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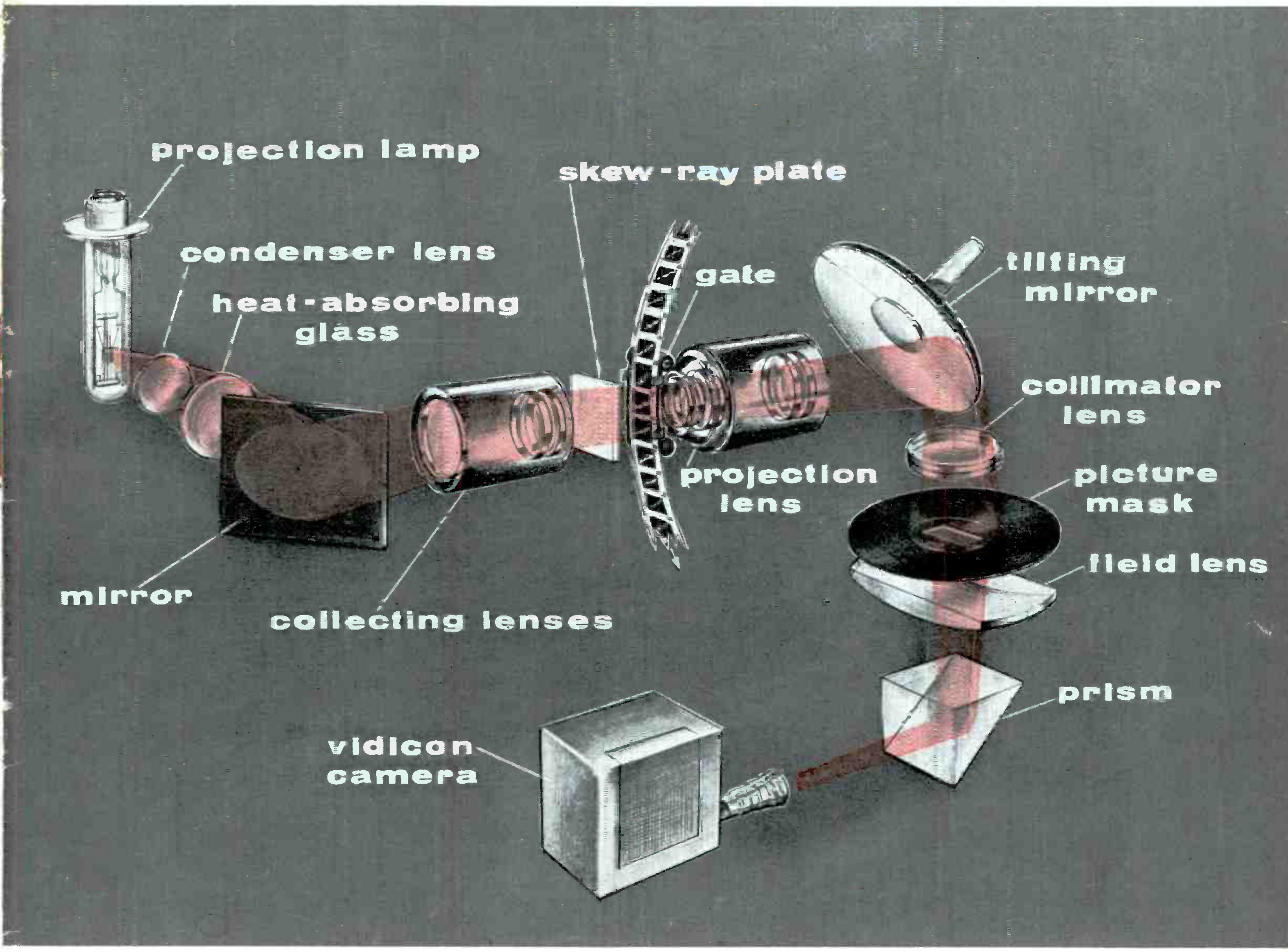
BROADCAST ENGINEERING

THE TECHNICAL JOURNAL OF THE BROADCAST INDUSTRY



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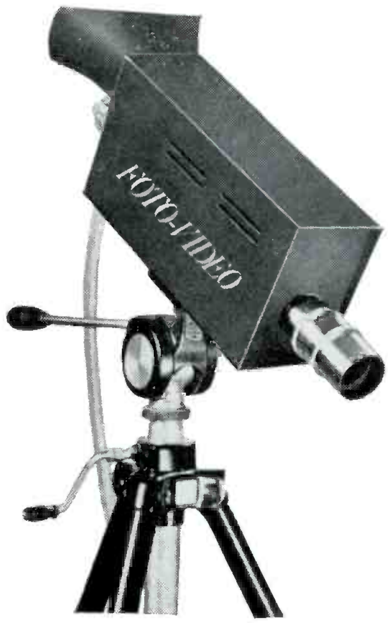

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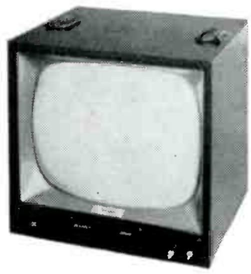

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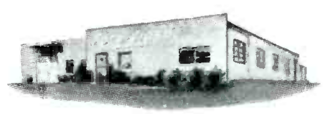

STRAIGHT TALK

to

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By EVERETT GILBERT
Broadcast Field Service Engineer
Collins Radio Company

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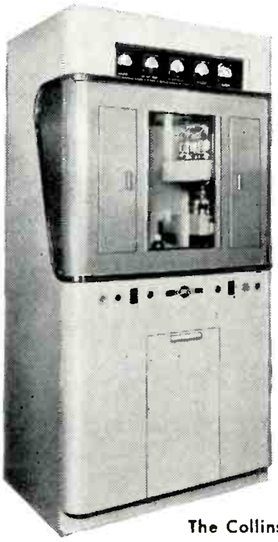

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BROADCAST ENGINEERING

THE TECHNICAL JOURNAL OF THE BROADCAST INDUSTRY

VOLUME 2 MAY, 1960 NUMBER 5

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Cover

A block schematic of a newly developed film projector which is designed specifically for television film use is shown with the light path traced in color. The description of this projector and explanation of its method of operation is detailed in the article beginning on page 8.

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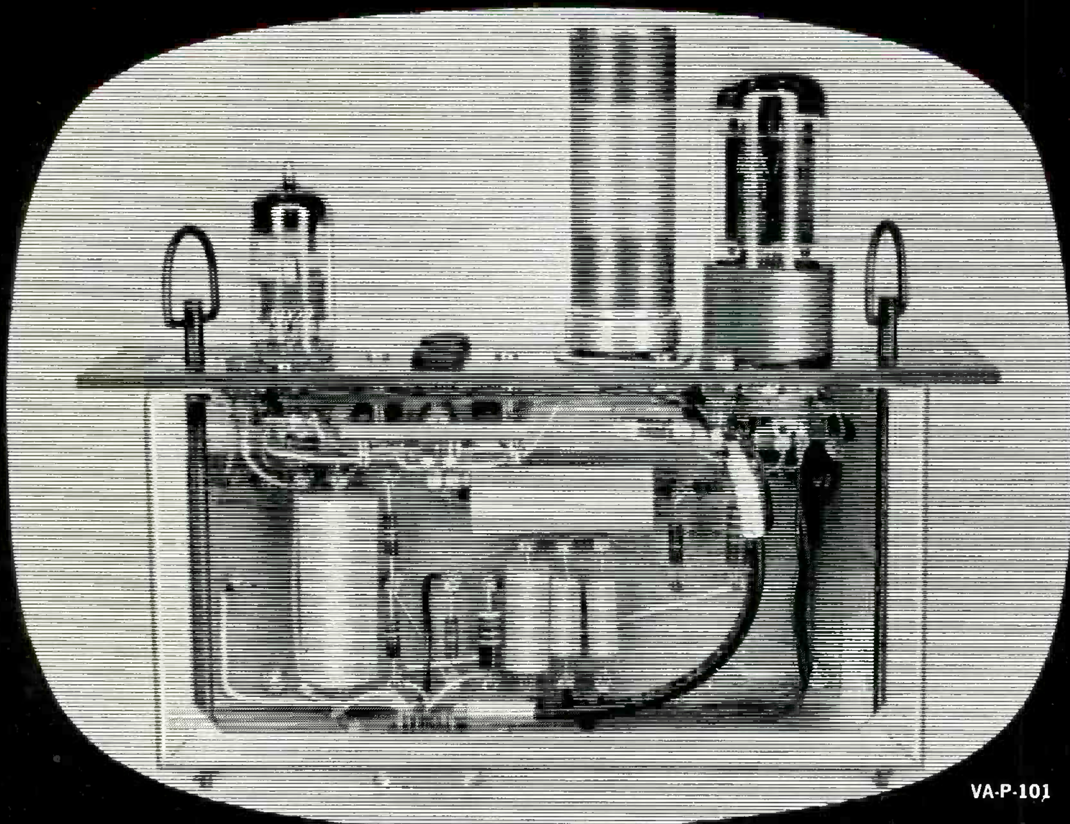

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VA-P-103	1 in/1 out Video Dist. Amp.	+3db	0.7 Volt	1	Flat ±2% to at least 8.0mc	0.7% max	0.35° max	60 ma
VA-P-201-0	1 in/3 out Video Dist. Amp.	Unity	1 Volt	3	Flat ±2% to at least 8.0mc	0.7% max	0.35° max	125 ma
VA-P-201-3	1 in/3 out Video Dist. Amp.	+3db	0.7 Volt	3	Flat ±2% to at least 8.0mc	0.7% max	0.35° max	125 ma
VA-P-201-6	1 in/3 out Video Dist. Amp.	+6db	0.5 Volt	3	Flat ±2% to at least 8.0mc	0.7% max	0.35° max	125 ma
VA-P-202	Sync Adder for VA-P-201 Amps.	—	4 Volts	1 to 3	—	—	—	30 ma
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A Compatible Stereophonic Sound

By F. K. BECKER*

THE NEW "concert-hall realism" and "living presence" of modern sound reproduction and transmission are really not new at all. But these terms are descriptive of the great strides that have been made in recent years in the mass reproduction and broadcast transmission and reception of high-fidelity, stereophonic sound. Actually, techniques for transmitting stereophonic, or two-dimensional, sound were developed some years ago at Bell Laboratories.

Because the transmission and reception of sound is basic to communication, telephone engineers since the days of Alexander Graham Bell have studied in detail the physical and subjective aspects of speech and hearing. Specifically, in 1933 a group at Bell Laboratories directed by Dr. Harvey Fletcher, undertook a series of such studies designed to further our understanding of "auditory perspective"—how and why we hear spatially. Later that year, these tests culminated in a demonstration of the long-distance transmission of stereophonic sound (RECORD, *May* and *June*, 1933; *March*, 1934).

Under the auspices of the National Academy of Sciences, a concert of the Philadelphia Orchestra was transmitted from the Academy of Music in Philadelphia to Constitution Hall in Washington, D. C. The orchestra was conducted by Associate Conductor Smallens, while the director, Dr. Leopold Stokowski, manipulated controls from his position in the rear of Constitution Hall.

To reproduce a perception of dimensional sound, three microphones were placed before the orchestra, one at each side and one in the center. The output of each microphone was transmitted over a separate Bell System circuit specially "tailored" for the experiment. At Constitution Hall, the loudspeaker associated with each microphone was placed on the stage in a cor-

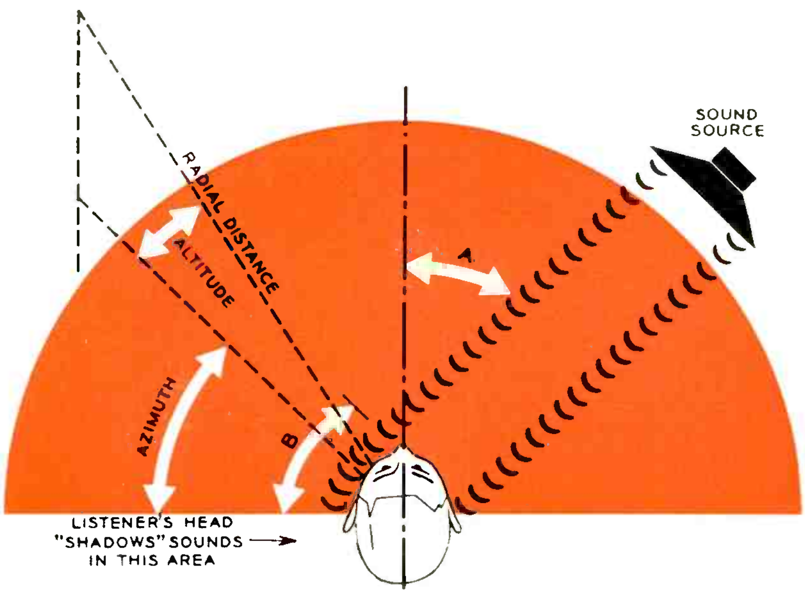

Figure 1. Diagram showing how we localize sound. Sound coming from azimuth angle A reaches the two ears with a time difference of T=B/C where C is the velocity of the sound. If A is 45 degrees and the interaural distance is 20 centimeters, the time difference is about 0.5 milliseconds. The sound wave that bends around the head is also weakened at the higher frequencies.

*Bell Telephone Laboratories, 463 West St., New York 14, N. Y.

Reprinted from the Bell Laboratories Record

System

Broadcasts designed for stereo listening frequently sound distorted to the single channel listener. Recently, however, Bell Laboratories has demonstrated a compatible stereo system that assures balanced, high-quality reception for these listeners, along with the full stereo effect for those equipped to receive it.

responding position. Many of those who heard the reproduced concert proclaimed the development of a system that promised even greater emotional appeal than "live" music. Much of this reaction was undoubtedly due to the enhanced volume range of the reproduced sounds.

One of the latest developments in the field of stereophonic sound is a "compatible" stereo system, which means that listeners who have only one receiver, or who prefer to use only one receiver, can also enjoy broadcasts intended primarily for stereo reception. The system was demonstrated earlier this year on a portion of the "Perry Como Show" television program, broadcast by the National Broadcasting Co. over its nationwide network. This article will be principally concerned with some of the concepts underlying the development of this system.

The broadcasting of radio and TV programs in stereo, over two separate channels, became popular about 1952. To a large extent, this popularity was created and enhanced by the widespread acceptance of high-fidelity recordings and sound equipment. In various experimental arrangements, the two channels required for stereo are selected from different combinations of the AM, FM, and television broadcast bands. The listener spaces the receivers in his home in the proper way to get stereo sound. Listeners' reactions have been so favorable that more broadcasters are considering offering additional stereophonic sound programs.

The major obstacle to an increase in this type of broadcasting, however, is the majority of the potential audience, who have or prefer to use only one receiver. If the broadcaster tries for the full stereophonic effect, the sound the single-channel listener hears comes from only one of two widely spaced microphones. Thus, he misses a portion of the program. In many cases, this effect is similar to listening to one-half of an orchestra or to one side of a two-way conversation. And what the single-channel listener does receive is poorly bal-

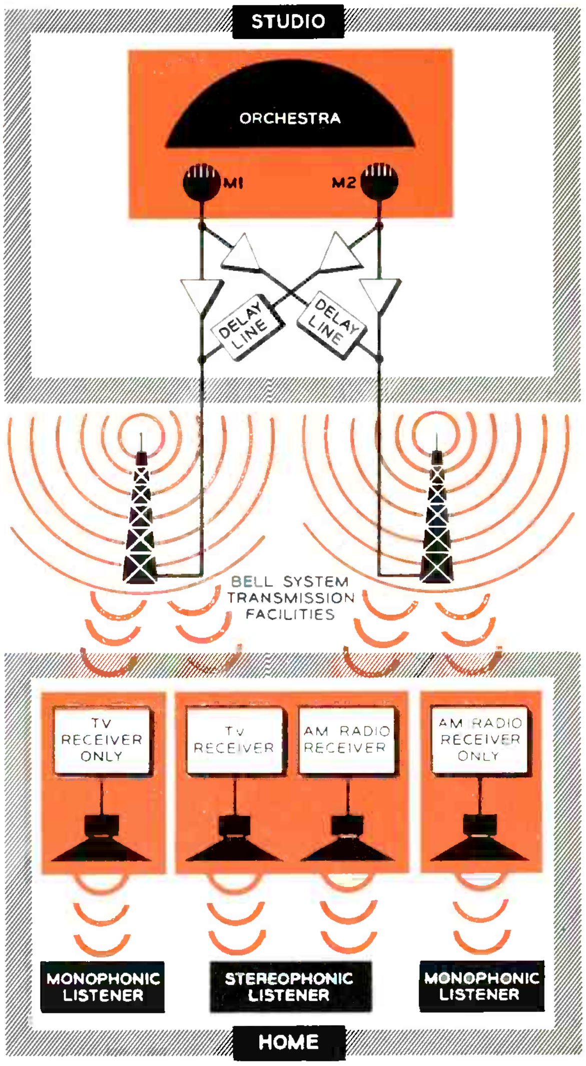

Figure 2. The new compatible stereo circuit for a two-channel broadcast, showing transmission facilities and alternative receiving arrangements. Broadcast circuits can vary from local to transcontinental.

anced, because of the placement of the microphone in relation to the sound sources.

Broadcasters, in order to protect the investment of their sponsors, must dilute the stereophonic effect to preserve satisfactory reception for the single-channel listener. If the broadcaster does this—by moving the microphones closer together or intentionally blending the signals electrically—he spoils the true stereophonic effect.

Single-Channel Systems

For this reason, some effort has been made by broadcasters and others to develop a compatible stereo system: one adaptable to the broadcast of high-quality signals for both stereo and monaural listeners. Most of this effort has been directed at single-channel transmission systems. Such arrangements generally use either frequency-division or time-division multiplexing—that is, the two or three signals necessary for stereo are sent over a single channel that uses carrier transmission. Multiplexing schemes like this have been used for many years on Bell System toll trunks to send many telephone conversations over a single carrier channel. Most of the stereo multiplex systems are indeed compatible with present day single-channel receivers. But to reproduce stereophonic sound, they require additional equipment not ordinarily found in standard AM and FM receivers. In effect, the receiver must have a "de-multiplexer" in addition to its normal components.

The proposed stereophonic transmission circuit invented at Bell Laboratories offers a solution to this compatibility problem on both two- and three-channel broadcasts. Successful compatibility in this circuit depends on a psychoacoustic phenomenon known as the *precedence effect.* Before discussing this phenomenon and how it is used to achieve compatibility, it would be well to review some of the fundamentals of how we localize sound.

To locate the source of a sound, we require some perception in the three spatial coordinates—radial distance, altitude, and azimuth. These three coordinates and some other important localization concepts are shown in Figure 1. Man's auditory perception of distance seems to be primarily governed by loudness and the ratio of direct to reverberant sounds. As a result, distance perception is poor. We have little or no altitude perception, but azimuth perception is extremely good. An average listener can localize a sound source to within about two degrees in azimuth.

The mechanisms for detection in azimuth are: (1) phase differences between the sound waves at the two ears; (2) interaural differences in the time of arrival of transient sounds; and (3) differences in intensity of sound at the two ears due to "shadowing" by the head. These intensity differences also depend on frequency, and thus result in an interaural difference in "quality."

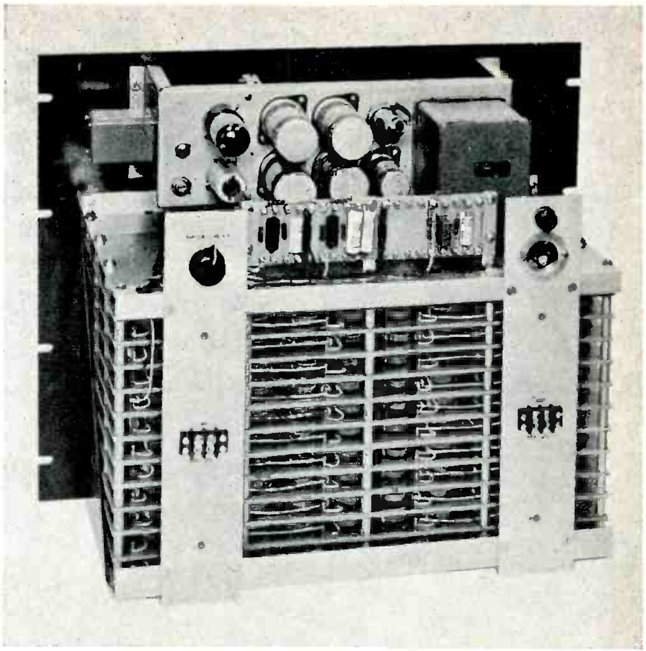

Figure 3. The above audio delay line produces the precedence effect of the compatible stereo system described in this article by delaying one channel ten milliseconds. Photo courtesy the Daven Co.

In reverberant rooms, even those with an optimum reverberation time for the reproduction of music, the "standing-wave" patterns tend to destroy our sense of directivity for prolonged pure tones. Hence, in ordinary listening environments, the interaural differences in arrival time and the intensity of the transient sounds assume the predominant roles in azimuth localization.

Psycho-acoustic experiments have shown that it is possible to trade loudness differences for arrival-time differences. For example, a listener seated equidistant from two in-phase loudspeakers separated by several feet will have the impression of a single, centrally located source if the two loudspeakers have the same intensity. If the intensity of one speaker increases while the other correspondingly decreases, the apparent source of the sound will shift toward the more intense loudspeaker. The amount of the apparent shift depends on the correlation of the sound pressures at the two ears and that which a single sound source at some azimuth angle would produce.

