixing of tape signals with other signals. The new Linelock mode is useful when special effects are not required or when extremely fast recovery is required from disturbances that originate from improper mechanical or electronic splices, tape dropouts or other tape disturbances. The Non-Phase Color mode (NPC) is required to replay color tapes made by the earlier heterodyne process. All modes are controlled by the operator at the push of a button.

Space Age Instrumentation

Complementing the sophistication of the TR-70, in-depth biomechanical engineering is applied to aid the operator in quickly establishing the condition or operating status of the machine. A color-coded system of mode and warning indicators alerts the operator, and instantly pinpoints any area of difficulty that may result in marginal or improper operation. More than 50 discrete signals covering audio, picture, waveform, and DC voltage information can be monitored on a pushbutton basis. The TR-70 is instrumented to virtually think ahead for the operator, leaving little to chance or imagination.

Standardized Maintenance

Forward engineering is also reflected in the election of standard construction for the TR-70. All plug-in modules are the same type, each consisting of a module frame, component board, and identical connector. Each connector is keyed, making it impossible to insert a module in an incorrect position. Over 160 test points and pushbutton monitoring points trace the signal from the input to the output of the machine, permitting convenient monitoring of the FM, servo, video, color processing, and power supply system. All are easily accessible without removing

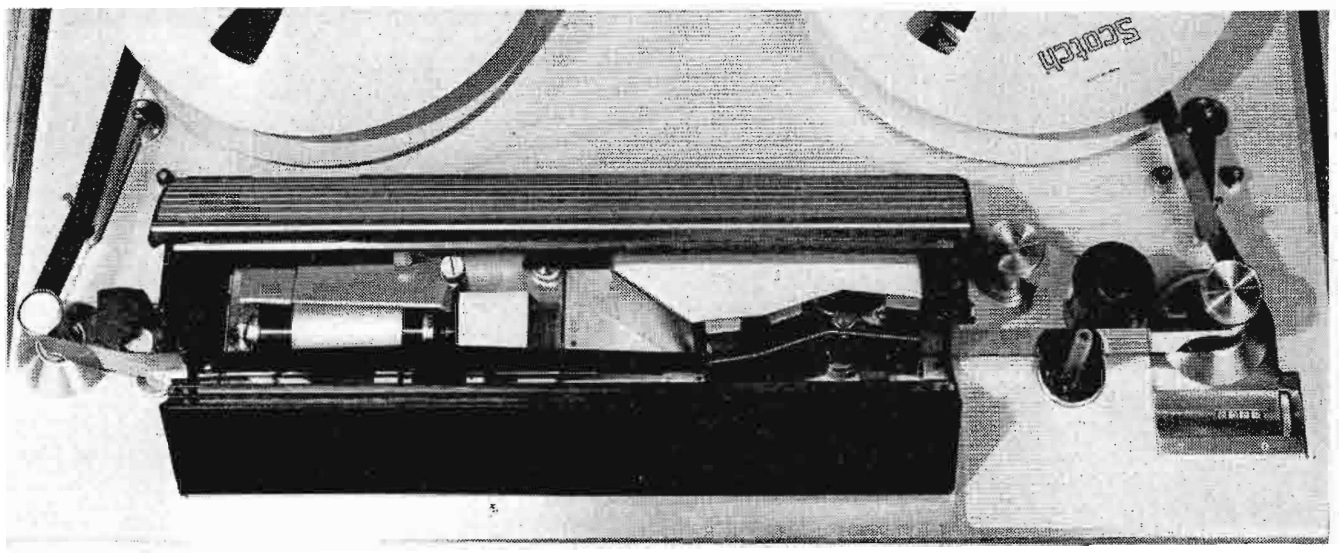


FIG. 6. A new high-performance air-bearing headwheel has been introduced in the TR-70 that improves performance and eliminates quadrature delay lines. It may be used interchangeably with other RCA high band converted machines. The entire tape transport mechanism has been advanced in design to more accurately control tension and alignment, thereby facilitating color tape interchangeability.

module front panels or screws. Shielding between adjacent modules is accomplished by built-in separators, which are permanently attached to the machine console. Thus, no shield covers are required. When a module is removed, components in the module are exposed for immediate access. No tools are needed to remove the modules. The record control and play control panels are hinged to swing forward for servicing. The audio, picture and waveform monitors are all slide mounted for easy withdrawal. The base of the console houses the compressors for low and high air pressures, main cooling blower, and the power supply system.

New High Band Headwheel

New concepts in headwheels were developed to complement the advanced TR-70 electronics and to satisfy the demanding requirements of high band operation. Guide repeatability of this new high-performance headwheel is excellent, and produces color pictures with complete absence of color banding. Precise quadrature alignment of the heads is now accomplished by using new manufacturing techniques, alleviating the need for machine delay lines. A 9-element slip ring assembly, with independent ground returns for each head, reduces crosstalk between heads well below the system requirements. A guide height control, easily accessible, can be adjusted to remove guide height error independently of guide penetration.

4-Mode FM Test Facility

This built-in convenience greatly aids the operator in setting up tape recorder measurements such as signal-to-noise, moire, frequency response, and further permits precise matching of the headwheel to the playback amplifiers. Conveniently located directly below the tape transport, the FM Test Panel is complete with head resonance probe, channel select switch, test switch, and test select switch.

In the head resonance position, use is made of the built-in modulator to generate the signal required in optimizing the headwheel panel; therefore, there is no need for external test equipment. Important safety features are also incorporated in the FM Test Facility; for example, when the head resonance probe is attached to the headwheel, all running modes are locked out to prevent the headwheel from turning and causing damage. Thus, the probe must be in its normal resting position before the machine can be activated in a running mode. In another safety feature, if the head resonance probe is in its normal position, the test mode is automatically dropped should the operator push Stop, Start, Wind, or any other mode. This occurs whether or not the test select switch is in its normal position, making it impossible for the operator to make a mistake.

Velocity Error Corrector Accessory

The velocity error corrector, available for the TR-70, is a plug-in module designed to give further improvement of high band or low band color program quality in playback. Employing integrated circuits and other advances in the state-of-the-art for higher reliability, the velocity error corrector compensates for inherent mechanical defects in TV tape systems that cause color hue banding.

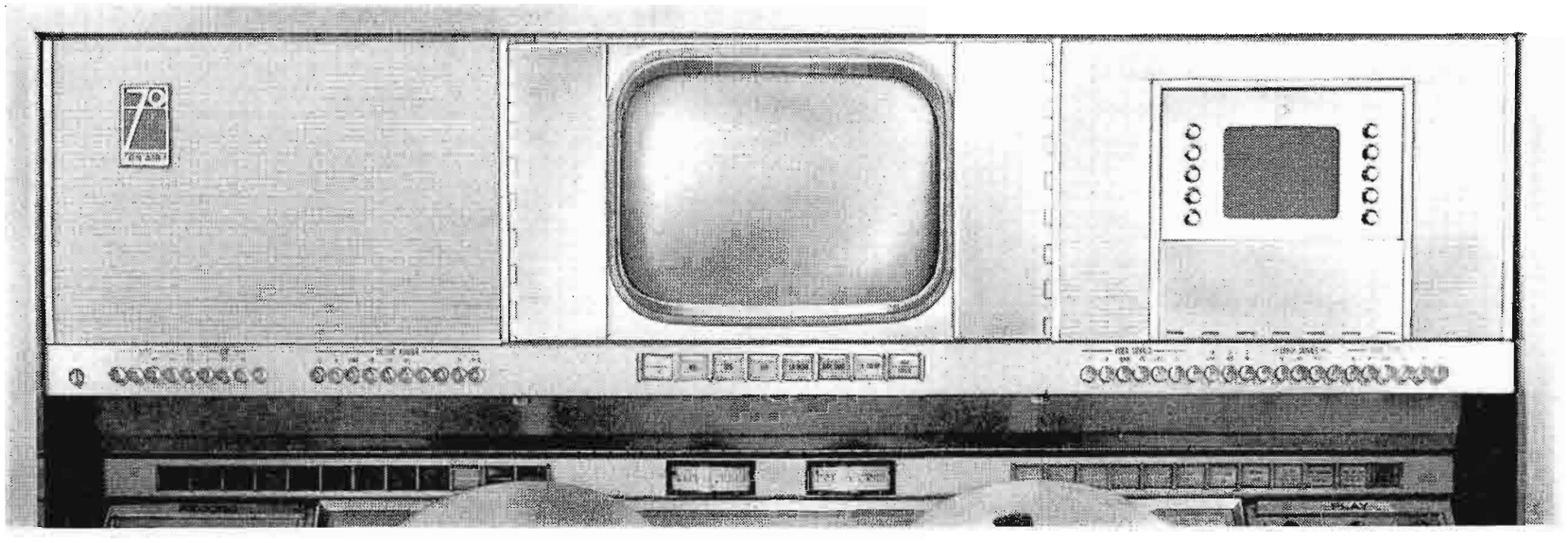


FIG. 7. The monitoring facilities for audio and video in the TR-70 are strategically positioned in a bridge, above the operating center at eye and ear level. A selector panel includes choice of preview facilities and head channel identification. The audio and video monitors are all solid state. In the audio monitoring system a hi-fi monitor amplifier and extended range speaker, in wooden enclosure, enable operators to rapidly discern any audio distortions and to make corrections. The audio panel includes preview of alternate channel input.

In the video area the picture monitor features the all-important pulse-cross display. This provides another precision tool for the operator to discern timing errors, displaced equalizing pulses, sync width, etc. The channel identification signal eliminates need for manually placing marks on the screen to identify the individual channels. The waveform monitor is the most functional available today. Push button set up and operation aid the operator to speedily and accurately monitor key signals. The selector switch provides immediate display of all critical waveforms — video and control signals — at the touch of a button.

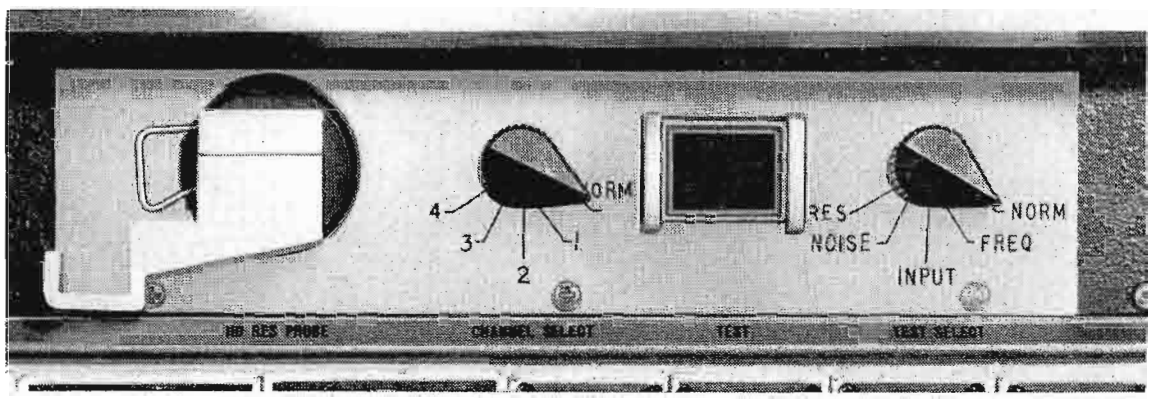


FIG. 8. FM test facility incorporated in TR-70 employs signal from built-in module to optimize the headwheel. This assists operator in set up, making measurements, and matching. It assists production of tapes without annoying disturbances. Automatic safety feature disconnects test mode if operator inadvertently selects another mode.

Effective Dropout Compensation

There are various ways to approach the problem of full color replacement during a dropout. One is to compensate in the video domain, another is to reinsert the FM signal. The action of the RCA Dropout Compensator is in the video domain, where the composite video signal is divided into its two active vision components, luminance and chrominance. As a result of this division and processing within the Dropout Compensator the reinserted material that is substituted during a dropout contains wideband luminance information and correctly phased chrominance information. In the case of FM reinsertion, the chroma is 180 degrees out of phase, resulting in incorrect color being inserted. (Recently a major network released the results of tests they carried out on all available dropout compensators. First on their list for effectiveness was the system RCA is offering for high band machines. Second was the monochrome only insertion. Third was the FM insertion process).

Push Button Splicer

This accessory consists of two transistorized plug-in modules and offers a fast, accurate means of electronically adding or replacing sequences in recorded color or monochrome tape without need for cutting and rejoining the tape. Three modes of operation are provided, "add-on", "insert" and "normal" (non-splicing mode), and provisions can be made for remote selection of modes.

Automatic Chroma Corrector

The plug-in Automatic Chroma Corrector is an option that automatically corrects the inherent frequency response differences between heads. The correction takes place in the FM domain during a tape playback. Tape burst is compared with a fixed reference to develop an error signal that is used to correct the chroma level of each head, thus reducing chroma banding.

Forward Step

The TR-70 establishes an unsurpassed excellence in picture realism, color and brilliance. It is a machine designed specifically for high band color, employing the latest state-of-the-art television electronics. It retains and enhances the proven operator-engineered control concepts of other RCA TV tape machines. The TR-70 is a significant forward step in TV tape technology. It advances high band TV tape operations from laboratory to production status, achieving the high degree of performance repeatability required, particularly in broadcast operations.

EXPO '67 TO USE RCA COLOR TV

Mobile Units with TK-42 Camera to Serve for Color Originations Under Auspices of the CBC

by PIERRE LABARRE
and GORDON GAETZ

Project Engineers, Broadcast Engineering, RCA Victor Company, Ltd., Montreal, Canada

1967 is Canada's Centennial Anniversary year, and the most important single event in the celebration of the Centennial will be the Universal and International Exposition to be held in Montreal from April 28th to October 27th. Expo '67 will be the first official exhibition of its class (Premier Category Universal) to be held in North America.

The Canadian Broadcasting Corporation is participating by building and staffing an International Broadcasting Centre whose primary purpose is to act as a service centre for broadcasters from countries participating in Expo '67.

The pavilion has been designed for a second function—that of an exhibit, where the public will be able to see television productions in progress.

Basically the broadcast centre will be equipped with two television studios, four TV mobile units and one mobile tape. Two of the mobile units are for color and have been designed and built at an address very familiar to Canadian broadcasters—1001 Lenoir St., the main plant of RCA Victor Company, Ltd., Montreal.

Each of these units will be equipped with three RCA TK-42 color cameras. Two additional similar vehicles, each equipped with four TK-42 cameras, were built for the CBC at the same time, one

FIG. 1. The International Broadcasting Centre features facilities for radio and television including color transmission, has been built by the Canadian Broadcasting Corporation on the Expo 67 site.

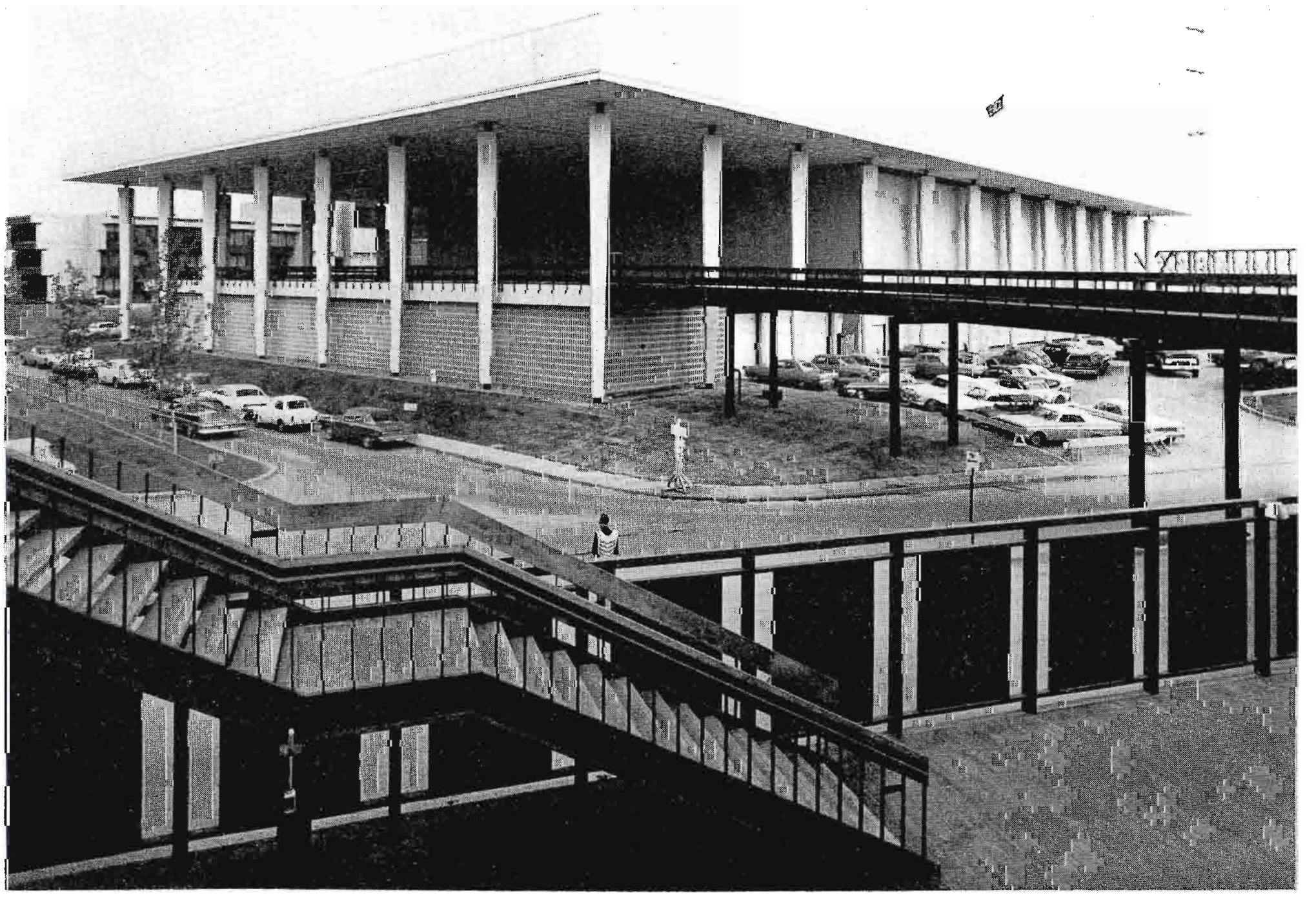


FIG. 2. One of the RCA Victor equipped vans, with four TK-42 cameras, and complete production facilities, at Westmount Park in Montreal.

for Montreal (headquarters of the French network), the other for the English network headquarters in Toronto. All four mobile units were built as a single project with delivery commencing in October 1966 and the final unit scheduled for Expo in February, 1967.

