

Mobile Television Units

The "Mobile Equipment and Systems" heading in the Society's Bibliography of Papers on Television spans thirty years of Journal publication. Beginning with "Television Pickup of Pasadena Rose Tournament Parade" by H. R. Lubcke in the September 1940 Journal a dozen papers were published before "CBS Mobile Color Broadcasting Facilities for 1968 Political Conventions" by Benkowsky, Cohn, Horowitz and Rocco appeared in the July 1969 Journal. The lapse in covering this subject between 1969 and now has been no fault of authors. It is hoped that amends are made with editorial resources now applied to make the following group of papers.—Ed.

Color Television Mobile Units

By ALLEN A. WALSH

New ultra-modern color mobile units designed and constructed by NBC and put into operation in 1966 were designed specifically for the expansion of NBC-TV's color programming, with emphasis on sports coverage. The primary units were three 40-ft trailers designated as the Equipment or Camera Trailer, the Control or Production Trailer and the Carryall Trailer. Technical operating facilities supplied with the three trailers consisted of five color cameras, a black-and-white insert camera, pulse-generating and distribution equipment, color videotape recorders capable of instant replay, a video-switching system accommodating 20 inputs, chroma key facilities and an audio system that accommodates 30 inputs.

A REVIEW OF THE television networks experience with mobile equipment shows that between 1948 and 1954, there was great activity in building monochrome units and a few isolated color units. A lapse of several years occurred before experience with some of the more spectacular events (e.g., political conventions and inaugural ceremonies) forceably brought the inadequacies of the existing equipment to the attention of programming and engineering managements. The majority of the early mobile units had minimum technical facilities. In almost every instance, once the equipment was installed and tested, it was painfully realized that there was barely enough room for technical personnel and none for program personnel and client representatives.

The "novelty" days of programming from the field are over. Today it is not uncommon to find field production requirements in excess of those of a studio. Besides demands for more cameras, there are demands for additional facilities to process camera signals, insert titles, intermix videotape for instant

replay, genlock to other remote locations, and various other features required for field production. Consideration of all these factors and the rapid expansion from monochrome to color operations dictated an entirely new concept of mobile unit design. New NBC mobile units have been designed and constructed to combine the highest standards of technical performance with adequate, comfortable, and esthetic working environments, and to minimize transport delays.

In September 1965, NBC put into service the first of a series of color mobile units designed to these specifications. In August 1966 a second series was put into service, and a third series was scheduled for delivery in August 1967.

Vehicles

An NBC color mobile complex is comprised of three air-ride 40-ft (12-m) tractor-driven trailers, designated A, B and C. A is the equipment unit, B is the control or production unit, and C is the carryall or cargo unit. The trailers were custom built and incorporated many special features, including a 2-in (50-mm) insulation on all walls and top, underfloor cable trenches, and recessed lighting and air-conditioning distribution. The A and B units are equipped with adequate ventilation, heating and cooling to provide comfortable interior conditions over a range of outside temperature from 10°F (-12°C) to 100°F (38°C). These vehicles comply with all legal and safety requirements in all states, and when equipped are loaded to approximately 75% axle capacity.

Two very important vehicle design features included in this complex are tractor drive and air suspension. Tractor drive offers greater reliability of transport than a self-powered vehicle, because a relatively simple engine breakdown or other mechanical failure of a self-powered vehicle may cause a delay

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(This paper was received on April 17, 1967, and has been abridged and somewhat revised in mid-1972, to bring it up to date in a few ways. *Edit. Note:* This paper's publication has been delayed by editorial circumstances outside the author's control.)