A subjective shift in sound source can also be achieved by holding the sound levels constant in both speakers and by introducing a time delay in one of them. In this case, the apparent source will shift toward the undelayed speaker. Delays as short as 0.25 millisecond will produce a substantial shift in the apparent source. The sound source seemingly shifts because delays of this order are about equal to the difference in the time it takes for transient sounds to arrive at the two ears when a single sound source is displaced 20 degrees to one side of the listener. If the

(Continued on page 40)

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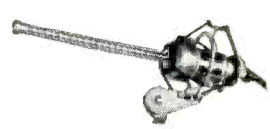

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New Projector Development Improves TV Film Production

A new mechanical system based on uninterrupted film movement, a never-closing aperture and an optical system using rotating-tilting mirrors gives the TV industry the first film projector designed specifically for video.

THE INCREASING demand for improved playback of 16mm films has resulted in an entirely new type of projector, the first successful unit especially designed to present a non-intermittent image to the picture-tube.

From the very beginning, the telecasting of filmed program material has presented certain complications resulting from the disparity between the motion-picture process and video technology.

Like television, the motion-picture image is an illusion based on the eye's power of retention. Unlike the moving dot of the TV image, however, the film image consists of a series of complete "still" pictures or frames, presented to the eye one at a time in rapid succession. The eye can understand this and translate it into a message of moving people or objects. The scanning ray of the TV camera, however, has difficulty in matching its cycle of horizontal and vertical sweep to the film's cycle of intermittency.

The traditional motion-picture projector has certain mechanical

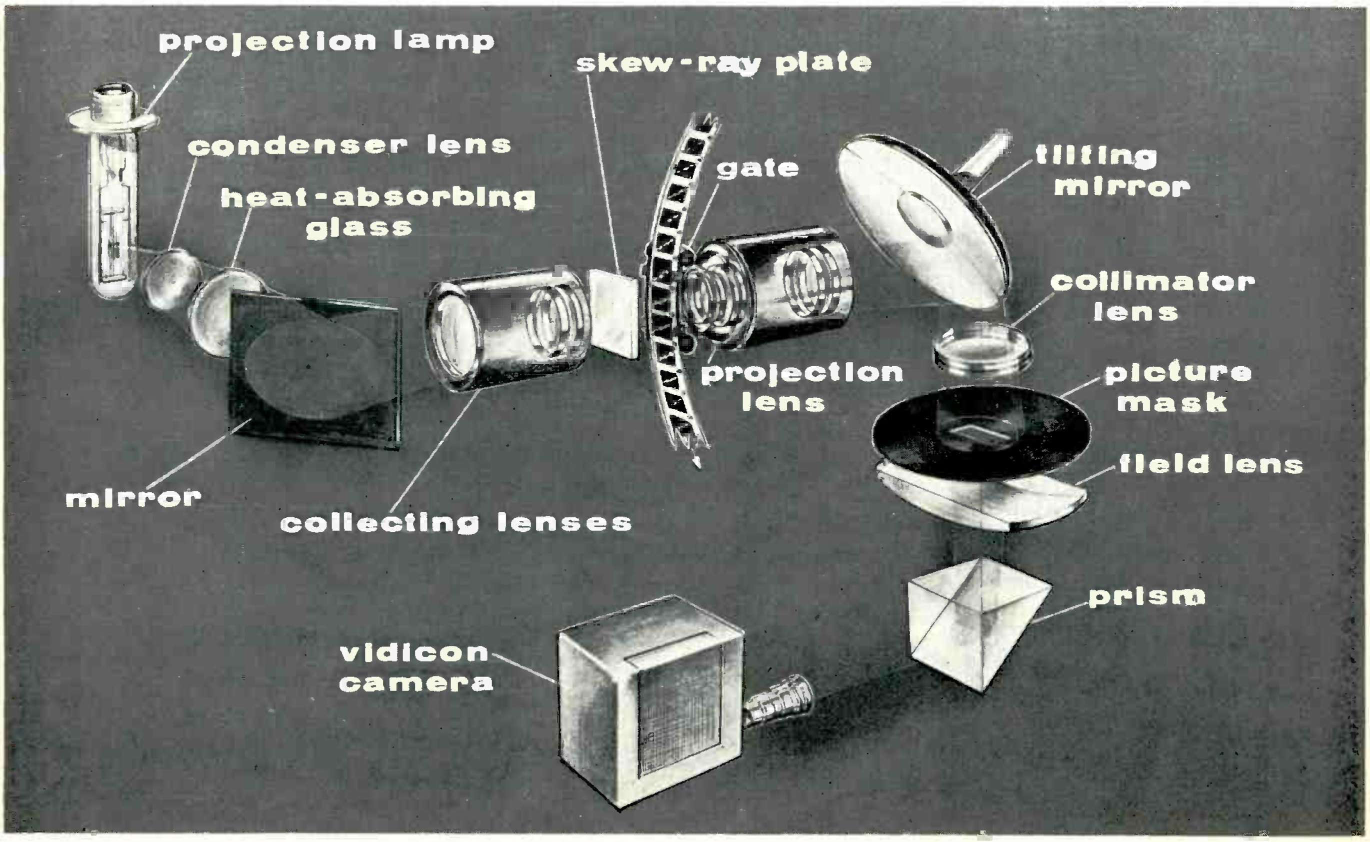


Figure 1. Optical system of CMP 350 projector showing path of light from projection lamp to camera.

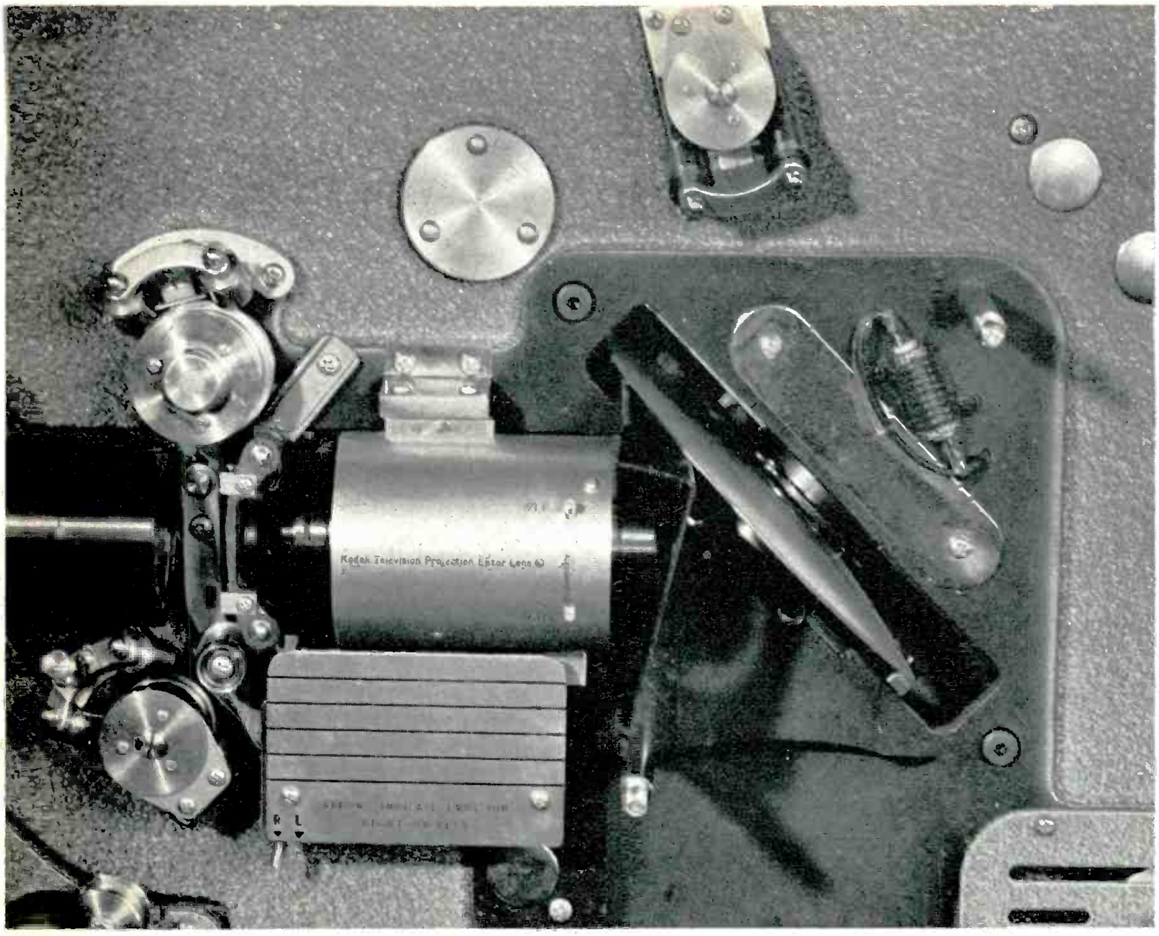


Figure 2. Close-up of lens and film guide system. Housing has been removed to show rotating-tilting mirrors in place.

devices to run the film through at a controlled rate of stop-and-go: a set of driving and take-up sprockets to mesh in perforations along the edge of the film, a clamp to hold the film tight against the gate every time a complete frame lines up with the gate aperture, an opening and closing shutter to present light to the optical system when the film is stopped in the full-frame position, and to keep the light out of the optics when the film is speeding by the gate between frames.

These mechanical devices and the intermittent action have often resulted in scratched or abraded film, torn perforations, vibrations and mechanical noise, all of which have interfered with the search for perfect playback, and have meant shortened film life and, in some cases, slightly higher film-program costs.

Add to this the fact that the older feature films were all exposed to the high lighting contrast required by theater projection, and you have some of the reasons the broadcasting industry—and the public—have not been completely happy with the quality of movies on the TV screen.

These problems, and efforts to solve them, have for some time been on the research agenda of the Eastman Kodak Co., concerned as it is with a desire to make the film image, whether still or in motion, as perfect as possible an art form, entertainment medium or functional tool. Kodak, realizing it was to their advantage to make film look its best, and to enhance the inherent qualities of film in order to bring to the public the ultimate in viewing, set out to design a machine that would

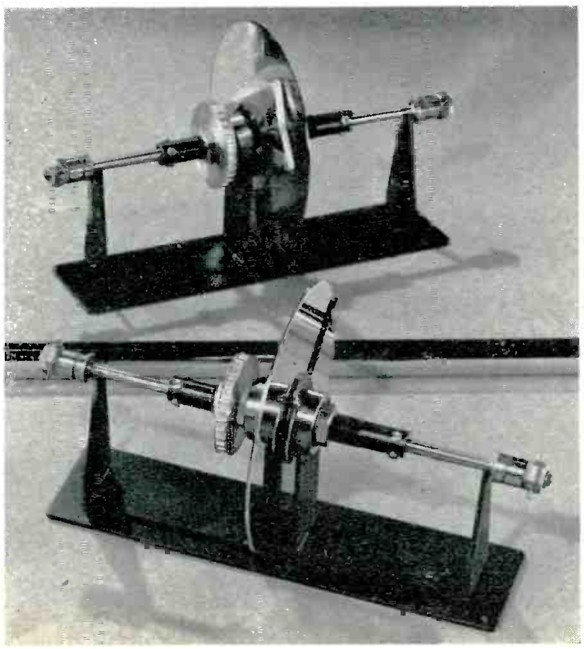


Figure 3. Rotating tilting mirror assembly removed from projector and placed against mirror so both sides of system may be seen.

be a genuine video projector rather than an unfortunate marriage of a theater projector and a video camera.

Such a projector, they stipulated, would have to meet a number of major requirements, including these:

1. It must present to the picture-tube a continuous image, rather than requiring the picture-tube to act as a storage device.

2. This image must be in sharp focus, with high resolution.

3. The image must be kept in perfect stability on the face of the picture-tube, eliminating any lateral motion due to flutter, or any change in image size due to shrinkage or stretch of the film.

4. The projector must handle film gently, minimizing the introduction of scratches, tears or perforation breaks.

5. It must have an optical system designed to (a) minimize image impairment due to existing scratches, dirt or other defects, and (b) reduce the soot-and-whitewash type of television image often resulting from the high lighting contrast of films shot originally for theatrical projection.

6. It should be capable of reversing the film for cueing, and should have a stop-motion provision for projecting single frames, as in some news and spot announcement work.

What's more, these were only the requirements for technological perfection. Eastman was also aware of certain requirements for economic feasibility. It's not enough to manufacture the ultimate; you have to be able to get people to buy it. No matter how thoroughly Eastman's dream projector might solve the mechanical and artistic problems of telecasting movies, and no matter how it would increase film life and reduce film losses, there were still economic considerations to be met, especially if the smaller stations were to be able to use the unit. Some of these were:

1. The projector would have to be compatible with existing station equipment, particularly electronic circuitry and picture-tubes.

2. It should be compatible with fields and patterns used in all countries, not just the United States.

3. It should be capable of being diplexed or multiplexed.

4. Price should be competitive.

5. Because of the major role played by 16mm in local station broadcast programming, this should be a 16mm unit, and it should be capable of conversion to color.

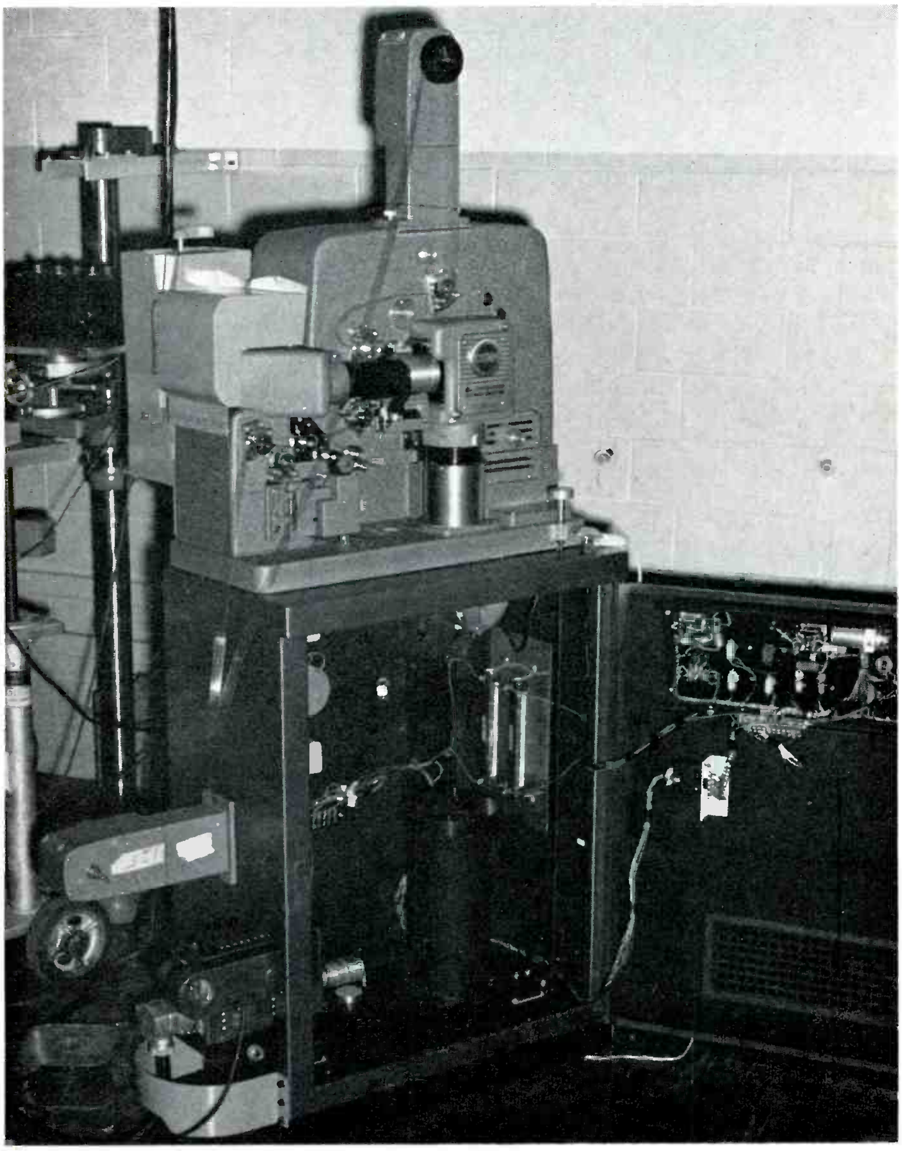


Figure 4. Projector with console cabinet open revealing wiring.

The Answer

This, then, was the problem with all its sub-problems. Eastman's answer was the Eastman 16mm Continuous Television Projector, Model 350, which was converted by General Electric in its exhibit space at the recent National Association of Broadcasters show in Chicago, April 3-6, and which was scheduled to be in network use from a Chicago affiliate a few weeks later. (G. E. will market the projector as the CMP 350.)

The reaction of the convention visitors who crowded in to see the projector at work can be summed up in the statement by a station film manager, who commented, "This solves all my film problems . . . I have $30,000 worth of old films we can start using again," and a broadcast engineer who watched the scratches disappear in projection of a test leader and simply shook his head in disbelief.

Engineered by Eastman Kodak with electronic design by G. E., the CMP 350 is being sold by the latter

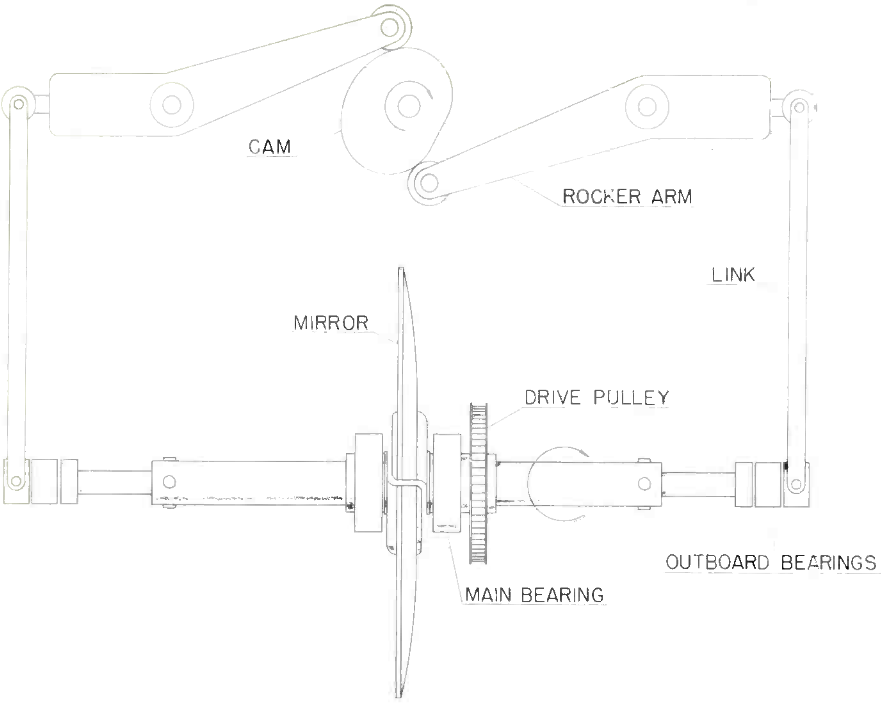


Figure 5. Mirror control linkage.

company. It is in production with delivery on a 30-day basis. It departs from the traditional intermittent film movement and the opening-and-closing shutter of the theater-type projector. Instead, a new mechanical system based on uninterrupted film movement and a never-closing aperture with 100 per cent light application is coupled with an ingenious optical system including rotating-tilting mirrors.

Several automatic features adjust the optics to assure continuously uniform magnification and sharp focus despite any shrinkage or stretch that may have occurred in the film. At the same time, the optical system has provision for sharp focus to assure wider-range frequency response.

By eliminating the intermittent movement of the film and introducing a curved film gate with sapphire edge-guides and a control sprocket that adjusts automatically to film-perforation spacing, the CMP 350 protects expensive films from what, until now, was considered normal wear and tear.