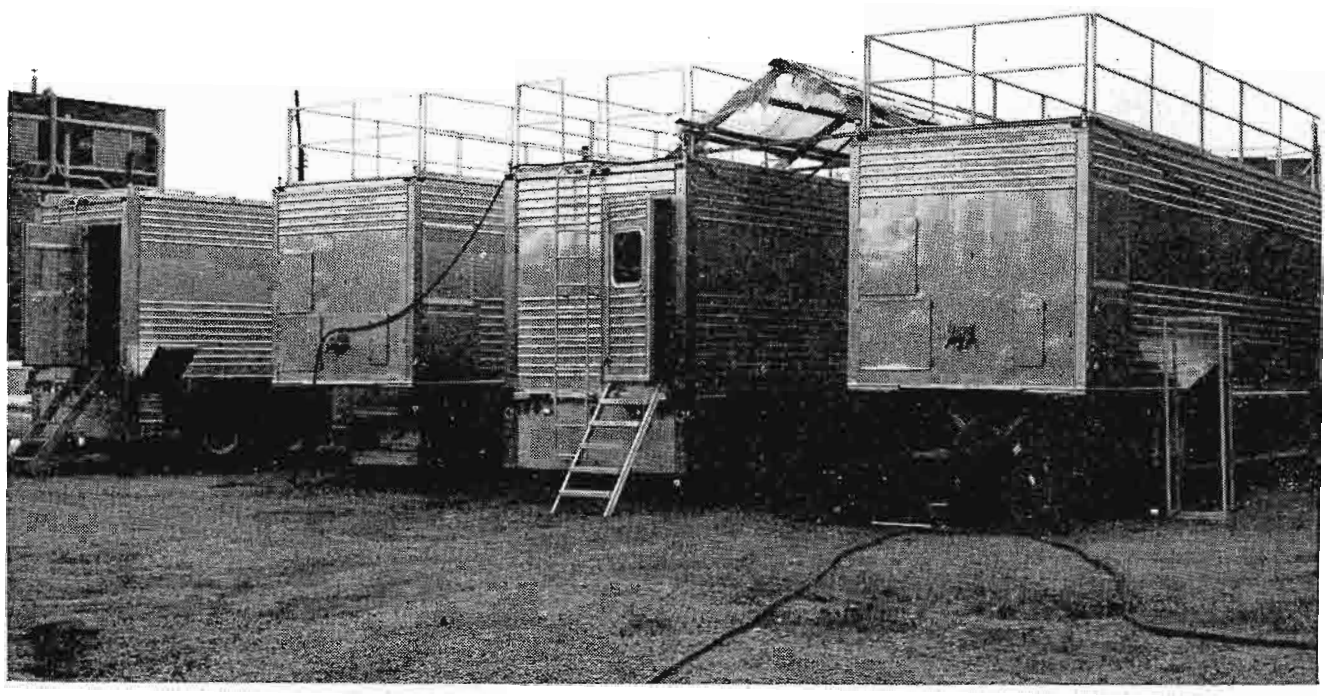
This latter vehicle will be on loan to the CBC for the duration of Expo, and represents one of several notable contributions made by RCA Victor to this focal point of Canada's Centenary celebrations.

Description of Mobile Units

A unique feature of the units is that they have the necessary facilities designed into them for supplying two separate audio programs to match up with the single video program.

The other features include very thorough thermal insulation in the walls, roof and underbody to combat low Canadian temperature. Salt is a formidable enemy of cars in Canada, and liberal use has been

FIG. 3. A total of four mobile vans have been constructed for CBC by RCA Victor: Two for Expo, one for Montreal (French net), one for Toronto (English net).



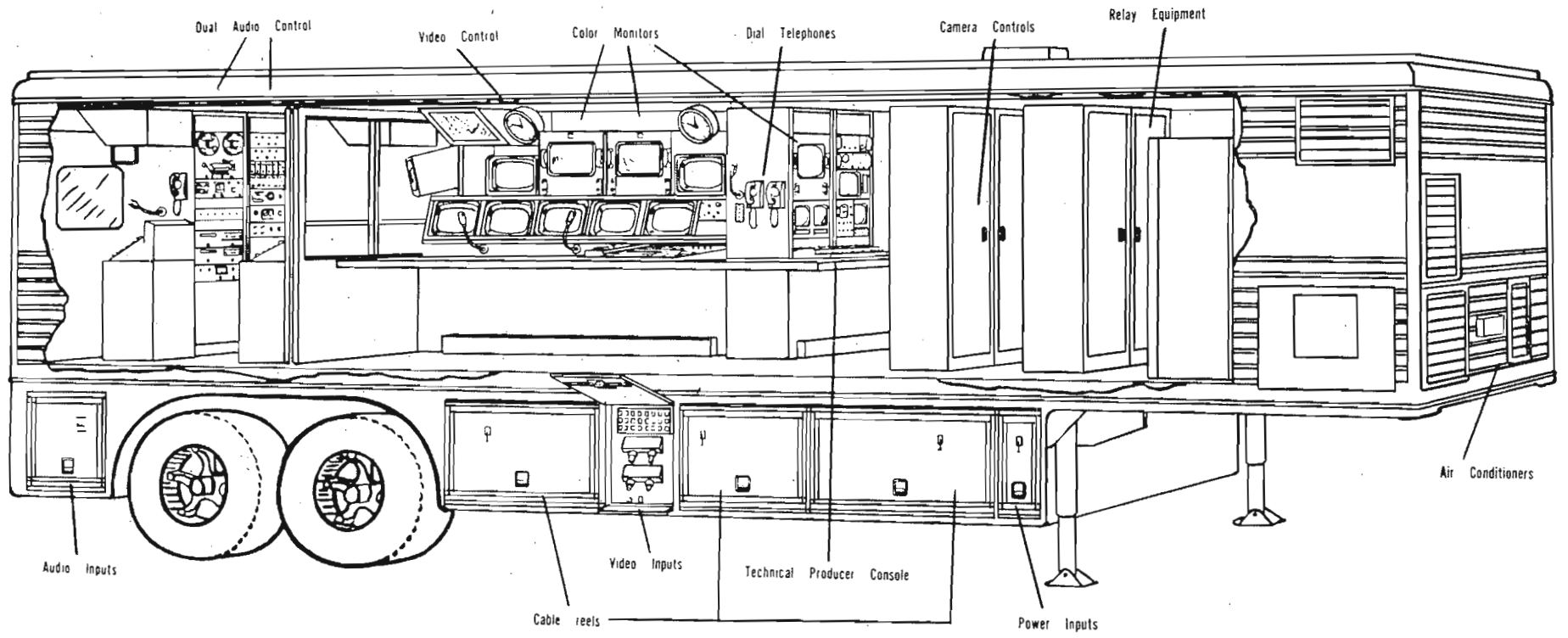


FIG. 4. Cutaway drawing of CBC Color Mobile Van showing audio and video production facilities.

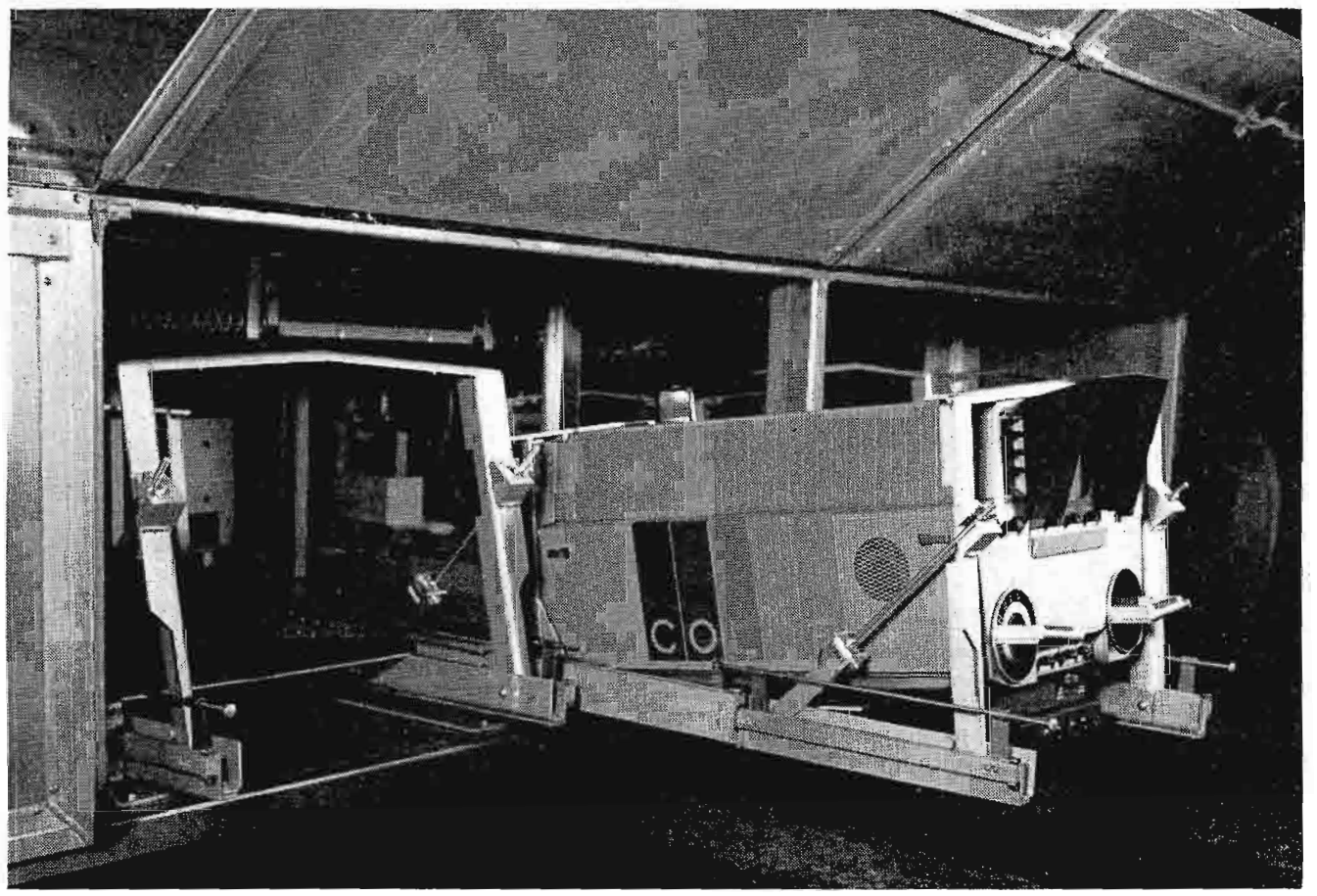


FIG. 5. One of four TK-42 cameras secured to the roll out undercarriage camera tray. Above the camera is the main cable duct.

made of stainless steel in the outer walls and underbody to reduce corrosion.

Dimensions — Overall dimensions of the units are 36 feet long, 8 feet wide and 12 feet, 2 inches high.

Weight — Each vehicle weighs approximately 40,000 lbs., complete with 15,500 lbs. of electronic equipment.

Air Conditioning — The 6-ton capacity air conditioning equipment is installed at the extreme front of the vehicle, separated from the balance of the operating space by a heavy metal partition, with extensive acoustic and thermal insulating properties.

Audio and Video Control Compartments— Light partitions with sliding doors separate the audio and video compartments.

Underbody Compartments—Storage space for cameras, camera cable and similar miscellaneous equipment is provided in below-deck compartments, each equipped with lockable doors either on the curb or street side.

Personnel Doors — There are three personnel doors—two on the curb side and one at the back, each equipped with double glass windows and sunshade.

Suspension and Brakes — A special air suspension is installed on the dual rear axles to reduce road shocks and vibration during transit. Brakes are of the "fail-safe" type with a reserve air tank.

Roof Construction — The roof is constructed of a single aluminum sheet, retained by a light aluminum ribbing, which also helps support the roof platform. This is a separate lightweight aluminum assembly, with fold-down all-around guard assembly. An aluminum ladder at the rear provides access to the roof, and two 1000 lb. capacity jib boom sockets are provided on either side of the vehicle to lift the TV cameras to and from the roof.

Four antenna sockets are provided — one at each corner of the roof.

Audio, Video and Power Panels — The audio, video and power panels are located on the rear curbside, each with a door for ease of service.

Video System

In each of the four vehicles the video system consists basically of four TK-42 Color cameras with associated monitoring facilities, a 12 x 9 matrix switching system and associated patching and distribution facilities.

The camera control facilities have been reduced in bulk by the use of a Canadian-

FIG. 6. The video control section features two color, ten black and white monitors, and the TS-40 switching equipment. To the right is the technical producer's position.

designed RCA Victor device, which permits several waveform displays to be simultaneously viewed on a single waveform monitor, facilitating the video operator's task of matching cameras levels and maintaining iris settings.

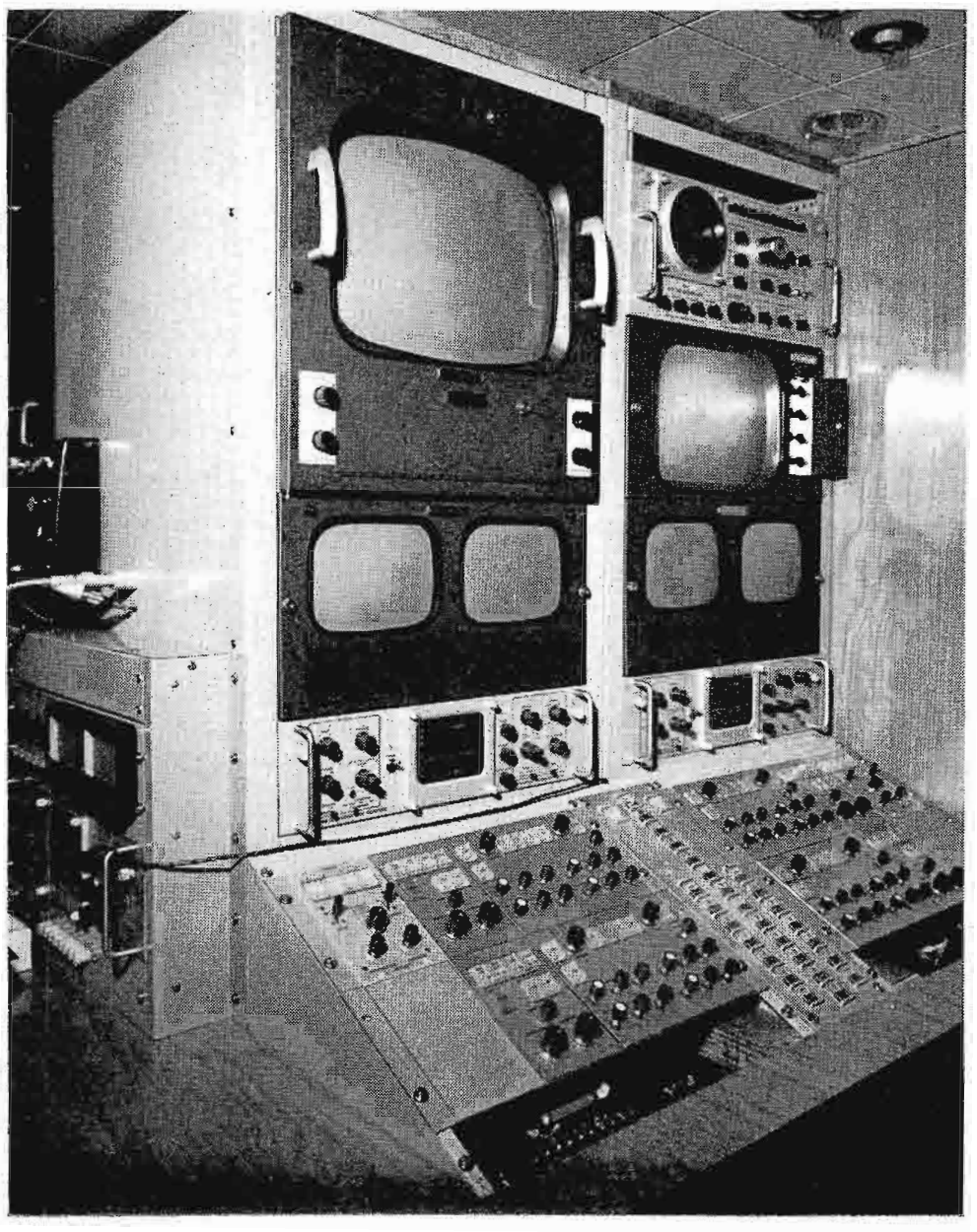
Individual monitoring of cameras can still be achieved for line-up purposes.

In each vehicle are two TG-3 sync generators with full genlock facilities which together with a sync change-over switch and associated TA-33/34 distribution amplifiers provide the required overall video control system.

The program switcher consists of a TS-40 vertical interval switcher of which the primary section consists of a twelve input buss matrix.

