



PRACTICAL EQUIPMENT LAYOUTS FOR TELEVISION STATIONS





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Introduction

The equipment required for a television studio installation varies widely depending on the type of station, the size of the community in which it is located, and the magnitude of the station operation. In this respect it differs greatly from the equipment requirement of the transmitter part of a TV installation which, with the exception of transmitter power, is much the same for all stations.

If the station is a network origination point, located in a large city, it will probably be a multiple-studio installation requiring a large number of cameras, associated control equipment, master control equipment and elaborate distribution facilities. If it is a non-network station in a large city it will probably require almost as much camera and control equipment (due to the fact that it must compete programwise with the network stations), but it will not, of course, require the distribution facilities. On the other hand a network station in a medium-sized community, because it will receive most of its programs from the network, will need only relatively simple studio facilities. In some instances, network stations in small communities may not have any origination facilities except a slide projector for station identification, and a simple film pickup system.

This wide range of requirements, plus the fact that many stations will wish to install minimum equipment and "grow" with the development of the audience, led RCA engineers to the conclusion that TV studio equipment should be made of carefully planned units so coordinated that they could be easily fitted together to provide almost any desired combination of facilities. This is essentially the "building block" idea which is today employed in many types of industrial apparatus. However, in the design of RCA TV units the idea has been carried further in that the equipment has been broken down into smaller units. Thus, when expanding a system made up of RCA TV units it is usually necessary to add a whole desk or console. For instance, another camera (either studio or film) can be added to an existing system by the addition of a 14 inch wide

section to the video console. Single amplifiers, monitors, relay units or the like can be added at will. Moreover, all of these units are designed to operate at a standard level and into a standard impedance. Thus input and output connections can be brought out to jacks, so that units can be patched in or out as desired (thereby providing for temporary modifications of the system as may be required).

The six system layouts described in this article have been chosen to illustrate the wide range of equipment combinations which are practical. For the most part these are layouts actually in use at existing studios or now being installed at stations under construction. Thus they represent a large amount of thoughtful planning and are based, to the largest possible degree, on actual operating experience. There are, of course, many modifications of these systems, and numerous in-between-designs, which will occur to station engineers. Using RCA TV units it will be relatively easy to make such modifications as may be necessary to meet the specific requirements of individual stations.

Of the six different layouts to be described, types A, B, and C utilize only one live-talent studio and a single control room. The single control room is a combined studio control room, film control room and master control room. The Type D station also has only one live-talent studio; but it has two control rooms, one for the live-talent studio and one for the master control room. The Type E station is a deluxe arrangement of the Type D; including a program console, which provides additional facilities over Type D. Finally, the Type F Station is a master layout employing two studios, each with its own control room, and separate film control and master control rooms.

General Considerations

All TV studio installations—large or small—are alike in many respects. The difference in size, for instance, is mostly a matter of the number of studios involved. The single studio of a small station with its associated control room is almost identical to one of the studios and associated control room of the large sta-

tion. Thus the general arrangement of the equipment in the control room proper is very much the same in all stations. Moreover, the equipment for all stations is made up from the same basic units. And, finally, the basic control system used in all of them is the same.

Because of these similarities it is worthwhile to discuss some of the basic considerations in a general way before beginning the detailed description of the six equipment layouts. Inasmuch as this part of the discussion has to do with rather elementary aspects of the subject those with some previous background or experience may wish to skip this part and continue with the detailed descriptions of the six layouts which begin on Page 18.

Basic TV Studio Arrangement

It is not the purpose of this article to discuss the design of TV studio buildings.² However, several partial floor plans have been included in order to indicate relative sizes and the general arrangement of studios, control rooms, workshops and dressing rooms.

The dimensions of these studios, as well as the control rooms, may seem large, by broadcast standards. Experience indicates, however, that the dimensions shown are close to the practical minimum. TV studios should be large enough to provide for as many as two or three sets, which may be successive scenes in a program; while control rooms should be made large enough to admit additional equipment as the station grows. As a matter of fact, the floor plan suggested for the Types A and B small stations will serve also for the larger Type C station. Because large studios are used, the control room window can be quite large compared to that of most broadcast stations. This is an advantage in that the control room audio and video consoles when placed end to end require much more space than audio alone. Of course it is not absolutely necessary for all the technical operators to be able to see into the studio. It is important, however, that the program director be able to see all of the studio action from his position in the con-

² For a discussion of TV building design see "Facilities for TV Housing", BROADCAST NEWS No. 50, Page 8.

control room. In order to give all of the personnel in the control room a better view of the studio, the control room floor is usually elevated about two feet above the studio floor level.

There are several ways of arranging the equipment in the control room. RCA engineers are inclined to recommend that all the equipment consoles; i.e., audio, video and director's (if used) be placed side by side directly in front of the control room window. A somewhat different method, preferred by some broadcasters, is to place the program director and audio operator on a platform, (Fig. 11) elevated two or three feet above the control room floor. This particular arrangement is illustrated and described more fully in the layout for the Type C station.

At least one announce booth is essential in a TV station layout. Such a booth is provided with the necessary audio facilities and a picture monitor. It enables a commentator, for example, to see the picture upon which he is commenting, so that he can follow the action accurately.

This booth may be located in one corner of the film control room, or it may be

located just outside the master control room. If one announce booth is to serve also for station identification, it may be advisable to locate it outside the master control room, and construct it so that visual "cue" can be given from the master control room.

Basic TV Studio Equipment

Most of the units which make up the video system of a television station are counterparts of the audio units in a broadcast station. The camera itself corresponds to the microphone, the camera amplifier to the microphone preamplifier and so on.¹ In general, these television units are arranged in much the same manner as the corresponding audio units of a standard broadcast station. The output of each studio or film camera is fed into one of the input positions on a video control console in the control room. At this console position, the video signals from the cameras are mixed (or switched) in the same manner as microphone and transcription inputs are mixed at the audio console. From the video console the picture signal is fed either directly to the transmitter line or to a master control room where it is mixed with signals from the studio, the

network line, or outside points. Here again the operation is directly comparable to that of a standard broadcast setup.

There are several major differences, however, in the video setup. One of these is due to the fact that the video output the camera has several qualities, such as brightness, contrast and focus, which require constant supervision. This operation is roughly comparable to that of riding gain in an audio setup. It is, however, a much more complicated process, and for this reason is generally separated from the mixing or switching function. In all but the smallest setups, this supervision of the individual camera signals is exercised by a "video operator" who sits at a video console (Fig. 7). This console is made up of sections usually referred to as camera control units. There is one of these control units for each studio camera and one for each film camera. Each unit (Fig. 5) contains a picture monitor showing at all times the picture picked up by the camera

¹ All of the RCA television equipment units referred to in this article are described in detail in individual equipment bulletins available from the Television Equipment Sales Section, RCA Engineering Products Dept., Camden, N. J.

RCA UNIT-BUILT EQUIPMENT LENDS ITSELF

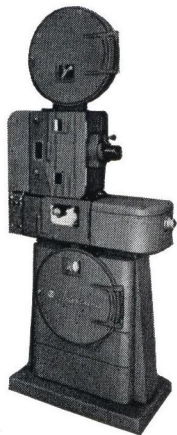


FIG. 1. Type TP-35A 35mm Television Film Projector which enables television broadcasters to use standard 35mm motion picture film as program material.



FIG. 2. Type TK-20A Film Camera. This camera converts motion pictures projected from 16mm or 35mm projectors to video signals for television transmission.



FIG. 3. Type TC-5A Program Director's Console. This console provides the program director in the control room with pictures of the scenes being picked up by the studio cameras, so that he can choose the picture to be transmitted.



FIG. 4. Microphone Boom and Perambulator. This boom enables the audio man in the studio to pickup the sound while keeping the microphone out of the view of the camera.

it is associated with. It also contains an oscilloscope for "waveform" monitoring and all of the necessary controls for adjusting the brightness, contrast, focus and other attributes of the particular camera picture. The video operator uses these controls to keep the several camera pictures in optimum adjustment at all times. Thus, the technical director, or whoever does the switching, is free to concentrate on the action without worrying about the camera adjustments.

Another major difference in the video setup is occasioned by the fact that video signals cannot be "piped" about quite as freely as audio signals. For this reason it is usually necessary (in all but the smallest systems) to employ relay switching. Thus, the video switching setup of most stations will correspond more nearly to the relay type of audio switching used in the larger broadcast station and network studios.

The audio equipment used in a television station is very much like that used in a standard broadcast station. There are, however, several minor differences. One is occasioned by the fact that the microphones must be kept out of sight. This

usually requires either more microphones or else the use of elaborate boom mounts (Fig. 4). Another is the desirability of being able to add background sound (from a transcription turntable) and have it heard in the studio (which involves some changes in control circuits since most standard audio equipments are interlocked to prevent this).

The audio control requirements for TV also differ somewhat from those used in AM and FM broadcasting. In TV studios, microphones are usually suspended on the ends of movable boom stands. The boom operator, under the direction of the audio engineer, maintains the placement of the boom microphones for best sound pickup. He must also keep the boom and microphone out of the view of the camera. Good communication, therefore, must be maintained between audio engineer and boom operator. This necessity of directing the microphone movement (in addition to his normal job of riding gain) keeps the audio operator much busier than in standard broadcasting.

Because the video and audio operators are so busy exercising their individual monitoring functions, it is standard TV prac-

tice to place the actual switching (or mixing) operation in the hands of a third technician who is usually the technical director. The location and arrangement of facilities for switching varies widely with the type of setup (and with the personal preference of station planners). In medium-sized stations, a simple but effective arrangement consists in adding to the video console two additional monitor sections. These sections (Fig. 5) are similar in size and appearance to the camera control units. One of these acts as a master (or program) monitor. On its screen appears at all times the picture output of the control room (i.e., the picture being sent to the transmitter or the master control room). There is a space on this unit for a panel containing a push-button switching system with lap-dissolve levers, signal lights, etc. The technical director uses these controls to select the picture for transmission. The monitor in the unit gives him a constant visual check on the transmission. Ordinarily a second unit, similar in size and arrangement, is located next to the master monitor. This second monitor is used as a "preview" monitor. The technical director uses a set of push-buttons on it to select the camera input he

A VARIETY OF TV STATION LAYOUTS

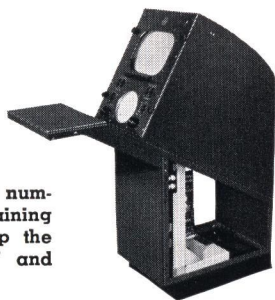


FIG. 5. Video Console Section. A number of these sections, each containing 10-inch picture monitors, make up the video consoles shown in Fig. 7 and in the layout photos.

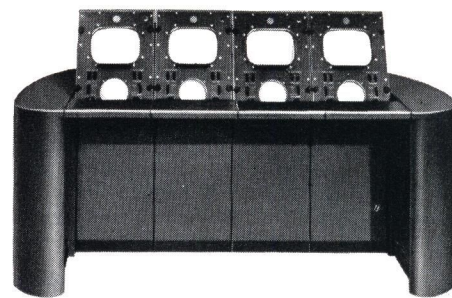


FIG. 7. Video Console. These sections can be individually equipped as TK-10A camera controls, TS-10A camera switching systems, and "preview" and program monitors sections.



FIG. 6. Television Audio Console. This console is the control center for the audio part of the television program.

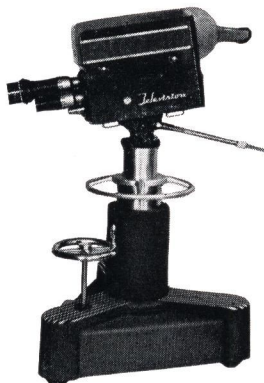


FIG. 8. TK-10A Studio-type Camera and Pedestal.

proposes to use next. This allows him to monitor (for quality and action) his upcoming shot. This monitor may also be used to take visual "cue" from a preceding program by switching to the video line from the preceding origination point.

The "master" and "preview" monitors obviously do not have to be a part of the video console. They may, if desired, be located some distance away as, for instance, on an elevated platform beside the program director's position. Several such alternatives are shown in the equipment layouts which are described in the following pages. Also described are several different types of switching controls. However, the general operation is the same in all cases.

It will be evident by now that the major difference between TV and AM (or FM) equipment layouts is in the relative complexity of the former. In addition to the three technicians mentioned above, the active personnel in a TV studio control booth usually includes a program director and one or more assistants. All of these people must be provided with some monitoring facilities. Here again there are wide differences between setups. In the smallest layouts, the program people simply peek over the shoulders of the technicians. In the most elaborate setups, the program director has his own program console (Fig. 3). Various program monitoring setups are described in connection with the layout description on following pages.

Basic TV Studio Control System

The control systems included in the television layouts treated in this article are similar in arrangement to those used in broadcast stations of corresponding size. Thus, in this respect also many of the operational procedures used in AM broadcasting are carried over into television broadcasting.

The average television program consists of a succession of studio pickups, plus the occasional inclusion of signals from remote points or other studios. A simple example of the latter is the insertion, into the program, of a station identification slide or short picture sequence originating in the film projection room. Another is the occasional (although less frequent) insertion of outdoor scenes picked up by field equipment and fed to the station by line or microwave relay. Thus, even though the major part of any one program will originate in one studio, with control of the program centered in its control room, some provision must be made for coordinated

control of the remote signals, as well as the signals emanating from the projection room and other studios. In almost any television setup, switching from local to remote signals can be done, of course, in master control. But a feature of the layouts described here (with the exception of Types A, B and C which have a single combined control room) is that the remote signals and the signals from other studios may also be brought into any of the camera switching systems, thereby allowing control of all program source material within any studio control room, as well as in master control. Fig. 9 is a simplified drawing of such an arrangement. Note that video plugs and jacks are employed between the cameras and camera switching relays, and at one point, into the master switching relays. By locating all these jacks and plugs in one room such as master control, remote signals as well as signals from the projection room can be patched into the control rooms of either studio. With this arrangement, the program director in the studio control room can introduce outside signals at any time into the studio

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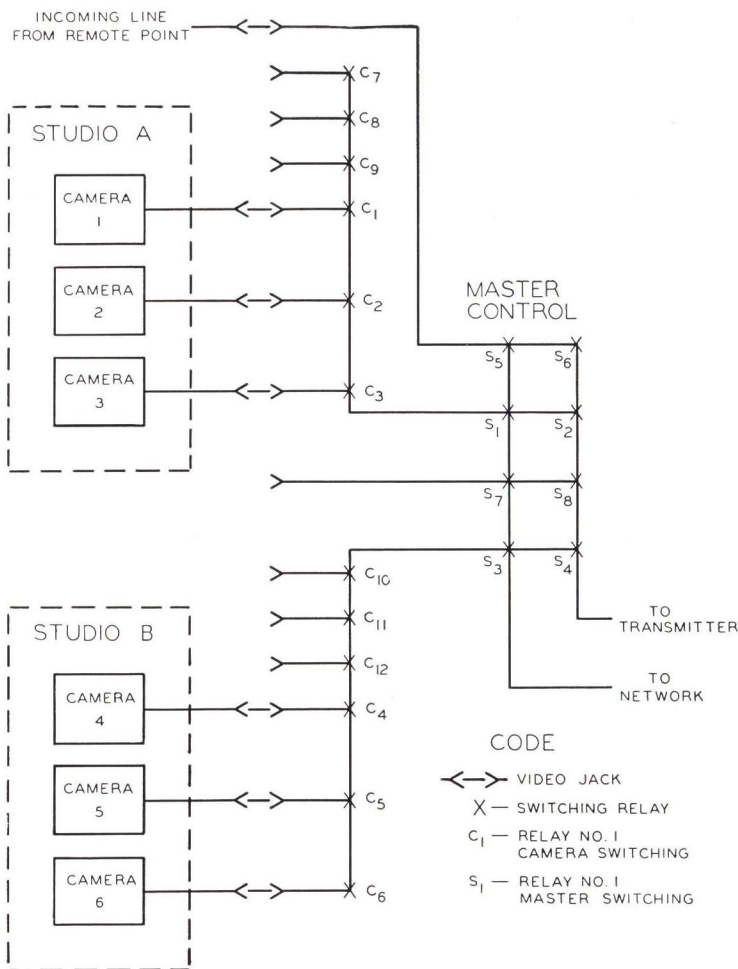


FIG. 9. Simplified diagram of the camera switching and master switching systems. Jack panels, rack-mounted near the switching relays, permit program material to be patched directly into any control position.

FIG. 10. This partial floor plan shows the space and housing facilities required by the standard size station for the origination of studio and film shows. Clients' viewing room is located above the studio control room.