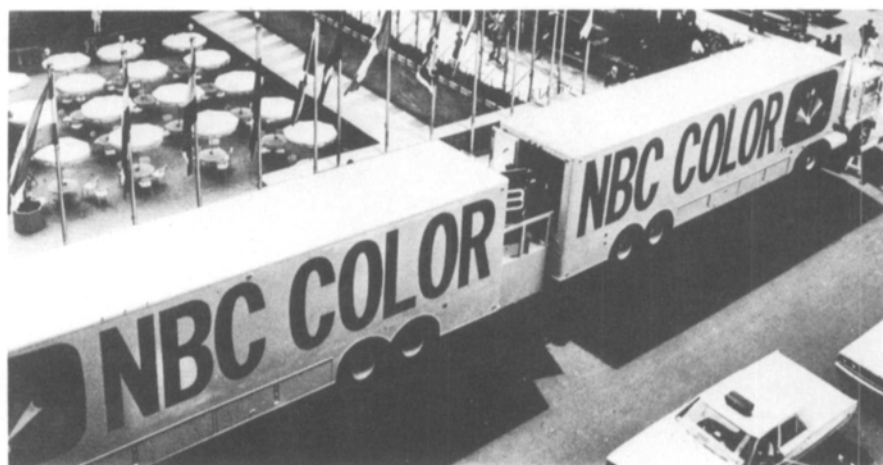


Fig. 1. Two units at Rockefeller Center.