Two busses for effects/mix are associated with a TA-60 amplifier. Two busses mix/effects make use of another TA-60 amplifier. The effects generator output are brought through an effects transfer switch to either of the two above mentioned amplifiers. This provides both the effects-on-mix and the mix-on-effects facility, while maintaining proper phasing for color operation.

Color inserts from a luminance keying signal can be created by the use of another Canadian designed RCA Victor product — the Black Burst Generator. This has two



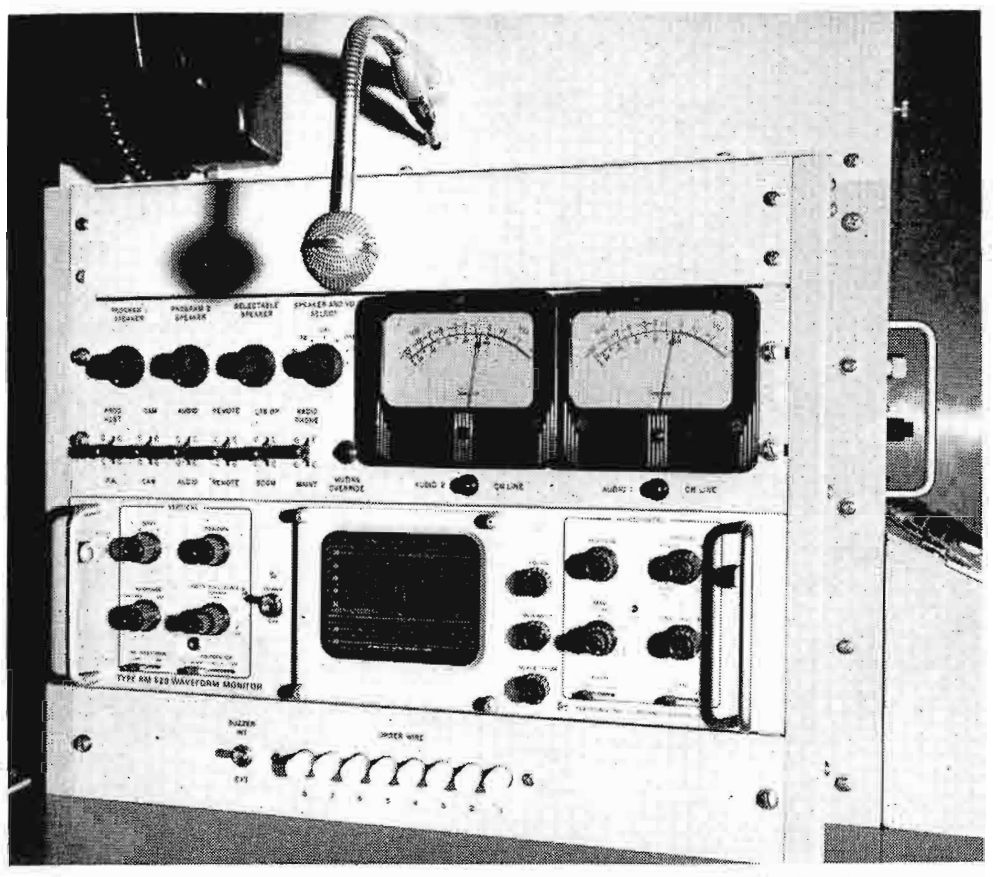


FIG. 7. The technical producer position illustrates the versatility of the system, placing him between the camera control and video switching sections.

FIG. 8. Compacted for economy of space, the camera control position operates four TK-42 cameras, and seats both camera controller and lighting director.

outputs, one is a saturated color signal which can be adjusted to provide any luminance, chrominance and hue, while inserting colored titling in the picture.

Preview buss: Provides conventional preview facility.

Program cut: Provides conventional facility.

Audio man's buss: The control panel of this buss is located in the audio section of the vehicle.

Match buss: A control panel for this buss is located at the camera control position where a color monitor and vectorscope are provided for matching cameras.

The secondary section of the switcher is used to select any of the three signals.

The switcher outputs are arranged so as to permit three separate pictures to be simultaneously fed from the vehicle, e.g., during a hockey broadcast, the program must be fed to three networks, CBC English, CBC French and one U.S. network. While the game is in progress the three networks are fed the same picture, but the interviews or comments, which occur in the hall between the hockey periods, would differ for each network.

Extensive use is made of video distribution amplifiers on a patch basis to accommodate various floor monitoring requirements. The usual assortment of stop-coils and equalizers is available. A microwave system is permanently installed to permit transmission of the live telecast to the master control located downtown.

In the production area of the vehicle several 14-inch black and white monitors provide preview facilities on all incoming feeds as well as from the associated cameras. In addition, two color monitors in this area allow monitoring the preview and program outputs of the switcher.

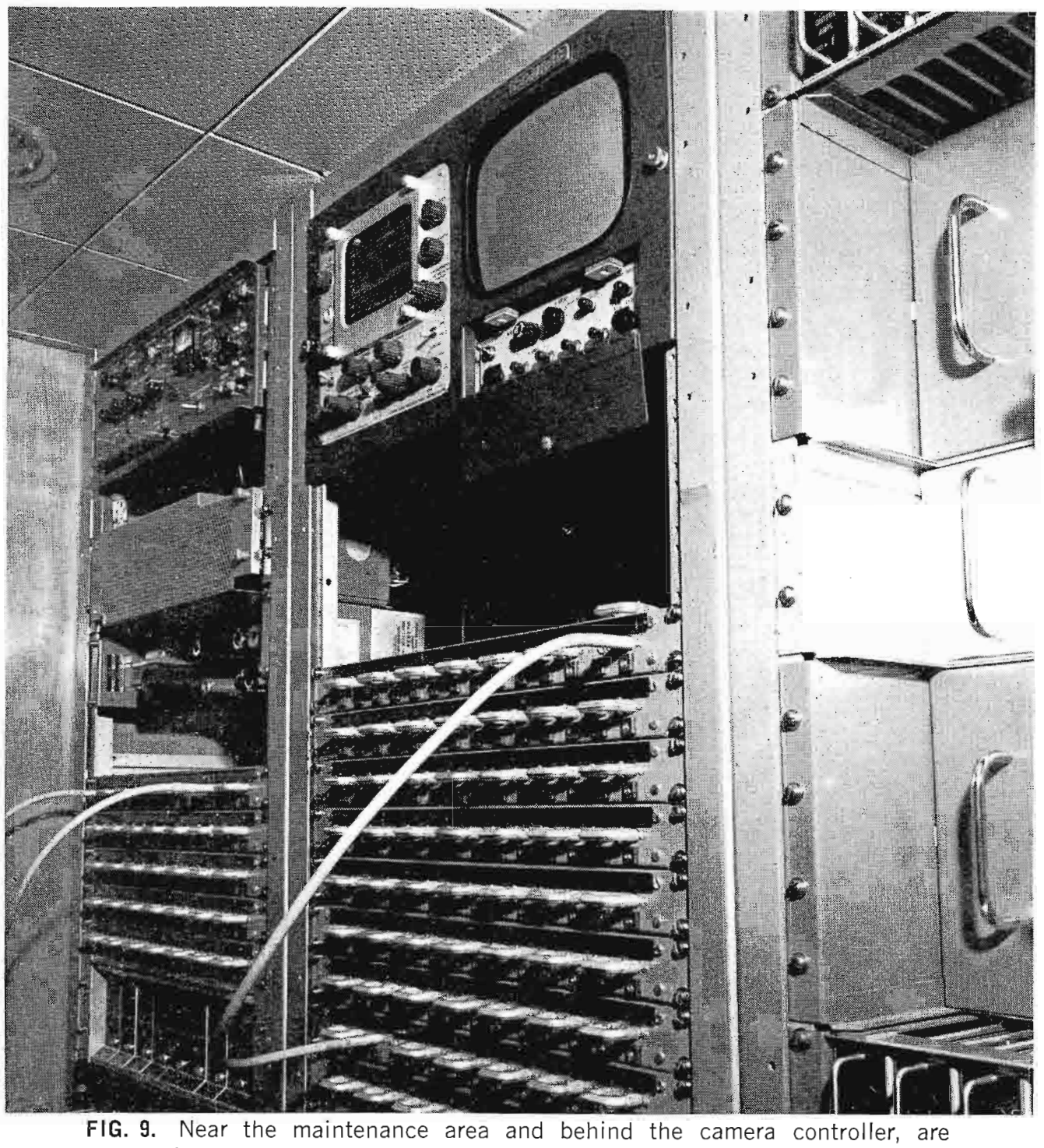


FIG. 9. Near the maintenance area and behind the camera controller, are the equipment racks housing the video switching modules, power supplies, video patch bays, video test equipment, VHF tuners, and microwave equipment.

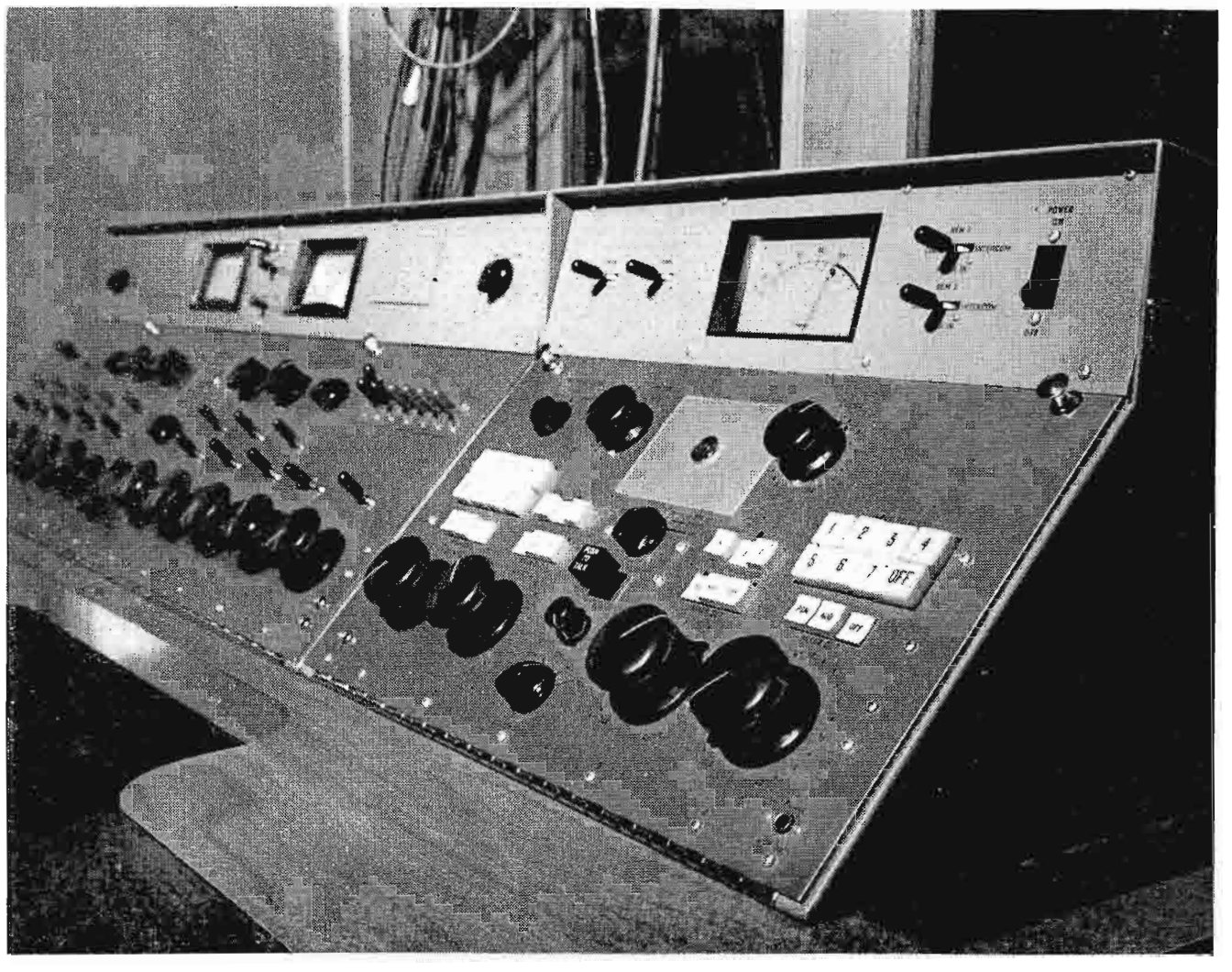


FIG. 10. Labelled Audio 1, this control handles the main channel audio for the dual system and features the BC-9A and BC-7 consoles.

Audio System

Grouped at the rear of the trailer, the audio system is in duplicate for French and English — a frequent requirement in Canadian Broadcast operations.

One half of the dual system designated "Audio 1" comprises the major portion of the audio equipment. The other half, designated "Audio 2" is less elaborate but still provides a complete, independent, high-performance working system. Audio 1 includes an RCA BC-9A Master Output Console, an RCA BC-7 Sub-Mixer, and an

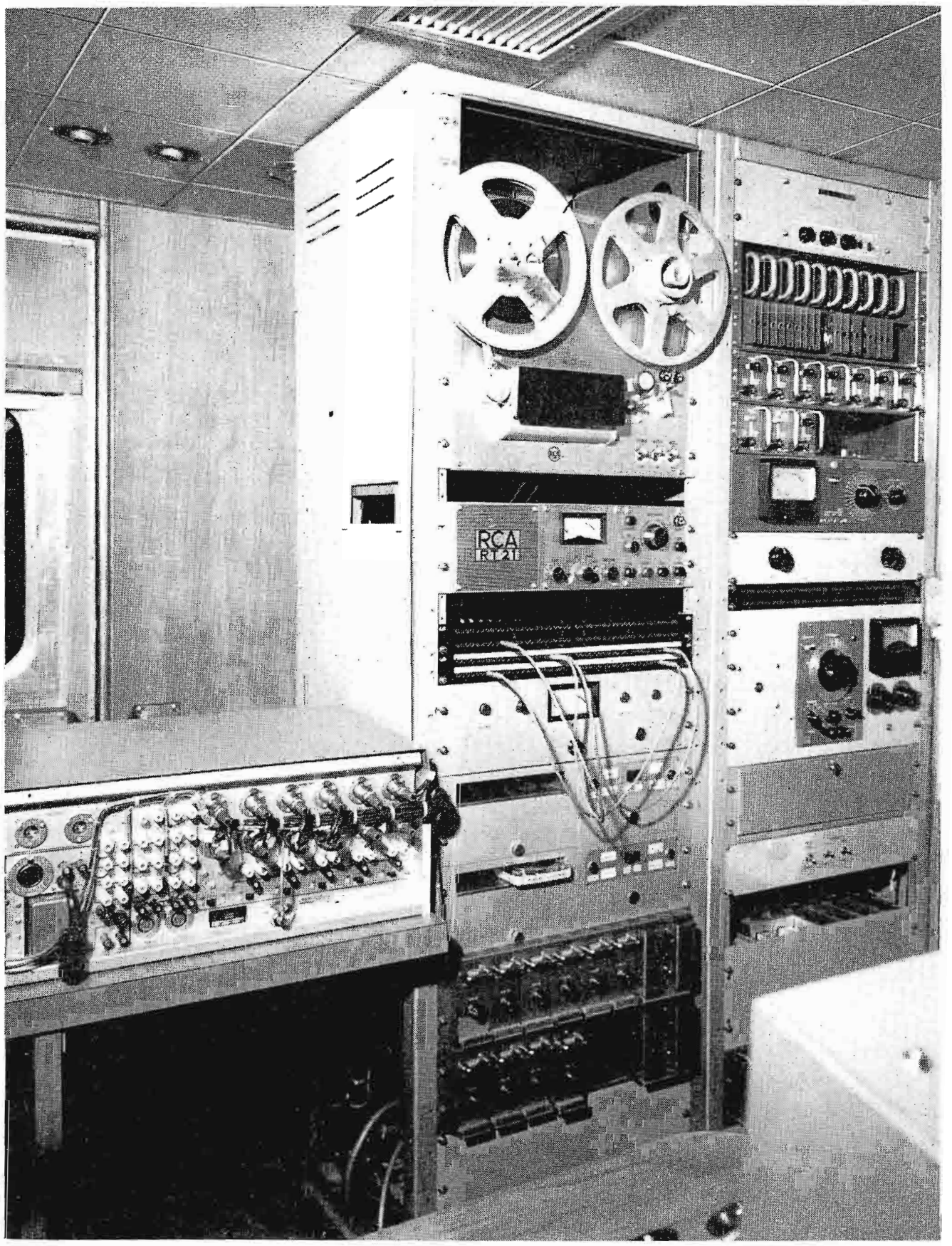


FIG. 11. The main audio racks: illustrating RT-21 reel-to-reel tape, and two cartridge tape units (1 record and replay, and 1 replay only.)

RCA BCM-2A Control Console, the latter feeding into the mixer busses of the BC-7 unit.

The output is also brought out on a patch panel so that it may be used for miscellaneous common sound sources, (such as crowd noises).

Audio 1 has a total of 25 microphones and 17 line inputs.

Audio 2 has 10 microphone and 5 line inputs.

Additional rack equipment includes an RCA RT-21B Tape Recorder and 2 RCA RT-17A Cartridge Tape units, one of which is equipped with an RCA BA-17 Recording Amplifier. These units are normally fed to Audio 1.

Other audio rack equipment includes nine distribution amplifiers and seven loudspeaker amplifiers, an extended range B1-5B VU meter, an audio oscillator, and several isolation transformers.

In order to fit all the equipment into the limited available space, the BC-9A Console was rebuilt into the BCM-2A Mixer cabinet to mount alongside the BC-7 Console. The BCM-2A was in turn repackaged with its level controls and switches mounted into a new cabinet on the wall and its electronic equipment mounted on a shelf under the Audio 1 desk.