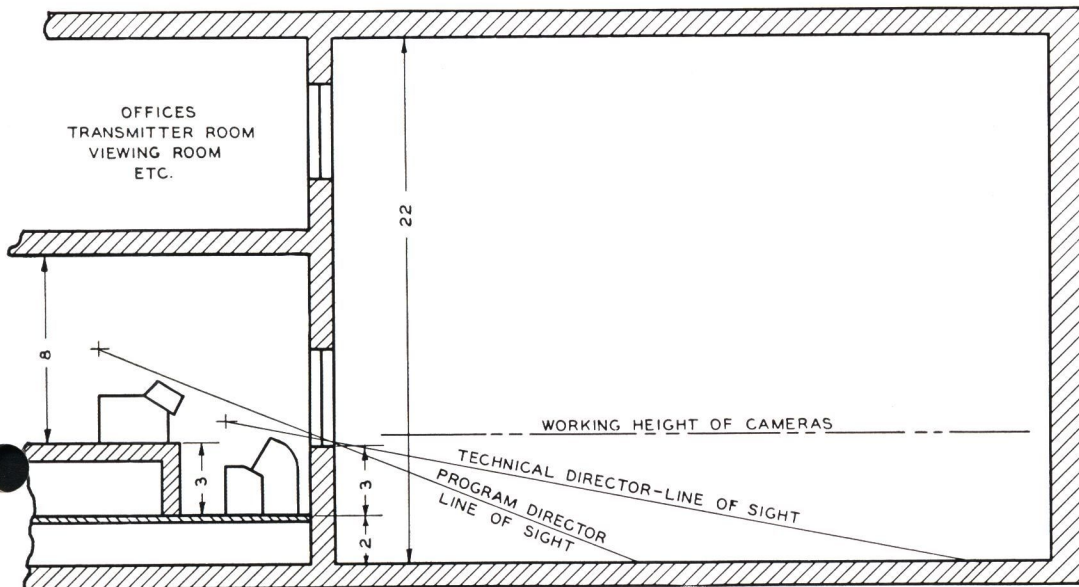
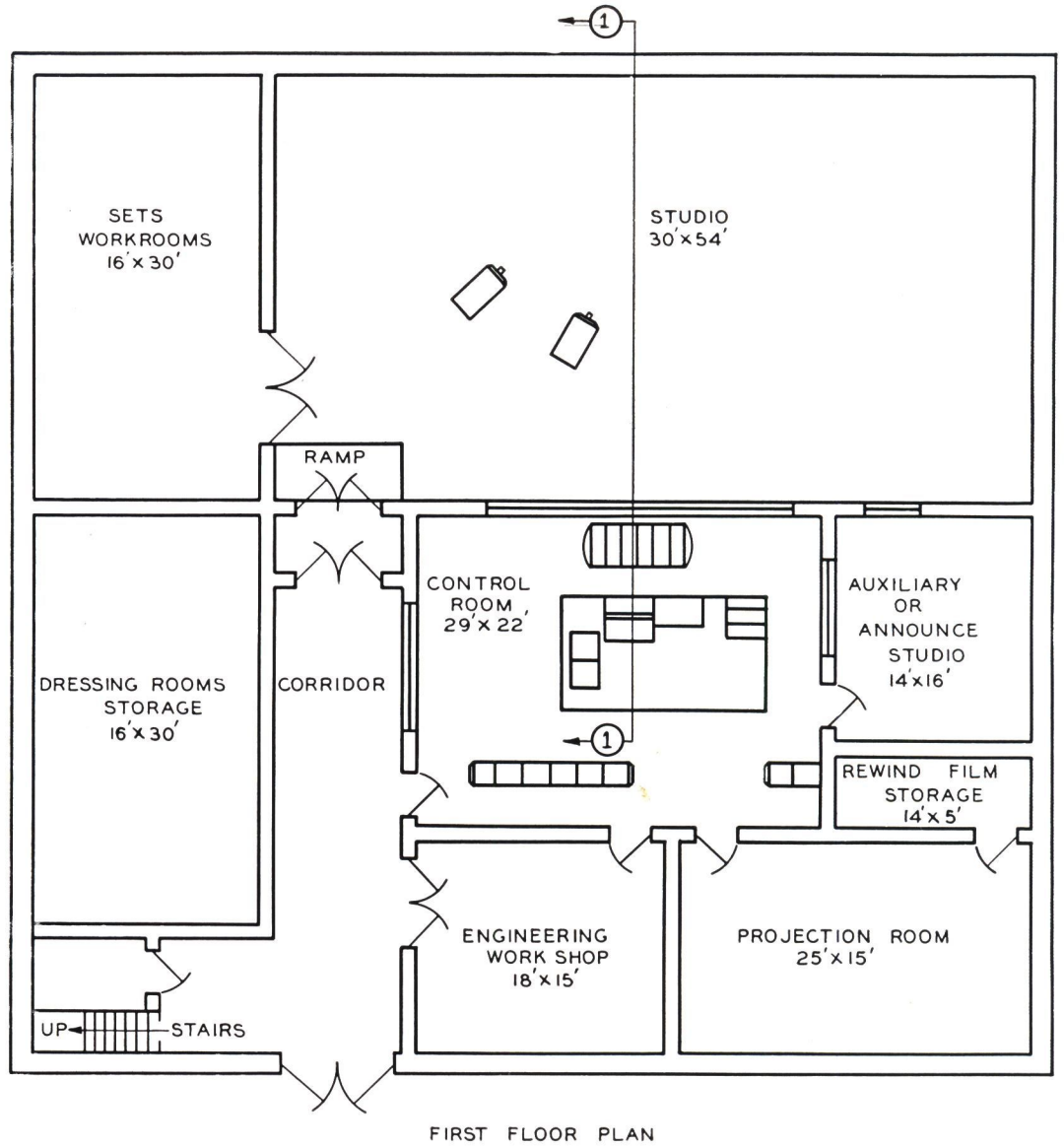


FIG. 11. (Left) Cross-section of control room of Fig. 9, shows elevation of program director to provide him with a good view into the studio.

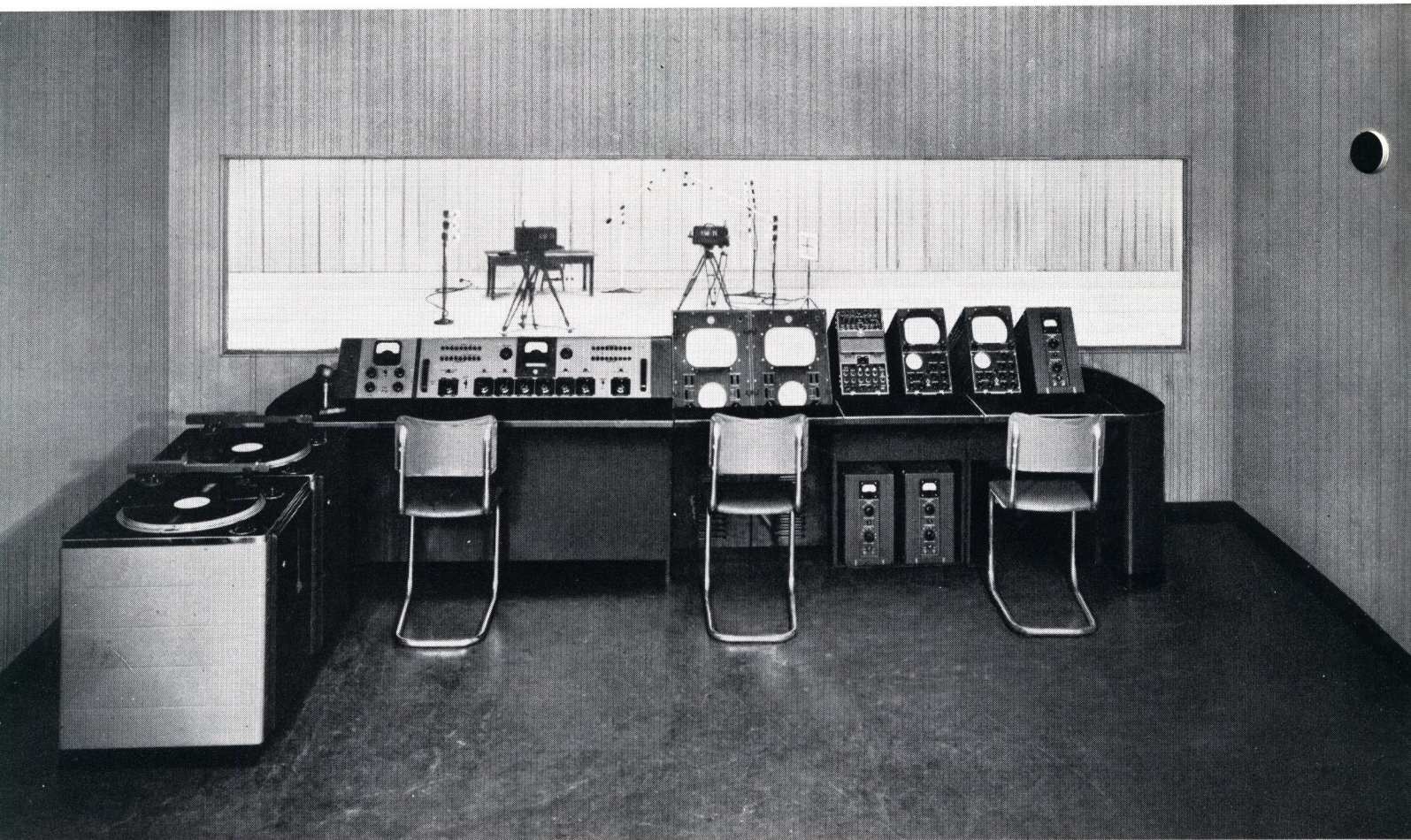


FIG. 12. Typical Control Room for the Type A Small Television Station. Two console sections with picture monitors (center) are standard studio control room units. Portable field-type units on the right, when not used for outdoor pickups, are placed in the control room for production of local studio shows. At left are transcription turntables and the audio control console.

TYPE A LAYOUT FOR A STATION WITH ONE LIVE TALENT STUDIO, FILM PROJECTOR AND CONTROL ROOM

This plan for a small television station provides the facilities necessary for broadcasting the four main types of television programs; namely, (1) network programs received by coaxial cable from the studios of a network key station, (2) standard 16mm entertainment and commercial films, (3) local studio programs, including live talent, and (4) programs "picked up" at points remote from the studio with portable field equipment, and which are sent to the station via coaxial line.

Broadcasting of these four types of programs with an equipment which represents a relatively low initial investment is made possible by dual use of the RCA Television Field Equipment. This equipment, which consists of portable field cameras, plus small-size, easily portable auxiliary units, is especially designed for use in picking up programs from locations outside the studio—such as boxing matches, football games, nightclubs and the like. In medium-size and larger television stations it will, most likely, be used exclusively for that pur-

pose. However, in small stations (where studio programs may be relatively few in number) it can also be used, at least in the initial stages, as the regular studio equipment. Special, inclined-top tables can be used in the control room to accommodate the camera control units. These tables when placed side by side with the audio or video consoles form an attractive studio control room layout. The field type cameras when used in the studio can be mounted on tripods fitted with mobile dollies. Or, of course, the cameras can be mounted on studio pedestals, or even on crane-type dollies, if desired. Technically, the field type cameras operate very well in the studio.

The facilities for the Type A layout include: one live-talent studio, a film projection room, a combined studio and film control room and an announce booth. In larger stations, the projection room has a control room too, but in this plan for the small station the studio control room houses the film camera control equipment as well as

the studio camera control equipment. Thus, it becomes a combined film and studio control room. Master switching, i.e. between studio, film and remote signals, is also done in the studio control room in this layout.

Studio Equipment

Equipment for the studio of the small station consists of two RCA field cameras plus the necessary lighting and props required to put on live-talent shows. The field cameras are complete with electronic viewfinders and folding tripod mountings. As previously mentioned, special studio pedestals or crane dollies can be made a part of the studio equipment to enable the cameramen to dolly the cameras, as well as move quickly between two or three "sets" methodically arranged in the one studio. Power for the cameras is supplied through the camera cable from the studio control room. The cameras, microphones, and their mountings, therefore, are the only items of television equipment required in the studio.

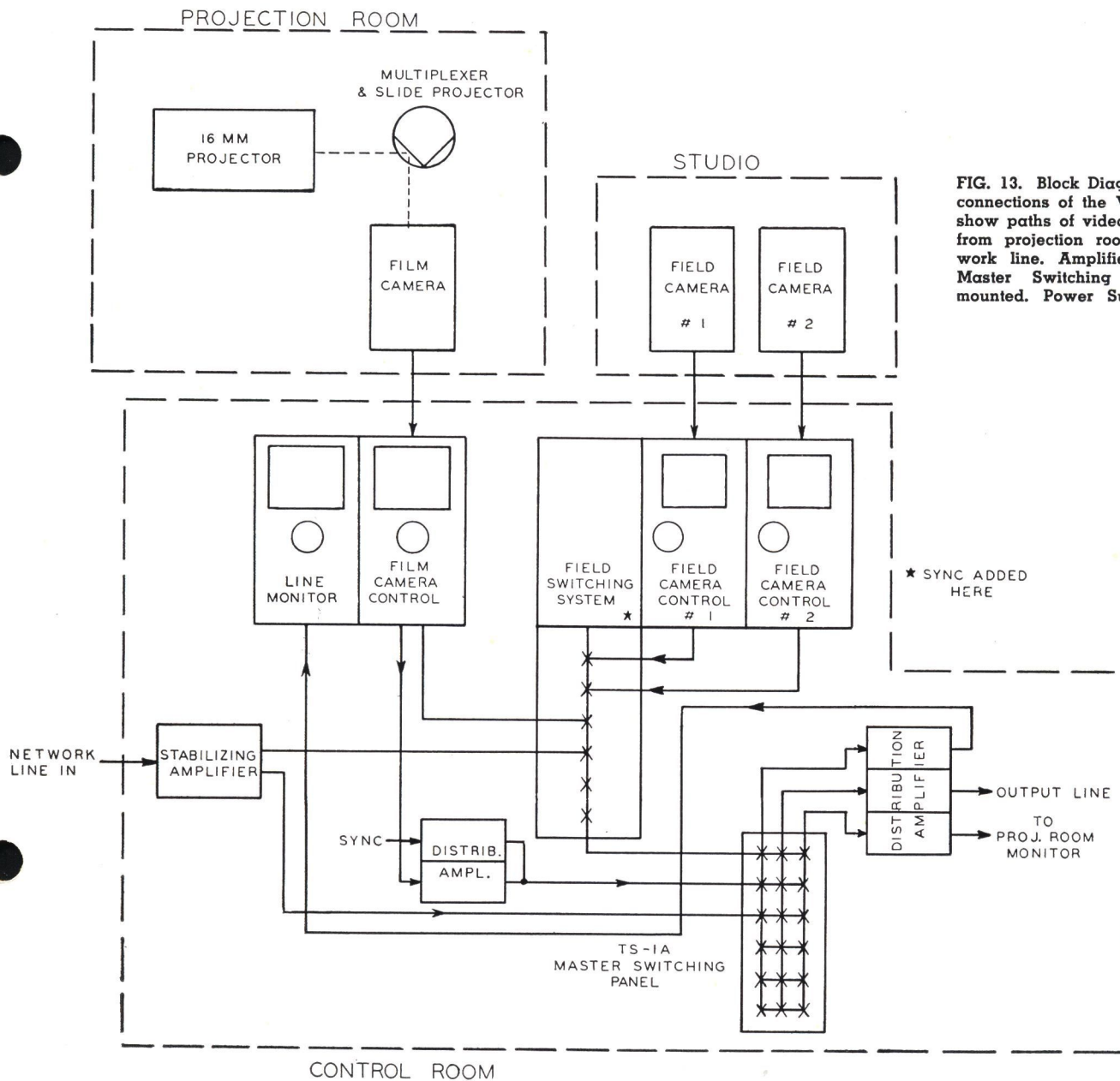


FIG. 13. Block Diagram Showing Interconnections of the Video Units. Arrows show paths of video signals emanating from projection room, studio and network line. Amplifiers and the TS-1A Master Switching Panel are rack-mounted. Power Supplies not shown.

Control Room Equipment

When the two field cameras are used in the studio for producing live-talent shows, the complete control room equipment will be that shown in Fig. 12. The major items consist of a three-operator console (requiring a program director, one audio and one video operator), two audio turntables, and equipment racks to house the amplifiers, sync generator, and power supplies. The control room console is actually made up of separate audio and video units. But these units are designed to go together to provide a console with unified appearance. The audio control equipment shown in the photos consists of two consolettes. The A 76 consolette is the large one next to the video monitors, and the small consolette to the left provides an additional audio channel and private telephone cir-

cuits. This audio equipment is described more fully following the description of these layouts.

At the video operator's position are (a) the two field type camera control units for the cameras in the studio, (b) a field type switching system, and (c) three field type power supplies. Each of the two camera control units contains a 7-inch picture tube, waveform oscilloscope and manual controls for making the necessary adjustments of the picture signals. It is through manipulation of these camera controls that the video operator, while watching the picture produced by each camera, controls its technical aspects. He makes sure each picture has the proper shading and contrast, and that the video and sync levels are correct, as indicated by the built-in oscillo-

scopes. Moreover, he may, at the request of the program director seated beside him, switch the selected signal into the program line; although, it is possible that the director may choose to do his own switching, while at the same time previewing these signals on the picture tubes of the camera controls. The field switcher, which serves for switching any of the incoming signals (including network, film or remote line) to the transmitter room, is located close to the program director for that purpose.

In this plan A setup for the small station, the program director is seated before two standard control room units (a) a line monitor and (b) a film camera control unit. Both of these units are installed in standard studio console housings. In the

upper compartment of each housing is a TM-5A Master Monitor, which has a 10-inch picture tube and a 5-inch CRO tube. This is the monitor which is used in all RCA standard studio and master control room equipments. It is illustrated in Fig. 5, Page 15.

The film camera control has a function similar to that of the field camera control unit in that it supplies the blanking and driving signals for the film camera, and also reproduces a preview picture of the signal generated by the film camera. Controls for adjustment of picture levels and shading are located on the console. The film camera control is located adjacent to the video operator so that he can conveniently observe the picture being displayed on the monitor and keep it at all times technically suitable for broadcasting.