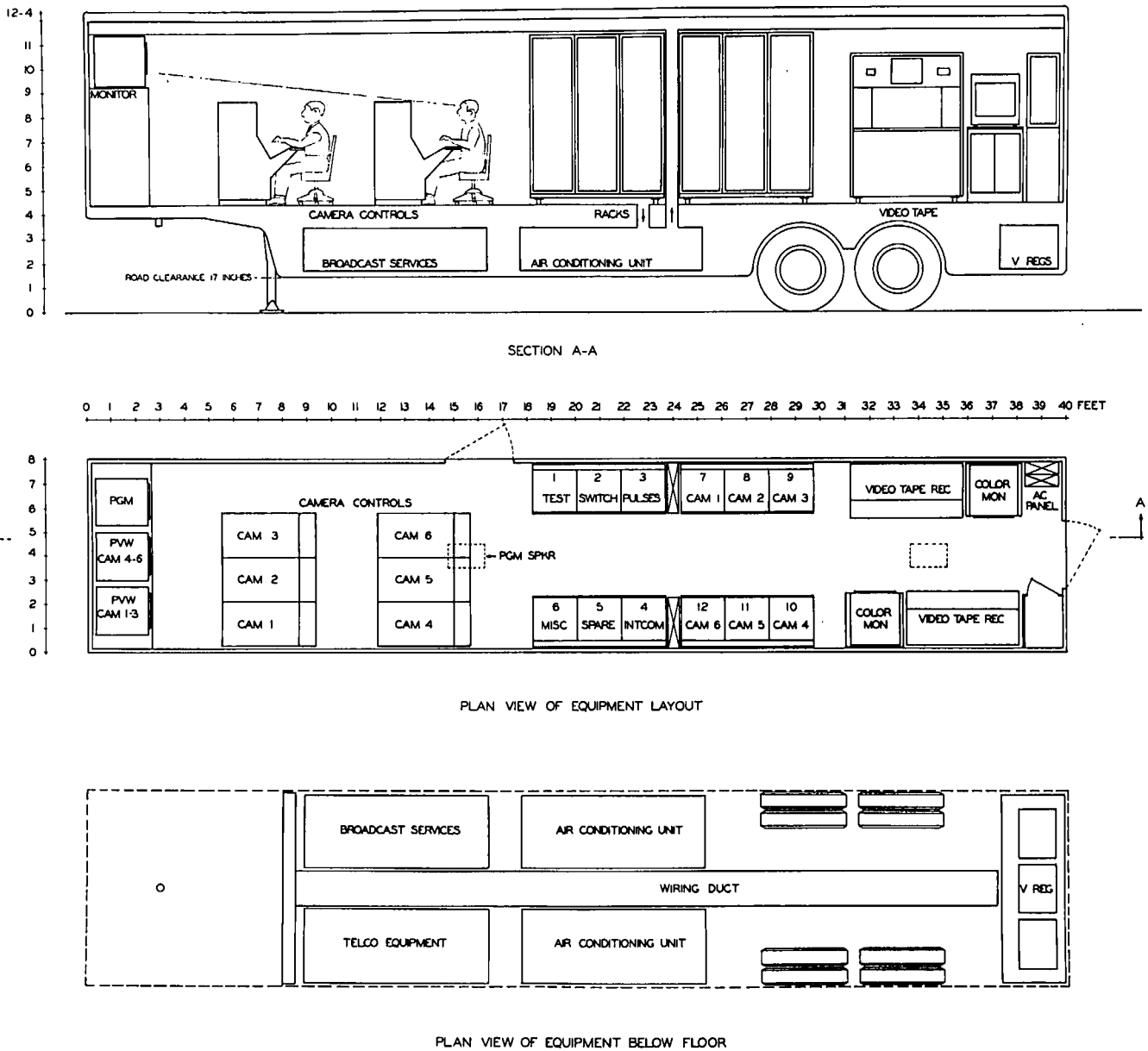


Fig. 2. The layout of the A or equipment unit.

of several days, whereas a faulty tractor can be replaced in any part of the country in two to three hours. The all too common problem of an overloaded self-powered vehicle can also be avoided.

Air suspension was selected in preference to conventional leaf springs because of higher efficiency isolation to road shock. By having the mass of the entire vehicle shock-mounted, the use of individual equipment mounts was unnecessary, saving valuable equipment mounting space as well as being more economical.

Power

Power required to operate the mobile complex may be either 208-V ac 3-phase 4-wire or 230 V ac single-phase 3-wire. The total current drain with all technical equipment and air-conditioners operating is 230-250 A per phase. The A unit is equipped with two 4-ton air-

conditioners and the B unit with two 2-ton units. These units represent a substantial part of the total power load and are operated on 230-V ac single-phase 3-wire power. The design of the power distribution system would have been less complicated and more efficient with a 3-phase 208-V ac 4-wire source; however, there are many areas, particularly in nonindustrial districts, where only 230-V single-phase 3-wire source is available. Voltage regulators are provided in the A and B units for technical equipment only. Other elements, such as air-conditioning units, general lighting and convenience outlets are supplied with unregulated power.

Telco Equipment

The A and B units have permanently installed telephone facilities with a number of private line extensions in each unit. This equipment was installed by

the telephone company in accordance with NBC specifications. Some advantages gained from this type of installation are that the instruments are always in the same location, the connections to external telco lines are made in an underfloor compartment (eliminating the disturbance and confusion caused by an installer fastening wires all over the inside of the vehicle) and the time required to establish telephone communications is reduced to a minimum, with a resultant economy in job setup time.

Camera or Equipment "A" Unit

The "A" unit (Fig. 2) has combined in one vehicle the functions of camera and video control, pulse generation and distribution, transmission, testing and videotaping. Starting at the front of the unit there are three color monitors used for camera balancing and program monitoring, six video consoles (five for TK41

three-image-orthicon color cameras, and the sixth for a monochrome insert camera) and a group of 12 equipment racks containing the equipment associated with the color cameras (pulse generation and distribution, video transmission, test equipment and the intercommunications system), as shown in Fig. 3. Further



Fig. 3. Looking toward the front of the A unit.

toward the rear are two color videotape recorders with monitoring and tape storage facilities, and at the extreme rear right is the power panel equipped with metering for line voltage and current and branch circuit distribution of a type similar to that employed in any central plant system. Opposite the power distribution panel is a coat closet. Air-conditioning controls are located on the wall about midpoint of the vehicle. In addition to the normal thermostat, these controls include switching for ventilation, heating or cooling, and, as a special precautionary measure, Magnehelic gauges installed in the supply ducts to indicate air velocity. Because the air-conditioning is a closed system, any obstruction in either the supply or the return ducts can be detected by a change in the indication of the Magnehelic gauge, thus preventing abnormal or damaging operation of the air conditioning units.