One of the features that got the most attention at the N.A.B. exhibit was the CMP 350's ability to optically minimize existing scratches and dirt on projected film. To dramatize this the engineers who demonstrated the unit had provided several films which had been scratched with emery paper. These

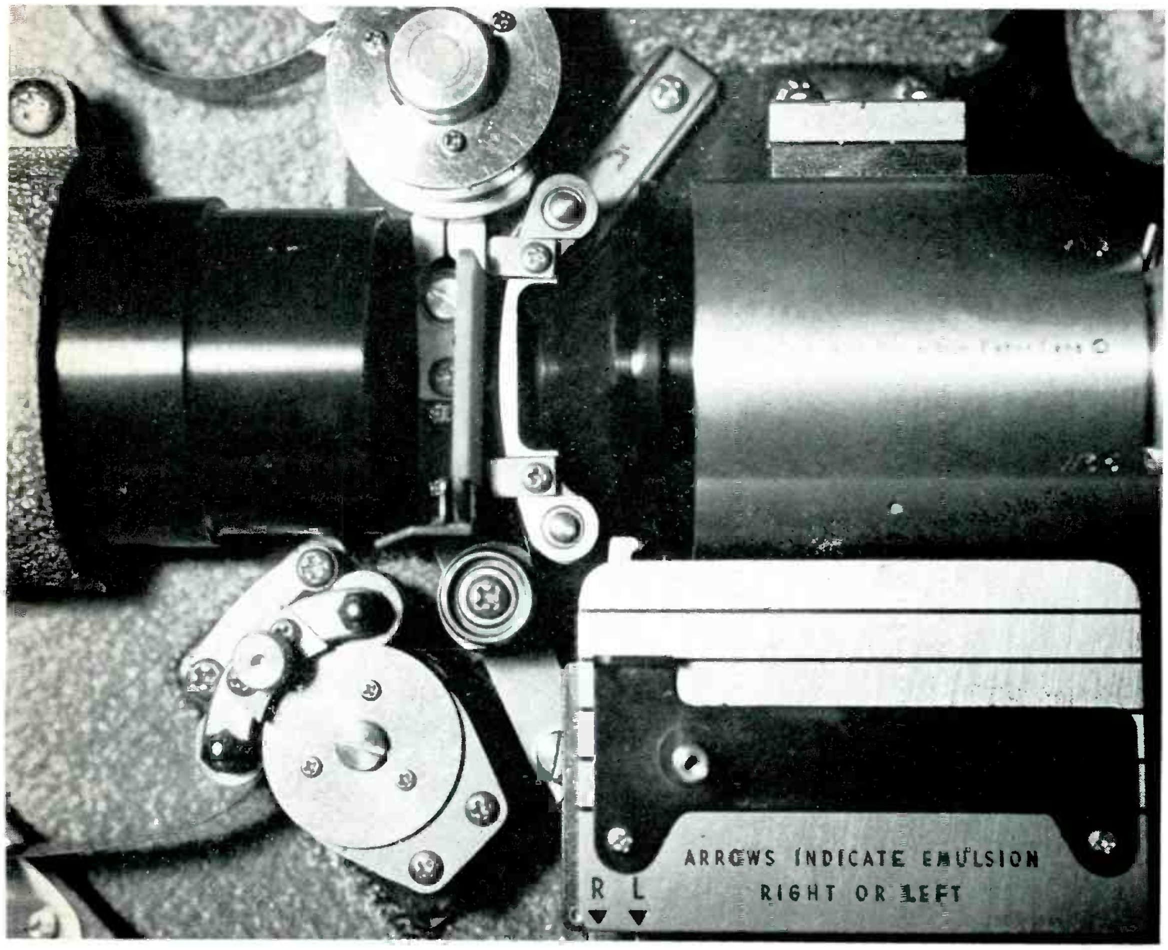


Figure 6. A close-up candid of the film guide system. High precision, variable-pitch sprocket (top, center) passes film down to curved film gate. Film is curved at gate for maximum stability, preventing film buckle. At lower right, R-L setting keeps film in perfect focus regardless of emulsion position.

films were handled by viewers, and the gouges in the emulsion observed. The films were then run through the projector and seen on a number of monitors spotted around the exhibit space. Under normal-type projection, the scratches could be seen in all their brutal damage. Projection on the CMP 350 showed the monitor image without any other change in image quality.

Another thing that impressed observers at the exhibit was the stability of the playback image on the monitors, as evidenced by projected test-pattern films. Your reporter overheard one observer comment, as he watched the SMPTE test pattern on a monitor, "I just want to see how still it is . . . it's pretty darn still . . . is it running?" It was.

How It Works

Figure No. 1 is a block schematic of the CMP 350, showing how it functions. Included are: the lamphousing and associated light-gathering optics, with a mirror to turn the

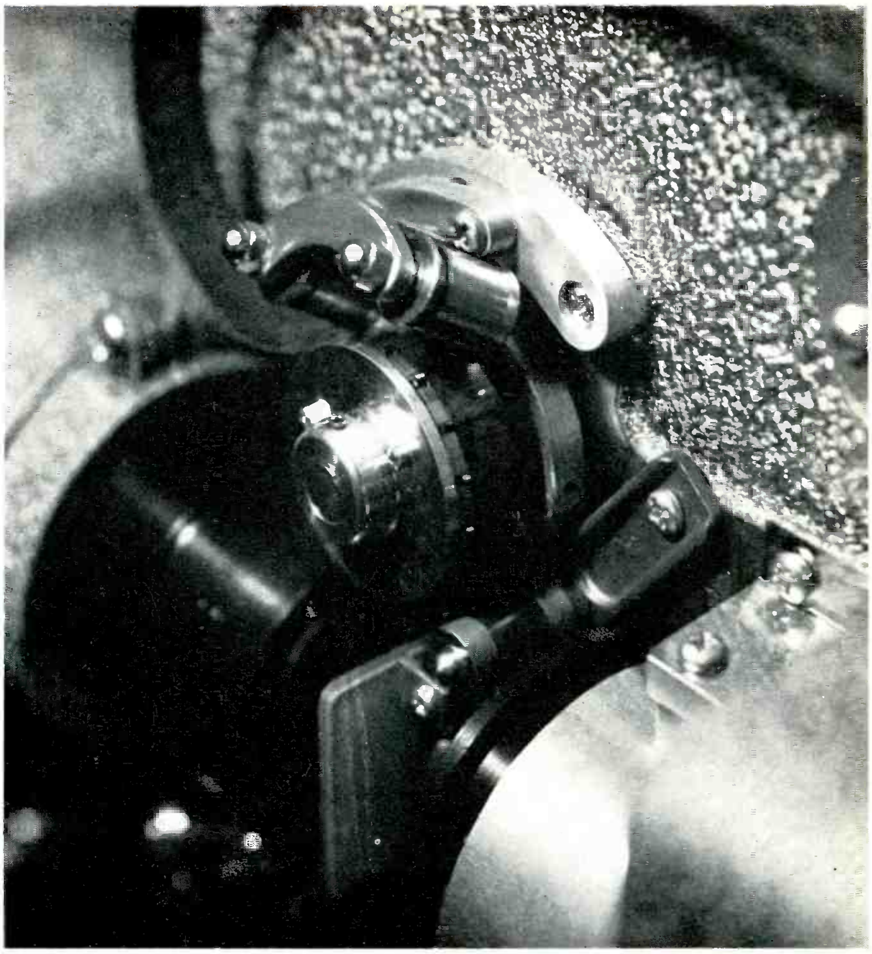


Figure 7. Close-up of high-precision, variable-pitch sprocket. Immediately below sprocket is edge of skew-ray device.

Figure 8. Picture of monitor image, showing film scratches made by emery cloth. Note how scratches show up when special skew-ray plate is removed from projector optics.

light at right angles; the skew-ray plate, which has the dual function of minimizing scratches and dirt on the film, and reducing excess contrast (it can be readily removed for cleaning); the film gate, curved to match the optics of the rotating mirrors; the projection lens with its rear element very close to the film gate; the mirror assembly, illustrated and described in more detail elsewhere in this article; the collimator, which also includes provision for picking up the projected image from a 2 by 2 slide projector; a relay lens, whose function it is to fill the optical system with light. The prism turns the image at right angles to feed it into the vidicon camera which is located inside the cabinet base.

Installation in the studio is a routine matter. Once positioned where convenient, the projector's power cord is plugged into any 117-volt ac line, and the vidicon's cable is plugged into any existing station channel amplifier and monitor system. Film loading is no different from the procedure on traditional projectors, and all controls are located on the side of the projector or a small control strip on the same side of the base cabinet.

Figure No. 2 shows in detail the all-important mirror-control linkage. Two semi-circular front-surfaced mirrors are positioned so as to form a complete circle interrupting the path of the image that emerges from the projection lens. This circle is caused to rotate about its center by motion applied to the drive pulley. At the same time, motion is applied to the cam, which has two followers 180° apart. The rise and return of the rocker arms on this cam, transmitted through the links and outboard bearings, imparts a tilting action to each of the mirrors, which results in dissolving one frame image into the other.

The motion of the film image, continuously projected through the curved gate onto rotating mirrors, is reflected down through the collimator and relay lens onto the face of the vidicon. The tilting-mirror action, by dissolving one frame into the next, results in a continuous, stable image on the picture tube, instead of the intermittent image resulting from conventional projectors.

Sharp and Clear

The use of the skew-ray filter is an interesting application, with considerable significance in film playback. It delivers a diffused or nonspecular illumination to the film, which results in a sharp projection of the picture but seems to bypass any surface imperfections such as scratches or dirt. This characteristic is assisted by the fact that the rear element of the projection lens is right up against the film.

Real and apparent sharpness of the image is ensured by a number of features. For one thing, the image eliminates the apparent fuzzi-

Figure 9. Same image with skew-plate in place. Scratches on the film are optically minimized.

ness that might result from an unstable image. There is also a simple and instantaneous flip-lever adjustment for changing the focus to take care of emulsion position, as in changeover from reversal film to positive type stock. This lever can be seen, with its "L" (left) and "R" (right) positions, in Fig. 6; it guarantees positive control of emulsion focus, and maximum picture resolution. A similar "L" and "R" lever, a short distance from this one, adjusts for focus of the photographic sound image, guaranteeing maximum frequency response for sound. The sound optics, combined with this instant-focus lever, present an effective slit width of .0003 for good high-frequency response.

The perforation pitch or spacing is continuously being measured automatically by the control sprocket mechanism during operation. This accomplishes several important things:

1. It adjusts the focal length of the projection lens to take care of necessary changes in magnification and maintain constantly uniform picture-frame size on the picture-tube, compensating for any change in picture-frame size that may have resulted from film stretch or shrinkage.

2. At the same time it adjusts focus to maintain sharp image on the vidicon despite changes in projection-lens focal length.

3. It controls the pitch of the sprockets to match perforation pitch and

4. Automatically centers the sprockets over the perforations. In these two ways it: (a) keeps film movement uniform, minimizing jitter or flutter and (b) reduces wear on both film and machine by assuring perfect mesh of sprockets and perforations.

Film wear is further reduced by several features, such as the continuous motion of the film, more like the movement of tape past a sound-head than the intermittent movement of film past the shutter in traditional theater-type projectors; the elimination of the clamping gate plate on the gate, which may scratch or mutilate film; the curved film gate of hardened steel; the set of sapphire edge-guides, spring-loaded to maintain the center line of sprocket teeth in the center line of the perforations; and the design of all sprocket elements so they will easily pass any two or three broken perforations that the film may present.

Throughout, design and engineering are heavy-duty, with special emphasis on stability of image and quietness of operation. Not satisfied with the elimination of vibration through the change from intermittency to uniform film velocity, the Eastman engineers have separated many of the motor functions in order to avoid vibration feedback. For example, the film mechanism and the sound sprockets, if mechanically linked, might pick up cam movement and introduce flutter. This is avoided by using separate motors. At the same time these are kept in perfect step by using synchronous motors electrically phased.

There is a separate drive motor for the take-up spool to eliminate problems of over-run or tension. Use of a separate motor on the cooling blower eliminates excess load on the drive motors. There is even a separate motor on the reverse for optimum efficiency.

The reverse, incidentally, provides a half speed drive for precision in cueing. There is also a simple provision — a "stop" button and light-control switch on the console —to give instant, accurately framed "stills" at any time, with an immediate and accurately framed return to "motion" by pushing another button.

Framing on the projected image is controlled simply by moving the entire vidicon assembly and its right-angle mirror (see Fig. 1) laterally with respect to the optical axis through the projector and relay lens.

While intended primarily for black-and-white, the CMP 350 can be adapted to color. This is a comparatively simple job that could be done on location.

N.A.B. Exhibit Reaction

While the steady, sharp, scratch-free image on the monitors was the big attraction to N.A.B. visitors who previewed the new CMP 350, a number of other features were brought to your reporter's eavesdropping attention by visitors who had specific needs.

A typical reaction was that of a representative of broadcasting operations for an overseas "network." Since most of his organization's broadcasting is from 16mm film, he was impressed with the scratch-minimizing aspect of the CMP 350. Aside from this, he seemed unimpressed. A G-E engineer, probing for the reason for the lack of interest, finally got this response: "We have a different electrical set-up in our country. Your broadcasting in America is 30 frames because you have 60-cycle current. We have 50-cycle ac, so our broadcasting is 25 frames. Your equipment just doesn't work well for us: we have to get most of it from England, which also has 50 cycles and 25 frames."

"That's no problem at all," the engineer explained. "With the continuous image this machine delivers to the picture-tube, we can take care of any system. All you'd have to do is replace the 60-cycle synchronous motors with 50-cycle units, and you can use this projector in your country—or for that matter in any station, anywhere."

At which point the overseas broadcasting representative became more interested, and proceeded to examine the machine in all its detail and ask for literature to take along.

An entirely different response came from the chief engineer for a southern TV station. Convinced of the 350's virtues, he wasn't sure his station could afford it.

"We've been waiting for somebody to do something about this business of perfect 16mm playback," he said, "but it has to be packaged so it's within our price range.

"I can see the very obvious advantages of the optical system—in fact, I think you're getting an optical transfer beyond what can be reproduced electronically, which is all to the good. However, this means we're going to have to have a separate channel amplifier and monitor for each program source. It's out of our reach."

It was at this point that your reporter, listening in, learned that, as we've already mentioned, the unit is currently diplexed and can be multiplexed. Specifically, the answer to the question as to whether or not he could adapt to use two movie projectors and a slide projector on a single channel amplifier was, "Yes."

Reduced Library Cost

A little later the midwest division

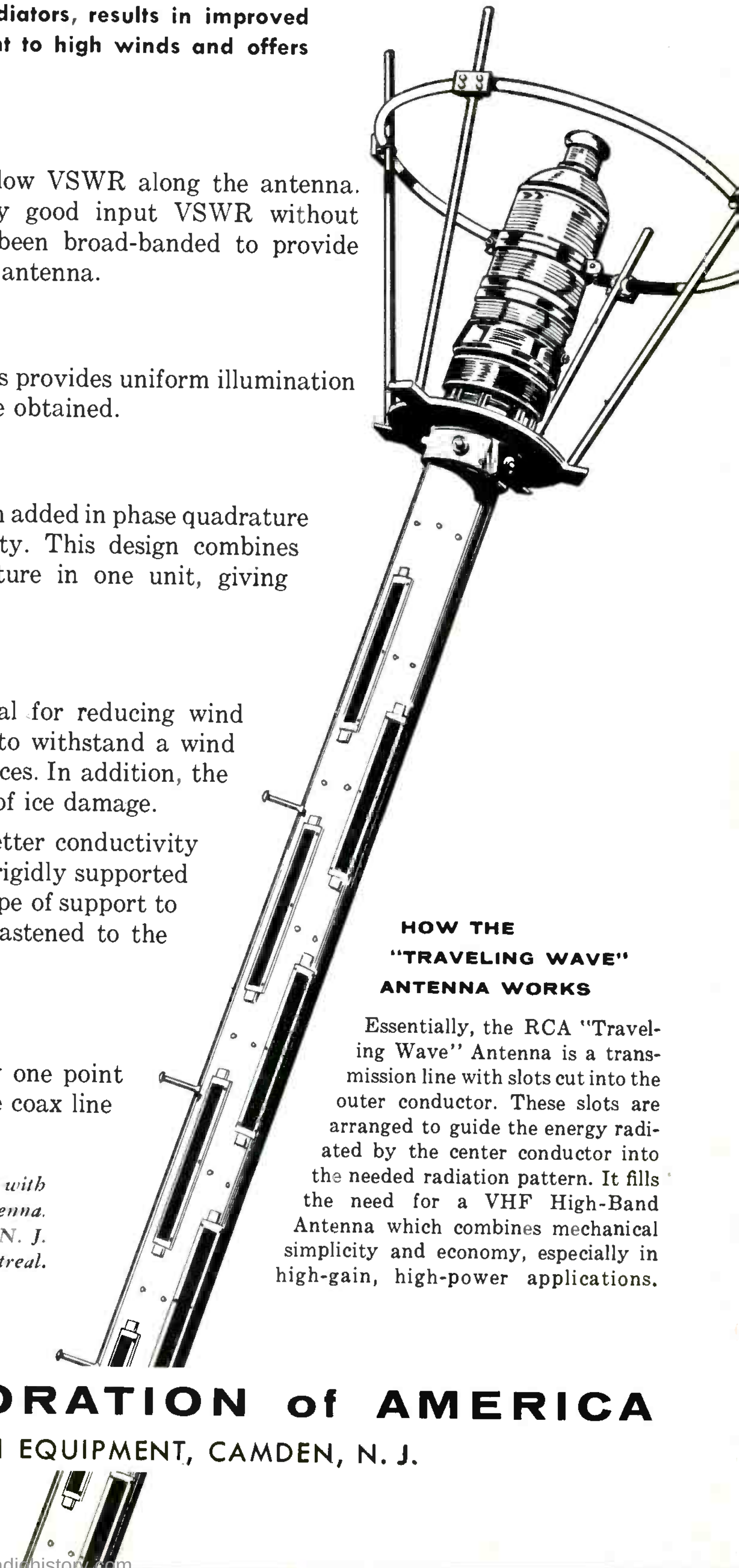
(Continued on page 23)

RCA "Traveling Wave" Antenna

ANOTHER WAY RCA SERVES BROADCASTERS THROUGH ELECTRONICS

Combines Improved Electrical Characteristics with Mechanical Simplicity and Economy... for High Power TV Applications

Here is a VHF high-band antenna that has inherently low VSWR and produces smoother patterns. The design, based on slot radiators, results in improved circularity. This new antenna is strongly resistant to high winds and offers better weather protection.



INHERENTLY LOW VSWR

The traveling wave nature of the feed results in a low VSWR along the antenna. This characteristic gives the antenna an inherently good input VSWR without compensating or matching devices. The input has been broad-banded to provide a smooth transition from the transmission line to the antenna.

EXCELLENT VERTICAL PATTERN

The null-less vertical pattern is extremely smooth. This provides uniform illumination of the desired service areas. Gains from 9 to 18 can be obtained.

IMPROVED CIRCULARITY

The individual patterns produced by slot radiators when added in phase quadrature result in an overall pattern with improved circularity. This design combines radiating elements, feed system and antenna structure in one unit, giving excellent horizontal circularity.

LOW WIND RESISTANCE

The smooth cylindrical shape of the antenna is ideal for reducing wind load and has high structural strength. It is designed to withstand a wind pressure of 50 psf on flats, or 33⅓ on cylindrical surfaces. In addition, the absence of protruding elements minimizes the danger of ice damage.

The steel outer conductor is hot-dip galvanized for better conductivity and protection. The inner conductor of the antenna is rigidly supported at the bottom end without relying on any insulator type of support to carry the dead weight. Polyethylene slot covers are fastened to the pole over every slot for better weather protection.

SIMPLIFIED FEED SYSTEM

The feed system is completely self-contained with only one point of connection. Simplified feed system consists of a large coax line and coupling probes.

Your RCA Broadcast Representative will gladly help with TV antenna planning. See him for details on this new antenna. Or write to RCA, Dept. G-367, Building 15-1, Camden, N. J. In Canada: RCA VICTOR Company Limited, Montreal.

HOW THE "TRAVELING WAVE" ANTENNA WORKS

Essentially, the RCA "Traveling Wave" Antenna is a transmission line with slots cut into the outer conductor. These slots are arranged to guide the energy radiated by the center conductor into the needed radiation pattern. It fills the need for a VHF High-Band Antenna which combines mechanical simplicity and economy, especially in high-gain, high-power applications.

RCA

Tmk(s) ®

RADIO CORPORATION of AMERICA

BROADCAST AND TELEVISION EQUIPMENT, CAMDEN, N. J.