The line monitor alongside the film camera control provides the director with a large bright picture of the video signal being sent (through a rack-mounted master switching panel) to the transmitter room. This picture appears on the monitor as the desired video signal is switched into the transmitter room line. There is a possibility that in some station layouts the control room rack which contains the master switching panel might be located so that the video operator could conveniently reach the switching panel. In this case, the switching panel would then become a master switching position which would enable the operator to view the selected signal on the preview monitor before he switched it to the transmitter room. In either case, of course, the camera control units provide excellent preview pictures, so that a special preview monitor is not an absolute necessity in this layout. Power supplies, for the line monitor and film camera control monitor are mounted in the control room equipment racks.

When the two field cameras are used outside the studio to make remote pickups, the two field camera control units, the three field type power supplies and the field switcher are removed from the control room and taken along with the field cameras and a field type sync generator. These units can be readily removed and replaced without disturbing other equipment in the control room.

During field use of the cameras, there will be three possible sources of program signals: (1) Remotes picked up by the field camera and relayed by coaxial line to the control; (2) Film signals produced in the projection room; and (3) Signals coming in from an outside network. All

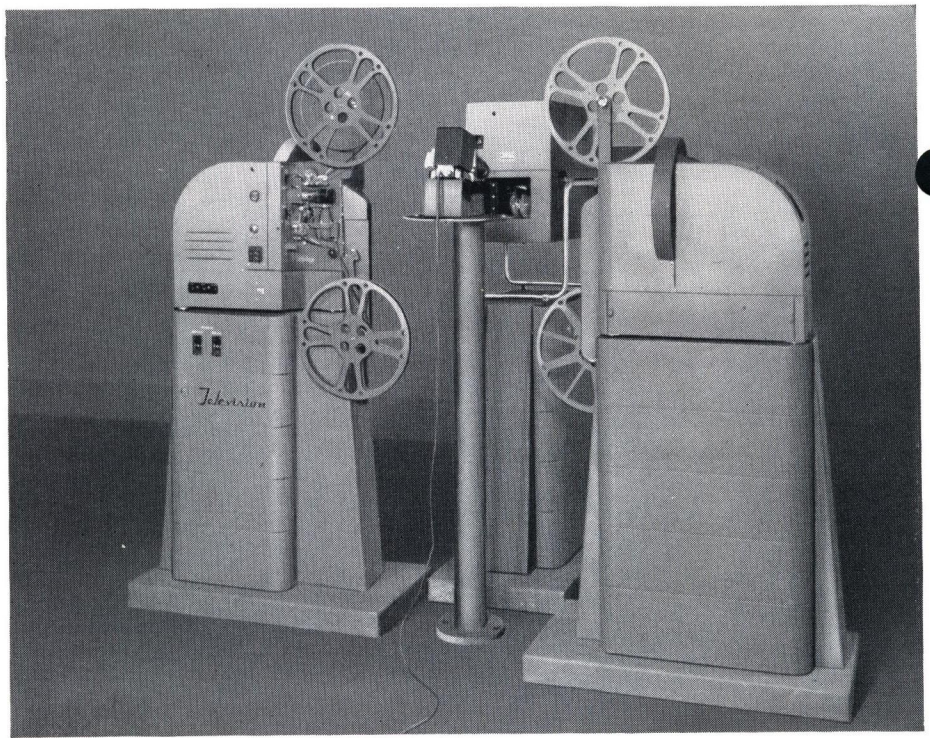
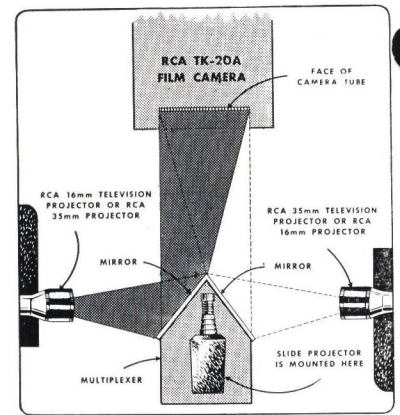
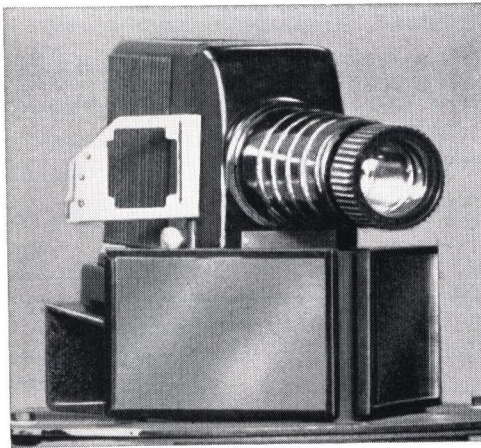


FIG. 14. (Above) Projection Room Setup Consisting of Two TP-16A 16mm Film Projectors, TP-9A Multiplexer (center) and TK-20A Film Camera (rear). Multiplexer operation is illustrated in diagram below. The TP-9A Multiplexer consists of two mirrors and provision for mounting a slide projector. Images from the slide projector, or from either film projector, focus directly into the film camera.



these signals are fed to the rack-mounted switching panel in the control room, from which the program director can select the program signal and route it to the transmitter room. Any one of these signals can be viewed on the monitor, before it is switched to the transmitter line.

Projection Room Equipment

The film projection room equipment for this typical small station consists of a single 16mm film projector, a film camera for translating the projected picture into a video signal, a rack-mounted picture monitor, and a film multiplexer. The film multiplexer has two mirrors mounted at the re-

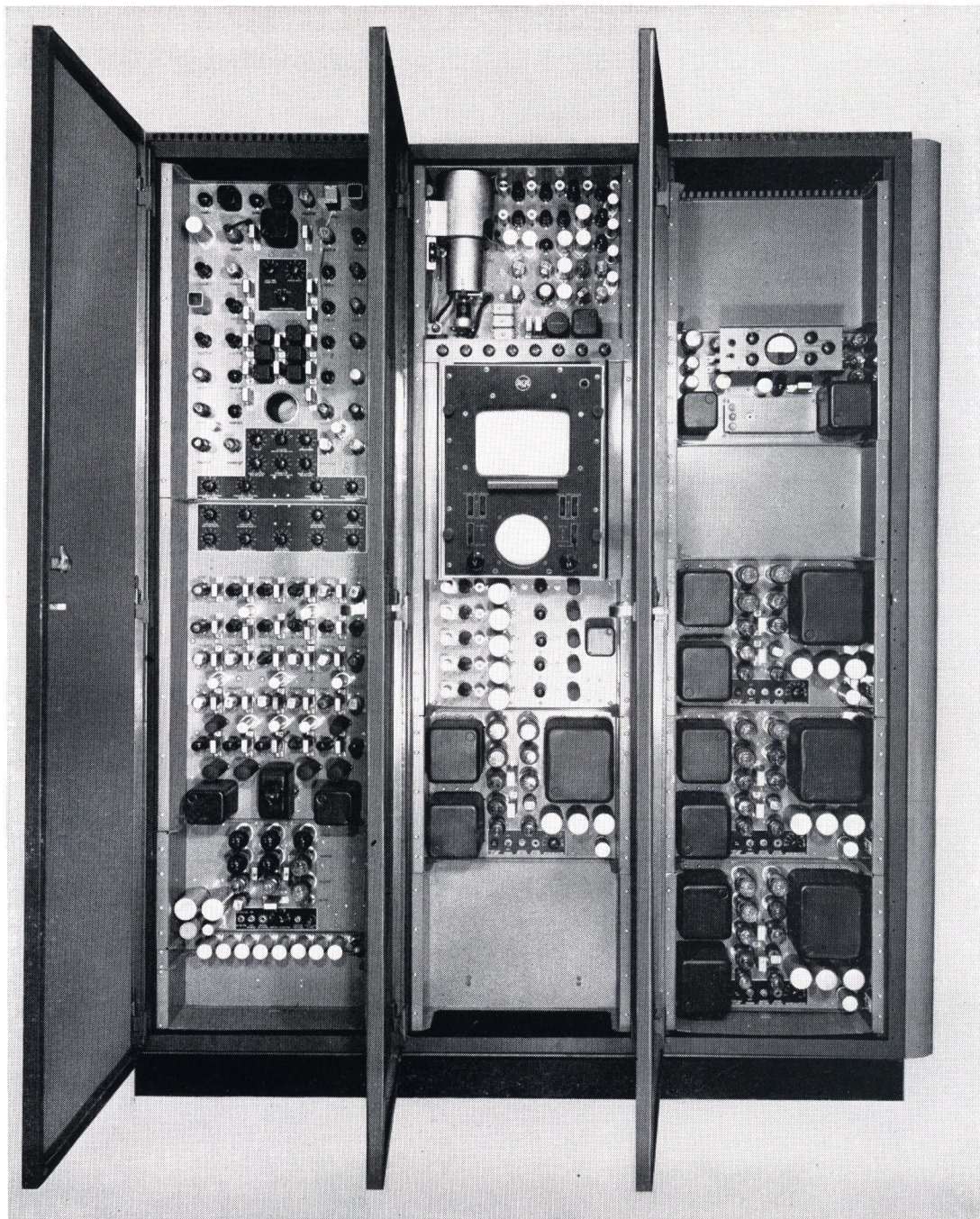
quired angle for projecting the images from either one of two projectors on the pickup tube in a single film camera. Use of the multiplexer is suggested in this layout because it is also fitted with a slide projector which can be used for station identification or for projecting other stills.

Technical Aspects

A functional block diagram of the equipment required by plan A of the small station is shown in Fig. 13. This diagram also shows the schematic arrangement of the various units.

Direction of signal flow between the units is indicated by the arrow-headed lines. Signals brought in through the net-

FIG. 15. The synchronizing generator, power supplies, amplifiers, and in some cases, video monitors are rack-mounted items. The three-section rack shown here contains the TG-1A Studio Sync Generator (left section), TK-1A Monoscope Camera, TM-5A Master Monitor, TA-1A Distribution Amplifier (center section), TRR relay receiver control, three WP-33A Power Supplies (right section).



work line or remote pickup line are already mixed with sync. This is the usual condition, the sync being added at the remote source of programming. On the other hand, the video signals from the film camera and from the field cameras (when they are used in the studio) obtain sync from the RCA Type TG-1A Studio Sync Generator (also located in the control room).

The switching system is designed so that the Type TS-1A Switching Panel, a rack-mounted unit, is a master switching point for selection of the major program sources for the transmitter. This makes it possible for the station to use the TS-30A Field Switching System solely for studio re-

hearsals, during which time the TS-1A can be used for switching between network or film signals. Two identical outputs from the film camera feed video to the field switcher and to the distribution amplifier. Sync is added in each of these units. Therefore, when the field switcher is used along with the field cameras to make remote pickups, and the TS-1A panel is in use at the control room, the distribution amplifier will combine sync with the film camera signal. Of course, the Type TG-10A Field Sync Generator can be used as an auxiliary for emergency operation. Like the other field units, this generator is a portable suitcase-type unit. It is used during

outside pickups to supply driving signals to the field cameras and sync to their video outputs.

The Stabilizing Amplifier, through which the network programs pass, is a six-stage video amplifier with special keying and clipping stages. It removes low-frequency disturbances which may be present in the line, and enables the operator to match the sync and video levels of incoming signals to that of the signals generated by the local cameras.³

³ For an explanation of the operation of the Stabilizing Amplifier see "How To Use The Stabilizing Amplifier" by John H. Roe, BROADCAST NEWS No. 49, Page 34.

TYPE B LAYOUT FOR A STATION SIMILAR TO TYPE A, MODIFIED TO PROVIDE ADDITIONAL PROGRAM FACILITIES

Plan B for the small television station differs from Plan A principally in the technical facilities available for programming. This plan requires slightly more control room equipment and therefore is not quite as economical from an initial investment standpoint. The additional equipment, however, requires no greater floor space than for Plan A, and the added facilities provided permit more flexible programming.

In Plan B, the program director can do more than simply switch from one signal to another. He can fade one camera out, fade the other in, mix the two camera signals in a lap-dissolve, or hold them superimposed. This unique feature, a means for very effective programming, is made possible by the use of RCA's TS-10A Studio Camera Switching System, which supplants the field switcher used in Plan A. This camera switching system (Fig. 17) is described in detail in one of the RCA tele-

vision equipment brochures. It consists of a studio console section identical to the director's monitor section in Plan A. Like this section, it has a large-picture monitor mounted in the upper compartment, but in addition, a mixing amplifier chassis (which performs the technical process of dissolving signals) is mounted in the lower compartment.

In the Type B setup the program director can preview network and relay signals on the monitor directly in front of him before switching them into the transmitter room. There is a selector switch on the TS-10A panel which enables him to do this. Thus, the monitor in this setup can be both a "preview" and "line" monitor for the remote signals. Of course, the monitor in the film camera control section of the console serves for previewing the film signal, and the field camera controls provide preview of the studio cameras, so

that this signal, if desired, is visible to the program director at all times.

The photo, Fig. 16, shows the equipment arranged in the control room. As can be seen, this layout is similar to that for Plan A. Actually it requires somewhat less space than Plan A because the field switching system is not needed in the control room, and the more elaborate TS-10A Switching System occupies space already available in the program director's preview section of the console.

As in Plan A, film facilities are furnished by a film camera, a 16mm projector and a slide projector located in the projection room. The film camera control is a console section similar to the studio camera controls, and is located with them in the control room. The projectionist utilizes a 10-inch picture monitor for cueing and for changeover. This monitor can

FIG. 16. (Below) Control Room for the Type B Small Station. This equipment layout utilizes the Type TS-10A Camera switching and lap-dissolving system, designed for studio control room use. Video units are identified in the block diagram, opposite page.



be mounted in the rack which houses the projector control mechanism, if desired. The Multiplexer is a device which has provisions for mounting a slide projector, and two mirrors mounted at the required angle for reflecting the images from either of two film projectors on the pickup tube in the film camera. Thus, by the addition of another projector, this setup can be easily made to handle multi-reel film shows.

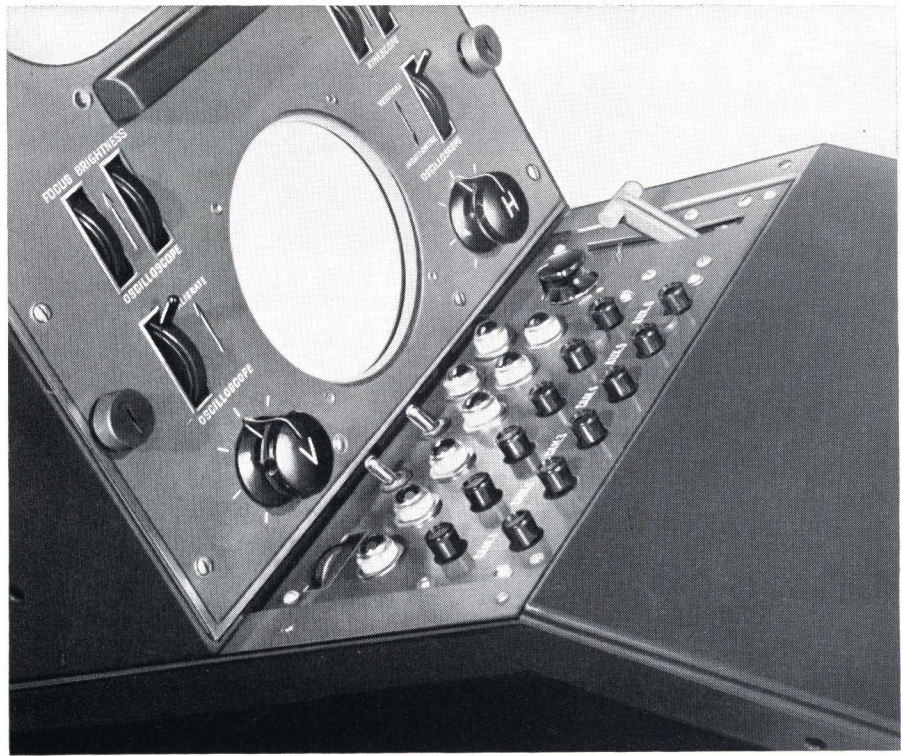
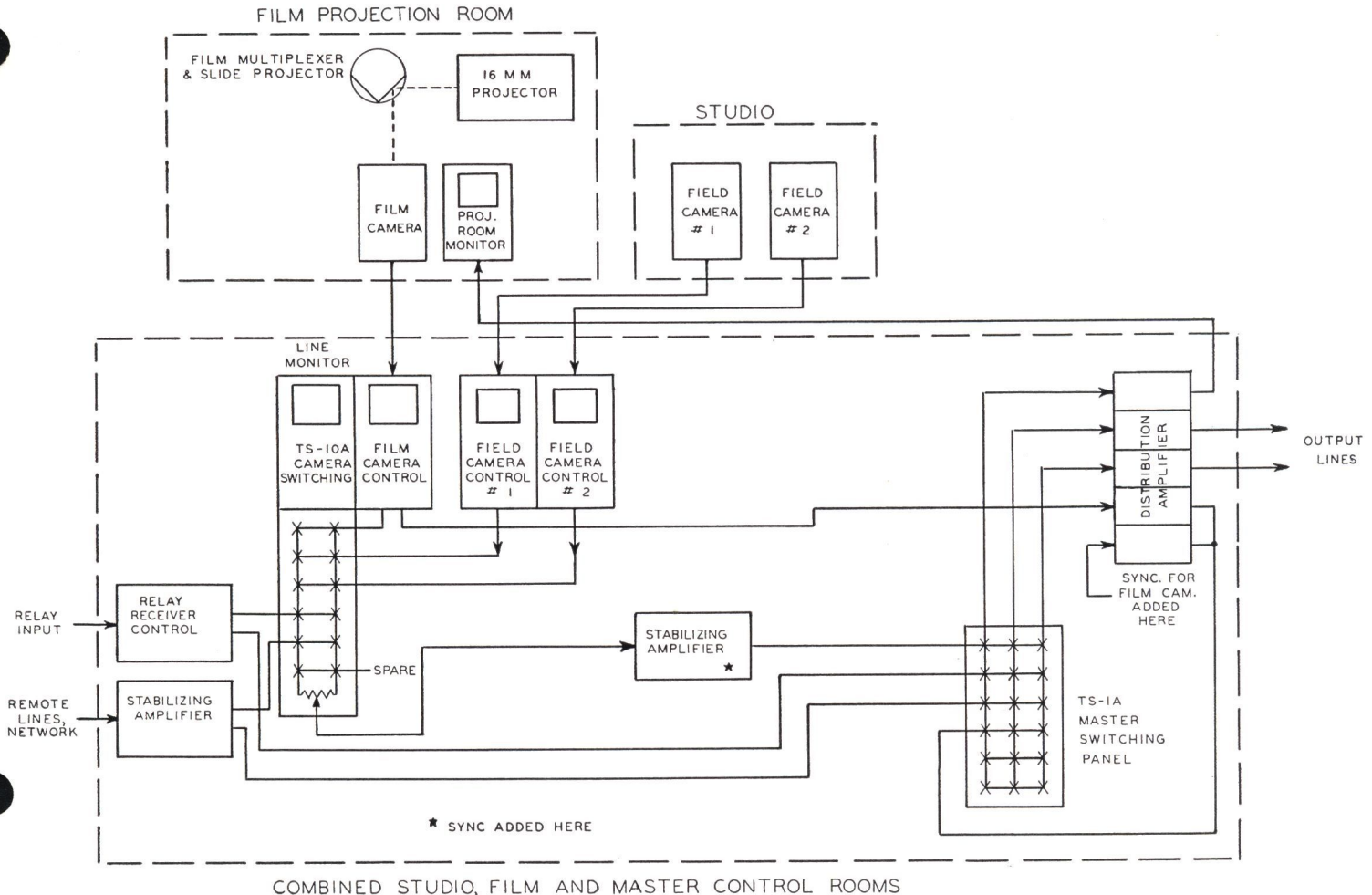