Cameras

The camera chains are basically the standard RCA TK41 image-orthicon color units, except for the repackaging of the console equipment into one 22-in (56-cm) console employing a 14-in (36-cm) monochrome camera monitor, a 529 CRO, and the addition of a "cable stretcher" to permit cameras to work with as much as 2000 ft (610 m) of cable.

A variable six-step 0-1.2 neutral density filter system was also added to each camera. The "cable stretcher" is a variable horizontal pulse-delay multivibrator which produces early pulses. The feeding of these early pulses to the camera will effectively cancel the increased total video path from control unit to camera and return. The variable neutral density filter system is used by the cameraman to compensate for changes in total ambient light level, such as those changes which occur during the progress of an afternoon football game.

Pulses

The pulse distribution system consists of two synchronizing generators with an emergency automatic changeover feature, two black burst generators, and individual isolated pulse feeds to each camera chain. The sync pulse is added to video in the colorplexer to obtain composite video output. In normal operation, sync generator #1 feeds the pulse distribution system supplying all cameras and a black burst generator. The horizontal and vertical outputs from sync generator #2 are terminated; blanking, burst flag, sync and subcarrier are fed to the second blank burst generator. This configuration of the #2 or standby sync generator feeding the second black burst generator provides a steady state composite video reference for sync generator #1 when operating in the genlock mode.

A typical example of this operation would be to assume that cameras are being fed from sync generator #1, which is genlocked to generator #2, until it is required to switch to a nonsynchronous video source. Before the technical director switches the program bus from the local camera to a nonsynchronous source, the input to sync generator #1 can be switched from black burst generator #3 to the incoming nonsynchronous video signal. The local camera, while "on the air," will take a slow rate of vertical lockup, and, when vertical and horizontal coincidence have been established, any type of switching or special effects can be performed between the two signals. Coincidence of the local and the nonsynchronous signals is indicated by a tally light located on the technical director's console. The sync comparator circuit (which delivers information to the synchronous tally indicator) also inhibits the accidental mixing of any two nonsynchronous video signals until coincidence has been established. The method of mating sync generators and black burst generators not only achieves fast genlock operation, but also provides a very convenient method of sync generator testing by eliminating the old procedure that requires the discontinuance of pulse feeds to cameras when switching generators.

Communications

There are three distinct local communications provided in this mobile systems complex. They are IFB (Interrupted Feedback), headset interphone and engineering command (squawk box).

The IFB system used by NBC is program monitoring feedback to all local and remote locations; it can be interrupted by the program coordinator for verbal instructions. This system is used primarily by production personnel. The headset interphone system is shared jointly by engineering and production personnel for the relaying of instructions via conventional headset-type equipment and may, if required, be connected to the telco private line. The engineering command is used by engineering personnel only for the relaying of technical information to a limited number of critical locations via loudspeakers. The design of the communication system was made so that all three phases may be expanded as operating conditions require.

Videotape

The videotape section is equipped with two TR-22 color TV tape recorders with associated monitoring and switching facilities. These recorders may be used for on the spot pre-recording, such as interviews and instant replay.

Control or Production "B" Unit

The control or production vehicle incorporates all the mechanical features of "A" unit but has an entirely different layout (Fig. 4). It is divided into two compartments, each of which is provided with 2 tons of air-conditioning. Starting at the front there is the audio control room with console, associated equipment racks, video switching racks, power distribution panel, plus adequate space for tape recorders, turntables, technical and production personnel. The second compartment contains all production monitors, director's console, TD switching console, comfortable seating for six program and technical people, and two convenient coat closets at the rear. It is in this area that the greatest departure from conventional mobile unit design has been made. The two units, A and B, although designed primarily to operate as a pair, may be operated individually or with other units as required.