Characteristics and Performance of Television Clamping Circuits

By A. J. BARACKET*

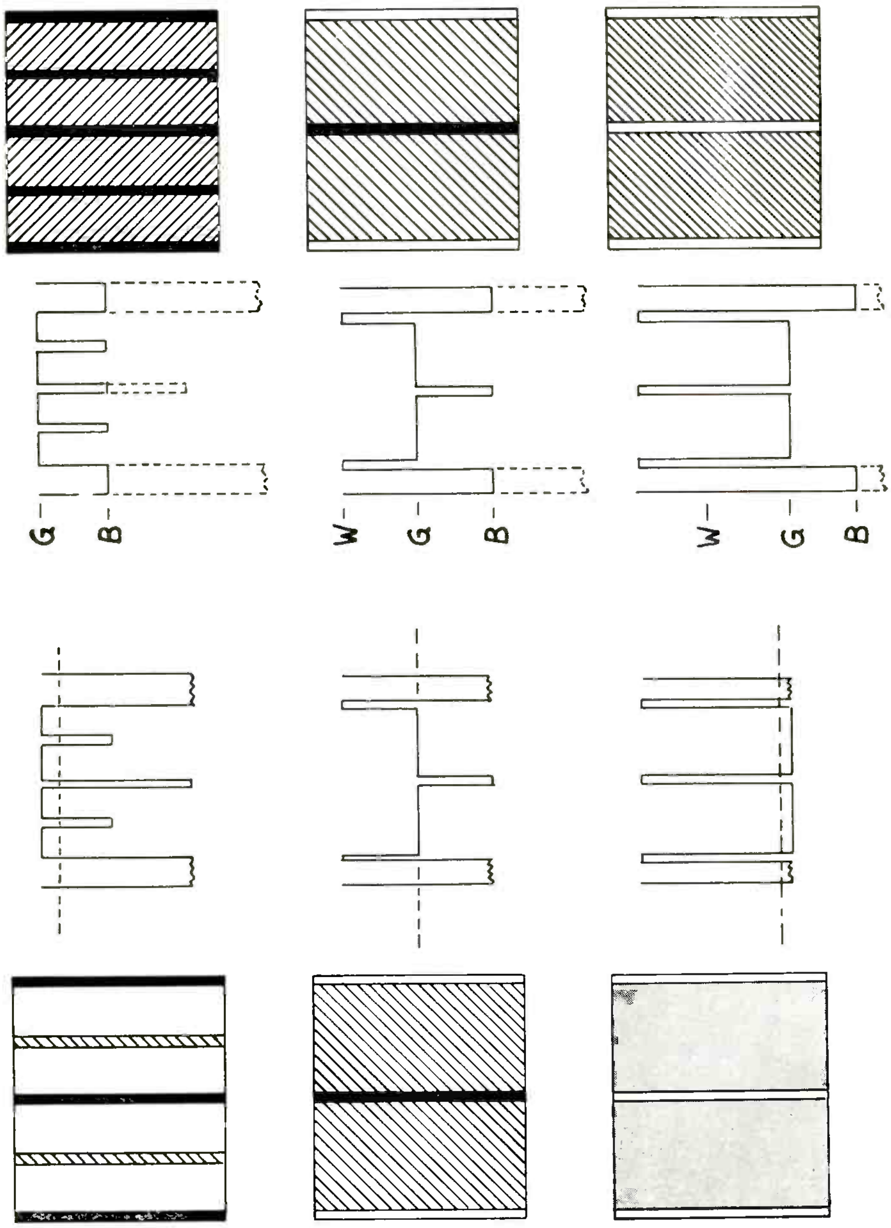


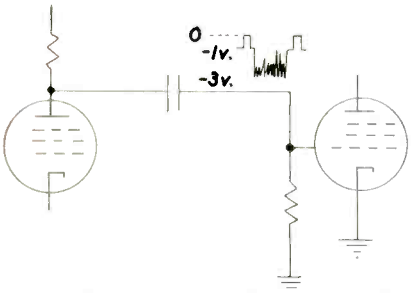
Figure 1

TELEVISION clamping circuits are used widely to refer black level or sync tips to a definite voltage or current value. It is the purpose of this article to discuss some of the characteristics of dc insertion circuits and to examine, especially, the performance of the keyed clamp type of inserter, in the presence of tilt, low-frequency transients, power-line transients and impulse-type noise.

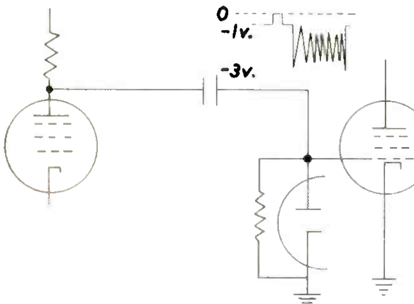
Importance of DC Insertion and Reinsertion

Because of the predominant use of ac coupling in the camera video-amplifier circuits, the dc value of picture blacks at the point of blanking insertion will vary with picture content unless a well-performing dc inserter is used.

As an indication of the need for this, let us look at Figure 1, showing three scenes differing in average brightness. The center scene consists of black and white bars on a gray field; the upper scene, gray and black bars on a white field; and the lower scene, white bars on a black scene. Let us assume that the operator has manually set blanking close to picture blacks for the middle scene. The scene now changes to the upper one. With no dc insertion, the previously set blanking clipper will limit not only blanking but also the picture blacks and the result will be that all the bars will be black on the gray field. If the lower scene is next transmitted, the blanking clipper limits at a level well below picture blacks with the result that



GRID CURRENT RESTORER



DIODE D.C. RESTORER

Figure 2

the bars are now white on a gray field.

The DC Restorer

One of the functions of a clamp is to return the blacks in the picture to the proper voltage value, regardless of the picture content. A circuit which tends to do this is the dc restorer. Figure 2 shows two conventional dc restorer circuits. The upper is the grid-current restorer, and the lower uses a separate diode in order to obtain a somewhat lower forward resistance. These circuits are upset by noise, by low frequency transients, and their performance varies with level and picture content.

The Keyed Clamp

A circuit which has been used successfully in studio equipment and which is superior because of its extremely low ratio of on-to-off time constants is the keyed clamp.

Figure 3 shows the basic circuit for the two diode keyed clamp. Here, regardless of which direction the charge on the condenser has traveled since the last clamping cycle, due to the extremely low on-resistance which depends on the auxiliary clamp pulses to key the diode on the grid side of the condenser it is brought to the reference potential during the next clamp cycle. In the circuit shown in Figure 3, if the clamp pulses are of equal amplitude and duration and the RC coupling time constants the same, the reference voltage will be the center tap of the two diode resistances or ground potential.

The input waveform shown is characterized by tilt, due to a loss of low frequencies in previous circuits. However, due to the constant return to the reference value of the repetitive part of the signal, in this case the horizontal blanking time, the tilt component is produced across the coupling capacitor, and, as a result, is subtracted from the input signal.

Characteristics of Clamp Circuits

In Figure 4, we have listed some of the characteristics of clamp circuits, both of the restorer and the keyed type. Many of these have been treated in the literature by Wendt and Doba.

The dc error is the constant difference between the value at black level or at sync tips and the intended value due to imperfection in the dc insertion circuits. In the dc restorer, the impedance during conduction of the restorer depends on picture content and level.

Generally, due to the finite impedance of the video source, the sync portion of the composite picture signal will be reduced by a certain percentage. The latter will be variable if the average value of the picture signal is changing. These are termed *sync loading effects*. Susceptibility to noise and correction of poor low frequency response are treated more fully later in this article.

The lack of black level constancy at the output of a dc insertion circuit is often due to sync amplitude variations and sync loading effects.

In the keyed clamp, *extraneous signals* are often introduced into the picture signal at the point of clamping, or at points synchronized in time with the leading and trailing edges of the clamping pulses used. This may be due to unbalance in the vacuum tubes or devices used for switching or due to waveform asymmetry in the clamping pulses. Another frequent cause is a large source impedance for the video signal.

Fast dc restorers sometimes cause a waveform disturbance during vertical interval. This has been discussed by Wendt.

Performance vs. Signal Level—The dc restorer presents a varying impedance during conduction, depending on picture content and level.

Susceptibility to Signal Overload—In the keyed clamp, if the video signal equals or exceeds the clamp pulses in amplitude, the switching devices may conduct or switch during picture time instead of during clamping time.

Recovery from the effect of low frequency transients and the ability to handle power line interferences are treated more fully later in this article.

In the discussion that follows, the scope will be restricted to consideration of the keyed clamp and the only noise treated will be impulse

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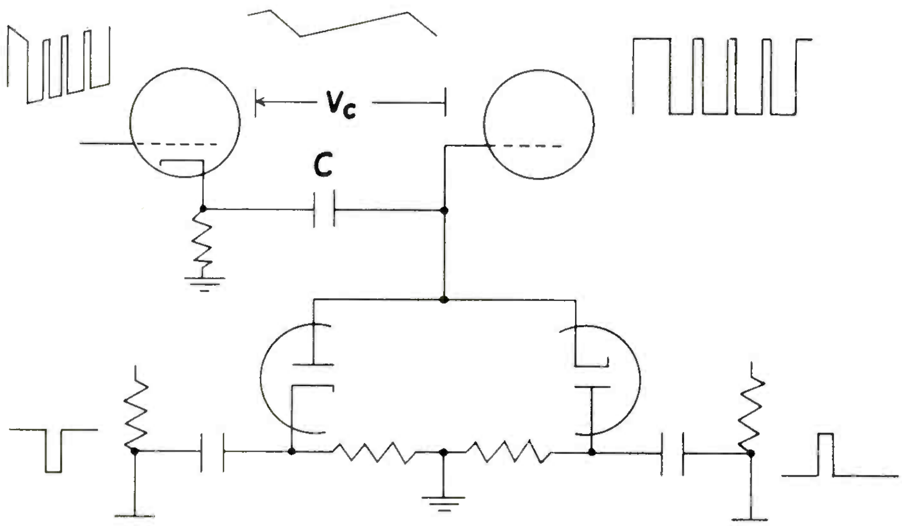


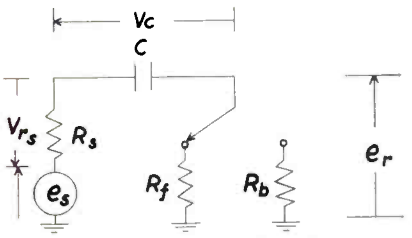
TWO-DIODE CLAMP

Figure 3

CHARACTERISTICS OF CLAMP CIRCUITS

- D.C. Error
- Sync Loading Effects
- Susceptibility to Noise
- Correction of Poor Low Frequency Response
- Black Level Constancy
- Introduction of Extraneous Signals
- Waveform Disturbance During Vertical Interval
- Performance vs. Signal Level
- Susceptibility to Signal Overload
- Recovery from the Effect of Low Frequency Transients
- Handling of Power Line Interference

Figure 4



$0 \leq t \leq T_1$ $\quad$ $T_1 \leq t \leq T$

EQUIVALENT CIRCUIT

$R_f + R_s = R$

$R_b + R_s = R_b$ approx.

$$(1) \quad \frac{q_1}{c} + R\frac{dq_1}{dt} = e_s(t) \qquad (0 \leq t \leq T_1)$$

$$(2) \quad \frac{q_2}{c} + R_b\frac{dq_2}{dt} = e_s(t) \qquad (T_1 \leq t \leq T)$$

Figure 5

LOW FREQUENCY TRANSIENTS

Let $e_s = E(t)$

RECOVERY TIME IN CYCLES

$$n = \frac{\ln \frac{1}{K}}{\frac{T_1}{RC} + \frac{T - T_1}{R_b C}}$$

Figure 6

type noise, having a sharp peaked characteristic.

The Equivalent Circuit—Figure 5 shows the equivalent circuit for the keyed clamp. E_s is the signal voltage; R_s is the source resistance; C is the clamp coupling capacitor; V_c is the voltage developed across the clamp capacitor; and e_r is the output voltage. This is a switch circuit with R_f the forward resistance present during the clamp interval, and R_b the back resistance present during the off time.

There are two sets of circuit equations; one for the interval from O to T_1, the clamp interval, and the other during the balance of the horizontal period from T_1 to T.

Performance

Recovery from Low-Frequency Transients

The keyed clamp is very valuable in the elimination of the effects of such frequency disturbance as line surges, power supply bops, and switching transients. In Figure 6, we show a step function added to the video signal to represent such a low frequency transient. It is important to note that the clamp is successful in removing the effect of such disturbances if they are added to the signal and do not modulate it. The number of cycles required to reduce the disturbance to a fraction K of the original amplitude E is shown to be a function of $\frac{T_1}{RC}$. The second factor in the denominator may usually be neglected.

In Figure 7, we have the recovery time in cycles as a function of T_1 divided by Rc for several correction factors 1 per cent, 2 per cent and 5 per cent. As an example, in order to recover within a period of a line the clamp interval must be approximately five times the "on" time constant if the clamp duration is five microseconds. Reasonable values of R and C would be 1000 ohms and 1000 micro-microfarads. For much larger values of RC, more clamping cycles must occur to reduce the disturbance at the output to the order of 1 per cent to 5 per cent.

Figure 8 is an oscillogram, showing a square wave disturbance (top) and the resulting output signal (bottom) when the time constant was many times the clamp interval of five microseconds. The clamp coupling capacitor was a 0.1 microfarads. In Figure 9, the bottom oscillogram shows a disturbance lasting a shorter time when the coupling condenser was reduced to .01 microfarads; while the oscillogram above shows the practical elimination of the disturbance with the further reduction of the coupling capacitor to 500 micro-microfarads.

Correction of Tilt

If the tilt in the signal has been caused by loss of low frequencies in simple RC coupling circuits, we, to a close degree of approximation, may consider the source to be a square-wave generator coupled to our clamp circuit through a single-coupling time constant. This is

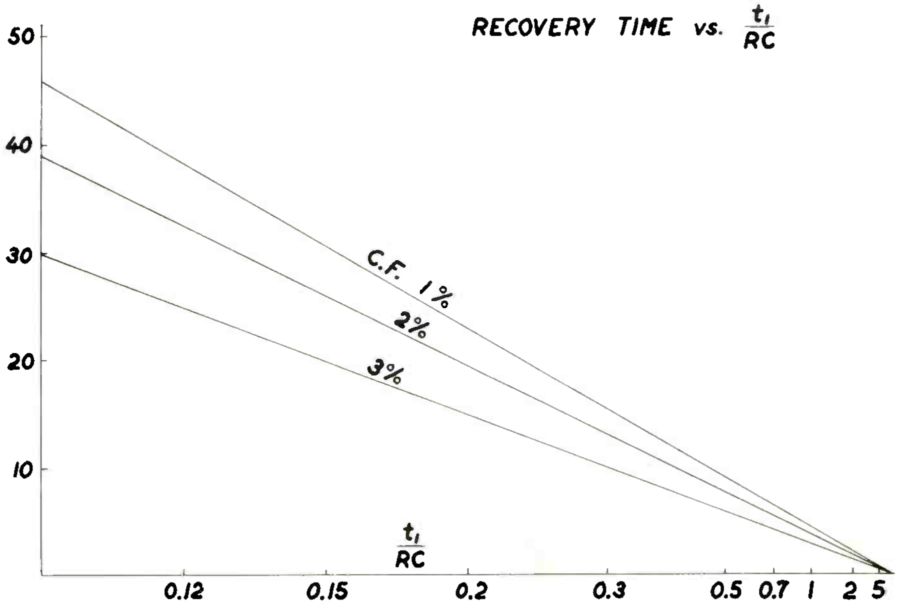


Figure 7

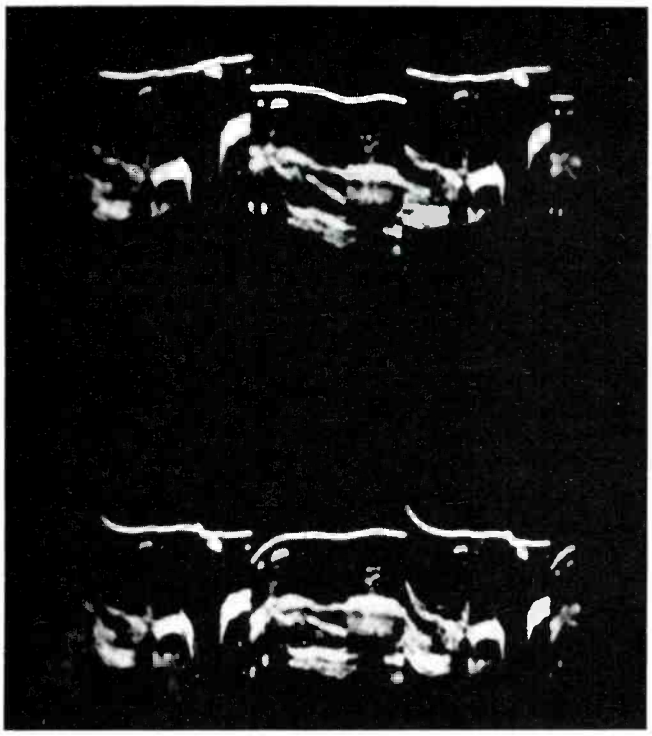


Figure 8. Oscillograms of performance against low-frequency transients.

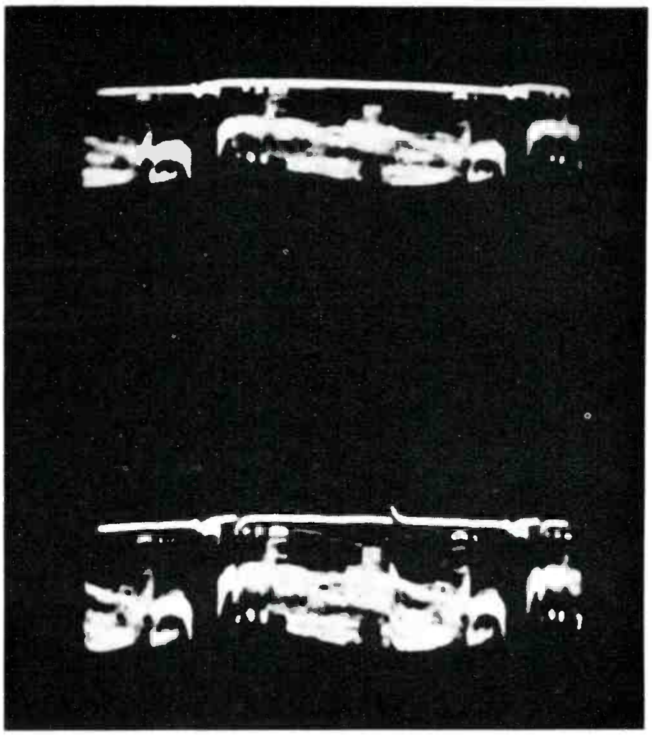


Figure 9. Oscillograms of performance against low-frequency transients.

shown in Figure 10. The tilt fraction S is expressed in terms of the peak-to-peak amplitude E.

This makes up the low frequency component of the over-all picture signal shown on Figure 11, a picture white for half a field and black during the other half.

The signal voltage at the input to the clamp is the locus of the tips of the blanking pulses. The clamp output tilt is less than the input by the factor K where K again depends on the clamp interval T_1 and the "on" time constant RC. See Figure 11.

Figure 12 shows the tilt reduction factor as a function of T_1 divided by RC. For example, if the time constant is 50 times the "on" interval, the tilt is reduced to 7 per cent of its input value.

Figure 13 shows the oscillogram of an input video signal having considerable tilt and low frequency disturbance. The upper oscillogram shows the clamp output signal when the clamp coupling condenser was 500 micro-microfarads.

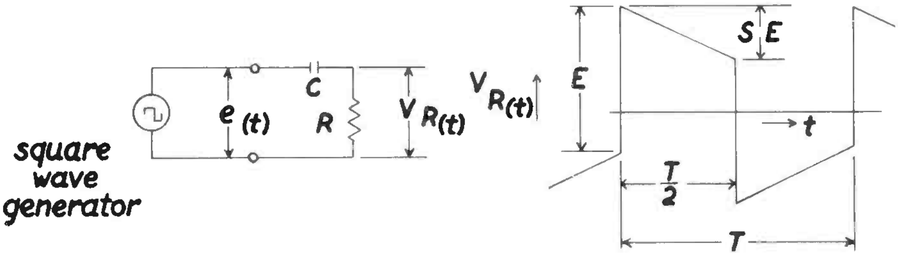
In the upper oscillogram in Figure 14, the capacitor was raised to .01 microfarads and the lower oscillogram is the output signal with a 0.1 microfarad coupling capacitor.

In considering the reduction of low frequency response requirements of an amplifier due to the use of a keyed clamp, it is interesting to note how poor a response we can tolerate. The limit, of course, is determined by how much shading we can stand along a horizontal line. This has been established by various observers as between 2 per cent and 5 per cent of the video amplitude. If we take the 2 per cent figure, this leads to a minimum effective time constant ahead of the clamp of approximately 1600 microseconds. This corresponds to a low frequency cutoff of 100 cycles. With no clamp the low frequency limit would have to be extended down to approximately 3/10 of a cycle. See Figure 15.

Handling of Power Line Interference

The results of analysis of power-line interference in the signal again shows that the ability of the clamp to develop the hum voltage across the clamp coupling capacitor and thereby subtract it out of the signal is greater the longer the clamp interval and the smaller the clamp time constant.

Figure 16 shows the output signal when the input signal has twice as



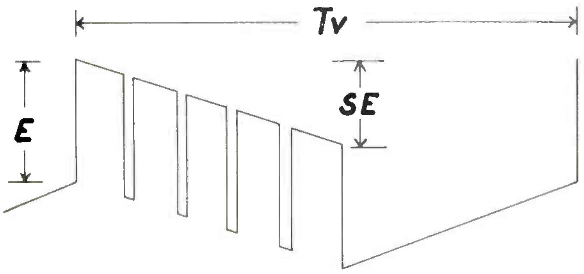
$$e(t) = E \qquad 0 \le t \le \frac{T}{2}$$

$$e(t) = 0 \qquad \frac{T}{2} \le t \le T$$

$$S = \frac{1 - \varepsilon^{-\frac{T}{2RC}}}{1 + \varepsilon^{-\frac{T}{2RC}}}$$

Figure 10.

TILTED INPUT SIGNAL



For low frequency component

$$e_s = \frac{E\left(\varepsilon^{-\frac{t}{R_1C_1}} - 1\right)}{1 + \varepsilon^{-\frac{Tv}{2R_1C_1}}}$$

Tilt Reduction Factor

$$K = \varepsilon^{-\frac{mT_1}{RC}}$$

$$m = \frac{Tv}{2T}$$

Figure 11.