Intercom and Telephone

Intercom facilities are available to Audio 1, Audio 2, Script Assistant, Producer, Technical Producer, CCU operator and the maintenance crew. Featured is a combination speaker-microphone and headset operation. A separate headset intercom unit is available for the lighting director. A special custom-built panel allows the TK-42 headsets to be operated in the main system or use "private line" to the CCU operator. An outside paging speaker is included and is muted during audio "on line" periods.

Paging routing over-ride is available to the Technical Producer.

The intercom control equipment is located in the audio racks and includes input-output amplifiers, matrix racks, headset coils, sound splitting pads, relays and other related incidental items.

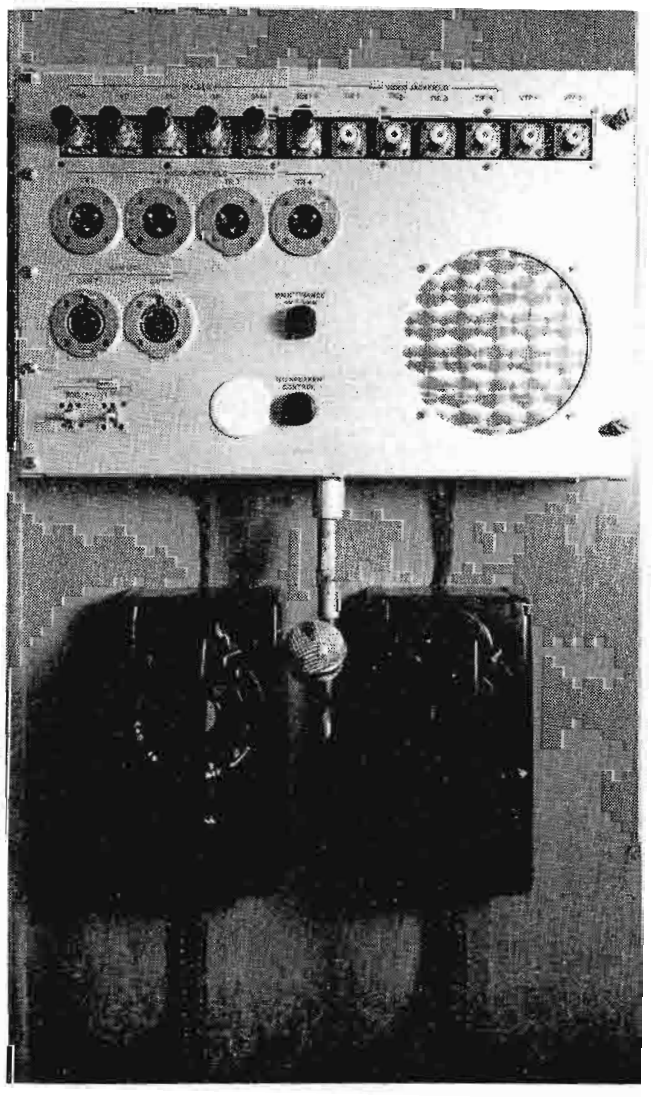
The telephone system is designed with 10 lines, one line each for business phone and script assistant, and 8 lines for the order wire system.

The latter are physically located at both audio control positions, and at the producer and technical producer positions.

TV Will Give Wide Coverage

Expo '67, pictorially covered by these advanced color vans with the finest color cameras, will bring to a large percentage of the world's population much of the pageantry, glamor, entertainment, and knowledge experienced in this magnificent symbol of Canada's 100th birthday.

FIG. 12. Near hitch end of van, this panel facilitates test points for the Maintenance Department plus both order wire and outside line telephones.



REMOTE OPERATION OF UHF TELEVISION TRANSMITTERS

Most of the information given here was presented in a paper at the 1966 NAB Convention at Chicago, Ill., March 1966, by the authors.

WKBS-TV, Owned by Kaiser Broadcasting Corporation, Shows How Remote Control of Unmanned Transmitters, Using RCA Equipment, Offers Large Savings to Television Broadcasters

by L. S. LAPPIN
RCA Broadcast Antenna Engineering

D. R. MUSSON
RCA UHF Transmitter Engineering

E. R. HILL
Kaiser Broadcasting, Director of Engineering

After many years of allowing AM and FM remote control operation, the FCC, on May 6, 1963, put into effect rules permitting remote control of UHF television transmitters. While remote operation of VHF television stations is not presently permitted, it is being given serious consideration by the FCC.

Some of the advantages resulting from remote transmitter operation are: Reduced cost of operation due to unmanned transmitter site, reduced space and human comfort requirements at the transmitter site, reassignment of transmitter operating personnel to the studio and improvement of operational efficiency. Remote control is of special importance to a new UHF station starting up in an established VHF market with low UHF receiver penetration, where operating costs must be held to a minimum. It can be readily seen that remote control equipment pays for itself in a short time with the inherent reduced costs.

FCC Rules

The FCC rules for remote control of UHF-TV transmitters are similar to those for AM and FM transmitters, and basically are intended to make certain the radiated signal meets the technical requirements and ensures complete control of the unattended transmitter. The FCC rule for remote control operation of UHF-TV, Paragraph 73.676 is quoted as follows:

1. Television broadcast stations operating on Channels 14-83 may be authorized to operate by remote control upon a satisfactory showing as to the manner of compliance with the following requirements.

a) Suitable control circuits shall be installed to:

I. Turn the transmitter on and off at will.

II. Determine the power output of the visual and aural final radio frequency amplifiers or the power delivered to the antenna.

III. Adjust the power output of the final radio frequency amplifier to compensate for variations in line voltage.

IV. Make such adjustments as may be necessary to insure that the characteristics of the transmitted signal comply in all respects with the technical requirements of the rules.

b) The control point shall be equipped with apparatus suitable for observing the waveform and other pertinent characteristics of the transmitted visual signal and the percent of modulation of the transmitted aural signal.

c) The control circuits from the control point to the transmitter shall be so designed and installed that open circuits, short circuits, accidental grounding, or other line faults will not activate the transmitting apparatus and any fault which results in loss of control of the transmitting apparatus will automatically remove power from the transmitting antenna.

d) The transmitting equipment and control equipment shall be adequately protected against tampering or activation by unauthorized persons.

2. Where a transmitter is operated by remote control the transmitting apparatus and associated controls shall be checked as often as is necessary to insure proper operation and confirm the accuracy of the transmitter data sent to the control point over the control circuits and in all cases at least once each week until it can be demonstrated to the Commission that checks at less frequent intervals are satisfactory.

WKBS System

In December 1965, Station WKBS in Philadelphia operating on Channel 48, with a transmitter power of 30 KW became one of the first high power UHF television stations to operate by remote control, and since the latter part of January 1966, the transmitter has been operating completely unattended. As of July 1966, the WKBS transmitter was field converted to an RCA TTU-50C 55-kW. The WKBS station will be discussed as a typical remote controlled television system. Individual station requirements will vary, however most of the equipment and circuits used at WKBS are required to meet FCC Rules and Regulations.

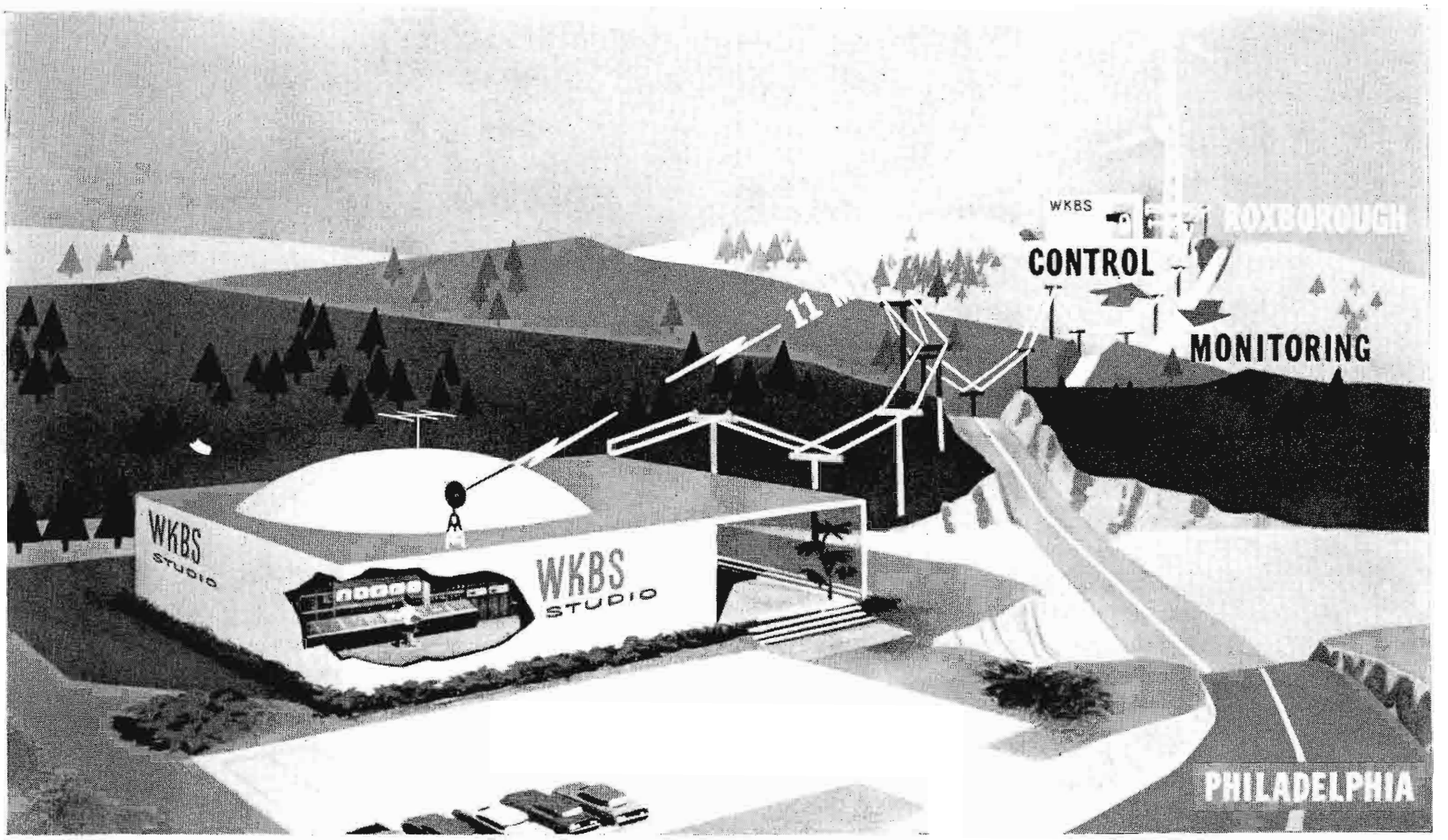
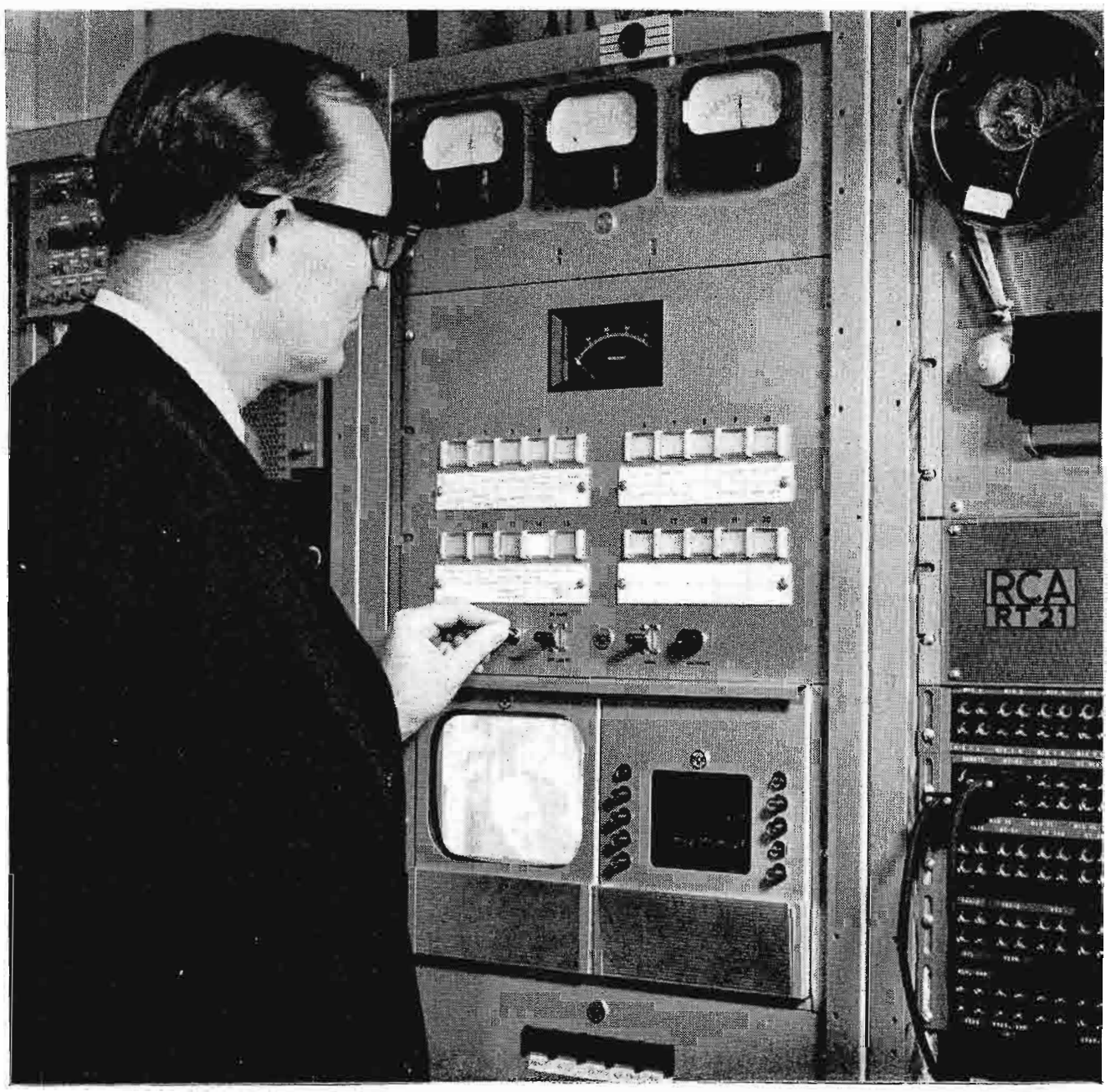


FIG. 1. The WKBS Studio with its remote controlled transmitter located 11 miles away is shown in artists rendering. Programming is transmitted by microwave link and remote control functions are carried on two DC land lines.



The WKBS system uses the RCA BTR-20C remote control equipment, which provides for up to twenty control and metering functions, including a "homing" function for the control portion and a "calibrate" function for the metering portion. The system can give satisfactory performance at a distance of twenty miles or more.

The studio is located near the center of Philadelphia, and all programming and operating controls are in the master control room, along with a single rack, containing the studio remote control equipment. The transmitter is located about eleven airline miles from the studio in the highest part of the city with an antenna approximately 1100 feet high. The remote control and monitoring functions are provided by two DC telephone land lines and the programming information is transmitted from studio to transmitter via STL microwave link.

FIG. 2. The WKBS remote control rack installed in the Studio Master Control Room. E. R. Hill, Director of Engineering for Kaiser Broadcasting is shown operating the RCA BTR-20C Remote Control Studio Unit.

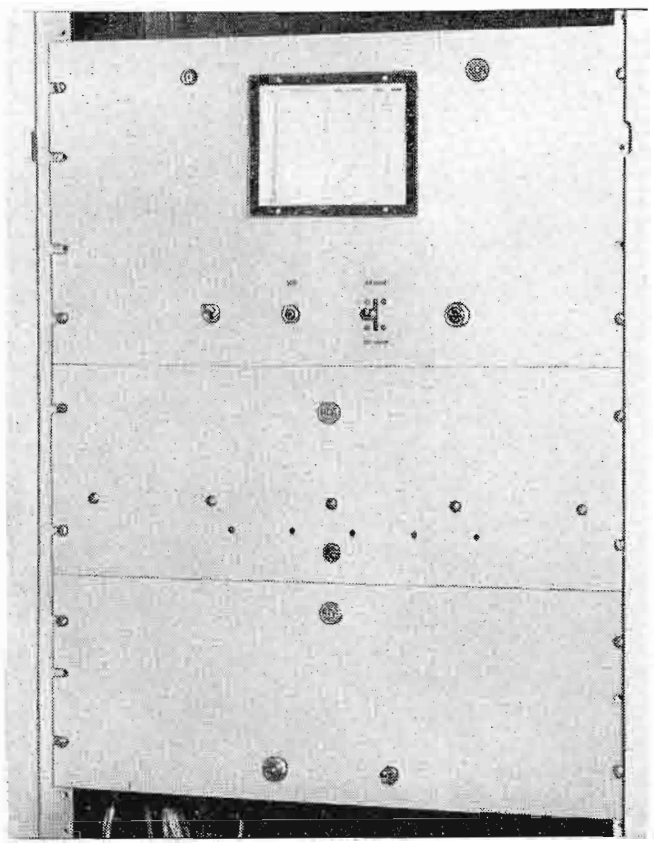


FIG. 3. The WKBS remote control rack installed in the transmitter building.

Equipment Racks

Figure 2 shows the WKBS studio remote control rack. The top panel contains the monitor meters. The next panel is the BTR-20C studio remote control unit. The third panel down has the picture monitor on the left and waveform monitor on the right. The panel under the monitors is the tone alarm unit and at the bottom is the Conrac off-air receiver monitor.

The transmitter site has an RCA TTU-50C 55-kW UHF Transmitter, operated at rated output. The remote control equipment at the transmitter site consists of three rack-mounted units, occupying part of one rack.