Audio

The audio system, comprised of a console (Fig. 5), with self-contained jackfield and two equipment racks, was constructed to a design employing RCA BN-16C transistorized field amplifiers. Auxiliary services such as monitoring feeds, loudspeaker drivers and facilities to feed split outputs employ the con-

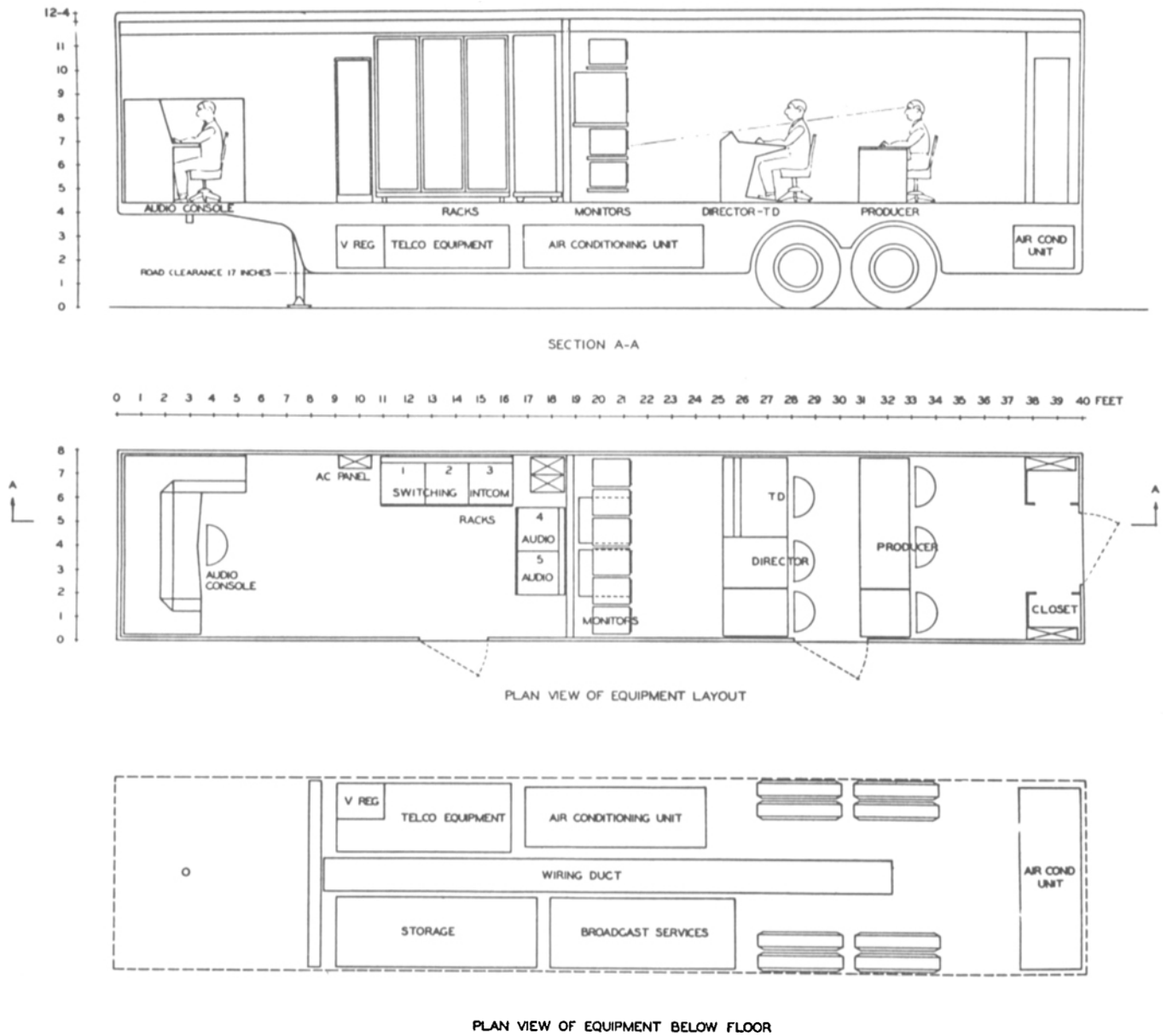


Fig. 4. The layout of the B or production and control unit.