FIG. 17. (Above) Closeup of the TS-10A Switching System. With this system, the program director or the technical director can select the desired camera picture, or superimpose two pictures.

FIG. 18. Block Diagram of the major video items used in the Type B Small Station Layout. The TS-10A Camera Switching System is mounted in a section of the video console. The Master Switching Panel is rack-mounted.



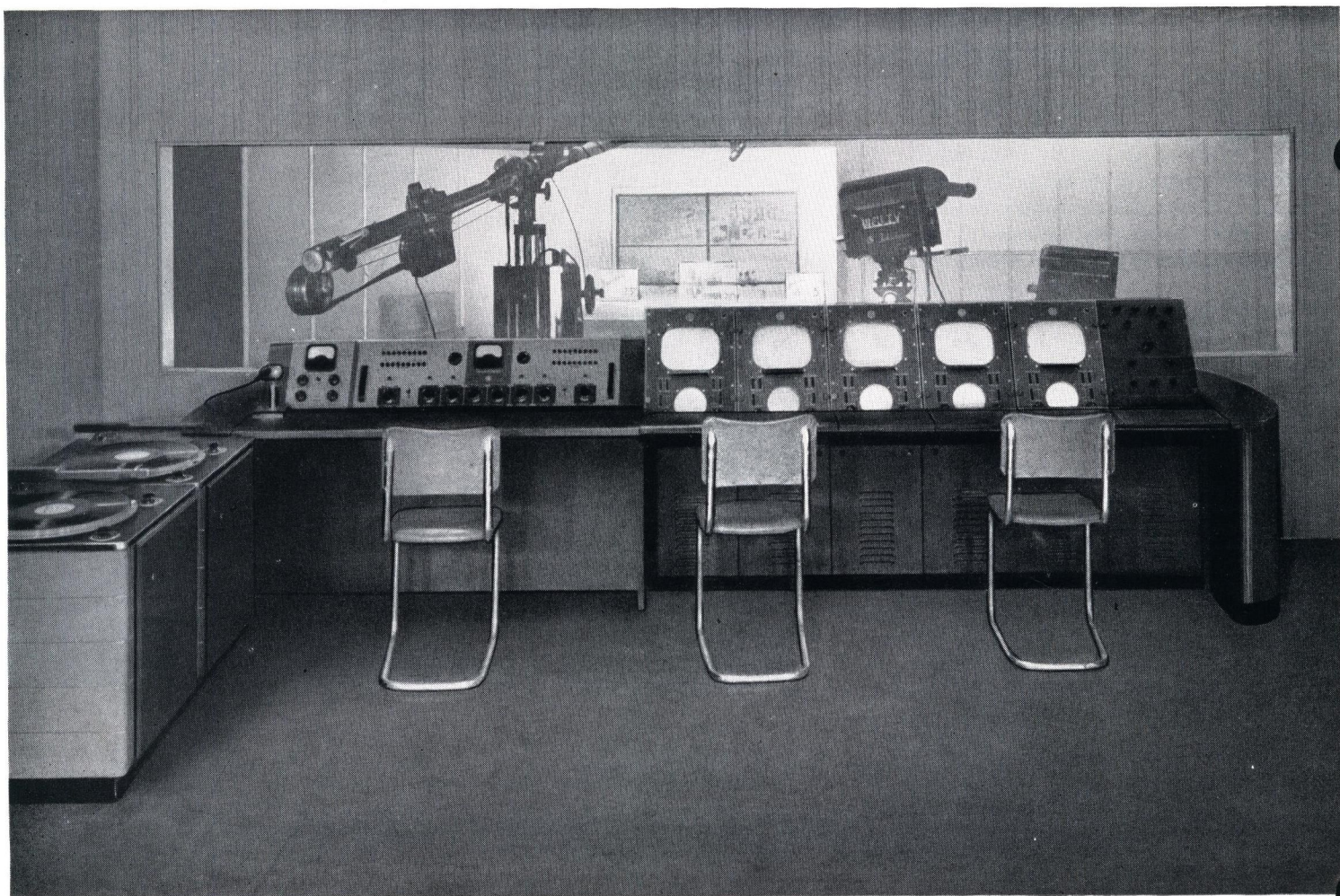


FIG. 19. Control Room of the "Standard" or Medium Size Type C Television Station. This station utilizes Studio-type Cameras and control room equipment. In this layout, field-type cameras and auxiliary control units are used for outdoor and remote pickups.

TYPE C LAYOUT FOR A STATION WITH INDEPENDENT FACILITIES FOR MAKING STUDIO AND FIELD PICKUPS

The Type C layout is suitable for the so-called "standard" or medium-size television station. In addition to field camera equipment, it includes studio type Image Orthicon Cameras in the studio, and standard RCA studio type control room equipment. Thus, studio programs can be put on even when the field equipment is at some remote location. It has other advantages over the small station layouts previously described, in that, (1) network shows, field pickups, and film shows can be run independently of the studio rehearsals and (2) studio and film productions can be combined with field pickups or other remote signals.

A typical floor plan for the Type C station is shown in Fig. 10. The layout includes a large live-talent studio, a projection room, a combined studio and projection control room, an announce booth, engineering workshop, and props and

dressing rooms. The studio has adequate floor space to accommodate all scenery, property, floor lights, microphone booms, camera dollies, etc. Since there is only one studio in this type station, sufficient space is provided for setting up more than one scene. With sets at either end, for instance, the cameras in the center of the studio can shoot either way. The announce booth is provided with a microphone and video monitor. The video monitor displays a program line picture so that the announcer can see the scene he is commenting on.

In this layout, a program director works directly with one audio and one video operator. The program director is seated at the console located in front of a window looking into the studio, from where he does all the switching, and directs the show through the intercom system. Seated on the director's right is a video operator whose duty it is to get a technically good

picture from each camera. The audio switching and control are done by the audio operator who sits to the left of the program director. Line amplifiers and power supplies for video and audio are located in equipment racks. These racks may be located in an adjoining room if desired. However, it is a distinct advantage to have them on the same floor level, to permit easy movement of video and test equipment between the areas.

Fig. 20 is a functional block diagram of the equipment used in the Type C layout. The combined studio, film and master control room has all the necessary monitoring facilities to monitor and cue the programs emanating from remote points or from both the projection room and the live-talent studio. It also has the switching facilities for routing any of these signals to the transmitter. Video control equipment consists of a TS-10A Switching System, two studio camera controls, one film camera

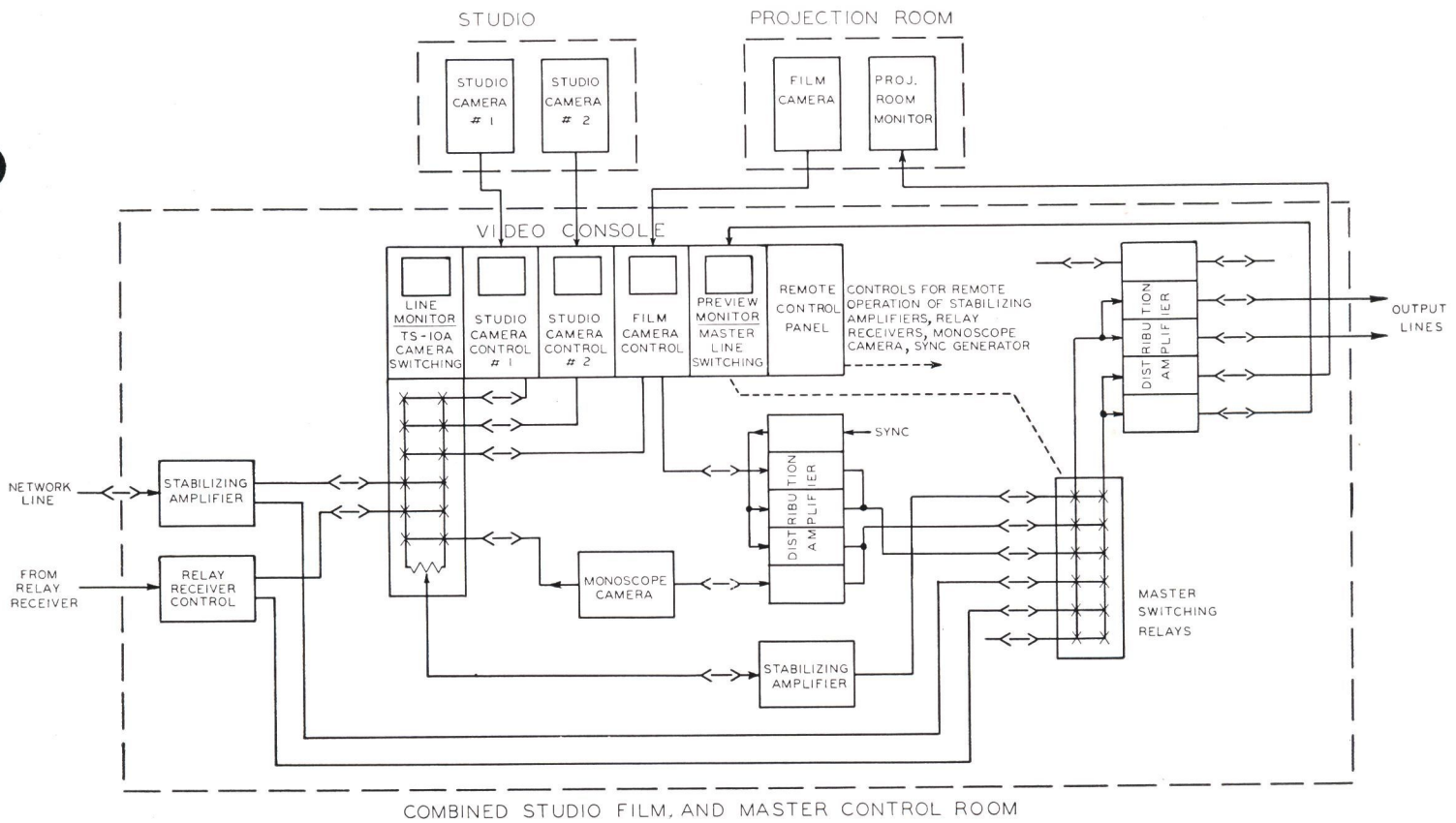
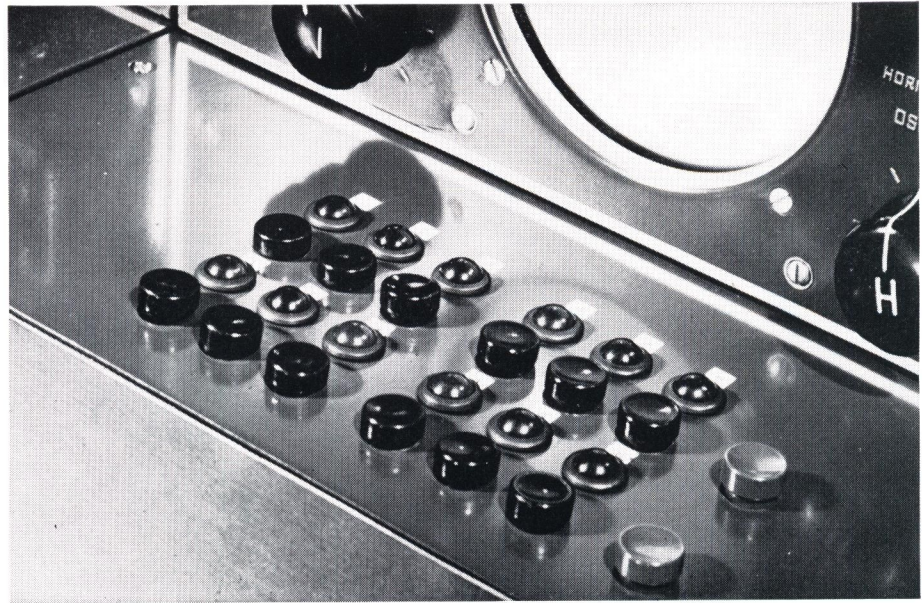


FIG. 20. Block Diagram of the Major Video Units Used in the Type C Station. Master switching in this layout is performed at the video console. Note use of video jacks for patching sources of signal into either the camera or master switching systems.

FIG. 21. (Right) Closeup of Master Switching Position. These pushbuttons, mounted in a console section, electrically operate relays rack-mounted in the control room.



control, a combined preview monitor and master switching section, and a remote control panel. The TS-10A Switching System serves for switching between the two studio cameras, film camera and remote incoming signals such as network or relay signals. The associated line monitor displays the signal going to master control. It also can be used to preview network and relay signals. The remote control panel is mounted in a console section at the right end of the video console. By means of the controls, the operator can make video and sync level adjustments on rack-mounted video amplifiers and sync insertion units.

Master Switching

The master switching panel is mounted on a sloping portion of the console desk top (see Fig. 21). It consists of a number of pushbuttons which electrically operate the rack-mounted master switching relays. It can accommodate six input lines

and two outgoing lines. One outgoing line is connected to the preview monitor which provides for preview of any of the six inputs. The other outgoing line is connected into the transmitter. The operator, from his position at the console, can preview upcoming signals from all sources on his preview monitor. He can also switch any

desired signal to the two outgoing lines. As can be seen by the block diagram, this layout employs a number of video jacks. These jacks, which are all rack-mounted on panels adjacent to each other, enable operators to patch in any signal either remote or local to either the camera switching system or the master switching system.

Elevated Platform Setup

Fig. 22 shows another possible arrangement for the equipment in the Type C control room. This arrangement requires another operator (technical director) at the video console. In this plan, the program director and audio operator are located on a platform (2 or 3 feet high) behind the console desk, where they can see all the video monitors as well as all studio action. The video operator is located at the console desk in front of the control room window, to the right of the technical director who has charge of all technical aspects of programming and who does all video switching.

In the platform arrangement, which actually can be used in any of the layouts described, it is important that the program director's desk be as close to the video console as possible to enable the director to look over the heads of the video operator and technical director. Therefore, the distance between platform and console should be kept to a minimum (2 feet, if possible). This, combined with the height of the program director's position gives him a view of the studio and the video monitors. Station layouts Types E and F described later, however, make use of the RCA Director's Console which provides both preview and line monitors in front of the director, and thus obviates the need for a platform arrangement.