Figure 3 shows the transmitter remote control rack. At the top is the BTR-20C transmitter remote control unit. Below it is the monitor amplifier assembly containing five solid state plug-in amplifiers, and two plug-in power supplies. The bottom panel is the tone alarm unit.

Basic Signals

A simplified schematic diagram of the remote control equipment is shown in Figure 4. Four basic signals are required to perform the control functions:

1. High level positive signal to actuate studio and transmitter stepping switches controlled by a pulse generator.

2. High level negative signal to home or synchronize the two stepping switches.

3. Low level positive and negative signals to perform the "ON" and "OFF" operations after the desired function has been selected.

4. AC fail-safe signal to shut down the transmitter in the event of loss of transmitter control due to telephone line failure or loss of remote control power.

Remote Control System Operation

A functional block diagram of the remote control system is shown in Figure 5. The BTR-20C studio unit is the system master control. All transmitter controls originate at this point and all signals are read on the multimeters and monitors in the studio remote control rack.

When the desired function is selected at the BTR-20C studio unit, the BTR-20C transmitter unit selects the desired function, on command from the studio unit, and

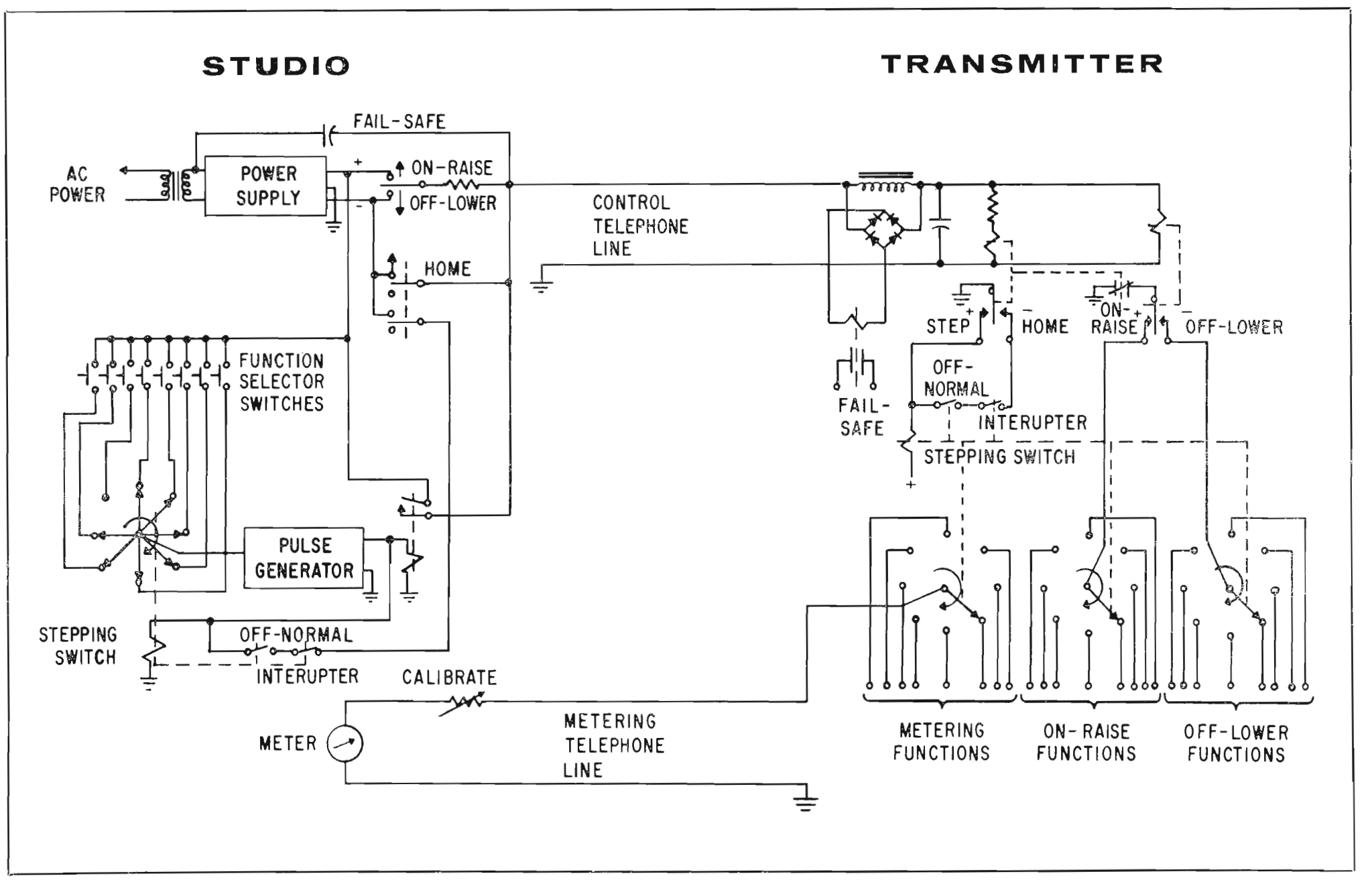


FIG. 4. Simplified schematic diagram of the RCA BTR-20C Remote Control System.

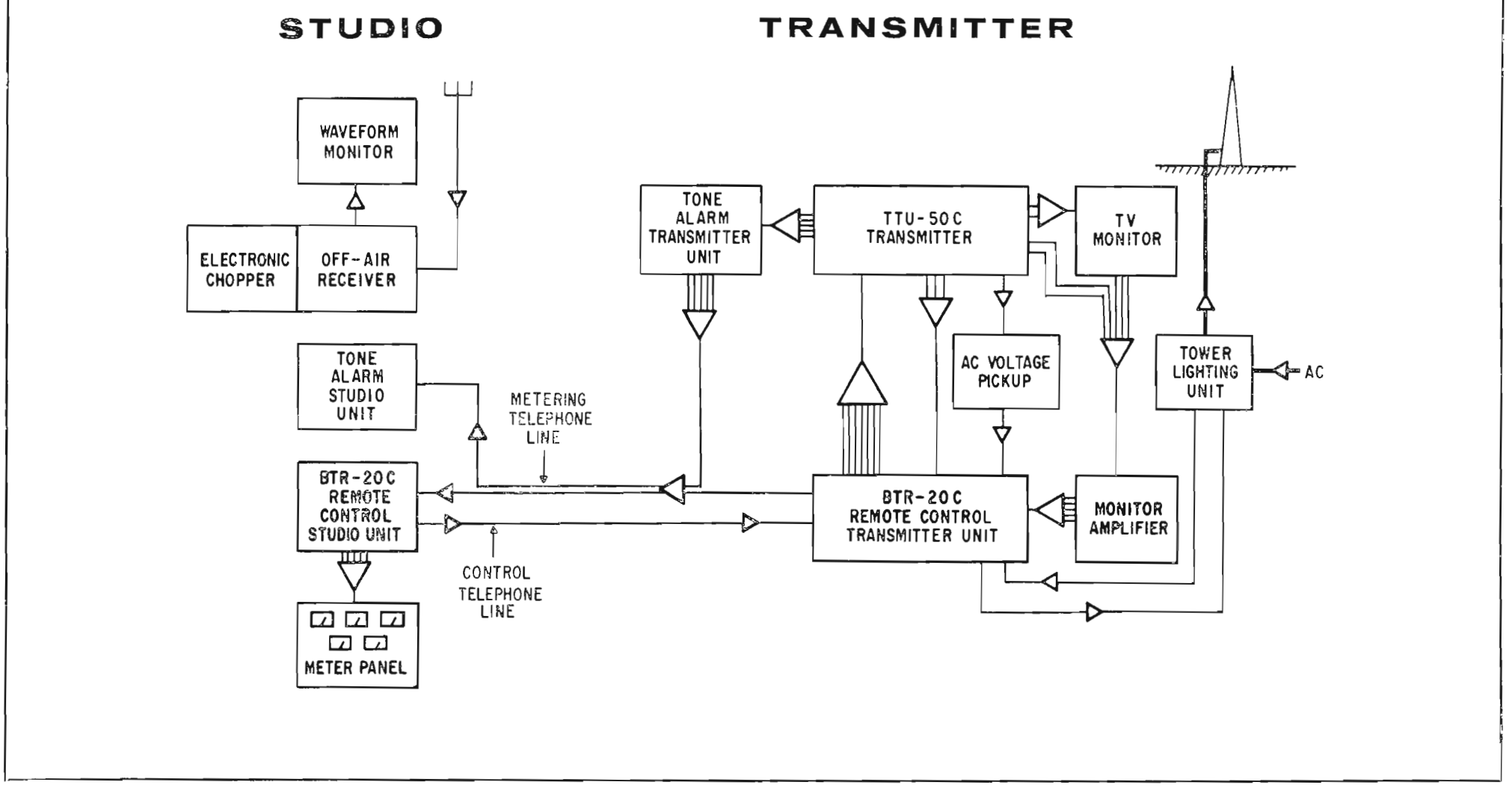


FIG. 5. Simplified block diagram of the WKBS Remote Control System using RCA BTR-20C equipment.

performs one of the eight transmitter control or tower lighting functions. Simultaneously, the selected metering function is displayed on the appropriate meter or monitor at the studio. Ten metering signals are provided, six originating in the transmitter, three in the TV monitor and one for tower lighting current.

For maximum accuracy and freedom from extraneous telephone line noise, all metering functions have been standardized at 200 microamperes DC, corresponding to a full scale meter indication. In some of the remotely monitored metered functions, such as frequency deviation, power output and aural modulation, the available current is as low as 20 microamperes. To permit remote metering of such low currents, five plug-in solid state amplifiers, connected as current amplifiers, are used in these circuits. Excellent stable operation is achieved with very heavy feedback. A separate meter calibrated for the signal to be monitored is provided for each function at the studio.

The visual signal waveform is picked up by an off air receiver at the studio, and displayed on a waveform monitor with an electronic chopper that operates only during the vertical blanking interval. Continuous chopping can take place because it is synchronized with the video signal, allowing the radiated picture to be viewed on the picture monitor without distortion, while the baseline appears on the waveform monitor. The operator at the studio has all of the necessary information to adjust the video gain, blanking level and visual excitation by remote operation of the motorized controls in the transmitter.

A latching contactor in the lighting circuit provides tower light control, and metering is accomplished by rectifying the output of a current transformer connected in series with the lighting line.

In addition to the control and metering functions, a tone alarm system, utilizing lights and a buzzer, indicates five abnormal conditions. The alarm tones are in the low audio frequency range and are superimposed on the metering telephone line. Additional alarm functions may be obtained by adding a second tone alarm system to the control line.

Remote Control and Metering Functions

The remote control and metering functions are listed in Table 1. The normal sequence of operation is first to home the system by pressing the HOME switch. This synchronizes the studio and transmitter stepping switches. The telephone line resistance is then calibrated using the front panel control and meter. Pressing the function 2 switch selects the TRANSMITTER ON/OFF AND FILAMENT VOLTAGE circuits, and operation of the ON-RAISE switch starts the transmitter. The remote control multimeter indicates the filament voltage to show that the desired switching function has been accomplished. After the necessary time delay, the high voltage may be turned on, and the collector voltage meter indication read and recorded. The next two functions are for visual and aural collector currents. In the event of an overload, the circuit may be reset by using function 4. The visual excitation, blanking level and video gain may now be adjusted using functions 6, 9 and 10, while viewing the visual output meter and the chopped waveform. Aural output power is adjusted with function 7 by varying the aural excitation while observing the output meter. Function 8 is for the Emergency Broadcast System. Functions 11 and 12 are used to read the frequency deviation meter indication and function 13 is used to control the tower lights and read the meter tower light current indication. Finally, the aural modulation level meter indication is read using function 14.

Whenever the remote control equipment is not otherwise used, the aural modulation is monitored. Wherever practical, control

Table 1 **REMOTE CONTROL FUNCTIONS**

Function	Control	Metering
1	Spare	Calibrate
2	Transmitter On/Off	Fil. Voltage
3	H. V. On/Off	Collector Voltage
4	O. L. Reset	Collector Current (Vis.)
5	Spare	Collector Current (Aur.)
6	Vis. Excitation Raise/Lower	Output (Vis.)
7	Aur. Excitation Raise/Lower	Output (Aur.)
8	Emergency Broadcast System	
9	Blanking Level Raise/Lower	Output (Vis.)
10	Video Gain Raise/Lower	Output (Vis.)
11	————	Frequency Dev. (Vis.)
12	Spare	Frequency Dev. (Aur.)
13	Tower Lights On/Off	Tower Light Current
14	Spare	Modulation (Aur.)
15-19	Spares	Spares
20	Home	Spare

functions are associated with the most meaningful meter reading, so as to be most useful in making adjustment or to indicate that the desired control function has been accomplished.

The alarm functions shown in Table 2 call attention to conditions which demand immediate attention. In addition to the individual lights, a buzzer operates when any of the alarms are actuated. The alarmed functions are Klystron Body Overload, VSWR Overload, Power Supply Overload, Water Overtemperature and Loss of AC Power. It may be desirable, in some stations, to add fire, forced entry, building overtemperature, and standby generator status alarms by the addition of a second alarm system.

WKBS Objective

The WKBS objective was to provide adequate control and metering which could be expanded as desired. As seen by control functions 2, 3 and 4, a two step control sequence is used, with the third overload reset operation included to augment a three shot reclosure system in the transmitter. Functions 6 and 7 control excitation to the final amplifiers to obtain optimum drive levels. The video modulation monitor assists in visual drive adjustment. Functions 9 and 10 allow control of video modulation. Blanking level adjustment, though seldom required, can be used effectively when vertical interval test signals are available. The remaining metering completes the readings required. Warning functions have been applied to selected transmitter overloads, loss of primary power and water overtemperature.

Transmitter Operation

Now that the WKBS remote control installation has been outlined and has proved that remote control of an unattended UHF television transmitter is not only possible, but highly practical, it is important to analyze the remote operation of the UHF transmitter. Each transmitter type has a compatible control level, based on its design and operation. The success of a remote operation depends on proper integration of control system and transmitter.

Fundamentally, a television transmitter is more complex than an AM and FM transmitter. To avoid a cumbersome control system, maximum use is made of a minimum number of control functions. Two methods are employed to simplify the control problems. First, the transmitter is called upon by circuit logic to provide self control. As an example, during start up a sub-system must be in complete normal operation before a succeeding system is automatically commanded to start. Secondly, a single function is designed to perform several operations simultaneously; thus eliminating duplicated effort, even though it is necessary to maintain individual control over one function of the group. For example, it is desirable to control aural and visual amplifier on and off functions simultaneously, and have a separate control to mute aural carrier for EBS operation. The start up sequence is simplified in this manner, but the aural carrier can still be controlled independently. Starting of all systems by sequencing them automatically on step by step, in preparation for plate voltage application, is another control system simplification. Additional metering can be provided for status indicators in the subsystems; such as the cooling system, but seldom do these provide additional information that would save an emergency trip to the transmitter. A transmitter ready light can be remoted, but is not mandatory.

On the WKBS installation, the basic group of functions; transmitter start, high voltage on and overload reset, provide all the essential operator control. Some might suggest that time delay bypass is desirable. In this installation, the transmitter contains a hold-in relay that prevents filament circuit dropout for the time required for power station breakers to recycle in a power outage.

Supervisory Control

The second set of functions provide the necessary supervisories and monitors required to maintain optimum television picture and sound transmission. The same principles that were used to simplify the control circuits are used to simplify the video and RF control. First, place as much of the control burden as possible on the transmitter itself. Secondly, make each control serve a multitude of functions. Some examples of transmitter self control can be taken from the means used to gain output power stability in the UHF klystron transmitter. The Klystron amplifier saturates at a steady and predictable power output level as long as DC input power is held constant, so that by regulating the overall power supplied to the transmitter, and driving the klystron to approximate saturation, the peak power output is greatly stabilized, requiring little, if any, supervision.

A second example is klystron amplifier gain stabilization. Slight changes in struc-

	Functions	Alarm
Table 2 ALARM FUNCTIONS	1	Body Overload
	2	VSWR Overload
	3	Power Supply Overload
	4	Water Overtemperature
	5	Loss of AC Power

tural dimensions of the klystron amplifier results in a change of gain more than in a change of response in the amplifier. By stabilizing the cavity and drift tube cooling water temperature, using a temperature controlled mixing valve on the inlet, the cavity dimensions are made virtually independent of surrounding ambient temperature, and temperature of the air passing through the heat exchanger. This temperature control also minimizes start-up drift.

In a UHF-TV transmitter a great deal of the burden of stabilization can be placed on the transmitter itself. Those controls remaining, must necessarily be planned so as to provide maximum control, and be adjustable from a simple indicator. Some supervision is desirable of RF gain stability, over periods of time, because it is one of the more difficult long term characteristics to stabilize in a high power transmitter, particularly at UHF. To adjust for variation of gain in the linear amplifier circuits, an excitation control is desirable, which can be used to correct for gain differences in the amplifier chain and should ideally not affect the overall performance of the system.

In the WKBS transmitter, a motorized attenuator following the modulated amplifier is used for r.f. gain, or excitation control. It has virtually no effect on differential phase or gain of the system, and little effect on the frequency response with 10 dB of control, so it is used to correct for gain changes from many sources. The video modulation monitor and power output meter provide the necessary indication. Video gain control is provided to maintain proper modulation levels and to compensate for all variations of video levels; although these are usually only experienced ahead of the transmitter. If this control is included in a remote control system, it should be located ahead of gain and phase pre-emphasis. The system linearity is then not a function of the setting of this control.