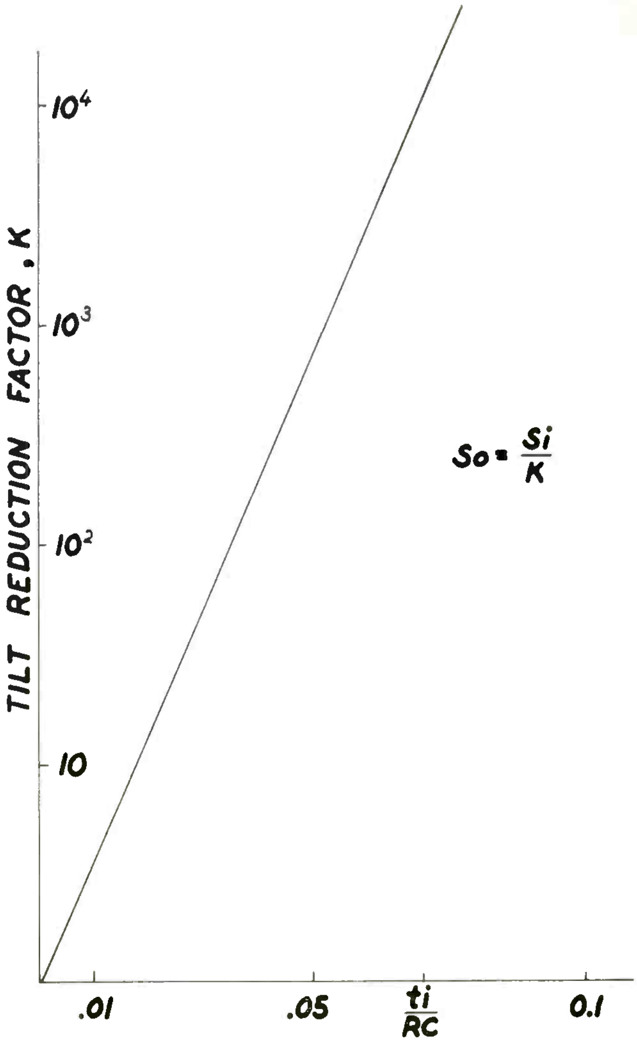


Figure 12.

much peak-to-peak hum as video. The upper oscillogram is for a two diode clamp with C = .01 microfarads and lower for a four diode clamp having somewhat lower forward resistance.

In Figure 17, for the same input signal again having twice as much peak-to-peak hum as video, we see the output signals for the two and the four diode clamp when the coupling capacitor has been reduced to 500 micro-microfarads.

Impulse Tube Noise in Video Channel

In all our performance consideration thus far, on recovery from the effects of low frequency transients, on the correction of tilt, and on the handling of power line interference best performance was obtained with large values of $\frac{T_1}{RC}$. It had been originally thought, because of short re-

(Continued on page 25)

Figure 13. Oscillograms of performance against tilt.

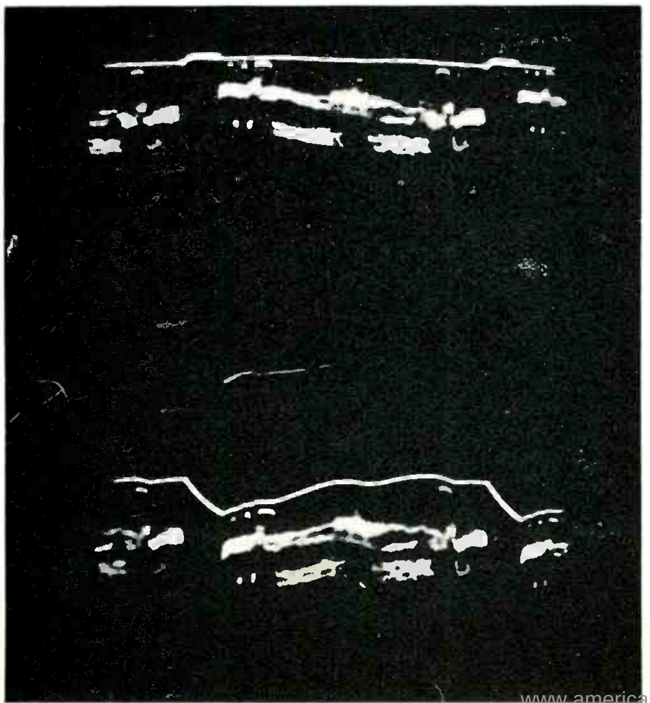
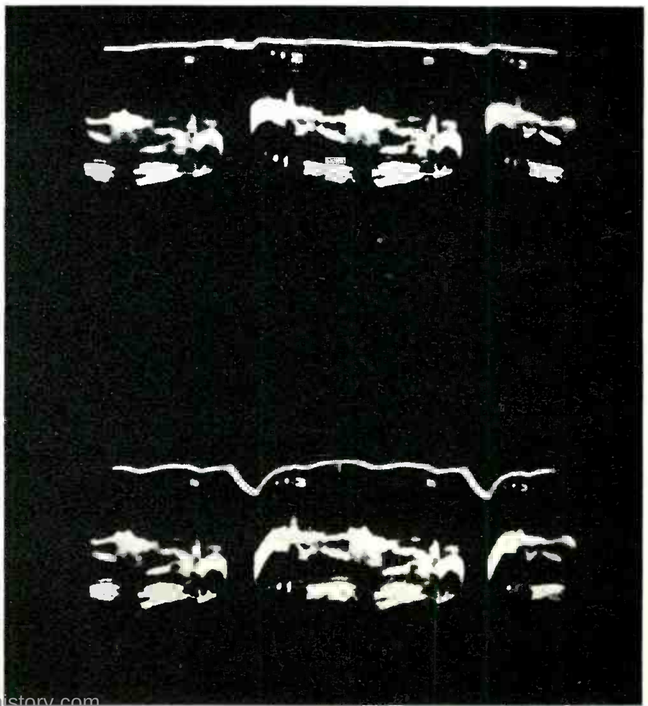


Figure 14. Oscillograms of performance against tilt.



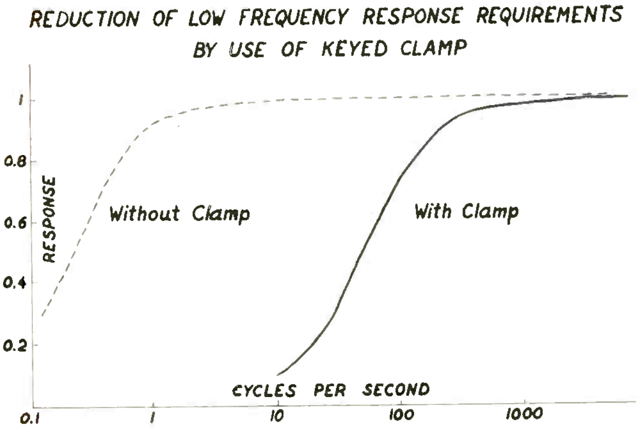


Figure 15.

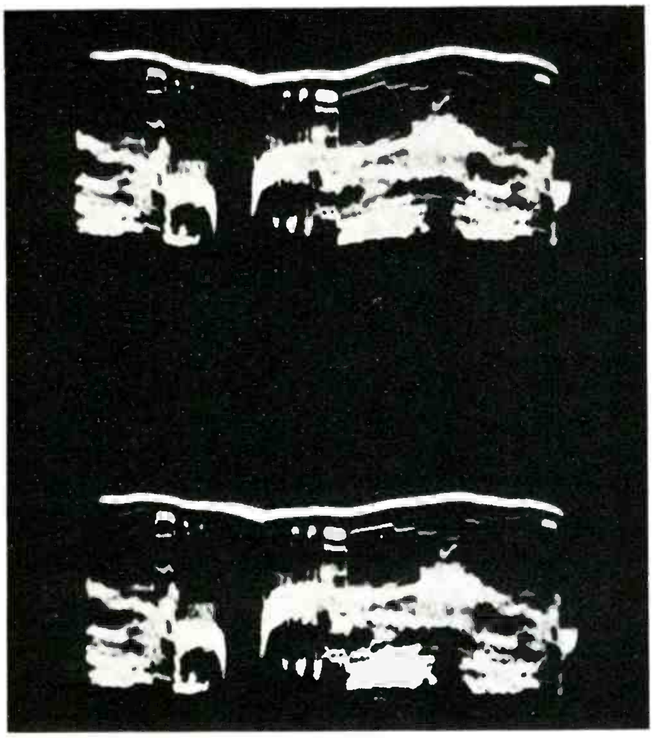
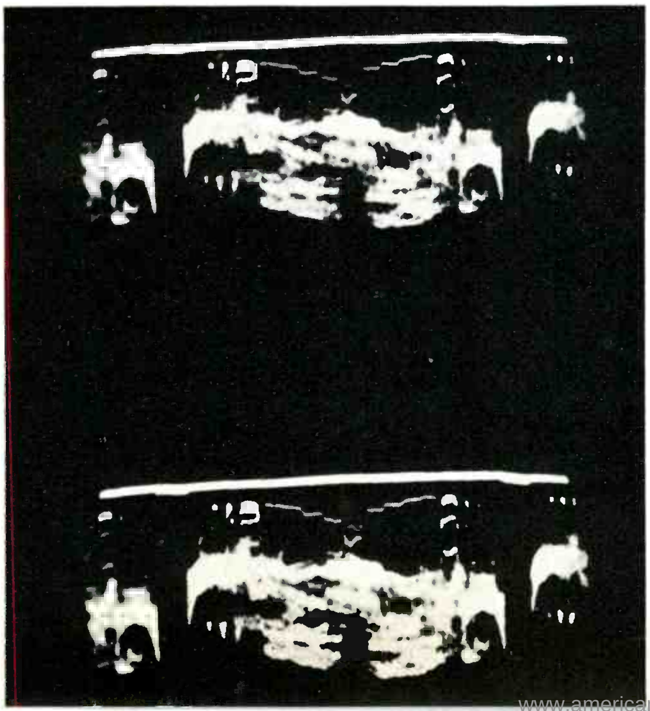
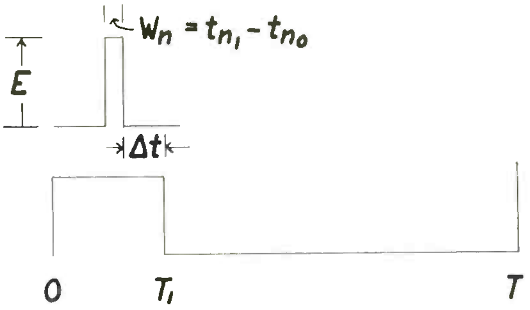


Figure 16. Oscillograms of performance against power-line interferences.

Figure 17. Oscillograms of performance against power-line interferences.



IMPULSE NOISE DURING CLAMP INTERVAL



$$e_s = E\left[u(t-t_{n_0}) - u(t-t_{n_1})\right]$$

NOISE REDUCTION FACTOR

$$K = \varepsilon^{-\frac{\Delta t}{RC}}\left(1-\varepsilon^{-\frac{W_n}{RC}}\right)$$

Figure 18.

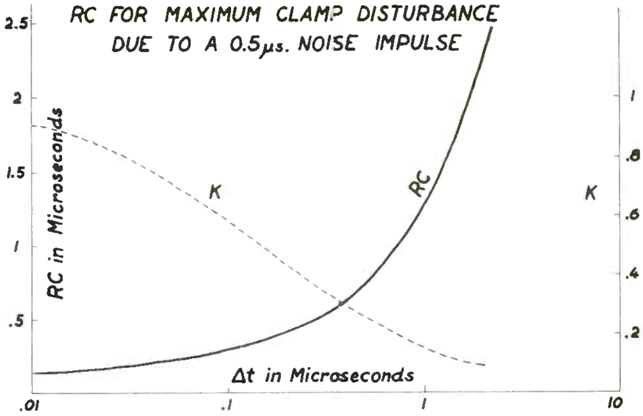


Figure 19.

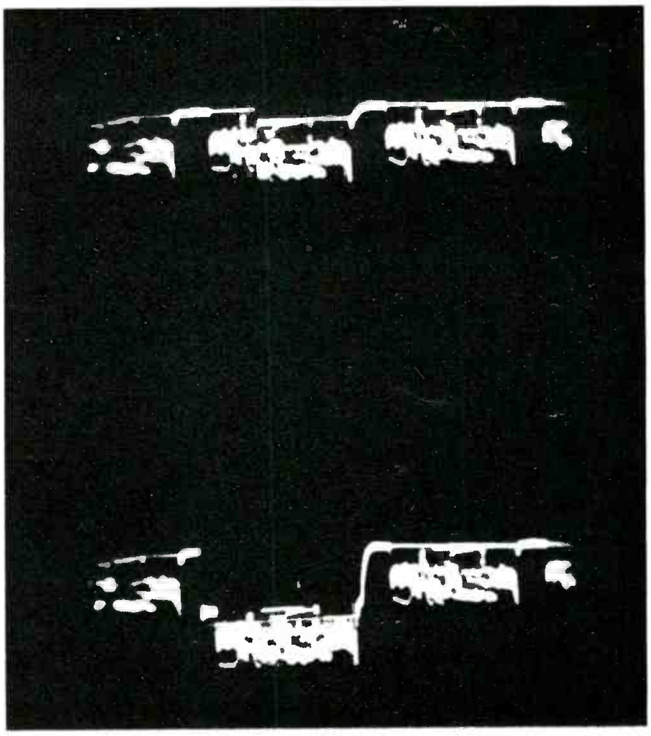


Figure 20. Oscillograms showing performance against impulse-type noise.

R. F. VISUALIZER SPRAY

The professor invents a method
to see an R. F. field.

By Professor Oscar der Snikrah

Since the beginning of communication by radio waves, there has been some question in the minds of many regarding the basic theory of the actual processes involved that permit the propagation to take place.

Although it is a well known fact that application of R.F. energy to a device known as an antenna will cause the radiation or propagation of this signal to parts elsewhere, little is known or has been explained about the actual processes taking place as the signal is wending its way through space.

The largest barrier in the way of understanding what's going on lies in the fact that the "waves" are totally invisible to the naked eye and are only apparent by using devious means of interception such as some sort of a "detector." In recent years many crafty devices of this nature taking many different forms have been evolved largely from man's inventive nature.

Even though many curious things have resulted from this unique process of detecting invisible things taking place in the area this has not been the answer to the question of what's going on in the first place. Even though detection processes have been developed that display pictures derived out of the invisible energy present in the air, some of the more serious thinking scientists have wondered if the whole thing isn't some sort of a self-hypnosis phenomenon subject to some other unknown theory that might overnight cause the whole thing to cease existing just as rapidly and unexplained as it started.

Although our research staff has long been aware of the dangerous ground upon which a whole industry has been founded, we have kept the matter relatively quiet in order not to cause any alarm or mass hysteria.

At this date, however, we can talk about the matter since our many years of research have produced the development of a method that not only proves the existence of R.F. "waves" but actually makes it possible to see them.

Just as sound waves consist of rarefraction and compression of air particles, the same takes place in the case of radio waves except that it is on a magnetic principle instead of air pressure system concepts.

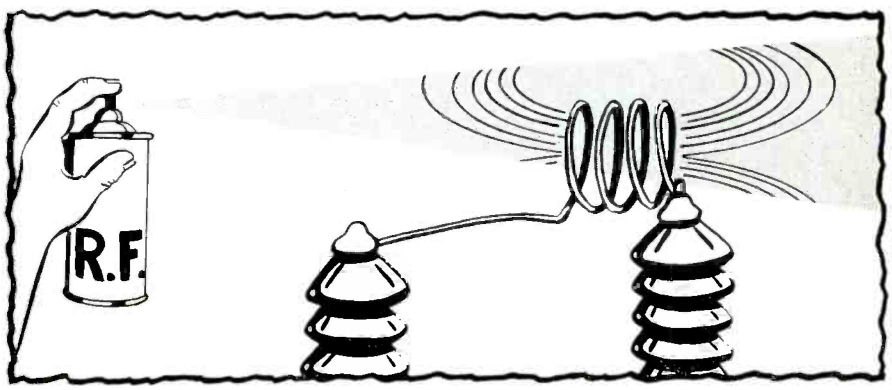
Our contribution then was to develop a special spray which caused these "radio" waves to become visible when applied to areas where they were present. Although it is beyond the scope of this preliminary article to discuss the actual basic invention, let it be said that the final result is the important thing.

A special spray consisting of ionized rare dust particles is blown out in the air under examination. The spray is kept under pressure and does not become "active" until released in the air. A form of precipitation instantly takes place upon its release causing it to assume a density in direct relation to the magnetic or electrostatic wave it encounters. Regardless of the speed of the wave (which some say is 186,000 miles per second), the instantaneous precipitation causes the wave to appear at a standstill as seen in the presence of the spray.

The value of this discovery will become immediately apparent in the mind of every engineer who has often wished he could "see" the radio waves. Since the spray will soon be available in large quantities at low prices, the immediate use of crop dusting airplane techniques is predicted for spraying the area around an AM directional antenna system. Photographs of the radiated energy would save countless hours of tedious measurements.

Somewhat similar to the aurora borealis display of northern lights, special considerations were necessary in manufacturing the spray so that various frequencies could easily be identified from each other. Now available in the m/f-h/f, or vhf types, the particular spray can be used that fits the particular problem. More selective types are being field tested.

There is a possibility that the government will find some military uses of this discovery and its use has been offered to them.



R. F. Spray shown in application around an H.F. coil.

Projector Development

Starts on page 8

manager of one of the largest film distributors was looking at another part of the economic picture.

"When this machine is in use it will cut down marvelously on our overhead, and we should be able to pass on some of the savings in print replacement costs to the broadcasters. The release print we send out to stations costs us a lot of money. If it comes back ruined, we have to throw it out. Anything that's done to make the new film last longer is a boon to the industry."

On the other hand, a station program manager was concerned about the problem of longer life for old films. "This thing solves our film problems," he said. "It makes our old films look like new. We held off buying equipment for a year, waiting for this thing to be ready. Why, we've got $30,000 worth of old films that we've put out to pasture on our shelves. We can start making use of those films again."

Another visitor concerned with film-to-tape transfers announced that he was looking into the advantages of Kodak's continuous 16mm film projector as a program source for dubbing film inserts into tape shows.

"We're always concerned about presenting the best possible image to the tape," he said, "and we think this will help."

Some viewers met the unit with hopeful reserve. One station owner put it this way:

"In every improvement there are, undoubtedly, problems, and we don't know what they might be. We have had lots of problems with the existing projection equipment: loss of loop, scratches, sprocket troubles. We'll have to put this thing in our station before we can give you our opinion of it."

Although it comes from a representative of the organization which will be marketing the projector, the statement by John Wall, G. E.'s broadcast sales manager, pretty well sums up general N.A.B. reaction to the new CMP 350:

"We feel that this is the most significant development in television projection in the past 15 years," commented Wall. "Now local stations across the nation can combine the economy of 16mm projection with 35mm quality."

Minnesota
Minneapolis
Electronic Expeditors, Inc.
FEderal 8-7597

Mississippi
Jackson
Ellington Radio, Inc.

Missouri
Kansas City
Burstein-Applebee Company
BAltimore 1-1155

New Mexico
Alamogordo
Radio Specialties Company, Inc.
HEmlock 7-0370
Albuquerque
Radio Specialties Company, Inc.
AM 8-3901

New York
Buffalo
Genesee Radio & Parts Co., Inc.
DElaware 9661
Mineola, Long Island
Arrow Electronics, Inc.
Pioneer 6-8686
New York City
H. L. Dalis, Inc.
EMpire 1-1100
Milo Electronics Corporation
BEekman 3-2980
Sun Radio & Electronics Co., Inc.
ORegon 5-8600
Terminal Electronics, Inc.
CHelsea 3-5200

Ohio
Cincinnati
United Radio Inc.
CHerry 1-6530
Cleveland
Main Line Cleveland, Inc.
EXpress 1-1800
Pioneer Electronic Supply Co.
SUperior 1-9411
Columbus
Buckeye Electronic Distributors, Inc.
CA 8-3265
Dayton
Srepco, Inc.
BAldwin 4-3871

Oklahoma
Tulsa
S & S Radio Supply
LU 2-7173

Oregon
Portland
Lou Johnson Company, Inc.
CApital 2-9551

Pennsylvania
Braddock
Marks Parts Company
ELectric 1-1314
Philadelphia
Almo Radio Company
WAlnut 2-5918
Radio Electric Service Co.
WAlnut 5-5840
Reading
The George D. Barbey Co., Inc.
FR 6-7451

Tennessee
Knoxville
Bondurant Brothers Company
3-9144

Texas
Dallas
Graybar Electric Company
RIverside 2-6451
Houston
Busacker Electronic Equipment Co.
JAckson 9-4626
Harrison Equipment Company
CApitol 4-9131

Utah
Salt Lake City
Standard Supply Company
EL 5-2971

Virginia
Norfolk
Priest Electronics
MA 7-4534

Washington
Seattle
Western Electronic Supply Company
AT 4-0200

West Virginia
Bluefield
Meyers Electronics, Inc.
DAvenport 5-9151

Wisconsin
Milwaukee
Electronic Expeditors, Inc.
WOodruff 4-8820

". . . hard clamps are often susceptible to noise . . ."

CIRCUITS starts on page 16

covery time, that this would also be the case in performance against impulse type noise. Field experience, however, has shown that hard clamps, that is, clamps with short time constants having small coupling capacitors of the order of 500 micro-microfarads are highly susceptible to impulse type noise and, in many cases, it has been necessary to completely by-pass the clamp or immobilize it to let the program go through.

An analysis of the clamp behavior in the presence of noise pulses gives some insight on this problem. In Figure 18, we have a single noise pulse occurring during the clamp interval from 0 to T_1. Its amplitude is E.