ventional line of RCA audio amplifiers of the BA-31-34 series. The more important audio features are:

- (1) 32 active microphone inputs;
- (2) 4-position submixer;
- (3) 30 switchable nemo job inputs with preview and level setting facilities;
- (4) regular and emergency program amplifiers;
- (5) program and preview video monitoring;
- (6) audio-video tracking switching on 20 inputs;
- (7) 4 patchable no-loss audio filters;
- (8) 2 patchable audio compressors;
- (9) 2 pultec variable-effects filters;
- (10) 8 utility patchable faders; and
- (11) ample spare coils, keys and line isolation pads.

Test results of the system show the overall frequency response to be ± 1 dB from 50 to 15,000 Hz, noise level 56 dB

below 8 VU output, and overall distortion at 16 VU, 0.7% or less.

Monitoring and Switching System

The basic concept in the design of this system was to provide a field equivalent of the facilities employed in any modern-

day studio. Therefore, a 14-in (36 cm) monochrome monitor is provided for each source input and two 21-in (53 cm) color monitors for program and preset. To satisfy some producers it was necessary to install a monitor position and tally switching system whereby the

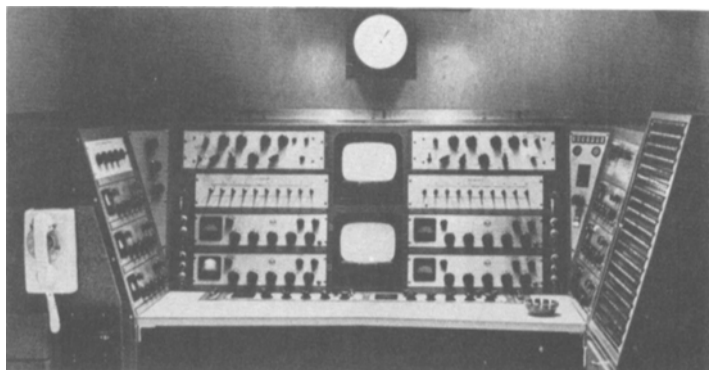


Fig. 5. The audio system.