Cost Factors

One of the factors that must be considered to assure minimum operating costs, is the careful management of heater power in the power amplifier tubes. Operation just above the knee of the emission curve for the UHF klystron cathode can pay great dividends in life expectancy for the tube. Of first importance is regulating the input power to the heater. Secondly, economy requires a reading accurate enough at the remote location to indicate when an increase of heater power is dictated on an aging filament, without first suffering loss in emission. With regulated voltage, the desirable remote indication is heater current to establish a given threshold heater power.

Warning System

In addition to the individually metered circuits, several warning devices are typically included in any high power transmitter remote system. They are generally not unique to television transmission, but warrant mention in a typical system. Physical security, fire detection, and building overtemperature are often included. When the transmitter includes a major air system, it is desirable to detect restricted flow. On the WKBS system, a water overtemperature warning alarm circuit in the transmitter performs this function at a temperature low enough to allow travel time to the site to remove the air blockage. This type of system can anticipate a problem due to buildup of foreign matter deposited from the air stream, and prevent lost air time.

In general, any detection warning system should be planned to anticipate a major problem and allow time to act before air-time is lost. Double locked doors, with the indicator on the outer door, might allow time for police to investigate a forced entry before transmission is jeopardized.

Transmitter Requirements

Operating a transmitter via remote control requires that the transmitter incorporate certain relays, wiring motor-driven controls, meter shunts, meter multipliers, etc. All RCA transmitters produced in recent years have those provisions built-in.

Reliability

The reliability of transmitters has improved rapidly in the past few years, making remote control of unattended transmitters practical. Reliability and stability in a remote controlled transmitter is very important, because a minor fault resulting in a power shutdown can cause loss of expensive air time. A carefully planned preventive maintenance program, based on the manufacturers' recommendations, will anticipate potential failures before they occur and reduce off-air time. The highest grade components and simplicity of circuits with adequate safety factors, must be stressed to reduce the possibility of failure and to shorten trouble-shooting time, when it becomes necessary.

In many cases, reliability can be improved through the use of duplicate facilities; such as, parallel transmitters which provide, in effect, an operating standby transmitter. In the event one unit fails, the remaining unit continues to provide one-quarter normal radiated power. By the addition of automatic or remote controlled switching, radiated power can be maintained at one-half of normal until repair of the defective unit can be accomplished. Loss of air time, due to power failure, can be minimized by the use of a standby generator with automatic changeover. Redundancy in the remote control system is seldom required for normal system application, due to the reliability of the equipment.

Conclusion

The WKBS-TV system represents a practical application of a remote control system to a high power UHF-TV transmitter. Although basic functions were made available in this system, many additional ones could have been included to provide more detailed information at the studio. Each transmitter station will have unique requirements, but those outlined in the WKBS-TV system are typically required.

INSTRUCTIONAL TELEVISION FIXED SERVICE

by E. N. LUDDY
Manager, Transmitter Merchandising

More than one hundred and twenty "educational broadcast stations" are in operation today in the standard VHF and UHF television bands. Approximately two-thirds of these are directly connected with a school system, college or university. The remainder are so-called community stations. Both groups have been performing an increasingly important service in providing adult education programs as well as programs intended for classroom instructional use.

Unfortunately, the number of standard-band channels available for ETS service is very limited. Most communities will have only one — and even large metropolitan centers only two or three. This is hardly enough for the community-type service— and certainly far short of the many channels which will be needed to establish large-scale classroom instruction by television.

In order to obtain the multi-channel distribution which they need, many school systems are now investigating the possibilities of the Instructional Television Fixed Service. This service utilizes a group of channels in the 2500 megahertz band and has the advantage that a fairly large number of channels will be available in each area. It is also relatively economical— especially when multi-channel distribution is involved.

FIG. 1. Typical classroom scene utilizing the RCA 2500 MHz Instructional Television System.

TABLE 1 — FIXED SERVICE CHANNELS

GROUP A		GROUP B		GROUP C		GROUP D	
Channel No.	Band limits MHz	Channel No.	Band limits MHz	Channel No.	Band MHz limits	Channel No.	Band limits MHz
A-1	2500-2506	B-1	2506-2512	C-1	2548-2554	D-1	2554-2560
A-2	2512-2518	B-2	2518-2524	C-2	2560-2566	D-2	2566-2572
A-3	2524-2530	B-3	2530-2536	C-3	2572-2578	D-3	2578-2584
A-4	2536-2542	B-4	2542-2548	C-4	2584-2590	D-4	2590-2596

GROUP E		GROUP F		GROUP G		GROUP H	
Channel No.	Band limits MHz	Channel No.	Band limits MHz	Channel No.	Band limits MHz	Channel No.	Band limits MHz
E-1	2596-2602	F-1	2602-2608	G-1	2644-2650	H-1	2650-2656
E-2	2608-2614	F-2	2614-2620	G-2	2656-2662	H-2	2662-2668
E-3	2620-2626	F-3	2626-2632	G-3	2668-2674	H-3	2674-2680
E-4	2632-2638	F-4	2638-2644	G-4	2680-2686		

There are many interesting facets of this new instructional television service but this introductory article will deal primarily with the technical aspects of the 2500 MHz radio frequency distribution system. In future issues BROADCAST NEWS will present descriptions of systems planned and operating.

Definition and Purpose

The Instructional Television Fixed Service was established by the Federal Communications Commission in July 1963 to provide an economical method of distributing instructional and cultural television

material. It was designed primarily as a means of transmitting classroom material from a central point to a number of schools, each with its own closed circuit distribution system to the individual classrooms. For this purpose the FCC allocated 31 channels in the 2500-2690 megahertz band (see Table 1) and arranged them in groups of four channels each. These channels have the same characteristics as standard TV broadcast channels and each group contains alternately spaced channels to facilitate heterodyning down to VHF for closed circuit distribution within the schools.

In addition to the primary purpose of transmitting instructional and cultural material, the circuits may also be used for the transmission of data and other information related to the administrative activities of the licensee or to tie into educational television stations or networks. This offers considerable potential for future utilization of these circuits.

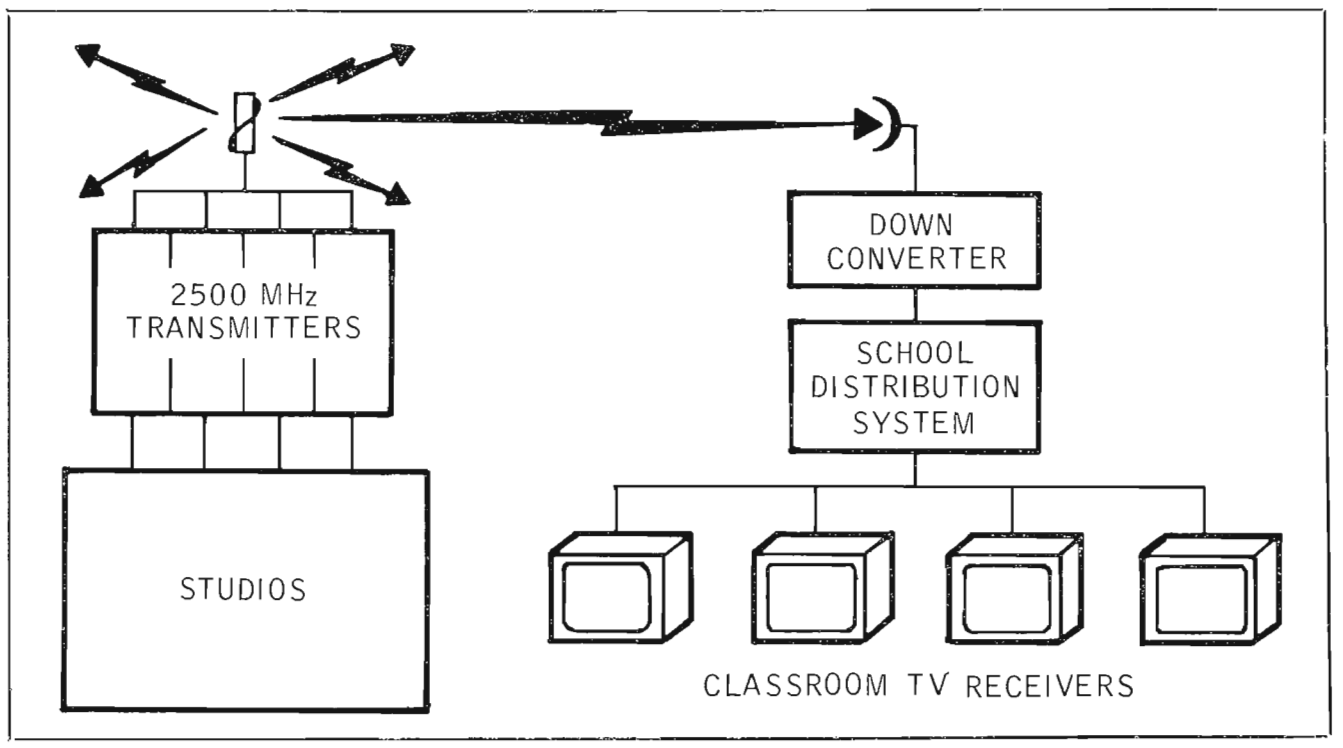


FIG. 2. Basic system for Instructional Television with four separate programs.

FCC Rules and Regulations

The Instructional Television Fixed Service is provided for in Part 74, Sub-Part I, of the Federal Communications Commission Rules and Regulations. Thirty-one channels are allocated in the 2500-2690 MHz frequency band which is currently shared with operational fixed stations.

Application to construct an instructional television system must be made on FCC Form 330P, which covers the legal and financial qualifications of the applicant as well as a description of the television service to be provided and engineering data concerning the proposed system. Competent legal, financial, and technical assistance are required to properly complete the form. Considerable engineering information is required concerning both details of the equipment and of the specific transmitting and receiving sites to be employed.

FIG. 3. A portion of the RCA 2500 MHz transmitter equipment installed at the Communications Center at St. Joseph's Seminary in Yonkers, New York a part of the Archdiocese of New York ITV System.

The FCC provides for nominal transmitter power outputs of 10 watts, although they point out that the lowest possible power output should be utilized. They also provide for translators to repeat the signals of the main originating transmitter. The signals are "broadcast" to a number of receiving points within the coverage area of the transmitter which is normally limited to a radius of fifteen to twenty miles.

The FCC refers to the standard TV broadcast performance Rules and Regulations in Part 73 for the technical transmission requirements. Therefore, the quality of the signal is required to be comparable to those received direct from regular commercial and educational television stations.

The operator requirements are somewhat relaxed as third class operators can provide operational control but the system must be under the technical supervision of a first or second class radio operator. Provision is made for simplified remote control of the transmitters, and unattended operation of the heterodyne repeaters.

Typical Systems

A typical basic instructional television system is shown in Figure 2. In this system, four separate instructional programs originate in the studio and are fed to separate 2500 MHz transmitters. The outputs of these transmitters are combined

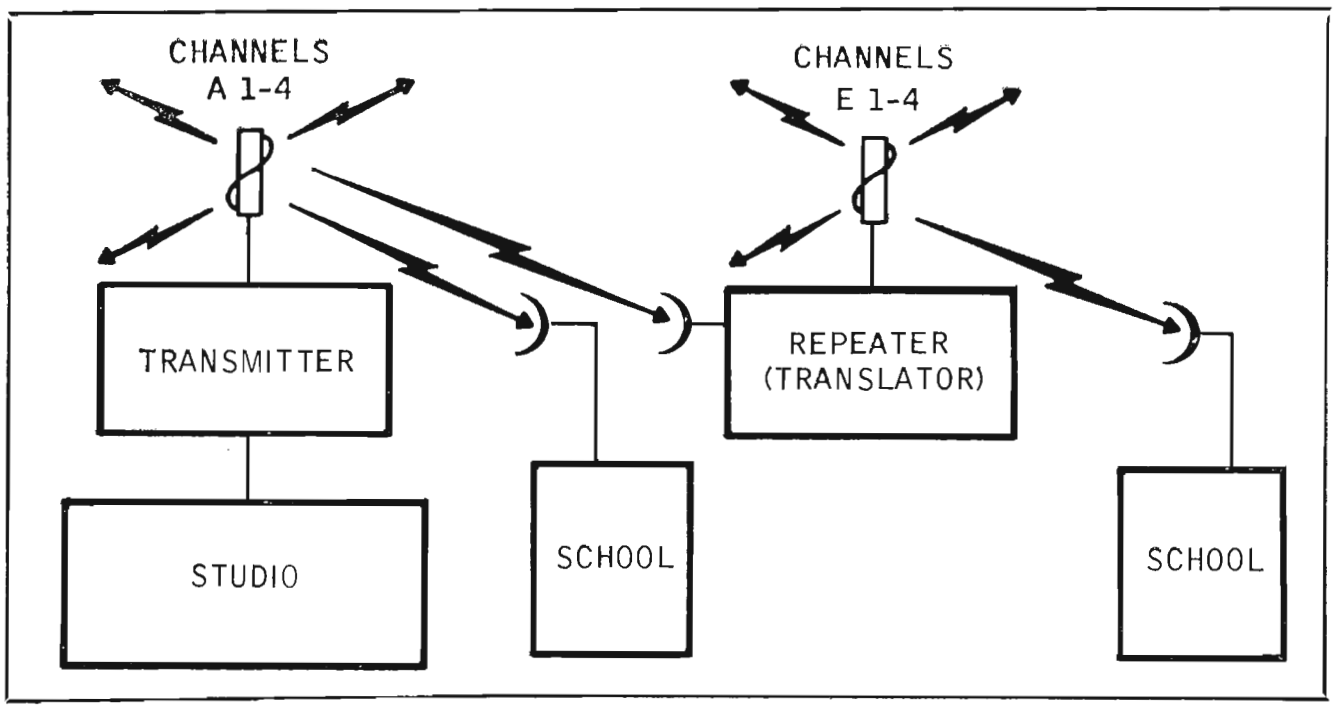


FIG. 4. Block diagram showing Instructional Television System using Repeater (Translator) to increase the coverage area.

into a single transmission line that in turn feeds the antenna. In a typical case, the transmitting antenna is omni-directional and it "broadcasts" the signal to highly directional parabolic receiving antennas located at the participating schools. The receiving antennas feed the signals to down converters which convert the 2500 MHz channels into the VHF TV broadcast frequency range. For example, the four 2500 MHz channels would appear as Channels 7, 9, 11, and 13 at the output of the down converter. The output of the down converter is fed to receivers in the classrooms through the school distribution system.

A system utilizing a repeater or translator is shown in Figure 4. This system enlarges the coverage area by using a repeater to translate the signals of the main transmitters to another set of 2500 MHz channels and retransmit the signals to an additional group of schools. This translation is accomplished by heterodyning the original signals down to VHF, amplifying them, then again heterodyning back up to the 2500 MHz frequency range. The AM heterodyne translator equipment is somewhat less complex than a receiver/transmitter combination, but it also has some rather serious limitations. For example, it does not permit correction of signal degradation that occurs in the r.f. amplifiers with regard to linearity, differential phase and gain, and envelope delay. One of these amplitude modulated heterodyne translators can be used without serious signal degradation but they should not be used in cascade for multiple relay of the television signal.

Figure 5 illustrates a method of transmitting instructional television material over relatively long distances and through several relay points where the signals are also transmitted to schools in the vicinity. This system utilizes frequency modulated microwave TV relay equipment to connect the 2500 MHz transmitting sites. The television signal degradation experienced in high quality FM microwave TV relay equipment is negligible in systems employing up to five relay points.

An example of a large system employing multiple relay points is shown in Figure 6. Three channels of instructional material originate at Yonkers and are transmitted to schools in that area. The signals are also fed by 12 GHz FM television relay to the Empire State Building in Manhattan where they are transmitted to schools in the Manhattan area and also sent on

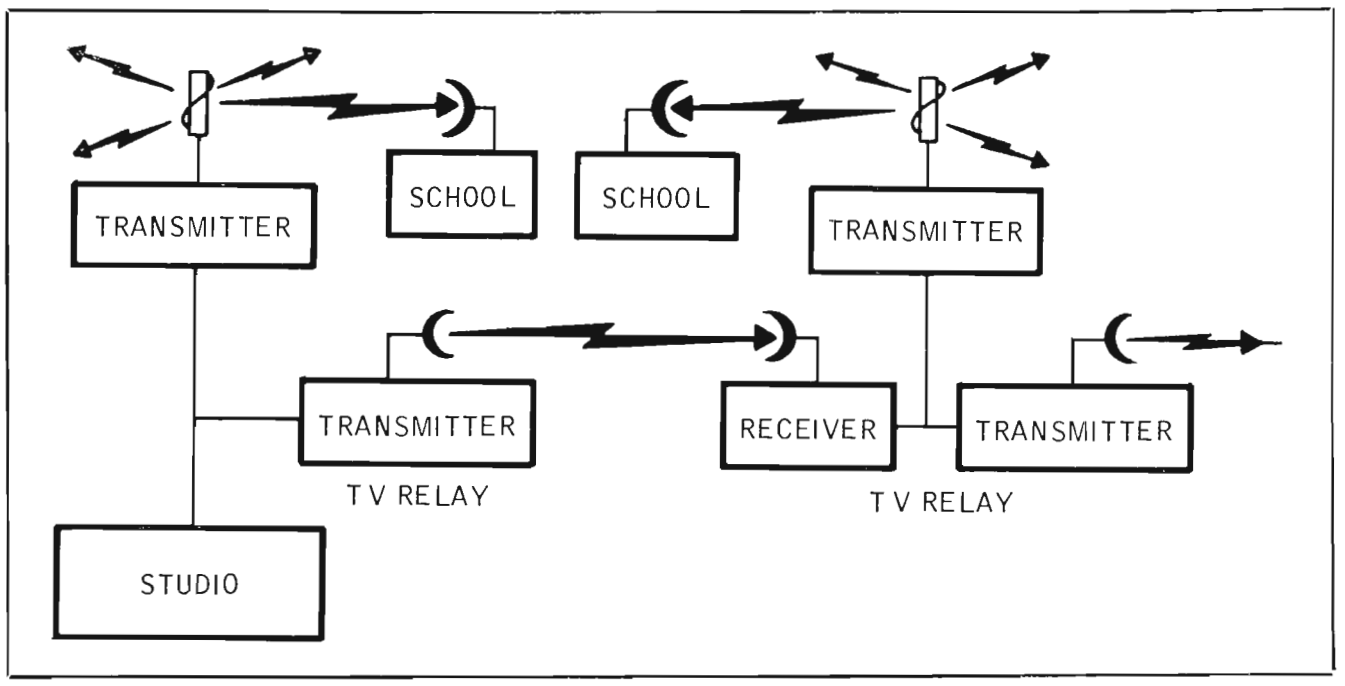


FIG. 5. Block diagram showing Relay System method of transmitting Instructional Television over long distances.