Let the trailing edge of the noise occur at a time Δt away from the end of the clamp cycle. The percentage of the noise amplitude E clamped in at the Time T_1 is then given by the relation shown. This is independent of the clamp interval and depends only on the clamp time constant, the noise pulse width, and the nearness of the noise pulse to the end of the clamp cycle. This has a minimum for two values of RC. It is naturally most severe when the end of the noise pulse coincides with the end of the clamping interval, but, even in this condition, the effect may be minimized for all noise pulse widths by an increase in the value of the clamp coupling capacitor. In order to limit the clamping disturbance to a maximum 2 per cent, then the clamp coupling capacitor must be raised to approximately .05, assuming of course our original 500 ohm circuit resistance.

Figure 19 shows a plot of the relationship for RC to give maximum disturbance for different values of ΔE.

In Figure 20, we have an oscillogram showing the effect on a clamp circuit of a noise pulse. The upper oscillogram shows the much lesser effect when the noise pulse occurs between clamping intervals when the diode is protected by bias. In order to show even this effect, the bias had to be reduced to a couple of volts by lowering the amplitude of the clamping pulses.

Conclusion

Clamping circuits, both of the restorer and the keyed clamp types, have a number of characteristics by which their performance may be evaluated. These include the dc error, sync loading effects, the effect of variation of video level and picture content, distortion of waveform during the vertical interval, the effect of low frequency transients and the correction of tilt, the elimination of power line interference and susceptibility to noise. The last four have been examined, and we have concluded that the performance against tilt, power line interference, and low frequency transients, calls for as large a ratio of clamping time to clamp time constant as is practical. In the case of noise, performance is not dependent on the duration of the clamping time and is aided by an increase in the time constant. Ability to correct tilt, remove hum, and recover from low frequency transients, though lessened, still remain effective to a considerable degree.

FM Antenna Design Considerations For Multiplexing

A description of a new FM transmitting antenna designed to provide the high gain, broad bandwidth, and linearity desirable for multiplex operation.

By DWIGHT "RED" HARKINS*

SINCE the advent of FM broadcasting, new types of radiation systems have been appearing. The purpose of each system is to provide the maximum radiation efficiency together with a power gain obtained by "stacking" more than one antenna together.

During the past, various configurations have been used. Some have been tuned slots, others have appeared in the form of tuned rings, others have been complex tuned "batwings," and there has been a family of antennas using the folded dipole principle.

Prior to the advent of multiplexing, little attention was given to the band width of the antenna system. Even the proper tuning of the array was not too critical as no noticeable deterioration resulted in received signal.

As detailed in my earlier articles in this magazine, the addition of supersonic subcarriers to the transmitter requires the use of a properly designed and adjusted antenna if cross-modulation is to be avoided. To review the problem briefly, it has been found that any condition in the system that permits the sidebands generated to become altered either in amplitude or phase from their original form will result in intermodulation.

Audio components that are modulating the main channel will produce a multitude of side bands above and below the center carrier. If this "band" of energy passes through a network of any kind that offers reactance that changes in value respective to the center frequency in a non-linear manner, the resulting intermodulation to the sub-carriers is readily apparent.

The same basic design problems presented themselves with TV transmitting antennas and were resolved by designing low-Q broad band systems properly phased and terminated.

Careful analysis of the requirements for FM transmitting antennas was made by Pete Onnigian, owner of Jampro Antenna Co. The result was a complete line of FM antennas that incorporated many features permitting ideal operation.

First, let us look at the basic radiating element itself which is a complete antenna if used alone. As shown in Figure 1, it is a folded dipole, folded back upon itself. This results in an omni-directional radiation pattern. As many as 16 of these individual units may be properly spaced on a tower with a power gain of 15.85 resulting from the array.

The biggest problem in using multi-element systems is to obtain proper power distribution and impedance matching. The feed point of each radiating element has a non-reactive impedance of 50 ohms. The transmission line from the transmitter is terminated in a power divider "junction box" located in the center of the array. This junction box divides the power equally and matches the impedance of the load to either 2-4-8-12 or 16 bays as the case requires.

Here, then, is the only simple way of correctly allowing each element to be properly tuned and individually adjusted for its own correct feed point impedance of 50 ohms non-reactive.

Figure 2 illustrates a power divider designed for feeding 12 bays. To insure absolute phasing that is uniform with frequency, each individual bay is fed with a length of ⅞-inch Prodelin Spir-o-line, teflon dielectric coax. The length of the line to each bay is kept identical. The length of the interconnecting cable to the furthest bay determines the length used for each of the other bays that are located closer to the power divider junction box. As seen in Figure 3, the extra cable feeding the closer radiator elements is coiled around the tower or supporting mast. This is the same procedure

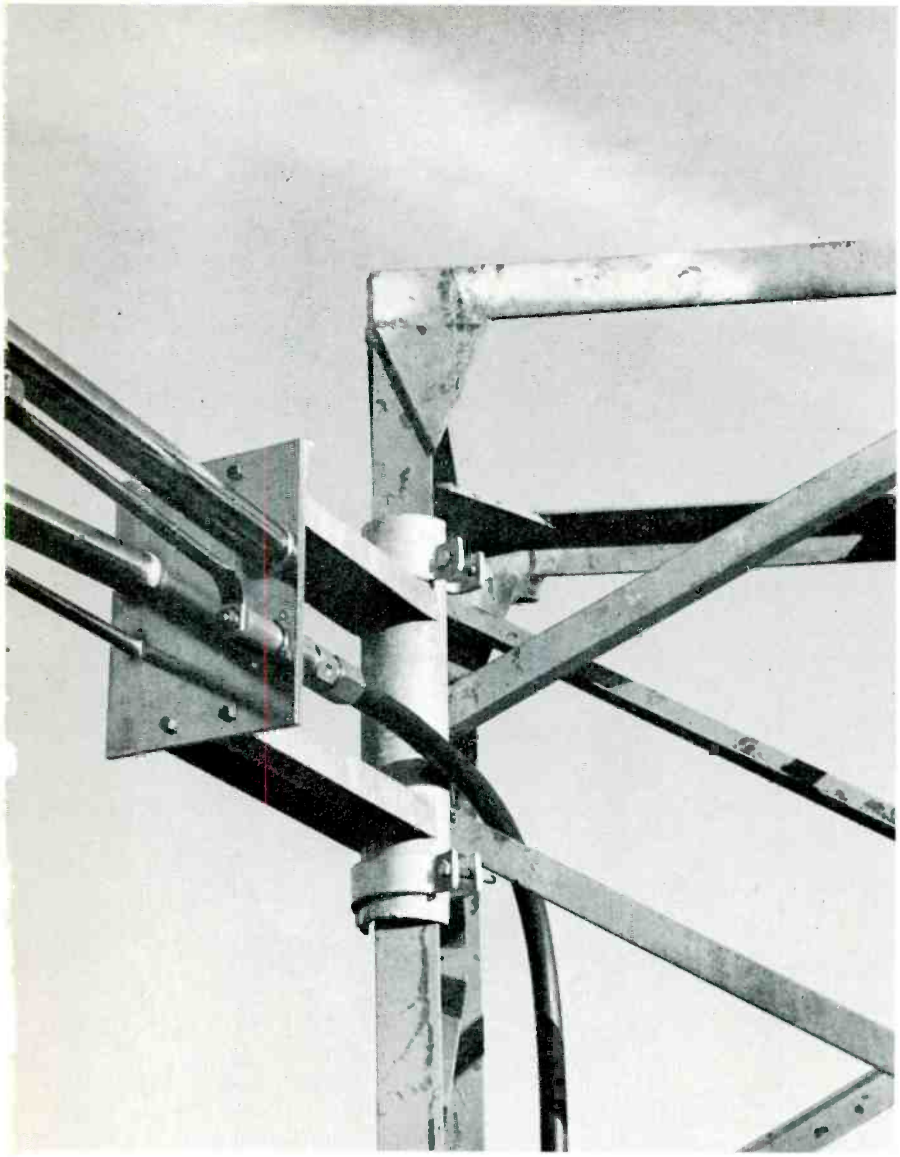


Figure 1. Single bay of Jampro antenna described in this article.

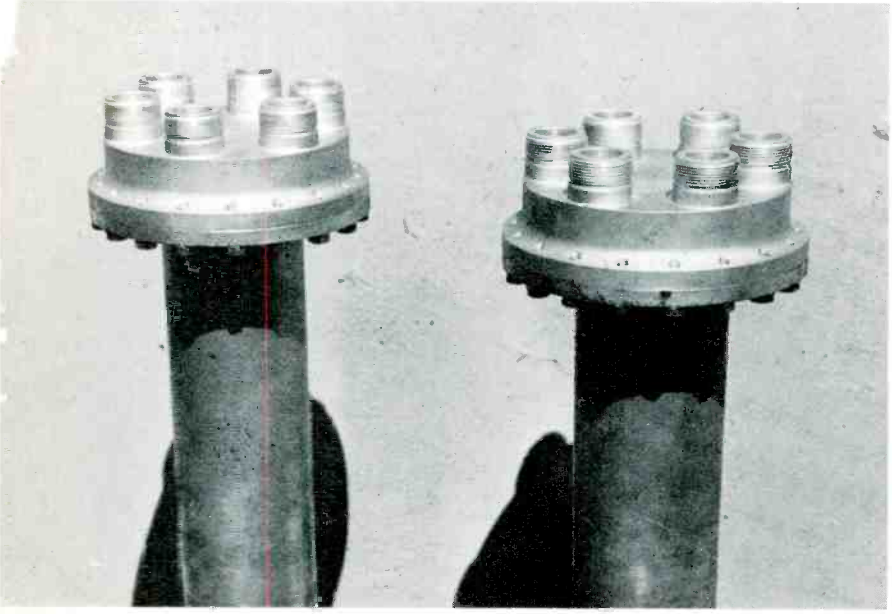


Figure 2. Power divider to feed twelve bays of antenna.

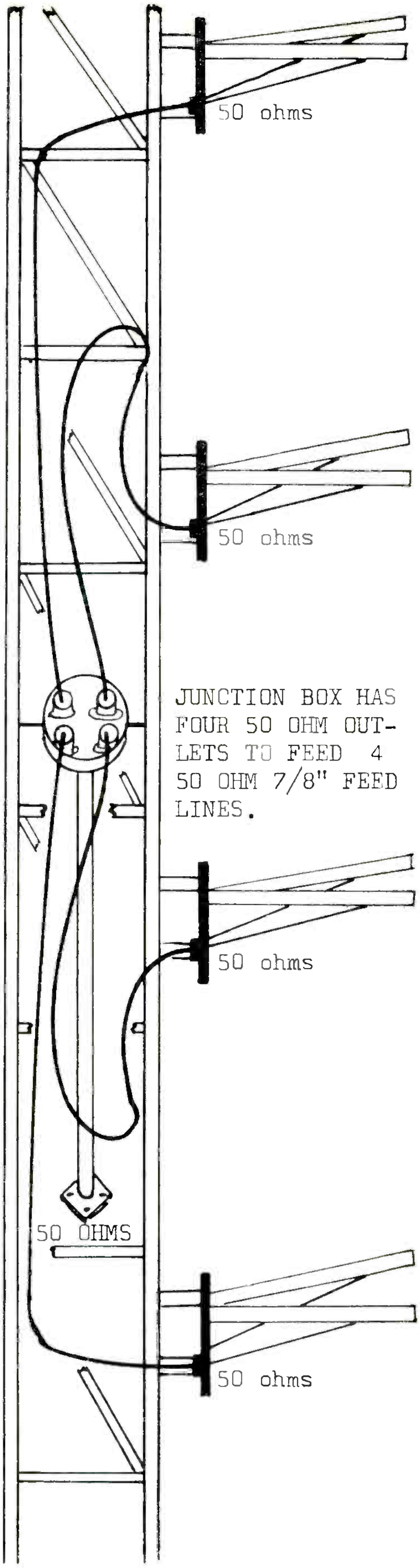


Figure 3. Antenna feed system. All elements receive equal power of the same phase.

*4444 East Washington, Phoenix, Arizona

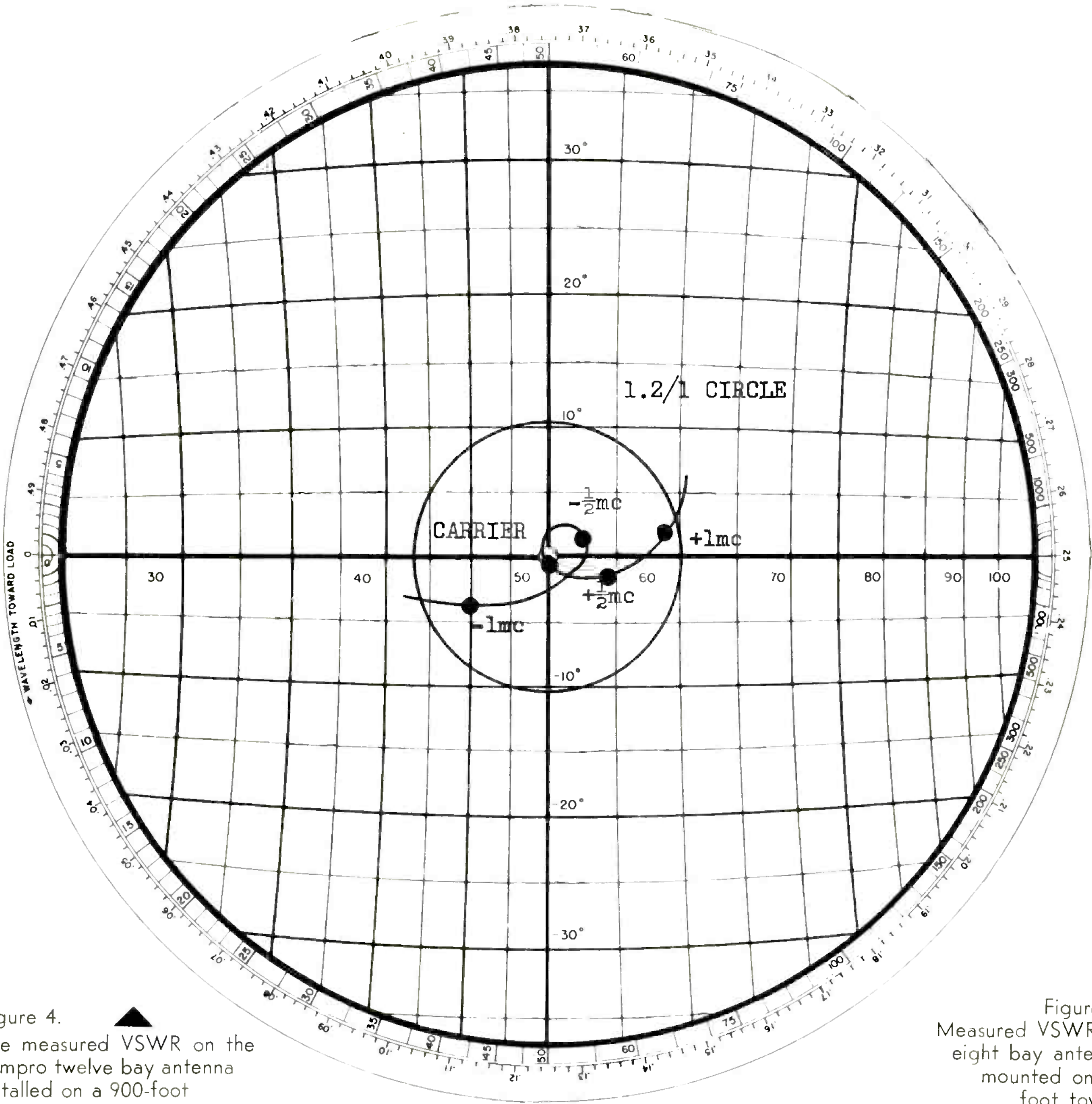
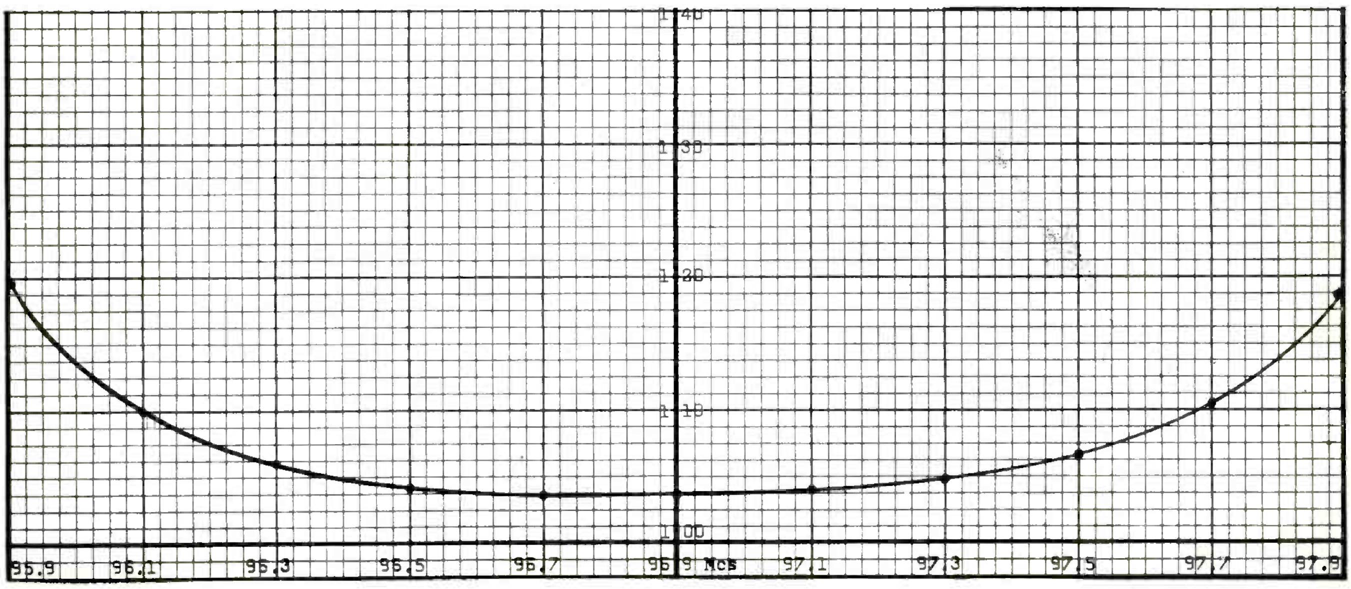


Figure 4.
The measured VSWR on the Jampro twelve bay antenna installed on a 900-foot TV tower.

Figure 5.
Measured VSWR of eight bay antenna mounted on 30 foot tower.



that has been used to properly feed TV transmitting arrays.

Some idea of the excellent results obtained in using these procedures is shown from the actual measurements obtained at an installation which used the 12-bay model mounted on a 900-foot tower. Figure 4 shows the measurements obtained with a Model 803A VHF bridge.

The excellent low VSWR over a broad band width is also shown by the measurements depicted in the graph of Figure 5. It is to be specially noted that the change in VSWR is uniform with the change in frequency both above and below center frequency. This has resulted from proper termination of each radiator together with proper power distribution.

Electrical beam tilting is possible for use in installations where the area to be served is relatively close to an extremely high antenna location. As much as nine degrees of electrical beam tilting can be obtained.

For areas where heavy icing occurs, heating elements are mounted and sealed inside of each radiating element where absolutely no change in antenna tuning is experienced. This special method of de-icing does not change the VSWR of the antenna in any way even under the heaviest of icing conditions.

Another feature is the ease with which this system can be installed on any type of tower. Brackets are supplied, tailor made, for the individual tower whether it be a round pole, triangular, or square section. For tapering self supporting towers, brackets are supplied with each section permitting final correct alignment. A bracket is also supplied for mounting the junction box.

The horizontal radiation pattern approaches the ideal and is entirely dependent upon the mounting structure. Horizontal radiation within 2 db. is possible when mounted on towers up to 36 inches on each face. When mounted on towers with over 3 feet on each face, the pattern tends to become more of a cardiod shape. On towers of 6 feet and larger, the whole antenna can be mounted inside the structure if the antenna is pretuned at the factory to overcome the de-tuning effect of the tower members.

AMENDMENTS AND PROPOSED CHANGES OF F.C.C. REGULATIONS

CONELRAD; Participation by Telephone Services

At a session of the Federal Communications Commission held at its offices in Washington, D. C., on the 7th day of April, 1960:

The Commission having under consideration the provisions of section 210 (b) of the Communications Act of 1934, as amended, which permit the rendition by common carriers of free service to agencies of the Government in connection with preparation for the national defense; subject, however, to the provision that such free service may be rendered only in accordance with such rules and regulations as the Commission may prescribe therefor; and

It appearing that it is necessary and desirable that the Commission further implement the statutory provision so as to permit the rendition of such free service in connection with the CONELRAD operating system and in furtherance of the national defense and the Commission's obligations under Executive Order 10312; and

It further appearing that it is necessary and desirable in the public interest that such service be made available for the furtherance of the national defense without delay, and that any delay would be contrary to the public interest; and

It further appearing that the amendment adopted herein pertains to military matters and hence that compliance with the public notice and procedural requirements of the Administrative Procedure Act is unnecessary;

It is ordered, That, pursuant to the provisions of sections 1, 4 (i), 210 (b) and 303 (r) of the Communications Act of 1934, as amended, Part 3 of the Commission's rules and regulations is hereby amended, effective April 8, 1960, to add the following section:

§ 3.980 Participation by telephone companies.