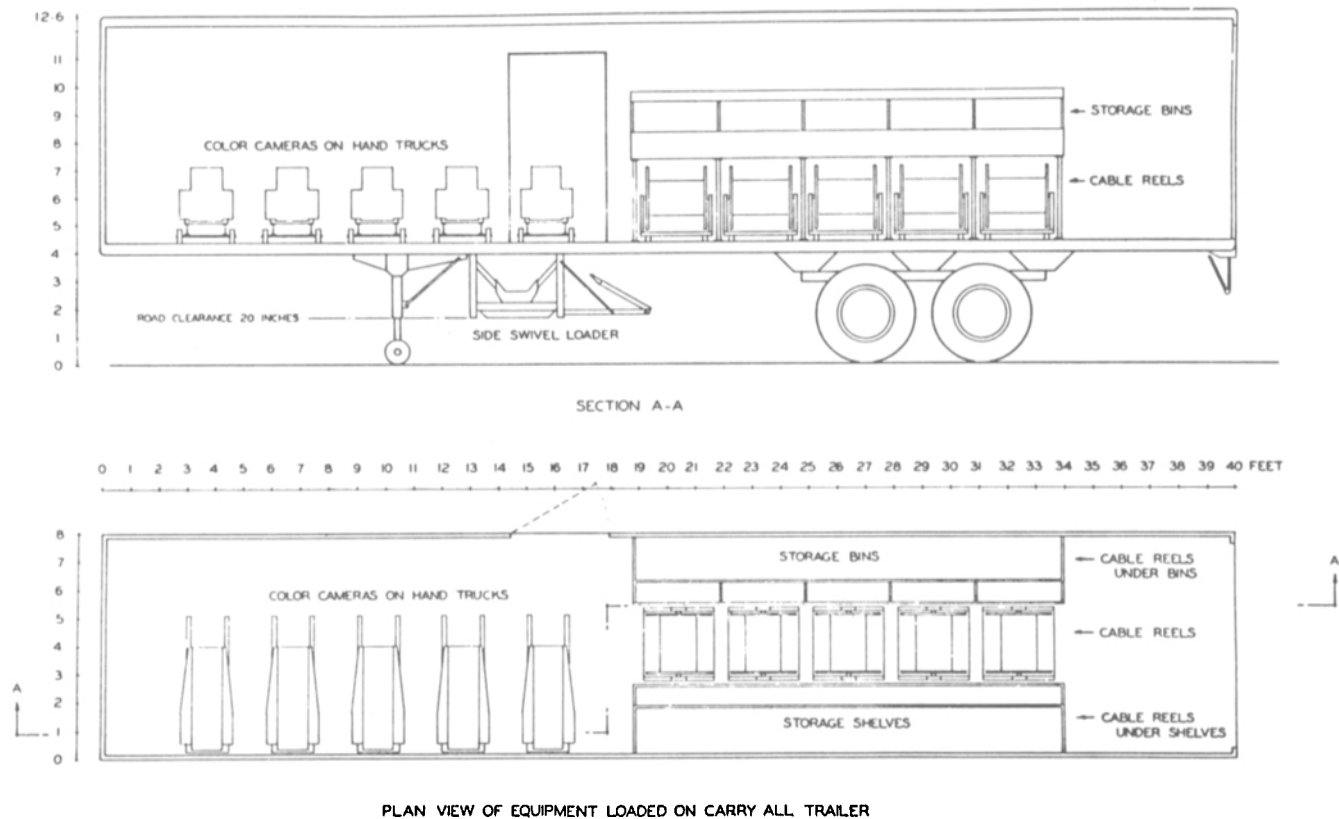


Fig. 6. The layout of the C or carryall vehicle.

assignment of monitors within the bank can be changed without physically being removed to other than normal positions.

The switching system is comprised of a TD console and two equipment racks. It is fundamentally an RCA TS-40 solid-state vertical-interval-type switcher, assembled to handle 19 composite inputs to each of nine primary buses. By means of the secondary logic system, five of the nine buses were channelled into either of two lap-dissolve amplifiers and the special-effects system. The four remaining buses are used for video previews, videotape and transmission.

The first five buses designated Program, Preset, A, B and C constitute the program assembly portion. Though

the mechanics of a vertical-interval-type switcher are well known, it is worth noting that logic from a dc source directs the trigger pulse, generated from vertical sync, to the proper cross-point where the actual video switch is made in 1 to 2 microseconds during the vertical blanking interval. Through the use of two lap dissolves and special-effects equipment, a wide variety of novel program effects, including title inserts, can be achieved.

Carryall

The carryall (Fig. 6) is the third vehicle in the complex, designed basically to conform with the old proverb of "A place for everything and everything in place." This vehicle is a standard com-

mercial-type trailer equipped with a side-located, battery-operated lift to assist in loading and unloading. Cameras and other pieces of delicate equipment (mounted on special cushioned dollies), cable reels, tripods and all other miscellaneous items are transported in the carryall. Considerable effort was devoted to developing improved methods of handling and transporting television equipment. That proved worth while because, since the first complex was delivered in 1965 in approximately 40,000 miles (64,000 km) of road travel over the next 18 months of continuous service from coast to coast, there was not one instance of equipment damage attributable to faulty transport.