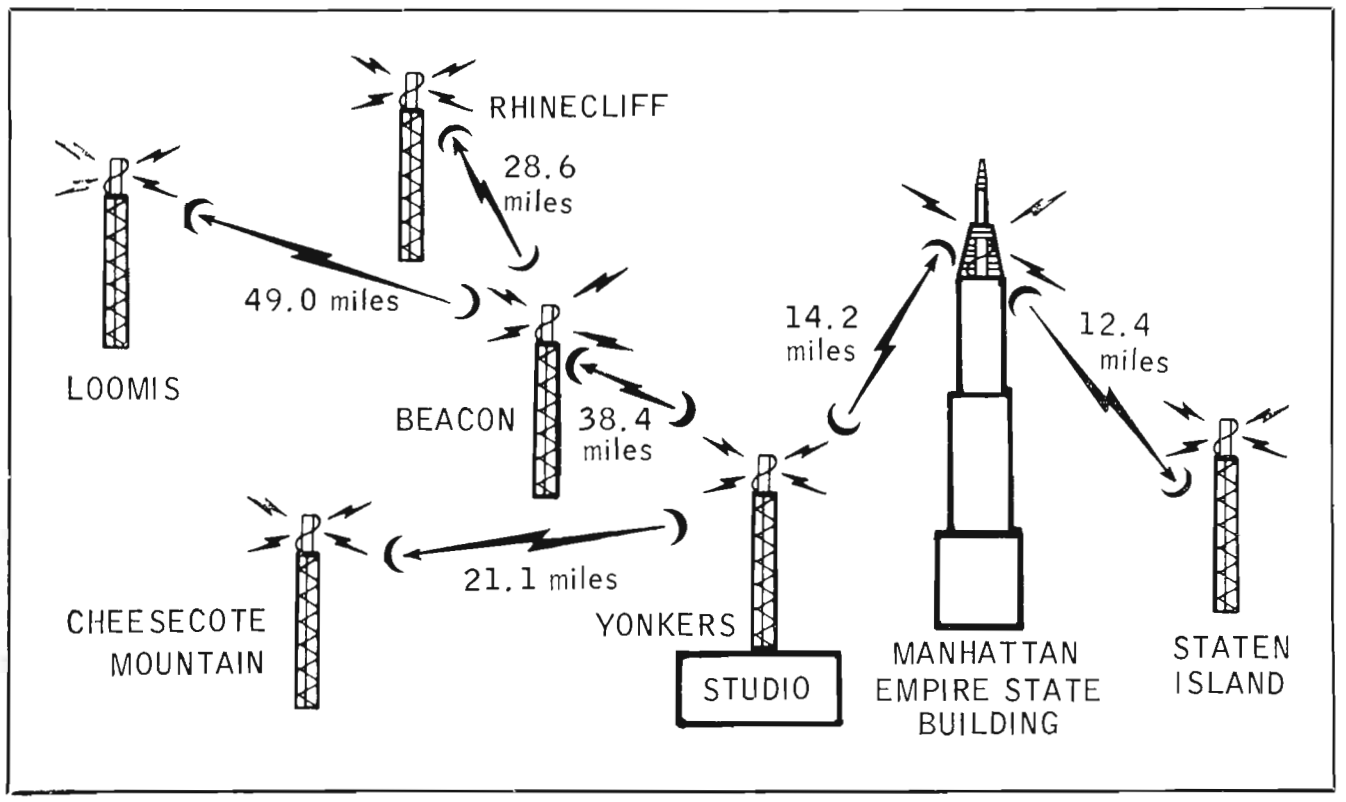


FIG. 6. Example of a large system using multiple relay points. This is the Archdiocese of New York ITV System.

to Staten Island by FM relay. The signals from Yonkers are also sent via TV relay to Cheesecote Mountain and Beacon where they are transmitted and in turn relayed to Rhinecliff and Loomis. This system permits the transmission of color television signals to its extremities without serious degradation and well within FCC requirements.

Planning and Survey Considerations

Even though this paper deals primarily with the technical aspects of the 2500 MHz radio distribution system, there are of course other factors of equal importance in planning an instructional television system. Some person within the educational organization should be assigned the prime responsibility for planning the system. It is important that this assignment be made in the initial planning stage. Other operating systems should be studied in order to benefit from their operating experience. In addition, industry and educational committees have prepared a considerable amount of information that will assist in planning an instructional television system.

After the general programming requirements have been determined, very careful consideration should be given to the studio and studio originating equipment to make sure that it is adequate to meet programming requirements. The studio plan should always provide for future expansion as it is almost impossible to envision all of the requirements in the initial planning stage. The studio equipment should be of high quality as the ultimate picture in the classroom can be no better than those originating from the studio. Origination of color television program material should be considered from the very start, and even though initial programming may be in monochrome, the studios and basic studio equipment should be compatible for color transmission.

TABLE 2 — SURVEY REQUIREMENTS FOR FCC FORM 330P

1. Map of School District
2. Location of Transmitters
3. Height of Transmitting Antennas
4. Azimuth and Distance to Schools
5. Height of Receiving Antennas
6. FAA Information

One of the major considerations in any instructional television system is to determine the type of distribution to be employed. If multi-channel television service to a large number of outlying schools is required, signal distribution by 2500 MHz will probably provide the most economical means of accomplishing the objective.

After the system has been sketched out and the program origination facilities outlined, a survey should be made to determine the 2500 MHz r.f. distribution equipment requirements (see Table 2). In suburban and rural areas, topographic maps will provide a reasonably accurate basis for determining the antenna supporting structures required to provide unobstructed transmission paths. In metropolitan or heavily built-up urban areas this information can be obtained accurately only by direct sighting or r.f. transmission tests. Since the heights of supporting antenna structures are needed for completion of the FCC 330P form, some type of survey must be made before filing for a construction permit.

The FCC Form 330P requires a considerable amount of detailed information concerning legal, financial, and technical matters. It is recommended that legal counsel be retained to assist in the preparation of this form. The services of a radio consulting engineer or TV broadcast engineer should be employed to complete the engineering portion of the form.

Qualified personnel should be hired at the earliest possible date. Certainly the overall managing director should be appointed in the early planning stages, and it is very desirable to have both technical and program personnel available to plan and facilitate the production center and distribution system. When an educational organization undertakes to program from one to four channels of instructional television material, they are in the television "broadcast" business in a big way, and if the job is to be done properly both adequate facilities and personnel are required.

TABLE 3 — TECHNICAL PERFORMANCE REQUIREMENTS

Visual Frequency Response	±2 dB 0.2—3.58 MHz ±2 dB 2.1—4.1 MHz (3.58 MHz reference)
Differential Gain	±20%
Differential Phase	±10°
Envelope Delay	±50 ns at 3. 58 MHz
Harmonics (r.f.)	—60 dB
Spurious	—40 dB
Carrier Frequencies	±60 kHz visual ±1 kHz aural (compared to visual)

Technical Performance Requirements

The 2500 MHz Television Fixed Service is covered in FCC Part 74, Sub-Part I, but the transmission standards refer back to the TV Broadcast Rules and Regulations in Part 73, specifically Section 73.682 and Section 73.687. Some of the most important performance requirements are listed in Table 3, highlighting the characteristics that are related to the transmission of broadcast quality pictures.

The frequency response of the visual transmitted signal is defined in Section 73.687. For color television transmission, the frequency response at 3.58 MHz must be within ±2 dB as compared with response at 0.2 MHz. In addition, the response from 2.1 to 4.1 MHz shall not vary by more than ±2 dB from its value at 3.58

MHz. Instructional television fixed stations are not required to attenuate the lower sideband, although the lower sideband cannot exceed the amplitude of the upper sideband.

The linearity and phase-versus-brightness requirements are the same as those specified for television broadcast. These characteristics are usually specified in terms of differential gain and differential phase, however the FCC Rules and Regulations do not set forth their requirements in these terms. The FCC requires that when reproducing saturated primary colors and their complements at 75% of full amplitude their amplitude shall be within ±20% and their angles within ±10° of theoretical values. In general the transmitter itself will require approximately half of these tolerances while the studio equipment should contribute very little distortion.

The envelope delay characteristic is the same as that required for standard television broadcast stations. The relative delay is to be constant up to a frequency of 3.0 MHz and then linearly decreasing to 4.18 MHz so as to be equal to -170 nanoseconds at 3.58 MHz. The tolerance is ±50 nanoseconds at 3.58 MHz, increasing to ±100 nanoseconds above and below the color subcarrier. This means that the 2500 MHz instructional television transmitting system should correct for any low frequency envelope delay distortion it produces, and at high video frequencies not only correct for its own envelope delay but also pre-compensate for the envelope delay distortion created by the sound notch in the TV receiver.

The radio frequency harmonics of the visual and aural carriers must be attenuated no less than 60 dB below the peak visual power output. All other emissions appearing on frequencies more than 3 MHz above or below the upper and lower edges of the channel shall be attenuated no less than 40 dB for transmitters rated at 10 W or more visual peak power output.

The frequency of the visual carrier shall be maintained within 60 kHz of the assigned frequency. The frequency of the aural carrier shall be maintained within ±1 kHz with respect to the 4.5 MHz spacing between the visual and aural carriers.

In summary, the technical performance required by the FCC is the same as for TV broadcast stations except for:

a. Visual carrier frequency stability
b. Lower sideband attenuation
c. Spurious emissions.

Operation

The production of television program material to support several distribution channels requires not only a considerable investment in facilities but also well-qualified program and production personnel. In addition to operating personnel, technicians must be available for regular maintenance work on the studio originating equipment if transmission quality and reliability are to be maintained.

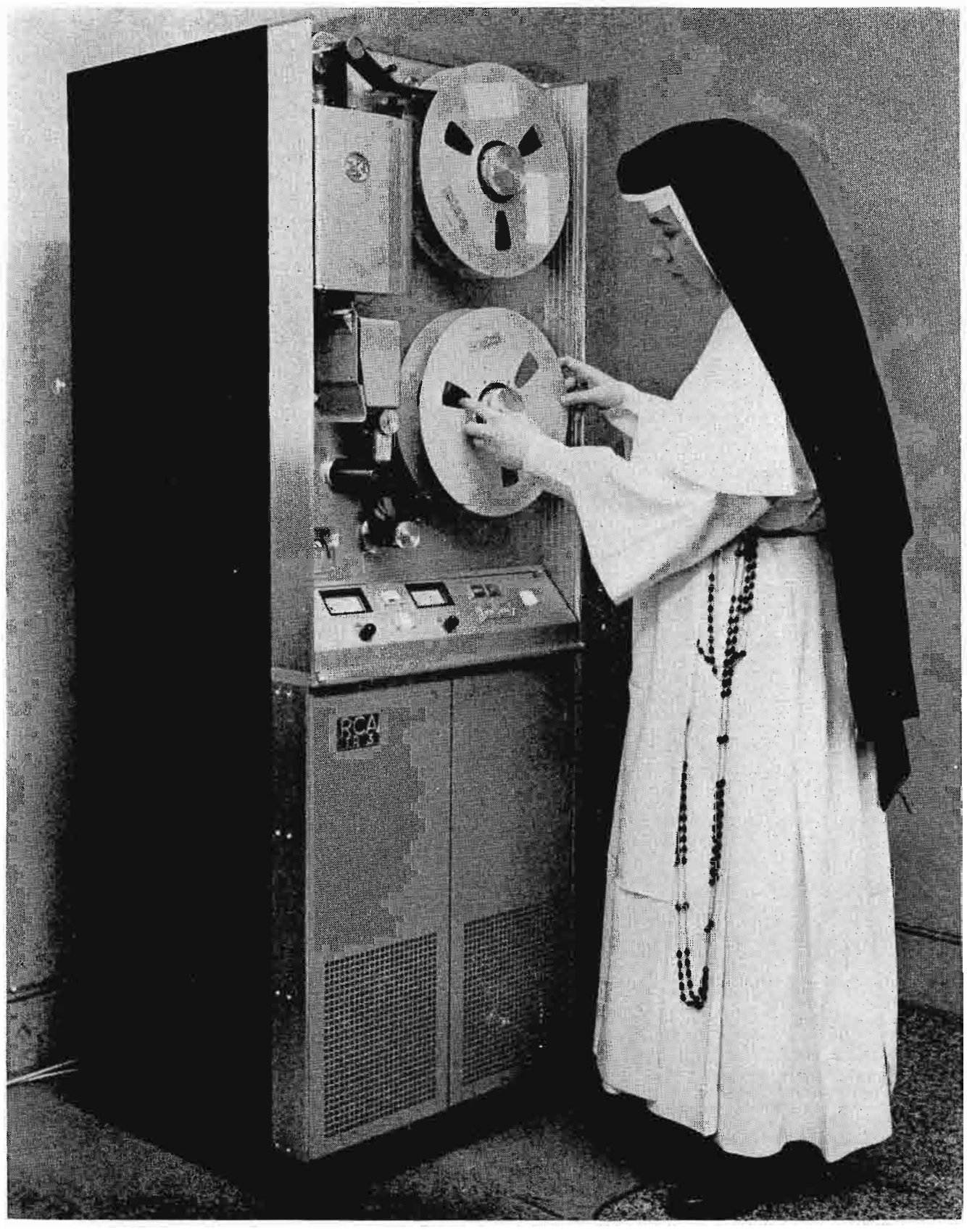
Operators with third class radio telephone permits can operate the 2500 MHz transmitting equipment, but an operator with a first or second class radio telephone license must be available to make more sophisticated adjustments and properly maintain the equipment. Operating logs must be maintained for all transmitters.

The 2500 MHz receiving equipment, in-school VHF distribution systems, and receivers must be properly maintained and serviced. This type of service can be handled on a sub-contract basis if desired.

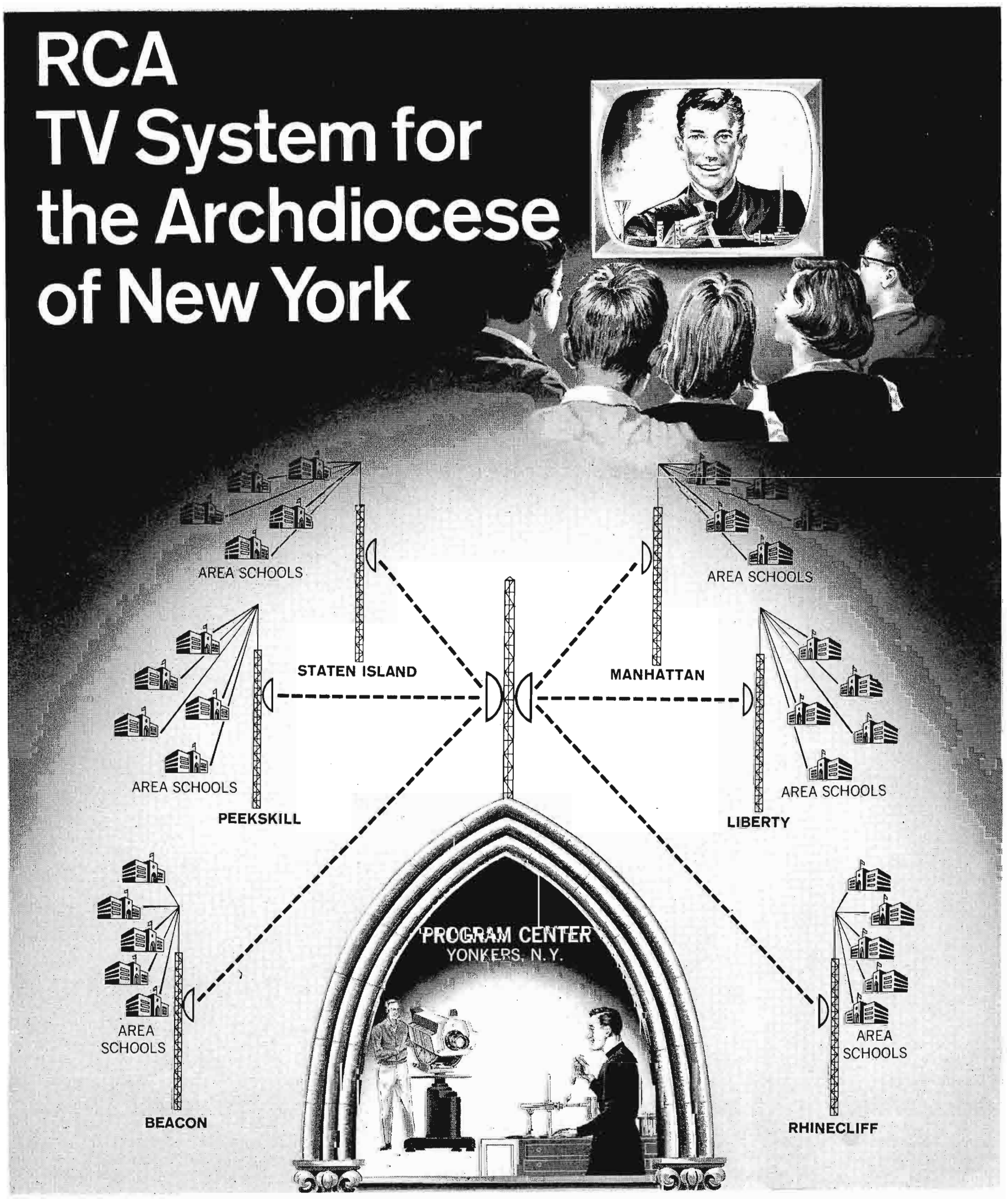
Conclusion

The new 2500 MHz Instructional Television Fixed Service provides the framework for distribution of multi-channel instructional television material. With proper systems planning and implementation the instructional television fixed service can provide an effective means of utilizing television as a teaching tool.