(a) Telephone companies that have facilities available in place may connect without charge in the interest of preparation for the national defense commercial radio broadcast stations not affiliated with a commercial radio network operated by ABC, CBS, MBS, NBC, or any other network, to one of the aforesaid networks during CONELRAD Drill or Radio Alert periods, and at the expiration of the aforesaid periods disconnect said unaffiliated station from the network; *Provided*, That

(1) The radio station is authorized by the Commission to participate in the CONELRAD operating system under § 3.951;

(2) The network authorizes such connection; and

(3) The radio station has in service a local channel from the radio station studio or radio transmitter to the telephone company principal central office (toll test).

(b) Every such carrier rendering any such free service shall make and file, in duplicate, with the Commission, on or before the 31st day of July and on or before the 31st day of January in each year, reports covering the periods of six months ending on the 30th day of June and the 31st day of December, respectively, next prior to said dates. These reports shall show the call letters and locations of the broadcast stations to which free service was rendered pursuant to this rule and the charges in dollars which would have accrued to the carrier for such service rendered if charges therefor had been collected at the published tariff rates.

REMOTE CONTROL AUTHORIZATIONS

1. Reference is made herein to: (a) The Commission's Order of April 25, 1958, modifying § 3.66 (c) (4) of the rules; (b) Petition for Reconsideration thereof filed on May 26, 1958, by the International Brotherhood of Electrical Workers; (c) the Commission's Memorandum Opinion and Order adopted on July 29, 1959; (d) the Commission's Notice of Proposed Rule Making adopted on July 29, 1959; (e) Statement of International Brotherhood of Electrical Workers filed October 1, 1959.

2. Prior to the amendment of § 3.66 (c) (4) of the Commission's rules by the above referenced Order of April 25, 1958, it was required that: "An authorization for remote control will be issued only after satisfactory showing has been made in regard to the following, among others:

* * * * *

(4) The station, if authorized to operate with a directional antenna and/or with a power in excess of 10 kw, will be equipped so that it can be satisfactorily operated * * * on a CONELRAD frequency with a power of 5 kw or not less than 50 per cent of the maximum licensed power whichever is the lesser * * *."

Apart from the foregoing, which related only to authorization for remote control, the Commission's rules nowhere specify minimum transmitter power for CONELRAD operation. The power to be employed for CONELRAD use is, instead, determined by CONELRAD Field Supervisors on a case-to-case basis and is, in some instances, less than 50 per cent of the licensed power. Such a station seeking authorization for remote control under the aforequoted portion of the rules might be required to install a new transmitter for operation on a CONELRAD frequency with 50 per cent of maximum licensed power, simply to qualify for operation by remote control.

3. The above-referenced order of April 25, 1958, modified § 3.66 (c) (4), quoted in part above, to the extent of adding a provision that the requirement thereof regarding power for CONELRAD operation would not apply in instances where the CONELRAD Field Supervisor certifies that power of less than 50 per cent of maximum licensed power will provide satisfactory service under CONELRAD. In this order, the amendment was considered procedural in nature, and prior publication of the Notice of Proposed Rule Making was, accordingly, omitted as unnecessary.

4. In the Memorandum Opinion and Order adopted on July 29, 1959, the Commission granted the above-referenced International Brotherhood of Electrical Workers petition for reconsideration of the order of April 25, 1958, on the basis that the amendment effected thereby was, in fact, substantive and not procedural in nature, and that the rule making procedure provided by the Administrative Procedure Act had not been followed, although there was no finding that such procedure would have been either impracticable, unnecessary, or contrary to the public interest in this particular instance. The order of April 25, 1958, was vacated, with the effective date stayed, pending Commission action on the above-referenced Notice of Proposed Rule Making adopted on July 29, 1959, wherein it is proposed that § 3.66 (c) (4) of the rules, quoted in part in paragraph 2 above, be amended by the addition of: "*Provided, how-*

ever, That the power may be less than 50 per cent upon certification by the CONELRAD Field Supervisor that such a power will provide satisfactory service under CONELRAD."

5. In the Statement filed with the Commission on October 1, 1959, the International Brotherhood of Electrical Workers contends that the proposed amendment would: (a) Reduce the minimum power required for CONELRAD operation of remote control stations and in effect eliminate any requirement of an objectively determinable minimum; (b) redelegate to field supervisors responsibilities with respect to national defense which the President has delegated to the Commission; (c) overemphasize the importance of denying navigational aid to an enemy and neglect the increased importance of transmitting civil defense information to the public, with particular regard to evacuation and the dangers associated with radioactive fallout; (d) weaken the "framework for CONELRAD operations" which depends upon the total number of participating stations and their operating power which would thereby be reduced. The International Brotherhood of Electrical Workers is of the opinion that minimum CONELRAD power should be increased rather than decreased in view of "the necessities of Civil Defense." The International Brotherhood of Electrical Workers would allow the Commission to take cognizance of the special situation of licensees authorized for remote control operation prior to July 29, 1959, and, in individual cases, allow continued operation in accordance with the CONELRAD field supervisors' certifications. The International Brotherhood of Electrical Workers submits, however, that the Order of April 25, 1958, should be vacated.

6. The Commission has carefully considered the IBEW Statement which was the only response to the Notice of Proposed Rule Making of July 29, 1959. CONELRAD Field Supervisors, both before and after the amendment of April 25, 1958, have had the task of determining on a case by case basis with what power stations must operate to provide the needed CONELRAD coverage to the area. The CONELRAD Rules, which have been coordinated with the North American Air Defense Command (NORAD), specify a maximum power of 10 kw for CONELRAD operation but do not specify minimum power. The amendment would eliminate the disparity between CONELRAD power capabilities as required by the remote control rules and those established individually by the CONELRAD Field Supervisors.

7. In accordance with §§ 3.920 and 3.921 of the Commission's rules: "CONELRAD activities under the authority

of FCC are under the immediate supervision of three FCC Zone Supervisors whose respective zones are coextensive with the three Air Defense Force Areas * * * Each zone is divided into several divisions corresponding to USAF Air Divisions. An FCC Coordinating Engineer is assigned to each Air Division and has responsibility under the Zone Supervisor for all CONELRAD activities under the authority of FCC in his division." In accordance with one of the provisions of NORAD Regulation No. 55-7: "FCC NORAD Region Supervisor personnel are under the direct supervision of the U. S. Supervisor (CONELRAD) FCC, Washington, for the purpose of effecting rapid coordination on all matters relative to CONELRAD, and are responsible for directing the implementation of non-government CONELRAD plans for the NORAD Regions." Accordingly, while case-to-case decisions are made by field supervisors, the FCC and NORAD have indicated, apart from the proposed amendment, that there is every confidence in the ability of these supervisors to make the necessary determinations in the interest of national defense.

8. With regard to the importance of denying navigational aid to the enemy and of furnishing civil defense information to the public, Defense Commissioner Robert E. Lee has stated on a Special CONELRAD program of December 3, 1959:

"You may be interested in knowing that the CONELRAD requirement has recently been reevaluated by the Defense Department, and we have been advised that for the aforeseeable future, perhaps ten years, CONELRAD is a military as well as a Civil Defense requirement. This is not only to deny navigational aid but to deny intelligence to the enemy, and to deny interference to our own sophisticated offensive and defensive guided missiles."

At the same time, Mr. John A. McLaughlin, Administrative Secretary to the Secretary of the Air Force, stated:

"The denial of navigational aid to the enemy in the event of an attack is a most important part of CONELRAD. But of equal importance is the strict control of all radiation devices which do not directly contribute to continental defense and necessary national operation."

It is further noted that evacuation and dangers associated with radioactive fallout are matters beyond the cognizance and jurisdiction of the FCC and neither can nor need be commented upon in the present context, except to the extent of noting that CONELRAD activities are properly coordinated with the Department of Defense, the Office of Civil and Defense Mobilization, Atomic Energy Commission, and other government organizations.

9. Operation on a CONELRAD basis is voluntary and the Commission has no control over the number of CONELRAD stations. In accordance with § 3.951 of the Commission's rules, the station desiring to participate in the CONELRAD system indicates its willingness and receives Commission authorization; any participating station may withdraw from the CONELRAD system simply by giving thirty days' notice and submitting its authorization for cancellation. This procedure would not be affected by the proposed amendment and, accordingly, the "framework for CONELRAD operations" will not be weakened by any reduction in the number of participating stations resulting from this amendment. As to weakening of CONELRAD by reducing the operating power of CONELRAD stations, in accordance with paragraph 7 above, there has been no reduction of any required minimum power for CONELRAD operation, and, in accordance with the Commission's records, there has not been a single instance of reduction in power by CONELRAD station authorized for remote control under the above-referenced Order of April 25, 1958. Instead, prior to this amendment of § 3.66 (c) (4) of the Commission's rules, there were instances of stations satisfactorily equipped for normal and CONELRAD operations which were required to provide a third set of facilities for CONELRAD operation at high power in order to qualify for operation by remote control for normal operation. The Order of April 25 was adopted, albeit without a rule making procedure, in order to rectify this situation which had resulted in instances of undue hardship imposed upon station operators desiring remote control authorization. The presently proposed amendment, like its predecessor, would eliminate this situation and would not result in a reduction in power below CONELRAD operating practices in any instance. Accordingly, the Commission does not agree that the "frame-work for CONELRAD operations" would be weakened in any way by the proposed amendment.

10. Any consideration of increasing the power required for CONELRAD operations, as suggested by the International Brotherhood of Electrical Workers, is beyond the scope of this proceeding, and, in fact, would require coordination with government agencies other than the Federal Communications Commission.

11. In summation, the Commission has determined that the proposed amendment would not: (a) Reduce the "minimum power requirement" for CONELRAD operations; (b) have the effect of reducing the power of any CONELRAD station; (c) decrease the total number of CONELRAD stations; (d) delegate new and unusual responsibilities to CONELRAD field supervisors; (e) have the effect of a misinterpretation of the purpose of CONELRAD on the part of the Commission; or (f) weaken the "framework for CONELRAD operations." The Commission further finds that the primary effect of the amendment would be to eliminate a situation where the minimum power established by CONELRAD Field Supervisors on a case by case basis is different from the power which the remote control rules require that stations be equipped to use on a CONELRAD frequency.

12. Authority for the action taken herein is contained in sections 4 (i) and 303 (r) of the Communications Act of 1934, as amended.

13. In view of the foregoing: *It is ordered*, That effective May 16, 1960: (a) Section 3.66 of the Commission's rules is hereby amended as set forth below; (b) the Stay of the Commission's Order of July 29, 1959, vacating the Commission's Order of April 25, 1958, is hereby removed and this order rendered permanently vacated; and (c) the proceeding In the Matter of Amendment of § 3.66 (Broadcast Service) of the Commission's rules relating to Remote Control Authorization is hereby terminated.

(Sec. 4, 48 Stat. 1066, as amended; 47 U.S.C. 154. Interprets or applies sec. 303, 48 Stat. 1082 as amended; 47 U.S.C. 303)

Section 3.66 (c) (4) of the Commission's rules is amended to read as follows:

§ 3.66 Remote control authorization.

* * * * *

(c) * * *

(4) The station, if authorized to operate with a directional antenna and/or with a power in excess of 10 kw will be equipped so that it can be satisfactorily operated in accordance with Subpart G of this part, on a CONELRAD frequency with a power of 5 kw or not less than 50 per cent of the maximum licensed power, whichever is the lesser, and that the necessary switching can be accomplished from the remote control position: *Provided, however,* That the power may be less than 50 per cent upon certification by the CONELRAD Field Supervisor that such power will provide satisfactory service under CONELRAD.

[F.R. Doc. 60-3412; Filed, April 13, 1960; 8:49 a.m.]

MINIMUM OPERATING REQUIREMENTS OF BROADCAST STATIONS

Daytime Operation; Schedule

1. Notice is hereby given of proposed rule making in the above-entitled matter.

2. The Commission proposes to revise § 3.71 of the rules insofar as its provisions govern the minimum operating requirements for standard broadcast stations authorized for daytime operation only. Section 3.71 of the rules, in its present form, requires all standard broadcast stations to operate a minimum of two-thirds of the total hours they are authorized to operate between 6 a.m. and 6 p.m., local standard time, and two-thirds of the total hours they are authorized to operate between 6 p.m. and midnight, local standard time, on each day of the week except Sunday. In order to meet the minimum requirement for operation after 6 p.m., standard broadcast stations authorized to operate during the period of time between local sunrise and local sunset must operate after 6 p.m., during the months when the time of local sunset specified in their licenses falls after 6 p.m. For example, during a month when sunrise and sunset times are specified as 5 a.m. and 7 p.m., respectively, the present rule requires a daytime station to operate a minimum of 8 hours between 6 a.m. and 6 p.m. and 40 minutes between 6 p.m. and 7 p.m. The required minimum operation after 6 p.m. changes, moreover, from month to month, as the interval between 6 p.m. and local sunset increases or decreases.

3. For several years the Commission has received 75 or more requests yearly from daytime stations for waiver of § 3.71 of the rules to permit them to sign off the air at 6 p.m., during some or all of the months when their specified local sunset time is later than 6 p.m. These stations claim they find it a hardship and economically unfeasible to meet the minimum requirement for operation after 6 p.m. It has been the Commission's policy to grant these requests. We believe, however, that a rule change is warranted to eliminate the necessity for these waiver requests. The rule proposed below would permit daytime only stations to sign off at 6 p.m., regardless of whether their specified local sunset time is later.

4. We also propose to revise the provision in § 3.71 relating to the notification required when a standard broadcast station must go off the air because of technical failures and similarly to revise the same provision in §§ 3.261 and 3.651, which respectively govern the minimum operating requirements of FM and television broadcast stations. The notification provisions in these rules now require licensees to notify the Commission and the Engineer in Charge of the radio district in which the station is located in writing immediately in every instance when the station must cease operating because of technical difficulties. We do not believe it necessary to require such notification when the period a station must be off-the-air because of technical problems is of such short duration that the minimum hour requirements for operation can still be met. The notification provision in the proposed § 3.71 set forth below—paragraph (b)—would re-

quire notification of operation stoppages only when they make it possible for a station to adhere to minimum operating requirements, and, in that event, would further require subsequent notification when operation is resumed.

5. Authority for the adoption of the amendments proposed herein is contained in sections 4 (i) and 303 (c) and (r) of the Communications Act of 1934, as amended.

6. Pursuant to applicable procedures set out in § 1.213 of the Commission's rules, interested parties may file comments on or before May 20, 1960, and reply comments on or before June 3, 1960.

7. In accordance with the provisions of § 1.54 of the rules, an original and 14 copies of all written comments shall be furnished the Commission.

It is proposed to amend § 3.71 to read as follows:

§ 3.71 Minimum operation schedule.

(a) All standard broadcast stations are required to maintain an operating schedule of not less than two-thirds of the total hours they are authorized to operate between 6 a.m. and 6 p.m., local standard time, and two-thirds of the total hours they are authorized to operate between 6 p.m. and midnight, local standard time, on each day of the week except Sunday: *Provided, however,* That stations authorized for daytime operation need comply only with the minimum requirement for operation between 6 a.m. and 6 p.m.

(b) In the event that causes beyond the control of the licensee make it impossible to adhere to the operating schedule in paragraph (a) of this section or to continue operating, the station may limit or discontinue operation for a period of not more than 10 days, without further authority of the Commission: *Provided,* That the Commission and the Engineer in Charge of the radio district in which the station is located shall be immediately notified in writing if the station is unable to maintain the minimum operating schedule and shall be subsequently notified when the station resumes regular operation.

It is also proposed to amend §§ 3.261 (FM) and 3.651 (TV) by substituting paragraph (b) above for the provisions of those sections relating to the notification required in the event of technical difficulties which cause a station to cease operation.

CONELRAD ATTENTION SIGNAL
Transmission Standards; Order Extending Time for Filing Comments

In the matter of amendment of CONELRAD Manual BC-3 to provide for transmission standards for the CONELRAD Attention Signal; Docket No. 13335.

The Commission has before it for consideration a petition filed April 5, 1960, in this proceeding by the National Association of Broadcasters (NAB) requesting that the time for filing comments herein be extended to June 13, 1960.

The petition states that additional time will be needed to enable individual licensees to study the proposal in light of the additional information recently furnished them by the National Association of Broadcasters.

Upon consideration of the view expressed, the Commission believes the public interest would be served by granting an extension of time to June 13, 1960, to file comments.

Accordingly, it is ordered, This 8th day of April 1960, that the time for filing comments herein is extended from April 11, 1960, until June 13, 1960; and that the time for filing reply comments is extended from April 25, 1960, to June 27, 1960.

CLEAR CHANNEL BROADCASTING IN STANDARD BROADCAST BAND
Order Extending Time for Filing Reply Comments

At a session of the Federal Communications Commission held at its offices in Washington, D. C., on the 20th day of April 1960;

The Commission has before it for consideration petitions filed April 13, 1960, by Clear Channel Broadcasting Service (CCBS) and Radio Service Corporation of Utah requesting that the time for filing reply comments herein be extended to June 1, 1960.

Both petitions note the large number of comments filed (nearly 100) and the need for additional time to properly review the comments and the detailed engineering data many of them contain. Both further state that some delay was experienced in obtaining copies of all comments. In addition, CCBS invites attention to the fact that one week of the period originally allotted for filing reply comments was consumed in attendance at the National Association of Broadcasters annual meeting.

Upon consideration of the views expressed, the Commission believes the public interest would be served by granting the requested extension of time.

Accordingly, it is ordered, That the petitions of Clear Channel Broadcasting Service (CCBS) and Radio Service Corporation of Utah for additional time to file reply comments is granted; and the time for filing reply comments is extended from May 2, 1960, to June 1, 1960.

Industry News

ITA Appoints Heck Senior Project Engineer

Clyde Heck, formerly director of the Atlantic Division of the American Radio Relay League, has been named senior project engineer for Industrial Transmitters & Antennas, Inc., Upper Darby, Pa., manufacturer of broadcast transmitting equipment. He has been chief engineer of stations WMMN, WPIC, WSOM, and private engineering consultant on broadcast transmitters, antennas and audio equipment. In his new post he will participate in the design of broadcast and communications equipment.

Narma Now Engineering Manager at Ampex

Rein Narma has joined the Ampex Professional Products Co. as manager of engineering for the Audio Products Division. Narma formerly was vice-president of Fairchild Recording Equipment Corp. where he supervised the development of various moving coil and moving magnet phonograph cartridges. He also worked with the stereophonic disc cutter system and band width compressing devices. He is a fellow in the Audio Engineering Society.

Henry Joins Collins Radio Co.

Jerrell R. Henry, former owner of KGRN, Grinnell, Iowa, has been appointed as broadcast sales representative of central region sales for Collins Radio Co. Henry was formerly with radio stations WKRO and WCIL in Illinois, WHIT in North Carolina, and served as chief engineer and manager of stations of the Midwest Broadcasting System in Farmington, Mo.

Patent Is Granted To W. O. Stanton

Walter O. Stanton, president of Pickering & Co., has been granted a patent covering Pickering's T-Guard and V-Guard stylus assemblies used in the 371 MK II and 380 cartridges. The models feature plastic-grip which permits the user quickly to interchange styli of different playing characteristics or to replace a damaged or worn styli without the use of tools and without having to remove the pickup from its mounting in the pickup arm.

Dr. Fletcher Named Consultant By Shure

Shure Brothers, Inc., Evanston, Ill., has named Dr. Harvey Fletcher as a consultant. Fletcher, one of the pioneers of acoustical science, is dean emeritus of the College of Physical and Engineering Sciences at Brigham Young University. From 1916 to 1949 he was with the Bell Telephone Laboratories, retiring as director of physical research. Fletcher pioneered in the development of stereophonic sound transmission and reproduction as early as 1933 when he gave the first stereophonic demonstration, using the Philadelphia Symphony Orchestra in Constitution Hall, Washington.

Bill Nielson Appointed By Gates

Gates Radio Co. has announced the appointment of Bill Nielson as broadcast sales engineer covering northern California, southern Oregon and western Nevada. Mr. Nielson was formerly project engineer for the Philco Corp.

Cylindrical Waveguide Carries Up to 400 TV Signals

FLEXIBLE, cylindrical waveguide has been developed by International Telephone & Telegraph Corp. to carry many hundreds of television, microwave radio and telephone signals in dense traffic routes where it is impractical to use additional coaxial cable or radio relay links.

The new waveguide is expected ultimately to carry up to 400 television channels or equivalent telephone channels in a single conductor approximately three inches in diameter. Normally, the waveguide will be buried.

In conventional microwave systems, rectangular waveguide has such high inherent attenuation losses that its length is limited to a few hundred feet. However, a cylindrical waveguide, using the circular electric mode of the signal, greatly reduces attenuation losses and the system can be operated with a very great bandwidth to carry a large number of channels.

Millimetric waves (wavelengths less than one centimeter) enable the circular waveguide to have reasonable dimensions, an enormous available bandwidth, and sufficiently low attenuation to make it useful for many miles.

Ideally, maximum efficiency is obtained from an optionally straight waveguide with a perfectly circular cross section. Such an installation is, of course, impractical. One of the solutions to the bending problem has been achieved by the Standard Telecommunication Laboratories of Standard Telephones & Cables Ltd., a British affiliate of ITT.

The ITT solution is to form the guide with helically wound aluminum wire covered with a waterproofing and strengthening coating. This construction enables the microwaves to follow bends in the conductor without prohibitive losses.