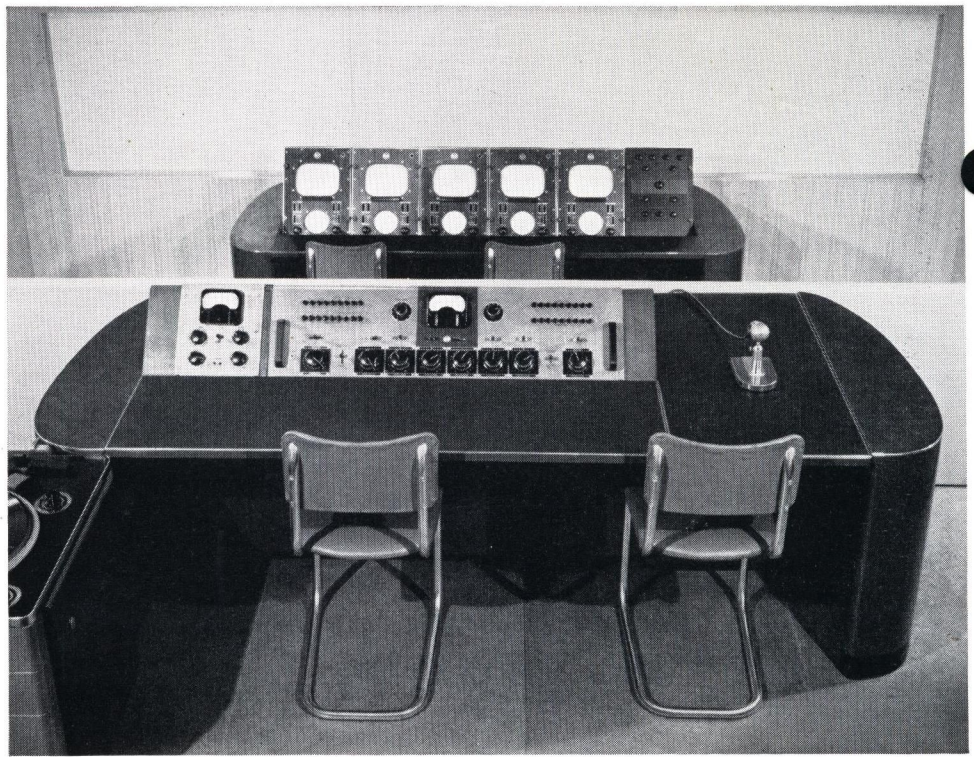


FIG. 22. Some broadcasters prefer to locate the program director and audio engineer on an elevated platform to provide them with a better view into the studio. Shown on the platform in this photo is the audio control console, plus a desk section providing space for the program director and his scripts.

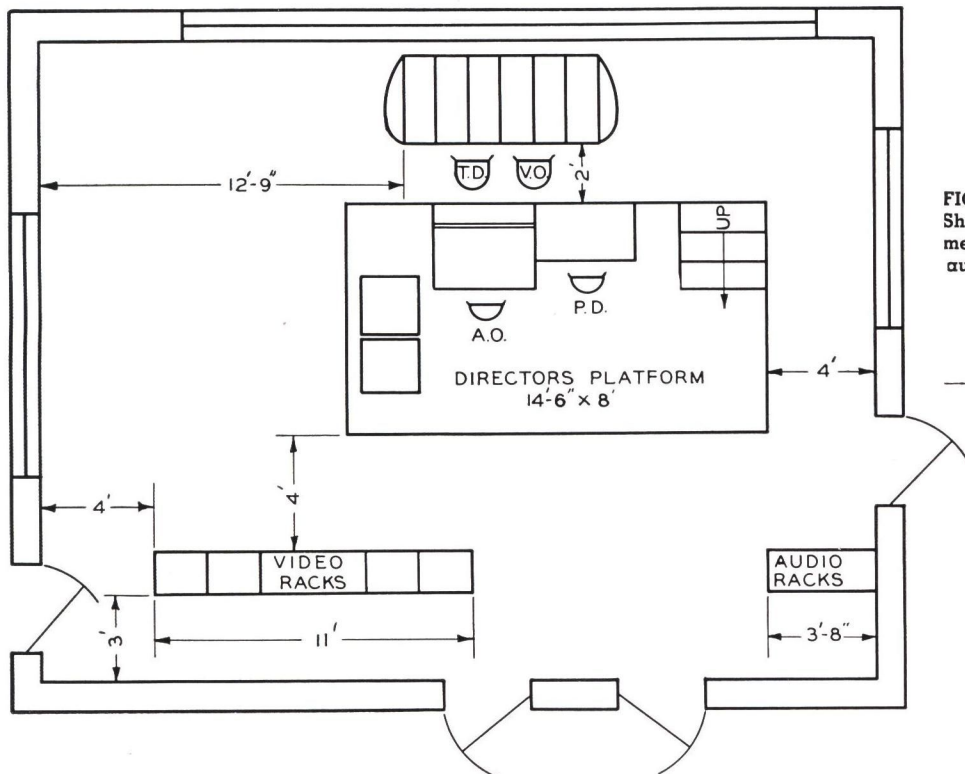


FIG. 23. Plan View of Type C Control Room Showing Program Director's Platform and Arrangement of Control Equipment. The racks contain audio and video amplifiers and power supplies.

A.O. - AUDIO OPERATOR
P.D. - PROGRAM DIRECTOR
T.D. - TECHNICAL DIRECTOR
V.O. - VIDEO OPERATOR

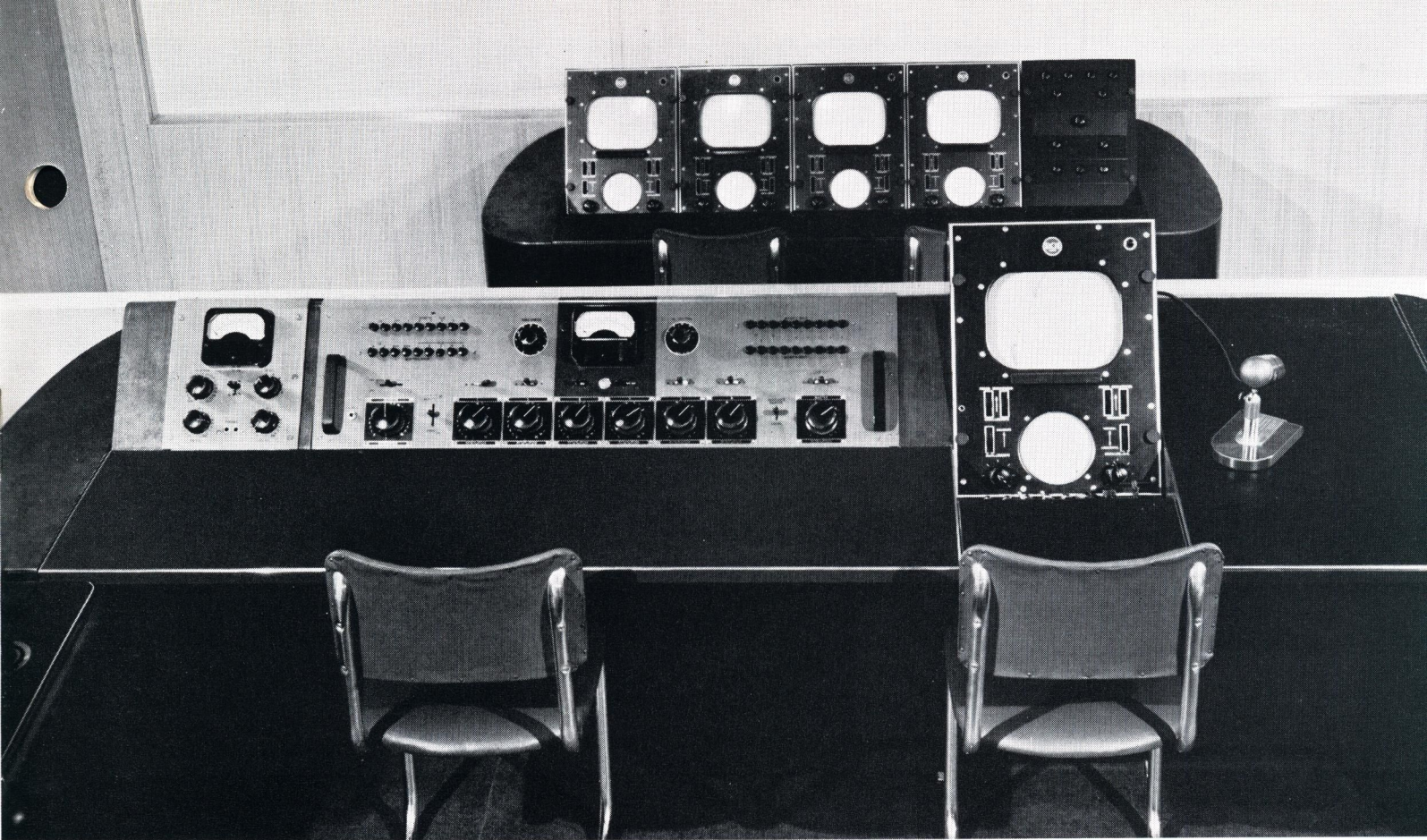
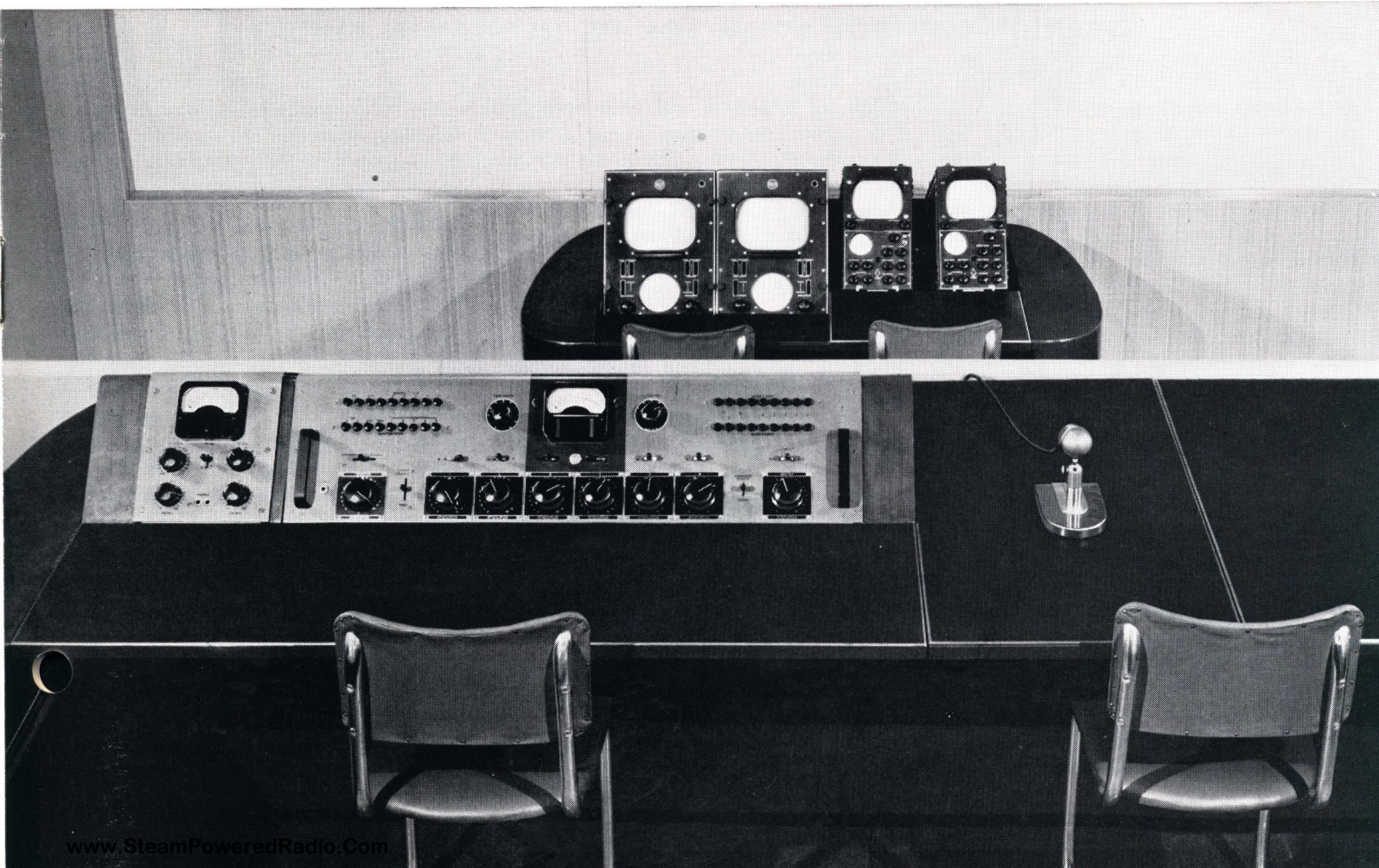


FIG. 24. To provide the director with closer supervision over video switching operations, the TS-10A Camera Switching System can be located on the platform with the audio console, as shown above. Platform setups are possible with any of the equipment layouts described. Photo below shows an arrangement for the Type B station previously described.



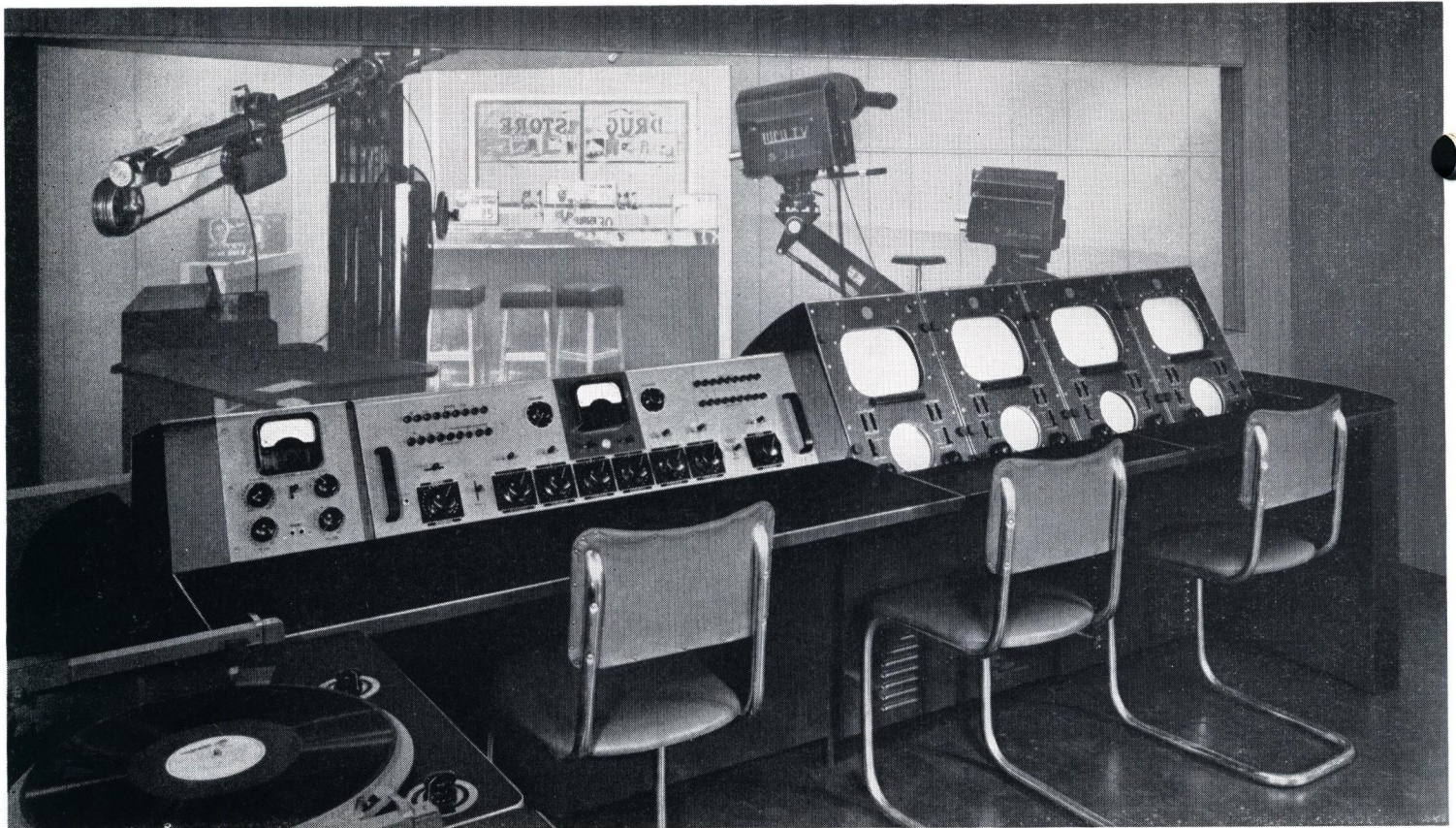


FIG. 25. Studio Control Room of Type D Layout. This layout has a separate control room for the live talent studio, which permits camera rehearsals while remote pickups, network or film shows are being broadcast through master control.

TYPE D LAYOUT FOR A STATION PROVIDED WITH A SEPARATE CONTROL ROOM FOR ITS LIVE-TALENT STUDIO

A further refinement in the design of the television station is the provision of a separate control room for the live-talent studio. This makes it possible for studio rehearsals to be conducted using the separate control room, while at the same time, broadcasts of network, relay or film programs are being handled in the combined master and film control room. Thus complete camera rehearsals of studio programs can be run without interrupting regular program output of the station.