FIG. 7. Archdiocese of New York System employs RCA TR-3 TV Tape Player for presenting programs that are recorded on video tape.



RCA TV System for the Archdiocese of New York



beams educational programs to 3,000 classrooms in color and black-and-white

This new educational television system serves a total area of 4,717 square miles — embracing 400 elementary and secondary schools with an enrollment of 225,500 students throughout ten counties.

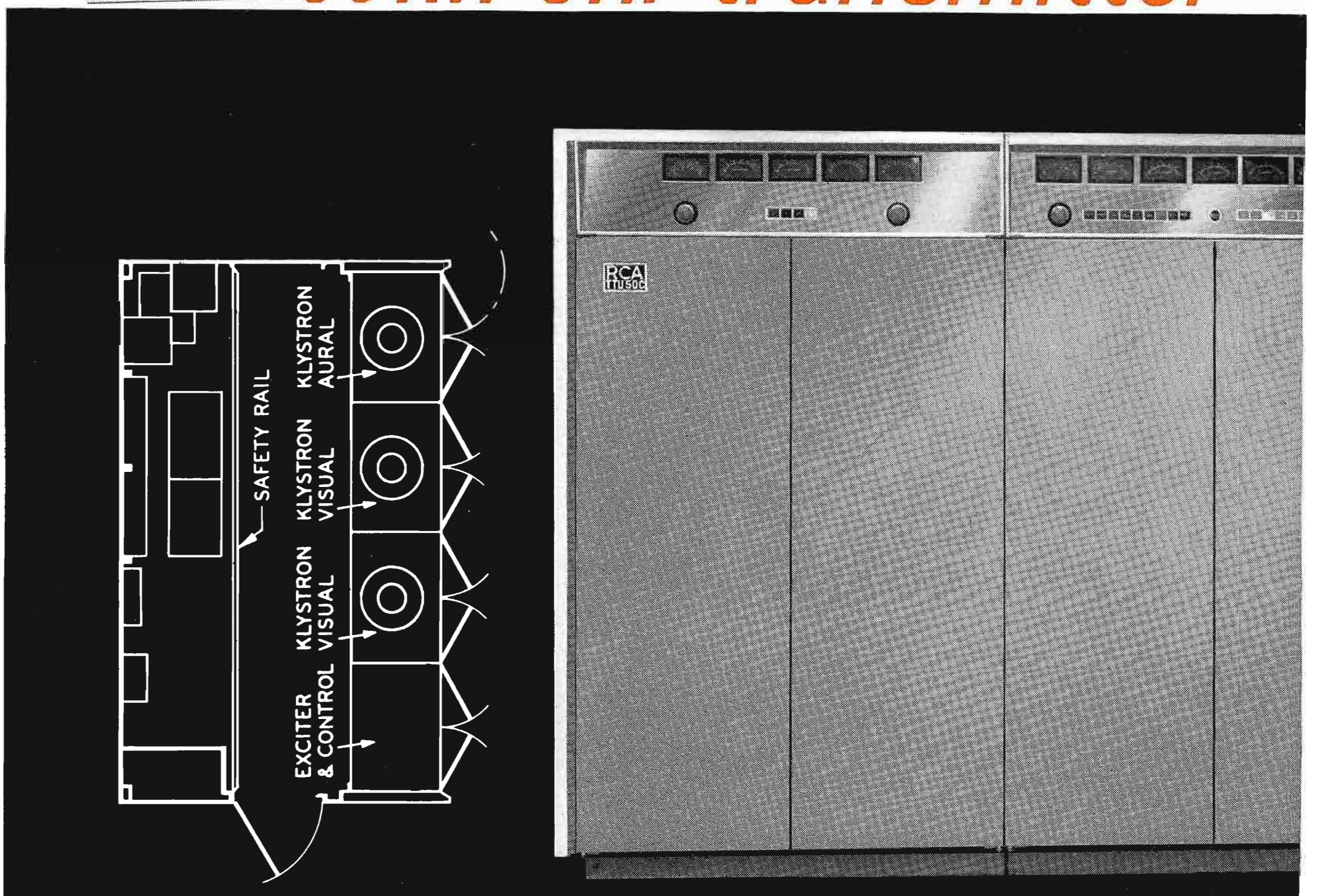
One of the largest ETV systems in the world, it originates programs from a new communications center at St. Josephs Seminary, Yonkers, N. Y. Programs are beamed by microwave to six additional distribution points, then sent by 2,500 megahertz transmitters to the area schools. The 2500 MHz system is known as "on-air closed circuit" since the programs cannot be received by the ordinary home set. Multiple channels give flexibility, allowing for different courses to be aired at the same time, as well as for repetition of "taped" programs.

The space-age studio equipment includes a complete RCA "Big Tube" color film system, film and slide projectors, switching and control consoles; also provision for live programs, using color and monochrome studio cameras.

Helping develop reliable, maintenance-free educational TV systems for closed circuit or on-air applications is another way the RCA Broadcast and Communications Products Division lends a hand to keep America in the forefront of educational progress.

RCA TTU-50C

55KW UHF transmitter



Diplexed Power Amplifiers...

Two separate visual power amplifiers in this new UHF Transmitter will mean it is never at a loss for power. One is always ready to back up the other thus providing a new high order of reliability for the transmitting plant. This is added assurance of uninterrupted operation.

2½ MILLION WATTS ERP

Combined with a TFU-46K antenna, this transmitter provides RCA's most powerful transmitter-antenna package, giving up to 2½ million watts, ERP.

KLYSTRON POWERED

Its unique integral cavity vapor-cooled klystrons are the same klystrons used in proven RCA 30KW transmitters. They offer high reliability and long life.

VAPOR COOLED

Vapor cooling is better than water cooling. Volume for volume, vapor cooling is more efficient resulting in lower transmitter operating expenses.

WALK-IN DESIGN

Walk-in cabinetry is not only an important factor in the reduced size of the TTU-50C, but also of value in speeding maintenance and reducing expense.

for 2½ million watts ERP

More Reliable Operation

ANTENNA CHOICES

A choice of three antennas is offered...the TFU-46K, delivering a gain of 46 and up to 2½ million watts; the TFU-30J delivering a gain of 27 (vertical with 0.5 electrical beam tilt); the TFU-25G delivering a gain of 25.

For more information, call your RCA Broadcast Representative. Or write to RCA Broadcast and Television Equipment, Bldg. 15-5, Camden, N.J.

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Also in this new line are the 30KW (with integral cavity, vapor cooled klystrons), a completely air cooled 10 KW, and a 2 KW that is easily expanded to a 10 KW.

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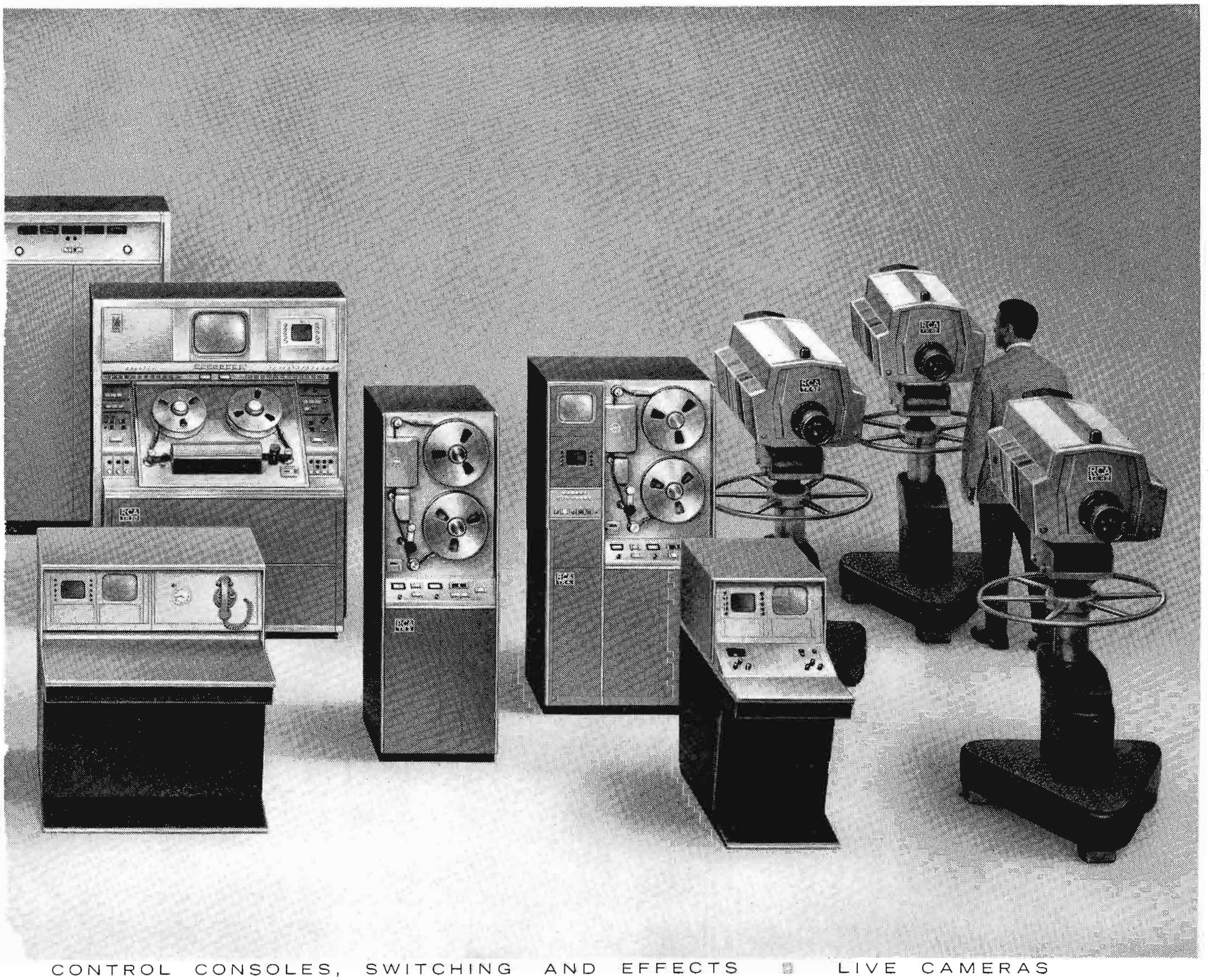
"MATCHING" MEANS A BETTER INVESTMENT



CONTROL CONSOLES, SWITCHING AND EFFECTS ◻ LIVE CAMERAS

matched line

The "Matched Line" is the end result of a multi-million-dollar engineering program to produce a new generation of broadcast equipment. RCA Matched Equipment reflects the newest in styling, performance and operation.

Matching means equipments that are designed to provide the ultimate in performance when used together... equipments that are designed and styled to fit together efficiently, and to provide the finest, most modern appearance for the whole station. It means installations that are compact, yet easily expandable, that offer greater reliability, and that provide for easy operation and maintenance. It means simplicity in ordering, easier follow-up and guaranteed satisfaction... from one factory, one ultimate source of responsibility, one set of designers and engineers. And it means equipment that is designed for tomorrow, assuring a better investment.

If owning equipment that performs and looks better together, and lasts longer, appeals to you, why not consider RCA's Matched Line? From "big tube" cameras, advanced quadruplex recorders, film and slide projectors... to transistorized switching, controls, transmitters and antennas, the RCA Matched Line is a good thing, all the way, for you.

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RCA SERVICE

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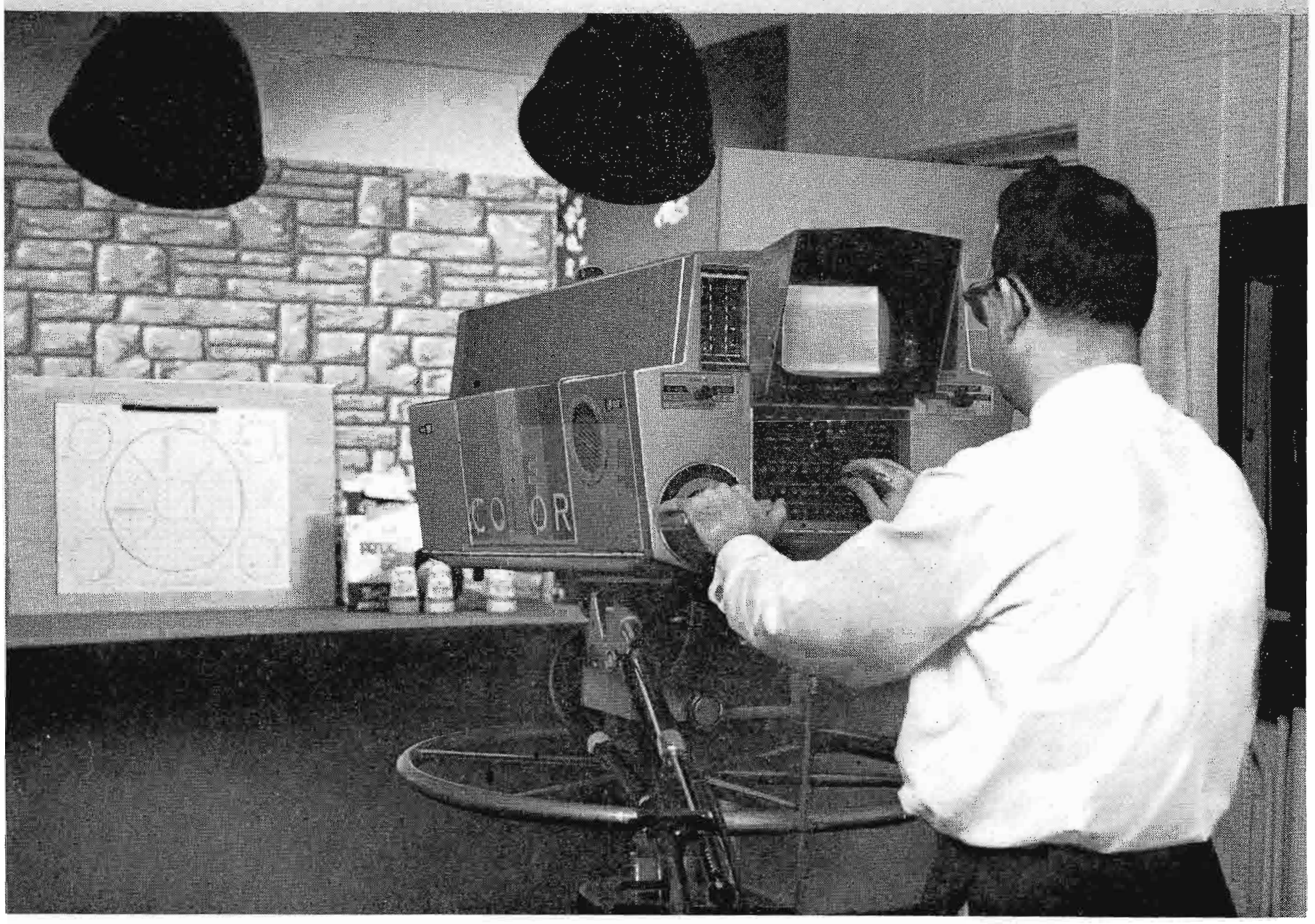

TK-42

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The Most Trusted Name in Electronics

NEWEST AND FINEST COLOR TAPE RECORDER...TR-70

The TR-70 Deluxe High Band Color Tape Recorder is the newest entry in a race where each new design "leapfrogs" the last. RCA engineers designing the TR-70 were not satisfied—dared not be satisfied—just to match the already available machines. They had to make the TR-70 better—much better. And they did. Thus, the TR-70 does everything, has everything (good) that the very best previously available recorder could boast of. But that's just the start. In addition it has a whole host of features and advantages not found in other recorders. Read on.

THE TR-70 DOES EVERYTHING

It produces the sharpest, most brilliant, truest color pictures you have seen. Makes superb color dupes through four generations. Offers all the wanted accessories—to electronically edit, compensate for dropouts, dimensional errors, variations in tapes. Operates at four switchable standards. And does it all more easily, more surely and more conveniently than ever before.

THE TR-70 HAS EVERYTHING

Everything you've ever heard of before. The basic machine is High Band *color* (not monochrome). It's designed, tested, and delivered that way. When you get it, it's ready to go! It's an integrated machine—there's no need to find space for a compressor—everything's built-in. Space is also provided for accessories, and all wiring's in place—no downtime to install—just plug in modules: Velocity Error Correction, Automatic Chroma Control, Dropout Compensator and Remote Control. (Pixlock, Line Lock, ATC and Color ATC are part of basic machine.)

THE TR-70 HAS MORE

Features not available in other machines, features that make for better, easier, more convenient operation and maintenance. Such as all-front access, eye-level (and ear-level) monitoring, less floor space. Standard modules, all the same type, same extenders—easily removed (you don't need a screwdriver). Test points on front of panels, D-C metering panel, built-in FM test facility. Grouped operating controls, automatic guide positioning, foot-operated brake release. And many more. *To learn the whole story—hear all of the facts—call your RCA Broadcast Representative.*

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RCA TR 70

NEWEST AND FINEST

Unexcelled Performance . . . Unequalled Features

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