Transmission in a long waveguide is subject to signal distortion arising from echo effects and from time delays in signals carried by parasitic modes. The use of pulse code modulation greatly increases the discrimination against noises and delivers a signal that is easily regenerated.

In the pulse code modulation system, signal amplitudes are sampled at a frequency slightly more than double the top frequency component of interest. The amplitude samples are converted into a binary code. The coded signals modulate the output of a continuous-wave, millimeter-wave oscillator. Preliminary experimental equipment using a 5-megacycle sampling frequency and capable of coding 16 different signals levels recently has been demonstrated displaying a television picture. It is believed that this equipment is the first to show pulse code modulation transmission of an actual moving television picture.

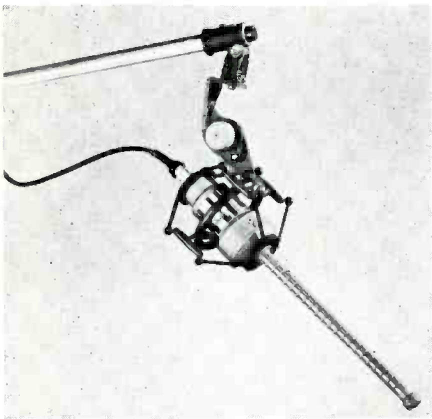
With a 3 mc video bandwidth and a usable spectrum in the waveguide of 80,000 mc, the system would possibly give a capacity, per waveguide, of 400 television channels or several hundred thousand one-way telephone conversations.

The expected attenuation of a long distance pipe of this type is about 2 db to 3 db per mile. Pulse regenerative repeaters will be used approximately every 20 miles, a distance corresponding to a 60 db attenuation.

A demonstration by Standard Telephones & Cables Ltd., at Frogmore Hall, Herts, England, transmitted the pulse code modulated TV signal through a 3,600-ft. loop of 2¾-inch waveguide. The loop consisted of a 1,800-ft. length of the helical aluminum guide and a 1,800-ft. length of optically straight plain aluminum tube. Two specially designed right-angle corners, at the far end, return the signal from the helical to the plain guide.

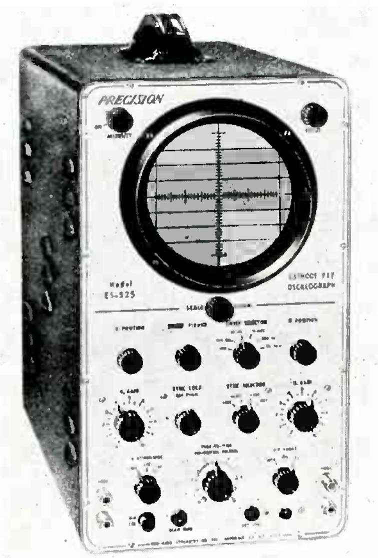
The transmitted TV picture is acceptable to ordinary viewing but is not good enough for long distance transmission. An improved version of the equipment is under development using a 10 mc/sec sampling frequency and coding 54 levels.

Product News



MODEL 642 ELECTRO-VOICE MICROPHONE

Electro-Voice, Inc., Buchanan, Mich., has introduced its Model 642 Cardiline microphone which produces a highly directional pickup pattern for television and other broadcast applications. A complete description of this microphone appeared in an article written by George Riley of Electro-Voice in the April issue of Broadcast Engineering.

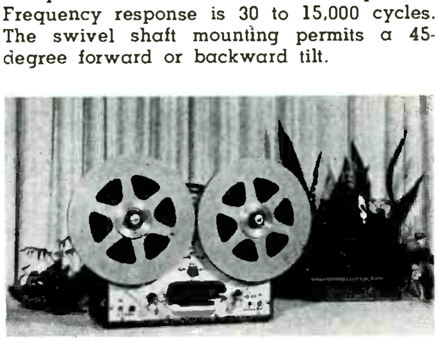


GENERAL PURPOSE OSCILLOSCOPE

Precision Apparatus Co., Inc., 70-31 84th St., Glendale, Long Island, N. Y., has announced its Model ES-525 oscilloscope. Specifications include a push-pull vertical amplifier with a response within 3 db from 10 cps to 500 kc and within 6 db to 700 kc. Sensitivity is 20 mv per inch. A push-pull horizontal amplifier with a response of 3 db from 10 cps to 150 kc. Sensitivity of 60 mv per inch. Internal linear sweep is 10 cps to 100 kc with retrace blanking. The unit is designed from negative, positive, external, and line synchronization. The scope can be used as a high impedance VTVM with the direct reading built-in, peak-to-peak voltage calibrator. It has square wave response from 20 cps to 50 kc. It comes in a custom styled, blue-gray, ripple finished heavy gauge steel cabinet with two-color, satin brushed-aluminum panel.

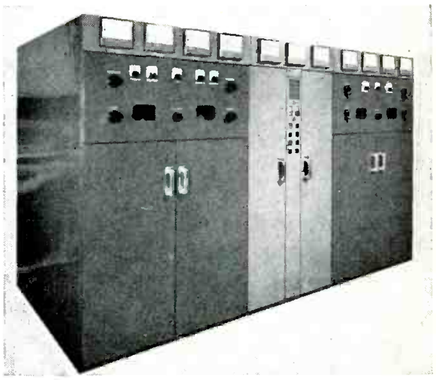
NEW RCA MICROPHONE

A new lightweight general purpose ribbon microphone was shown for the first time by the Radio Corp. of America at the 1960 NAB exhibition. The BK-11A weighs two pounds and has a bi-directional pattern. Frequency response is 30 to 15,000 cycles. The swivel shaft mounting permits a 45-degree forward or backward tilt.



MONAURAL TAPE PLAYER

Crown International, Box 261, Elkhart, Ind., is supplying a monaural tape player designed for continuous operation in music systems. It has a three motor mechanism, featuring a hysteresis synchronous drive motor, and ball bearing reel motors. It has an automatic photo electric self-reversing system, heavy fly wheel, straight line threading, fast forward and rewind, plug-in preamplifier, and plastic enclosed relays. It accommodates up to 14-inch reels and plays up to 16 hours of unrepeated time at 3¾ ips.

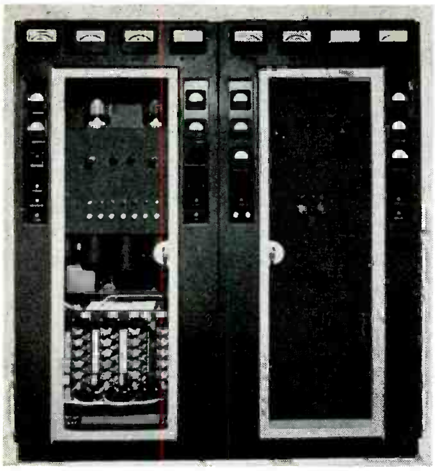


NEW FIFTY KILOWATT AM TRANSMITTER

Gates Radio Co. has introduced a new 50,000-watt transmitter designated the BC-50C. Final tubes used are two type 5891 operated in parallel. The tubes are operated at approximately 50 per cent of the manufacturer's rating, according to Gates. Dry rectifiers are used throughout and only 15 tubes are used of which there are only six types. The modulator also uses two type 5891 tubes. The transmitter occupies 55 sq. ft. of floor space and is 11 ft. wide by 5 ft. deep. Heavy components and the control and rectifier cubicle are located external to the transmitter unit and occupy nine square feet of floor space. Frequency response is plus or minus 1.5 db from 30 to 10,000 cycles. Power consumption varies from 89 kilowatts at zero modulation to 134 kilowatts at 100 per cent modulation.

VIDEO TEST TERMINATION

A high precision video test termination, Model PL 259-75, is now available from Holland Electronics, Inc., 772 East 53rd St., Brooklyn 3, N. Y. The terminations are rated at 75 ohms plus or minus 1 per cent and provide a simple, convenient method for accurately terminating video cables in order to eliminate undesirable reflections while checking waveform and level. The maximum VSWR is 1.1 from DC to 250 megacycles. The average rated power dissipation is ½-watt. A turret type terminal lug is swaged into a XXX phenolic insulator and is suitable for use with standard clip leads or soldering.

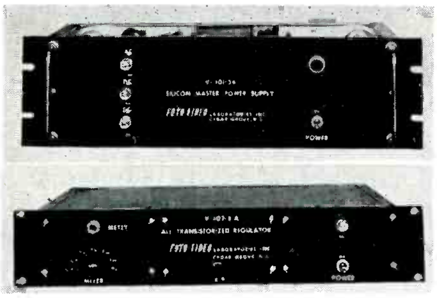


NEW FIVE KW AM TRANSMITTER

Bauer Electronics Corp., 1011 Industrial Way, Burlingame, Calif., has introduced its new FB-5000-J transmitter. The transmitter uses an Eimac 4CX5000A ceramic tetrode in the final RF stage. Maximum power output is 6000 watts. Ten tubes of six different types are used. Additional features include silicon rectifiers, a variable vacuum condenser, automatic voltage control, a vacuum crystal and built-in remote control facilities.

NEW LITERATURE FROM ZOOMAR

A new brochure describing the new developments in Zoomar Lenses is available from Television Zoomar, 500 Fifth Ave., New York 36, N. Y. The new third convertor for the Super Universal which zooms from 12 to 72 inches and the close-up adapter for production of commercials are described.



ALL-TRANSISTORIZED VIDEO POWER SUPPLY

A new all-transistorized video power supply designed to provide a large measure of space, power, heat and cost saving has been developed by Foto-Video Electronics, Inc., of Cedar Grove, N. J. The unit comprises the V-401, silicon master power supply, and the V-402 regulator. These require 1¾ and 3½ inches of rack space. The transistorized V-400 provides 900 watts output, 400 volts at 3 amps, with 1200 watts input.

Classified

Advertising rates in the Classified Section are ten cents per word. Minimum charge is $2.00. Blind box number is 50 cents extra. Check or money order must be enclosed with ad.

EQUIPMENT FOR SALE

TV VIDEO MONITORS—8Mc., Metal cabinets starting at $189.00. Never before so much monitor for so little cost. 30 different models, 8" thru 24". Miratel, Inc., 1083 Dionne St., St. Paul, Minn. 2-60 11t

TEFLON COAXIAL TRANSMISSION LINE 1⅝", 51 ohm. Unused. Suitable for AM, FM, VHF-TV, Communication Systems, and some Microwave frequencies. RETMA flanges. Write: Sacramento Research Labs., 3421-58th Street, Sacramento 20, Calif. 2-60 6t

Vidicon Tubes Type 6198 New, at bargain rates. All types TV equipment bought and sold. Al Denson, Box 85, Rockville, Conn. 4-60 3t

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West. Manager - chief engineer - announcer for small station. Age 39. Family. Ten years Broadcast radio. Now employed. Broadcast Engineering. Dept. BE-3, Kansas City 5, Mo. 5-60 1t

SERVICES

Cambridge Crystals Precision Frequency Measuring Service. Specialists for AM-FM-TV. 445 Concord Ave., Cambridge 38, Mass Phone: TRowbridge 6-2810. 3-60 12t

AM, FM, TV Applications, proofs, measurements. Paul Dean Ford, Broadcast Engineering Consultant, 4341 South 8th St., Terre Haute, Ind., Crawford 4496. 4-60 6t

Approved FCC operator's license course offered by America's oldest broadcasting school. This proven ticket-getter given by FCC experts. Register now for day classes, 20 weeks, evening classes, 31 weeks. Academy of Broadcasting Arts, 316 West 57th St., New York 19, PL 7-3211. 4-60 3t

Advertisers' Index

Stereophonic Sound

Starts on page 4

delay in one speaker is increased to two or three milliseconds, the undelayed speaker becomes the apparent sound source. The power of the delayed source must be increased by a factor of ten over the undelayed source before a listener will judge the two speakers to have the same loudness.

Precedence Effect

This dominance of the undelayed source prevails for delays up to about 35 milliseconds. At this point, the average observer begins to detect a distinct echo. In the 1- to 35-millisecond-delay region, then, the mechanism of azimuth localization determines the source of a sound by the direction of the first-arriving sound and virtually disregards the later-arriving echoes. This reaction of our azimuth perception facilities is called the *precedence effect*. Basically, it is our natural acuity for the preceding sounds in locating a sound source. Succeeding sounds only contribute to loudness.

The precedence effect may seem amazing, but it is an everyday experience. In the average indoor environment, the bulk of the sound we hear arrives by way of reflections or echoes. Yet, in this same environment we have no difficulty localizing the source of various sounds.

As mentioned, the precedence effect is the basis of the compatibility arrangement for the proposed stereophonic system. The circuits between the two microphones and their corresponding FM-radio and TV transmitters are cross-connected through two delay lines. This arrangement is shown in Figure 2. Each circuit and cross connection also has its own buffer, or one-way, amplifier. With these cross connections, music or voice signals from the left (M1) microphone are transmitted directly to the left (TV) loudspeaker in the listener's home, while the same signal is slightly delayed before reaching the (AM) speaker to his right. Because of the precedence effect, a listener with a stereo setup will hear the sound as if it came only from the left (TV) loudspeaker.

Conversely, the sound from the right (M2) microphone goes directly to the right speaker but is delayed before reaching the left (TV) speaker. It is therefore "unheard" in the left speaker. Thus, the stereo listener localizes the total sound he hears just as he would in the theater—as coming directly from each of his two speakers, or sides of the stage. For him, the full stereophonic effect is maintained.

With this arrangement, monophonic reception is completely compatible because a person listening to either single channel hears the total sound from both microphones in a "balanced" reproduction. The slight delay of one signal does not affect his reception at all.

A three-channel system would operate in a similar manner. The direct signal travels only in the primary channels, while a delayed replica of the other two direct signals is added to it to achieve the balance necessary for compatibility.

Both prior to and following its demonstration, this new stereo system has been tested to determine the subjective reactions of listeners. With a two-channel system broadcasting music, the test results indicate that most listeners prefer a time delay of about ten milliseconds, with the intensity of the delayed signal equal to the direct signal. A different set of parameters appears optimum for speech, however. Here, the results show a preference for a five-millisecond delay, with the intensity of the delayed signal three db less than the direct signal. For variety programs, a compromise using a ten-millisecond delay with three db of attenuation in the delayed signal was very well received in the tests.

Additional Advantages of the System

In addition to compatibility, a stereo system based on the precedence effect has two interesting and desirable side advantages. For many listeners, this effect may eliminate two *subjective* reactions to stereophonic sound—"the hole in the middle" and the inadequacy of a three-cubic-foot box to the task of reproducing the music of a full orchestra.

The "hole in the middle" is an effect that some people experience when listening intently to stereophonically reproduced sound, generally orchestral music. After a time, one becomes aware that the speakers are the only sources of sound present, and there appear to be virtually no sound sources between them. The use of the precedence effect for channel separation enlarges the area of the apparent sound sources, however, and the listener is less aware of any hole.

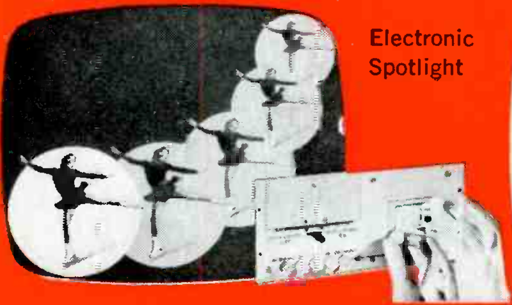
This apparent enlargement of the sound sources is also more suggestive of the large loudspeakers generally associated with the reproduction of orchestral music. And for many stereo listeners, this phenomenon may overcome their reaction to small-speaker reproduction.

Most importantly, the proposed compatible stereophonic system should make it possible for broadcasters to offer stereophonic programs that do not dilute the full stereo effect or penalize the single-channel listener. In turn, this may make possible more two and three-channel stereo programming on both local and national networks.

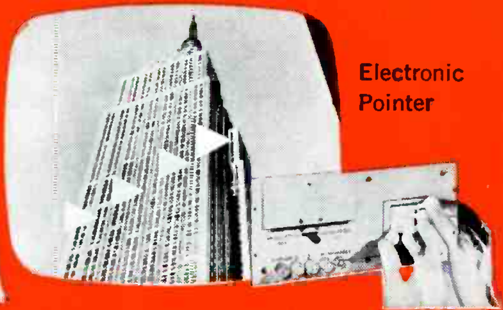
NEW
"Joy Stick" Positioner

Insert May Be Placed At Any Position on Raster.

Model 491-A1



Electronic Spotlight



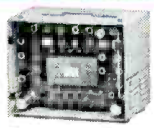
Electronic Pointer

Create Wipes With Motion

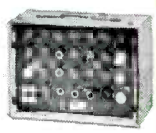
TELECHROME SPECIAL EFFECTS GENERATOR
with Exclusive "JOY STICK" POSITIONER

First, Telechrome provided broadcasters with a vastly improved system for producing a wider variety of dramatic wipes, inserts, keying and other special effects. Now, Telechrome engineering introduces the "Joy Stick" Positioner. This makes it possible to create many hundreds more effects and to move wipes, inserts, keying or other special effects to any place on the TV screen. The effects are startling! A new era in program creativity begins now! Ask to see the "Joy Stick" Positioner demonstrated, today!

Write, Wire, Phone for Literature



490WA1 Waveform generator. Generates keying signals for the 72 different wipes.



490SA1 Switching Amplifier. Combines two picture signals in accordance with applied keying waveform.

490RA1 Remote Control Unit. Selects and controls desired effect. Designed for console or desk mounting. Easily modified for integration into existing studio facilities. Complete with power supply—512CR1

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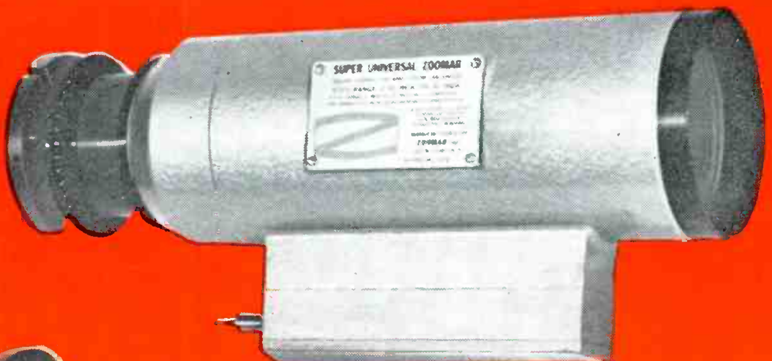
Television Zoomar
for the 4½ Inch I-O Camera



CLOSE-UP ADAPTOR

The SUPER UNIVERSAL ZOOMAR (above)—specially designed for the popular 4½ inch Image Orthicon Camera—has a zoom range of 2½ to 16 inches. The convertors to extend zoom range from 4 to 25 inches and 6½ to 40 inches are included in the SUPER UNIVERSAL price—*the close-up portrait adaptor and 12 to 72 inch convertor are available at extra cost.*

2½ to 72" Remote Iris Control

The iris is controlled in all ranges—2½ to 16 inches, 4 to 25 inches, 6½ to 40 inches and 12 to 72 inches by the remote iris control mechanism of the camera. The zoom rod controls zoom—speed of zoom—focusing and "tracking." This rod runs through a special shaft on the lower right side of the camera.

The SUPER UNIVERSAL mounts on a camera in a minute. The superior definition and zoom range complement the 4½ inch Image Orthicon Camera. Zoomars are fast, light and compact. These features combine to give maximum flexibility and economies of operation.

SUPER UNIVERSAL ZOOMAR PERFORMANCE CHARACTERISTICS

The Super Universal Zoomar zooms from 2½ to 72 inches in four fast ranges:

- 2½ to 16 inches at F:3.9 with basic lens
- 4 to 25 inches at F:5.6 with Convertor #1
- 6½ to 40 inches at F:8 with Convertor #2
- 12 to 72 inches with convertor #3
- Maintains speed throughout zoom
- Remote Iris control works in all ranges
- Change range quickly

Super Universal Zoomars are used by NBC, CBS, ABC and leading independent TV stations for football, baseball, golf, bowling—all remote telecasts. Most top network Shows and local telecasters use the Super Universal 2½ to 16 inch range for flawless STUDIO PRODUCTION. Videotape Producers say Zoomars reduce—problems on location, number of cameras and set-ups. Super Universal Zoomars are completely COLOR-balanced and corrected . . . make monochrome pictures sharper and crisper.

SUPER UNIVERSAL ZOOMAR FEATURES

- Completely color-balanced and corrected
- Iris remote controlled in all ranges
- The Super Universal is fast at F:3.9
- 6 to 1 zoom ratio technically ideal—dramatic impact appeals to advertisers and directors
- Weight 12 pounds—length 17½ inches
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- Non counter-balancing necessary
- Change from camera to camera like a fixed focus 50 mm.
- Convert from one zoom range to any other zoom range quickly
- Zoomars are serviced by the engineers who build them
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CLOSE-UP ADAPTOR FOR TELEVISION COMMERCIALS

With the new close-up adaptor or Portrait Lens, you position the camera 4½ to 6 feet from the subject. You zoom entire range to an extreme tight close-up pack of cigarettes. An area of 3 inches by 4 inches fills the monitor. THIS IS A MUST FOR PRODUCERS MAKING TAPED OR LIVE COMMERCIALS.

ZOOMS FROM THIS *(waist shot)* **TO THIS**

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