The studio control room in this case employs a four-section video console comprising a TS-10A Camera Switching System, two studio camera controls and a preview monitor. The combined master and film control room consists of a five-section video console which employs a TS-10A Switching System (for switching and lap-dissolving between the two film cameras), two film camera controls, a transmitter line monitor, a preview monitor and a console section containing the master switching pushbutton and a control panel for remote control of the gain and other functions in

stabilizing amplifiers and relay receivers. The remote control panel is not a necessity, since the units which it controls are usually rack mounted in the control room. However, remote control of these units permits a single operator to make adjustments at the console while watching the picture on the adjacent preview monitor. Also, this system of remote control can be extended to include stopping and starting of film projectors, adjustment of monoscope cameras and shifting of sync generator phase, thus permitting many operations to be carried out from one point in the control room.

A typical arrangement of the equipment in the Type D studio control room is shown in the photo above. This control room is a complete unit capable of putting on live-talent shows, film shows, network programs, outdoor pickups, and slides. The flexible system of jack panels in the master control room enables any of these signals to be patched into, and thus be controlled from, either the studio control room or master control. Another feature, the

use of preview relays (controlled from a switching panel on the preview monitor desk) provides preview pictures of any one of these signals.

Using the studio and this control room, both production and technical aspects of the television program can be carried out. The photo shows positions for three operators: left to right, they are audio operator, program director and video operator. Here, the program director has charge of all camera switching which he can perform by use of the TS-10A switching system in the console section before him. The picture appearing on the monitor in this console section is that from the camera which he selects for program line. The picture appearing on the monitor in this console section is that from the camera which he selects for the program line. The video operator's duty is to keep each of the cameras at the proper contrast and brightness levels and in general maintain good picture quality. Preview pictures from each camera, of course, are viewed on the two

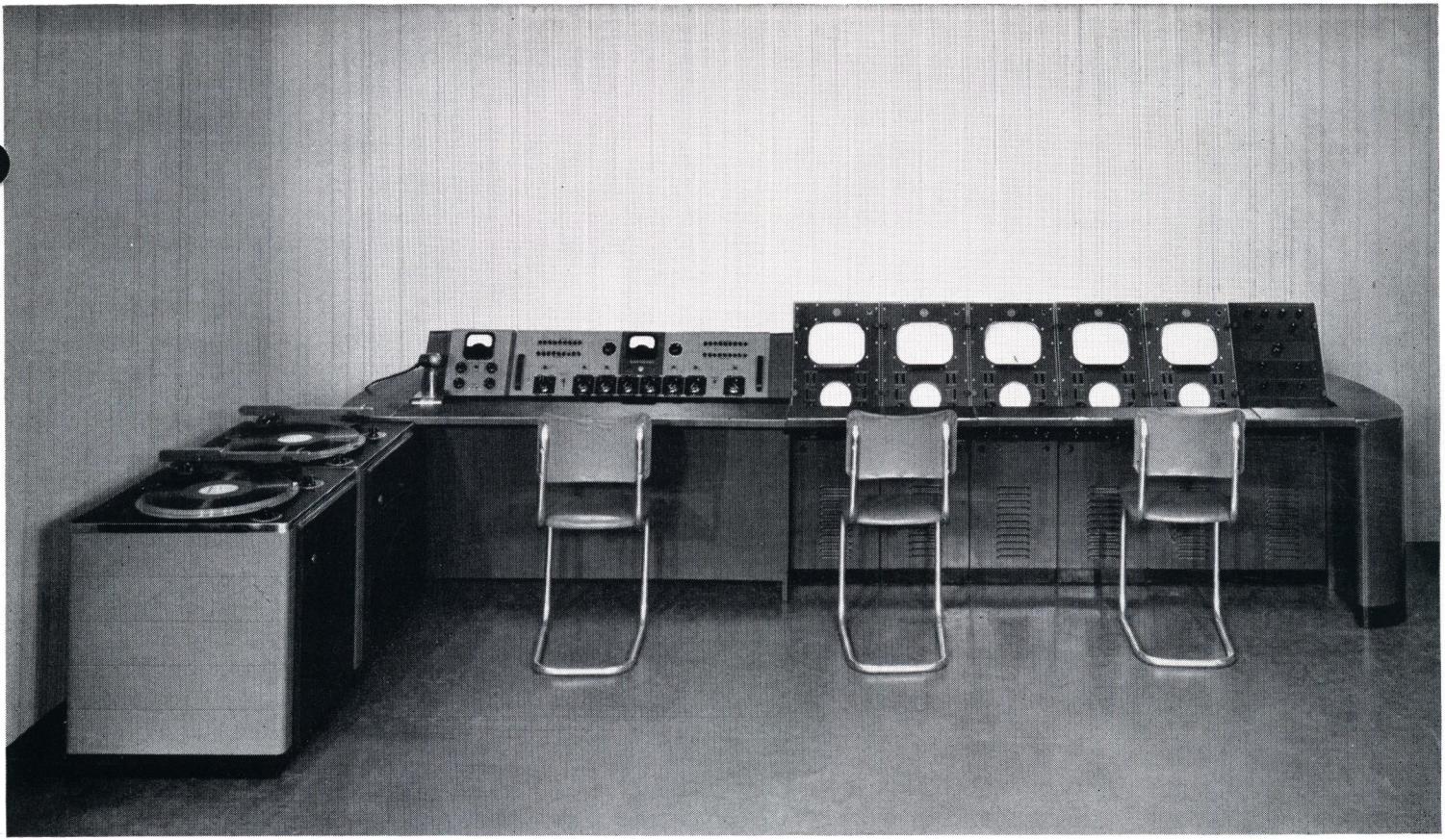
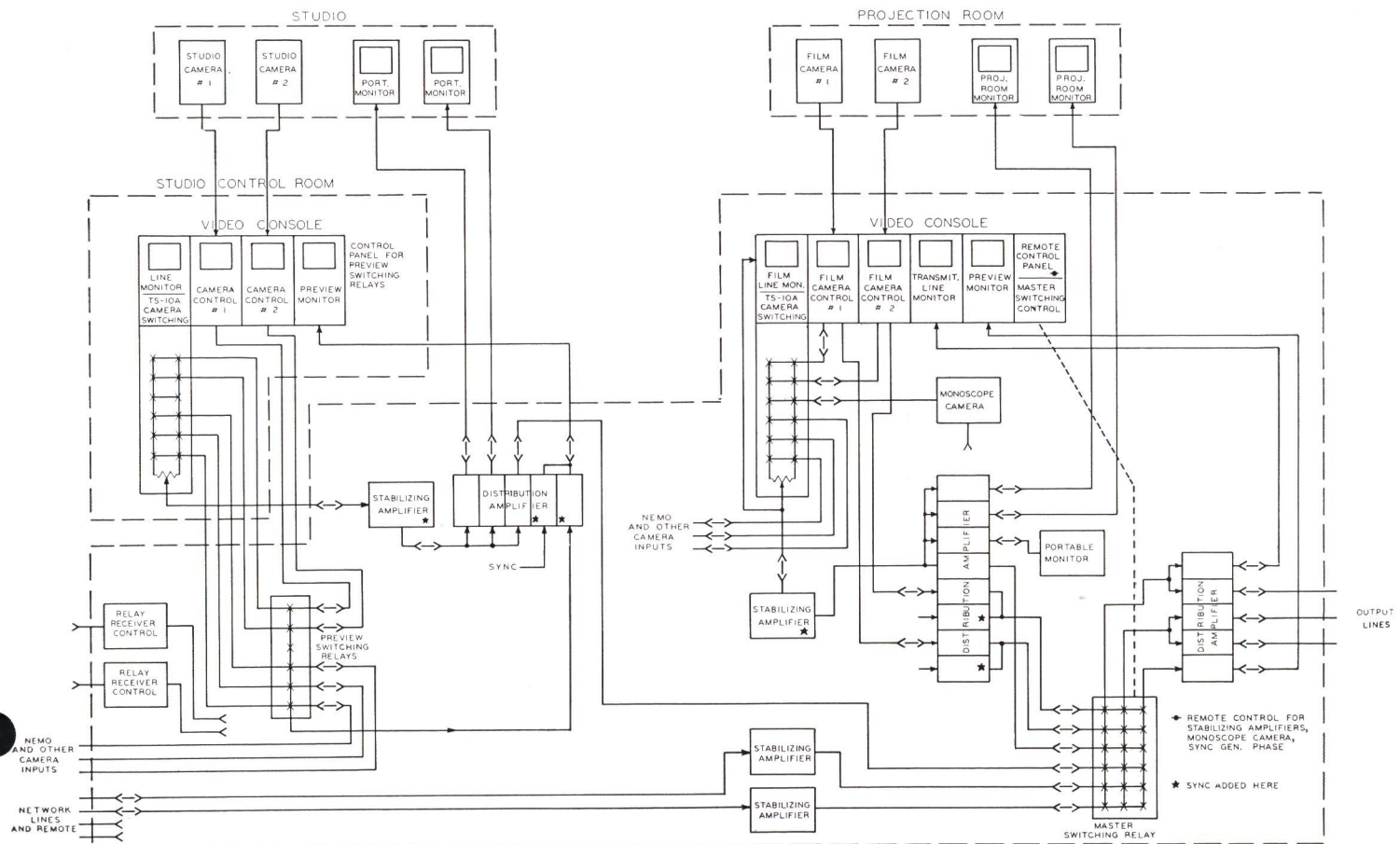


FIG. 26. (Above) Combined Film Control and Master Control Room of the Type D Station. Audio and video console handles output from film projection room, network lines and microwave relay. FIG. 27. (Below) Block Diagram of Video Units in Type D Layout. The video console in each control room contains a TS-10A Camera Switching System. Through a rack-mounted system of jacks, any source of signal can be fed to either control room for cue or insertion into the program.



COMBINED FILM AND MASTER CONTROL ROOM

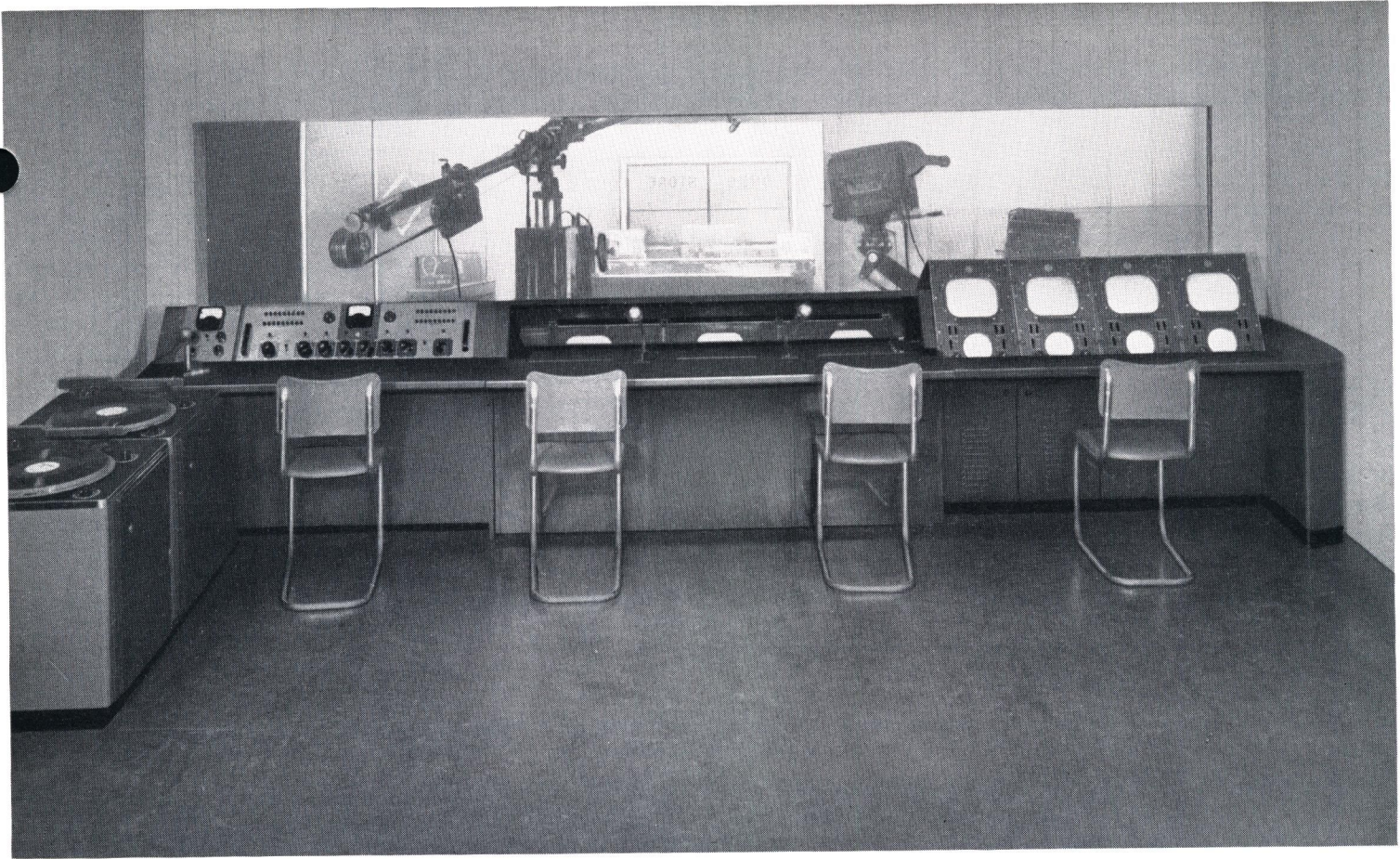


FIG. 29. Studio Control Room of the Type E Layout. This layout employs two control rooms, and features the utilitarian Program Director's Console (center), described in the text. Video Console at right displays pictures from each of three Studio Cameras plus picture on studio output line.

TYPE E LAYOUT FOR A STATION SIMILAR TO TYPE D, MODIFIED FOR FURTHER FLEXIBILITY IN ARRANGEMENT AND UTILITY

The fifth type of television station is the Type E arrangement. Like the Type D previously described, Type E employs one live-talent studio, a studio control room, a projection room and a combined master and film control room. It differs from the D layout in that an RCA Program Director's Console (center in photo above) replaces the TS-10A Camera Switching System in the video console. The director's console has a pushbutton switching panel which operates rack-mounted relays for camera switching. It also has large picture monitors which provide the director with preview and line pictures. Another difference in the layout is the use of three studio cameras instead of two: Space in the video console section previously occupied by the TS-10A Camera Switching System now houses the camera control chassis for the additional camera. As in layout D, a TS-10A Camera Switching System is used for switching between two film cameras and remote signals. A functional block diagram of the layout is shown above.

Use of electrically-operated relays for studio camera switching adds to the layout flexibility of the system, particularly as to the locations of the control rooms. This becomes even more important when more than one studio is provided. Delay compensation for the different studio runs is simpler when all camera switching is done at one central location.

Camera Relay System

The camera switching system used here is designated as the Type TS-20A Remote-Control Studio Switching Equipment. Basically it consists of the program console with its monitors, banks of momentary-contact pushbuttons and tally lights, and fader controls mounted on the console desk, plus associated rack-mounted equipment such as relay panels and fader and stabilizing amplifiers. As can be seen in the drawing, signals from all cameras including monoscope test cameras, network and relay sig-

nals, when patched into the relay system, can be switched to master control. These local signals can also be lap-dissolved and faded.

The Program Director's Console is another outstanding feature of this layout.

This console, which is illustrated in Fig. 30, is designed expressly for use by program and technical directors in supervising studio programs. The console is only 37 inches high (which provides full view of the studio). It can accommodate as many as five 10-inch monitors, which are recessed below the desk top to prevent direct light from striking the screens. These five monitors can provide the directors with preview pictures of all cameras if desired, plus pictures from a network signal and the program line. The photographs show the arbitrary use of three monitors in the console: a preview monitor which displays the picture produced by any one of the three cameras; a line monitor which displays the signal switched to master con-

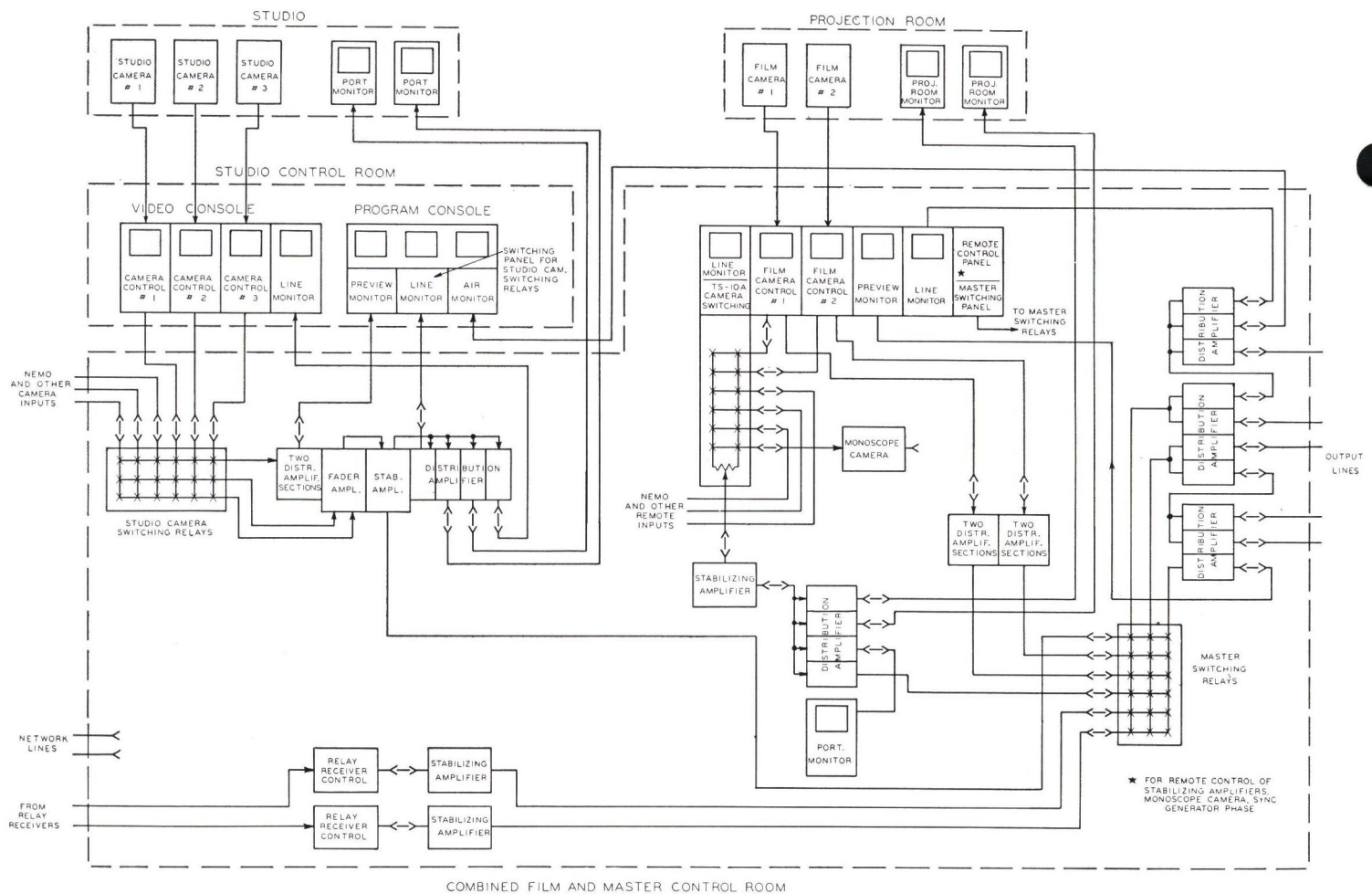


FIG. 31. Block Diagram of the Type E Layout. In this layout studio camera switching is performed at the program director's console. Pushbuttons mounted on the console operate relays rack-mounted in the control room.



FIG. 30. Type TC-5A Program Director's Console. This modern console provides the program director and technical director with pictures of the scenes being picked up by the individual cameras, from which the program signal can be selected.

trol; and an "air" monitor which shows the picture on the output line of the master control room.

The Director's Console is unique in that the program and technical directors have large bright pictures of the program directly before them and need not depend on their ability to see the monitors in the video operator's console, which may be located several feet away. In this setup, the technical director would ordinarily do the necessary switching at the request of the program director. Both directors can use the intercom and talkback system, built into the console, for communicating with production and technical personnel at the cameras and in the control room, projection room, dressing rooms, etc.

Use of a number of distribution amplifiers on the outgoing lines of the master switching system provides in this layout three independently switched output lines from master control. These output lines may be used to feed the transmitter room, clients' viewing rooms, and one or more networks lines.

TYPE F LAYOUT FOR A STATION UTILIZING TWO (OR MORE) LIVE-TALENT STUDIOS

Type F is a complete equipment layout for a "master" television station with facilities for the production and broadcasting of all types of television programs. It includes facilities for simultaneously originating and rebroadcasting different network shows. Such a station is usually provided with: (1) a film projection room with a projection control room; (2) two or more studios with individual control rooms, so that live-talent rehearsals can be carried out while studio programs are on the air; (3) facilities for picking up outdoor events; and (4) a master control room in which the desired program material can be selected from any of the above mentioned sources.

The Type F layout does not represent the ultimate as far as a station layout

is concerned; but it does illustrate the schematic arrangement of the equipment required for a station employing two studios and providing the facilities needed for the master type station. This layout is designed to furnish a high degree of flexibility in programming. Facilities are provided to handle live-talent shows, films, outdoor pickups and remotely originated shows, while rehearsals are in progress at the station. It consists of a large studio (Studio A) with its own control room; a smaller studio (Studio B) with its own control room; a projection room with its own control room; and a master control room. Each of the studios is a complete unit, capable of producing live-talent shows. Output from film control and from each of the studios, as well as signals from networks and remote pickups

are routed through master control where the signal to be fed to any one of the outgoing lines can be selected. The flexible system of jack panels permits remotes, film and other studio outputs to be switched at either of the studio control rooms as well as at master control.

Film Facilities

The projection room houses the film projectors, film cameras, and slide projectors. Three film cameras can accommodate as many as six projectors, using the Type TP-9A Multiplexer, a mirror device previously described. However, as suggested in the drawing, a more utilitarian arrangement might be to set up one film camera which will handle slides exclusively, and provide four film projectors (two 16mm

FIG. 32. One of the Studio Control Rooms in the Type F Station. This type station employs two or more studios each with similarly equipped control rooms. Several other physical arrangements of the unit-built control equipment are possible.



and two 35mm) to be used with the other two film cameras. However, the Multiplexers can be obtained equipped with slide projectors so that it is possible to insert slides into any camera chain even though it has been set up with two motion picture projectors.

The switching system for the film camera control room is a relay switching system of the same general type used in the studio control rooms. The pushbuttons which operate the relays are mounted on

the desk section of the video console located in the film control room. The system is capable of switching and fading between any of the three film camera outputs. Jack panels located in master control also provide for patching in remote signals or signals from other cameras to this switching system. In addition to the above, the output of each film chain is connected to the master switching system through a distribution amplifier (where the sync signal is added). This makes it possible to put on film shows or preview a film in a

client's room without use of the camera switching system.

Remote Signals

Facilities are available for handling a number of remote signals by telephone company lines and by microwave relay. Stabilizing amplifiers are available on the same jack panels as the incoming signals so that they can be connected into the circuits. The stabilizing amplifiers are designed to set the proper synchronizing-to-picture ratio and to improve the quality of the synchronizing signal of incoming remotes. The stabilizing amplifier utilizes clamp circuits to remove hum, bounce, and other line disturbances.

The relay receivers and the stabilizing amplifiers are rack mounted in the master control room and their remote controls are brought to a console section for convenience in setting up and operating the equipment. Each of these pieces of equip-

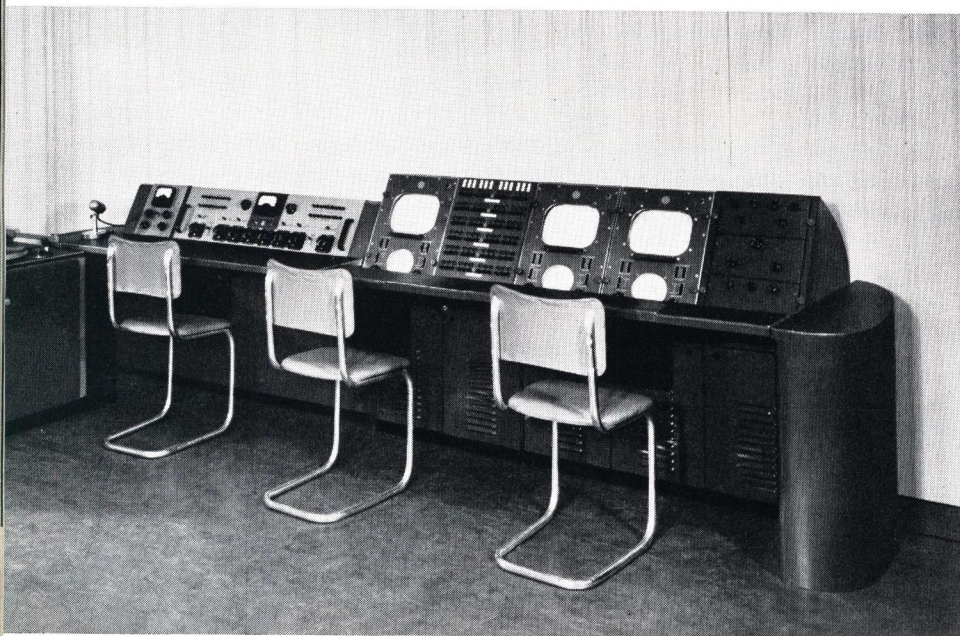
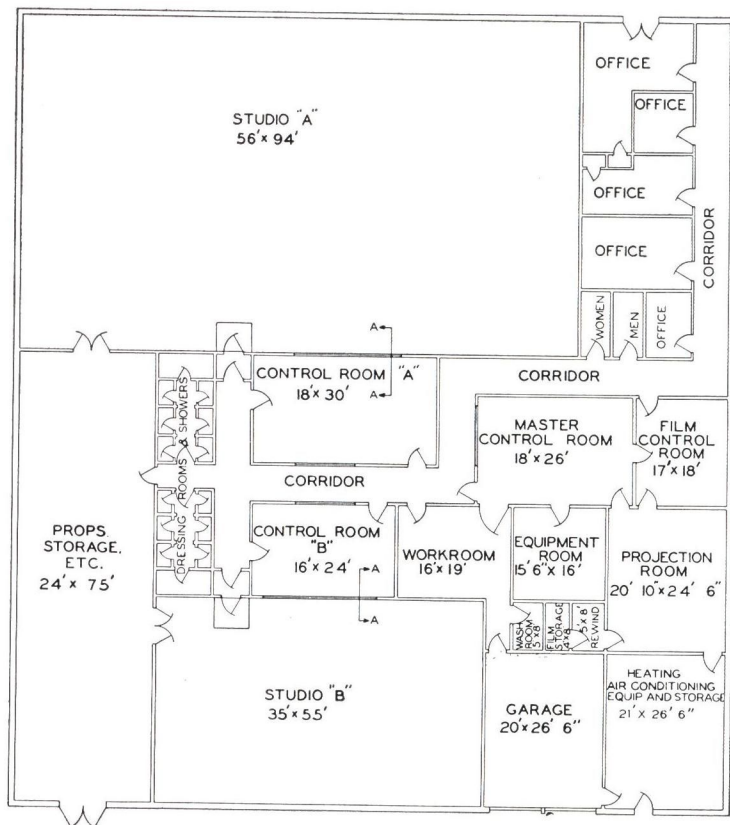
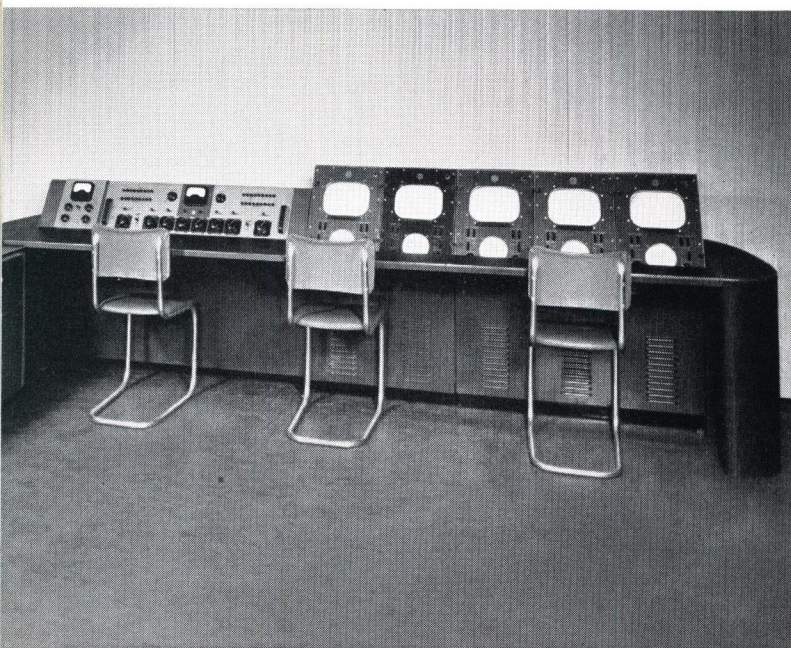


FIG. 33. The Type F "master" station employs separate control rooms for its studios, projection rooms and for master control functions. Above photo shows the master control console; below is the film control console. Diagram at right is a partial floor plan of the station.



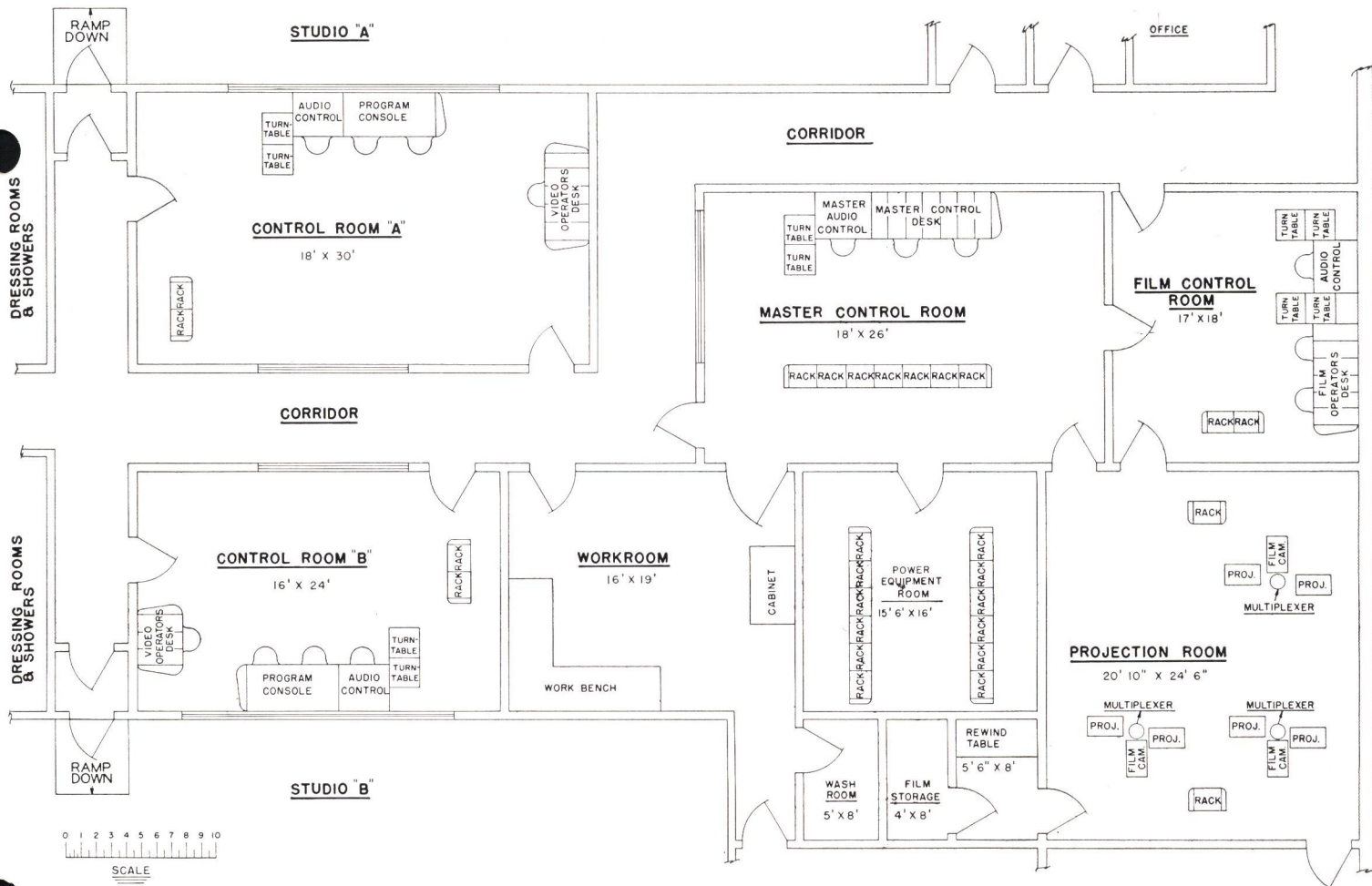


FIG. 34. Diagram showing Layout of Control Rooms and Arrangement of Equipment for the Type F Station.

ment has two outputs available at jack panels so that signals can be fed to the master switching system or to the studio camera switching system independently.

Master Control Room

All switching for the station (including studio camera switching) is accomplished by relays located in the master control room. Video signals, local and remote, are fed to jack panels where they can be connected into any part of the system. All camera signals are fed to a jackboard where they are normally connected through to the corresponding video switching relays. These relays are controlled from pushbuttons located in the various switching positions. Each studio control room has associated with it three banks of interlocked relays, two for the fader amplifier and one for the preview monitor.

The master control switching selects the desired composite signal for transmission. This system consists of six banks of twelve interlocked relays each, thus providing for six output circuits and up to twelve input circuits. Two of the output circuits are

fed to two preview monitors located in the master control console. The four remaining lines can be switched independently to any of the twelve incoming signals. This provides for four separate programs to be transmitted at one time. Each of the four outgoing program signals can be connected to distribution amplifiers to give additional outgoing lines to feed clients' rooms, viewing rooms, offices, studios, etc.

The master control console itself consists of five video console sections. Two of these contain the two preview monitors, one contains the on-the-air monitor, one the switching controls, and one contains the remote controls for stabilizing amplifiers, relay receivers, and sync generator phasing controls.

Two synchronizing generators (one a spare) are provided in the master control room with a switch to select the desired generator for use. This then feeds distribution amplifiers to distribute the blanking, driving, and synchronizing signals to the various parts of the system. In case

the differences in physical separation of the master control room and the individual studio control room is great, delay compensation can be inserted between the sync generator and the various distribution amplifiers.

This overall system is extremely flexible as it provides numerous combinations of camera facilities for programming and rehearsal. Cameras and remotes can be patched into any studio switching system so that the program director at his console in a studio control room can have complete control over the switching of any studio cameras, film cameras, or remotes that he may require to make up a given program. A complete film program can be run entirely by master control room when so required. In this way the facilities of an individual studio may be used for rehearsals while another studio or film is put on the air. One film chain may be used for a program while other film is previewed in a client's room without interference. Thus almost any combination of facilities may be used to suit the particular requirements that may arise.

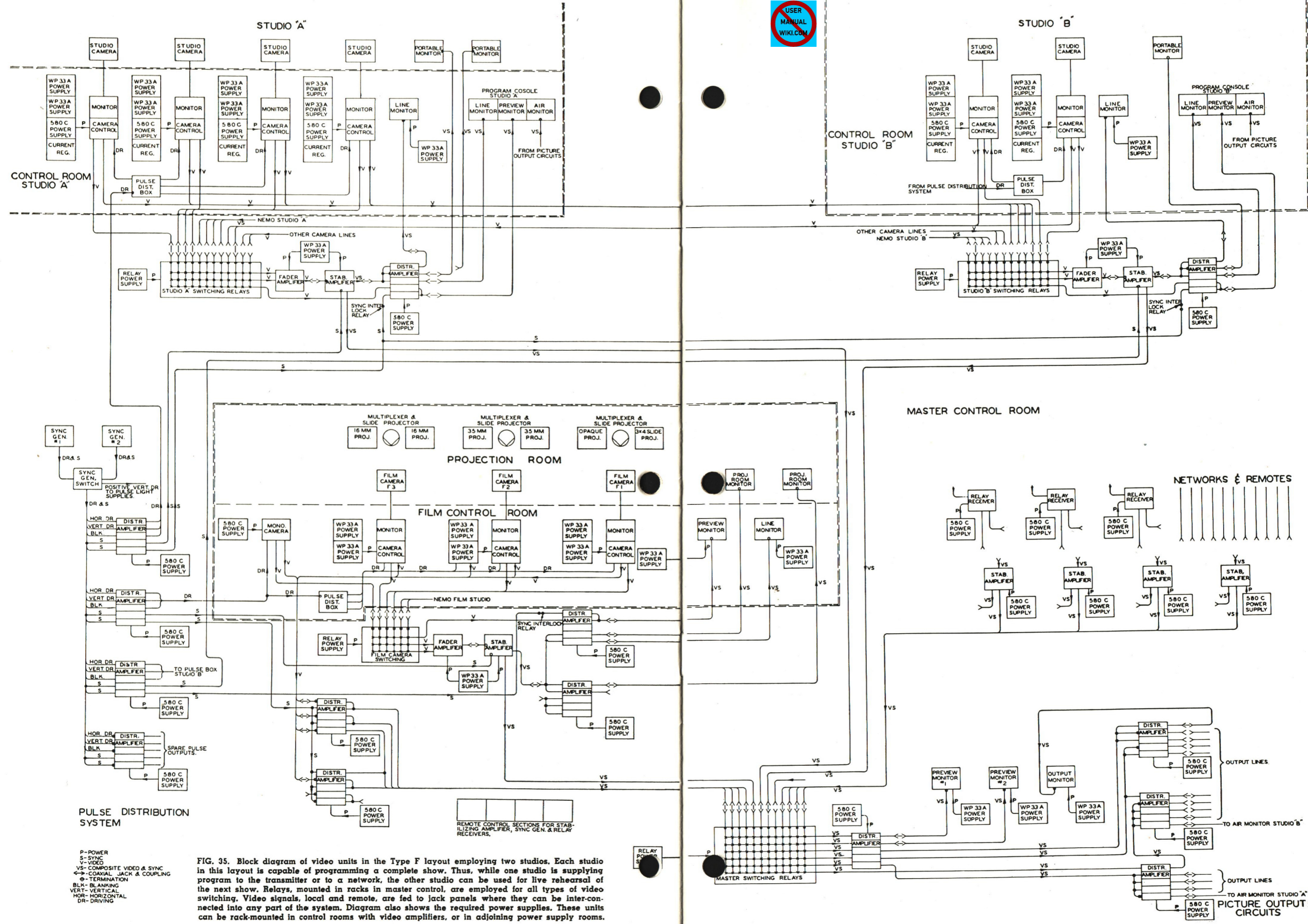


FIG. 35. Block diagram of video units in the Type F layout employing two studios. Each studio in this layout is capable of programming a complete show. Thus, while one studio is supplying program to the transmitter or to a network, the other studio can be used for live rehearsal of the next show. Relays, mounted in racks in master control, are employed for all types of video switching. Video signals, local and remote, are fed to jack panels where they can be interconnected into any part of the system. Diagram also shows the required power supplies. These units can be rack-mounted in control rooms with video amplifiers, or in adjoining power supply rooms.

PULSE DISTRIBUTION SYSTEM

P-POWER
S-SYNC
V-VIDEO
VS-COMPOSITE VIDEO & SYNC
C-COAXIAL JACK & COUPLING
T-TERMINATION
BLK-BLANKING
VERT-VERTICAL
HOR-HORIZONTAL
DR-DRIVING

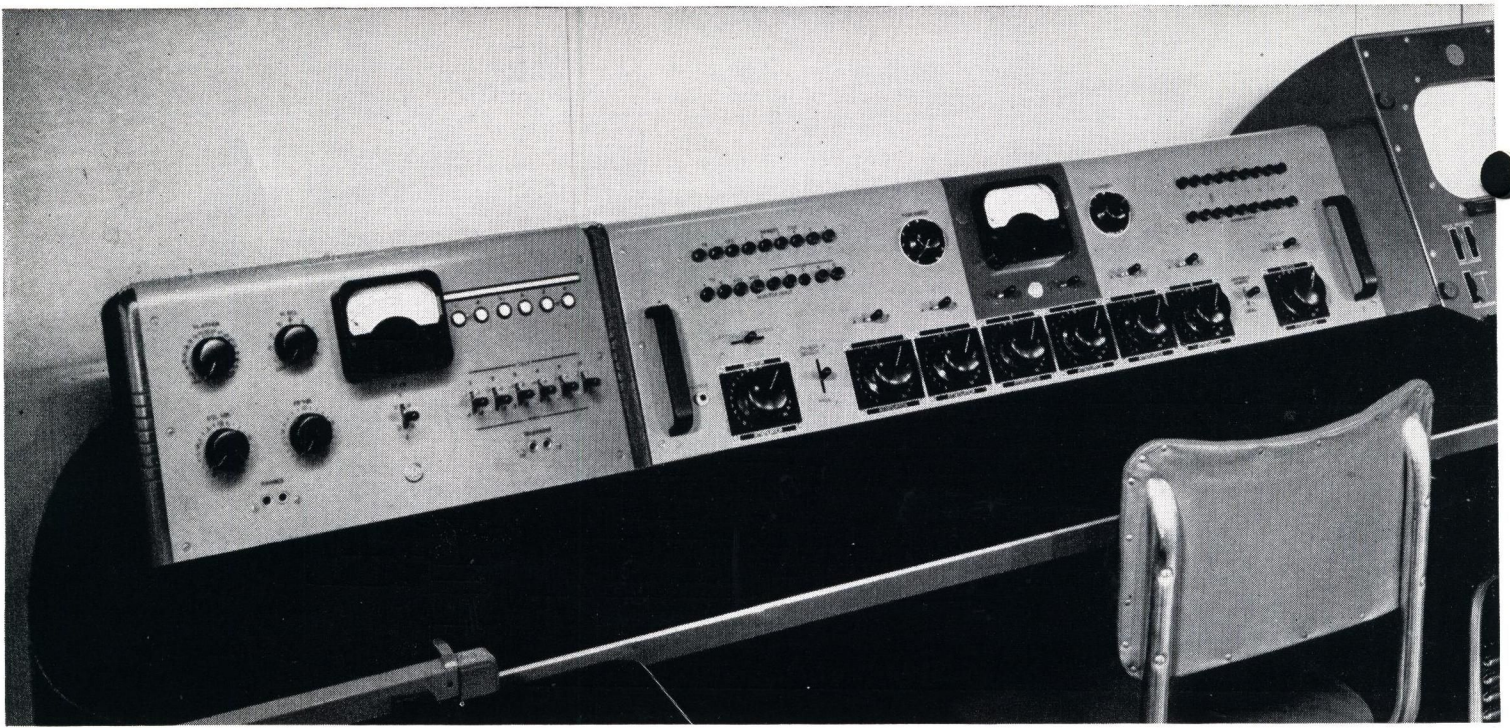
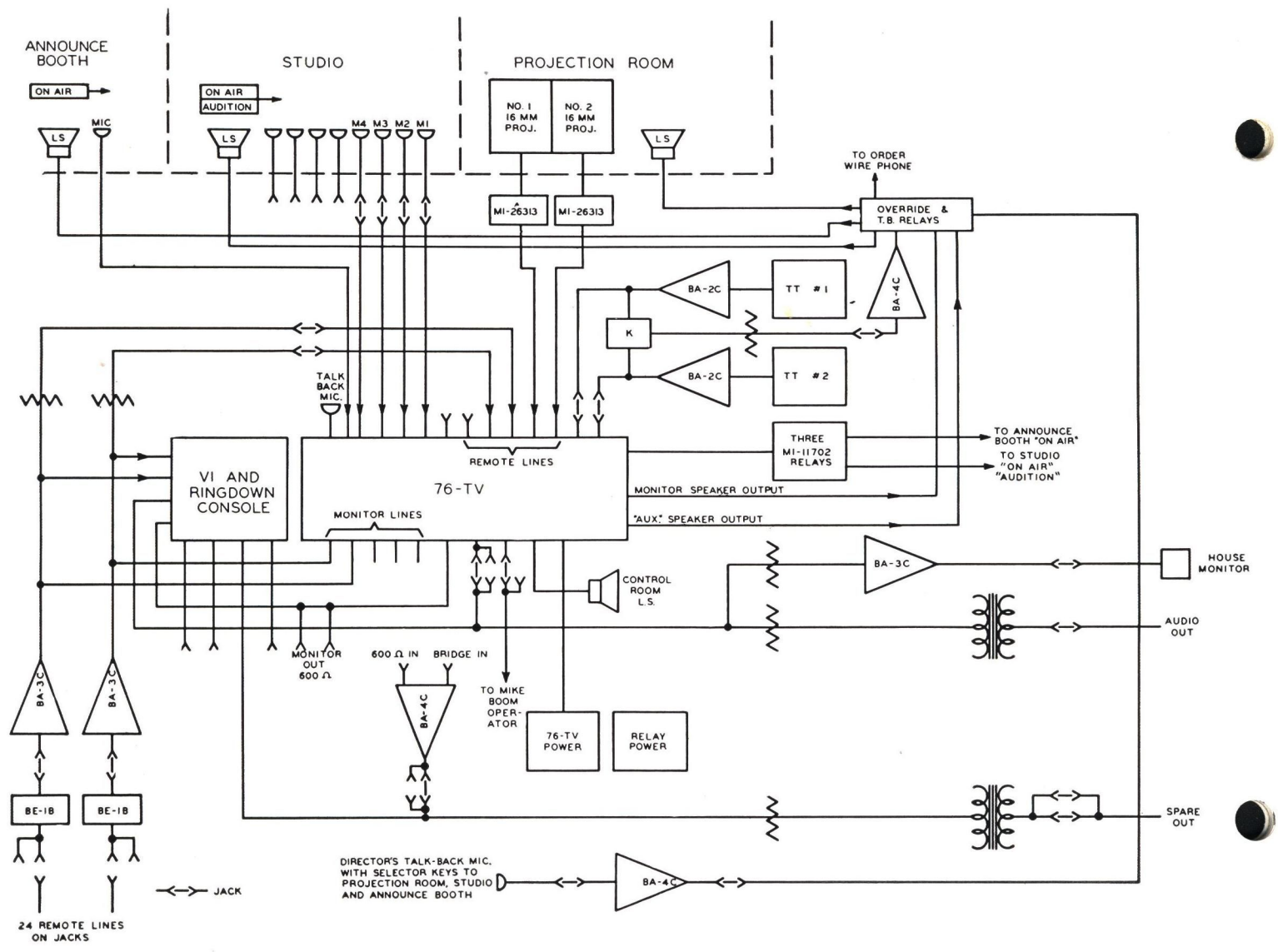


FIG. 36. The audio console above will handle the audio requirements for most television stations. Equipment shown is the Type BCS-3A Auxiliary Switching Unit (smaller unit at left) and the Type 76-TV Consolette. (Below) Block Diagram of the Audio Control Setup for a Television Station Employing a Single Studio, a Projection Room and Control Room.



TELEVISION AUDIO AND COMMUNICATION FACILITIES

The audio facilities at a television studio are similar in most respects to those now in use at AM and FM stations. The principal differences are: (1) provision must be made for handling the sound channel of television film projectors; and (2) means must be provided for feeding transcription sound to loudspeakers in the studios for accompaniment of video performers, or for sound effects.

There are, however, basic differences in talkback and intercommunications requirements, these facilities for video being more elaborate than those used in AM and FM studios. In even the most modestly equipped TV station, the communication system at some time will be called upon to perform these functions: (1) *talkback* (override, carrying cue or orders to studio, projection room, and announce booth—a function of the audio facilities); (2) *Order-Wire* (telephone facilities to offices and to outside lines for communication with remote pickup locations); (3) *Intercom* (two separate channels to provide private and conference wire communications—one channel for production and one channel for technical personnel).

General Considerations

As mentioned at the beginning of this article, the audio engineer is responsible for placement of studio microphones and proper sound pickup. Present practice is to use as few microphones as possible, usually suspended on the ends of movable microphone boom stands. Throughout the show, the microphone boom operator, under the direction of the audio engineer, maintains the correct placement of the boom microphone. He moves it in and out, raising or lowering it as required to secure the best sound pickup. Moreover, the boom operator must keep the boom and microphone out of the view of the camera. Therefore, good communication must be maintained between the audio engineer and the boom operator. Also, the audio engineer should be located so that he has a good view of the outgoing line picture monitor.

Boom stands require the use of lightweight microphones. Moreover, the microphone is subject to considerable movement and, therefore, must be constructed so that it will not pick up wind noise or other noises when the boom is moved about. RCA types 77-D, 44-BX, 88-A, and KB-2C are used for studio pickup. The

77-D, 44-BX and the KB-2C have adjustments to attenuate low frequencies, which is an advantage since it removes some of the boominess present when the microphones are several feet from the source of sound.

Audio for A, B, and C Layouts

A typical TV setup for the types A, B, and C layouts described in this article consists of a single studio, an announce booth, a film projection room and a combined studio, film, and master control room. In addition to the studio and film programs, part of the station's program probably will be from a video network or remote pickups. Basic audio and communications requirements for these three layouts⁴ are then as follows:

Studio:

- (1) Four studio microphones with four additional microphone lines that can be patched to console input circuits.
- (2) Studio loudspeaker for turntable feed and talkback.
- (3) On-Air Signals.
- (4) Intercom and talkback from audio engineer to microphone boom operator.
- (5) Intercom and talkback from director to camera operators and video operator.

Film Projection Room:

- (1) Control for sound outputs of two film projectors.
- (2) Intercom and talkback from director to film projection room.

Control Room:

A. Mixer Facilities

- (1) Mix and switch four microphone lines.
- (2) Patching facilities for four additional microphones.
- (3) Mix audio outputs of two film projectors.
- (4) Mix and switch remote and network lines.
- (5) Mix and switch outputs of two turntables.

- B. Intercom and talkback enabling audio operator to talk to microphone boom operators.
- C. Intercom and talkback enabling program director to talk to video operator, camera operator and to film projection room.
- D. Feed turntables to studio loudspeaker for background purposes, or for accompaniment of vocalist and other similar purposes. (Possibility for the output of the turntable at the same time to be mixed as a part of the consolette program.)
- E. Studio equipment to feed loudspeakers in studio control room, studio, announce booth, and projection room. Studio control room equipment able to feed one regular and one spare program line.
- F. Program line to feed house monitors through an isolation amplifier.
- G. Program cue to camera and boom operators.
- H. Termination and equalization facilities provided for 24 remote broadcast and private lines. Ringdown equipment provided for magneto telephones. Equalization of telephone lines to 15 KC.
- I. Switching facilities in studio so that program from air monitor and other studios, etc., can be readily monitored.

Announce Booth:

Announce booth containing these audio items:

- (1) a microphone
- (2) a monitor loudspeaker.

The audio control equipment to provide the facilities just outlined consists of the Type 76-TV Consolette, plus a Type B CS-3A Auxiliary Unit and one equipment rack. These audio control facilities are illustrated in the photo and block diagram (Fig. 36).

The BCS-3A contains a VU meter, six ringdown relays and control keys for private line telephone facilities. With the BCS-3A, it is possible to feed turntable outputs to a loudspeaker for vocalist accompaniment, or for background purposes. The equipment rack contains the amplifiers, jacks, equalizers and power supplies.

⁴ Audio systems for types D, E, and F stations will be described in a forthcoming article devoted to TV audio facilities.

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